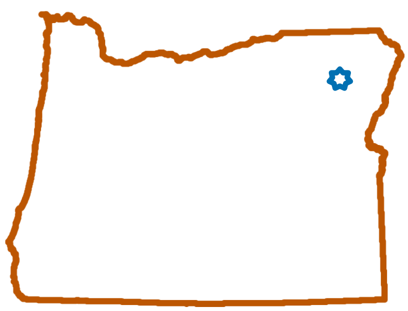


CITY OF LA GRANDE
THE HUB OF NORTHEASTERN OREGON


City of La Grande

NATURAL HAZARDS MITIGATION PLAN



FEMA

Effective JANUARY 8, 2024 through JANUARY 7, 2029

The *2024 La Grande Natural Hazard Mitigation Plan* is a living document that will be reviewed and updated periodically. It will be integrated with existing plans, policies, and programs. The Disaster Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions maintain an approved NHMP to receive federal funds for pre- and post-disaster mitigation grants.

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

For further information and to provide comments, contact:

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City of La Grande developed this Natural Hazards Mitigation Plan through a partnership funded by the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance Grants. In 2022, the Department of Land Conservation and Development (DLCD) received Hazard Mitigation Grant Program – Post Fire (HMGP-PF) for FM-5327-OR from FEMA through the Oregon Department of Emergency Management (OEM) to assist La Grande with the NHMP.

Acknowledgments

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City of La Grande Resolution

CITY of LA GRANDE
RESOLUTION NUMBER 4856
SERIES 2024

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LA GRANDE, UNION COUNTY, OREGON, ADOPTING THE CITY OF LA GRANDE NATURAL HAZARDS MITIGATION PLAN

WHEREAS, the City Council of the City of La Grande, Union County, Oregon, recognizes the threat that natural hazards pose to people and property within our community; and,

WHEREAS, undertaking hazard mitigation actions will reduce the potential for harm to people, property, and infrastructure from future hazard occurrences; and,

WHEREAS, an adopted Natural Hazards Mitigation Plan (NHMP) is required as a condition of future funding for mitigation projects under multiple pre- and post-disaster mitigation grant programs; and,

WHEREAS, the City Council of the City of La Grande, Union County, Oregon, has prepared a multi-hazard mitigation plan, hereby known as The City of La Grande NHMP in accordance with federal laws, including the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended; the National Flood Insurance Act of 1968, as amended; and the National Dam Safety Program Act, as amended; and,

WHEREAS, The City of La Grande NHMP identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in the City of La Grande from the impacts of future hazards and disasters; and,

WHEREAS, adoption by the City Council of the City of La Grande, Union County, Oregon, demonstrates its commitment to hazard mitigation and achieving the goals outlined in the City of La Grande NHMP;

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of La Grande, Union County, Oregon, that the City of La Grande Natural Hazards Mitigation Plan be adopted as an official plan; and,

BE IT FURTHER RESOLVED by the City Council of the City of La Grande, Union County, Oregon, that the City of La Grande will submit this adopted Resolution to the Oregon Department of Emergency Management and the Federal Emergency Management Agency Region 10 officials to enable final approval of the City of La Grande Natural Hazards Mitigation Plan.

PASSED and EFFECTIVE ON this Third (3rd) day of January, 2024, by Five (5) of Seven (7) Councilors present and voting in the affirmative.

Justin B. Rock, Mayor

David Glabe, Mayor Pro Tem

ABSENT EXCUSED

Corrine Dutto, Councilor

Nicole Howard, Councilor

Molly King

Molly King, Councilor

Mary Ann Miesner

Mary Ann Miesner, Councilor

ABSENT EXCUSED

Denise Wheeler, Councilor

ATTEST:

Stacey M. Stockhoff

Stacey M. Stockhoff
City Recorder

Federal Emergency Management Agency Approval

U.S. Department of Homeland Security
FEMA Region 10
130 228th Street, SW
Bothell, WA 98021-8627

FEMA

January 8, 2024

Justin Rock, Mayor
City of La Grande
City Hall, 1000 Adams Avenue
La Grande, Oregon 97850

Reference: Approval of the City of La Grande Local Hazard Mitigation Plan

Dear Mayor Rock:

In accordance with applicable[1] laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the City of La Grande local hazard mitigation plan. The approval period for this plan is from January 8, 2024 through January 7, 2029.

In addition, the City of La Grande has met the requirements for addressing all dam risks listed in the local hazard mitigation plan.

An approved hazard mitigation plan is one of the conditions for applying for and receiving FEMA mitigation grants from the following programs:

- Hazard Mitigation Grant Program (HMGP)
- Hazard Mitigation Grant Program Post-Fire (HMGP Post-Fire)
- Building Resilient Infrastructure and Communities (BRIC)
- Flood Mitigation Assistance (FMA)
- High Hazard Potential Dams Grants Program (HHPD)

Having an approved hazard mitigation plan does not mean that mitigation grant funding will be awarded. Specific application and eligibility requirements for the programs listed above can be found in each FEMA grant program's respective policies and annual Notice of Funding Opportunities, as applicable.

To avoid a lapsed plan, the next plan update must be approved before the end of the approval period. Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please also include time for any revisions, if needed, and for your jurisdiction to formally adopt the plan after the review, if not adopted prior to submission. This will enable you to remain eligible to apply for and receive funding from FEMA's mitigation

[1] Robert T. Stafford Disaster Relief and Emergency Assistance 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 Local Mitigation Planning Policy Guide (FP-206-21-0002).

grant programs with a hazard mitigation plan requirement. Local governments, including special districts, with a plan status of “Approvable Pending Adoption” are not eligible for FEMA’s mitigation grant programs with a hazard mitigation plan requirement.

If you have questions regarding your plan’s approval or FEMA’s mitigation grant programs, please contact Joseph Murray, Lead Planner at Oregon Department of Emergency Management at (503) 378-2911, who coordinates these efforts for local entities.

Sincerely,

Kristen Meyers, Director
Mitigation Division

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management

EC; vl

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Chapter 1 PLAN SUMMARY

The City of La Grande has updated its Natural Hazards Mitigation Plan (*2024 La Grande NHMP* or *La Grande NHMP*), an update which is based – in part – on the version of it contained within the *2014 Northeast Oregon Regional NHMP*. For more information see page 14, page 249, et al. This update was accomplished in collaboration with the Oregon Department of Land Conservation and Development (DLCD), to prepare for the long-term effects resulting from natural hazards. This section provides a general introduction to natural hazard mitigation planning. In addition, it addresses the planning process requirements contained in 44 CFR 201.6(b) thereby meeting the planning process documentation requirement contained in 44 CFR 201.6(c)(1). The section concludes with a general description of how the plan is organized.

What is Natural Hazard Mitigation?

The Federal Emergency Management Agency (FEMA) defines hazard mitigation as "…any sustained action taken to reduce or eliminate long-term risk to life and property from hazards."

Hazards mitigation uses long and short-term strategies and actions to reduce the potential effects of hazards on the lives, property, and critical infrastructure and facilities in a community. This can be achieved through **local plans and regulations**, such as adjustments to land use designation within floodplains; **structure and infrastructure projects**, such as seismic retrofits to critical facilities; **natural systems projection and nature-based solutions** such as wetland restoration and preservation, and **education and awareness programs**, such as presentations to neighborhood organizations.

Natural hazard mitigation is the responsibility of the "whole community," which includes individuals and families; businesses; faith-based and community organizations; nonprofit groups; schools and academia; media outlets; and all levels of government, including state, local, tribal, territorial, and federal partners to prepare their community for threats and hazards. Taking the whole community approach to planning, in which all parts of the community are engaged and empowered in the development and implementation of a NHMP is a guiding principle to the process. This process positions the planning team to better understand and comprehensively approach the actual needs of a community. To work well, this approach requires a diverse array of community members at the table.

Engaging in mitigation activities provides community with several benefits, including reduced loss of life, property, essential services, critical facilities and economic hardship; reduced short-term and long-term recovery and reconstruction costs; increased cooperation and communication within the community through the planning process; and increased potential for state and federal funding for recovery and reconstruction projects.

Why Develop a Mitigation Plan?

La Grande developed this NHMP in an effort to reduce future loss of life and damage to property resulting from natural hazards. It is impossible to predict exactly when natural hazard events will occur, or the extent to which they will affect community assets. However, with careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, it is possible to minimize the losses that can result from natural hazards.

In addition to establishing a comprehensive community-level mitigation strategy, the Disaster Mitigation Act of 2000, as amended by the Disaster Recovery Reform Act (DRRA) of 2018, and the regulations contained in 44 CFR 201, require that jurisdictions maintain an approved NHMP in order to receive federal funds for mitigation projects. Local and federal approval of this plan ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

What Federal Requirements does this Plan Address?

DRRA is the federal legislation addressing mitigation planning. It reinforces the importance of mitigation planning and emphasizes planning for natural hazards before they occur. As such, this Act established the Non-Disaster (ND) Mitigation Grant program (formerly the Pre-Disaster Mitigation grant program or PDM), which has become the Building Resilient Infrastructure and Communities (BRIC) program, and requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP).

Section 322 of the Act specifically addresses mitigation planning at the state and local levels. State and local jurisdictions must have approved mitigation plans in place to qualify to receive post-disaster HMGP funds. Mitigation plans must demonstrate that the proposed mitigation actions are based on a sound planning process that accounts for the risk to the individual and their capabilities. Title 44 Code of Federal Regulations (CFR), section 201.6, also requires a local government to have an approved mitigation plan to receive HMGP project grants.

Pursuant of Title 44 CFR, the Natural Hazard Mitigation Plan planning processes shall include an opportunity for the public to comment on the plan during review. Moreover, the updated Natural Hazard Mitigation Plan shall include documentation of the public planning process used to develop the plan. The Natural Hazard Mitigation Plan update must also contain a risk assessment, mitigation strategy and a plan maintenance process that has been formally adopted by the governing body of the jurisdiction. Lastly, the Natural Hazard Mitigation Plan must be submitted to the Oregon Department of Emergency Management (OEM) for initial plan review, and then it is submitted to FEMA for review and federal approval. Once FEMA provides the Approved Pending Adoption (APA) letter, the local jurisdictions must adopt the NHMP. Once the City Council of La Grande provides a signed resolution showing the adoption of the NHMP, FEMA will send a letter with the date of the NHMP approval. The approval period is for five years.

What State Requirements does this Plan Address?

Planning for natural hazards is an integral element of Oregon’s statewide land use planning program, which began in 1973. All Oregon cities and counties have comprehensive plans (Comprehensive Plans) and implementing ordinances that are required to comply with the statewide planning goals. The challenge faced by state and local governments is to keep this network of local plans coordinated in response to the changing conditions and needs of Oregon communities.

Statewide land use planning Goal 7, Areas Subject to Natural Hazards, calls for local plans to include inventories, policies and ordinances to guide development in or away from hazard areas. Goal 7, along with other land use planning goals, has helped to reduce losses from natural hazards. Through risk identification and the recommendation of risk-reduction actions, this plan aligns with the goals of the jurisdiction’s Comprehensive Plan and helps La Grande meet the requirements of statewide land use planning Goal 7.

The primary responsibility for the development and implementation of risk reduction strategies and policies lies with local jurisdictions. However, resources exist at the state and federal levels. Some of the key agencies in this area include the Oregon Department of Emergency Management (OEM or ODEM), Oregon Building Codes Division (BCD), Oregon Department of Forestry (ODF), Oregon Department of Geology and Mineral Industries (DOGAMI), and the Oregon Department of Land Conservation and Development (DLCD).

How was the Plan Developed?

The La Grande Natural Hazards Mitigation Plan Steering Committee (Steering Committee), with collaboration of DLCD staff, updated specific sections to the *2014 Northeast Oregon Regional Natural Hazard Mitigation Plan*[1] *(2014 Northeast Oregon Regional NHMP),* which expired on June 4, 2019. The *2024 La Grande NHMP* is the result of a collaboration with DLCD, which led the Steering Committee through the NHMP update process. The plan holders are those organizations or jurisdictions that signed Intergovernmental Agreements (IGAs) with DLCD for the work on the NHMP; La Grande is a plan holder. The Steering Committee formally convened on seven occasions via Zoom and in-person to discuss and revise the plan. Steering Committee members contributed data, maps (where applicable), and reviewed and updated the community profile, risk assessment, action items, and implementation and maintenance plan.

An open public involvement process is essential to the development of an effective plan. To develop a comprehensive approach to reducing the effects of natural disasters, the planning process shall include opportunity for the public, neighboring communities, local and regional agencies, as well as private and nonprofit entities to comment on the plan during review (44 CFR § 201.6(b)(2)). The City of La Grande provided a publicly accessible project website for the public to review. Feedback from the public was obtained through a community survey on the draft Risk Assessment. Elkhorn Media Group contributed to the public outreach through a social media posting to encourage the public to offer feedback on the plan update. In addition, La Grande attended the local farmers’ market as an in-person outreach opportunity.

How is the Plan Organized?

Each chapter of the plan provides specific information and resources to assist readers in understanding the hazard-specific issues facing city residents, businesses, and the environment. Combined, the chapters interact constructively to create a mitigation plan that furthers the community’s mission to

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[1] The 2014 NHMP included Baker, Grant, Union, and Wallowa Counties

reduce or eliminate long-term risk to people and their property from hazards and their effects. This plan structure enables stakeholders to use the section(s) of interest to them.

Chapter 1: Plan Summary

This chapter provides an overview of the federal and state requirements the plan addresses and an introduction that briefly describes the citywide mitigation planning efforts and the methodology used to develop the plan.

Chapter 2: Community Profile

The community profile describes the city from several perspectives to help define and understand the city's sensitivity and resilience to natural hazards. The information in this chapter represents a snapshot in time of the current sensitivity and resilience factors in the region when the plan was updated.

Chapter 3: Risk Assessment

Chapter 3 provides the factual basis for the mitigation strategies contained in Chapter 4. Additional information is included within Chapter 3, which contains an overall description of La Grande. This chapter includes a brief description of community sensitivities and vulnerabilities. The Risk Assessment allows readers to gain an understanding of the city's vulnerability and resilience to natural hazards.

A hazard summary is provided for each of the hazards addressed in the plan. The summary includes hazard history, location, extent, vulnerability, impacts, and probability. This NHMP addresses the following hazards:

- Air Quality
- Drought
- Earthquake
- Flood (includes High Hazard Potential Dams)
- Invasive Species and Insect Pests
- Severe Weather (includes Extreme Heat, Windstorm, Winter Storm)
- Volcanic Event
- Wildfire

Additionally, this section provides information on the city's participation in the National Flood Insurance Program (NFIP).

Chapter 4: Mitigation Strategy

This section documents the plan vision, mission, goals, and actions (mitigation strategy) and describes the components that guide implementation of the identified actions. Actions are based on community sensitivity and resilience factors, and the risk assessments in Chapter 3. Federal, state, and local mitigation activities, successes, and resources are identified in this section as well.

Chapter 5: Planning Process

This chapter provides information on the implementation and maintenance of the plan. It describes the process for prioritizing projects and includes a suggested list of tasks for updating the plan, to be completed at the semi-annual and five-year review meetings.

This chapter also includes documentation of all the citywide public processes utilized to develop the plan. It includes invitation lists, agendas, sign-in sheets, and summaries of Steering Committee meetings as well as any other public involvement methods.

Chapter 6: Acronyms

This chapter includes common state and federal acronyms.

Chapter 7: References

All cited material found in the *2024 La Grande NHMP* are listed in this chapter.

Chapter 8: Appendices

The appendices are designed to provide the users of the NHMP with additional information to assist them in understanding the contents of the mitigation plan and provide them with potential resources to assist with plan implementation.

Appendix 8.1: Mitigation Action Worksheets

This appendix contains detailed action item forms for each of the mitigation actions identified in this Plan.

Appendix 8.2: Economic Analysis of Natural Hazard Mitigation Projects

This appendix describes the FEMA requirements for benefit cost analysis in natural hazards mitigation, as well as various approaches for conducting economic analysis of proposed mitigation activities.

Appendix 8.3: Grant Programs and Resources

This appendix lists federal, state, and local resources and programs.

Appendix 8.4: OCCRI Future Climate Projections Union County, Oregon, OCCRI

This appendix contains Oregon Climate Change Research Institute (OCCRI) analysis of the influence of climate change on natural hazards. This appendix contains the full report excerpted within the NHMP.

Appendix 8.5: Morgan Lake Dam Floodplain Management Plan

This appendix contains the final draft of the *Morgan Lake Dam Floodplain Management Plan*. This final draft is currently with FEMA for review. Once this dam floodplain management plan has been approved by FEMA, the approved plan will replace the final draft in this appendix.

Appendix 8.6: FEMA Review Tool

This appendix includes the FEMA Review Tool for the plan.

Chapter 2 COMMUNITY PROFILE

2.1 Introduction

Community resilience can be defined as the community's ability to manage risk and adapt to natural hazard impacts. It is the measure of the sustained ability of a community to use available resources to respond to, withstand, and recover from adverse situations (Rand). The following capacities will be examined to help define and understand City of La Grande's resilience to natural hazards:

- History
- Natural Environment
- Socio-demographic Capacity
- Economic Capacity
- Built (or Infrastructure) Capacity
- Community Connectivity
- Political Capital

The Community Profile describes the sensitivity and resilience to natural hazards of La Grande as they relate to each capacity. It provides a snapshot of the time when the plan was developed and will assist in preparation for a more resilient city. The information in this section, along with the hazard assessments located in the Risk Assessment (Chapter 3), should be used as the local level rationale for the risk reduction actions identified in Mitigation Strategy (Chapter 4). The identification of actions that reduce the city's sensitivity and increase its resiliency assist in reducing overall risk of disaster.

2.2 History

This history and description of the City of La Grande is directly excerpted from the Oregon Encyclopedia, a Project of the Oregon Historical Society (Hartman, 2023).

> La Grande, the seat of Union County, is nestled in the eastern foothills of the Blue Mountains. Situated in the Grande Ronde Valley, La Grande is the third largest city in eastern Oregon, with an estimated population of 13,026 in 2020.
>
> The Oregon Trail passed through the Grande Ronde Valley, and La Grande was first settled in 1861 by immigrants originally bound for the Willamette Valley. One of the founding settlers, Benjamin Brown, was a community and business leader in the town, which was originally referred to as Brown's Town or Brownsville. Because there was already a Brownsville in Linn County, the Post Office Department required a new name, and in 1863 a post office was established under the name La Grande. The city was incorporated in 1865.
>
> …
>
> Before white settlement, the Grande Ronde Valley was an important rendezvous site for Native people of the southern Columbia Plateau. Umatilla, Nez Perce, Cayuse, and others

traveled to the valley in the summer to harvest camas root and other plants and to hunt, fish, and trade. White settlement created competition for the land and its resources, and in 1862 a band of Umatilla challenged the newcomers' right to claim land in the valley. U.S. soldiers who were sent to arrest three Umatilla chiefs who were involved in the dispute killed several men before the rest of the group could escape.

During the 1860s and 1870s, La Grande grew rapidly, as miners moving into the gold fields of Idaho and eastern Oregon provided a ready market for homesteaders' agricultural products. La Grande's importance as a commercial center grew when, in 1884, the Oregon Railway and Navigation Company (OR&N) completed its main trunk line through the town. The railroad drastically altered the landscape of La Grande, as businesses relocated from the original site of the town along the southwest edge of the valley to the flats near the proposed tracks and train depot.

During the late nineteenth century, La Grande, like many towns in the rural West, had a significant Chinese population. Many had come to work in the mines and on the railroads, and they stayed on as small business proprietors and agricultural laborers. On September 24, 1893, a mob of about two hundred armed men looted and burned some of the city's Chinese businesses and homes and forcibly removed many Chinese residents by marching them to the nearby rail depot at Oro Dell and demanding that they leave the country. According to accounts in the La Grande Gazette the next week, some of the mob victims returned to settle their business affairs before leaving La Grande permanently. While the newspaper reported that the sheriff and others attempted to protect the Chinese, articles also noted that public sentiment opposed the presence of Chinese in the community. Over fifty men were arrested, ten of whom were indicted and charged with arson. All were found not guilty.

From 1875 to 1884, La Grande was home to Blue Mountain University, founded and operated by the Columbia River Conference of the Methodist Episcopal Church. In 1929, Eastern Oregon Normal School opened its doors as a teacher's college. The Oregon legislature renamed the college Eastern Oregon State College in 1973; in 1997, it became Eastern Oregon University. The university, with an on-campus enrollment of about 1,600 students, is a major employer in La Grande and plays an important economic and cultural role in the region. It is the only state liberal arts university east of the Cascade Mountains.

La Grande, whose nickname is "The Hub City," hosts the Eastern Oregon Film Festival, the Crossing the Blues Arts festival, and the Grande Ronde Symphony Orchestra. ArtEast, home of the Eastern Oregon Regional Arts Council, was founded in 1977 as a nonprofit organization to deliver arts education and outreach programs in eastern Oregon.

With its proximity to the Blue and the Wallowa Mountains, La Grande is a popular year-round destination for outdoor enthusiasts, including hunters, campers, mushroom hunters, birders, cyclists, skiers, snowmobilers, and snowboarders. Nearby Anthony Lakes Ski Resort boasts some of the best powder snow in the Intermountain West. Five miles south of La Grande, the 6,000-acre Ladd Marsh Wildlife Area, a popular destination for birdwatchers and hunters, is the largest hardstem bulrush marsh in northeastern Oregon, offering a glimpse of what the valley was like before agricultural development.

Additional information about La Grande is provided from the Oregon Encyclopedia (La Grande (oregonencyclopedia.org)) and excerpted throughout this community profile.

2.3 Natural Environment

La Grande's natural environment is a product of geography, climate, ecozone, land use, and settlement patterns. The capacity of the natural environment is composed of elements known as natural capital. Natural capital is essential in sustaining all forms of life including human life, yet it often plays an underrepresented role in community resiliency to natural hazards. Natural capital includes land, air, water, and other natural resources that support and provide space to live, work and recreate (Mayunga, 2007). Natural capital such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from weather-related hazards, such as flooding and landslides. When natural systems are impacted or depleted by human activities, those activities can adversely affect community resilience to natural hazard events.

Geography

The City of La Grande is in the Grande Ronde Valley, which is "one of the largest, enclosed circular valleys in the United States" according to the City of La Grande's website. The Wallowa Mountains and Blue Mountains surround the Grande Ronde Valley. The city is located against the eastern base of the Blue Mountains and has an average elevation 2,785 feet above sea level within city limits (Oregon Blue Book).

According to the U.S. Census Bureau, La Grande has a total area of 4.61 square miles (11.94 km^2), of which 4.58 square miles (11.86 km^2) is land and 0.03 square miles (0.08 km^2) is water. The city is located on the south bank of the Grande Ronde River. Interstate 84 travels through the city in a northwest-southeast direction. Oregon Route 30 also travels through the city in a northwest-southeast direction. The intersection of Oregon Route 82 and Interstate 84 occurs in the central region of the city. Oregon Route 82 travels from the city center northeast through Island City and rural areas outside the La Grande-Island City Urban Growth Boundaries. The primary river that flows through La Grande is the Grande Ronde River; other important streams that pass through are Catherine Creek, North Powder River, Little Creek, Gekeler Sough, Taylor Creek, Fresno Creek, Clark Creek, Indian Creek, and Wolf Creek.

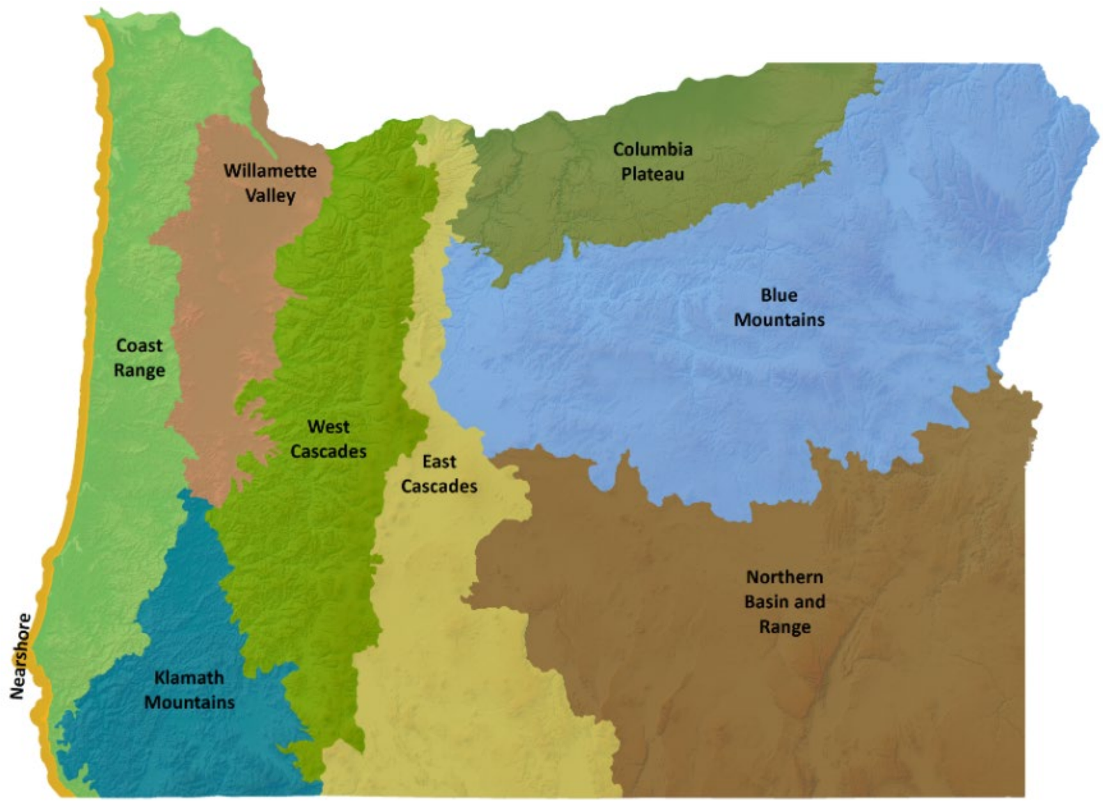
According to La Grande's Annual Water Quality Report 2022, five wells serve as the primary water source for La Grande. Three of these wells are shallow alluvial wells that are supplied by the Grande Ronde aquifer and the other two are deep basalt wells supplied by the Ladd Creek aquifer. According to the City of La Grande, the city's average summer water use is 460 million gallons with an average winter use of approximately 405 million gallons

Physical Geography and Ecoregions

Figure 2-1 below is a map that shows the physiographic provinces of Oregon. Physiography is physical geography. Land is often described in terms of ecoregions. According to the Environmental Protection Agency (EPA), ecoregions are areas where ecosystems (and the type, quality, and quantity of environmental resources) are similar. In *Level III and IV Ecoregions of Oregon*, the EPA states,

> Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources; they are designed to serve as a spatial framework for the research, assessment management, and monitoring of ecosystem components. By recognizing the spatial differences in the capacities and potentials of ecosystems, ecoregions stratify the environment by its probable response to disturbance.

Figure 2-1. Physiographic Provinces of Oregon



Source: Oregon Conservation Strategy

La Grande is in the Blue Mountains physiographic province. At 23984 square miles, the Blue Mountains ecoregion is the largest in Oregon, according to the Oregon Conservation Strategy. The Blue Mountains ecoregion includes a diverse complex of mountain ranges, valleys, and plateaus that extends beyond Oregon into the states of Idaho and Washington. Overall, the ecoregion has short, dry summers and long, cold winters. Because much of the precipitation falls as snow, snow melt gives life to the rivers and irrigated areas.

Current and Projected Weather Climate

Weather is how the atmosphere behaves and its effects upon life and human activities. Weather can change from minute-to-minute. Most people think of weather in terms of temperature, humidity, precipitation, cloudiness, brightness, visibility, wind, and atmospheric pressure. Climate is the description of the long-term pattern of weather in a place. Climate can mean the average weather for a particular region and a period of 30 years. Climate is the average of weather over time (Best Places).

Like most of the Union County, La Grande has a Mediterranean climate, closely bordering on a hot-summer Mediterranean climate where summers are warm and dry, and winters are cold (Wikipedia, 2023). According to Western Regional Climate Center, the average annual precipitation is approximately 20.24 inches with the heaviest rainfall in late fall and winter. With major snow falls being common, the region has an average annual snowfall of 11.2 inches.

The weather and climate of La Grande and Union County are also discussed in the Risk Assessment. Union County is in Climate Divisions 8 (Figure 3-28), which consists of snowy winters and dry and hot summers.

Based on the report *A Framework for Addressing Rapid Climate Change* by the Climate Change Integration Group,[2] localized climate projections for the regions within Oregon must be developed; these localized assessments are essential for both the public and private sectors to respond to climate change.

In the *2020 Oregon Natural Hazard Mitigation Plan (2020 Oregon NHMP)*, the U.S. EPA's ecoregions are used to describe areas of ecosystem similarity. Within the *2020 Oregon NHMP*, Oregon's Natural Hazard Regions are identified as 1 through 8. We refer to the *2020 Oregon NHMP* and the *Future Climate Projections Union County, Oregon* report for climate change information about La Grande, Union County, and the Northeast Oregon Region (Region 7). Region 7 includes Baker, Grant, Wallowa, and Union Counties. The hazards faced by Region 7 and Union County that are projected to be influenced by climate change include extreme heat, heavy precipitation, drought, wildfire, and flooding. The *Fifth Oregon Climate Assessment Report: State of Climate Science: 2021* provides a comprehensive assessment of the state of climate change as it pertains to Oregon. It covers the physical, biological, and social dimensions. In summary, it notes the following assessments:

State of Climate Science

- *Temperature. Oregon's annual average temperature increased by about 2.2°F per century since 1895*
- *Precipitation. Precipitation is projected to increase during winter and decrease during summer.*
- *Snowpack and runoff. Snowpack throughout Oregon, especially on the west slope of the Cascade Range, is accumulating more slowly, reaching lower peak values, and melting earlier.*
- *Science advances. In addition to simulations of future climate from the newest generation of global climate models, advances in climate science have improved the accuracy of climate forecasts one week to one month into the future.*

Climate-Related Natural Hazards

- *Extreme heat. The frequency and magnitude of days that are warmer than 90°F is increasing across Oregon.*

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[2] The Climate Change Integration Group (CCIG) was convened to oversee implementation of the recommendations from the 2004 Advisory Group; to assess the current state of knowledge about the sensitivity, adaptive capacity and vulnerability of natural and human systems to global warming; and to prepare recommendations about how Oregon can adapt to unavoidable changes (State of Oregon Biennial Energy Plan 2013-15)

- *Drought. Over the past 20 years, the incidence, extent, and severity of drought in the Northwest increased.*
- *Wildfire. Wildfire dynamics are affected by climate change, past and contemporary land management and human activity, and expansion of non-native invasive grasses.*
- *Floods. Flood magnitudes in Oregon are likely to increase.*
- *Coastal hazards. Sea-level rise, storminess, sediment supply, and human adaptation measures influence whether a given stretch of Oregon's coastline has eroded or built up in recent decades.*
- *Marine and coastal change. Off the Northwest coast, the open-ocean surface temperature increased by more than 1.2 ± 0.5°F since the year 1900 and is projected to increase by about another 5.0 ± 1.1°F by the year 2080.*

Adaptation Sectors

- *Natural systems. Climate change is affecting the timing of seasonal events in the life cycle of some plants and animals, and the viability of some species.*
- *Built environment. Climate change is likely to stress Oregon's infrastructure.*
- *Public health. Racial and economic injustices have created disparities in health outcomes among populations in Oregon. Black, Indigenous, and People of Color; underinvested rural, Tribal, and low-income communities; the young and the old; and those with pre-existing conditions or disabilities are more likely to experience negative health effects of climate extremes.*
- *Tribal cultural resources. Tribes may experience distinct impacts of climate change that relate to their cultures, identities, histories, relations with other governments, and land-holding status.*
- *Social systems. Social, political, and economic systems mediate the effects of climate change.*

Section 2, Risk Assessment, contains hazard-specific information. In addition, the Risk Assessment includes climate information and describes in full the Hazard Vulnerability Assessment (HVA). Climate data such as precipitation and temperature are presented below and provide a framework for understanding the weather and climate in La Grande and Union County.

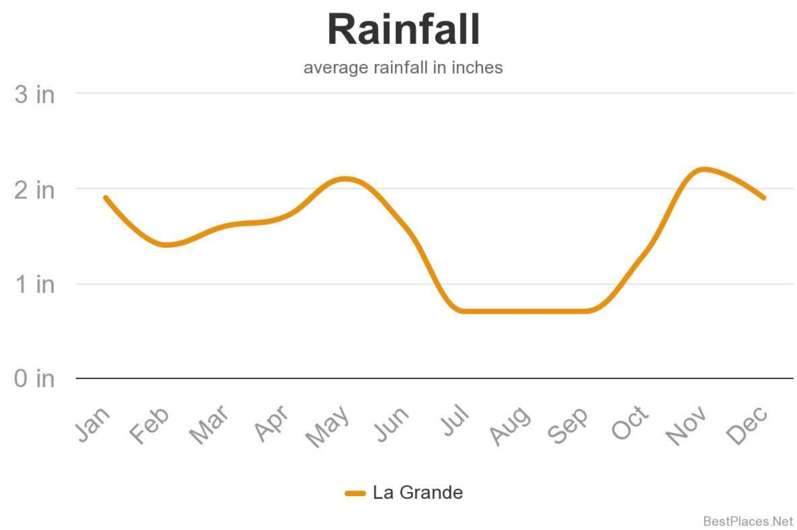
Precipitation, Rainfall, and Snowfall

As a summary and a comparison with the rest of the U.S., here are some statistics from Best Places to Live in La Grande, Oregon. La Grande's annual precipitation is 18 inches[3]. The U.S. average is 38 inches of rain per year. La Grande averages 23 inches of snow per year. The U.S. average is 28 inches of snow per year. On average, there are 192 sunny days per year in La Grande. The U.S. average is 205 sunny days. La Grande gets some form of precipitation, on average, 110 days per year. Precipitation is rain, snow, sleet, or hail that falls to the ground. For precipitation to be counted there must be at least .01 inches on the ground to measure. Precipitation in La Grande is highest during the winter months, while summer tends to be dry with an occasional rain shower or

[3] Western Regional Climate Center estimates 20.24 inches.

thunderstorm. November is the wettest month with 2.2 inches of rain and July is the driest with 0.7 inches of rain. Figure 2-2 illustrates the average monthly rainfall days for the La Grande area.

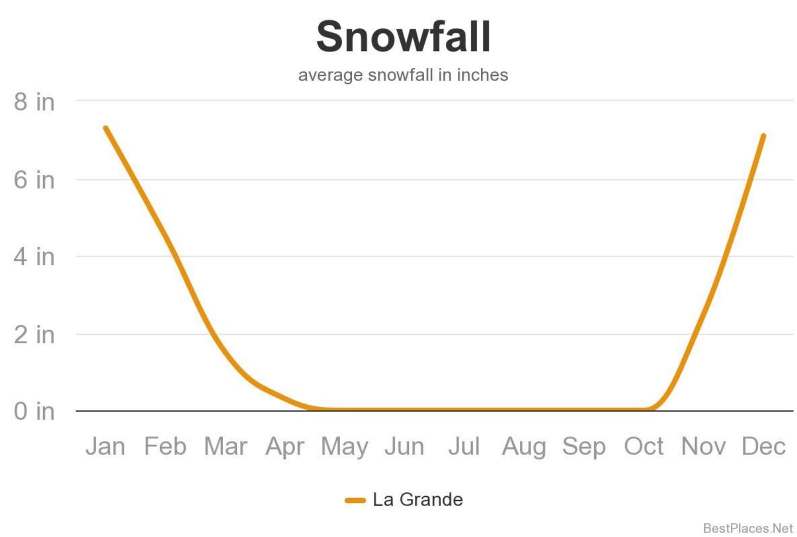
Figure 2-2. Average Rainfall in Inches, La Grande, Oregon



Source: Best Places to Live

Figure 2-2 illustrates that the La Grande is snowier than most places in Oregon with January being the snowiest with 7.3 inches of snow and five months of the year have significant snowfall.

Figure 2-3. Average Snowfall in Inches, La Grande, Oregon



Source: Best Places to Live

Temperature

August is the hottest month for La Grande with an average high temperature of 86 degrees, which ranks it warmer than most places in Oregon. In La Grande, there are two comfortable months with high temperatures in the range of 70-85°. The most pleasant months of the year for La Grande are September, June and July, according to Best Places. There are approximately 24.9 days annually when the high temperature is over 90 degrees.

December has the coldest nighttime temperatures for La Grande with an average of 24.9 degrees. This is colder than most places in Oregon. In La Grande, there are 118.9 days annually when the nighttime low temperature falls below freezing, which is colder than most places in Oregon.

Clouds and Sun

According to Weather Spark for La Grande, the average percentage of the sky covered by clouds experiences extreme seasonal variation over the course of the year. The clearer part of the year in La Grande begins in June and lasts for about 3.6 months, ending in October. The clearest month of the year is August, during with the sky is clear, mostly clear, or partly cloudy 78% of the time. The cloudier part of the year begins in October and lasts for over eight months, ending around June. The cloudiest month of the year is January, during which the sky is overcast or mostly cloudy 65% of the time.

The length of the day in La Grande varies significantly over the course of the year. According to Weather Spark, for 2023 the shortest day is December 21 (8 hours, 44 minutes) and the longest day is June 21 (15 hours, 40 minutes). The earliest sunrise is at 5:03 AM on June 15, and the latest sunrise is at 7:35 AM on November 4. The earliest sunset is at 4:09 PM on December 10, and the latest sunset is at 8:44 PM on June 26.

Wind

This section discusses the wide-area hourly average wind vector (speed and direction) 10 meters above the ground. The wind experienced at any given location is highly dependent on local topography and other factors, and instantaneous wind speed and direction vary more widely than hourly averages.

The average hourly wind speed in La Grande experiences mild seasonal variation over the course of the year, according to Weather Spark. The predominant average hourly wind direction in La Grande also varies throughout the year. The windier part of the year is typically from the end of October to the end of March, with average wind speeds of more than 6.4 miles per hour. The windiest month of the year in La Grande is January, with an average hourly wind speed of 7.8 miles per hour. The calmer time of year is typically from the end of March to the end of October. The calmest month of the year in La Grande is August, with an average hourly wind speed of 4.9 miles per hour.

Hazard Severity

Oregon's Department of Land Conservation and Development (DLCD) contracted with the Oregon Climate Change Research Institute (OCCRI) to analyze the influence of climate change on natural hazards. The scope of the analysis that yielded the report entitled *Future Climate Projections Union County, Oregon* is limited to the geographic area encompassed by Union County, however OCCRI has performed this analysis for many other Oregon counties to inform the Natural Hazard Mitigation Plan update process.

The *Future Climate Projections Union County*, Oregon report states,

> Industrialization has increased the amount of greenhouse gases emitted worldwide, which is causing Earth's atmosphere, oceans, and lands to warm (IPCC, 2021). Climate change and its effects already are apparent in Oregon (Dalton et al., 2017; Mote et al., 2019; Dalton and Fleishman, 2021; Fleishman, 2023). Climate change is expected to increase the likelihood of natural hazards such as heat waves, heavy precipitation, flooding of rivers and streams, drought, wildfires, and poor air quality, and to decrease the likelihood of cold waves.

The complete OCCRI *Future Climate Projections Union County, Oregon* report is discussed in more detail in Chapter 3, Risk Assessment, and is available as Appendix 8.4.

Land Cover

La Grande has a mix of residential, commercial, industrial, and open space land uses. The central main street business district is in the core of downtown La Grande. Residential zoned lands emanate in all directions from downtown. In many areas, agricultural use lands buffer in between the urban growth boundary and residential zoned areas. Due to the river and stream network in La Grande, many residential and commercial zoned lands can be impacted by potential flooding, in the event the Morgan Lake Dam breach and other local rivers and creeks overflow their banks. The built environment is discussed in more detail below.

Synthesis

The physical geography, weather, climate, and land cover of an area are interrelated systems that affect overall risk and exposure to natural hazards. Climate change variability also has the potential to increase the effects of hazards. These factors combined with a growing population and development intensification can lead to increasing risk of hazards, threatening loss of life, property and long-term economic disruption if land management is inadequate. Climate change is further discussed as part of the Risk Assessment (Chapter 3), and throughout the identified hazards.

2.4 Socio-demographic Capacity

Socio-demographic capacity characterizes the community population in terms of language, race and ethnicity, age, income, educational attainment, and health. These attributes can significantly influence the community's ability to cope, adapt to, and recover from natural disasters. In addition to those described the status of other socio-demographic capacity indicators such as graduation rate, quality of schools, median household income can have long term impacts on the City of La Grande economy and stability of the community affecting future resilience. These factors that are vulnerabilities can be reduced with outreach and mitigation planning.

Population

The population of the City of La Grande in 2021 was estimated to be 13,212, according to the U.S. Census Bureau. La Grande is located within Union County and as of 2020 the La Grande Urban Growth Boundary (UGB) contained more than 50% of the county population (Marquez, 2023). Table 2-1 shows the forecasted populations for Union County and all sub-areas, which La Grande is one.

Table 2-1. Union County Forecasted Population

	Population			Share of County Population		
	Estimates	Forecast		Estimates	Forecast	
	2020	2040	2070	2020	2040	2070
County Wide	26,196	26,977	25,650	100%	100%	100%
Sub-areas						
Cove	551	558	575	2.10%	2.07%	2.24%
Elgin	1,720	1,703	1,526	6.57%	6.31%	5.95%
Imbler	256	265	250	0.98%	0.98%	0.97%
Island City	1,283	1,447	1,555	4.90%	5.36%	6.06%
La Grande	13,549	14,725	14,954	51.72%	54.59%	58.30%
North Powder	499	560	585	1.91%	2.08%	2.28%
Summerville	118	121	126	0.45%	0.45%	0.49%
Union	2,128	2,299	2,413	8.12%	8.52%	9.41%
Unincorporated	6,091	5,296	3,667	23.25%	19.63%	14.30%

Source: Marquez et al., 2023

Biological Sex and Gender

The concepts of sex and gender are often used interchangeably but are distinct; sex is based on biological attributes (chromosomes, anatomy, hormones) and gender is a social construction that may differ across time, cultures, and among people within a culture. Moreover, these two may differ across cultures and among people within a culture, and even across time (U.S. Census Bureau, 2021).

According to the U.S. Census Bureau, the sex question wording very specifically intends to capture a person's biological sex and not gender. Ambiguity of these two concepts interferes with accurately and consistently measuring what U.S. Census Bureau intends to measure--the sex composition of the population.

In FEMA's annual 2020 National Preparedness Report, it discusses the historically disadvantaged groups, such as the lesbian, gay, bisexual, transgender, queer (LGBTQ+) persons are "more likely than others to be severely impacted by disasters" (Frank, 2020). Research has shown that after a disaster, LGBTQ+ people are more likely to be socially isolated and face disrespect or harassment in settings such as emergency shelters.

Empirical research has begun to emerge about the ways in which gender influences resilience to disasters. It indicates that gender influence is much more pervasive and expressed differently among men, women, LGBTQ+, and non-binary populations than has been recognized (Enarson, 2017). This is an area deserving of more attention as the field develops

The 2020 U.S. Census gave people the option to identify a relationship as same sex. Furthermore, in July 2021, the U.S. Census Bureau, began asking Americans about their sexual orientation and gender identity through the Household Pulse Survey. This survey measures how the coronavirus pandemic and other emergency issues are impacting households across the country from a social and economic perspective.

Based on the estimated 2021 population of the City of La Grande at 13,212, there are slightly more females with 6,924 (approximately 52.4%) than males with 6,288 (approximately 47.6%). It is important to recognize that women tend to have more institutionalized obstacles than men during recovery due to sector-specific employment, lower wages, and family care responsibilities. The population pyramids in Figure 2-5, below, show how the demographics of age and biological sex vary over time for Union County.

Figure 2-4, provided by Movement Advancement Project (MAP), is a profile of the state's LGBTQ+ population.

Figure 2-4. Oregon Equity Profile

Percent of Adults (18+) Who are LGBTQ	Total LGBTQ Population (13+)	Percent of Workforce That is LGBTQ	Total LGBTQ Workers	Percent of LGBTQ Adults (25+) Raising Children
5.6%	207,000	6%	129,000	23%
Gallup/Williams 2019	*Williams 2020*	*Census 2018; Williams 2020*	*Williams 2020*	*Gallup/Williams 2019*

Source: Movement Advancement Project

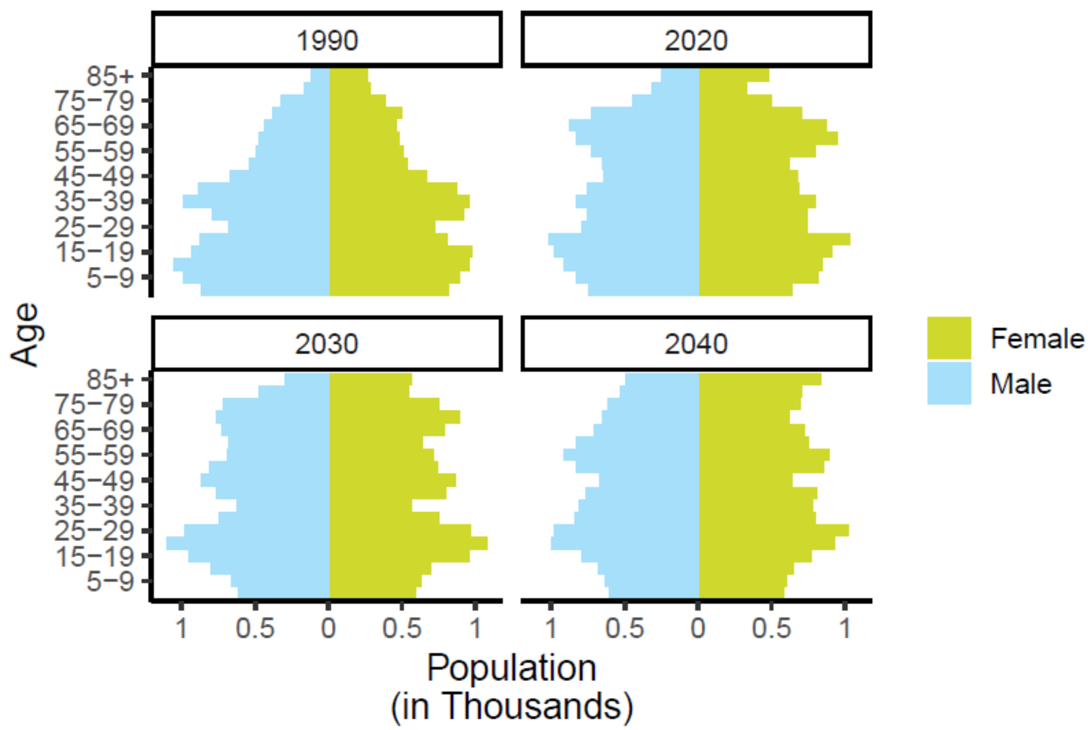
The Human Rights Campaign Foundation's Municipal Equality Index looks at LGBTQ+ friendly policies and inclusiveness. However, the index does not score all municipalities within a state. The 2022 index does not include Union County or the City of La Grande. Notwithstanding this information, outreach materials used to communicate with, plan for, and respond to underserved and under-represented populations such as LGBTQ+ persons should take into consideration the needs of this population.

Age

Of the factors influencing socio-demographic capacity, the most significant indicator in La Grande may be the age of the population. According to the U.S. Census American Community Survey, persons 65 years of age and older made up 17.8% of the total City of La Grande population in 2022, increasing 0.7% in two years. Persons 18 years and younger comprised 23.1% of the population, a level that was nearly stable from the previous two years. Nationwide, the U.S. has a higher percentage of the population occurring in age cohorts between the ages of 55 and 74 than other age groups due to the “baby boom” which occurred after World War II (from 1946 to 1964) as is evident in the pyramid below in Figure 2-5. Senior populations are typically more vulnerable to temperature extremes than other residents. The very young and very old share a proclivity for a wide range of conditions that require the support of family or community and are more likely to thrive under consistent, accessible, comfortable conditions.

The population pyramids below show how the demographics of age and sex vary over time for Union County.

Figure 2-5. Forecast of Union County Population by Age and Sex



Source: Marquez et al., 2023
Note: Years prior to 2023 represent population estimates while years after 2023 represent population forecasts.

The age profile of an area has a direct impact both on what actions are prioritized for mitigation and how response to hazard incidents is carried out. School age children rarely make decisions about emergency management. Therefore, a larger youth population in an area will increase the importance of outreach to schools and parents on effective ways to teach children about fire safety, earthquake response, and evacuation plans. Furthermore, children are more vulnerable to the heat and cold, have few transportation options and require assistance to access medical facilities. Older populations may also have special needs prior to, during and after a natural disaster. Older populations may require assistance in evacuation due to limited mobility or health issues. Additionally, older populations may require special medical equipment or medications, and can lack the social and economic resources needed for post-disaster recovery (Wood, 2007)

Race and Language

Race is a social construct that can be used to understand a community's history and guide policies. The impact in terms of loss and the ability to recover may also vary among minority population groups following a disaster. Studies have shown that racial and ethnic minorities can be more vulnerable to natural disaster events. This is not reflective of individual characteristics; instead, historic patterns of inequality along racial or ethnic divides have often resulted in minority communities that are more likely to have inferior building stock, degraded infrastructure, or less access to public services.

Special consideration should also be given to populations who do not speak English as their primary language. Language barriers can be a challenge when disseminating hazard planning and mitigation resources to the public, and it is less likely they will be prepared if special attention is not given to language and culturally appropriate outreach techniques.

While English is the dominant language spoken in La Grande, according to the 2021 American Community Survey (U.S. Census Bureau), 687 people in City of La Grande, or 5.5% (margin of error is +/- 1.4%) speak a language other than English at home. Of this non-English speaking population, 227 people speak Spanish at home, 170 people speak "Other Indo-European" languages, and 279 people speak Asian and pacific Island languages. Outreach materials used to communicate with, plan for, and respond to non-English speaking populations should take into consideration the language needs of these populations.

Table 2-2. Population by Race, La Grande, Oregon

City of La Grande Population by Race	2010		2021	
	Pop.	%	Pop.	%
Total Population	12,882	100.0%	13,212	100.0%
Hispanic or Latino	605	4.7%	863	6.5%
White alone	11,504	89.3%	11,789	89.6%
Black or African American alone	77	0.6%	97	0.7%
Native American and Alaska Native alone	103	0.8%	152	1.2%
Asian Alone	103	0.8%	139	1.1%
Native Hawaiian and Other Pacific Islander alone	167	1.3%	336	2.5%
Some other race alone	90	0.7%	103	0.8%
Two or more races	360	2.8%	541	4.1%

Source: U.S. Census Bureau, 2010 and 2020

It is important to identify specific ways to support all portions of the community through hazard mitigation, preparedness, and response. Culturally appropriate, and effective outreach can include both methods and messaging targeted to diverse audiences. For example, connecting to historically disenfranchised populations through already trusted sources or providing preparedness handouts and presentations in the languages spoken by the population will go a long way to increasing overall community resilience.

Health

Individual and community health play an integral role in community resiliency, as indicators such as health insurance, people with disabilities, dependencies, homelessness, and crime rate depict a picture of a community's overall well-being. These factors translate to a community's ability to prepare, respond to, and cope with the impacts of a disaster.

It is recognized that those who lack health insurance or are impaired with sensory, mental, or physical disabilities, have higher vulnerability to hazards and may require additional community support and resources. On a similar note, a community with high percentages of drug dependency and violent crimes may experience increased issues with the disruption of normal social systems. It is likely that the continuity of services will be interrupted by a disaster.

According to the 2021 U.S. Census, it is estimated that 8.9% of the City of La Grande population has a mobility (ambulatory) difficulty, and this expands to 25.8% of the population for people over 65. The population with a cognitive difficulty averages 8.7%, except people over 75 suffer cognitive difficulties at a rate of 21.2%. These patterns are similar for independent living—the average of 8.3% with a difficulty increases to 26.1% at 75 years or older.

Table 2-3. Characteristics of the Disabled Population

	Total Population	%
City of La Grande	13,091*	100%
With a Disability	2,367	18.1%
With a Hearing difficulty	799	6.1%
With a Vision difficulty	467	3.6%
With a Cognitive difficulty	1,068	8.7%
With an Ambulatory difficulty	1,094	8.9%
With a Self-Care difficulty	507	4.1%
With an Independent-Living difficulty	837	8.3%

Source: U.S. Census Bureau, 2021
Note: *U.S. Census Bureau Table 1810 population estimates a "total civilian noninstitutionalized population" of 13,091 while other tables (e.g., Table S0101) estimates city population to be 13,212.

There is a wide variation of the disabled population. Some individuals may have strong support structures and a high level of care provided to them by friends, neighbors, and care providers. Others may lack sufficient support. Some individuals may be self-reliant. In some cases, multiple risk factors, access limitations, or special needs can increase personal vulnerability.

Table 2-4. Disabled Population

Age	%
Under 18 years	5.0%
18 to 64 years	32.9%
65 years and over	53.1%

Source: U.S. Census Bureau, 2021

Families and Living Arrangements

The two ways the census defines households are by type of living arrangement and family structure. A householder may live in a "family household" (a group related to one another by birth, marriage or adoption living together); in a "nonfamily household" (a group of unrelated people living together); or alone. According to the 2021 U.S. Census, La Grande is comprised of family households (39.5%). Of all households, 28.6% are one-person non-family households (householder living alone). About 14.7% of householders live alone and are over the age of 65.

Table 2-5. Selected Households and Families

	Total Households	%
City of La Grande	5,220	100%
Married-couple family household	2,060	39.5%
Single-parent family household	1,094	20.1%
Nonfamily household	2,066	39.6%
Householder living alone		28.6%

Source: U.S. Census Bureau, 2021

Table 2-6 shows household structures by type and for families with children. These populations may require additional support during a disaster and may inflict strain on the system if improperly managed.

Table 2-6. Selected Households by Type and Age of Own Children

	Total Households	%
City of La Grande	5,220	100%
Households with own children of householder under 18	1,410	
Under 6 years only		29.5%
Under 6 years and 6 to 17		24.5%
6 to 17 years only		46.0%
Households with one or more people under 18 years		30.9%
Households with one or more people 60 years and over		44.2%
Households with one or more people 65 years and over		33.5%
Households living alone		28.6%
65 years and over		14.7%

Source: U.S. Census Bureau, 2021

Household income and poverty status are indicators of socio-demographic capacity and the stability of the local economy. Household income can be used to compare economic areas but does not reflect how the income is divided among the area residents. Table 2-7 lists the distribution of household income and the median income in La Grande in 2017 and 2021. Between 2017 and 2021 the share of households making less than $15,000 decreased by 4.4%. Median household Income increased across La Grande from $40,750 to $44,868.

Table 2-7. Household and Median Income

	2017		2021		Change in Share	
Household Income	**Households**	**%**	**Households**	**%**	**Households**	**%**
Total	5,315	--	5,220	--	-95	--
Less than $10,000		10.8%		8.5%		-2.3%
$10,000 to $14,999		7.7%		5.6%		-2.1%
$15,000 to $24,999		12.1%		11.8%		-0.3%
$25,000 to $34,999		14.2%		12.9%		-1.3%
$35,000 to $49,999		14.4%		15.3%		0.9%
$50,000 to $74,999		14.5%		17.5%		3.0%
$75,000 to $99,999		10.4%		12.3%		1.9%
$100,000 to $149,000		8.0%		10.2%		2.2%
$150,000 to $199,999		3.3%		3.3%		0.0%
$200,000 or more		4.6%		2.6%		-2.0%
Median income (dollars)	$40,750		$44,868		$4,118	
Mean income (dollars)	$62,448		$60,549		-$1,899	

Source: U.S. Census Bureau, 2017 and 2021

Table 2-8, below identifies the percentage of individuals and cohort groups that are below the poverty level in 2021. It is estimated that 19.6% of individuals, 20.3% of children under 18, and 10.5% of people 65 and older live below the poverty level in La Grande.

Table 2-8. Poverty Rates

	Total	Below Poverty Level	Percent Below Poverty Level
	Estimate	**Estimate**	**Estimate**
Population for whom poverty status is determined	12,704	2,485	19.6%
AGE			
Under 18	2,982	606	20.3%
18 to 64	7,451	1,640	22.0%
65 years and over	2,271	239	10.5%

Source: U.S. Census Bureau, 2021

Cutter's (2003) research suggests that lack of wealth contributes to social vulnerability because individual and community resources are not as readily available. Affluent communities are more likely to have both the collective and individual capacity to rebound from a hazard event more quickly, while impoverished communities and individuals may not have this capacity-leading to increased vulnerability. Wealth can help those affected by hazard incidents to absorb the impacts of a disaster more easily. Conversely, poverty, at both an individual and community level, can drastically alter recovery time and quality (Cutter, 2003)

Federal assistance programs such as food stamps are another indicator of poverty or lack of resource access. Statewide social assistance programs like the Supplemental Nutritional Assistance Program (SNAP) and Temporary Assistance for Needy Families (TANF) help individuals and families. In La Grande, SNAP helped feed an estimated 1,440 or 27.6% of households in 2021, according to the U.S. Census Bureau. According to the Office of Family Assistance (2022), between October 2020 and September 2021, the average number of monthly TANF program recipients in Oregon was 14,390. Those reliant on state and federal assistance are more vulnerable in the wake of disaster because of a lack of personal financial resources and reliance on government support.

In 2019, Oregon Housing and Community Services (OHCS) conducted a Point-in-Time (PIT) count[4] to identify the number of homeless, their age and their family type. The OHCS homeless count was typically conducted county-wide. The City of La Grande is in Union County. The OHCS 2019 PIT count found that 32 individuals and persons in families in Union County identify as homeless; 3 were sheltered and 29 were unsheltered.

The homeless have little resources to rely on, especially during an emergency. It will likely be the responsibility of the city and local nonprofit entities to provide services such as shelter, food and medical assistance. Therefore, it is critical to foster collaborative relationships with agencies that will provide additional relief such as the American Red Cross and homeless shelters. It will also be important to identify how to communicate with these populations, since traditional means of communication may not be appropriate or available.

Education

According to the Union County Chamber of Commerce (2023), La Grande has a K-12 school system, including public, parochial, and private schools. According to La Grande Public Schools, the district includes the communities of La Grande and Island City. The district serves over 2,100 students and families and has a staff of over 290 employees. According to the U.S. Census, 7.2% of the population is enrolled in nursery school or preschool, 59.5% are enrolled in kindergarten to 12th grade, and 33.2% are enrolled in higher education (undergraduate and graduate). As illustrated in Figure 2-6, the student population of the school district is primarily white at 90%, followed by the student population of Pacific Islander/Native Hawaiian (3.8%), Asian (2.5%), Black/African American (1.9%), and American Indian/Alaskan Native (1.8%). La Grande is also home to Eastern Oregon University, which had Fall Term enrollments of 2,825 and 2,674 in 2021 and 2022, respectively (Eastern Oregon University).

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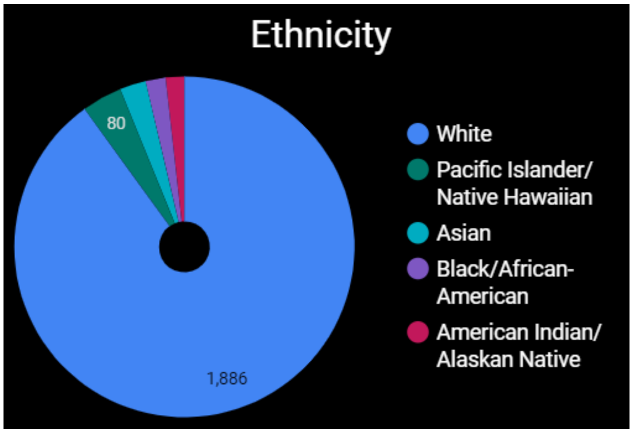
[4] The OHCS Point in Time (PIT) count, occurs once every two years, and is designed to enumerate persons living in homeless facilities and on the streets. It does not capture people who are staying a few nights with a relative, youth who are couch surfing temporarily, or those being put up in a garage or a barn. Some PIT number may vary slightly from individual reports produced by individual counties. The discrepancies may result in differences between HUD mandated and local reporting.

Figure 2-6. La Grande School District Ethnicity



Source: La Grande School District, 2023

Educational attainment of community residents is also identified as an influencing factor in socio-demographic capacity. Educational attainment often reflects higher income and therefore higher self-reliance. Widespread educational attainment is also beneficial for the regional economy and employment sectors as there are potential employees for professional, service and manual labor workforces. An oversaturation of either highly educated residents or low educational attainment can have negative effects on the resiliency of the community.

According to the U.S. Census, 33.8% of the La Grande's population over 25 years of age has graduated from high school or received a high school equivalency, with 22.5% going on to earn a bachelor's degree or higher.

Table 2-9. Education Attainment

	Total	%
AGE BY EDUCATIONAL ATTAINMENT		
Population 18 to 24 years	1,903	
Less than high school graduate	177	9.3%
High school graduate (includes equivalency)	637	33.5%
Some college or associate degree	789	41.5%
Bachelor's degree or higher	300	15.8%
Population 25 years and over	8,259	
Less than 9th grade	111	1.3%
9th to 12th grade, no diploma	405	4.9%
High school graduate (includes equivalency)	2,789	33.8%
Some college, no degree	2,385	28.9%
Associate degree	707	8.6%
Bachelor's degree	1,383	16.7%
Graduate or professional degree	479	5.8%
High school graduate or higher	7,743	93.8%
Bachelor's degree or higher	1,862	22.5%

Source: U.S. Census Bureau, 2021

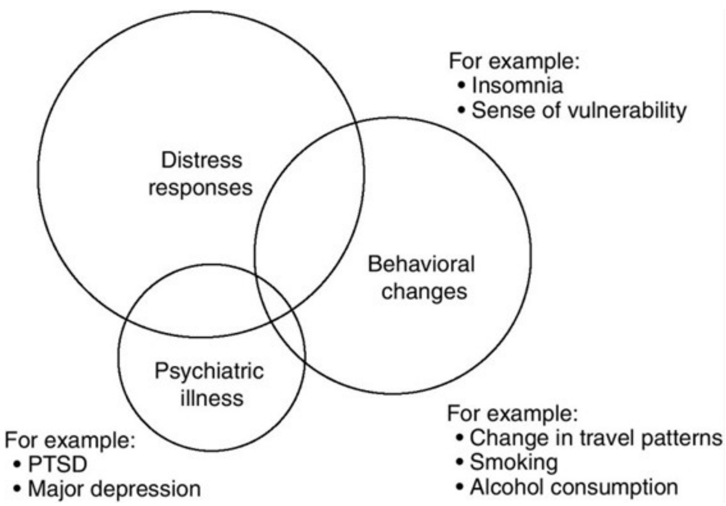
Mental Health and Trauma

Disaster conditions can aggravate anyone affected. For those who suffer from trauma or other mental illness, new stressors can be debilitating or have unpredictable result. Evidence of this is shown by a case study done following the Mt. St. Helens eruption disaster showing there was a marked increase in the caseload for mental health crisis services in the weeks following the eruption. Another important consideration is the ability of disaster conditions to cause mental illness. It is estimated that 10% of disaster victims can develop mental health problems, including depression, and substance abuse.

In *Preparing for the Psychological Consequences of Terrorism: A Public Health Strategy*, by Institute of Medicine (2003) it states,

> The effect of exposure to a traumatic event is variable and specific to the individual; both psychological and physiological responses can vary widely. Social context, biological and genetic makeup, past experiences, and future expectations will interact with characteristics of the traumatic experience to produce the individual's psychological response (Ursano et al., 1992). In general, those exposed to a traumatic event show increased rates of acute stress disorder, posttraumatic stress disorder (PTSD), major depression, panic disorder, generalized anxiety disorder, and substance use disorder (Kessler et al., 1995). Although psychiatric illnesses such as PTSD are the more severe outcomes of traumatic events, they are also the best studied

Figure 2-7. Psychological Consequences of Disaster and Terrorism



Source: Institute of Medicine, 2003 and Ursano, 2002.
Note: Indicative only; not to scale.

Experience of a traumatic event does not dictate a psychological problem but understanding the range of symptoms can help in understanding what type of support is needed.

Because disasters often result in the activation of mass care centers, sponsors of these centers may be particularly interested in addressing or understanding the effect of trauma on the populace.

Providing compassion to the community by offering support services could be construed as a mental health intervention with positive benefits. This is sometimes called trauma-informed service or care when trauma is taken into consideration as something that may need to be addressed as a root cause of an individual or group problem.

For many, receiving community support to meet basic needs may resolve any observable impacts of a disaster on mental health. This is the definition of disaster “relief”—there are tangible physical and psychological benefits.

Management of congregate settings could include some form of monitoring to identify the level of stress or distress by common signs. For example, some people may be inclined to use coping mechanisms like smoking or alcohol. Others may be predisposed to a mental health crisis due to drug withdrawal. Unfortunately, psychiatric emergencies are a possible result of a disaster or its secondary impacts. Preparation for mass care should include training so that the causes and differences in psychiatric emergencies can potentially be identified, treated, or de-escalated before harm occurs.

Socially Vulnerability and Underserved Communities

Disasters are terrible because of the loss they bring. Anyone can experience a loss in their personal capabilities during or because of a disaster. This is particularly true for people already underserved or disadvantaged by one or more risk factors. Vulnerable populations present a special challenge to emergency managers and response agencies as they are more likely to have unique needs, and combinations of needs, which put them at risk of being victims of a disaster.

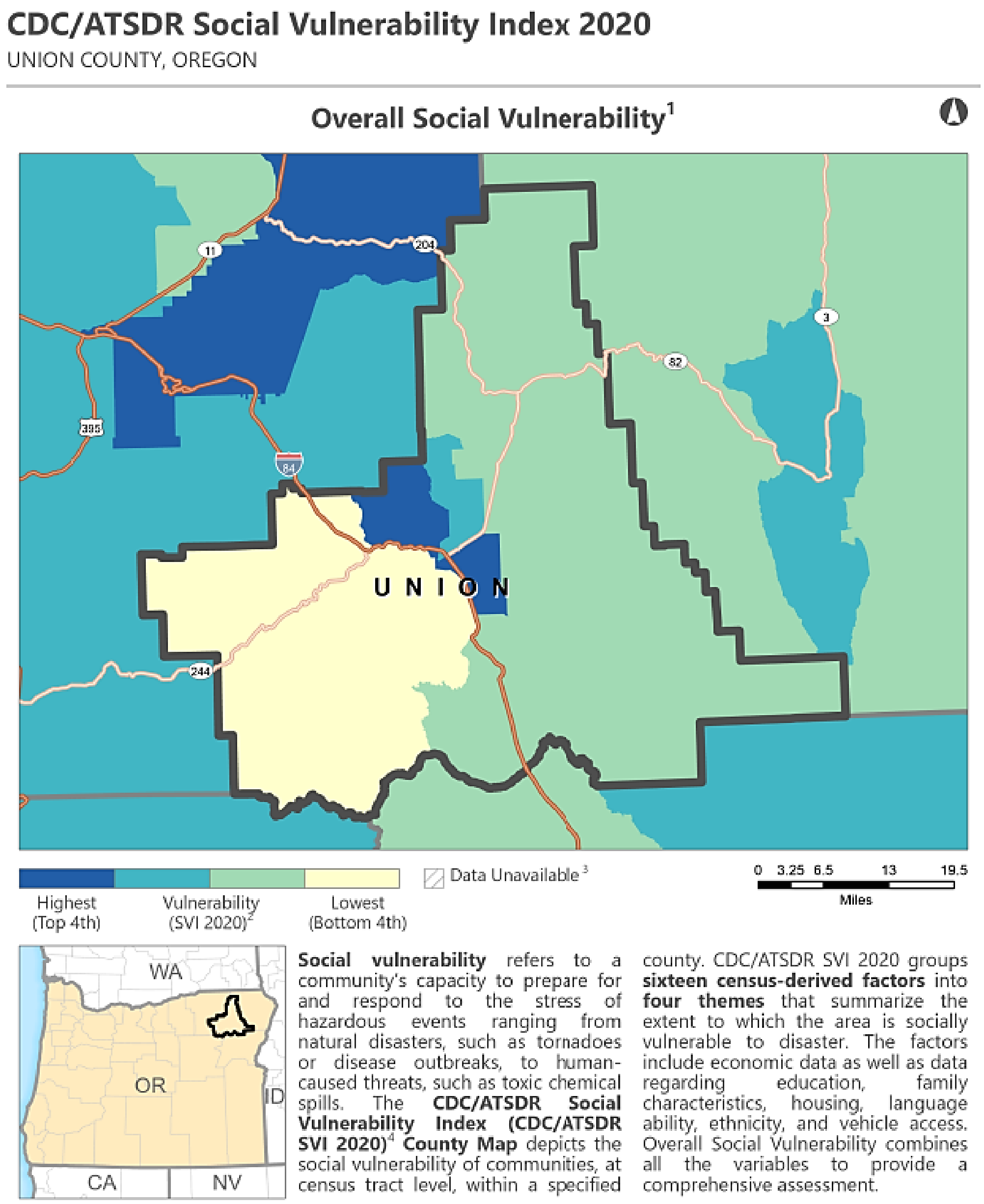
Vulnerable populations are those groups that possess specific characteristics that inhibit their ability to prepare for, respond to, or recover from a disaster. In addition, people from non-white or non-able-bodied populations may be considered “underserved.”

The State of Oregon Equity Framework defines historically and currently underserved communities as Oregonians who are:

- Native Americans, members of Oregon’s nine federally recognized tribes, American Indians, Alaska Natives
- Black, Africans, African Americans
- Latinx, Hispanic
- Asian, Pacific Islanders
- Immigrants, refugees, asylum seekers
- Undocumented, ‘Development, Relief, and Education for Alien Minors’ Act Recipients (DREAMers)
- Linguistically diverse
- People with disabilities
- LGBTQ+
- Aging/older adults
- Economically disadvantaged
- Farmworkers, migrant workers
- Living in rural parts of the state

Individuals often identify with multiple communities and are impacted by compounding systems of oppression, also known as intersectionality. Identity and experience impact racial, health, and economic equity and should be considered in applying core elements that help decision makers center equity in their planning and response efforts (Office of Governor Kate Brown, 2020).

Figure 2-8. Union County Overall Social Vulnerability Index 2020



Source: Agency for Toxic Substance and Disease Registry, 2020

Tourist Population

Tourists are not measured in U.S. Census data so it can be difficult to document the number of visitors. According to Travel Oregon's Monthly Barometer (2023), hotel and short-term rental occupancy in Eastern Oregon was at 66.8% and 81%, respectively for the July 2023 report. The Year-To-Date (YTD) short-term rental performance was up 3.3% from the previous 2022 reporting year. During this time. In the 2022 Travel Economic Impact Report for the Union County, overnight visitor volume was approximately 246,000 by travelers staying at a private home, hotel, motel, and short-term rentals.

Tourists are particularly vulnerable during natural hazard events. This is because tourists are usually unfamiliar with the hazards in the region and because they do not have the knowledge, or the materials needed to take care of themselves in a disaster. For example, a typical tourist unfamiliar with La Grande, Union County, or the Northeast Oregon region may have difficulty identifying or using evacuation routes or finding shelters in the event of an earthquake or wildfire. A typical tourist is less likely to have a supply of food, water, flashlights, radios, and other supplies that locals can use to take care of themselves in a disaster. And finally, tourists usually do not have a local support structure of family, friends, and neighbors.

Synthesis

For planning purposes, it is essential La Grande consider both immediate and long-term socio-demographic implications of hazard resilience. Immediate concerns include the growing elderly population and language barriers associated with a culturally diverse community. Even though most of the population is reported as proficient in English, there is still a segment of the population not proficient in English. These populations would serve to benefit from mitigation outreach, with special attention to cultural, visual and technologically sensitive materials. The status of other socio-demographic capacity indicators such as graduation rate, poverty level, and median household income can have long-term impacts on the economy and stability of the community ultimately affecting future resilience.

In mitigation and preparedness planning it is critical for the safety of all residents that messaging, and actions are culturally sensitive to all racial and ethnic groups. This may range from providing multi-lingual services to adopting entirely different strategies for outreach or specialized mitigation actions to address the unique risk faced by various racial and ethnic groups. For example, if multigenerational family units are more typical in some cultures, evacuation may be more take longer to accommodate the elderly and children living at home or could even be impeded if there is only one family car. Additionally, varying cultural perceptions of the trustworthiness of government may need to be overcome so that suggestions to evacuate or shelter in place are taken seriously by residents.

2.5 Economic Capacity

Economic capacity refers to the financial resources present, and revenue generated in the community to achieve a higher quality of life. Income equality, housing affordability, economic diversification, employment and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources and infrastructure are interconnected in the existing economic picture. Once any inherent strengths or systematic vulnerabilities become apparent, both the public and private sectors can take action to increase the resilience of the local economy.

Based on social science research, a region's cohesive response to a hazard event may be affected by the distribution of wealth in communities that have less income equality (Cutter, 2010).

Oregon State University together with The Oregon Community Foundation issued a report in 2015 that describes a comparison to all other states; Oregon has average levels of income inequality. Nationally, Oregon ranks 22nd among the 50 states and Washington D.C., where ranking 1st means having the lowest inequality and ranking 51st means having the highest inequality. Oregon's level of inequality is slightly below the national average (Rahe et al., 2015; Ruffenach and Worcel, 2017).

According to an Oregon Employment Department article dated July 24, 2018, Barbara Peniston states,

> The degree of wage inequality in Oregon has generally increased since 1990, though not steadily. The state's Gini coefficient for all year-round workers rose from 1991 through the mid-1990s, and then was relatively level before rising to a peak in 2000. Since 2000, the coefficient fell slightly in 2001 and 2002, during the first economic slowdown of the decade. Afterwards, it began a steady rise to a second peak in 2007, as the state's economy recovered from the recession earlier in the decade. The coefficient decreased a little again in 2008 and 2009 and subsequently rose to reach its highest point in 2015. It dropped slightly in 2016 and remained essentially unchanged in 2017.

Regional Affordability

The evaluation of regional affordability supplements the identification of Socio-demographic capacity indicators, such as. median income and is a critical analysis tool to understanding the economic status of a community. This information can capture the likelihood of individuals' ability to prepare for hazards, through retrofitting homes or purchasing insurance. If the community reflects high-income inequality or housing cost burden, the potential for homeowners and renters to implement mitigation can be drastically reduced. Therefore, regional affordability is a mechanism for generalizing the abilities of community residents to get back on their feet without Federal, State or local assistance.

Income Equality

Income equality is a measure of the distribution of economic resources, as measured by income, across a population. It is a statistic defining the degree to which all persons have a similar income.

The Gini index is a measure of income inequality. The index varies from zero to one. A value of one indicates perfect inequality (only one household has any income). A value of zero indicates perfect equality (all households have the same income). The Gini is based on the difference between the Lorenz curve (the observed cumulative income distribution) and the notion of a perfectly equal income distribution (U.S. Census Bureau, 2021).

La Grande has a Gini coefficient of 0.44. Based on social science research, the region's cohesive response to a hazard event may be affected by the distribution of wealth in communities that have less income equality (Cutter, 2010).

Table 2-10. Regional Income Equality

Jurisdiction	Income Inequality Coefficient
Oregon	0.46
Union County	0.4345
La Grande	0.4461

Source: U.S. Census Bureau

Housing Affordability

Housing affordability is a measure of economic security gauged by the percentage of a metropolitan area's households paying less than 35% of their income on housing (University of California Berkeley). Households spending more than 35% are considered housing cost burdened. In general, the population that spends more of their income on housing has proportionally fewer resources and less flexibility for alternative investments in times of crisis (University of California Berkeley). Table 2-11 below displays the percentage of homeowners and renters reflecting housing cost burden across the region.

Table 2-11. Housing

	La Grande	U.S.
Housing Units, July 1, 2022 (V2022)	X	143,786,655
Owner-occupied housing unit rate, 2017-2021	54.4%	64.6%
Median value of owner-occupied housing units, 2017-2021	$187,400	$244,900
Median selected monthly owner costs-with a mortgage, 2017-2021	$1,298	$1,697
Median selected monthly owner costs-without a mortgage, 2017-2021	$499	$538
Median gross rent, 2017-2021	$862	$1,163
Building permits, 2022	X	1,665,088

Source: U.S. Census Bureau QuickFacts

High incidence of housing cost burden can impose serious challenges for a community recovering from a disaster, as housing costs may exceed the ability of residents to repair or move to a new location. These populations may live paycheck to paycheck and are extremely dependent on their employer. In the event their employer is also impacted, it will further the detriment experienced by these individuals and families.

Economic Diversity

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times, but it is not a guarantor of economic vitality or resilience (University of California Berkeley). According to the Northeast Oregon Economic Development District (NOEDD) C*omprehensive Economic Development Strategy 2018-2023* (2018), which covers Baker, Union, and Wallowa Counties, indicates that the region has "notable employment in manufacturing, trade/transportation/utilities, education and heath, leisure and hospitality, and government. Some of these sectors primarily serve a local market and some mainly bring money into the economy from external markets."

One method for measuring economic diversity is through use of the Herfindahl-Hirschman Index (HHI), a formula that compares the composition of city and regional economies with those of states or the nation. Using the HHI, a diversity ranking of 1 indicates the city with the most diverse economic activity compared to the state, while a ranking of 36 corresponds with the least diverse city economy. The table below describes the HHI-score for counties in the region.

Table 2-12 shows that Union County has economic diversity rankings of 13 as of 2021 (Tauer, 2022). This is on a scale between all 36 counties in the state where 1 is the most diverse economic county in Oregon and 36 is the least diverse.

Table 2-12. Northeast Oregon Regional Herfindahl Index Scores

	2021		1999	
County	**Value**	**Rank**	**Value**	**Rank**
Baker	0.461	14	0.463	16
Grant	0.080	33	0.144	33
Union	0.490	13	0.479	15
Wallowa	0.187	28	0.216	30

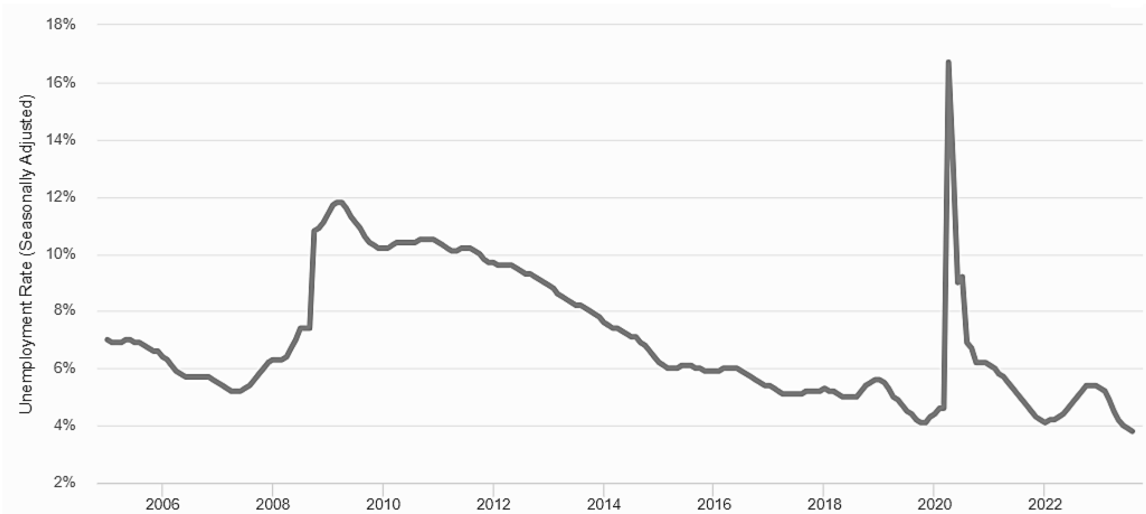
Source: Tauer, 2022
Note: Values range from zero to 1.00; higher values indicate a more diverse economy. The 2018 Hachman Index values are based on 3-digit NAICS industry breakouts, while the 1999 values are based on 2-digit SIC industry breakouts.

While illustrative, economic diversity is not a guarantor of economic vitality or resilience. The Oregon Employment Department designates counties, cities, communities, or other geographic areas experiencing high unemployment, poverty, and job loss as economically distressed. The Distressed Cities List is used to highlight Oregon communities that may need additional support. The distressed designation may provide a community with an advantage if it applies for funds from state and federal sources. Business Oregon gives priority when funding technical assistance, programs and projects to geographic areas determined to be economically distressed as prescribed by Oregon law. According to Business Oregon's 2023 Distressed Counties, Union County is listed as an economically distressed county as prescribed by Oregon Law. The economic distress measure is based on indicators of decreasing new jobs, average wages, and income, and is associated with an increase in unemployment.

Employment and Wages

According to the Oregon Employment Department, unemployment has declined since a high of 11.5% in April 2009. As of August 2023, the unemployment rate for Union County is 3.8%.

Figure 2-9. Unemployment Rate, Union County



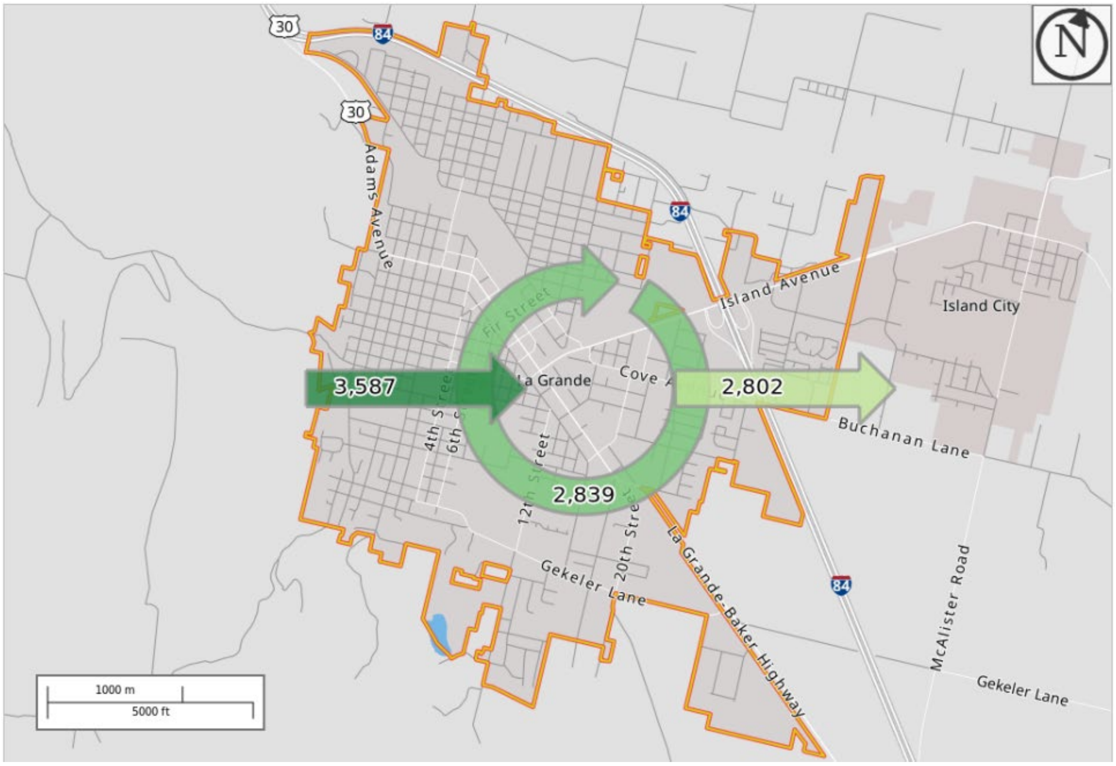
Source: Oregon Employment Department, 2023

La Grande employers draw in a majority (55.8%) of their workers from outside the city. The La Grande economy is a cornerstone of regional economic vitality. Figure 2-10, below, shows the city's laborshed as of 2020; the map shows that about 44.2% of workers live and work in the city (2,839), 55.8% of workers come from outside the city (3,587), and about 49.7% of residents work outside of the city (2,802).

Mitigation activities are needed at the business level to ensure the health and safety of workers and limit damage to industrial infrastructure. Employees are highly mobile, commuting from all over the surrounding area to industrial and business centers. As daily transit rises, there is an increased risk that a natural hazard event will disrupt the travel plans of residents across the region and seriously hinder the ability of the economy to meet the needs of La Grande residents and businesses.

According to the U.S. Census (2021), approximately 80.6% of commuters travel by car, truck, or van; 70.1% of these individuals commute alone while 10.5% carpool. In addition, 0.2% used public transportation, 9.6% walked, 0.6% used a bicycle, 1.7% used a taxicab, motorcycle or other means, and 7.3% worked from home. Increased commuting creates a greater dependency on roads, communications, accessibility, and, in the event of a hazard incident, emergency evacuation routes to reunite people with their families. Before a natural hazard event, large or small businesses can develop strategies to prepare for natural hazards, respond efficiently, and prevent loss of life and property.

Figure 2-10. Laborshed, La Grande, Oregon



Source: U.S. Census Bureau, OnTheMap, 2020

Industry

Key industries are those that represent major employers and are significant revenue generators. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry specific discussions below. Identifying key industries in the region enables communities to target mitigation activities towards those industries' specific sensitivities. The *2020 Oregon NHMP* indicates that for the Northeast Oregon (Region 7), it is important to recognize that the impact that a natural hazard event has on one industry can reverberate throughout the regional economy.

This is of specific concern when the businesses belong to the basic sector industry. Basic sector industries are those that are dependent on sales outside of the local community; they bring money into a local community via employment. The farm and ranch, information, and wholesale trade industries are all examples of basic industries. Non-basic sector industries are those that are dependent on local sales for their business, such as retail trade, construction, and health services (*2020 Oregon NHMP*).

Employment by Industry

Economic resilience to natural disasters is particularly important for the major employment industries in the region. If a natural hazard negatively impacts these industries, such that employment is affected, the impact will be felt throughout the regional economy (*2020 Oregon*

NHMP). Thus, understanding and addressing the sensitivities of these industries is a strategic way to increase the resiliency of the entire regional economy.

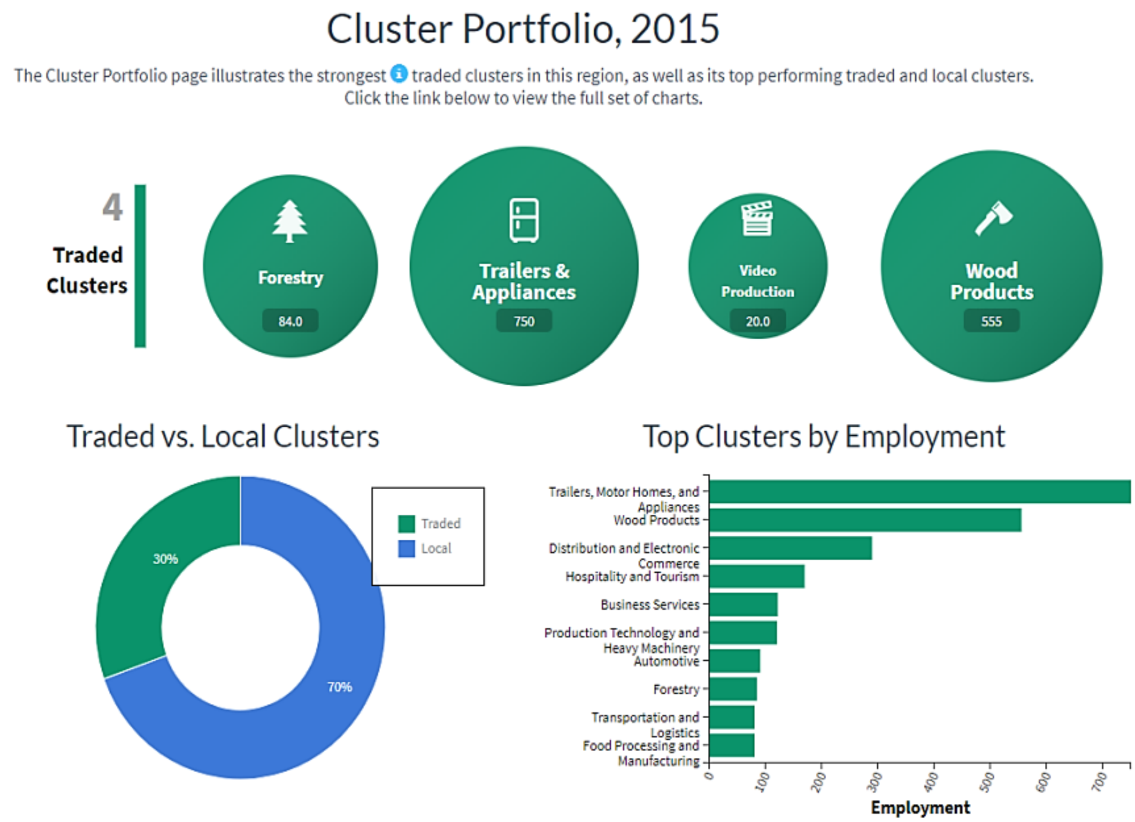
La Grande relies on both basic and non-basic sector industries, and it is important to consider the effects each may have on the economy following a disaster. Basic sector businesses have a multiplier effect on a local economy that can spur the creation of new jobs, some of which may be non-basic. The presence of basic sector jobs can help speed the local recovery; however, if basic sector production is hampered by a natural hazard event, the multiplier effect could be experienced in reverse. In this case, a decrease in basic sector purchasing power results in lower profits and potential job losses for the non-basic businesses that are dependent on them. While La Grande has some basic industries, such as Manufacturing; four out of their five largest industrial sectors are of the non-basic nature and thus they rely on local sales and services. Trending towards basic industries can lead to higher community resilience.

As noted previously, the NOEDD C*omprehensive Economic Development Strategy 2018-2023* (2018), indicates that the region has “notable employment in manufacturing, trade/transportation/utilities, education and health, leisure and hospitality, and government. Some of these sectors primarily serve a local market and some mainly bring money into the economy from external markets.” The NOEDD *Comprehensive Economic Development Strategy 2018-2023* provides the cluster portfolio for Union County in Figure 2-11.

The NOEDD C*omprehensive Economic Development Strategy 2018-2023* states,

> The region’s economy continues to have strong base in natural resources and timber, while the agricultural and tourism sectors are also very important. The region has high self-employment, and locally owned businesses provide a key link in the circulation of capital in the region. All three counties have seasonal economies with reduced employment during the winter months….
>
> One way of analyzing an area’s economy is to look at the industry clusters that are present. U.S. Cluster Mapping http://www.clustermapping.us/) utilizes a standardized methodology for identifying industry clusters. The export industry clusters identified for the region are described below. Clusters such as forestry, agriculture, wood products, nonmetal mining, electric power, and hospitality are all directly related to the abundant natural resources in the region and are the traditional industries that have provided the backbone of the region’s economy. Trailer manufacturing and downstream metals point to the importance of some of the diversified manufacturing present in the region

Figure 2-11. Union County Industry Clusters



Source: Northeast Oregon Economic Development District, 2018

The NOEDD states that approximately 30% of the region's land is in agricultural production, including cropland, woodland, rangeland, and pastureland with approximately 2,000 farms. Cattle production is the single largest commodity ($84.6 million) in the region according to NOEDD, with hay and grain production following in value ($55.7 million and $40.8 million, respectively (2018).

Historically, the timber industry has been the most important source of above-average-wage jobs in the Northeast Oregon region but experienced a sharp decline beginning in the mid-1980s. By 2016, timber harvest on public lands declined by approximately 72% compared to 1962, according to Northeast Oregon Economic Development District (2018). A simultaneous decline in jobs and mill closures were also experienced and between 1998 and 2016, 516 industry jobs were lost (NOEDD, 2018). According to NOEDD, there is currently one plywood plant and one particle board plant operating in Union County.

The Leisure and Hospitality Industry in Northeast Oregon is responsible for 18 percent of private employment in the region (NOEDD, 2018). Although tourism jobs may hold lower-than-average annual wage levels, the tourism industry in the region provides the opportunity for many business owners to benefit from tourism-related sales, and direct earnings in the region are significant.

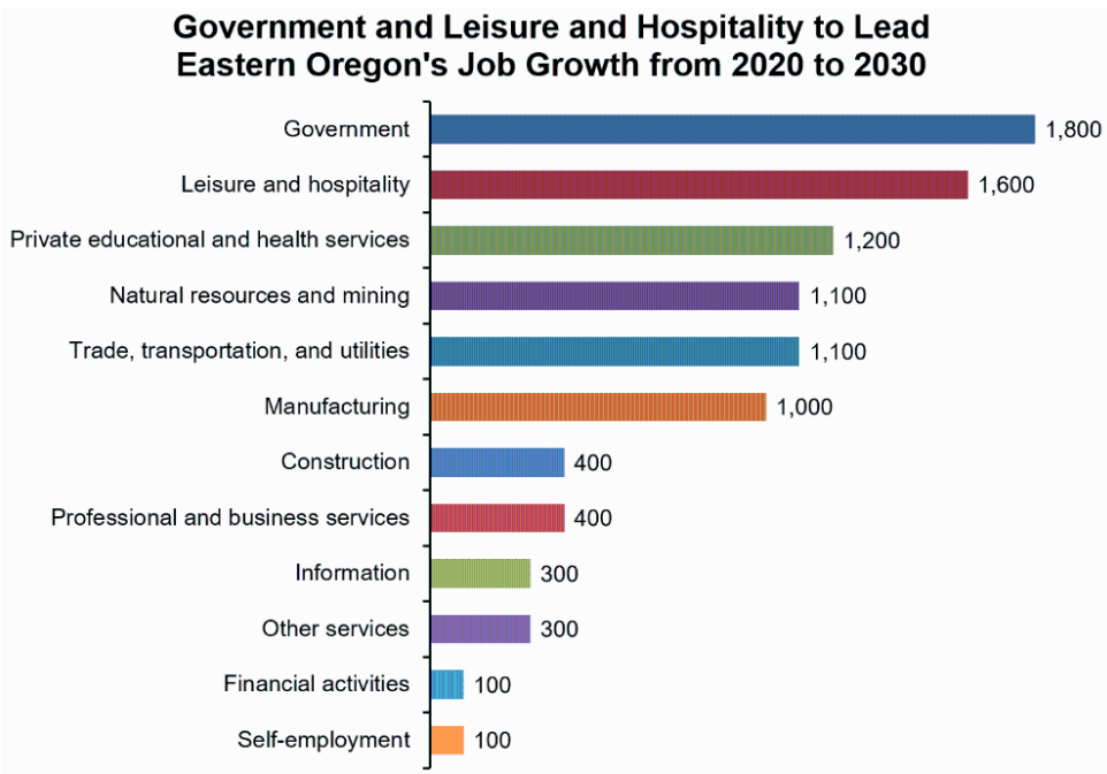
Self-employment rates are very high in Northeast Oregon, ranging from a low of 27.9 percent in Union County to a high of 43.8 percent in Wallowa County, according to the NOEDD *Comprehensive Economic Development Strategy 2018-2023*.

Future Employment in Industry

The Eastern Oregon region, which includes eight counties (Baker, Grant, Harney, Malheur, Morrow, Umatilla, Union, and Wallowa counties) and the City of La Grande, will add 9,300 jobs between 2020-2030, according to the Oregon Employment Department. This represents a 12% increase in employment over 10 years. The projection report for Eastern Oregon states, "The industries projected to add the most jobs in Eastern Oregon are government; leisure and hospitality; private education and health services; natural resources and mining; and trade, transportation, and utilities. No major private industry sectors are projected to decline. Government job growth is projected in local sectors and state government. Federal government jobs are projected to be essentially unchanged." (Wendel, 2022)

Sectors that are anticipated to be major employers in the future also warrant special attention in the hazard mitigation planning process. As shown in Figure 2-12, between 2020 and 2030, the largest employment growth is anticipated within the government sector (1,800) and leisure and hospitality (1,600). Another sector that is projected to grow is private educational and health services with 1,200 jobs (Wendel, 2022). Lastly, the region's trade, transportation, and utilities sectors are projected to grow by approximately 1,100 jobs over the decade.

Figure 2-12. Eastern Oregon Employment Growth: 2020-2030



Source: Wendel, 2022

Synthesis

The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families, and the community to absorb disaster impacts for a quick recovery. It is important to consider what might happen to the City of La Grande, together with Union County, economy if some of the largest revenue generators and employers, were heavily impacted by a disaster. The city's economy is expected to grow by 2030, with much of the growth within the industries of government; leisure and hospitality; private educational and health services; and trade, transportation, and utility industries. Areas with less income equality, particularly in the smaller cities, higher housing costs, and overall low economic diversity are factors that may contribute to slower recovery from a disaster.

2.6 Built Environment Capacity

Built Environment capacity refers to the built environment and infrastructure that supports the community. The various forms, quantity, and quality of built capital mentioned above contribute significantly to community resilience. Physical infrastructures, including utility and transportation lifelines, are critical during a disaster and are essential for proper functioning and response. The lack or poor condition of infrastructure can negatively affect a community's ability to cope, respond and recover from a natural disaster. Following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediately available resources.

Land Use and Development Patterns

One significant way in which La Grande residents can increase or decrease their vulnerability to natural hazards is through development patterns. The way in which land is used – is it a parking lot or maintained as an open space – will determine how closely the human-made systems of transportation, economy, etc., interact with the natural environment. All patterns of development, density as well as sprawl, bring separate sets of challenges for hazard mitigation. Buildable lands within the UGB were intended to satisfy the demands of population and employment growth for a 20-year period. Follow this link for a map of La Grande's current UGB: https://cityoflagrande.maps.arcgis.com/apps/webappviewer/index.html?id=7ccb75d85bc74111a849979be8c18907

Regulatory Context

Oregon land use laws require land outside UGBs to be protected for farm, forest, and aggregate resource values. This law limits the amount of development in the rural areas. However, the land use designation can change from resource protection in one of two ways:

- The requested change could qualify as an exception to Statewide Planning Goals, in which case the city must demonstrate to the State of Oregon that the change meets requirements for an exception. These lands, known as exception lands, are predominantly designated for residential use.
- Resource land can also be converted to non-resource use when it can be demonstrated that the land is no longer suitable for farm or forest production.

Local and state policies currently direct growth away from rural lands and into UGBs, and, to a lesser extent, into rural communities. If development follows historical development trends, urban areas will expand their UGBs, rural unincorporated communities will continue to grow, and overall rural residential density will increase slightly with the bulk of rural lands kept in farm and forest use. The existing pattern of development in the rural areas, that of radiating out from the urban areas along rivers and streams is likely to continue. Most of the "easy to develop" land is already developed, in general leaving more constrained land such as land in the floodplains or on steep slopes to be developed in the future, perhaps increasing the rate at which development occurs in natural hazard areas.

Since 1973, Oregon has maintained a strong statewide program for land use planning. The foundation of that program is a set of 19 statewide planning goals that express the state's policies on land use and on related topics, such as citizen involvement, land use planning, and natural resources.

Most of the goals are accompanied by "guidelines," which are suggestions about how a goal may be applied. Oregon's statewide goals are achieved through local comprehensive planning. State law requires each city and city to adopt a comprehensive plan and the zoning and land-division ordinances needed to put the plan into effect. The local comprehensive plans must be consistent with the statewide planning goals. Plans are reviewed for such consistency by the state's Land Conservation and Development Commission (LCDC). When LCDC officially approves a local government's plan, the plan is said to be "acknowledged." It then becomes the controlling document for land use in the area covered by that plan.

Oregon Statewide Planning Goal 7

The Oregon Statewide Planning Goal 7, Areas Subject to Natural Disasters and Hazards, has the overriding purpose to “protect people and property from natural hazards”. Goal 7 requires local governments to adopt comprehensive plans (inventories, policies and implementing measures) to reduce risk to people and property from natural hazards. Natural hazards include floods, landslides, earthquakes, tsunamis, coastal erosion, and wildfires.

To comply with Goal 7, local governments are required to respond to new hazard inventory information from federal or state agencies. The local government must evaluate the hazard risk and assess the:

a) frequency, severity, and location of the hazard;
b) effects of the hazard on existing and future development;
c) potential for development in the hazard area to increase the frequency and severity of the hazard; and
d) types and intensities of land uses to be allowed in the hazard area.

Local governments must adopt or amend comprehensive plan policies and implement measures to avoid development in hazard areas where the risk cannot be mitigated. In addition, the siting of essential facilities, major structures, hazardous facilities and special occupancy structures should be prohibited in hazard areas where the risk to public safety cannot be mitigated. The state recognizes compliance with Goal 7 for coastal and riverine flood hazards by adopting and implementing local floodplain regulations that meet the minimum National Flood Insurance Program (NFIP) requirements.

In adopting plan policies and implementing measures for protection from natural hazards local governments should consider:

a) the benefits of maintaining natural hazard areas as open space, recreation, and other low density uses;
b) the beneficial effects that natural hazards can have on natural resources and the environment; and
c) the effects of development and mitigation measures in identified hazard areas on the management of natural resources.

Local governments should coordinate their land use plans and decisions with emergency preparedness, response, recovery, and mitigation programs. Given the numerous waterways and forested lands throughout Corvallis, special attention should be given to problems associated with riverbank erosion and potential for wild land/urban interface fires.

Goal 7 guides local governments to give special attention to emergency access when considering development in identified hazard areas, including:

a) Consider programs to manage stormwater runoff to address flood and landslide hazards,
b) Consider non-regulatory approaches to help implement the goal,
c) When reviewing development requests in high hazard areas, require site specific reports, appropriate for the level and type of hazards. Site specific reports should evaluate the risk to the site, as well as the risk the proposed development may pose to other properties.
d) Consider measures exceeding the National Flood Insurance Program.

Changes in Development

Since the *2014 Northeast Oregon Regional NHMP*, the city has seen very little growth or in-fill development across La Grande. The following is a general list of projects that have occurred in the last five years, not all of which are within a hazard zone.

- Grande Ronde Hospital Emergency Room addition, which included a seismic and landslide retrofit
- La Grande School District Middle School – Construction of new gymnasium & classrooms (Wildcat Center)
- La Grande School District seismic upgrades to Greenwood Elementary School and La Grande High School
- Eastern Oregon University track fieldhouse project ($14M+ project)
- New Napa Auto Parts commercial store on Island Avenue (near 2726 Island Avenue)
- Full demo of two fuel service stations and rebuild of a new Jackson Car/Truck stop (near 2706 Island)
- New construction of a hotel right in 2023 at Mulholland & 26th (near 2830 Mulholland Drive)

Housing

In addition to location, the characteristics of the housing stock affect the level of risk posed by natural hazards. The table below identifies the types of housing most common throughout the city. Of interest are mobile homes and other non-permanent residential structures, which account for 11.3% of the housing in La Grande. These structures are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing the structures, because they are more prone to wind damage than wood-frame construction. In other natural hazard events, such as earthquakes and floods, these structures are more likely to shift on their foundations and create hazardous conditions for occupants.

Table 2-13. Units in Structure, Housing Profile

Units in Structure	Estimate	%
1-unit, Single-family (detached)	3,382	59.1%
1-unit, Single-family (attached)	175	3.1%
2 units	217	3.8%
3 or 4 units	248	4.3%
5 to 9 units	229	4.0%
10 to 19 units	194	3.4%
20 or more units	636	11.1%
Mobile home	636	11.1%
Boat, RV, van, etc.	9	0.2%
Total housing units	5,726	--

Source: U.S. Census Bureau, 2021

Aside from location and type of housing, the year structures were built has implications. Seismic building standards were codified in Oregon building code starting in 1974 more rigorous building code standards were passed in 1993 that accounted for the Cascadia earthquake fault (Oregon Building Codes Division, 2012). Therefore, homes built before 1993 are more vulnerable to seismic events. Also, in the 1970's, FEMA began assisting communities with floodplain mapping as a response to administer the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Upon receipt of floodplain maps (locally 1979), communities started to develop floodplain management ordinances to protect people and property from flood loss and damage.

Based on U.S. Census data, approximately three-quarters of the residential housing in La Grande was built before the current seismic building standards of 1990 were constructed prior to the local implementation of the flood elevation requirements of the 1970's (city Firms-were not completed until 1979).

Table 2-14. Year Built, Housing Profile

Year Structure Built	Estimate	%
Built 2020 or later	0	0.0%
Built 2010 to 2019	251	4.4%
Built 2000 to 2009	321	5.6%
Built 1990 to 1999	757	13.2%
Built 1980 to 1989	695	12.1%
Built 1970 to 1979	1,013	17.7%
Built 1960 to 1969	402	7.0%
Built 1950 to 1959	356	6.2%
Built 1940 to 1949	303	5.3%
Built 1939 or earlier	1,628	28.4%
Total housing units	5,726	--

Source: U.S. Census Bureau, 2021

The National Flood Insurance Program's (NFIP's) FIRMs delineate flood-prone areas. They are used to assess flood insurance premiums and to regulate construction so that in the event of a flood, damage is minimized. City of La Grande FIRM panels were issued April 3, 1996. La Grande is currently working to update their FIRMs. There are approximately 400 properties located in the regulatory floodplain. If the amendment is accepted by FEMA, the number of properties located within the regulatory floodplain will be reduced to 325 (Boquist, 2023).

Critical Facilities

Critical Facilities include buildings, their internal components and trained personnel, and may also include certain mobile units, such as those of first responders. For example, many vehicles of the police department, fire department (including ambulances), and public works department are key and essential components of the functions provided by these critical facilities. The interruption or destruction of any of these facilities would have a debilitating effect on incident management and long-term recovery. Not all Critical Facilities are of equal importance and are therefore subject to prioritization of criticality.

While lifelines and other physical infrastructure, such as, transportation routes, dams, power generation facilities and transmission lines, are also critical, they have been documented under physical infrastructure and utility lifelines for the purposes of this profile. This information provides the basis for informed decisions about the infrastructure and facilities already in place that can be used to reduce the vulnerability of La Grande to natural hazards.

The following Table 2-15 is taken from the *2022 Union County Natural Hazards Mitigation Plan* (*2022 Union County NHMP*) regarding county-wide critical facilities, some of which are located within the City of La Grande.

Table 2-15. Critical Facilities, Union County

Facility	Number
Hospital (beds)	1 (25)
Police Stations[5]	1
Fire & Rescue	7
Power Plants	0
Dams	17
Bridges	161

Source: *2022 Union County NHMP*

[5] Since the 2014 Northeast Oregon Regional NHMP, law enforcement and emergency management moved into one facility, which is sometimes referred to as the Union County Law Enforcement Facility and which houses the 911 Dispatch, La Grande Police, Union County Sheriff's Offices, Union County Jail, and Union County Emergency Operations Center.

Physical Infrastructure

Physical infrastructure includes transportation networks, dams, and utilities. These infrastructures support the La Grande community and economic activity. Due to the fundamental role that physical infrastructure plays both in pre- and post-disaster, they deserve special attention in the context of creating resilient communities (Oregon Department of Land Conservation and Development, 2020).

Transportation

Roads and Bridges

Roads and bridges in the City of La Grande are vulnerable to hazards, specifically earthquakes. Because bridges vary in size, materials, siting, and design, any given hazard will affect them differently. When considering the expanse and integrity of transportation infrastructure within La Grande and how it will impact the resilience of the city, it is imperative that infrastructure across Union County is also considered. If a principal arterial is obstructed beyond the city limits it will have significant impacts on access in and out of La Grande.

According to the *2022 Union County NHMP*, the transportation routes within the county include following interstate and state highways:

- Interstate-84 freeway;
- Highway 82 which connects La Grande to Island City, Imbler, Summerville, and Elgin;
- Highway 203 which connects La Grande to Union; and
- Highway 237 which connects Union, Cove, North Powder and La Grande.

Bridge conditions surrounding the city are also a factor that affects risk from natural hazards. Bridges damaged by hazards such as earthquakes can disrupt traffic and exacerbate economic losses because of the inability of industries to transport services and products to clients. The *2022 Union County NHMP* identified 161 bridges within the county (Table 2-15). The *2014 Northeast Oregon Regional NHMP* makes note of two bridges in La Grande: 1) Spruce Street bridge is low and could be affected by debris in a flood and 2) the 2nd Street bridge is an older bridge that may need to be replaced. Limiting maximum vehicular weight on bridges can reduce bridge maintenance, extend bridge lifespan, and preserve transportation system continuity. Bridges provide functional links for La Grande transportation corridors, and if they are not maintained the bridge may become unusable in the event of a natural disaster, effectively isolating the city if no other alternative transportation network exists.

Alternate Modes of Transport

Other important modes of transportation include railway (freight), airport, public transportation, and pedestrian and bicycle routes. Union Pacific and Oregon Short Lines operate freight lines that traverse through La Grande, connecting the transport of products to Oregon and inland U.S. (e.g., Boise, Idaho) (Oregon Department of Transportation, 2022). Amtrak passenger rail was discontinued in 1997 (Wikipedia, 2023) but in 2019 the citizens of La Grande expressed interest in returning Amtrak to the region (Mason, 2019). Amtrak coordinates with Greyhound bus lines to provide service to passengers from eastern Oregon to the Portland Amtrak station (City of La Grande, 2013).

Facilities that support air travel include La Grande/Union County Airport, the only commercial service public use airport and one heliport at the Grande Ronde Hospital, according to Oregon Airport Directory (Oregon Department of Aviation, 2020). As noted, Amtrak now coordinates with Greyhound bus lines to provide service to passengers from eastern Oregon to the Portland Amtrak station. There is also a limited route of public transportation within the City of La Grande that is operated by Northeast Oregon Public Transportation. There is also transportation through Kayak[6] Public Transit, provided by the Confederated Tribes of the Umatilla Indian Reservation. The Kayak provides community and economic support by managing a rural regional transportation system reaching into southeastern Washington and northeastern Oregon, which includes some routes to La Grande.

According to the La Grande Comprehensive Plan, the city strives to evaluate, improve upon, and add new pedestrian and bicycle safety features on existing roads to help pedestrians and cyclists move more safely through the community.

Dams

Dams play a crucial role in power generation and water control mechanisms for the region. Dam failures can occur rapidly and with little warning, according to FEMA's Dam Safety program. Fortunately, most failures result in minor damage and pose little or no risk to life safety. However, the potential for severe damage still exists. The Oregon Water and Resources Department has inventoried all dams located across Union County and the Northeast Oregon region. The "hazard level" estimates the amount of damage that could occur in the event of dam failure.

According to the *2022 Union County NHMP*, there are 17 dams. Two of these dams – Jubilee Lake Dam and Morgan Lake Dam – are ranked as a high hazard. Both Jubilee and Morgan Lakes are used for recreation. According to the Oregon Department of Water Resources, both dams are considered a hazard for the populations downstream that would be at risk in the event of a dam failure. Morgan Lake Dam, in particular, is owned by the City of La Grande and would be a major risk to populations in La Grande in the event of dam failure. These two dams are assigned a hazard rating based on downstream hazard to people and property, not on the condition of the dam. Additional details regarding these Morgan Lake Dam can be found in Chapter 3, Risk Assessment under the Flood hazard.

Utility Lifelines

Utility lifelines are the resources that the public relies on daily, (i.e., electricity and fuel). If these lines fail or are disrupted, the essential functions of the community can become severely impaired. Utility lifelines are closely related to physical infrastructure, (i.e., dams and power plants) as they transmit the power generated from these facilities.

More than half of Oregon's electricity comes from hydropower, and about one percent comes from renewable sources, primarily biomass and wind (Loy et al., 2001). The network of electricity transmission through La Grande and the greater Union County area is operated and distributed by the Bonneville Power Administration and Oregon Trail Energy Cooperative (Loy et al., 2001).

[6] K'ay'ak is a Nez Perce word meaning "to be free of hindrances or obstacles" (Confederated Tribes of the Umatilla Indian Reservation).

Oregon does not have any crude oil resources or refineries, and so must import all its petroleum products. According to the Oregon Department of Energy's Assurance Plan (2012), most petroleum is extracted and refined regionally – 90% of Oregon's petroleum products are refined in the Puget Sound area of Washington and 80% of the crude oil used to make these products comes from Alaska's North Slope oil fields. The remainder of Oregon's petroleum comes primarily from refineries in Utah and British Columbia. Most of Oregon's oil enters on tanker ships at the Port of Portland and is then distributed via tanker truck or via the Kinder-Morgan pipeline, which runs from Portland south to Eugene (ODOE Assurance Plan, 2012). Oregon's petroleum supply system has many vulnerabilities that pose a risk to La Grande. First, there is the possibility for disruption of the transmission system: the pipelines are 30 years old, and tanker trucks rely on the road network (ODOE Assurance Plan, 2012).

City utilities include water and wastewater facilities as being essential functions of the community. La Grande's water supply includes the sources and areas to which the city holds the water rights: Beaver Creek Watershed and five operational wells (two basalt wells and three alluvial wells). The water from the five wells is described as of good quality and serves as the primary water source for the city. In 1992, the Beaver Creek Watershed water supply was placed into a reserved status to bring it into compliance with the safe Drinking Water Act. La Grande also has two wastewater treatment facilities. According to the *2014 Northeast Oregon Regional NHMP*, both facilities are vulnerable to flooding, but are designed to withstand a 100-year flood.

Synthesis

The planning considerations most significant for the city are contingency planning for emergency services, medical resources, and lifeline systems. Functionality of the critical facilities should be a significant priority in providing for the La Grande community. To maintain functionality, memorandums of understanding can be established with surrounding cities and counties for medical transport, treatment, utility and transportation lifeline service and infrastructure repair.

While these elements are traditionally recognized as part of response and recovery from a natural disaster, it is essential to start building relationships and establishing contractual agreements with entities that may be critical in supporting community resilience.

2.7 Community Connectivity Capacity

Community connectivity capacity places strong emphasis on social structure, trust, norms, and cultural resources within a community. In terms of community resilience, these emerging elements of social and cultural capital will be drawn upon to stabilize the recovery of the community. Social and cultural capital is present in all communities; however, it may be dramatically different from one town to the next as these capitals reflect the specific needs and composition of the community residents.

Social Systems

Social systems include community organizations and programs that provide community-based services, such as employment, health, homeless, senior and disabled services, professional associations, and veterans' affairs for the public. In planning for natural hazard mitigation, it is important to know what social systems exist within the community because of their existing connections to the public. Often, actions identified by the plan involve communicating with the public or specific subgroups within the population (e.g., elderly, children, low income, etc.). The city can use existing social systems as resources for implementing such communication-related activities because these service providers already work directly with the public on many issues, one of which could be natural hazard preparedness and mitigation.

The following is a brief explanation of how the communication process works and how the community's existing social service providers could be used to provide natural hazard related messages to their clients.

There are five essential elements for communicating effectively to a target audience:

- The source of the message must be credible,
- The message must be appropriately designed,
- The channel for communicating the message must be carefully selected,
- The audience must be clearly defined, and
- The recommended action must be clearly stated, and a feedback channel established for questions, comments and suggestions.

The social organizations identified in La Grande can be involved in hazard mitigation; a few methods are defined below.

- <u>Education and outreach</u> – organization could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.
- <u>Information dissemination</u> – organization could partner with the community to provide hazard related information to target audiences.
- <u>Plan/project implementation</u> – organization may have plans and/or policies that may be used to implement mitigation activities or the organization could serve as the coordinating or partner organization to implement mitigation actions.

Libraries and Museums

Libraries and museums develop cultural capacity and community connectivity as they are places of knowledge and recognition, they are common spaces for the community to gather, and they can serve critical functions in maintaining the sense of community during a disaster. They are recognized as safe places and reflect normalcy in times of distress.

The Cook Memorial Library is part of the City of La Grande and is located at 2006 Fourth Street, La Grande. The citizens of La Grande petitioned the La Grande City Council in November 1911, requesting a city library. In December 1911 the council passed a resolution and set aside a city lot for the future use of a library. The La Grande Public Library, however, was first established temporarily in an existing building in March 1912. However, it eventually moved into its new building by December 1913. In 2006, the La Grande Public Library moved to its current location and was officially renamed as the F. Maxine and Thomas W. Cook Memorial Library.

There are at various museums in the La Grande area including Eastern Oregon Fire Museum, Blue Mountain Crossing, Oregon Trail Interpretive Park, Whitman Route Interpretive Site, Bird Track Interpretive Site, Manuel Museum (Hot Lake); The Think Link Discovery Center. Art Central East (ArtEast), home of the Eastern Oregon Regional Arts Council, was founded in 1977 as a nonprofit organization to deliver arts education and outreach programs in eastern Oregon.

Historic Resources

Historic resources such as historic structures and landmarks can help to define a community and may also be sources for tourism revenue. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

The City of La Grande has a rich history. According to the city, “the Grande Ronde Valley was an important rendezvous site for Native people of the southern Columbia Plateau. Umatilla, Nez Perce, Cayuse, and others traveled to the valley in the summer to harvest camas root and other plants and to hunt, fish, and trade.” The Oregon Trail passed through the Grande Ronde Valley, and La Grande was first settled in 1861 by immigrants originally bound for the Willamette Valley. La Grande was incorporated in 1865 and is the seat for Union County.

The Oregon Department of Historic Preservation and National Register of Historic Places reports numerous historically significant structures and sites within La Grande, including the following structures in La Grande (taken from the *2022 Union County NHMP*):

- Eastern Oregon University Administration Building
- Anthony, John (House)
- Anthony-Buckley (House)
- Foley Building
- La Grande Commercial Historic District
- La Grande Neighborhood Club
- Roesch Building
- Slater Building
- Stange, August J. (House)

- U.S. Post Office and Federal Building
- Liberty Theater La Grande

A complete list of structures and landmarks can be found on the Oregon State Historic Preservation Office website: https://www.oregon.gov/oprd/OH/Pages/default.aspx

The following map represents a portion of the historic Oregon Trail, which travels diagonally through Union County, including La Grande, and covers several county miles. Historic landmarks are placed at multiple locations on the trail.

Figure 2-13. Historic Oregon Trail near La Grande

Source: National Park Service

Cultural Resources

Similar to historic resources, cultural resources and events can help to define a community and may also be sources for tourism revenue. These resources and events can strengthen community connectivity and can include festivals and organizations that engage diverse cultural interests.

La Grande hosts the Eastern Oregon Film Festival, Eastern Oregon Beer Festival, Community Harvest Festival, Crazy Days, and Grande Ronde Symphony Orchestra. Other notable events or institutions include La Grande Granada Theater, BirdDog Glass, Fire Arts Blacksmithing School, and Art Central East. ArtEast, home of the Eastern Oregon Regional Arts Council, was founded in 1977 as a nonprofit organization to provide “arts education to K-8 students and teachers across Eastern Oregon through the Artists in Rural Schools program, serving 80% Title I or low-income schools at no cost to families.” Art Center East also provides residents and visitors with numerous art classes and experiences, community music ensembles and lessons, and heritage dance classes. They also host the annual event, Handmade Holidays Makers Market, which features work of local artists, and three galleries exhibit work of national and international artists to this rural community.

Also worth noting are those events and institutions identified in the *2022 Union County NHMP*, which includes “The Stampede, hunting season, events that occur at the University campus (e.g., graduation), local high school events (e.g., softball and baseball tournaments), seasonal harvests, professional mushroom pickers come in the spring.”

In addition, the City of La Grande has numerous archaeological sites within its boundaries. Recognizing that city planning departments are faced with challenges arising from conflicts between development and cultural resource protection, the Oregon State Historic Preservation Office (SHPO) together with the University of Oregon Museum of Natural and Cultural History developed a cultural resource planning tool for the City of La Grande. The resulting report, *Desktop Assessment of Subsurface Cultural Resources for the City of La Grande, Union County, Oregon*, was issued in 2018 (Museum Report No. 2018-049). Archaeological resources below the surface of buildings and urban environment are often the only source of knowledge about a city's prehistory and the mostly undocumented history and lives of our historically marginalized populations, immigrants and the poor. The city has an archaeological compliance program to establish processes to identify these resources, assess their significance and mitigate potential damage development may do to these resources.

Community Stability

Residential Geographic Stability

Community stability is a measure of rootedness in place. It is hypothesized that resilience to a disaster stem in part from familiarity with place, not only for navigating the community during a crisis, but also accessing services and other supports for economic or social challenges (Cutter et al., 2010).

Table 2-16. Regional Residential Stability

Statistics	Union County		La Grande	
Total	25,726		12,911	
Same House 1 Year Ago	20,530	79.8%	9,397	72.8%
Moved within Same County	3,199	12.4%	2,224	17.2%
Moved from Different County within Same State	1,021	4.0%	663	5.1%
Moved from Different State	875	3.4%	623	4.8%
Moved from Abroad	101	0.4%	4	0.0%

Source: Social Explorer, 2018

Table 2-16, above estimates residential stability across the region. It is calculated by the number of people who have lived in the same house and those who have moved within the same city a year ago, compared to the percentage of people who have migrated into the region. La Grande overall has a geographic stability rating of about 90% (i.e., 90% of the population lived in the same house or moved within the county in the last year). For those that moved into the city, 5.1% of residents lived in a different Oregon city one year before, 4.8% lived in a different state and <1% lived in a different country (Social Explorer, 2018).

Homeownership

Housing tenure describes whether residents rent or own the housing units they occupy. Homeowners are typically more financially stable but are at risk of greater property loss in a post-disaster situation. As noted in Table 2-17 below, about 50.8% of the occupied housing units in La Grande are owner-occupied; about 49.3% are renter occupied. La Grande's vacancy rate is about 11%.

Table 2-17. Housing Tenure and Vacancy

	Housing Units	Owner-occupied		Renter-occupied		Vacant	
Total							
Union County	10,481	6,714	64.1%	3,767	35.9%	1,263	10.8%
La Grande	5,328	2,704	50.8%	2,624	49.3%	665	11.1%

Source: Social Explorer, 2018

According to Cutter (2003), wealth increases resiliency and recovery from disasters. Renters often do not have personal financial resources or insurance to assist them post-disaster. On the other hand, renters tend to be more mobile and have fewer assets at risk of natural hazards. In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or unaffordable post-disaster.

Synthesis

La Grande has social and cultural resources that work in favor of increasing community connectivity and resilience. Sustaining and preserving social and cultural resources such as social services and historic places may be essential to preserving community cohesion and a sense of place. All communities have social systems that could help raise awareness of available resources and services for the public. It may be of specific interest to these communities to evaluate social and cultural resources periodically to get a sense of what exists, what is needed, and who can provide it. It is important to consider that these social services may not be equally accessible to residents of rural areas beyond the La Grande jurisdictional boundaries, and La Grande may need to expand these provisions beyond traditional service areas.

2.8 Political Capacity

Political capacity includes the government and planning structures established within the community. In terms of hazard resilience, it is essential for political capital to encompass diverse government and non-government entities in collaboration as disaster losses stem from a predictable result of interactions between the physical environment, social and demographic characteristics and the built environment (Mileti, 1999). Resilient political capital seeks to involve various stakeholders in hazard planning and works towards integrating the Natural Hazard Mitigation Plan with other community plans, so that all planning approaches are consistent.

Government Structure

La Grande operates under the council-manager form of city government. The voters of La Grande elect the Mayor and six City Councilors. The Mayor position becomes vacant every general election year. The Mayor is the presiding officer of Council and represents La Grande at a variety of meetings, conferences, and ceremonial events. The City Council is empowered by the City Charter as the policy-making body of La Grande, adopting policies and legislation which will affect La Grande's growth and quality of life in the long-term and the efficient, cost-effective delivery of daily services in the short-term. (City of La Grande)

Beyond Emergency Management, most departments within the city governance structure have some degree of responsibility in building overall community resilience. Each plays a role in ensuring that city functions and normal operations resume after an incident, and the needs of the population are met.

Some departments of La Grande's government that have a role in hazard mitigation are the following (City of La Grande):

- **City Manager's Office** directs the day-to-day administration of the City through Department Directors and directs the work of staff in the City Manager's Office. This office helps to organize, coordinate, and manage City government operations based on City Council direction, state and federal law, and City ordinance.
- **Community Development Department** works to ensure the strength of the community at the neighborhood level and citywide through support for planning and civic involvement, permitting, inspecting and, where needed, protecting historic community resources and providing library services.
- **Economic Development Department** oversees the implementation of the Urban Renewal Plan, the Economic Development Plan and the Main Street program; and works in partnership with other local, regional and statewide economic partners to develop a strong and resilient local economy for the City of La Grande.
- **Parks and Recreation Department** provides recreation and life enhancement opportunities to La Grande residents by managing the City's Parks and Recreation programs, Safe Routes to School program, and the Urban Forestry Program.
- **Public Works Department** plans, constructs, and maintains the infrastructure necessary for the basic urban needs of La Grande. This includes a safe and reliable road system including bicycle and pedestrian lanes or pathways healthy and plentiful water supply, a well-functioning storm drainage system, and proper treatment of wastewater.

- **La Grande Police Department** brings police and citizens together to better fight crime in the community. Their mission is to "ethically protect the lives, property and quality of life of the La Grande community to the best of our ability, while respecting the constitutional rights of all persons. We will deliver competent and professional service with honor, integrity and fairness while morally seeking truth and justice."
- **La Grande Fire Department** is an all-hazard response agency that has been trained to mitigate emergencies involving fire, hazardous materials, and technical rescue (including rope rescue, water, confined space building collapse, and trench rescue). Emergency medical services and medical response are also a fundamental responsibility of the La Grande Fire Department, and providers respond to a wide variety of medical calls, ranging from minor medical assistance to life-threatening events.

Existing Plans and Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports or studies. Plans and policies already in existence have support from residents, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs (Burby, 1998).

The *2024 La Grande NHMP* includes a range of recommended action items that, when implemented, will reduce the city's vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the city's existing plans and policies. Linking existing plans and policies to the NHMP helps identify what resources already exist that can be used to implement the action items identified in the Plan. Implementing the natural hazards mitigation plan's action items through existing plans and policies increases their likelihood of being supported and getting updated and maximizes the city's resources.

Examples of plans, programs, or agencies that may be used to implement mitigation activities include:

- City Budget
- Community Wildfire Protection Plans
- Comprehensive Land Use Plans
- Economic Development Action Plans
- Emergency Operations Plans
- Zoning Ordinances and Building Codes

The specific plans that presently exist related to this NHMP and the FEMA requirements are listed in Table 2-18 below. These are the same plans listed in Table 5-1 (Chapter 5, Planning Process).

Table 2-18. City of La Grande NHMP Supported Plans and Policies

Document	Year
Natural Hazards Mitigation Plan	2024, 2014 previous
Desktop Assessment of Subsurface Cultural Resources for the City of La Grande, Union County, Oregon	2018
La Grande Emergency Operations Plan	1991, update expected fiscal year 2024-2025
La Grande Emergency Alert and Evacuation Plan	2018
La Grande Comprehensive Plan	2022, 2013 previous
La Grande Land Development Code	2023
Article 3.4 – Geological Hazards	
Article 3.5 – Historic Buildings and Sites	
Article 3.6 – Archaeological Resources	
Article 3.9 – Riparian Protection Area	
Article 3.10 – Dust Control Standards	
Article 3.12 – Flood Plains	Update forthcoming based on FEMA approval of revised FIRMs (pg. 123, 144 and Figure 3-23)
La Grande Commercial Historic District Design Standards	2022
La Grande Community Forestry Ordinance	2019
La Grande Community Landscape and Forestry Master Plan	1996
La Grande/Island City Transportation System Plan, 1999	1999, update anticipated
La Grande Pedestrian and Bicycle Improvement Plan	2007, 1999 previous
La Grande Parks Master Plan	2022
La Grande Economic Development Plan, 2010-2013	2010
La Grande Urban Renewal Plan	2014
La Grande Housing Needs Analysis	2021
La Grande Housing Production Strategy	2021
La Grande Stormwater Master Plan	2013
La Grande Water Management and Conservation Plan	2008, update in process
La Grande Water System Master Plan	2013
La Grande Wastewater Facilities Plan	1998
Snow and Ice Control Plan	2010
Morgan Lake Dam Emergency Action Plan	2013
Morgan Lake Dam Floodplain Management Plan	2023, draft submitted to FEMA
Union County Emergency Operation Plan	2023
Union County Continuity of Operations Plan	2012, update in 2024
Union County Community Wildfire Protection Plan	2016, update in process

Sources: 2024 La Grande NHMP Steering Committee

Synthesis

As addressed above, many governmental entities are responsible for work relevant to hazards planning; however, from this perspective it is challenging to decipher whether these structures work collaboratively in practice towards improving hazard mitigation. On a similar note, in short of reviewing each of the relevant policy documents it is questionable whether the documents effectively integrate hazard initiatives into implementation policy. Further analysis is needed to evaluate the effectiveness of political capital in terms of community resilience.

Chapter 3 RISK ASSESSMENT

3.1 Introduction

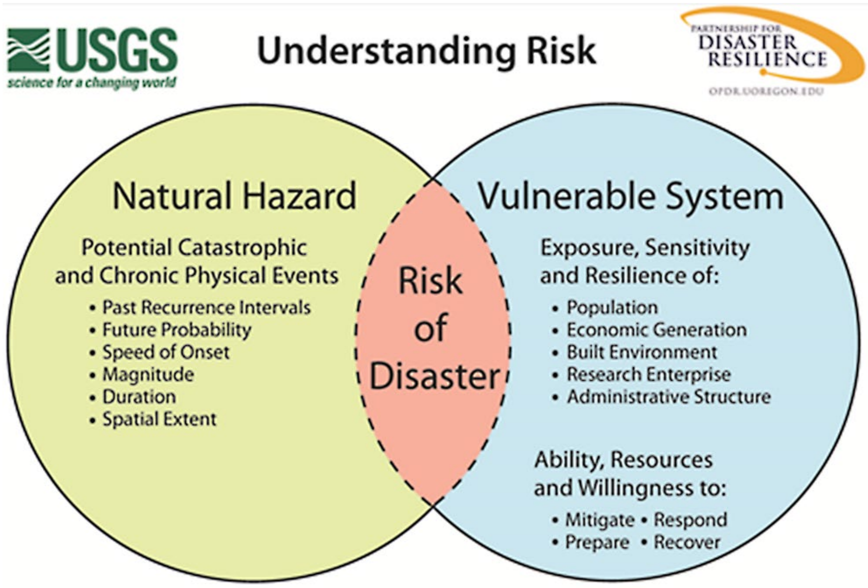
This section serves as the factual basis for City of La Grande to address Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. In addition, this section of the NHMP addresses 44 CFR 201.6(b)(2) - Risk Assessment. Assessing natural hazards risk has three primary phases:

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

This section provides information on the natural hazard risk assessment process. It is general in scope and provides information on what a risk assessment entails, describes the sources of information and risk assessment exercise used to assess risk of natural hazard events in the City of La Grande, and some of the related hazard vulnerability maps that are included in the natural hazard sections. The OEM Hazard Vulnerability Assessment exercise allowed the Steering Committee to identify and evaluate the natural hazards that pose the greatest risk to the City of La Grande and to evaluate the risk of each of those based on four factors (history, probability, vulnerability, and maximum threat).

The information presented below, along with hazard specific information presented with each Hazard and community characteristics presented in the Community Profile (Chapter 2) will be used as the local level rationale for the risk reduction actions identified in the Mitigation Strategy (Chapter 4). The risk assessment process is graphically depicted in Figure 3-1. The goal of hazard mitigation is to reduce the area where hazards and vulnerable systems overlap.

Figure 3-1. Understanding Risk

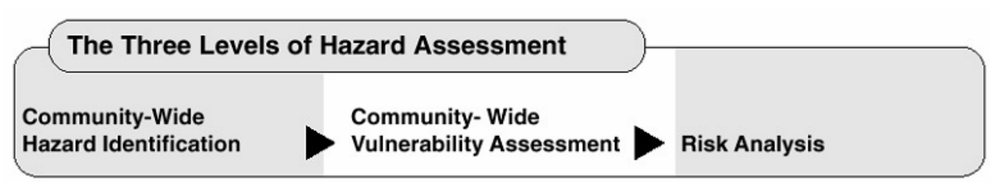


Source: Wood (2007)

Risk Assessment Approach

According to the FEMA Local Mitigation Planning Handbook, risk assessment is a product or process that collects information and assigns values to risks for the purpose of informing priorities, developing, or comparing courses of action, and informing decision making. Conducting a risk assessment can provide information on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events. A risk assessment consists of three primary levels: hazard identification, vulnerability assessment, and risk analysis. The *2024 La Grande NHMP* identifies a fourth level that includes consideration of how development trends affect risk assessments.

Figure 3-2. Understanding Hazard Assessment



Source: Oregon Department of Land Conservation and Development (2020)

This three-phase approach to developing a risk assessment should be conducted sequentially because each phase builds upon data from prior phases. However, gathering data for a risk assessment need not occur sequentially. These three levels, together with the fourth component La Grande added, are described below.

Hazard Identification and Analysis

The Hazard Identification and Analysis section involves the identification of the geographic extent of a hazard, its intensity, and its probability of occurrence. This level of assessment typically involves producing a map. The outputs from this phase can also be used for land use planning, management, and regulation; public awareness; defining areas for further study; and identifying properties or structures appropriate for acquisition or relocation (Burby, 1998).

The hazard identification includes a profiling of hazard events, which describes the causes and characteristics of each natural hazard, how each has affected La Grande in the past, and what part of La Grande's population, infrastructure, and environment has historically been vulnerable to each specific hazard. A full profile of each hazard discussed in this plan is provided in the Hazard Identification and Analysis section, including a full description of the history of hazard-specific events.

In the *2014 Northeast Oregon Regional NHMP*, the city identified the following major hazards that consistently affect this geographic area: drought, earthquake, extreme heat, flood, dam safety/failure, landslide, volcano, wildfire, windstorm, and winter storm. La Grande 2023 NHMP Steering Committee retained most of the previously identified hazards, except landslide. During the NHMP update process, the 2023 Steering Committee identified two additional natural hazards: air quality and invasive species/pests.

Another change made to the list of natural hazards addressed in the plan was the reconsideration of the impact of Climate Change. The Steering Committee agreed that the impact of climate change is experienced in the increased severity and frequency of natural hazard events and will be addressed throughout the NHMP.

Future Climate Projections

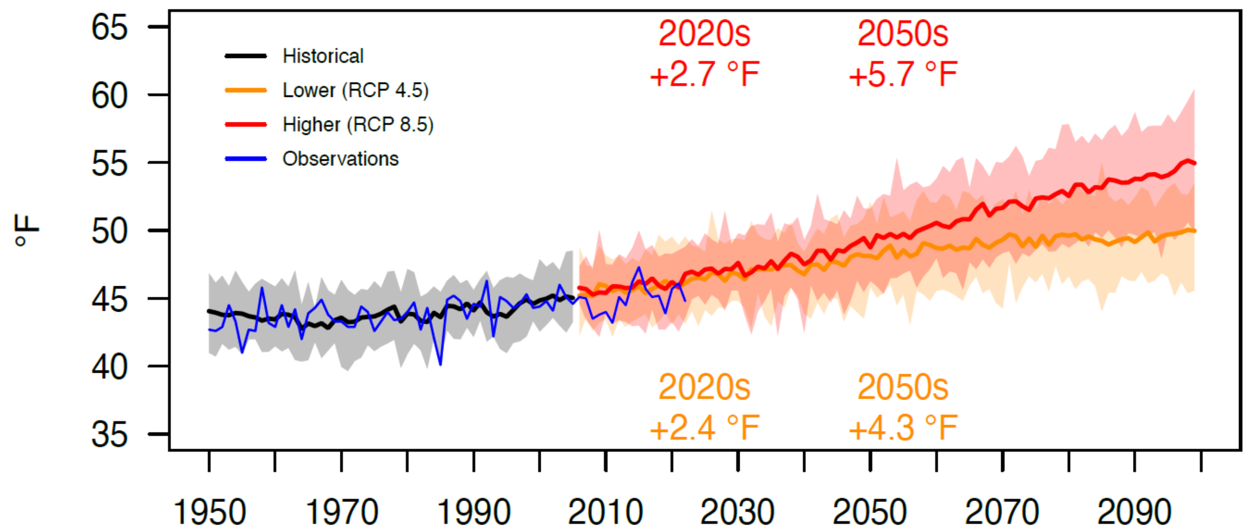
Oregon's Department of Land Conservation and Development contracted with the Oregon Climate Change Research Institute (OCCRI) to analyze the influence of climate change on natural hazards. The complete report is available as Appendix 8.4.The scope of the analysis that yielded the 2023 report entitled *Future Climate Projections Union County, Oregon* is limited to the geographic area encompassed by Union County. The future climate projections are presented under each identified hazard (Section 3.2), where applicable, in the Hazard Identification and Analysis. The following is a summary of said report.

The *Future Climate Projections Union County, Oregon* report states,

> Industrialization has increased the amount of greenhouse gases emitted worldwide, which is causing Earth's atmosphere, oceans, and lands to warm (IPCC, 2021). Climate change and its effects already are apparent in Oregon (Dalton *et al.*, 2017; Mote *et al.*, 2019; Dalton and Fleishman, 2021; Fleishman, 2023). Climate change is expected to increase the likelihood of natural hazards such as heat waves, heavy precipitation, flooding of rivers and streams, drought, wildfires, and poor air quality, and to decrease the likelihood of cold waves.

During the twenty-first century, the average temperature in Union County is projected to warm at a rate similar that of Oregon as illustrated in Figure 3-3.

Figure 3-3. Annual Average Temperature Projections, Union County



Source: Dalton et al., 2023)

The OCCRI report states that climate change is expected to increase the occurrence of many climate-related natural hazards. Confidence levels and changes in natural hazard risks are illustrated in Figure 3-4. Confidence that the risk of heat waves will increase is very high given strong evidence in the peer-reviewed literature, consistency among the projections of different global climate models, and robust theoretical principles underlying increasing temperatures in response to ongoing emissions of greenhouse gases. Additionally, confidence that the risk of many other natural hazards (e.g., drought, reduced air quality, and flooding) will increase as climate changes is high or medium, reflecting moderate to strong evidence and consistency among models. However, these risks are influenced by multiple secondary factors, in addition to increasing temperatures. Confidence in changes in risks is indicated as low for windstorms, for example, if projections suggest relatively few to no changes or evidence is limited.

OCCRI analysts projected the direction of change in the risks of climate-related natural hazards and the level of confidence in those changes. Very high confidence means that the direction of change is consistent among nearly all global climate models and there is strong evidence in the peer-reviewed literature. High confidence means that the direction of change is consistent among more than half of models and there is moderate to strong evidence in the peer-reviewed literature. Medium confidence means that the direction of change is consistent among more than half of models and there is moderate evidence in the peer-reviewed literature. Low confidence means that the direction of change is small compared to the range of model responses or there is limited evidence in the peer-reviewed literature.

Figure 3-4. Confidence Level and Changes in Natural Hazard Risk

	Low Confidence	Medium Confidence	High Confidence	Very High Confidence
↑ Risk Increasing		Drought Expansion of Non-native Invasive Species Reduced Air Quality Loss of Wetlands	Heavy Precipitation Flooding Wildfire	Heat Waves
= Risk Unchanging	Windstorms			
↓ Risk Decreasing				Cold Waves

Source: Dalton et al., 2023)

Future climate projections for Union County that are presented in the OCCRI report are relevant to specified natural hazards for the 2020s (2010–2039) and 2050s (2040–2069) relative to the 1971–2000 historical baseline. The projections are presented for a lower greenhouse gas emissions scenario (RCP 4.5) and a higher greenhouse gas emissions scenario (RCP 8.5) and are based on multiple global climate models. All projections in this executive summary refer to the 2050s, relative to the historical baseline, under the higher emissions scenario. Projections for both time periods and emissions scenarios are included in the main report.

Heat Waves

The number, duration, and intensity of extreme heat events is expected to increase as temperatures continue to warm.

In Union County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios.

In Union County, the number of days per year with temperatures 90°F or higher is projected to increase by an average of 24 days (range 7–35 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Union County, the temperature on the hottest day of the year is projected to increase by an average of about 8°F (range 3–11°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Cold Waves

Cold extremes will become less frequent and intense as the climate warms. In Union County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 19 days (range 11–28 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Union County, the temperature on the coldest night of the year is projected to increase by an average of 9°F (range 1–17°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Heavy Precipitation

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor.

In Union County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. However, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 15% (range 3–26%) and 10% (range 0–25%), respectively, relative to the1971–2000 historical baselines, under the higher emissions scenario.

In Union County, the number of days per year on which a threshold for landslide risk, which is based on prior 18-day precipitation accumulation, is exceeded is projected to increase by 1 (range 0-4). However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

River Flooding

Winter flood risk at intermediate to low elevations in Union County, where temperatures are near freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow.

Drought

Drought, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is projected to become more frequent in Union County by the 2050s. The incidence of related negative physical and mental health outcomes, especially among low income, tribal, rural, and agricultural communities, is likely to increase.

Wildfire

Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Union County by 16 days (range -4–38) by the 2050s, relative to the historical baseline, under the higher emissions scenario.

In Union County, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 31 days (range 12-44) by the 2050s, compared to the historical baseline, under the higher emissions scenario.

Reduced Air Quality

The changing climate is expected to reduce outdoor air quality. Further, the risks to human health from wildfire smoke in Union County are projected to increase. The number of days per year on which poor air quality occurs due to elevated concentrations of wildfire-derived fin particulate matter is projected to increase by 68% and the concentration of fine particulate matter is projected to increase by 129% under a medium emissions scenario.

Loss of Wetlands

Projected effects of climate change on wetlands in the Pacific Northwest include reductions in water levels and hydroperiod duration. The 6000-acre Ladd Marsh Wildlife Area, established in 1949 to conserve and enhance habitat for waterfowl and to provide a public hunting area, is one of the largest remaining wetlands in northeastern Oregon, and encompasses the region's most extensive remnant hardstem bulrush wetland. The End Creek Restoration Project (2006-2007), a public–private–tribal partnership, restored an additional 550 acres of wetlands and stream channels near La Grande. If withdrawals of ground water do not increase, then wetlands that are fed by ground water rather than surface water may be more resilient to climate change

Windstorms

Wind patterns affect provision of electricity, transportation safety, and the spread of wildfires and pollutants. Mean wind speeds in Oregon are projected to decrease slightly, but extreme winter wind speeds may increase. The frequency of strong easterly winds during summer and fall, however, is projected to decrease slightly.

Expansion of Non-native Invasive Species

In general, non-native invasive plant species in Union County are likely to become more prevalent in response to projected increases in temperature and the frequency, duration, and severity of drought. However, many of these responses are uncertain, are likely to vary locally, and may change over time.

Vulnerability Assessment

Vulnerability assessment endeavors to identify important community assets and system vulnerabilities. Vulnerabilities include both physical assets such as businesses, homes, roads and critical infrastructure like drinking water sources, and public service and health service establishments as well as community assets including people, historic places, and environmental assets. The vulnerability assessment combines the information from the hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard and attempts to predict how different types of property and population groups will be affected by the hazard. This step can also assist in justifying changes to building codes or development regulations, property acquisition programs, policies concerning critical and public facilities, taxation strategies for mitigating risk, and informational programs for members of the public who are at risk. (Burby, 1998)

The Steering Committee engaged in a Hazard Vulnerability Assessment exercise based on the OEM methodology to identify the relative vulnerability of the City of La Grande is to the hazards identified in phase one of the Risk Assessment and to describe the aspects of the community that are most at risk. A description of this HVA exercise and its results are contained in the Hazard Vulnerability Assessment section.

The critical facilities have been identified, listed in a table in the Community Profile (Chapter 2) and noted, where applicable, in each identified hazard.

Hazard Vulnerability Assessment Methodology

The hazard vulnerability assessment methodology in Oregon (primarily to inform Emergency Operations Planning) was first developed by FEMA circa 1983, and gradually refined by OEM over the years.

The methodology produces scores that range from 24 (lowest possible) to 240 (highest possible). Vulnerability and probability are the two key components of the methodology. Vulnerability examines both typical and maximum credible events, and probability endeavors to reflect how physical changes in the jurisdiction and scientific research modify the historical record for each hazard. Vulnerability accounts for approximately 60% of the total score, and probability approximately 40%. We include the hazard analysis summary here to ensure consistency between the EOP and NHMP.

The Oregon method provides the jurisdiction with a sense of hazard priorities, or relative risk. It doesn't predict the occurrence of a particular hazard, but it does "quantify" the risk of one hazard compared with another. By doing this analysis, planning can first be focused on where the risk is greatest.

In this analysis, severity ratings, and weight factors, are applied to the four categories of history, vulnerability, maximum threat (worst-case scenario), and probability as demonstrated below.

History (Weight Factor = 2)

History is the record of previous occurrences. Events to include in assessing history of a hazard are events for which the following types of activities were required:

- The Emergency Operations Center (EOC) or alternate EOC was activated;
- Three or more Emergency Operations Planning (EOP) functions were implemented, e.g., alert & warning, evacuation, shelter, etc.;
- An extraordinary multi-jurisdictional response was required; and/or
- A "Local Emergency" was declared.

Low = 0 to 1 event in the past 100 years, scores between 1 and 3 points
Moderate = 2 to 3 events in the past 100 years, scores between 4 and 7 points
High = 4+ events in the past 100 years, scores between 8 and 10 points

Probability (Weight Factor = 7)

Probability is the likelihood of future occurrence within a specified period.

Low = one incident likely within 75 to 100 years, scores between 1 and 3 points
Moderate = one incident likely within 35 to 75 years, scores between 4 and 7 points
High = one incident likely within 10 to 35 years, scores between 8 and 10 points

<u>Vulnerability</u> (Weight Factor = 5)

Vulnerability is the percentage of population and property likely to be affected under an "average" occurrence of the hazard.

Low = < 1% affected, scores between 1 and 3 points
Moderate = 1 - 10% affected, scores between 4 and 7 points
High = > 10% affected, scores between 8 and 10 points

<u>Maximum Threat</u> (Weight Factor =10)

Maximum threat is the highest percentage of population and property that could be impacted under a worst-case scenario.

Low = < 5% affected, scores between 1 and 3 points
Moderate = 5 - 25% affected, scores between 4 and 7 points
High = > 25% affected, scores between 8 and 10 points

The HVA exercise was conducted during the July 13, 2023 and August 9, 2023 Steering Committee meetings to rank these hazards using the OEM methodology. During the August 30, 2023 Steering Committee meeting, the HVA was reviewed and revised. Table 3-1 below displays the ranking of each of these hazards according to the group present at these meetings.

Hazard Vulnerability Assessment Matrix

The hazard vulnerability assessment matrix involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous sections), and (2) the likelihood or probability of the harm occurring. The methodology for the hazard analysis was first developed by FEMA and refined by the OEM, which is discussed above.

Table 3-1 presents the entire updated hazard analysis matrix for La Grande. The hazards are listed in rank order from high to low. The table shows that hazard scores are influenced by each of the four categories combined. With considerations for past historical events, probability or likelihood of a hazard event occurring, vulnerability to the community, and maximum threat or worst-case scenario, the La Grande Steering Committee ranked air quality, winter storm, and high hazard potential dams as the top hazard threats to the city. Invasive species/insect pests, flood, drought, and windstorm rank in the middle tier. Extreme heat, wildfire, volcanic event, and earthquakes comprise the lowest hazards in the city.

Table 3-1. La Grande 2023 Natural Hazard Vulnerability Assessment

HAZARD	HISTORY WF = 2			PROBABILITY WF = 7			VULNERABILITY WF = 5			MAX THREAT WF = 10			RISK SCORE
Air Quality	2 x	**10**	*20*	7 x	**10**	*70*	5 x	**5**	*25*	10 x	**10**	*100*	**215**
***Severe Weather*: Winter Storm**	2 x	**8**	*16*	7 x	**8**	*56*	5 x	**9**	*45*	10 x	**8**	*80*	**197**
High Hazard Potential Dams	2 x	**1**	*2*	7 x	**8**	*56*	5 x	**9**	*45*	10 x	**9**	*90*	**193**
Invasive Species/Pests	2 x	**1**	*2*	7 x	**4**	*28*	5 x	**4**	*20*	10 x	**10**	*100*	**150**
Flood	2 x	**7**	*14*	7 x	**5**	*35*	5 x	**6**	*30*	10 x	**6**	*60*	**139**
Drought	2 x	**10**	*20*	7 x	**10**	*70*	5 x	**1**	*5*	10 x	**4**	*40*	**135**
***Severe Weather*: Windstorm**	2 x	**4**	*8*	7 x	**6**	*42*	5 x	**6**	*30*	10 x	**5**	*50*	**130**
***Severe Weather*: Extreme Heat**	2 x	**3**	*6*	7 x	**5**	*35*	5 x	**5**	*25*	10 x	**6**	*60*	**126**
Wildfire	2 x	**6**	*12*	7 x	**5**	*35*	5 x	**5**	*25*	10 x	**5**	*50*	**122**
Volcanic Event	2 x	**1**	*2*	7 x	**1**	*7*	5 x	**1**	*5*	10 x	**10**	*100*	**114**
Earthquake	2 x	**2**	*4*	7 x	**7**	*49*	5 x	**8**	*40*	10 x	**2**	*20*	**113**

Source: La Grande NHMP Steering Committee, 2023

The following subsections describe relevant information for each hazard. For additional background on the hazards, vulnerabilities and general risk assessment information for hazards in the Northeast Oregon (Region 7) refer to https://www.oregon.gov/lcd/NH/Documents/2020ORNHMP_2.3.7_R7_NE.pdf.

Risk Assessment/Analysis

The risk assessment/analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment, and (2) the likelihood or probability of the harm occurring.

The following risk analysis draws upon four sources: *2014 Northeast Oregon Regional NHMP*, *2020 Oregon NHMP*, *2022 Union County NHMP*, Hazard Vulnerability Assessment exercise conducted with La Grande NHMP Steering Committee using the method developed by FEMA Region X and Oregon Department of Emergency Management (OEM), and the list of Local Essential and State-owned and Leased Properties for Union County contained within the above noted regional, state, and county NHMP. This list was evaluated and revised by the La Grande Steering Committee to develop the list provided in Section 2.6, Built Environment Capacity, of critical and essential facilities. The value and area of these structures comprises the data used to estimate potential losses.

Development Trends

Assessing vulnerability and analyzing development trends provides a general description of land uses and development trends within the community so that mitigation options can be considered in land-use planning and future land-use decisions. This plan provides a comprehensive description of the character of the La Grande community in Community Profile (Chapter 2). This description includes the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns. Analyzing these components of the La Grande community can help in identifying potential problem areas and can serve as a guide for incorporating goals and ideas contained in this mitigation plan into other community development plans.

Hazard assessments are subject to the availability of hazard-specific data. Gathering data for a hazard assessment requires a commitment of resources on the part of participating organizations and agencies. Each hazard-specific section of the plan includes a section on hazard identification using data and information from city, county, or state agency sources.

Regardless of the data available for hazard assessments, there are numerous strategies the City of La Grande can take to reduce risk. These strategies are described in the action items detailed in Chapter 4 of this plan. Mitigation strategies can further reduce disruption of critical services, reduce the risk to human life, and alleviate damage to personal and public property and infrastructure. Action items provide recommendations to collect further data to map hazard locations and conduct hazard assessments.

NHMP Planning Area

44 CFR 201.6(c)(2)(iii) – Multi-jurisdictional Risk Assessment: The Risk Assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area . . .

This is not a multi-jurisdictional NHMP; the only plan holder for this NHMP is City of La Grande. A plan holder is a partner that is a jurisdiction that signs the IGA with DLCD for the work on the NHMP. The planning area for the 2024 La Grande NHMP is the City of La Grande. There are other partners that participated in the 2024 La Grande NHMP, but they did not sign an IGA with DLCD. All partners are listed in the Special Thanks and Acknowledgements section of the 2024 La Grande NHMP. There are maps throughout the NHMP that illustrate the location of La Grande with reference to Union County and Oregon. In addition, there are maps of La Grande in detail.

Hazard Identification and Vulnerability Assessment

La Grande identifies 11 natural hazards that could impact the city. These hazards include air quality; drought; earthquake; flood, including dam failure; invasive species/inspect pests; severe weather including extreme heat, windstorm, and winter storm; volcanic event; and wildfire. At the La Grande NHMP Steering Committee meeting on July 13, 2023 and August 9, 2023, the DLCD Natural Hazards Planner led the group in an exercise called the Hazard Vulnerability Analysis or Assessment (HVA). At the August 30, 2023 Steering Committee meeting, the HVA was reviewed and revised. The results are discussed in detail in this Risk Assessment.

Table 3-2 categorizes the hazards identified by La Grande and compares it to the regional hazards identified in the 2020 Oregon Natural Hazard Mitigation Plan for the Northeast Oregon Region (Region 7). Region 7 includes Baker, Grant, Wallowa, and Union Counties.

Table 3-2. La Grande Hazard Identification Comparison

Hazard	La Grande	Union County	Oregon NHMP Region 7: Northeast Oregon
Air Quality	✓		
Drought	✓	✓	✓
Earthquake	✓	✓	✓
Flood	✓	✓	✓
Dam Safety/Failure	✓	✓	✓
Invasive Species/Pests	✓		
Landslide		✓	✓
Severe Weather	✓	✓	
Dust Storm		✓	
Extreme Temps/Heat	✓	✓	✓
Windstorm	✓	✓	✓
Winter Storm	✓	✓	✓
Volcanic Event	✓		✓
Wildfire	✓	✓	✓

Source: La Grande NHMP Steering Committee (2023); *2022 Union County NHMP*, *2020 Oregon NHMP*

This Hazard Identification and Analysis section includes descriptions for each natural hazard in the following ways: significant changes since the *2014 Northeast Oregon Regional NHMP*, characteristics, and the location/extent. The hazard identification and analysis also include profiling of hazard events, which describes the causes and characteristics of each natural hazard, how each has affected La Grande in the past, and what part of La Grande's population, infrastructure, and environment has historically been vulnerable to each specific hazard. For additional details on the history of events for each hazard, the relationship with climate projections, and maps of the hazards, see below under Hazard Characterization.

As part of the NHMP update process, there is a requirement to examine changes in development. Climate change and climate resilience are important parts of this discussion. The climate is changing, and the impacts are becoming more evident in both quantitative and qualitative information. According to the UN Intergovernmental Panel on Climate Change (IPCC), Climate Change 2014: Mitigation of Climate Change, resilience is defined as "the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation (Arctic Council, 2013)." (Allwood et al., 2014).

The Hazard Vulnerability Assessment and the analysis of risk are included within and after the Hazard Identification and Analysis section of this Risk Assessment. This analysis covers all the identified natural hazards in a brief manner. Note that Chapter 2, Community Profile, identifies the critical facilities, critical infrastructure, and vulnerable population centers of La Grande.

Of the *2020 Oregon NHMP*, Region 7 includes Baker, Grant, Wallowa, and Union Counties. As described in the Risk Assessment for Region 7, Climate Change section:

The hazards faced by Region 7 that are projected to be influenced by climate change include drought, wildfire, flooding, landslides, and extreme heat.

Climate models project warmer, drier summers for Oregon. Coupled with projected decreases in mountain snowpack due to warmer winter temperatures, Region 7 is expected to be affected by an increased incidence of drought and wildfire. In Region 7, climate change would result in increased frequency of drought due to low spring snowpack (very likely, >90%), low summer runoff (likely, >66%), and low summer precipitation and low summer soil moisture (more likely than not, >50%). It is very likely (>90%) that Region 7 will experience increasing wildfire frequency and intensity due to warmer, drier summers coupled with warmer winters that facilitate greater cold-season growth.

It is extremely likely (>95%) that the frequency and severity of extreme heat events will increase over the next several decades across Oregon due to human-induced climate warming (very high confidence).

Furthermore, flooding and landslides are projected to occur more frequently throughout western Oregon. It is very likely (>90%) that Oregon will experience an increase in the frequency of extreme precipitation events and extreme river flows (high confidence) that is more likely than not (>50%) to lead to an increase in the incidence and magnitude of damaging floods (low confidence). Because landslide risk depends on a variety of site-specific factors, it is more likely than not (>50%) that climate change, through increasing frequency of extreme precipitation events, will result in increased frequency of landslides.

While winter storms and windstorms affect Region 7, there is little research on how climate change influences these hazards in the Pacific Northwest. For more information on climate drivers and the projected impacts of climate change in Oregon, see Section 2.2.1.2, Introduction to Climate Change.

Presidential Disaster and Emergency Declarations

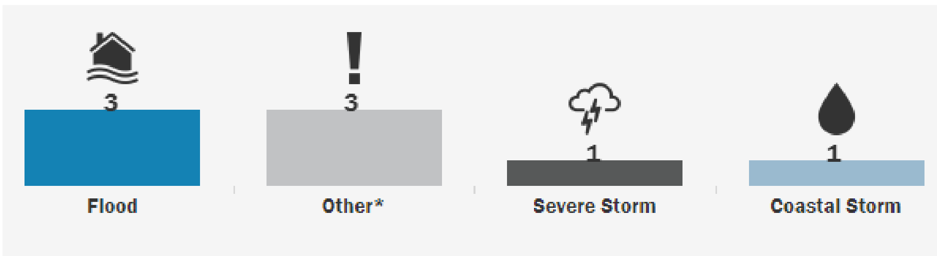
Reviewing past events that have occurred in La Grande and Union County can provide a general sense of the hazards that have caused significant damage in the city and surrounding area. Where trends emerge, disaster declarations can help inform hazard mitigation project priorities.

President Dwight D. Eisenhower approved the first federal disaster declaration in May 1953 following a tornado in Georgia. Since then, federally declared disasters have been approved within every state because of natural hazard related events. When governors ask for presidential declarations of major disaster or emergency, they stipulate which counties in their state they want included in the declaration.

A major disaster declaration can provide a wide range of federal assistance programs for individuals or public infrastructure, including funds for both emergency and permanent work. It also provides the Hazard Mitigation Grant Program (HMGP). An emergency declaration is more limited in scope and without the long-term federal recovery programs of a major disaster declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring. Fire Management Assistance (FMA) is provided after a State submits a request for assistance to the FEMA Regional Director at the time a "threat of major disaster" exists. This too provides HMGP funding.

According to FEMA's Disaster Declarations for States and Counties, FEMA has approved a total of 39 federal major disaster (DR) declarations in Oregon, as of February 2023. In addition, there have been 4 emergency (EM) declarations and 99 FMA declarations in Oregon as of February 2023. There are also 36 Fire Suppression Authorizations (FSA) on record for Oregon. Counting primary types of disaster declarations (DR, EM, and FM), the total number of disasters in Oregon is 142.

Figure 3-5. Union County Disasters by Incident Category



Source: Federal Emergency Management Agency (2023)

Table 3-2, shown above, uses FEMA's historical disaster data information as a visual for the disaster declarations in Union County. La Grande is in Union County. Of the 142 Oregon declarations, Union County is associated with 8 of those declarations, which include 5 DR and 3 EM. There were no FM declarations. Table 3-3 summarizes the FEMA disaster declarations declared in Oregon that have directly affected Union County since 1953; this table uses the FEMA disaster declarations information as noted in the source listed under the table.

Table 3-3. FEMA Major Disaster, Emergency, and Fire Management Assistance Declarations for Union County, Oregon

Declaration Number	Declaration Date	Incident Period From	Incident Period To	Incident	Individual Assistance	Public Assistance Categories
DR-184	12/24/1964	12/24/1964	12/24/1964	Heavy rains and flooding	Yes	A, B, C, D, E, F, G
EM-3039	4/29/1977	4/20/1977		Drought	None	A, B
DR-1099	2/9/1996	2/4/1996	2/21/1996	Severe Storms/Flooding	Yes	A, B, C, D, E, F, G
DR-1510	2/19/2004	12/26/2003	1/14/2004	Severe Winter Storm	None	A, B, C, D, E, F, G
EM-3228	9/7/2005	8/29/2005	10/1/2005	Hurricane Katrina Evacuation	None	B
EM-3429	3/13/2020	2/20/2020	5/11/2023	COVID-19 Pandemic	None	B
DR-4499	3/28/2020	1/20/2020	5/11/2023	COVID-19 Pandemic	Yes	B
DR-4519	4/3/2020	2/5/2020	2/9/2020	Severe Winter Storm, Flooding, Landslides, and Mudslides	None	A, B, C, D, E, F, G

Source: Federal Emergency Management Agency

3.2 Hazard Identification and Analysis

Air Quality

Significant Changes Since Previous Plan:

Air Quality Hazard is new to La Grande's NHMP

Causes and Characteristics

Communities across Oregon have begun to recognize the impacts of inversion layers trapping particulates in smoke from wood stoves, prescribed fire, wildfire, and field burning as a natural hazard. In addition, La Grande has begun to recognize the impacts of reduced outdoor air quality with warmer temperatures and increase in the number and size of wildfires in the region.

The nature of air movement or stagnation in a valley causes inversion layers to form. At the valley floor daytime temperatures heat the air. In the evening, air further up the slope of the mountains cools faster than the air lower down the slope. Because cool air is slightly heavier than warm air, the cool air sinks into the valley which displaces the warm air above it to form a "lid." If the weather creates stagnant conditions this inversion "lid" may persist trapping air pollutant discharges to create poor air quality.

The Oregon Climate Change Research Institute's *Future Climate Projections Union County, Oregon* report (August 2023) discusses how climate change is expected to reduce outdoor air quality through warmer temperatures; numerous and intense wildfire lasting longer; or increases in pollen abundance and seasonal duration that increase airborne allergens concentrations. The report states, "Poor air quality is expected to exacerbate allergy and asthma conditions and increase the incidence of respiratory and cardiovascular illnesses and death." (Dalton et al., 2023). As with impacts from wildfires, those that have occurred in the western United States have created extensive plumes of smoke, which travel at high altitudes over long distances. This can affect air quality near and far from a wildfire site and the risks to human health from wildfire smoke in Union County are projected to increase. "Wildfires are the primary cause 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)." (Dalton et al., 2023)

Air quality can be affected by several types of pollutants including ozone, particulate matter, air toxins (such as benzene), greenhouse gases (such as carbon dioxide), and products of combustion (such as carbon monoxide, sulfur dioxide and NOx). Among these, particulate matter with particles 2.5 microns or smaller ($PM_{2.5}$) is the pollutant of highest concern in La Grande.

Wildfires[7] tend to provide a wide-ranging source of smoke that can blanket large areas and be detrimental to the health of people, animals, and plants. Wood burning stoves tend to be a more concentrated, point source type of pollution that decreases air quality. Field burning is an agricultural technique that can contribute to air quality issues. Diesel emissions, often from vehicles on roads, also

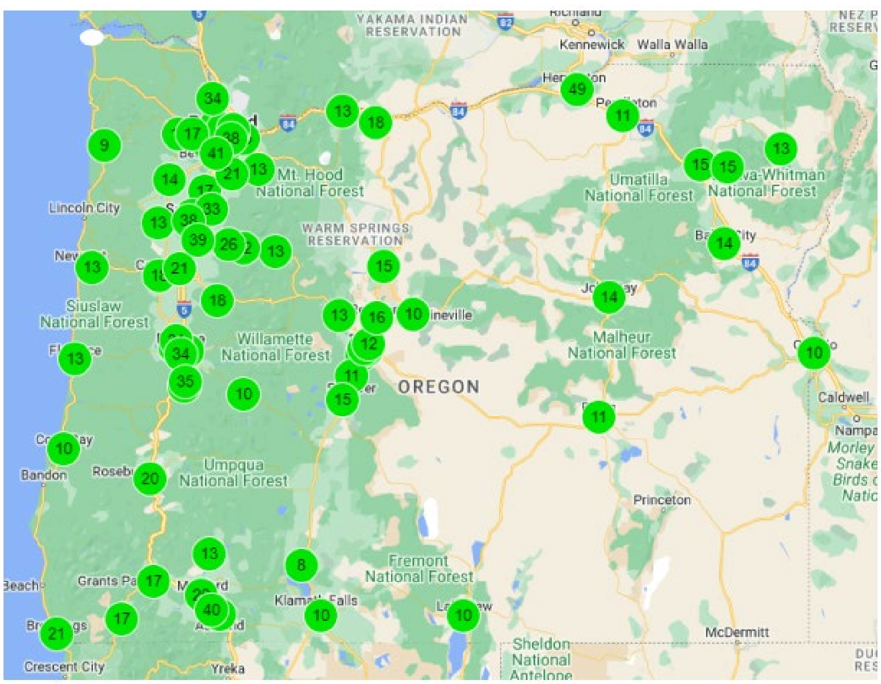
[7] See the Wildfire Hazard for more information about wildfire impacts

contribute to lower air quality. If a volcano[8] were to erupt, ashfall could inundate the surrounding areas sufficiently to impact transportation and cause widespread health concerns.

Location and Extent

According to the *2023 Oregon Annual Ambient Criteria Pollutant Air Monitoring Network Plan* issued by DEQ, air quality pollutants are currently monitored at various locations in the La Grande area including at the “Hall and North Street” site location (on North Willow Street). In the nearby city of Cove, there is a monitor located at Cove City Hall. Poor air quality has seasonality in that inversion layers tend to form from November to February. Once air temperatures warm the inversion layer conditions dissipate. During the summer months from June through August high pressure weather systems can remain in place for an extended period resulting in the accumulation of airborne particles in the lower levels of the atmosphere affecting the air quality. In addition, smoke from surrounding fires could impact La Grande and affect the air quality which may prompt Air Stagnation Advisories (Dalton et al., 2023). Figure 3-6 shows the 2023 Air Quality Index (AQI) Network sites in Oregon, which there are approximately 75 sites that will keep growing pending state funding. These are real time monitors that are used for hourly reporting of air quality for the AQI. In addition, Figure 3-10 shows the types of air quality monitoring stations in La Grande.

Figure 3-6. Oregon 2023 PM2.5 Ambient Air Monitoring Network (DEQ and LRAPA sites)



Source: Oregon Department of Environmental Quality, 2023
Note: Portland metro and Eugene metro cutouts are not shown here.

[8] See the Volcanic Event Hazard for more information about volcano impacts.

Air Quality Pollutants

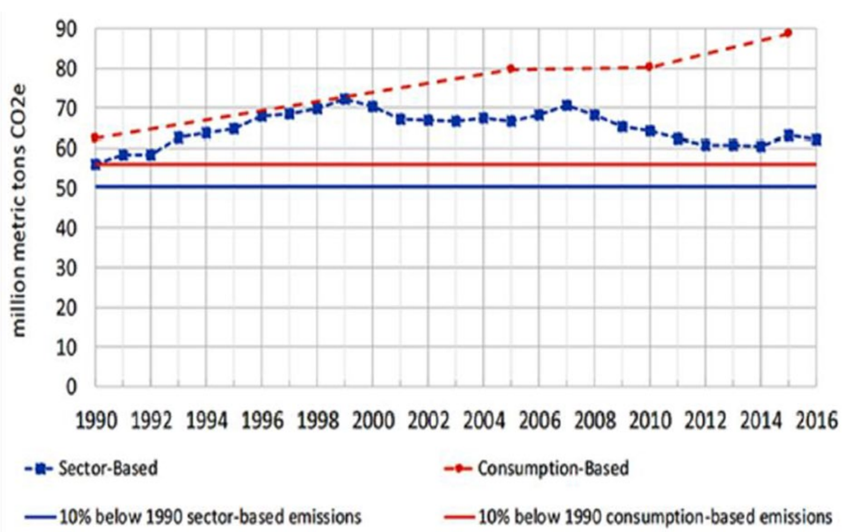
Oregon DEQ monitors air quality pollutants. DEQ operates the ambient monitoring network for the entire state, except Lane County, which is operated by the Lane Regional Air Protection Authority (LRAPA). These air quality monitoring networks measure ambient concentrations of the criteria pollutants – ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead. Air quality pollutants are currently monitored at various locations in the La Grande area, according to DEQ's *2023 Oregon Annual Ambient Criteria Pollutant Air Monitoring Network Plan*, including the "Hall and North Street" site location and at the neighboring Cove City Hall.

According to *Oregon Air Quality Monitoring Annual Report: 2020* (2021), the air pollutants of greatest concern in Oregon were the following:

- $PM_{2.5}$ – Fine particulate matter known as $PM_{2.5.}$ The concern is smoke impacts from woodstoves, fireplaces and other wood burning appliances besides wildfire smoke in the summer. Other sources include open burning, prescribed burning, wildfires, smoke from industrial stacks, and some road dust from vehicle travel.
- Air Toxics – Pollutants that cause or may cause cancer or other serious health effects.
- Ozone – Ground-level ozone is a component of smog.
- Greenhouse gas (GHG) – These emissions are produced directly from activities such as driving cars and heating homes. Indirectly, greenhouse gas emissions are contributed to when electricity, goods or food is purchased or manufactured in other states or countries. O

According to the *Oregon Air Quality Monitoring Annual Report: 2020* (2021), sector-based emissions are "produced in Oregon from transportation, residential, commercial, industrial, and agriculture sectors, including electricity produced elsewhere but used in state" while consumption-based emissions are "produced around the world due to Oregon's consumption of energy, goods, and services." Additional information about greenhouse gas emissions in Oregon are presented on DEQ's website at https://www.oregon.gov/deq/ghgp/Pages/GHG.aspx.

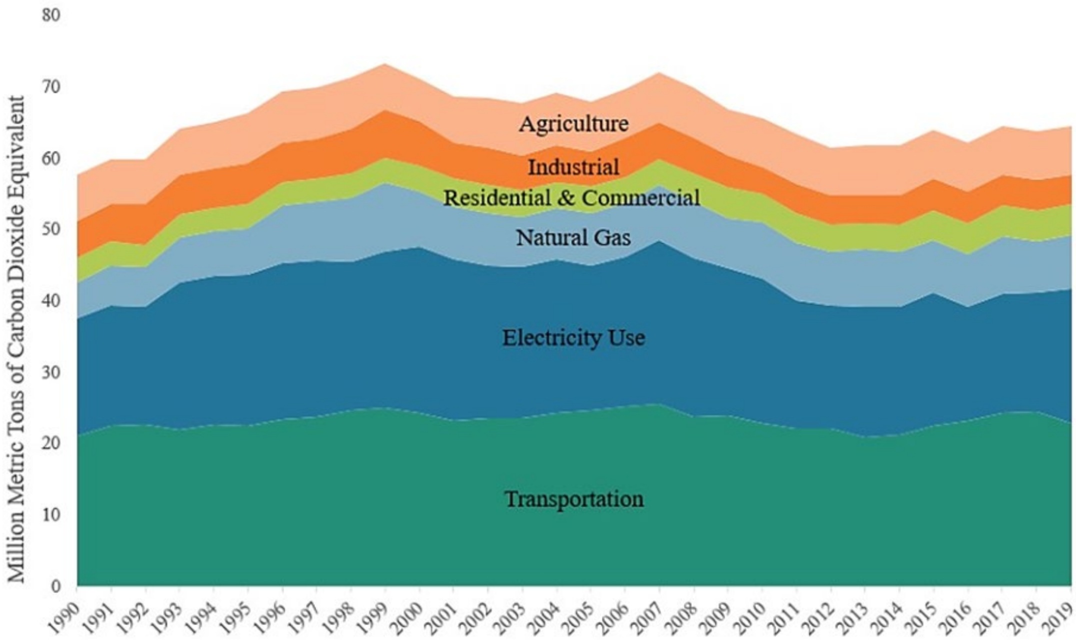
Figure 3-7. Oregon total greenhouse gas emissions by sector 1990-2016



Source: Oregon Department of Environmental Quality, 2021

Figure 3-7 is excerpted from the *2021 Oregon Air Quality Monitoring Annual Report* and shows Oregon's greenhouse gas emissions from 1990 through 2016 by sector. Emissions from transportation and electricity use are Oregon's largest sources of greenhouse gas emissions by the Oregon Greenhouse Gas Sector-Based Inventory Data.

Figure 3-8. Greenhouse gas emissions from 1990-2016



Source: Oregon Department of Environmental Quality, 2021

Identifying Poor Air Quality

Both specific measures of components of poor air quality and a general Air Quality Index are methods for determining the quality of the air.

Standards for air quality as determined by the EPA have changed over time. The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards. In 1996 the impact of 2.5-micron particles was recognized and the national $PM_{2.5}$ 24-hour and annual average National Ambient Air Quality Standard (NAAQS) was established. In 2006 the national $PM_{2.5}$ 24-hour standard was reduced to 35 ug/m3. In 2012 the national $PM_{2.5}$ annual average NAAQS was further reduced to 12 ug/m3. The PM_{10} annual average was revoked.

The Air Quality Index (AQI) is a daily index of air quality that reports how clean the air is and provides information on potential health risks. Oregon's index is based on three pollutants regulated by the federal Clean Air Act: ground-level ozone, particle pollution, and nitrogen dioxide. A rating of good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy, and hazardous are designated for the AQI providing a daily air quality rating (Table 3-4). The EPA provides all states with the AQI equation for national uniformity. DEQ and LRAPA report the AQI for cities in Oregon. The *Oregon Air Quality Monitoring Annual Report: 2020* provides a review of the health levels over the past year.

Table 3-4. Air Quality Index Ranges and Episode States for $PM_{2.5}$ and Ozone

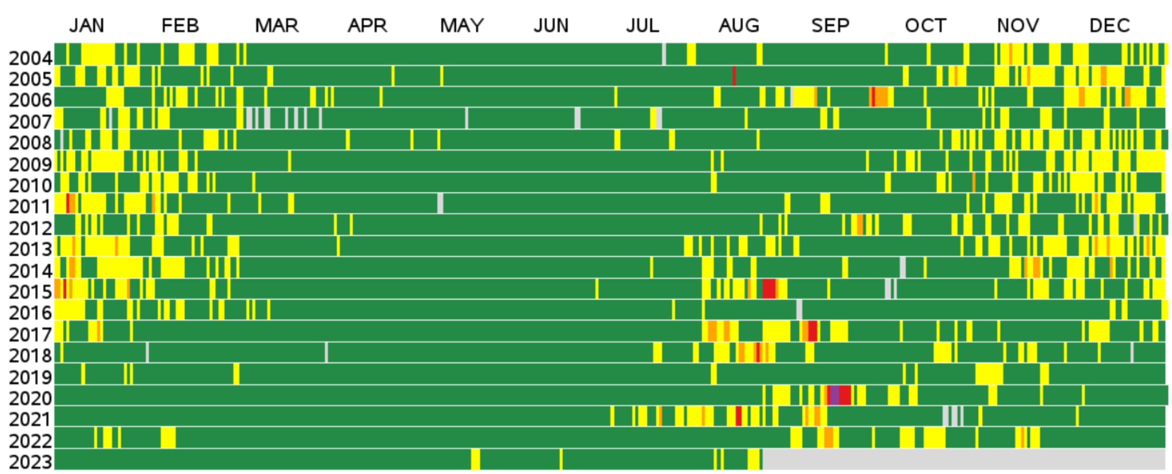
Air Quality Rating	Air Quality Index (AQI)	$PM_{2.5}$ 24-hour Average ($\mu g/m^3$)	Ozone 8-hour Average (ppm)
GOOD	0 - 50	0.0 - 12.0	0.000 - 0.054
MODERATE	51 - 100	12.1 - 35.4	0.055 - 0.070
UNHEALTHY FOR SENSITIVE GROUPS	101 - 150	35.5 - 55.4	0.071 - 0.085
UNHEALTHY	151 - 200	55.5 - 150.4	0.086 - 0.105
VERY UNHEALTHY	201 - 300	150.5 - 250.4	0.106 - 0.200
HAZARDOUS	>300	>250.5	>0.200

Source: Oregon Department of Environmental Quality, 2021

History

The data available to track poor air quality conditions in La Grande is limited to two permanent monitoring stations measuring $PM_{2.5}$. Figure 3-9 below shows a pattern of periods of the year where the likelihood of high levels of particulate matter of this diameter (2.5 microns) have been present at that station. One example is during the September 2020 wildfires in the region and as depicted in dark red in Figure 2-7, La Grande experienced extremely poor air quality.

Figure 3-9. PM2.5 Daily AQI Values, 2004 to 2023 for La Grande, OR

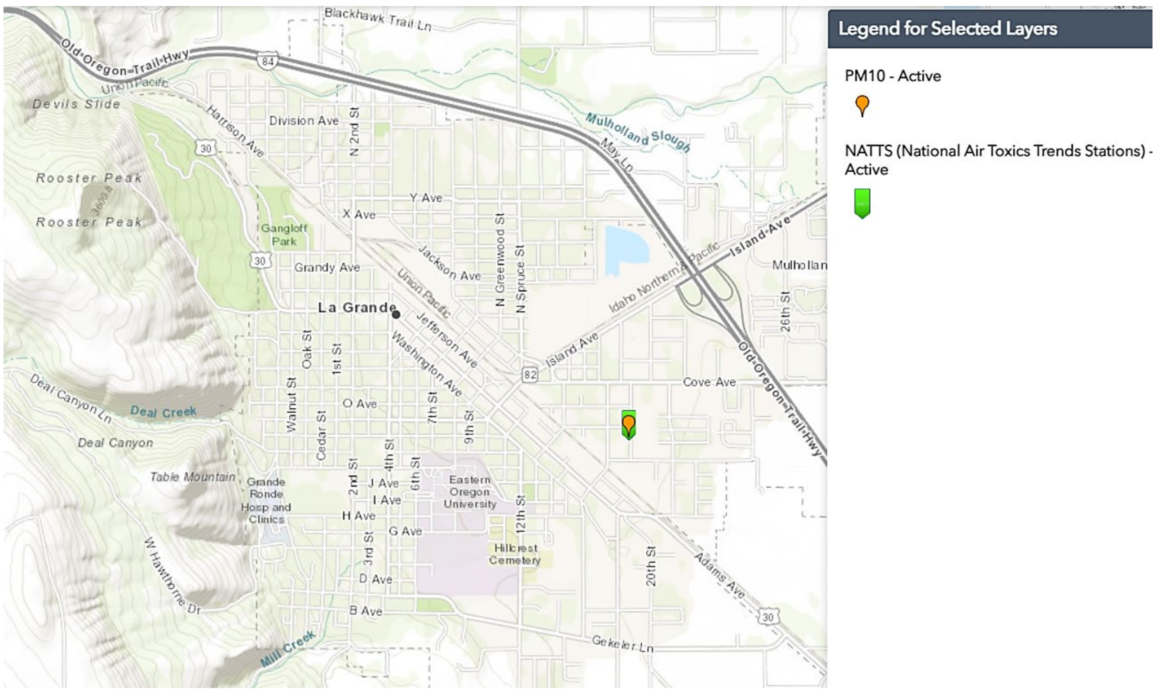


Source: U.S. Environmental Protection Agency, 2023

The EPA AirNow website maintains a real time [Fire and Smoke Map](#) for monitoring air quality and provides a tool for NHMP plan holders to use when using the plan. The figure below shows locations of both regulatory and low-cost sensors not valid for regulatory purposes but represented on the map in the interest of public health.

The determination of the severity of poor air quality and collecting data demonstrating the problem may provide support for mitigation actions aimed at managing prescribed burning, reduction of the risk of high intensity wildfire, and support for mitigation actions aimed at providing relief for vulnerable people during poor air quality conditions. The EPA [Ambient Monitoring Technology Information Center (AMTIC)](#) provides information on monitoring programs and methods, quality assurance and control procedures, and federal regulations.

Figure 3-10. Air Quality Monitoring Station Types



Source: U.S. Environmental Protection Agency, 2023

Future Climate Variability

The OCCRI *Future Climate Projections Union County, Oregon* (Dalton et al., 2023) report states that outdoor air quality will continue to deteriorate, in part due to the growing number of wildfires and increased amounts of fine particulate matter from wildfire smoke. Increased ozone concentration along with longer and more intense pollen seasons will contribute to this deterioration in air quality. Diminished air quality will significantly impact human health, exacerbating allergy and asthma conditions, as well as increasing incidences of respiratory and cardiovascular illnesses and conditions. Air quality will significantly impact the more vulnerable and marginalized populations of the region, including children, the elderly, and economically disadvantaged communities. When comparing the time periods of 2004–2009 to 2046–2051, the number of days per year with poor air quality due to elevated concentrations of wildfire derived fine particulate matter is projected to increase by 68%. Furthermore, the concentration of fine particulate matter on those days is projected to increase by almost 129%.

In addition, OCCRI's report indicates that plants are responding to changes in climate and atmospheric concentrations of carbon dioxide by producing more pollen, and producing pollen earlier in spring, for longer periods of time. In the conterminous United States, pollen seasons increased by about 20 days and pollen concentration increased by 21% from 1990 through 2018. Such poor air quality is expected to exacerbate allergy and asthma conditions and increase the incidence of respiratory and cardiovascular illnesses and death. Moreover, the report states,

> Those at high risk of adverse health outcomes as a result of wildfire smoke include people with preexisting conditions, outdoor workers, children, pregnant women, 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).

Probability Assessment

As previously noted, communities across Oregon have begun to recognize the impacts of inversion layers trapping particulates in smoke from wood stoves, prescribed fire, wildfire, and field burning as a natural hazard. In addition, La Grande has begun to recognize the impacts of reduced outdoor air quality with warmer temperatures and increase in the number and size of wildfires in the region.

Depending upon climate conditions, air stagnation can be infrequent or numerous in any given year, which can have a potential impact to air quality levels for both $PM_{2.5}$ and ozone in the area. Prevailing wind direction and strength can influence the location and extent of the air quality impacts. The probability of air quality at one level or another varies, as air quality is a range based on multiple factors such as those measured for carbon monoxide, particulate matter (PM_{10} and $PM_{2.5}$), ozone, and others described above.

The sources of air pollution in the region include wood stoves, prescribed fire, wildfire, and field burning, industrial, and motor vehicle emissions. Industry and residential wood stoves emit particulate matter and carbon monoxide. Concerns for air quality arise when smoke from regional wildfires either blows through the La Grande area or becomes trapped during inversions. See the Wildfire Hazard for more information about wildfire impacts. In addition, climate change has a relationship with natural hazards, as noted above.

Several key points from the OCCRI *Future Climate Projections Union County, Oregon* report is shared here:

- Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase under future climate projections in Union County.
- The average number of days per year on which vapor pressure deficit is extreme is projected to increase by 31 (range 12–44) by the 2050s, compared to the historical baseline, under the higher emissions scenario.
- With air quality, under future climate change, the risk of wildfire smoke exposure is projected to increase in Union County.

- In Union County, the number of "smoke wave" days is projected to increase by 68% by 2046-2051 under a medium emissions scenario compared with 2004-2009.

Warmer temperatures may increase ground-level ozone concentrations. Increases in the number and size of wildfires may increase concentrations of smoke and particulate matter. Although usually thought of as being a summer occurrence, wildfires can occur during any month of the year. Many wildfires burn during June to October time, but over the years there have been more and larger fires, extending the season beyond the past years' typical periods.

Additionally, plants also are responding to changes in climate and atmospheric concentrations of carbon dioxide by producing more pollen earlier in the spring and for longer periods of time. Lastly, the wood stove, industrial, and motor vehicle emissions can occur during any month of the year.

Based on the available data and research for La Grande, the NHMP Steering Committee assessed the **probability of experiencing locally poor air quality as "high,"** meaning one incident is likely within a 10 to 35-year period.

Vulnerability Assessment

A climate-related driver of health is air quality, including pollen, wildfire smoke, smog, and ozone. Poor air quality puts the health of all people at risk. However, people experience the impacts differently. According to OCCRI, *Fifth Oregon Climate Assessment* (2021), inequities and unequal investments in social determinants of health are contributing stress factors and include housing, education, income, wealth, transportation access, food security, income security, access to health care. The effects of poor air quality are long-term, chronic, and often difficult to trace. Those people most at risk tend to be the elderly, very young children, and people with pre-existing respiratory problems. The OCCRI *Fifth Oregon Climate Assessment* (2021) report states,

> The health effects of climate change are strongly affected by the baseline status of individuals and communities, especially people's living conditions and pre-existing health conditions. These factors differ significantly by race, historical levels of economic investment, and level of pollution exposure. Among the individuals most susceptible are those with existing chronic conditions, older adults, pregnant women, and children (Liu et al. 2017, Hutchinson et al. 2018). People of color, people with low incomes, unhoused populations, agricultural workers, first responders, and rescue workers are those most susceptible to wildfire smoke exposure (Rudolph et al. 2018). Asthma hospitalizations in Oregon disproportionately affect Black, Pacific Islander, and Indigenous people as compared to other racial or ethnic groups (OHA 2018a). Exposure to smoke compounds this existing disparity.

The La Grande NHMP Steering Committee is especially concerned about the increase in regional wildfire smoke and the impact it has on the community. According to NASA's Increased Fire Comes with Increased Health Risks, "Researchers believe recent fire seasons give a taste of the more active wildfires of the future. Such fires are likely to increase air pollution, even as emissions from industry and motor vehicles have fallen in recent decades." Furthermore, "The U.S. has really made great strides in reducing man-made particles," said study co-author Loretta Mickley of Harvard University. Mickley continues, however, "wildfires dominate poor air quality in the West." The study identifies that wildfires contribute roughly 18% of the total particulate emissions in the U.S.

That same study noted,

> Globally, fine particles have been linked to more than 3.3 million premature deaths…. Particulate pollution, one of the results of burning matter, can cause a slew of health problems, including chronic obstructive pulmonary disease, acute lower respiratory illness, asthma, ischemic heart disease, and lung cancer.
>
> …
>
> Using atmospheric and climate models, the research team found that more than 82 million people are likely to experience an increase in the frequency and duration of smoke waves. Northern California, western Oregon, and the Great Plains are among areas that researchers estimate will be hit hardest by particulate matter (PM2.5) in the atmosphere.
>
> "Wildfires are difficult to predict because they're variable one day to the next and one year to the next," said Jason West, a professor of environmental science at the University of North Carolina. The new research is valuable, he said, because it places the fires into a health context.
>
> "What's interesting [about the study] is that it shows that climate change can have a direct impact on public health," said Mickley. "We're used to thinking of climate change as affecting temperatures and rising sea levels. This is something different that requires a lot of resources to control, affects millions of people, and it has been overlooked."

According to the EPA's *Carbon Monoxide (CO) Pollution in Outdoor Air*, carbon monoxide can cause harmful health effects by reducing oxygen delivery to the body's organs, especially the heart, brain, and tissues. At extremely high levels, CO can cause death. Exposure to CO can reduce the oxygen-carrying capacity of the blood. People with several types of heart disease already have a reduced capacity for pumping oxygenated blood to the heart, which can cause them to experience myocardial ischemia (reduced oxygen to the heart), often accompanied by chest pain (angina), when exercising or under increased stress. For these people, short-term CO exposure further affects their body's already compromised ability to respond to the increased oxygen demands of exercise or exertion.

Ozone reacts with molecules in the lining of our airways. Chemical bonds break and reform in different ways with the addition of oxygen atoms (the process of oxidation) from ozone, and this causes acute inflammation. The lining of our airways loses some of its ability to serve as a protective barrier to microbes, toxic chemicals, and allergens. Our airways respond by covering the affected areas with fluid and by contracting muscles. Breathing becomes more difficult.

Shortness of breath, dry cough or pain when taking a deep breath, tightness of the chest, wheezing, and nausea are common responses to ozone, according to NASA's *The Ozone we Breathe*. Ozone also triggers asthma and may aggravate other respiratory illnesses such as pneumonia and bronchitis. Ozone concentrations can make the small bands of muscles that help control breathing more sensitive to dry air, cold or dust, so ozone exposure may increase allergic responses in susceptible people.

While the effects of acute, short-term episodes of ozone exposure are reversible, the human body's response to long-term exposure may not be reversible. Exposure to ozone at levels we commonly encounter in our own communities permanently scars the lungs of experimental animals, causing long-term impairment of lung capacity, or the volume of air that can be expelled from fully inflated lungs.

Ozone may have similar effects on human lungs. Studies in animals suggest ozone may reduce the human immune system's ability to fight bacterial infections in the respiratory system.

Ozone damage to people can occur without any noticeable signs. Even when initial symptoms appear, they can disappear while ozone continues to cause harm. Otherwise, healthy people can expect to experience acute but reversible effects if they exercise regularly outdoors when ozone levels are high. The National Institute of Environmental Health Sciences (NIEHS) considers such people to be especially susceptible as a group (NASA Earth Observatory, 2022).

Particulate matter is also known as particular pollution; it is a complex mixture of extremely small particles and liquid droplets that get into the air. Once inhaled, these particles can affect the heart and lungs, and cause serious health effects, according to EPA. The size of particles is directly linked to their potential for causing health problems. Small particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into lungs and the bloodstream. Exposure to such particles can affect both the lungs and heart. As noted by the EPA, People with heart or lung diseases, children, and older adults are the most likely to be affected by particle pollution exposure.

Numerous scientific studies, according to the EPA's *Particulate Matter (PM) Pollution*, have linked particle pollution exposure to problems, including:

- premature death in people with heart or lung disease,
- nonfatal heart attacks,
- irregular heartbeat,
- aggravated asthma,
- decreased lung function, and
- increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.

EPA also notes that fine particles ($PM_{2.5}$) are the main cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas. Particles can be carried over long distances by wind and then settle on ground or water. Depending on their chemical composition, the effects of this settling may include:

- making lakes and streams acidic,
- changing the nutrient balance in coastal waters and large river basins,
- depleting the nutrients in soil,
- damaging sensitive forests and farm crops,
- affecting the diversity of ecosystems, and
- contributing to acid rain effects.

Particulate Matter can stain and damage stone and other materials, including culturally important objects such as statues and monuments. Some of these effects are related to acid rain effects on materials, according to the EPA.

The La Grande NHMP Steering Committee rated the city as having **a "high" vulnerability to air quality hazards**, meaning over 10% of the city's population or property would be affected by a major air quality emergency or disaster.

Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of a natural disaster, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies and organizations. These activities and resources are highlighted in the Mitigation Strategy (Chapter 4).

Drought

Significant Changes Since Previous Plan:

The Drought hazard section has been updated to include new history and additional information since the last plan.

Causes and Characteristics

Drought is a normal, recurrent feature of the climate. It occurs almost everywhere, although its features vary from region to region. According to the National Drought Mitigation Center (University of Nebraska), defining drought is, therefore, difficult; it depends on differences in regions, needs, and disciplinary perspectives. In the most general sense, drought is defined as a deficiency of precipitation over an extended period (usually a season or more), resulting in a water shortage. A drought is a period of drier than normal conditions. Drought occurs in almost every climatic zone, but its characteristics vary significantly from one region to another. Drought is a temporary condition; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate. The extent of drought events depends upon the degree of moisture deficiency, and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city or county.

In the early 1980s, researchers with the National Drought Mitigation Center and the National Center for Atmospheric Research (NCAR) located more than 150 published definitions of drought. To simplify analysis, the NDMC now provides four primary ways in which drought can be defined based on the impacts of the drought. They are as follows: meteorological, agricultural, hydrological, and socioeconomic. The first three approaches deal with ways to measure drought as a physical phenomenon. The last deals with drought in terms of supply and demand, tracking the effects of water shortfall as it ripples through socioeconomic systems. Figure 3-11 below illustrates the interrelationship of these types of droughts.

Types of Drought

Meteorological Droughts: Meteorological droughts are defined in terms of the departure from a normal precipitation pattern and the duration of the event. These are region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.

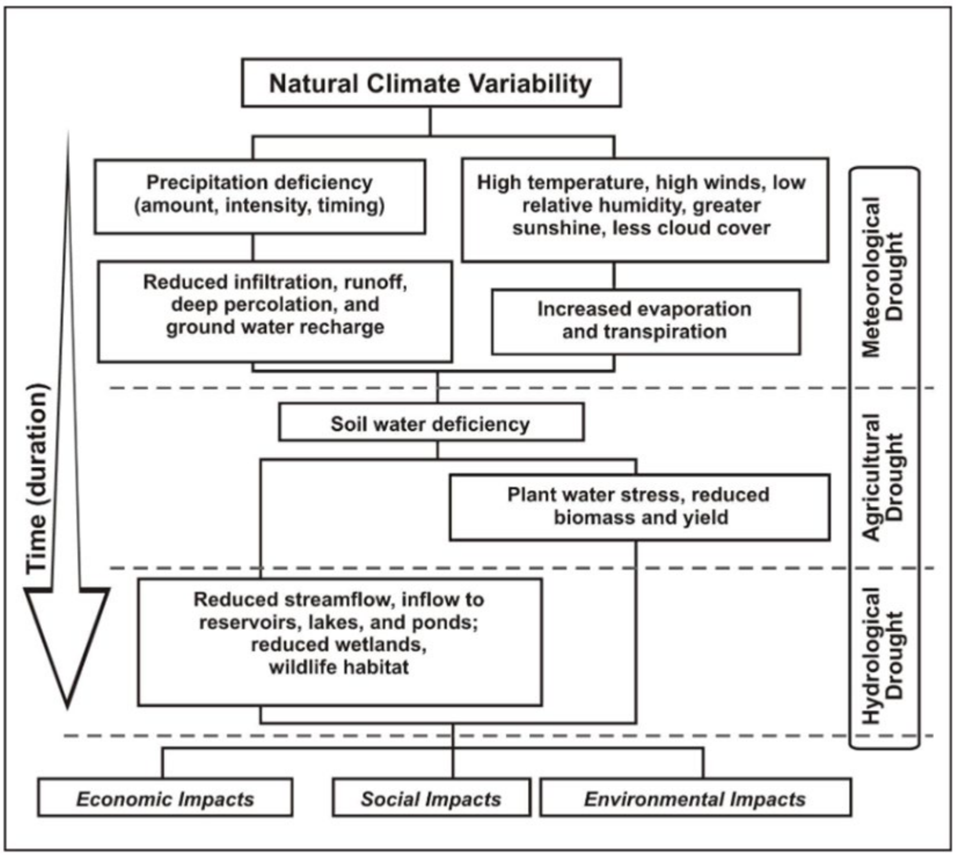
Hydrological Droughts: Hydrological droughts refer to deficiencies in surface water and sub-surface water supplies. It is measured as stream flow, and as lake, reservoir, and ground water levels. Hydrological measurements are not the earliest indicators of drought. Hydrological droughts are usually out of phase with the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and groundwater and reservoir levels.

Agricultural Droughts: Agricultural drought links various characteristics of meteorological or hydrological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced groundwater or reservoir levels.

Socioeconomic Drought: Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. It differs from the other three types of droughts because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts.

Ecological, Flash, and Snow Drought: In addition to these primary drought designations, three other drought designations—ecological, flash, and snow—were, according to OCCRI's *Fifth Oregon Climate Assessment* (2021), proposed more recently to reflect more-specific drivers and impacts of drought. For more information on these types of drought, OCCRI's *Fifth Oregon Climate Assessment*.

Figure 3-11. Types of Drought and impacts



Source: National Drought Mitigation Center

Location and Extent

Droughts occur in every climate zone and can vary from region to region. Drought may occur throughout La Grande and may have profound effects on the economy. The extent of drought events depends upon the degree of moisture deficiency, and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city and county. The *2020 Oregon NHMP*, Northeast (Region 7) Risk Assessment states,

> Drought is a common occurrence in the northeastern portion of the state. Every county in Region 7 has been impacted by drought on several occasions during the last 20 years. Together, winter snowpack and spring rains provide water for meeting a variety of needs. Extended drought conditions in this region can result in increased fire danger as well as in significant losses for the agriculture and tourism industries and therefore to the local economy.
>
> …
>
> High temperatures and low precipitation accompanying drought conditions reduce soil moisture, dry vegetation, and tend to enhance winds. These conditions can increase the amount of soil entrained by high winds, particularly in semi-arid regions where temperatures are increasing and precipitation is decreasing, and where areas of substantial land disturbance and development is occurring. Therefore, during extended dry and drought conditions, productive soils are vulnerable to loss, further impacting agriculture.

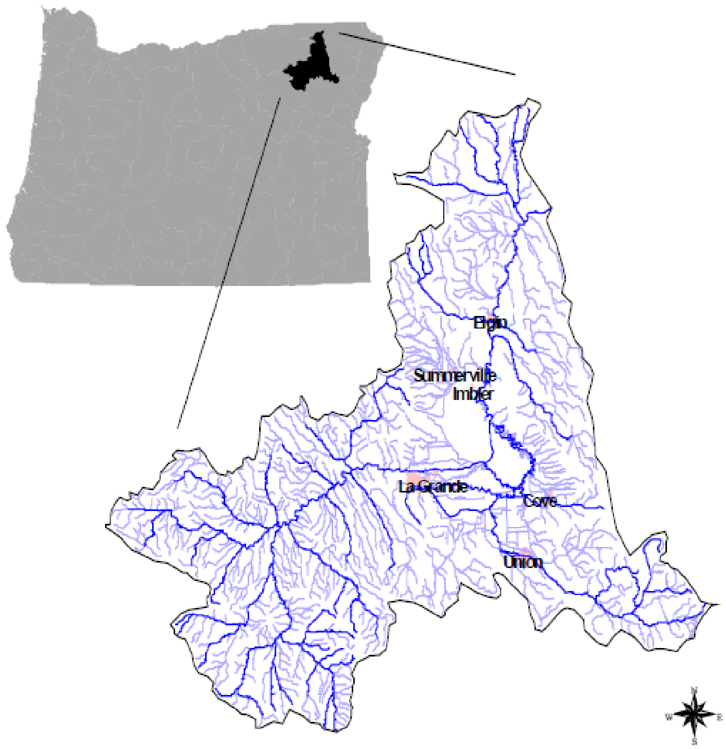
The U.S. Drought Monitor (USDM) is the current primary tool used to identify and categorize drought conditions in Oregon (https://droughtmonitor.unl.edu/) and is discussed in the subsequent section. In addition, the Natural Resources Conservation Service (NRCS) SWSI index is of current water conditions throughout the state and further discussed below.

Since the last NHMP update, City of La Grande participated in the development of the Place-Based Integrated Water Resources Planning with the Upper Grande Ronde River Watershed Partnership. The mission of the partnership is to address concerns related to water quality and quantity for both surface water and groundwater within the Upper Grande Ronde River Watershed (UGRRW). Union County convenes a diverse partnership composed of farmers, ranchers, fish and wildlife advocates, tribes, municipal representatives and federal and state agencies to develop and implement a place-based integrated water resources plan consistent with the State of Oregon's Integrated Water Resource Strategy. The Oregon Water Resources Commission passed a resolution recognizing the Upper Grande Ronde Watershed Partnership Place-Based Integrated Water Resources Plan in 2022 (Mason, 2022).

Northeast Oregon Watershed Basins

The Water Resources Commission determines the policies and procedures for the use and control of the state's water resources. The watershed basins are controlled and administered partially by basin programs which establish water management policies and objectives for the use and appropriation of the surface and ground water within each of the respective basins. The Water Resources Commission has adopted programs for the Grande Ronde Basin, the Powder Basin, and the John Day Basin. La Grande is in the Upper Grande Ronde River Subbasin, which includes the river, all its tributaries, and all lands that drain to the river or its tributaries upstream of the confluence of the Wallowa River at Rondowa (Grande Ronde Water Quality Committee, 2000). The Upper Grande Ronde River Subbasin is shown below in Figure 3-12.

Figure 3-12. Upper Grande Ronde River Subbasin



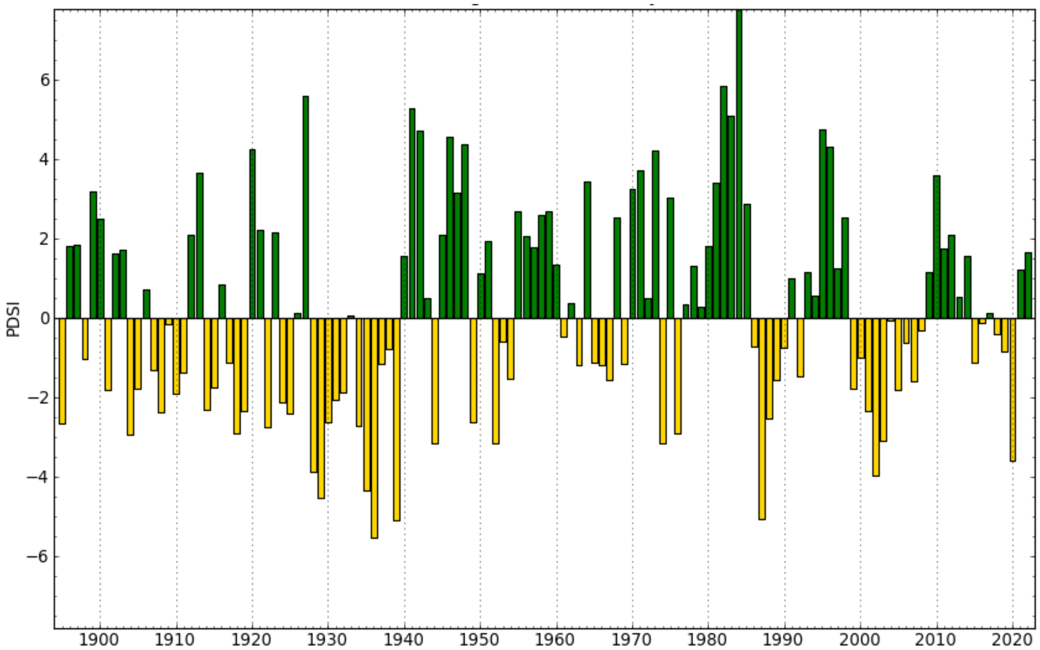
Source: Grande Ronde Water Quality Committee, 2000

Identifying Drought

The USDM is the current primary tool used to identify and categorize drought conditions in Oregon. The USDM is not a statistical model, although numeric inputs include the following: Palmer Drought Severity Index, Standardized Precipitation Index, and other climatological inputs; the Keech-Byram Drought Index for fire, satellite-based assessments of vegetation health, and various indicators of soil moisture; and hydrologic data, particularly in the West, such as the Surface Water Supply Index and snowpack. Three of these inputs are discussed below.

An example of a tool used to estimate drought conditions is the State Water Supply Outlook Report (WSOR) produced by the NRCS. The State Water Supply Outlook is a report containing forecasts of runoff and snowmelt runoff. It also contains a summary of current snowpack, precipitation, river flow volumes, reservoir storage and soil moisture, and data for these is published in the Maps and Data Summaries section. Runoff from the mountains is important for the major rivers in the province where reservoirs store water supplies for irrigation, hydroelectricity, community, and municipal purposes. Current WSOR are available for Oregon.

Figure 3-13. Palmer Drought Severity Index, Union County, Oregon 1895-2022



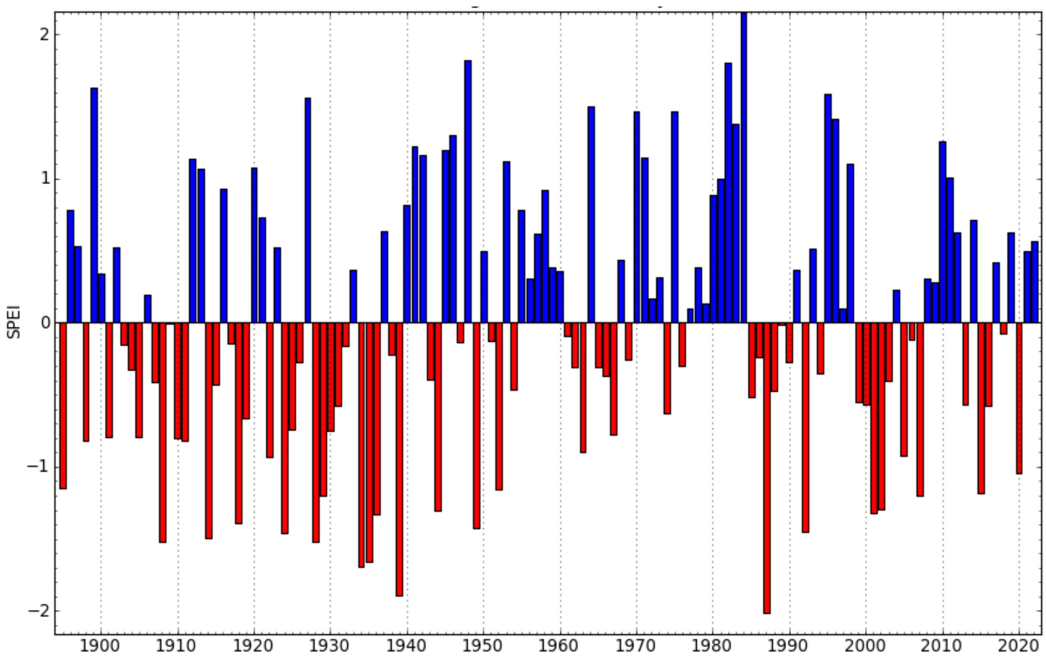
Source: Western Regional Climate Center
Note: PDSI uses a zero (0) as normal, and drought is shown in terms of negative numbers; for example, negative two (-2.00) is moderate drought, negative three (-3.00) is severe drought, and negative four (-4.00) is extreme drought.

Palmer Drought Severity Index (PDSI): The PDSI incorporates precipitation, runoff, evaporation, and soil moisture as variables. However, the PDSI 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 a long-term historical record of wet and dry conditions. Figure 3-13 illustrates the PDSI for Union County between 1895 – 2022.

Standardized Precipitation Evapotranspiration Index (SPEI): The SPEI is another method for analyzing drought conditions. It is an extension of the widely used Standardized Precipitation Index (SPI) and is designed to consider both precipitation and potential evapotranspiration in determining drought. For more information, refer to the *Fifth Oregon Climate Assessment* (2021). Figure 3-14 illustrates the SPEI for Union County between 1895 – 2022.

Surface Water Supply Index (SWSI): The SWSI index is of current water conditions throughout the state. The index utilizes parameters derived from snow, precipitation, reservoir and stream flow data. The data is gathered each month from key stations in each basin.

Figure 3-14. Standardized Precipitation-Evapotranspiration Index (SPEI), Union County, Oregon 1895-2022



Source: Western Regional Climate Center
Note: The SPEI employs a Drought Severity Scale where 0 represents normal and drought is represented by negative numbers (-1 to -1.49 = moderate drought; -1.5 to -1.99 = severe drought; -2.0 or less = extreme drought).

History

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. Union County, where La Grande is located, is no different as drought is common occurrent due to the semi-arid climate. It is rare for drought not to occur somewhere in North America every year. The average recurrence interval for severe droughts in Oregon is somewhere between eight and 12 years.

The Drought Monitor (National Weather Service Climate Prediction Center) shows episodes of drought within the past five years occurring during the summer through the fall. Periodically, this region experiences more significant drought conditions that affect the region or the state. Table 3-5 identifies historic drought events that impacted Northeast Oregon, including La Grande.

Table 3-5. Historic Droughts in Region 7

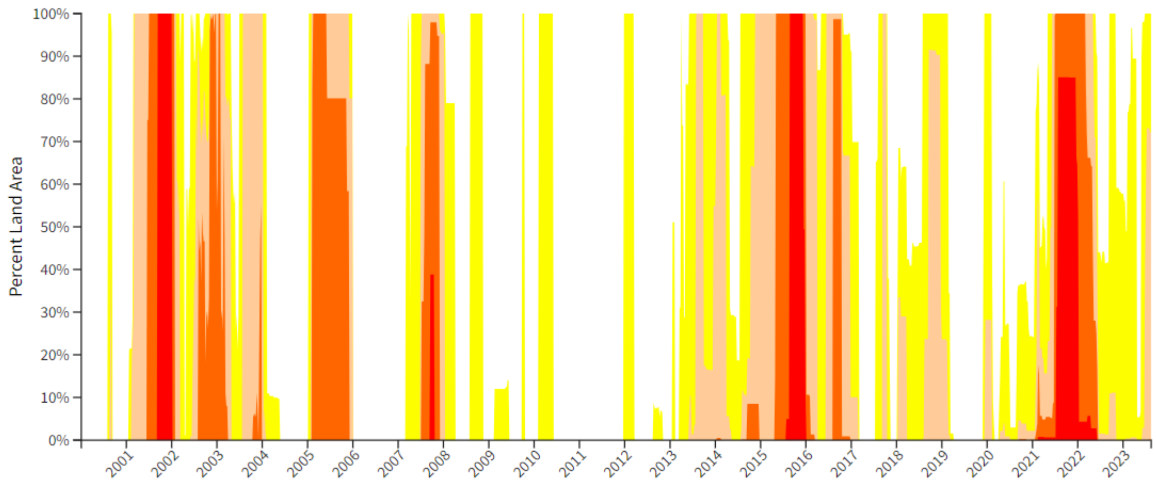
Year	Location	Description
1904-1905	Statewide	Statewide drought approximately 18 months
1917-1931	Statewide	A very dry period throughout Oregon, punctuated by brief wet spells in 1920-21 and 1927
1938-1939	statewide	The 1920s and 1930s, known more commonly as the Dust Bowl, were a period of prolonged mostly drier than normal conditions across much of the state and country

Year	Location	Description
1959-1964	Eastern Oregon	Low stream flows throughout Eastern Oregon
1976-1981	North and South-Central Oregon; Eastern Oregon	Intense drought in western Oregon; 1976-77 single driest year of the century
1985-1997	Statewide	A dry period, capped by statewide droughts in 1992 and 1994
1994	Regions 4–8	in 1994, Governor's drought declaration covered 11 counties located within regions 4, 5, 6, 7, and 8
1999	Northeast Oregon	Northeast Oregon, including Union County, was declared a disaster area by the Department of Agriculture due to drought. Approximately one-third of the wheat crop in those areas was lost due to weather
2002	Southern and Eastern Oregon	2001 drought declarations remain in effect for all counties, including Region 7's Baker, Union, and Wallowa Counties; Governor adds Grant County in 2002, along with five additional counties, bringing statewide total to 23 counties under a drought emergency.
2003	Southern and Eastern Oregon	Grant County 2002 declaration remains in effect through June 2003; Governor issues new declarations for Baker, Union, and Wallowa Counties, which are in effect through December 2003
2004	Region 5–8	Baker County receives Governor-declared drought emergency in June 2004, along with three other counties in neighboring regions
2005	Regions 5–7; 13 counties affected	Baker and Wallowa County receive a Governor drought declaration; all Region 5 counties affected, and most of Region 6 affected
2007	Regions 6–8	Grant, Baker, and Union Counties receive a Governor drought declaration; three other counties affected in neighboring regions
2013	Regions 5-8	Baker County receives a drought declaration, as well as four other counties in neighboring regions
2014	Regions 4, 6–8	Grant and Baker County receive drought declarations, including eight other counties in other regions
2015	Statewide	36 Oregon Counties across the state receive federal drought declarations, including 25 under Governor's drought declaration. Union County declared an emergency due to drought, which impacted local crop production and fire danger.
2018	Regions 1, 4-8	Baker and Grant County receive Governor's drought declarations, including 9 other counties in 5 other regions.
2021	Northeast Oregon	Four Northeast Oregon counties, including Union County, receive Governor's drought declaration
2022	Northeast Oregon	Wasco and Union Counties received Governor's drought declaration.

Sources: *2020 Oregon NHMP*; *2022 Union County NHMP*; Taylor and Hatton (1999). The Oregon Weather Book: State of Extremes, and the Oregon Secretary of State's Archives Division. NOAA's Climate At A Glance. Western Regional Climate Center's Westwide Drought Tracker http://www.wrcc.dri.edu/wwdt. Personal Communication, Kathie Dello, Oregon Climate Service, Oregon State University.

For additional historical events for Northeast Oregon refer to the Oregon Natural Hazards Mitigation Plan, Northeast Oregon (Region 7) Risk Assessment.

Figure 3-15. Union County Percent Area in U.S. Drought Monitor Categories (2000-2023)



Source: National Drought Mitigation Center

El Niño / La Niña

El Niño Southern Oscillation (ENSO) weather patterns can increase the frequency and severity of drought. La Niña is an oceanic and atmospheric phenomenon that is the colder counterpart of El Niño, as part of the broader El Niño–Southern Oscillation (ENSO) climate pattern. El Niño and La Niña can be indicators of weather changes across the globe. La Niña is discussed more in the Severe Weather Hazard.

During El Niño periods, alterations in atmospheric pressure in equatorial regions yield an increase in the surface temperature off the west coast of North America. This gradual warming sets off a chain reaction affecting major air and water currents throughout the Pacific Ocean. In the North Pacific, the Jet Stream is pushed north, carrying moisture laden air up and away from its normal landfall along the Pacific Northwest coast. In Oregon, this shift results in reduced precipitation and warmer temperatures, normally experienced several months after the initial onset of the El Niño. These periods tend to last nine to twelve months, after which surface temperatures begin to trend back towards the long-term average. El Niño periods tend to develop between March and June, and peak from December to April. ENSO generally follows a two to seven-year cycle, with El Niño or La Niña periods occurring every three to five years. However, the cycle is highly irregular, and no set pattern exists. The last major El Niño was during 1997-1998. After that event, four El Niño events occurred but each were weaker and had shorter effects than the 1997–98 event. With modern-day research and reanalysis techniques it has been found that at least 26 El Niño events have occurred since 1900, with the 1982–83, 1997–98 and 2014–16 events among the strongest on record (Wikipedia, 2023).

Future Climate Variability

Drought is common in northeast Oregon. Climate models project warmer, drier summers for Oregon, including Union County and La Grande. The *2020 Oregon NHMP* indicates that for these summer conditions coupled with projected decreases in mid-to-low elevation mountain snowpack due to warmer winter temperatures increases the likelihood that Union County and the northeast region would experience increased frequency of one or more types of drought under future climate change. In Union

County, climate change would result in increased frequency of drought due to low spring snowpack (60%), low summer runoff (55%), and low summer precipitation (33%) (Dalton et al., 2023).

The OCCRI *Future Climate Projections Union County, Oregon* report projects that drought conditions, represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is projected to become more frequent in Union County by the 2050s. It is estimated that by the year 2100, annual mean precipitation in Oregon will increase by 5-10%. However, summers will become increasingly drier and warmer, while winters will become warmer. As a result of warmer winters, snowpack across Oregon is projected to decline an estimated 25% by 2050, contributing to reduced summer soil moisture in the mountains and subsequent reduction in summer streamflow. As mountain snowpack declines, seasonal drought will become less predictable and snow droughts will increase the likelihood of hydrological and agricultural drought during the following spring and summer.

The incidence of related negative physical and mental health outcomes is likely to increase in response, especially among low income, tribal, rural, and agricultural communities. Other issues expected to be exacerbated due to drought include increased food scarcity and increased incidences of infectious, chronic, and vector-borne diseases that are exacerbated in drought conditions.

Probability Assessment

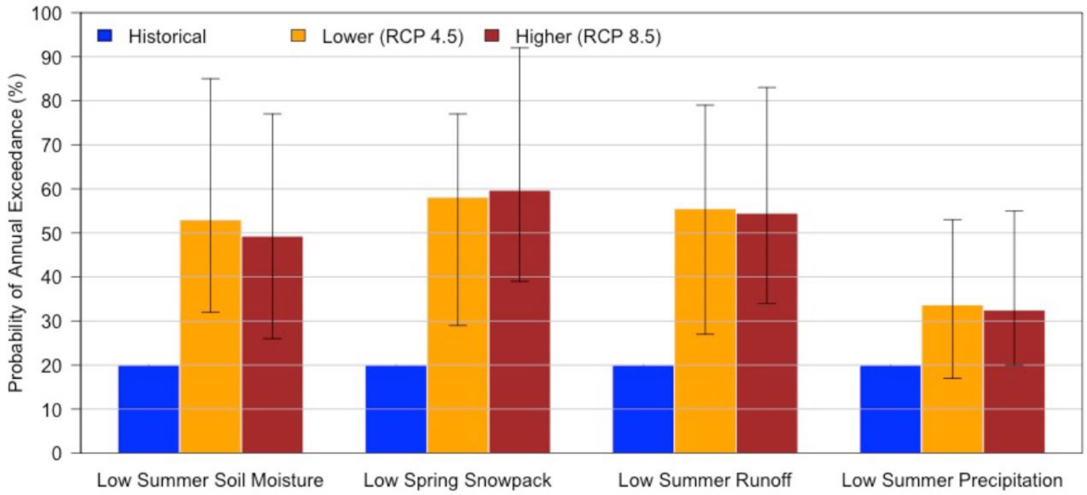
Droughts are common in the State of Oregon, nor are they just an "east of the mountains" phenomenon. They occur in all parts of the state, in both summer and winter. Oregon's drought history reveals many short-term and a few long-term events. The average recurrence interval for severe droughts in Oregon is somewhere between 8 and 12 years. The *2020 Oregon NHMP* states the following regarding the probability for the drought hazard in Northeast Oregon (Region 7),

> Despite impressive achievements in the science of climatology, estimating drought probability and frequency continues to be difficult. This is because of the many variables that contribute to weather behavior, climate change and the absence of long historic databases.
>
> Oregon has yet to undertake a comprehensive risk analysis for drought on a statewide basis, to determine probability or vulnerability for a given community. Considering historical statewide droughts and the number of drought declarations made in recent years, it is reasonable to assume that it is very likely that Region 7 will experience drought in the near future. Baker County has been under an emergency drought declaration on eleven different occasions or in 48% of the years since 1992: 1992, 2001 (remained in effect during 2002), 2003, 2004, 2005, 2007, 2013, 2014, 2015, and 2018. This is only second to Klamath County in Region 6. Grant has received drought declarations in 24% of these years, Union in 21%, and Wallowa in 17%. This accounts for their different probability ratings.

Based on the available data and research for La Grande the NHMP Steering Committee assessed the **probability of experiencing a locally severe drought as "high,"** meaning one incident is likely within a 10 to 35-year period.

Figure 3-16 shows the projected probability of exceeding the magnitude of seasonal drought conditions for which the historical annual probability of exceedance was 20%.

Figure 3-16. Projected Future Drought in Union County



Source: Dalton et al., 2023
Note: Projections are for the 2050s (2040–2069), relative to the historical baseline (1971–2000), under two emissions scenarios. Seasonal drought conditions include low summer soil moisture (average from June through August), low spring snowpack (April 1 snow water equivalent), low summer runoff (total from June through August), and low summer precipitation (total from June through August). The bars and whiskers represent the mean and range across ten global climate models.

Vulnerability Assessment

Droughts have obvious effects on lake and river levels, which cause harm to wildlife, farmers and ranchers. Its effect on forests is less obvious and can have a tremendous impact. During extended periods of drought trees are weakened by water shortages and tree pests proliferate. Wildfires also often coincide with droughts. The severity of a drought occurrence poses a risk for agricultural and timber losses, property damage, and disruption of water supplies and availability in urban and rural areas. Factors used to assess drought risk include agricultural practices, such as crop types and varieties grown, soil types, topography, and water storage capacity.

Droughts in the past have caused no personal injury or death. The potential for future injuries or deaths is anticipated to increase compared to historic events. La Grande estimates that greater than 10% of the city's population or property is likely to be affected by drought conditions. The following summary is reflected in the *2020 Oregon NHMP*, regarding the Northeast Oregon (Region 7) vulnerability of drought to the region,

> 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.
>
> Oregon has not undertaken a comprehensive statewide analysis to identify which communities are most vulnerable to drought. However, Baker and Grant Counties are vulnerable to and have experienced wildfire connected with drought conditions.

The Centers for Disease Control and Prevention (CDC) has calculated a social vulnerability index to assess community resilience to externalities such as natural hazard events. It employs fifteen social vulnerability factors and uses data from the US Census Bureau's American Community Survey. The index is reported in quintiles (1–5). Social vulnerability scores do not vary by hazard.

According to the CDC Social Vulnerability Index, Union County has a low level of social vulnerability. Vulnerability in Union County is driven by a higher poverty rate, the share of multi-unit structures, the percentage of people living in institutionalized group quarters, and the percentage of occupied housing units with more people than rooms (*2020 Oregon NHMP*).

Based on information in the *2020 Oregon NHMP*, Union County is rated low in social vulnerability to damages from drought. Vulnerability to wildfire because of drought has been considered in this rating.

The *2022 Union County NHMP* outlines the following susceptibility for a drought hazard event.

> Drought is frequently an "incremental" hazard, meaning both the onset and end are often difficult to determine. Also, its effects may accumulate slowly over a considerable period of time and may linger for years after the termination of the event. Dust storms are a common occurrence during simultaneous high wind events and drought periods.
>
> Droughts are not just a summer-time phenomenon; winter droughts can have a profound impact on agriculture, particularly east of the Cascade Mountains. Also, below average snowfall in higher elevations has a far-reaching effect, especially in terms of hydro-electric power, irrigation, recreational opportunities and a variety of industrial uses.
>
> Drought can affect all segments of a jurisdiction's population, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). Water-dependent activities, such as agriculture and ranging, are particularly vulnerable to droughts. The Steering Committee considered drought both an economic hazard (affecting employment) and an agricultural hazard. Discussions with community members during the hazard identification process indicated that drought conditions have a negative impact on cattle ranching, specifically those not dependent on irrigation. Droughts do not impact the communities as much in terms of restricted food availability.
>
> Domestic water-users within the cities may be subject to stringent conservation measures (e.g., rationing) and could be faced with significant increases in electricity rates.
>
> The Region has been impacted numerous times by precipitation shortfalls/drought conditions. Seasonal irrigation water from mountain snowpacks fizzles out towards the end of August. It is common to find municipal water systems imposing some type of water rationing during dry years. More specifics about the precipitation distribution can be found in the Community Profile in Appendix C. Location of reservoirs helps mitigate the impact of a drought – water availability is not always correlated to the amount of precipitation.
>
> Aquifer capacity is a notable concern for the watershed sub-basin in the Grande Ronde Valley. The City of La Grande is also concerned about aquifer capacities should growth continue. The amount of water within the Grande Ronde Valley is currently unknown. There is an action item to conduct an aquifer study for this sub-basin.
>
> 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.

There are also environmental consequences. A prolonged drought in forests promotes an increase of insect pests, which in turn, damage trees already weakened by a lack of water. A moisture-deficient forest constitutes a significant fire hazard (see the Wildfire summary). Discussions with community members during the hazard identification process indicate that while drought may limit the growth of fuel for wildfires, it does provide ideal conditions for wildfires to occur. Drought significantly increases the probability for lightning-caused wildfires to occur and provides ideal conditions for the rapid spread of wildfire. In addition, drought and water scarcity add another dimension of stress to species listed pursuant to the Endangered Species Act (ESA) of 1973.

Looking at the Northeast Oregon region (Region 7), the *2020 Oregon NHMP* states, "the value of state-owned and leased buildings and critical facilities is approximately $186,973,000 representing the total potential for loss of state assets due to drought." Locally owned critical facilities have an estimated value of $751,328,000 total potential for loss of state assets due to drought. These figures together represent the maximum potential loss to state assets and local critical facilities due to drought because drought could impact the entire region.

The NHMP Steering Committee rated the city as having **a "low" vulnerability to drought hazards**, meaning less than 1% of the city's population or property would be affected by a major drought emergency or disaster.

For information on the Upper Grande Ronde River Watershed Partnership and the Place-Based Integrated Water Resources Planning information for Union County, see the following reports:

State of Water Resources Report. https://union-county.org/wp-content/uploads/2018/02/Step-2-Report.pdf

Integrated Water Resources Needs and Vulnerabilities Report. https://union-county.org/wp-content/uploads/2019/05/Final-Step-3-Report-05.08.19.pdf

Integrated Strategies Report. https://union-county.org/wp-content/uploads/2021/01/Step-4-Report.pdf

Final Report. https://union-county.org/wp-content/uploads/2022/01/Step-5-Revised-1.13.21.pdfT

Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of a natural disaster, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies and organizations. These activities and resources are highlighted in the Mitigation Strategy (Chapter 4).

Earthquake

Significant Changes Since Previous Plan:

The Earthquake Hazard section has been reformatted and expanded with additional information since the previous plan.

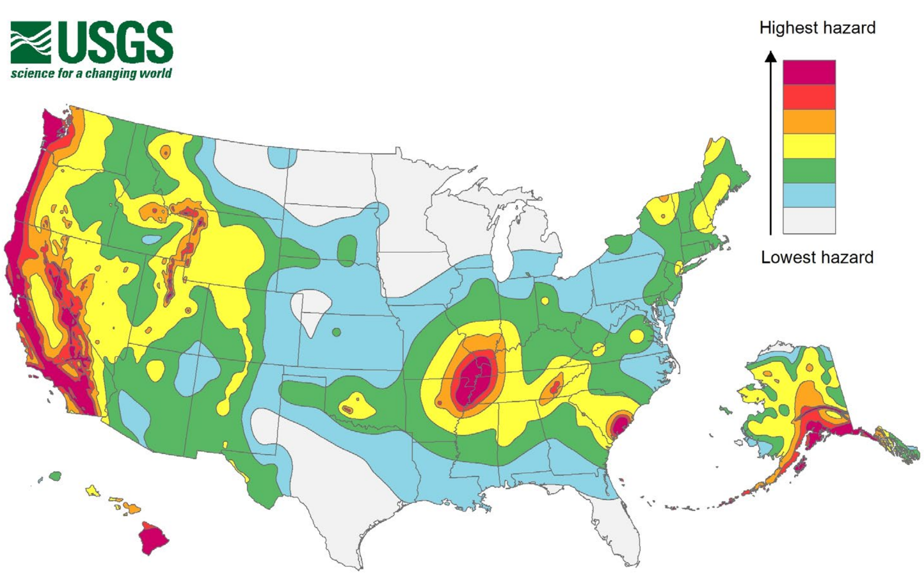
Causes and Characteristics

Earthquakes occur in Oregon every day; every few years an earthquake is large enough for people to feel; and every few decades there is an earthquake that causes damage. Each year, the Pacific Northwest Seismic Network locates more than 1,000 earthquakes greater than magnitude 1.0 in Washington and Oregon. Of these, approximately two dozen are large enough to feel. These noticeable events offer a subtle reminder that the Pacific Northwest is an earthquake-prone region.

Seismic hazards pose a real and serious threat to many communities in Oregon, including La Grande, requiring local governments, planners, and engineers to consider their community's safety. Currently, no reliable scientific means exists to predict earthquakes. Identifying seismic-prone locations, adopting strong policies and implementing measures, and using other mitigation techniques are essential to reducing risk from seismic hazards in Union County, including La Grande.

Although the relative hazard for earthquake in coastal Oregon is very high, the relative risk in northeastern Oregon, including La Grande is low as is shown by the USGS map of seismic hazard in Figure 3-17. The active faults and predicted shaking in La Grande and vicinity are shown in Figure 3-18.

Figure 3-17. USGS National Seismic Hazard Map



Source: U.S. Geological Survey

Types of Earthquakes

Oregon and the Pacific Northwest in general are susceptible to earthquakes from four sources: 1) shallow crustal fault – slippage events within the North American Plate; 2) deep intra-plate events within the subducting Juan de Fuca Plate; 3) the off-shore Cascadia Subduction Zone (CSZ); and 4) earthquakes associated with renewed volcanic activity. The first three identified are discussed below under Identifying Earthquakes.

Northeast Oregon contains high mountains and broad inter-mountain valleys. Although there is abundant evidence of crustal faulting, seismic activity is low when compared with other areas of the state. There are a few identified faults in the region that have been active in the last 20,000 years. The region has been shaken historically by crustal earthquakes and prehistorically by subduction zone earthquakes centered outside the area. All considered, there is good reason to believe that the most devastating future earthquakes would probably originate along shallow crustal faults in the region. Furthermore, the geographic position of this region also makes it susceptible to earthquakes from volcanic events.

While all three types of earthquakes have the potential to cause major damage, subduction zone earthquakes pose the greatest danger. A major CSZ event could generate an earthquake with a magnitude of 9.0 or greater resulting in devastating damage and loss of life. Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes. According to DOGAMI's *Geology of the Upper Grande Ronde River Basin, Union County, Oregon*, "Hazard studies indicate that the West Grande Ronde Valley fault zone is capable of generating a maximum credible earthquake of magnitude 7 (Simpson and others, 1993)." (Ferns et al., 2006)

Earthquake-induced Hazards

The severity of an earthquake is dependent upon several factors including: 1) the distance from the earthquake's source (or epicenter); 2) the ability of the soil and rock to conduct the earthquake's seismic energy; 3) the degree (i.e., angle) of slope materials; 4) the composition of slope materials; 5) the magnitude of the earthquake; and 6) the type of earthquake.

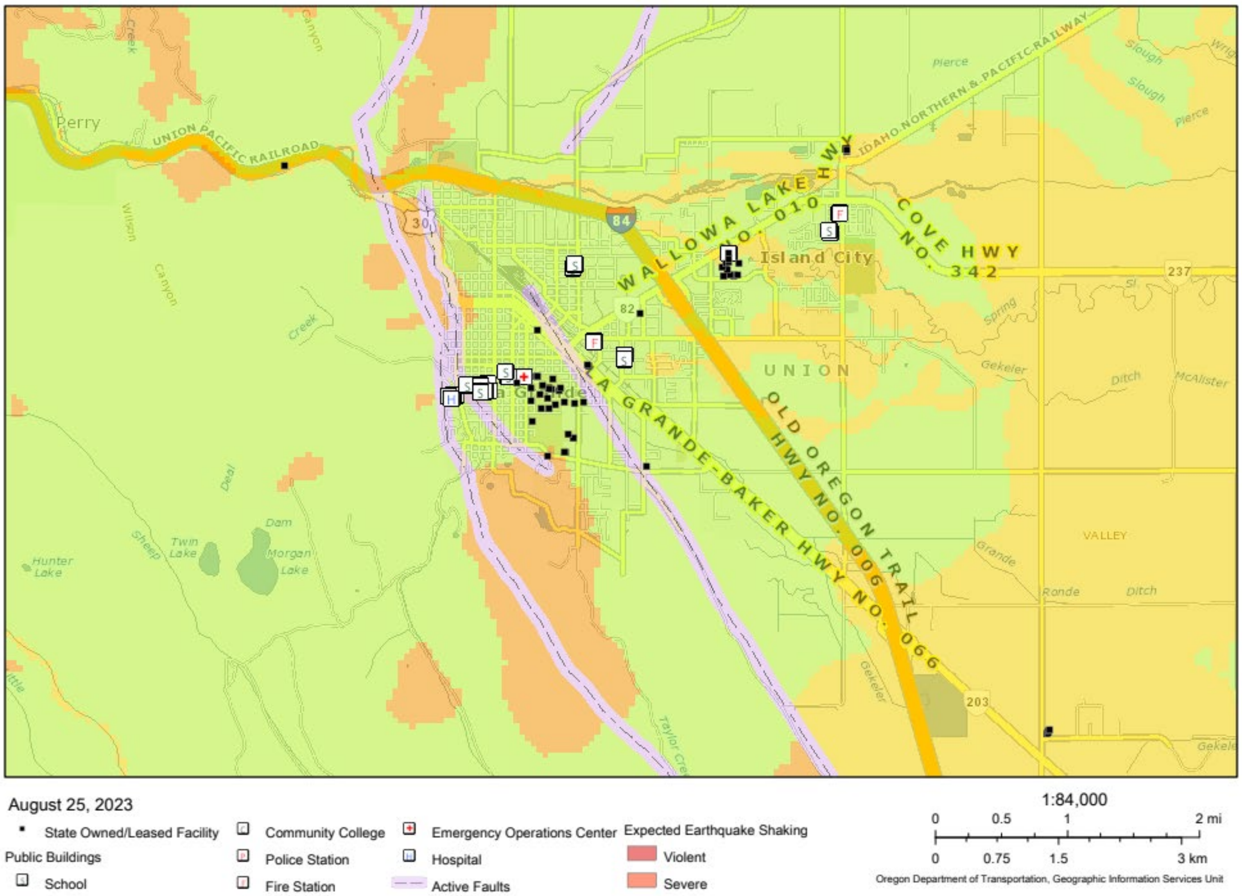
In addition to the direct effects of earthquake, there are also secondary and tertiary effects including interruption in utilities, interruption in supply chains and long-term economic impacts related to the breakdown of traditional transportation routes for Union County's natural resource-based economy. Union County may survive the direct effects of a Cascadia Subduction Zone event relatively unscathed but may have significant secondary and tertiary effects.

The following are earthquake-induced hazards:

Ground Shaking: Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. Ground shaking is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault that is slipping, and distance from the epicenter (where the earthquake originates). Buildings on poorly consolidated and thick soils will typically see more damage than buildings on consolidated soils and bedrock. The amount of damage sustained by a building during a strong earthquake is difficult to predict and depends on the size, type and location of the earthquake, the characteristics of the soils at the building site, and the characteristics of the building itself, according to DOGAMI's Earthquakes in Oregon site.

Figure 3-18 shows the expected shaking/damage potential for La Grande and surrounding area resulting from an earthquake event. The figure shows that the city will experience “moderate,” “very strong” and “severe” shaking that will last two to four minutes. The very strong and severe shaking will be extremely damaging to lifeline transportation routes including Interstate 84 and highway 30.

Figure 3-18. Active Faults and Expected Earthquake Shaking, La Grande, Oregon



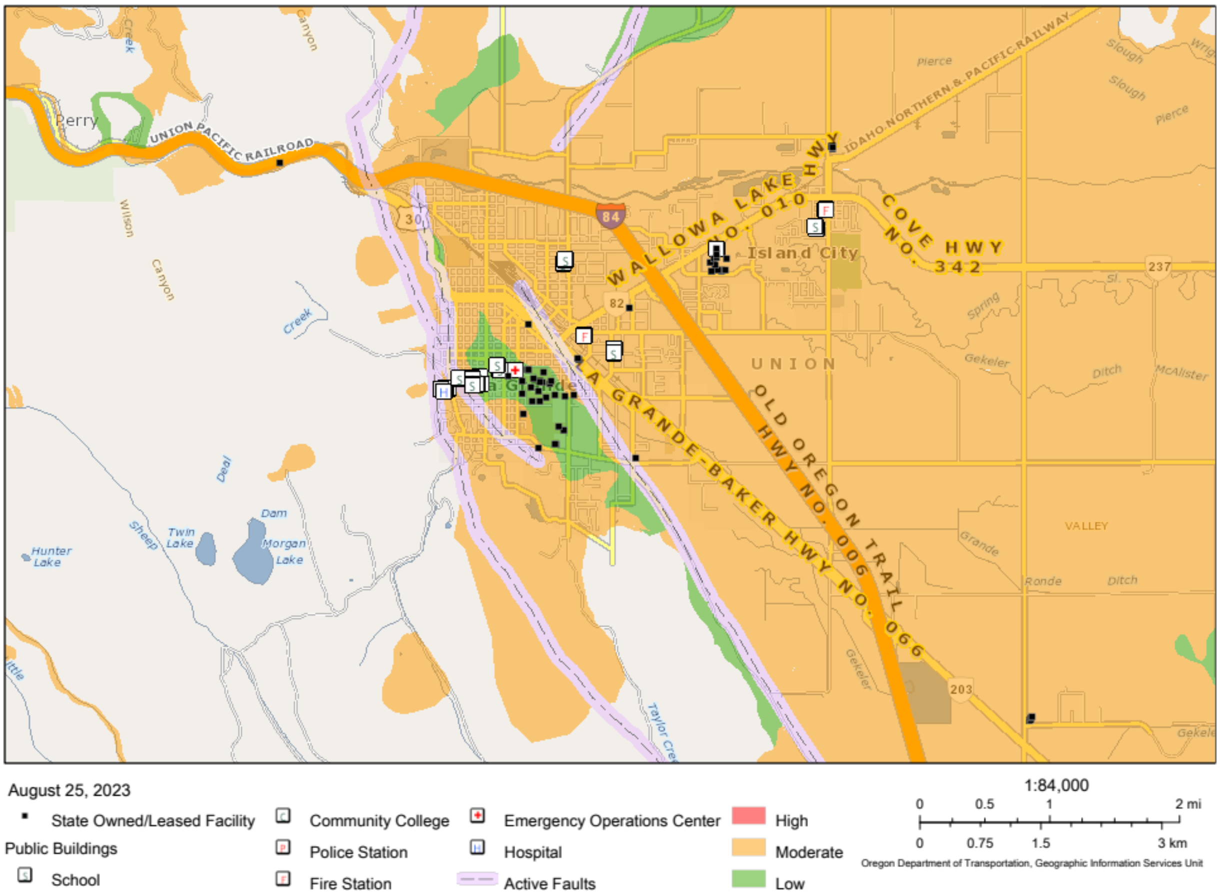
Source: Oregon Department of Geology and Mineral Industries, Oregon HazVu: Statewide Geohazards Viewer
Note: Map not to scale

Ground Shaking Amplification: Ground shaking amplification refers to the soils and soft sedimentary rocks near the surface that can modify ground shaking from an earthquake. Such factors can increase or decrease the amplification (i.e., strength) as well as the frequency of the shaking. The thickness of the geologic materials and their physical properties determine how much amplification will occur. Ground motion amplification increases the risk for buildings and structures built on soft and unconsolidated soils.

Surface Faulting: Surface faults are planes or surfaces in Earth materials along which failure occurs. Such faults can be found deep within the earth or on the surface. Earthquakes occurring from deep lying faults usually create only ground shaking.

Liquefaction and Subsidence: Liquefaction occurs when ground shaking causes wet, granular soils to change from a solid state into a liquid state. This results in the loss of soil strength and the soil’s ability to support weight. When the ground can no longer support buildings and structures (subsidence), buildings and their occupants are at risk. Figure 3-19 below shows the expected liquefaction in La Grande and surrounding area.

Figure 3-19. Expected Earthquake Liquefaction (Soft Soils) Hazard, La Grande, Oregon

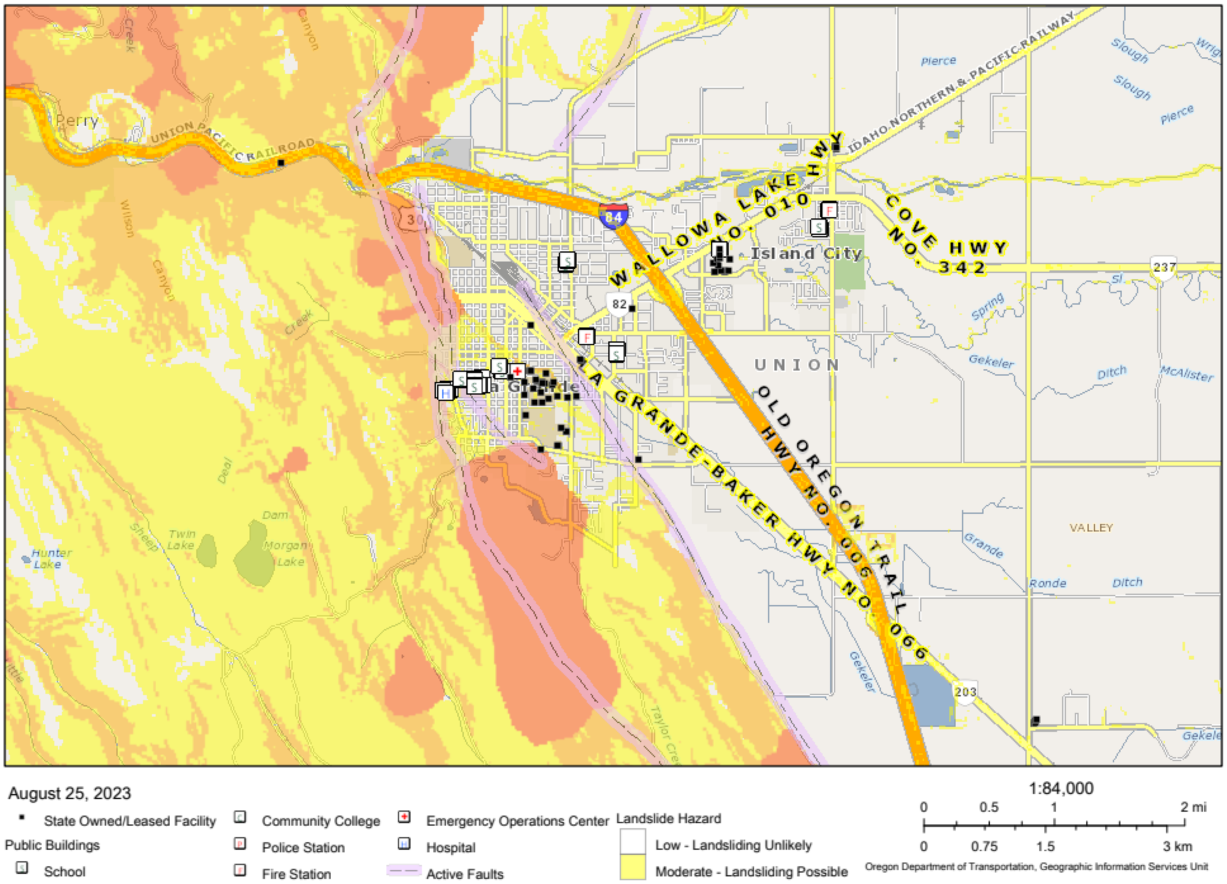


Source: Oregon Department of Geology and Mineral Industries, Oregon HazVu: Statewide Geohazards Viewer
Note: Map not to scale

Earthquake-Induced Landslides and Rockfalls: Earthquake-induced landslides are secondary hazards that occur from ground shaking and can destroy roads, buildings, utilities and critical facilities necessary to recovery efforts after an earthquake. These areas often have a higher risk of landslides and rockfalls triggered by earthquakes.

The following Figure 3-20 shows the landslide hazard areas in the La Grande area.

Figure 3-20. Landslide Hazard, La Grande, Oregon



Source: Oregon Department of Geology and Mineral Industries, Oregon HazVu: Statewide Geohazards Viewer
Note: Map not to scale

The La Grande NHMP Steering Committee decided not to include landslide as an identified hazard. However, understanding the location of existing and potential landslides in the area will better prepare the community if there is an earthquake-induced landslide or rockslide. The *2013 La Grande Comprehensive Plan* addresses the known potential landslide hazard areas located in the west and south portions of the city. Several studies were conducted in this area including *Engineering Geology of the La Grande Area* by DOGAMI in 1971 and S*oil and Hydrologic Properties and Processes Affecting the Stability of Hillslopes in the La Grande Area and the Potential for Residential Development* a city-initiated study in 1983. Through these studies it allowed the city to fully understand and plan for or exclude development in these areas. La Grande uses the latter study as a supporting document to which their Comprehensive Plan states,

> This report identifies the natural and man made influences upon the landslide hazard area which must be considered in reviewing alternatives for development. This report, in conjunction with the Geological Hazard Overlay Zone identified in the Zoning Ordinance, will be implemented when development is proposed in the hazardous areas identified by the Natural Hazard Map and within the La Grande UGB.

Since the adoption of the Comprehensive Plan in December, 1983, when the original response to Goal 7, Natural Hazards, was drafted, the City has experienced increased hillside residential development. This hillside development, although subject to the Geohazard Site Review process, has produced increased downstream flooding, increased erosion due to removal of natural ground vegetation and cutting slopes, and damage to public improvements from increased storm water velocities. The national Clean Water Act National Pollution Discharge Elimination System (NPDES) regulations have increased local requirements for erosion and sedimentation controls. These changes in conditions and regulations have prompted the City to consider a Hillside Development Ordinance to add further standards to residential development on slopes of 25% or greater.

Location and Extent

Because an earthquake can affect a wide area, it is unlike other hazards in this report — every building in the City of La Grande would be affected by it.

La Grande which lies near the Grande Ronde Valley Fault Zone. DOGAMI's HazVu hazard mapping tool shows the faults in the central and western parts of the city (Figure 3-20). In the Upper Grande Ronde River basin, the seismic hazards in the area primarily include the West Grande Ronde Valley fault zone, the East Grande Ronde Valley fault zone, and the Little Creek fault (Fern et al., 2006). According to DOGAMI's *Geology of the Upper Grande Ronde River Basin, Union County, Oregon*, "Hazard studies indicate that the West Grande Ronde Valley fault zone is capable of generating a maximum credible earthquake of magnitude 7 (Simpson and others, 1993)." (Ferns et al., 2006)

The likely shaking is most extreme adjacent to these faults where there are soils that may lose bearing capacity during an earthquake. Figure 3-18 above shows modeled expected shaking from a magnitude 7 earthquake that has a 2% in 50-year probability of occurring. The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event.

DOGAMI, in partnership with other state and federal agencies, has undertaken a rigorous program in Oregon to identify seismic hazards, including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. Several seismic hazard maps have been published and are available for communities to use. The maps show ground motion amplification (Figure 3-18), liquefaction (Figure 3-19), landslide susceptibility, and relative earthquake hazards. The DOGAMI Statewide Geohazards Viewer was used to present a visual map of recent earthquake activity, active faults, and liquefaction; ground shaking is generally expected to be higher in the areas marked by soft soils in the map above. The severity of an earthquake is dependent upon several factors including the distance from the earthquake's source (or epicenter), the ability of the soil and rock to conduct the earthquake's seismic energy, the degree (i.e., angle) of slope materials, the composition of slope materials, the magnitude of the earthquake, and the type of earthquake.

For more information, see the following reports:

Open-File Report: O-71-03, *Engineering geology of La Grande Area, Union County, Oregon*, 1971

Open-File Report: O-2002-02, *Geology of the surface and subsurface of the southern Grande Ronde Valley and Lower Catherine Creek drainage, Union County, Oregon*, 2001

Open-File Report: O-2003-02, *Map of Selected earthquakes for Oregon* (1841-2002), 2003

Open-File Report: O-2006-19, *Geology of the upper Grande Ronde River basin, Union County, Oregon*, 2006

Open-File Report: O-2007-02, *Statewide seismic needs assessment: Implementation of Oregon 2005 Senate Bill 2 relating to public safety, earthquakes, and seismic rehabilitation of public buildings*, 2007

Open-File Report: O-2013-22, *Cascadia Subduction Zone earthquakes: A magnitude 9.0 earthquake scenario*, 2013

Special Papers: SP-29, *Earthquake damage in Oregon Preliminary estimates of future earthquake losses* (1999)

Special Papers: SP-6, *Geology of the La Grande Area, Oregon*, 1980

Additional reports are available via DOGAMI's Publications Center website: https://www.oregon.gov/dogami/pubs

Oregon Seismic Safety Policy Advisory Commission Reports: *The Oregon Resilience Plan* (2013)

Identifying Earthquakes

Oregon Department of Geology and Mineral Industries, in partnership with other state and federal agencies, has undertaken a rigorous program in Oregon to identify seismic hazards, including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides.

The Modified Mercalli intensity scale measures the effects of an earthquake at a given location. Magnitude scales measure the inherent force or strength of an earthquake – an event occurring at greater or lesser depth. This is in contrast with the seismic magnitude usually reported for an earthquake. Seismic magnitude scales are used to describe the overall strength or "size" of an earthquake. These are distinguished from seismic intensity scales that categorize the intensity or severity of ground shaking caused by an earthquake at a given location. (Wikipedia, 2023)

Most large earthquakes in the Pacific Northwest are shallow crustal, deep intraplate, or subduction zone earthquakes. These earthquakes can have a great impact on Oregon communities. The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event.

Crustal Fault Earthquakes: According to OEM's *Cascadia Playbook* (2018). Crustal fault earthquakes are the most common and occur at relatively shallow depths of 6-12 miles below the surface. While most crustal fault earthquakes are smaller than magnitude 4.0 and generally create little or no damage, some can produce earthquakes of magnitude 7.0 and higher and cause extensive damage. Crustal earthquakes within the North American plate are possible on faults mapped as active or potentially active as well as on unmapped (unknown) faults.

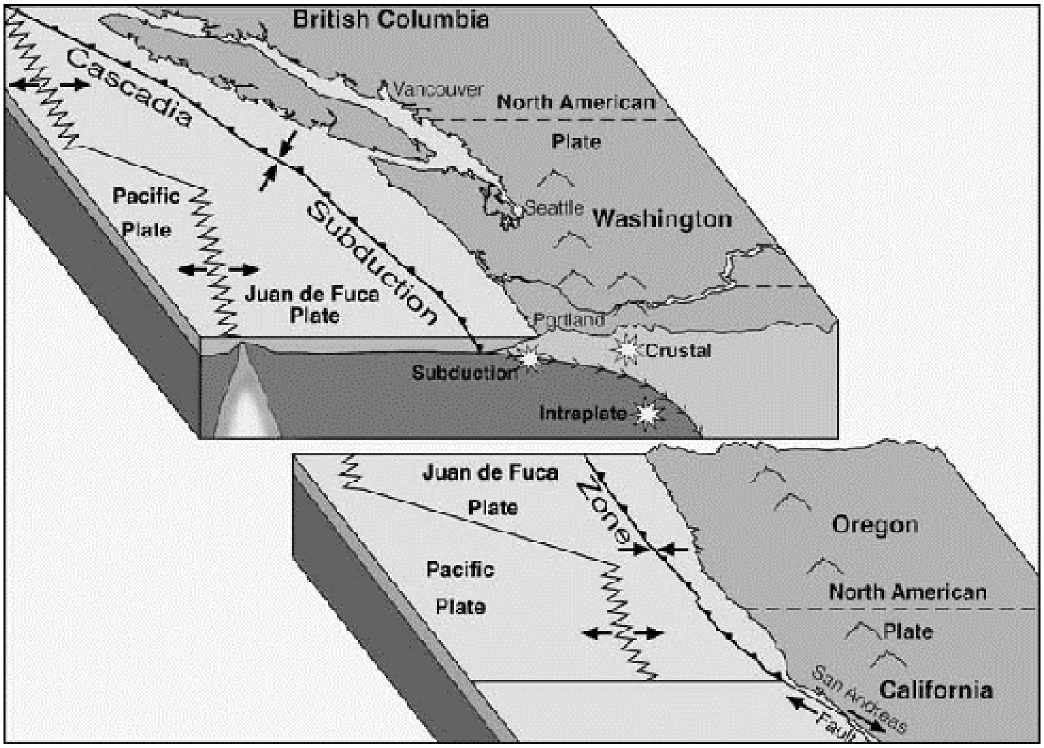
Deep Intraplate Earthquakes: Occurring at depths from approximately 30 – 37 miles below the earth's surface in the subducting oceanic crust, deep intraplate earthquakes can reach magnitude 7.5, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. This type of earthquake is more common in the Puget Sound of Washington. In Oregon these earthquakes occur at lower rates, and none have occurred at a damaging magnitude, according to the 2020 Oregon NHMP. The February 28, 2001, earthquake in Washington State was a deep intraplate earthquake. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah (Hill, 2002). A 1965 magnitude 6.5 intraplate earthquake centered south of the Seattle-Tacoma International Airport caused seven deaths (Hill, 2002).

Subduction Zone Earthquakes: The Pacific Northwest is located at a convergent plate boundary where the Juan de Fuca and North American tectonic plates meet. The two plates are converging at a rate of about 1.5 inches per year. This boundary is called the Cascadia Subduction Zone (CSZ) and is illustrated in Figure 20. The CSZ extends from British Columbia to northern California. Subduction zone earthquakes are caused by the abrupt release of slowly accumulated stress. Subduction zones like the Cascadia Subduction Zone have produced earthquakes with magnitudes 8.0 or greater. Historic subduction zone earthquakes include the 1960 Chile (magnitude 9.5) and the 1964 southern Alaska (magnitude 9.2) earthquakes. Geologic evidence shows that the Cascadia Subduction Zone has generated great earthquakes, most recently about 300 years ago. The largest is generally accepted to have been magnitude 9.0 or greater. According to Oregon State University (2016) research[9], the subduction zone earthquakes off Oregon and Washington more frequent than previously estimated. They state,

> A section of the zone from Newport to Astoria, Oregon, was previously believed to rupture on average about every 400-500 years, and that average has now been reduced to 350 years. A section further north from Astoria to Vancouver Island was previously believed to rupture about every 500-530 years, and that average has now been reduced to 430 years… The southern portions of the subduction zone south of Newport, Oregon, tend to rupture more frequently - an average of about every 300-380 years from Newport to Coos Bay, and 220-240 years from Coos Bay to Eureka, California.
>
> Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes.
>
> While all three types of earthquakes have the potential to cause major damage, subduction zone earthquakes pose the greatest danger. A major CSZ event could generate an earthquake with a magnitude of 9.0 or greater resulting in devastating damage and loss of life. Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon.

[9] The work was done by researchers from Oregon State University, Camosun College in British Columbia and Instituto Andaluz de Ciencias de la Tierra in Spain. The findings were published in the journal, Marine Geology.

Figure 3-21. Cascadia Subduction Zone



Source: Oregon Department of Land Conservation and Development

History

All of Oregon west of the Cascades is at risk from the three earthquake types and associated hazards. East of the Cascades the earthquake hazard is predominately of the crustal type. The amount of earthquake damage at any place will depend on its distance from the epicenter, local soil conditions, and types of construction. Due to Oregon's relatively short written history and the infrequent occurrence of severe earthquakes, few Oregon earthquakes have been recorded in writing. Moreover, in the past century, there has been no reported damage or injuries in the Northeast Oregon region due to earthquakes. However, several significant earthquake events have occurred in southeastern Washington in the past 150 years. Details concerning these events are highlighted below.

The Northeast Oregon region has been historically shaken by crustal and intraplate earthquakes centered on the area. However, even fewer earthquakes have caused structural damage to buildings. In the last 42 years, the region around Northeast Oregon has been affected by several earthquakes of estimated magnitudes of three and greater. Table 3-6 shows the approximate location of selected Northeast Oregon region earthquakes since 1900. This data relies on the Pacific Northwest Seismic Networks database. Among the three earthquakes whose magnitudes exceeded four, none of them had epicenters in any of the Northeast Oregon counties.

Table 3-6. Significant Earthquakes Affecting Region 7

Date	Location	Magnitude	Remarks
Approximate Years: 1400 BCE*, 1050 BCE, 600 BCE, 400, 750, 900	offshore, Cascadia Subduction Zone	probably 8-9	these are the mid-points of the age ranges for these six events
Jan. 1700	offshore, Cascadia Subduction Zone	about 9.0	generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast
Oct. 1913	Hells Canyon, Oregon	VI	damage unknown
Apr. 1927	Pine Valley-Cuddy Mountain, Oregon	V	damage unknown
June 1942	Pine Valley-Cuddy Mountain, Oregon	V	damage minor
Aug. 1965	John Day, Oregon	4.4	damage unknown
Nov. 1965	Halfway, Oregon	4.3	damage unknown
Dec. 1966	Halfway, Oregon	4.2	damage unknown
Mar. 1999	Joseph, Oregon	3.0	Damage unknown
Nov. 2014	Joseph, Oregon	3.1	Damage unknown
Jan. 2015	Pendleton, Oregon	3.7	Damage unknown

*BCE: Before Common Era.

Sources: University of Washington. List of Magnitude 4.0 or Larger Earthquakes in Washington and Oregon 1872-2002; Wong & Bott (1995); Pacific Northwest Seismic Network, https://pnsn.org/

Future Climate Variability

Future climate variability does not affect the community's earthquake risk.

Probability Assessment

The *2020 Oregon NHMP* Risk Assessment for Region 7 concluded that the probability of damaging earthquakes varies widely across the state. In Region 7, the hazard is dominated by local faults and background seismicity. DOGAMI has developed a new probability ranking for Oregon counties that is based on the average probability of experiencing damaging shaking during the next 100 years, modified in some cases by the presence of newly discovered lidar faults. In this ranking Union County, which La Grande resides in, is estimated to have a 10 to 20% chance of experiencing damaging shaking during the next 100 years.

Based on the available data and research for La Grande, the NHMP Steering Committee determined the **probability of experiencing an earthquake is "moderate,"** meaning one incident is likely within the next 35-75 years.

Vulnerability Assessment

The effects of earthquakes span a large area. The degree to which earthquakes are felt, however, and the damage associated with them may vary. Earthquake damage occurs because humans have built structures that cannot withstand severe shaking. Buildings, airports, schools, and lifelines (highways, phone lines, gas, water, etc.) suffer damage in earthquakes and can ultimately result in death or injury to humans. According to the *2020 Oregon NHMP*, “Region 7 is considered moderately vulnerable to earthquake hazards due to earthquake-induced landslides, liquefaction, and ground shaking.”

Based on the combination of local faults in the region, potential slope instability, and prevalence of certain soils subject to liquefaction and amplification give the city a low-risk profile. Due to the expected pattern of damage resulting from a CSZ event, *The Oregon Resilience Plan* (2013) divides the state into four distinct zones and places La Grande predominately within the “Eastern Zone” (also referred to as “Central/Eastern Zone”) that spans from the summit of the Cascade Range east to the state border. Within the Eastern Zone, shaking will be mild, landslides and liquefaction sporadic, and damage generally light. The mild to moderate impacts would allow rapid restoration of services and functions, and where communities would become critical hubs for the movement of response recovery and restoration personnel and materials for the rest of the state.

Death and Injury

Earthquakes in the past caused no injuries to the health and safety of residents. However, the potential for injuries or deaths from past events or from similar events in other communities could escalate resulting in multiple deaths and major injuries. Death and injury can occur both inside and outside of buildings due to falling equipment, furniture, debris, and structural materials. Likewise, downed power lines or broken water and gas lines endanger human life. Death and injury are highest in the afternoon when damage occurs to commercial and residential buildings and during the evening hours in residential settings (LeDuc et al, 2000). It is estimated that over 10% of the city’s population would be affected by an earthquake, accounting for the potential of homes that would be damaged from seismic activity, and there would be extensive impact on community social networks.

Building Damage

Wood structures tend to withstand earthquakes better than structures made of brick or unreinforced masonry buildings (Wolfe et al., 1986). Building construction and design play a vital role in the survival of a structure during earthquakes. Damage can be quite severe if structures are not designed with seismic reinforcements or if structures are located atop soils that liquefy or amplify shaking. Whole buildings can collapse or be displaced. Most facilities throughout the city anticipate moderate damage due to an earthquake, estimated at more than $1 million for hazard response, structural repairs and equipment replacement.

Development Change

Changes to development patterns in La Grande’s Hillside Development Zone of La Grande have the potential to incur increased risk. The Hillside Development Zone’s purpose is to reduce development in areas with a slope greater than or equal to 25%, or in hillside areas where there has been a history of slope failure and designated as Geological Hazard areas in the La Grande Comprehensive Plan. La Grande has not experienced much change in this area since the *2014 Northeast Oregon Regional NHMP*, except for the Grande Ronde Hospital expansion, which is in a geologic hazard area. Additional information is below in the Mitigation Activities and Resources section.

Bridge Damage

Earthquake damage to roads and bridges can be particularly serious by hampering or cutting off the movement of people and goods and disrupting the provision of emergency response services. All bridges can sustain damage during earthquakes, leaving them unsafe for use. More rarely, some bridges have failed completely due to strong ground motion. Bridges are a vital transportation link – damage to them can make some areas inaccessible.

Because bridges vary in size, materials, siting, and design, earthquakes will affect each bridge differently. Bridges built before the mid 1970's often do not have proper seismic reinforcements. These bridges have a significantly higher risk of suffering structural damage during a moderate to large earthquake. Bridges built in the 1980's and after are more likely to have the structural components necessary to withstand a large earthquake (LeDuc et al., 2000).

Damage to Lifelines

Lifelines are the connections between communities and critical services. They include water and sewer lines, food suppliers, electricity and gas lines, communications, and transportation systems. Ground shaking and amplification can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio or telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after an earthquake to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public (LeDuc et al., 2000).

The following was provided in the *2020 Oregon NHMP* for Region 7,

> According to the Oregon Department of Transportation's (ODOT) Oregon Seismic Lifeline Report (OSLR; see Appendix 9.1.16), the projected impacts of a CSZ event are considered negligible in this part of the state. Therefore, this region was not part of the OSLR study. However, ODOT did provide the following descriptions of general impacts a CSZ would have on Region 8's seismic lifelines, and the region's overall vulnerability.
>
> REGIONAL IMPACT. Within this region, adverse impacts from the CSZ event and secondary hazards (landslides, liquefaction, etc.) are not anticipated, but damage to I-84 to the west and damage to the Columbia River's freight functions could impact the region's economy.
>
> REGIONAL LOSS ESTIMATES. Losses in this region are expected to be nonexistent to low locally. Economic disruption from major losses in the larger markets of the state will affect the economy in this region.
>
> MOST VULNERABLE JURISDICTIONS. The vulnerability of this whole region to a CSZ event is low. Loss of life, property, and business are not expected to be issues in this area. However, impacts to import and export infrastructure and basic supply lines could have short- to mid-term economic impacts. With an intact surface transportation system to the east, adaptation is expected to be relatively easy.

Disruption of Critical Facilities

Critical facilities, also considered community lifelines, are police stations, fire stations, hospitals, other medical and social services, food and water suppliers, and shelters. These are facilities that provide services to the community and need to be functional after an earthquake event. The earthquake effects outlined above can all cause emergency response to be disrupted after a significant event (Wang & Clark, 1999).

The *2020 Oregon NHMP* provided the following assessment for state-owned/leased buildings and critical facilities and local critical facilities for Region 7,

> For the 2020 vulnerability assessment, DOGAMI used Hazus-MH to estimate potential loss from a 2500-year probabilistic earthquake scenario in Region 7. The analysis incorporated information about the earthquake scenario (such as coseismic liquefaction and landslide potential), as well as building characteristics (including the seismic building code and building material). The results of the analyses are provided as a loss estimation (the building damage in dollars) and as a loss ratio (the loss estimation divided by the total value of the building) reported as a percentage at the county level.
>
> DOGAMI used the loss ratio to formulate a separate relative vulnerability score for the state buildings, state critical facilities, and local critical facilities data sets. The percentage of loss for each county was statistically distributed into 5 categories (Very Low, Low, Moderate, High, or Very High).
>
> In Region 7, a 2500-year probabilistic earthquake scenario could generate a potential loss of over $5M in state building and critical facility assets. Baker and Union Counties each contain about 40% of the value of those assets. The potential loss in local critical facilities is more than triple that amount, over $16.7M. Baker County again would suffer the greatest loss with 54% of the value of local critical facilities….

Economic Loss

Seismic activity can cause great loss to businesses, either a large-scale corporation or a small retail shop. Losses not only result in rebuilding cost, but fragile inventory and equipment can be destroyed. When a company is forced to stop production for just a day, business loss can be tremendous. Residents, businesses, and industry all suffer temporary loss of income when their source of finances is damaged or disrupted. A major earthquake can separate businesses and other employers from their employees, customers, and suppliers thereby further hurting the economy. It is likely more than 10% of businesses located in the city and surrounding area would experience commerce interruption for a period of a year or longer.

Fire

The community energy and communication lifelines, such as power lines, gas lines, and telecommunication facilities can be damaged by an earthquake. Downed power lines or broken gas mains can trigger fires. When fire stations suffer building or lifeline damage, quick response to quench fires is less likely.

Natural Resources

Earthquakes would have extensive impacts on more than 75% of the city's ecological systems, including clean water, wildlife habitat, and parks.

Historic Resources

According to the *2020 Oregon NHMP*, of the 1,246 historic resources in Region 7, only 6 are in an area of high or very high liquefaction potential, all of them in Grant County. However, 1,074 (86%) of Region 7's historic resources are in areas of high or very high potential for ground shaking amplification. Of these, approximately one-quarter is located in each county.

Archaeological Resources

In Region 7, the *2020 Oregon NHMP* notes that 6,810 archaeological resources are in earthquake hazard areas and eight are in an area of high earthquake hazards. Most archaeological resources in earthquake hazard areas in this region are in Grant County, followed by Baker and Wallowa.

Social Vulnerability

The CDC has calculated a social vulnerability index to assess community resilience to externalities such as natural hazard events. It employs fifteen social vulnerability factors and uses data from the US Census Bureau's American Community Survey. The index is reported in quintiles (1–5). Social vulnerability scores do not vary by hazard.

According to the CDC Social Vulnerability Index, Union County has low levels of social vulnerability. Vulnerability in Union County is driven by a higher poverty rate, the share of multi-unit structures, the percentage of people living in institutionalized group quarters, and the percentage of occupied housing units with more people than rooms (*2020 Oregon NHMP*)

Debris

After damage occurs to a variety of structures, much time is spent cleaning up brick, glass, wood, steel or concrete building elements, office and home contents, and other materials. Following an earthquake event, the cleanup of debris can be a challenge for the community.

Figure 3-18 and Figure 3-19 above show the expected shaking and liquefaction (soft soils) potential for La Grande resulting from an earthquake event. The figure shows that the city will experience moderate to severe shaking and moderate liquefaction that will last two to four minutes. The shaking and liquefaction will be damaging to lifeline transportation routes. For more information on expected losses due to a CSZ event see *The Oregon Resilience Plan* (2013).

The NHMP Steering Committee rated the city as having a **"high" vulnerability to an earthquake hazard**, meaning that more than 10% of the city's population or assets would be affected by a major earthquake emergency.

2007 Rapid Visual Survey

In 2007, DOGAMI completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon Legislature in Senate Bill 2 (2005). Rapid Visual

Survey is a technique used by FEMA, known as FEMA 154, to identify, inventory, and rank buildings that are potentially vulnerable to seismic events. DOGAMI surveyed a total of 3,349 buildings in the state, ranked each building with a 'low,' 'moderate,' 'high,' or 'very high' potential for collapse in the event of an earthquake. It is important to note that these rankings represent a probability of collapse based on limited observed and analytical data and are therefore approximate rankings. To fully assess a building's potential for collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to survey.

According to This 2007 DOGAMI report, Union County is considered to be in a "Moderate Seismicity Region" (Wang et al., 2007). Of the 54 schools and emergency response buildings surveyed in Union County, the collapse potential and associated number of buildings are as follows (*2020 Oregon NHMP*, Table 2-690):

- Low (< 1%): 10
- Moderate (>1%): 6
- High (>10%): 14
- Very High (100%): 24

The Union County schools and emergency response buildings that were evaluated in this report are listed in Table 3-7.

Table 3-7. Union County DOGAMI Building Collapse Potential Scores

Facility	Collapse Potential Level			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Cove School (6 Buildings)	XX		X	XXX
Elgin High School (2 Buildings)				XX
Stella Mayfield Elementary (3 Buildings)			X	XX
Imbler High School (4 Buildings)			X	XXX
Central Elementary (1 Buildings)			X	
Greenwood Elementary (2 Buildings)				XX
Island City Elementary (2 Buildings)		X	X	
La Grande High School (5 Buildings)	X		X	XXX
La Grande Middle School (2 Buildings)		X	X	
Willow Elementary School (3 Buildings)			X	XX
Powder Valley School (4 Buildings)			XX	XX
Union Elementary School		X	XX	
Union High School (2 Buildings)			X	X
Union City Police Dept (1 Building)			X	
Grande Ronde Hospital (4 Buildings)		X		XXX
La Grande 9-1-1 Center (1 Building)				X

Source: Wang et al., 2007

According to *2020 Oregon NHMP* (Table 2-691) and the 2007 RVS report, the following is the projected dollar losses in Union County, based on a magnitude 8.5 subduction event and 500-year model.

Economic Base in Thousands (1999): $1,237,000
Greatest Absolute Loss in Thousands (1999) from a (M) 8.5 CSZ Event: less than $1,000
Greatest Absolute Loss in Thousands (1999) from a 500-Year Event: $9,000[10]

Lastly, based on the 2007 RVS of educational and emergency facilities, the estimated losses in Union County associated with a 500-year model includes the following (*2020 Oregon NHMP*, Table 2-692):

Injuries: 1
Deaths: 0
Displaced households: 1
Operational the day after the quake
  Fire stations: N/A
  Police stations: N/A
  Bridges: N/A
Economic losses to[11]
  Highways: $1M
  Airports: $618,000
  Communications: $479,000
Debris generated (thousands of tons): 5

Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of a natural disaster, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies and organizations. These activities and resources are highlighted in the Mitigation Strategy (Chapter 4).

[10] Greatest Absolute Loss in Thousands for year 2023: $16,513.92 (www.usinflationcalculator.com/)

[11] Economic losses for year 2023 are the following: Highways $1.8M, Airports $1.1M, and Communications: $878,907 (www.usinflationcalculator.com/).

Flood

Significant Changes Since Previous Plan:

The Flood hazard section has been updated to include new history and additional information, including High Hazard Potential Dam information, since the last plan.

Causes and Characteristics

Flooding results when climate or weather patterns (e.g., rain and snowmelt) combined with geology and hydrology create water flows that exceed the carrying capacity of rivers, streams, channels, ditches, and other water courses. These factors, combined with ongoing development can create seasonal flooding conditions. In Oregon, flooding is most common from October through April when storms from the Pacific Ocean bring intense rainfall. Most of Oregon's destructive natural disasters have been floods (Taylor & Hannan, 1999).

Flooding can be aggravated when rain is accompanied by snowmelt and frozen ground; the spring cycle of melting snow is the most common source of flood in the region. Statewide, the most damaging floods have occurred during the winter months, when warm rains from tropical latitudes melt mountain snowpacks. Lesser flooding has been associated with ice jams, normal spring run-off, and summer thunderstorms. Heavily vegetated stream banks, low stream gradients (e.g., Grande Ronde Valley), and breeched dikes have contributed to past flooding at considerable economic cost. Union County where La Grande is located, has experienced flooding associated with low bridge clearances, over-topped irrigation ditches, and natural stream constrictions.

Types of Floods

The principal types of floods that occur in Union County and La Grande include riverine floods, local flash floods, shallow area floods, snowmelt floods and urban floods.

Riverine Flooding: Riverine floods occur when water levels in rivers and streams overflow their banks. Most communities located along such water bodies have the potential to experience this type of flooding after spring rains, heavy thunderstorms or rapid runoff from snow melt. Riverine floods can be slow or fast rising, but usually develop over a period of days. The danger of riverine flooding occurs during the winter months, with the onset of persistent, heavy rainfall, and during the spring, with melting of snow. La Grande is in the Upper Grande Ronde River Subbasin (Figure 3-12), which is the source of riverine flooding

Local Flash Floods: Summer thunderstorms are common throughout the region. During these events, normally dry gulches can quickly become raging torrents – a flash flood. Flash floods are most common to Northeast Oregon and pose a real threat to the Union County and La Grande. This is because summer temperatures are much higher east of the Cascades and thunderstorms are common during the summer months. Although flash flooding occurs throughout Oregon, local geology in the region can increase the impact of this hazard. Bedrock, composed mostly of igneous rocks, is exposed at the surface throughout much of the region. Consequently, runoff has increased significantly. Lower elevations surrounded by mountains in the Region, such as La Grande, receive barely 10 inches of precipitation annually. This is enough precipitation, however, to make flood events an annual occurrence. These flash floods typically occur in isolated areas, such as in canyons and other natural drainages. Flash flood events can also be caused by rapid spring snowmelt.

Shallow Area Floods: These floods are a special type of riverine flooding. FEMA defines a shallow area flood hazard as an area that is inundated by a 100-year flood with a flood depth between one to three feet. Such areas are generally flooded by low velocity sheet flows of water.

The 2013 *La Grande Comprehensive Plan* addresses three recognized natural hazards, including flooding. The plan states,

> The second known natural hazard is the flood plain and floodway areas within the UGB. Much of the existing City is built in the flood plain as designated by the U.S. Army Corps of Engineers. The majority of the flood plain within the UGB is designated Zone B subject to one foot or less of water in a 100-year flood. In order to regulate development within the flood plain area, the City has adopted the Flood Management Regulations as required by the Department of Housing and Urban Development and incorporated those provisions with the La Grande Zoning Ordinance.

Snowmelt Floods: Flooding throughout the region is most linked to the spring cycle of melting snow. The weather pattern that produces these floods occurs during the winter months and has come to be associated with La Nina events, a three-to-seven-year cycle of cool, wet weather. Brief, cool, moist weather conditions are followed by a system of warm, moist air from tropical latitudes. The intense warm air associated with this system quickly melts foothill and mountain snow. Above-freezing temperatures may occur well above pass levels (4,000-5,000 feet).

Urban Floods: Urban floods occur when there is an inundation of land in a built environment, particularly in densely populated areas. It happens when rainfall overwhelms the capacity of drainage systems. According to the Center for Neighborhood Technology's *The Prevalence and Cost of Urban Flooding* (2014), although sometimes triggered by events such as flash flooding or snowmelt, urban flooding is a condition, characterized by its repetitive and systemic impacts on communities, which can happen regardless of whether the affected community is located within designated floodplains or near any body of water.

As noted under the Earthquake hazard section, the *La Grande Comprehensive Plan* addresses the known potential landslide hazard areas located in the west and south portions of the city. Several studies were conducted in this area which allowed the city to fully understand and plan for or exclude development in such areas. Since the adoption of a prior edition of the comprehensive plan, the city experienced increased hillside development, which "produced increased downstream flooding, increased erosion due to removal of natural ground vegetation and cutting slopes, and damage to public improvements from increased storm water velocities." The city has a Hillside Development Zone that includes standards for residential development on slopes of 25% or greater.

Other Flood Hazards: Flood is one of the identified climate change metrics in OCCRI's analysis that is included in the *2020 Oregon NHMP* for the Northeast Oregon (Region 7). Region 7 includes Baker, Grant, Union, and Wallowa Counties. Flooding and landslides are projected to occur more frequently throughout eastern Oregon. According to the *2020 Oregon NHMP* for Region 7, it is very likely (>90%) that Oregon will experience an increase in the frequency of extreme precipitation events and extreme river flows (high confidence) that is more likely (>50%) to lead to an increase in the incidence and magnitude of damaging floods (low confidence). Because landslide risk depends on a variety of site-specific factors, it is more likely (>50%) that climate change, through increasing frequency of extreme precipitation events, will result in increased frequency of landslides.

The *Emergency Action Plan (EAP) Morgan Lake Dam* (2013) identifies potential impacted areas if the dam were to fail. These areas include La Grande and unincorporated areas of Union County. The inundation area includes highways, key roads, schools, downtown La Grande, houses, businesses, and other structures. Morgan Lake Dam is addressed below under the High Hazard Potential Dam section of the Flood Hazard.

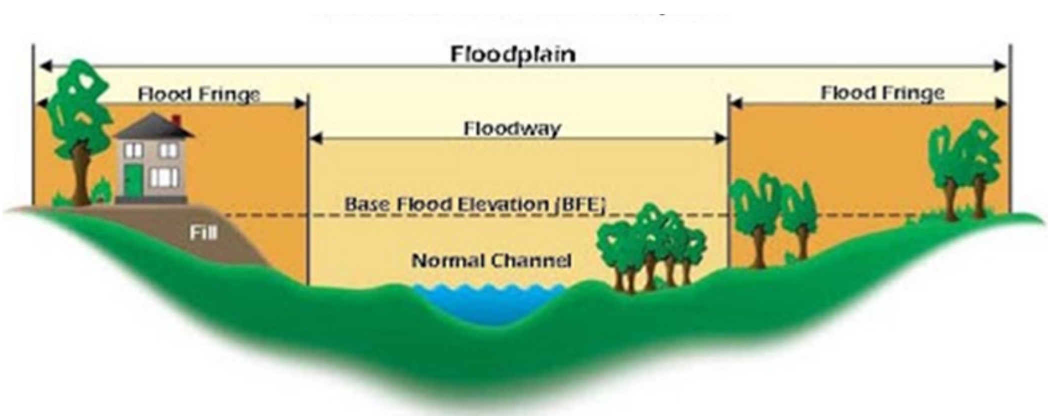
Flood Terminology

The following terms are provided for reference.

Floodplain: A floodplain is land 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 floodwater. The floodplain is made up of two areas: the flood fringe and the floodway.

Floodway: The floodway is the portion of the floodplain that is closer to the river or stream. For the NFIP and regulatory purposes, floodways are defined as the channel of a river or stream, and the over-bank areas adjacent to the channel. Unlike floodplains, floodways do not reflect a recognizable geologic feature. The floodway carries the bulk of the floodwater downstream and is usually the area where water velocities and forces are the greatest. The NFIP regulations require that the floodway be kept open and free from development or other structures, so that flood flows are not obstructed or diverted onto other properties. The NFIP floodway definition 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….” Floodways are not mapped for all rivers and streams but are typically mapped in developed areas.

Figure 3-22. Special Flood Hazard Area Schematic



Source: Oregon Department of Geology and Mineral Industries

Flood Fringe: The flood fringe refers to the outer portions of the floodplain, beginning at the edge of the floodway and continuing outward. This is the area where development is most likely to occur, and where precautions to protect life and property need to be taken.

Base Flood Elevation: Base Flood Elevation (BFE) means the water surface elevation during the base flood in relation to a specified datum or benchmark. The BFE is a baseline pulled together from historic weather data, local topography, and the best science available at the time. It's a reasonable standard to insure against, but it is not a guarantee that it will flood only one time every 100 years.

Location and Extent

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies often use historical records, such as streamflow gages, to determine the probability of occurrence for floods of different magnitudes. The probability of occurrence is expressed in percentages as the chance of a flood of a specific extent occurring in any given year.

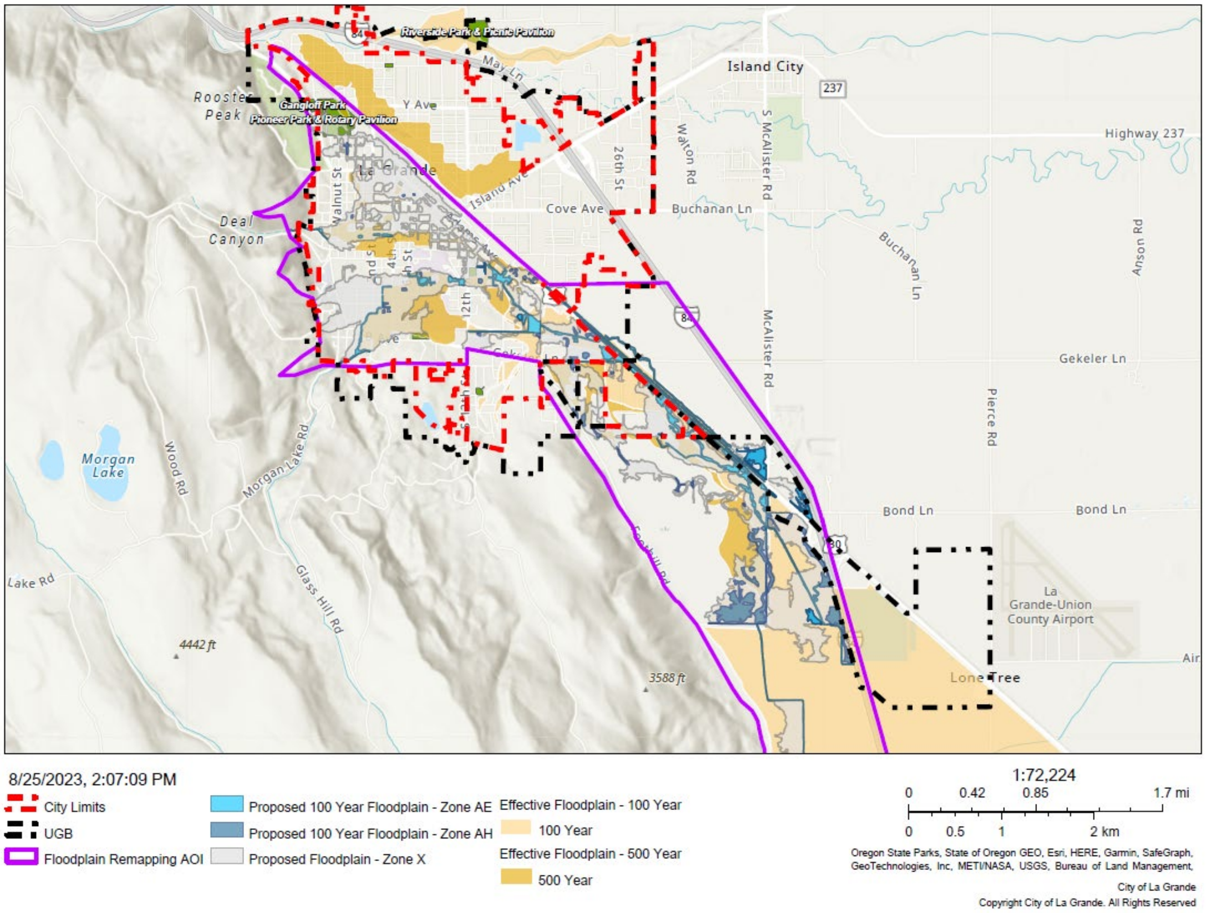
The magnitude of flood used as the standard for floodplain management in the United States is a flood having a probability of occurrence of 1% in any given year. This flood is also known as the 100-year flood or base flood. The most readily available source of information regarding the 100-year flood is the system of Flood Insurance Rate Maps (FIRM) prepared by FEMA. These maps are used to support the National Flood Insurance Program (NFIP). The FIRMs show 100-year floodplain boundaries for identified flood hazards. These areas are also referred to as Special Flood Hazard Areas (SFHAs) and are the basis for flood insurance and floodplain management requirements.

The 2013 *La Grande Comprehensive Plan* indicates that much of the existing city is built on flood plain (U.S. Army Corp of Engineers designated areas). Further, previous hillside development within the known potential landslide hazard areas have contributed to increase flooding in the city. La Grande has flood management and hillside development regulations.

The principal flood sources in Union County include Grande Ronde River, Catherine Creek, North Powder River, Little Creek, Gekeler Slough, Taylor Creek, Fresno Creek, Clark Creek, Indian Creek, and Wolf Creek. Further, Deal Creek, Mill Creek, Taylor Creek, and Gekeler Slough are flooding sources within the city limits of La Grande. The primary flooding sources for La Grande detailed in the Union County Flood Insurance Study (1988) include Old Settler's Slough and the Powder River.

The City of La Grande is currently working to update flood plain maps in the city, with an intention to identify and define the 100-year regulatory floodplain boundaries using modern technology, such as Lidar data and 3D modeling more accurately. Figure 3-23 illustrates the existing and proposed floodplain in La Grande and surrounding areas.

Figure 3-23. Existing and Proposed Floodplain, La Grande, Oregon



Source: City of La Grande Interactive ArcGIS Floodplain Map
Note: Map not to scale

Monitoring stream levels and rainfall in near real-time, which is done from several sites across Northeast Oregon region and throughout the Grande Ronde Watershed. The Grande Ronde River has a river gauge located northwest of the La Grande and can be electronically read on the National Weather Service's Northwest River Forecast Center website. The gauges also have the action stage, flood stage, moderate flood stage, and major flood stage on the chart so an individual can see immediately where the river is in reference to potential flooding. This gauge provides the city with up-to-date river levels that it can use to determine the immediate impact on the community. Using the seven-day forecast portion of the gauge provides the city the opportunity to plan for future impacts that flooding may have on specific portions of the city depending on river flood stages and city elevations.

Dam Failure and High Hazard Potential Dams

The Oregon Water Resources Department (OWRD) is the state authority for dam safety with specific authorizing laws and implementing regulations. Oregon's dam safety laws were rewritten in 2019. This law and new regulations both became operative on July 1, 2020. OWRD coordinates on but does not directly regulate the safety of dams owned by the United States or most dams used to generate hydropower. OWRD is the Oregon Emergency Response System contact in the event of a major emergency involving a state-regulated dam, or any dam in Oregon if the regulating agency is unknown. The Dam Safety Program also coordinates with the National Weather Service and the Oregon Department of Emergency Management on severe flood potential that could affect dams and other infrastructure. Oregon's statutory size threshold for dams to be regulated by OWRD is at least 10 feet high and storing at least 3 million gallons.

Under normal loading conditions dams are generally at very low risk of failure. Specific events are associated with most dam failures. Events that can cause dams to fail include:

- An extreme flood that exceeds spillway capacity and causes an earthen dam to fail;
- Extended 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.

Where a dam's failure is expected to result in loss of life downstream of the dam (a high hazard dam), an Emergency Action Plan (EAP) must be developed. The EAP contains a map showing the area that would potentially be inundated by floodwaters from the failed dam. These dams are often monitored so that conditions that pose a potential for dam failure are identified to allow for emergency evacuations.

According to the *2020 Oregon NHMP*, the state has records of at least 55 dam failures in Oregon. Many of these failures had very little or no impact on people, structures, or properties. Of these, 21 dams had more serious to tragic effects (Table 53, *2020 Oregon NHMP*) and included 16 east of the Cascade Range, 3 in southern and coastal Oregon (Jackson and Coos County), and 2 in the Willamette Valley region (Linn County and Marion County). A dam in Baker County about 40 miles from Morgan Lake failed in 1896 resulting in the deaths of an entire family of 7 people.

Oregon's new dam safety laws were developed considering the joint Association of State Dam Safety Officials and FEMA's Model State Dam Safety Program. Oregon uses the three recommended hazard ratings, High, Significant, and Low, and requires Emergency Action Plans for dams rated high hazard. The state has adopted these definitions (ORS 540.443–491) for state-regulated dams:

- "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.
- "Low Hazard" is assigned to all other state-regulated dams.
- "Emergency Action Plan" means 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.

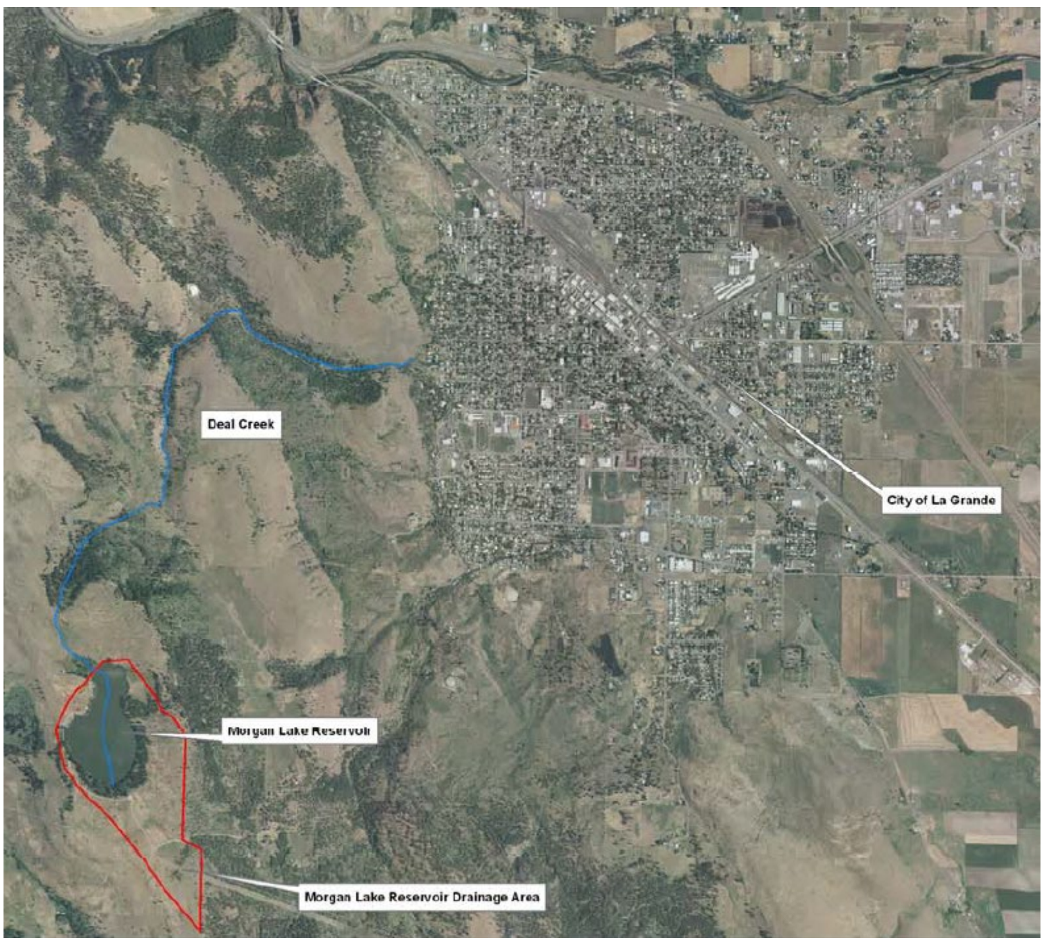
High Hazard Dam Affecting La Grande

There is one High Hazard Potential Dam – Morgan Lake Dam – regulated by Oregon that, if they were to fail, could impact La Grande. These types of dams, either within or proximity of city limits, are assigned a hazard rating based on downstream hazard to people and property, not on the condition of the dam. The following is a brief description of Morgan Lake Dam and auxiliary dam.

Morgan Lake Dam: There is only one High Hazard Potential Dam that, if it were to fail, would impact La Grande. The City of La Grande owns Morgan Lake dam. The La Grande Parks and Recreation Department, the Public Works Director and the City Manager have all met and coordinated with OWRD dam safety program on all aspects related to safety of and risks posed by Morgan Lake dam. The main dam and a small auxiliary "saddle" dam form Morgan Lake. The main dam is rated high hazard and is Morgan Lake dam, the auxiliary dam is not in the Deal Canyon basin and, if it were to breach, loss of life would be unlikely so is not a high hazard dam.

Dam Name	Morgan Lake	**NID**	OR00653	**File**	M-64
Type	Embankment	**Year Constructed**	c 1900	**Uses**	Recreation
Height	22 feet	**Normal Storage**	780 ac-ft		
Owner (public)	City of La Grande	**County**	Union		
PAR daytime	11,128 people	**PAR nighttime**	6,362 people		

Figure 3-24. Morgan Lake Dam Location



Source: City of La Grande Morgan Lake Dam EAP

Initial information on dam vulnerabilities: A Phase 1 inspection report from 1980 (detailed initial inspection) exists for this dam, but this report did not investigate the conduit condition, and had no evaluation of internal erosion risk. The dam was built in around 1900 for hydropower. The dam may be a puddle core fill dam. OWRD dam safety inspections have found the conduit may be made of clay and tin, it is not operable, and it is likely pressurized. Engineering consultant analysis including preliminary design work for an out of channel berm to divert potential dam breach flows from La Grande have been completed.

Condition Classification: POOR

PAR detail: The City of La Grande 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 La Grande. It is very possible that the flow will remove all debris from the canyon and have unusually high velocity. In 2008, a Dam Breach Analysis was completed for the dam. The results of the analysis indicated that if the dam were to fail, approximately 24,000 cubic feet per second of water would flow down Deal Canyon which enters La Grande on the south and flows through the city to the north. The resulting flood would cover the greater portion of LaGrande, placing over 10,000 residents at risk. 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 the highest water levels occur the very steep road to the dam has deep snow, is unplowed and is not accessed. The regional hospital, schools and Eastern Oregon University are near the canyon outlet. The average PAR of 8,745 is appropriate for the risk analysis of this dam as shown below. With the berm project the PAR is reduced to approximately 10, most of whom will have warning prior to inundation.

Information Sharing

The Oregon dam safety program and La Grande have the following plans and studies for this dam. Program staff meet with city staff every year for the annual dam inspections and have conducted meetings with the City Manager and Public Works Director on the dam's status. Most recently the dam safety program has funded development of the evaluation of a berm to divert a potential dam breach away from Deal Canyon, since the dam is located very close to a drainage divide.

Existing Plans and Studies

Dam Breach Inundation Analyses: Two analysis projects were completed for this dam. The first was completed in 2008 and uses the most current version of HEC-RAS available at that time. The second was completed in 2023 and re-evaluates the existing conditions failure breach flood and the breach flood if the berm were constructed. It used the current version of HEC-RAS. The output of the breach model is found in the HHPD Floodplain Management Pan described below.

Emergency Action Plan: The OWRD Dam Safety Program assisted La Grande in the development of an Emergency Action Plan (EAP) for the dam. The EAP was completed in 2013. An EAP table-top exercise based on the most likely potential failure mode is planned for October of 2023. This exercise will compile information necessary for more effective warning and evacuation if needed. It will be used to update the EAP as needed.

HHPD Floodplain Management Plan: A draft Morgan Lake floodplain management plan was completed for the dam by OWRD engineers as part of the FY 20 HHPD grant. It is included as **Appendix 8.4.**

Dam Safety Inspections As a high hazard rated dam, Oregon dam safety engineers inspect Morgan Lake once every year. A recent inspection included excavation of the buried outlet valve. Inspection summaries are provided to La Grande.

Notices and Enforcement: The dam safety program sent a formal notice dated March 17, 2021. It included the following language: "The non-functional conduit and the unknown conduit condition result in a Potentially Unsafe condition at Morgan Lake Dam. OWRD has been working with La Grande and has funded a project to conduct an engineering analysis and risk mitigation work for Morgan Lake Dam. The purpose of this analysis contracted project is to mitigate the risk associated with a potential breach of the dam. Diverting water from a dam breach away from Deal Canyon and into Sheep Creek will significantly reduce the risk to residents of La Grande. This work has been completed.

Spillway Construction Records: The Spillway was designed and constructed in 2014. This spillway is sized for the Probable Maximum Flood. As described in the risk evaluation there is no longer a risk of overtopping as long as this spillway is maintained.

Conceptual Berm Design The conceptual design includes all drawings necessary of a ditch and berm sufficient to divert water from the Deal Canyon drainage into the Sheep's Creek drainage, and also includes a full dam breach inundation analysis of the proposed design that reduces the number of persons affected by a breach by 3 orders of magnitude.

Morgan Lake Dam Semi Quantitative Risk Assessment

With risk assessment now an important dam safety function, Oregon dam safety staff have developed an assessment protocol for use on State of Oregon regulated dams to support FEMA grant processes. Fifteen 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. Events assessed in this project include flood, high water earthquake, and landslides above the reservoir or dam. The project evaluated seven general failure modes based on statistical frequency, including modes that have caused most historical U.S. incidents plus the seismic and landslide risks. Dam specific failure modes are also considered. The methods were influenced by a similar risk evaluation project for rapidly moving landslides and loss of life in Oregon. The use of historical failure frequencies is a more established means of determining risks.

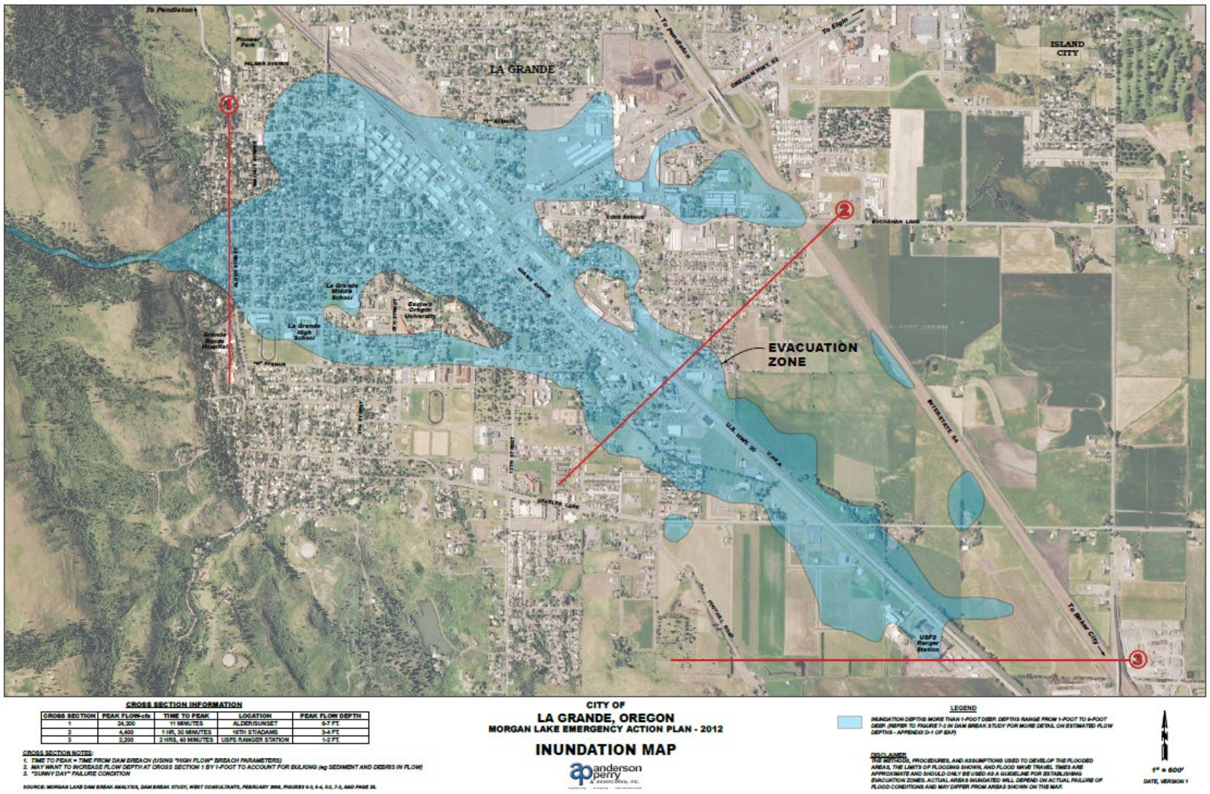
Existing file information was comprehensively reviewed with inspection elements based in information and gaps in the dam safety program files for those dams. The product is a consistent procedure and includes a rating of confidence in the information. Results are calculated in terms of expected loss of life on an annualized basis.

Potential Failure Modes: One mode of failure had the highest annual failure risk. These were described in Report EMW-2019-GR-0029 as follow:

Potential Failure Mode 8 – Dam Specific – Complete failure of a weak and pressurized conduit, with failure by static liquefaction or erosion along the pipe.

The combined mean annual risk of failure of this dam is 2.0E-04 plus or minus 2 orders of magnitude with on an annual loss of life basis is approximately 3.5E-01 plus or minus 2 orders of magnitude. This is an extreme risk and appears to be the highest risk dam in terms of potential loss of life of the Oregon FEMA HHPD eligible dams.

Figure 3-25. Morgan Lake Dam Inundation map



Source: City of La Grande Morgan Lake Dam EAP
Note: Map not to scale

Morgan Lake Mitigation Activities

The goal of mitigation is to modify the dam or its potential breach flow path so that any breach does not flow down Deal Canyon as an extremely rapid debris flood though most of the City of La Grande.

Mitigation action alternatives include the following:

- **Alternative 1**: Construct a flow redirection berm and trench. There is a preliminary design for this work, and inundation analysis of the existing and proposed work. This alternative will be ready for construction by the end of 2023. Cost: $1,200,000.00
- **Alternative 2**: Remove the dam. This option is not ready. Cost: $1,200,000.00
- **Alternative 3**: Rebuild a new dam after removal. This option is not ready. Cost $7,500,000.00
- **Alternative 4**: Continue current level of maintenance and operation. There is no change in costs for this option

The following alternative was selected as the most appropriate activity to mitigate a dam failure of Morgan Lake Dam. Implementation plan and steps are included below.

Alternative 1: Construct a flow redirection berm and trench. There is a preliminary design for this work, and inundation analysis of the existing and proposed work.

Responsibility: Public Works Director

Timeframe: As soon as summer 2024, if easement acquired and funding available

Steps:

1. Acquire easement
2. Finish design
3. Determine if permits are needed
4. Construct berm

History

According to the La Grande Comprehensive Plan, the majority of the city is built in the flood plain. The flood plain within the La Grande Urban Growth Boundary is designated Zone B subject to one foot or less of water in a 100-year flood. According to the *2020 Oregon NHMP*, *2022 Union County NHMP*, and the NOAA Storm Event Database, the following is a table of significant historic floods affecting Region 7, Northeast Oregon. Several of the listed events impacted La Grande.

Table 3-8. Significant Historic Floods Affecting Region 7

Date	Location	Description	Type of Flood
1894*	NE Oregon	widespread flooding	not recorded
1910*	NE Oregon	widespread flooding	not recorded
1917*	NE Oregon	widespread flooding	not recorded
1932*	NE Oregon	widespread flooding	not recorded
1935*	NE Oregon	widespread flooding	not recorded
May 1948	Columbia Basin / NE Oregon	unusually large mountain snow melt produced widespread flooding	snow melt
Dec. 1955 – Jan. 1956	Snake and Columbia basins	warm rain melted snow; runoff on frozen ground	rain on snow
Dec. 1964	entire state	widespread, very destructive flooding; warm rain, melted snow; runoff on frozen ground	rain on snow
Jan. 1974	much of state	warm rain / melted snow / runoff on frozen ground	rain on snow
Feb. 1986	entire state	warm rain / melted snow / runoff on frozen ground	rain on snow
June 1986	Wallowa County	severe thunderstorm / rain and hail / flash flooding	thunderstorm
May 1991	Union and Baker Counties	warm rain / melted snow; considerable damage to cropland and highways; several bridges destroyed	rain on snow
May 1998	eastern and central Oregon	persistent rains; widespread damage	rain on snow
July 2004	Union	$5,000 in property damage	

Date	Location	Description	Type of Flood
May 2008	Union and Wallowa Counties	flooding along Catherine Creek and Grande Ronde River damaged roads in Union County, causing $30,000 in damages; in Wallowa County the Imnaha River crested above flood stage	rain on snow
June 2010	Union County	Flooding occurred in Union County due to heavy rains overflowing rivers and creeks, including Little Creek, Wallowa River, and the Grande Ronde River in Union County. Flood damage experienced in the City of Union from Little Creek.	heavy rain
May 2011	Grant and Union Counties	heavy rainfall on above-average snowpack caused flooding to low lying areas of Grant and Union Counties; over $2.6 in property damage. Union County declared emergency due to flooding, which caused extensive damage to agricultural lands, homes, and infrastructure (roads, etc.).	rain on snow
March 2014	Union 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 6000ft. This allowed for a significant increase in runoff, which lead to a quick rise in rivers for the period	rain on snow
March 2017	Wallowa County	An extended period of snow melt, combined with a period of heavy rain, caused an extended period of flooding along portions of the Grande Ronde River.	rain on snow
May 2017	Wallowa County	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 snow melt.	flash flood
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.	flood after fire
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	flash flood
June 2018	Baker County	Thunderstorms with heavy rainfall developed over Southwest Baker County, Oregon on June 20th, leading to flash flooding and debris flow on the Rail and Cornet-Windy Ridge fires burn scar areas.	flood after fire
April 2019	Union, Grant, and Wallowa Counties	Snow water equivalents near 200% of normal in the Blue Mountains coupled with warm temperatures and near record rainfall totals for April produced significant river flooding across eastern Oregon. Disaster declared in Grant County (DR-4452)	rain on snow
Feb. 2020	Umatilla, Union, Wallowa	DR-4519: severe storms, flooding, landslides, and mudslides. Heavy snow, significant snow accumulation. This was the precursor to significant flooding that occurred later that week when the snow melted due to warm-up and heavy rains.	Snow melt, rain on snow
May 2020	Union County	Heavy rain across Blue Mountains, Blue Mountain Foothills, and John Day Highlands produced areal and river flooding. Grande Ronde River near Perry flooded, cresting 8.3 ft	Heavy Rain

Source: *2020 Oregon NHMP*; *2022 Union County NHMP*; NOAA Storm Event Database consulted April 2023

Future Climate Variability

According to the *Fifth Oregon Climate Assessment* (2021), flood magnitudes are likely to increase in Oregon. It is very likely (>90%) that Oregon will experience an increase in the frequency of extreme precipitation events and extreme river flows (high confidence), which is also driven by antecedent conditions (soil moisture, water table height), snowmelt, river network morphology, and spatial variability in precipitation and snowmelt Moreover, heavy precipitation events are expected to become more intense because a warmer atmosphere can carry more moisture and the relatively contribution to floods of rainfall will be greater than that of snowmelt. The report continues by indicating that the wet season precipitation is projected to increase and thus winter flood magnitude will also likely increase.

The OCCRI *Future Climate Projections Union County, Oregon* report projects the intensity and occurrence of extreme precipitation will increase as the atmosphere warms and holds more water vapor. In Union County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. Nevertheless, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 15% (range 3–26%) and 10% (range 0–25%), respectively. Moreover, landslides are often triggered by rainfall when the soil becomes saturated.

Furthermore, winter flood risk at mid- to low elevations in Union County, where temperatures are near freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to a rise in the percentage of precipitation falling as rain rather than snow.

First Street Foundation (2023) estimated that 5,501 properties in Union County (52%) have a >26% probability of being severely affected by flooding by 2053. Severe flooding corresponds to a 1-in-100-year flood, or a flood with a 1% probability of occurring each year, and such an event as a 26% probability of occurring one or more times during a 30-year mortgage period. Among the structures that may be affected by flooding are 5,389 residences (58%) and 330 commercial properties (73%) at major risk and 11 critical infrastructure facilities (e.g., hospitals; police, fire, and power stations; and water treatment facilities) (48%) and 36 (62%) social facilities (schools, houses of worship, museums, and government or historic buildings) at moderate risk. Of the 7,314 miles of roads in Union County, 2,075 (28%) were estimated to be at severe risk of flooding (First Street Foundation, 2023).

Specific to the City of La Grande, it is estimated that are 1,413 properties in the city that have greater than a 26% chance of being severely affected by flooding over the next 30 years (First Street Foundation, 2023). This represents 63% of all properties in La Grande. The *Future Climate Projections Union County, Oregon*, also states "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, and children and pregnant women (York *et al.*, 2020; Ho *et al.*, 2021)." Among the structures that may be affected by flooding are 2,547 residences and 235 commercial properties at moderate risk and 2 critical infrastructure facilities (e.g., hospitals; police, fire, and power stations; and water treatment facilities) and 7 social facilities (schools, houses of worship, museums, and government or historic buildings) at minor risk. Of the 110 miles of roads in La Grande, 64 were estimated to be at moderate risk of flooding (First Street Foundation, 2023).

Probability Assessment

The Federal Emergency Management Agency has mapped the 100 and 500-year floodplains in portions of La Grande (see Figure 3-23). The 100-year flood is the benchmark upon which the NFIP is based.

Based on the available data and research for La Grande the NHMP Steering Committee determined the **probability of experiencing a flood is "moderate,"** meaning one incident is likely within a 35 to 75-year period. In addition, the Steering Committee determined the **probability of experiencing dam failure is "high,"** meaning one incident is likely within the next 10 to 35-year period.

Vulnerability Assessment

The extent of the damage and risk to people caused by flood events is primarily dependent on the depth and velocity of floodwaters. Fast moving floodwaters can wash buildings off their foundations and sweep vehicles downstream. Roads, bridges, lifelines (pipelines, utility, water, sewer, communications systems, etc.), and other infrastructure can be seriously damaged when high water combines with flood debris, mud and ice. Extensive flood damage to residences and other structures can result in basement flooding and landslide damage related to soil saturation. Surface water entering crawlspaces, basements, and daylight basements is common during flood events not only in or near flooded areas but also on hillsides and other areas far removed from floodplains. Most damage is caused by water saturating materials susceptible to loss (e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings and appliances). If not properly protected from the entry of floodwaters, mechanical, electrical and similar equipment can also be damaged or destroyed by flooding. Economic damage from floods can be substantial.

Public Health

Protection of human life is of primary importance. This is paramount and is tied to several other community issues. Keeping homes safe from floodwaters will also help protect human life.

The Centers for Disease Control and Prevention warn that floodwaters pose a variety of health risks, including exposure to infectious diseases, chemical hazards, and injuries. Floodwaters can become contaminated with bacteria and hazardous chemicals which present the risk of disease through physical contact, ingestion, or open wounds. There is risk of physical injury from floating objects and damaged electrical power lines from floodwaters. The rapidly moving floodwaters also pose the risk of drowning. Floodwaters can also cause indirect health risks. Animals can be displaced during flooding and give rise to a public health risk. Standing water during and after a flood can increase insect populations, creating additional risk of insect-borne diseases. If clean-up efforts are delayed after flood events, water-damaged buildings can collect mold, which is a significant health concern to building occupants. Many of these indirect public health concerns can be reduced after flood events by expediting repair of water-damaged buildings and other clean-up efforts.

When it comes to notifying the public in the event of a natural hazard event, through its *Emergency Operations Plan*, Union County has put in place a preparedness team made up of various city and county departments including Fire, Police, Public Works, Community Development, Administrative Services, Human Resources, Information Technology, Emergency Management, School District, and the Public Information Officer. Preparedness support also includes various state and federal agencies, and local colleges, utilities, medical centers, transportation, and amateur radio emergency services.

Dissemination of information to the public is done through Emergency Alerts powered by Everbridge, a system for a variety of safety situations including evacuations, flooding, hazardous materials release, police activity requesting resident action. The Emergency Alerts program is a program where the La Grande Police Department partners with Union County Emergency Services to provide a comprehensive emergency alert system. The system allows La Grande Police Department, through Emergency Services, to send community residents emergency alerts. In addition, information for the public is provided on La

Grande's website, Facebook, YouTube, and EOA TV. In very extreme cases, door-to-door notification to evacuate is used.

Floods in the past caused multiple major injuries or death. The potential for future injuries or deaths is anticipated to remain similar to historic events. It is estimated that over 25% of the city's population would be physically displaced by a flood, accounting for the number of homes located in or near floodplains, and there would be moderate impact on community social networks.

Building Damage

Homes and commercial buildings in frequently flooded areas can experience blocked sewer lines and damage to septic systems and drainfields. This is particularly the case of residences and businesses in rural flood prone areas who commonly utilize private individual sewage treatment systems. Inundation of these systems can result in the leakage of wastewater into surrounding areas creating the risk of serious water pollution and public health threats. This kind of damage can render homes unlivable.

Many older manufactured home parks may be in floodplain areas. Manufactured homes have a lower level of structural stability compared to traditional lumber-built homes. Manufactured homes in floodplain zones should be anchored to provide additional structural stability during flood events.

According to the draft *Floodplain Management Plan – Morgan Lake Dam* (2023), the people at risk in the flood inundation zone resulting from a breach is approximately 11,128 people at daytime and 6,362 people at nighttime, recognizing that some of that population will be in residential, commercial, industrial, or other designated buildings at the time of a breach. According to the City of La Grande, approximately 400 properties are in the regulatory floodplain, some of which are in each of the residential, commercial, and industrial zoning districts of the city (Boquist, 2023). In addition to structural and life-safety impacts, flooding in residential areas can also result in the need for temporary shelters to house displaced residents. In the *2014 Northeast Oregon Regional NHMP*, it notes that the Wildflower Lodge, an assisted living and memory care facility, is near the floodplain.

Development Change

Changes to development patterns have the potential to incur increased risk of flooding. However, city development regulations restrict, but do not prohibit, new development in areas identified as floodplain. This reduces the impact of flooding on future buildings. La Grande has not experienced much change since the *2014 Northeast Oregon Regional NHMP*, except for the Grande Ronde Hospital expansion in the Geologic Hazard area.

Critical Facilities, Critical Infrastructure, and Vulnerable Population Centers

Of particular importance during flood events are critical facilities located in flood hazard areas. A critical facility is defined as a facility that needs to be operable during a flood, or for which even a slight chance of flooding might pose an unacceptable risk to health and safety. Critical facilities include schools, nursing homes, hospitals, police, fire, and other emergency responders, and installations that produce, use, or store hazardous materials. According to the draft *Floodplain Management Plan – Morgan Lake Dam* (2023), If the dam were to fail, water would flow down Deal Canyon, which enters La Grande on the south and flows through the city to the north. "The regional hospital is at the base of this canyon."

According to the *2020 Oregon NHMP*, in Region 7, there is a potential loss from flooding of about $20M in state building and critical facility assets, 73% of it in Grant County alone. There is a potential loss due to floods of almost twice that much, about $34M, in local critical facilities (81% of that value is in Grant County).

Business and Industry

Flood events impact businesses by damaging property and by interrupting business. Flood events can cut off customers' access to a business as well as close a business for repairs. The economic losses due to business closures often total more than the initial property losses that result from floods. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business. Floods can cut off customer vehicular and pedestrian access and close businesses for repairs. A quick response to the needs of businesses affected by flood events can help a community maintain economic viability in the face of flood damage. Responses to business damages can include funding to assist owners in elevating or relocating flood-prone business structures.

As previously noted, the draft *Floodplain Management Plan – Morgan Lake Dam* (2023) indicates that the number of people at risk in the flood inundation zone resulting from a breach is approximately 11,128 people at daytime and 6,362 people at nighttime. This is recognizing that much of that population will be in residential, commercial, industrial, or other designated buildings at the time of a breach. Overall, there are approximately 400 properties in La Grande that are in the regulatory floodplain, with some located in each of the residential, commercial, and industrial zoning districts of the city (Boquist, 2023).

Public Infrastructure (General)

Publicly owned facilities are a key component of daily life for all residents of La Grande. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Moreover, public buildings such as libraries, schools and government buildings are of concern to the city due to their potential utility in the event of a flood. These buildings can be used as temporary locations for medical and emergency housing services. Some public infrastructures noted here are provided in more detail below.

Roads and Bridges

Road systems, including bridges, are important to the local economy, and during hazard events, resilient road connections are critical for providing essential and emergency services. Emergency vehicles can be delayed because of restricted mobility in flooded areas. Roads are maintained by multiple jurisdictions. Federal, state, county, and city governments all have a stake in protecting roads from flood damage. Some roads in La Grande cross floodplain areas.

Bridges are key points of concern during flood events for two primary reasons:

1. Bridges are often important links in road networks, crossing watercourses or other significant natural features.

2. Bridges can be obstructions in the floodway, collecting debris and inhibiting the flow of water during flood events. This can cause water to back up and inundate areas upstream from the bridge that would not otherwise be affected. Also, this build-up of water can suddenly release, causing a flash flood of larger magnitude downstream.

The *2014 Northeast Oregon Regional NHMP* makes note of two bridges in La Grande: 1) Spruce Street bridge is low and could be affected by debris in a flood and 2) the 2nd Street bridge is an older bridge that may need to be replaced.

Wastewater Treatment Facility

Floods significantly impact drinking water and wastewater systems. When sewer systems are inundated with floodwaters, raw sewage can be flushed into the waterways, posing a significant health hazard. Additionally, drinking water supplies can be contaminated with flushed wastewater or high levels of solids (eroded soil for example), and made unsafe for consumption. Both water and sewage systems often require significant repair and maintenance work following a flood.

La Grande operates and maintains a wastewater treatment plan with secondary and tertiary treatment. The treatment plant holds a National Pollutant Discharge Elimination System (NPDES) permit issued by the DEQ. The majority of La Grande's treated wastewater is pumped five miles to the north to the discharge point located at the Grande Ronde River. The city's wastewater treatment plant is the only major NPDES permitted point source discharging to surface water in the Grande Ronde River (*Upper Grande Ronde River Subbasin WQMP, 2000*). Water is not pumped into the Grande Ronde River year-round. During the summer months, a portion of the treated wastewater is used to fill approximately 50 acres of ODFW wetland areas. A share of the treated wastewater is also used for irrigation purposes on a variety of crops that ODFW produce to provide wildlife and waterfowl habitat. (*La Grande Comprehensive Plan*, 2022)

The *La Grande Comprehensive Plan* states,

> La Grande has been taking steps to improve surface water quality. The City participated in the Total Maximum Daily Load (TMDL) study for the Grande Ronde River and is investing approximately $12 million dollars to alter its wastewater treatment operation to take wastewater out of the Grande Ronde River. Wastewater will instead be used to create and enhance wetlands in the Ladd Marsh area southeast of the City.

La Grande also has two wastewater treatment facilities. According to the *2014 Northeast Oregon Regional NHMP*, both facilities are vulnerable to flooding, but are designed to withstand a 100-year flood.

Stormwater Systems

Stormwater systems collect and concentrate rainwater and rapidly deliver it into the local waterway. This infusion of water causes increased flows downstream. During large rainstorms and floods, these systems are pushed past their capacity and stormwater begins flowing over-ground, causing other infrastructure damage. Traditional stormwater systems are a benefit to urban areas by quickly removing captured rainwater, however, they can be detrimental to areas downstream.

Other problems often develop where open ditches enter culverts or go underground into stormwater systems. An obstruction at these intersections causes overland water flow. The filling of ditches and swales near buildings can inhibit or prevent the flow of water and can compound these problems. Inadequate maintenance, especially following leaf accumulation in the fall, can also contribute to the flood hazard in urban areas.

La Grande provides its residents with a variety of stormwater collection systems. The stormwater collection system that must be maintained consists of ditches, streams, pipes, detention basins, and storm drainage structures in and around the city. To understand the La Grande stormwater management system and its connection to local waterways, the following is from the *La Grande Comprehensive Plan* (2022).

> The City of La Grande manages stormwater through the use of drainage ditches, drainage canals, street drainage, catch basins, underground storm drain piping, and dry wells. The area west of the Union Pacific Railroad, which receives runoff from Deal Creek, Mill Creek, and Taylor Creek, utilizes drainage canals and underground piping for creek flows. The remaining runoff from the basin is transported to the drainage canals and underground piping via streets, catch basins, and drainage ditches. The combined runoff outfalls into Gekeler Slough, which eventually drains into Catherine Creek.
>
> The area east of the Union Pacific Railroad develops runoff primarily from the developed and undeveloped land within the City limits. Drainage ditches and dry wells are used more predominantly within this area due to minimal ground slope. Some larger ditches occur at the downstream section of the basin which feeds into Gekeler Ditch. Eventually, this ditch drains into Catherine Creek

According to the comprehensive plan, La Grande is in the process of developing a Stormwater Management Plan that will be divided into six phases.

- Phase I: City-wide hydrology and water quality issues, completed in 1998
- Phase II: Lower Mill Creek, Taylor Creek, and Gekeler Slough hydraulic capacity, completed in 1998
- Phase III: Upper Deal Creek and upper Mill Creek hydraulic capacity
- Phase IV: Northeast La Grande hydraulic analysis
- Phase V: Northwest La Grande hydraulic analysis
- Phase VI: Summary of the completed plan.

Major points of interest that came from the completion of Phases I and II include the water quality analysis performed, the water quality standards developed, and the hydraulic improvements proposed for lower Mill Creek, Taylor Creek, and Gekeler Slough. The proposed resulting improvements include improving the hydraulic capacities of both Taylor Creek and Lower Mill Creek drainage to contain the 100-year flood event and diverting the flows away from the Gekeler Slough using the new Taylor Creek/Gekeler Slough Bypass. (*La Grande Comprehensive Plan*, 2022)

All water from this system will end up in the local waterways. The higher the water in the river or creek, the more difficult it is for stormwater run-off to make it to the river or creek. During significant rain events, the city may experience localized flooding first followed by river or creek flooding after the rain event has passed. During heavy rains not necessarily associated with high river levels, sections of the storm system can become inundated and result in localized flooding. In general, these events do not cause damage to the city’s stormwater system and subside relatively quickly.

The *La Grande Comprehensive Plan* states,

> La Grande has been taking steps to improve surface water quality. The City participated in the Total Maximum Daily Load (TMDL) study for the Grande Ronde River and is investing approximately $12 million dollars to alter its wastewater treatment operation to take

wastewater out of the Grande Ronde River. Wastewater will instead be used to create and enhance wetlands in the Ladd Marsh area southeast of the City.

The City recently installed signs on the curb above all storm water catch basins reading "No Dumping – Drains to River." The City has also been requiring bioswales in new developments to treat storm water before it enters the storm drain system.

The *La Grande Comprehensive Plan* addresses the soils in the urban development boundary of the city. There are six soil types – La Grande, Catherine, Palouse, Oxbow, Waha, and Hoopal series – in the city. Of the six soils in the city, the predominate soil in the La Grande soil type, which consist of somewhat poorly drained soils with moderate permeability, runoff is slow, and a slight erosion hazard. La Grande soils have "severe limitations for septic tanks, structures and roads due to floods and wet subsoil." (*La Grande Comprehensive Plan*, 2022)

Water Management and Water Quality

Floods significantly impact drinking water and long-term water quality monitoring is conducted by DEQ. La Grande's water supply includes the sources and areas to which the city holds the water rights: Beaver Creek Watershed and five operational wells (two basalt wells and three alluvial wells). The water from the five wells is described as of good quality. In 1992, the Beaver Creek Watershed water supply was placed into a reserved status to bring it into compliance with the safe Drinking Water Act.

City of La Grande participated in the Upper Grande Ronde River Watershed (UGRRW) Partnership for Union County that convened 28 groups and individuals between 2016-2021 "to make collaborative, consensus-based reports and decisions to characterize the water supply in the UGRRW." The Upper Grande Ronde Subbasin is located almost entirely within Union County with small portions of the subbasin in Umatilla and Baker counties. The outcome of the UGRRW Partnership was the completion of the *Union County, Oregon Place-Based Integrated Water Resources Plan*. The project was funded through the OWRD Place-Based Integrated Water Resources Planning Grant. Five reports were generated as a result and included the following:

- Step 1: Governance Agreement and Memorandum of Understanding
- Step 2: State of Water Resources Report, completed in 2018
- Step 3: Needs and Demands Report, completed in 2019
- Step 4: Integrated Strategies Report, completed in 2020
- Step 5: Integrated Water Resources Plan, completed in 2022

The *Union County, Oregon Place-Based Integrated Water Resources Plan* (2022) contains four primary water issues, each with a corresponding goal and two or three objectives. The presented issues include,

1. Surface water supply is limited in summer through late fall (circa July through November) when the combined demands for water instream and for irrigated agriculture and municipal uses is the highest (Step 3 report).
2. There is significant uncertainty with groundwater supply. The UGRRW Partnership needs to evaluate groundwater supply sustainability to inform strategic groundwater resource planning. Currently, the UGRRW lacks sufficient groundwater monitoring wells, long-term trend data, pumping/use data, and data regarding surface water interactions -- all are needed to inform strategic groundwater resource planning and management (Step 3 report).

3. Surface water quality is below statewide standards in all eight subwatersheds at various times of the year. The water quality issues are related to high temperatures, low DO, sedimentation, pH, and insufficient flows (DEQ, 2000; Step 2 report).
4. Natural hazards like flooding, fire, and drought impact the UGRRW frequently, and the UGRRW Partnership needs a plan to mitigate and respond to these events. The climate change scenario considered by the UGRRW Partnership suggests the frequency, magnitude, and duration of these events could change within the UGRRW (Step 2 report and Step 3 report).

Water quality is also addressed in the 2000 *Upper Grande Ronde River Subbasin Water Quality Management Plan* (*WQMP*).

Parks, Open Space, and Natural Environments

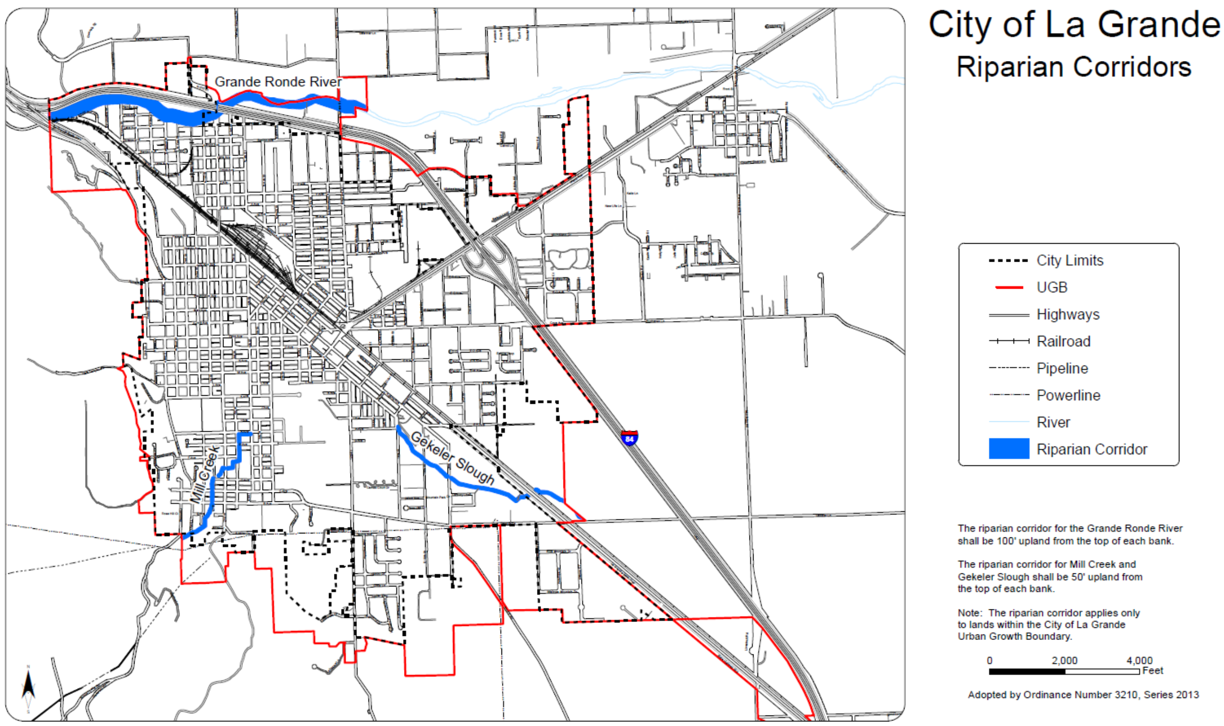
The capacity of the natural environment is essential in sustaining all forms of life including human life, yet it often plays an underrepresented role in community resiliency to natural hazards such as floods. The natural environment includes land, air, water, and other natural resources that support and provide space to live, work and recreate. Natural capital such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from weather-related hazards, such as flooding and landslides. When natural systems are impacted or depleted by human activities, those activities can adversely affect community resilience to natural hazard events.

Public parks and publicly owned open space and natural systems can provide a buffer between flood hazards and private property. Maintaining and restoring natural systems helps mitigate the impact of flood events on the built environment. Flooding changes the natural environment and hydrology of an affected area. High water can be beneficial to the natural processes within a floodplain and can benefit riparian areas. Wetlands in public ownership can reduce flood impacts by absorbing floodwaters and buffering water level fluctuations.

La Grande has a very good coverage of parks and recreational facilities which it maintains and operates in conjunction with the School District's facilities. These facilities, which are addressed in the *La Grande Parks and Recreation Master Plan*, constitute the bulk of the public open space available in the La Grande UGB. In addition to the city parks and school district facilities, La Grande has a vast amount of developed open space within the public rights-of-way. (*La Grande Comprehensive Plan*, 2022)

Riparian areas are important transitional areas that link water and land ecosystems. Vegetation in riparian areas is dependent upon stream processes such as flooding and often is composed of plants such as willow and cottonwood trees that require large amounts of water. Healthy vegetation in riparian buffers can reduce streamside erosion. During flood events, high water can cause significant erosion. Well-managed riparian areas can reduce the amount of erosion and help to protect water quality during flooding events. Figure 3-26 shows the designated riparian areas in La Grande.

Figure 3-26. Riparian Corridors, La Grande, Oregon

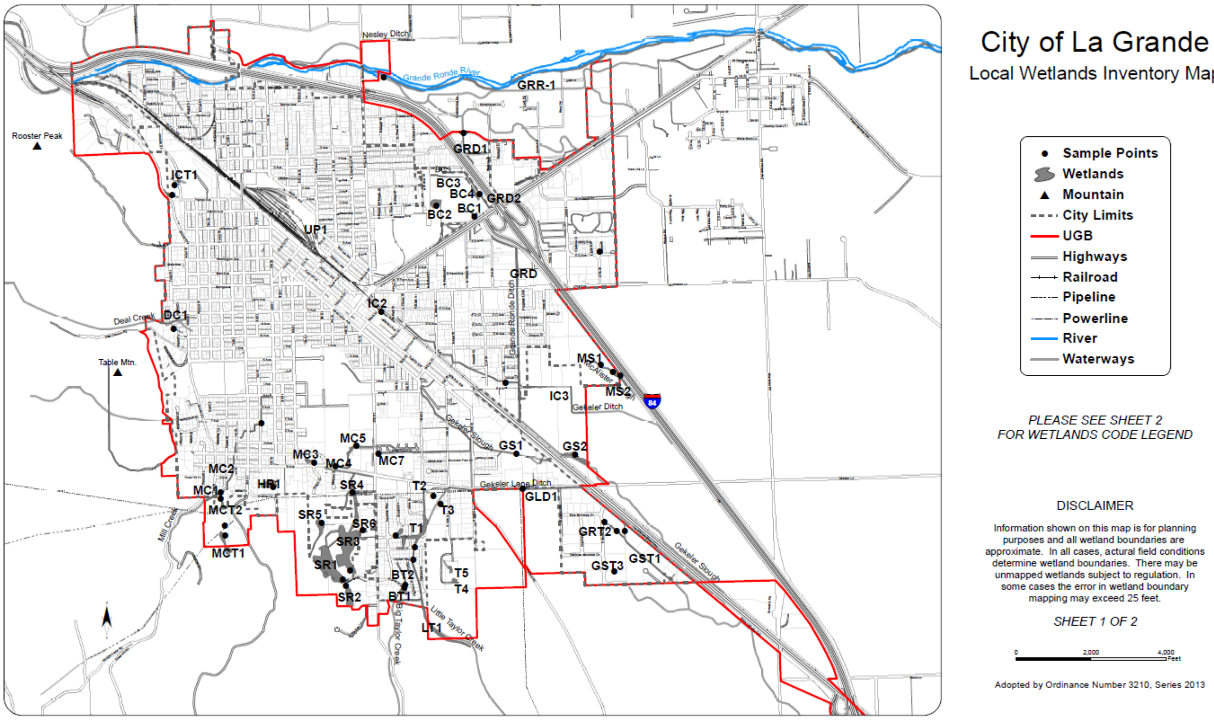


Source: City of La Grande
Note: Map not to scale

Many floodplain and stream-associated wetlands absorb and store storm water flows, which reduces flood velocities and stream bank erosion. Preserving these wetlands reduces flood damage and the need for expensive flood control devices such as levees. According to Oregon Department of State Lands (DSL), when the storms are over, many wetlands augment summer stream flows by slowly releasing the stored water back to the stream system. Wetlands are highly effective at removing nitrogen, phosphorous, heavy metals, and other pollutants from water. For this reason, artificial wetlands are often constructed for cleaning storm water runoff and for tertiary treatment (polishing) of wastewater. Wetlands bordering streams and rivers and those that intercept runoff from fields and roads provide this valuable service free of charge.

The 6000-acre Ladd Marsh Wildlife Area, established in 1949 to conserve and enhance habitat for waterfowl and to provide a public hunting area, is one of the largest remaining wetlands in northeastern Oregon, and encompasses the region's most extensive remnant hardsteam bulrush wetland. The End Creek Restoration Project (2006-2007), a public–private–tribal partnership, restored an additional 550 acres of wetlands and stream channels near La Grande. Figure 3-27 shows the local wetlands inventory in La Grande.

Figure 3-27. Local Wetlands Inventory, La Grande, Oregon



Source: City of La Grande
Note: Map not to scale

Power Supply

Flooding can also significantly impact electrical supply systems. Floodwaters short-out electrical lines and cause transformers to fail. Additionally, debris transported by floodwaters has the potential to knock down power poles and put live, high-voltage lines in the water, posing an electrocution hazard to people.

Communications/Phone Lines

Telephone and cable lines are similarly susceptible to floodwaters and floating debris. Underground lines are more resistant to flood damage, but often are exposed and damaged by swift currents.

The La Grande NHMP Steering Committee rated the city as having a **"medium" vulnerability to flood hazards**, meaning that 1 to 10% of the city's population or property would be affected by a major flood event. In addition, the Steering Committee determined the **vulnerability to dam failure is "high,"** meaning that over 10% of the city's population or property would be affected by dam failure.

Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of a natural disaster, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies and organizations. There are some programs currently under way in

La Grande as well as Union County that are designed to mitigate the impacts of flooding. These programs range from federally funded national programs to individual projects by landowners and projects by watershed councils and special districts. In addition to the information noted below, other activities and resources are highlighted in the Mitigation Strategy (Chapter 4).

National Flood Insurance Program

The NFIP is a federal program administered by FEMA. The function of the NFIP is to provide flood insurance to homes and businesses located in floodplains at a reasonable cost, and to encourage the location of new development away from the floodplain. The program maps flood risk areas, and requires local implementation to reduce the risk, primarily through restricting new development in floodplains. The City of La Grande participates in the National Flood Insurance Program.

Flood insurance covers only the improved land, or the actual building structure. It is important to note that property located outside the SFHA may still be subject to severe flooding. FEMA reports that 25% to 30% of all flood insurance claims are from owners of property located in low to moderate-risk areas located outside of the SFHA.

Repetitive Loss structures are defined as a NFIP-insured structure that has had at least two paid flood losses of more than $1,000 each in any 10-year period since 1978. Repetitive Loss structures are concerning because they continue to expose lives and property to the flooding hazard. Local governments as well as the federal agencies, such as FEMA, attempt to address losses by encouraging and requiring floodplain insurance and funding projects such as acquiring land and improvements, relocating homes, or elevating structures. Continued repetitive loss claims from flood events lead to an increased amount of damage caused by floods, higher insurance rates, and contribute to the rising cost of taxpayer funded disaster relief for flood victims.

According to La Grande, the city is currently working to update the Flood Insurance Rate Maps, with an intention to accurately identify and define the 100-year regulatory floodplain boundary using modern technology, such as Lidar data and 3D modeling. The city utilized the services of Anderson-Perry and Associates and the U.S. Army Corp. of Engineers (USACE) to prepare the required analysis and applications for consideration by the FEMA. Currently there are approximately 400 properties located in the regulatory floodplain and are either zoned residential, commercial, or industrial. If the amendment is accepted by FEMA, the number of properties located within the regulatory floodplain will be reduced to 325 (Boquist, 2023).

Table 3-9 shows that as of April 2023, La Grande has 31 National Flood Insurance Program (NFIP) policies in force. The last Community Assistance Visit (CAV) to La Grande was on April 29, 2004. La Grande is not a member of the Community Rating System (CRS).

Table 3-9. La Grande Flood Insurance Detail

	City of La Grande
Effective FIRM and FIS	4/3/1996
Initial Firm	9/30/1980
Total Policies	31
Total Claims Since 1978	6

	City of La Grande
Insurance in Force	$7,602,000
Total Paid Claims Since 1978	6
Substantial Damage Claims	0
Repetitive/Severe Repetitive Loss Properties[12]	--
CRS Class Rating	--
Last Community Assistance Visit	4/29/2004

Sources: Oregon Department of Land Conservation and Development.

The City of La Grande manages floodplain development through their local floodplain ordinance. The Planning Division within the Community Development Department is the city's lead work group that implements NFIP requirements and application of La Grande's Land Development Code, Article 3.12 – Flood Plain Zone. The local floodplain ordinance is based on the State of Oregon model flood zone ordinance and is in compliance with the Code of Federal Regulations for the NFIP. Once La Grande's FEMA application process concludes to update and replace the FIRMs, La Grande will be updating their floodplain ordinance at the same time as adopting the new maps. La Grande anticipates using the current State of Oregon model ordinance, along with any supplemental guidance to address the endangered species protection requirements.

The Planning Division maintains staff that are Floodplain Managers (Michael Boquist, Community Development Director) and trained in both NFIP policies, federal, state and local floodplain regulations. La Grande's Floodplain Manager oversees the floodplain management program and NFIP Community Assistance Visits with the Oregon Department of Land Conservation and Development NFIP Coordinator. The Floodplain Manager with the city reviews all development activity in the Special Flood Hazard Area prior to issuance of applicable permits (land development and building permits).

All projects within the Special Flood Hazard Area are reviewed by La Grande's Floodplain Manager for development permit requirements, including substantial improvement/damage of existing structures. Local officials determine if proposed work in a regulated SFHA or Interim Flood Hazard Area qualifies as a substantial improvement or repair of substantial damage as defined in La Grande's Article 3.12. The valuations for all projects are included in the initial development application and reviewed at submittal. For major improvements to existing structures, the applicant is notified that additional information is needed to determine substantial improvement/damage (SI/SD). In general, the project architect compiles the information needed to make the determination based on guidance in the FEMA Substantial Improvement/Substantial Damage Desk Reference, DLCD and FEMA support. If work on an existing structure constitutes substantial improvements or an existing structure is determined to be substantially damaged, then the existing structure must be brought into compliance with NFIP requirements for new construction.

After a flood event, local building officials review flooded areas to determine areas that cannot be reoccupied and require a building permit for repairs. Based on the scope of repair work required, a

[12] According to the *2020 Oregon NHMP*, FEMA identified two repetitive loss properties in Region 7, which consists of four counties in Northeast Oregon. According to the *2022 Union County NHMP*, there are no repetitive loss properties in the county. The author is unclear whether these two properties are in La Grande.

substantial damage determination will be made in cooperation with the local officials responsible for reviewing floodplain development activity. Work on structures that are determined to be substantially damaged is considered to be substantial improvement regardless of the actual repair work performed.

Flood Insurance Rate Maps

The FIRM floodplain maps are the basis for implementing floodplain regulations and for delineating flood insurance purchase requirements. A FIRM is the official map produced by FEMA, which delineates special flood hazard areas or floodplains where NFIP regulations apply.

The City of La Grande uses the FIRM to advise prospective homeowners of flood hazards, locate zoning boundaries that separate developable land from open space, make decisions for new development in floodplains, and administer the terms of the NFIP during the issuance of building permits. The maps are also used by insurance agents and mortgage lenders to determine if flood insurance is required.

As previously noted, La Grande is currently working to update the FIRM, with the intention to accurately identify and define the 100-year regulatory floodplain boundary. The current FIRM was issued April 3, 1996. Currently there are approximately 400 properties located in the regulatory floodplain. If the amendment is accepted by FEMA, the number of properties located within the regulatory floodplain will be reduced to 325 (Boquist, 2023). See also Figure 3-23.

Flood Insurance Study

For mapped floodplain areas, the flood hazard data included in the Flood Insurance Study (FIS) allow quantitative calculation of the frequency and severity of flooding for any property within the floodplain. Such calculations are very important for mitigation planning because they allow the level of flood risk for any structure to be evaluated quantitatively.

Standard hydrologic and hydraulic study methods were used to determine the flood hazard data contained in the FIS. Flood events of a magnitude expected to occur once on average every 10-, 50-, 100-, and 500-year period were studied for each of La Grande’s rivers and creeks.

Quantitative flood hazard data are very important for mitigation planning purposes because they allow quantitative determination of the frequency and severity (i.e., depth) of flooding for any building or other facility (e.g., road or water treatment plant) for which elevation data exist. Such quantitative flood hazard data also facilitate detailed economic analysis (e.g., benefit-cost analysis) of mitigation projects to reduce the level of flood risk for a particular building or other facility.

Community Rating System

The NFIP CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. The CRS program recognizes a community’s efforts to reduce flood risk, facilitate accurate insurance ratings, and promote the awareness of flood insurance.

For CRS communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount. Table X illustrates how the CRS point system is broken down.

Table 3-10. Summary of Points and Insurance Rate Discounts Under CRS

Credit Points	Class	Premium Reductions
0-499	10	0%
500-999	9	5%
1000-1499	8	10%
1500-1999	7	15%
2000-2499	6	20%
2500-2999	5	25%
3000-3499	4	30%
3500-3999	3	35%
4000-4599	2	40%
4500+	1	45%

Sources: Federal Emergency Management Agency, 2022

The City of La Grande is currently not a member of the Community Rating System (CRS).

Invasive Species and Insect Pests

Significant Changes Since Previous Plan:

The Invasive Species and Insect Pests Hazard is new to La Grande's NHMP.

Causes and Characteristics

Invasive species are animals, plants, and insect pests that are not native to an ecosystem and that cause economic or environmental harm. When an invasive species is introduced into a new environment, it leaves behind natural enemies, such as predators, disease, or parasites, that controlled its population growth in its original home. Invasive non-native species can have many negative consequences throughout Oregon.

Types of Invasive Species and Insect Pests

Animals: There are numerous animals in Oregon that are recognized as invasive species that include amphibians, birds, mammals, reptiles, and marine life. Each species has its own unique environment in which they survive and thrive. According to the Oregon Department of Fish and Wildlife (ODFW), not all non-native species (animals) are invasive, however many become a serious problem because they can aggressively compete with Oregon's native wildlife for food and habitat. For a full list of animals recognized as invasive to Oregon, go to ODFW's Invasive Species website https://myodfw.com/wildlife-viewing/species/invasive-species

According to ODFW's The Oregon Conservation Strategy, invasive species are the second-largest contributing factor causing native species to become at-risk of extinction in the United States. Invasive species also include disease-causing organisms, such as viruses, bacteria, prions, fungi, protozoans, and internal (roundworms, tapeworms) and external (lice, ticks) parasites that can affect the health of humans, livestock, and pets in addition to fish and wildlife. Non-native invasive species cause significant economic damage to landowners by degrading land productivity or values.

Noxious Weeds: Oregon has numerous invasive plants referred to as "noxious weeds." A noxious weed is a terrestrial, aquatic or marine plant designated by the Oregon State Weed Board under Oregon Revised Statute (ORS) 569.615 as among those representing the greatest public menace and as a top priority for action by weed control programs. Noxious weeds have become so thoroughly established and spreading rapidly on private, state, county, and federally owned lands and thus declared a threat to public welfare. (Oregon Department of Agriculture, 2022)

Insect Pests: Oregon Department of Agriculture's Insect Pest Prevention and Management (IPPM) Program conducts surveys for insect pests not known to occur in Oregon. Such pests include, but not limited to, mountain pine beetle, spongy moth, flighted spongy moth, Japanese beetle, and the emerald ash borer. These are serious pests in other parts of the world and could threaten Oregon's agricultural and horticultural industries, landscapes, forests, and recreational areas. Early detection of these pest problems allows for better management and protection of Oregon's agriculture, horticulture, environment, and quality of life from damaging insect pests and enhances or maintains the value of our agricultural and horticultural products.

The La Grande NHMP Steering Committee is most concerned with the Emerald Ash Borer (Agrilus planipennis Fairmaire), referred to as EAB. The EAB poses a natural hazard risk to the numerous ash trees within the city. According to Oregon Department of Forestry (2022), several North American ash species are at risk, including the native Oregon ash and non-native ash species widely planted as landscape trees. The EAB is a highly destructive invasive forest pest that has killed over 100 million ash trees in the eastern U.S since its first detection in Michigan, in 2002. Only 20 years after its arrival in North America, five eastern U.S. ash species – green, white, black, blue and pumpkin ash – are already listed as “critically endangered” by the International Union for Conservation of Nature. The EAB was detected in Oregon on June 30, 2022, in Forest Grove. Oregon ash occurs on both lands zoned for forestry and for agriculture. Oregon ash is widely used for stream restoration plantings due to its ability to stabilize soil, control sediment, and moderate stream temperatures. It is assumed that widespread death of Oregon ash will lead to ecological changes in water quality, stream temperatures and riparian plant communities. (Oregon Department of Forestry, 2022)

Other insect pests that pose a natural hazard risk regionally include the bark beetles Dendroctonus pseudotsugae (Doug-fir beetle), a bark beetle that preferentially infests >10” diameter at breast height (dbh) downed trees and then moves to nearby standing trees that are stressed, injured or less vigorous, Scolytus ventralis, (Fir engraver), a significant pest of mature and pole-sized true fir, and Dendroctonus ponderosae, (Mountain pine beetle), the most destructive forest pest in the west contributing to more tree mortality than any other bark beetle in Oregon.

The insect pests that act through defoliation include the Doug-fir tussock moth (DFTM; Orgyia pseudotsugata), a major defoliator of Doug-fir and true firs in the Western US, and the Larch casebearer (Coleophora laricella), an established, exotic defoliator that attacks western larch. Native and introduced natural enemies play an important role in controlling this pest.

The Balsam woolly adelgid (BWA; Adelges piceae), is the principal sap-sucking insect to affect timber species in the region. Both the BWA and the Larch casebearer are exotic species that have become established and invasive in nature.

Location and Extent

In their efforts to detect new outbreaks and track invasive species, experts conduct in-field and aerial surveys. However, there is the challenge of tracking hundreds of potential new and existing invaders across millions of acres of farms, forests, and waterways. Effectively managing threats from invasive weeds requires coordinated strategies on a local and regional scale. In addition, management considerations for insect pests requires a coordinated approach particularly considering the overlapping impact to susceptibility to wildfire that damage by insect pests and noxious weeds can create. Coordination is supported through collaboration among local and state governments and regional private nonprofits. Therefore, there are several sites that allow citizens to report a species in the field. One such site is the Oregon Invasive Species Online Hotline, which is a collaboration of Oregon Invasive Species Council, Western Invasives Network, and Portland State University.

Information on location and extent of invasive species, noxious weeds, and insect pests, is provided by several organizations including the following.

Animals: The Oregon Conservation Strategy is an overarching plan to conserve Oregon’s fish and wildlife, and their habitats. It combines the best available science and conservation priorities with recommended voluntary actions and tools for all Oregonians to define their own conservation role. A key conservation issue or threat that affects species and habitats throughout Oregon is invasive species, which includes monitoring said species.

The Oregon Conservation Strategy has nine delineated ecoregions of Oregon with similar climate and vegetation. La Grande is in the Blue Mountains ecoregion, which identifies invasive plants and animals as a limiting factor that disrupt and degrade native communities, diminish populations of at-risk native species, and threaten the economic productivity of resource lands.

Noxious Weeds: The Oregon Department of Agriculture (ODA) Noxious Weed Control Program has developed a geospatial mapping tool that displays a collection of spatial information on the distribution of noxious weeds listed by ODA.

In addition, ODA uses a written risk assessment process to identify, and rate weed species that pose the biggest threat to Oregon's agricultural and natural resources. The risk assessment consists of a series of questions that help evaluate the following:

- Current geographic distribution
- Plant biology
- Resource impacts
- Difficulty of detection and control

Risk assessments are scored using the best available information, observations, and literature reviews. Risk assessment scores help guide the Oregon State Weed Board in their actions to prioritize ODA program projects and in the weed listing process.

The Oregon State Weed Board (OSWB) updates the State Noxious Weed List annually with some change that may include adding new species, changing classification of a previously listed species (A, B, or T), or delisting a species that has become a lower priority.

The Union County Commissioners designate priority noxious weeds, weeds of economic importance, and weeds of economic importance within agricultural areas (Table 3-11). The Union County Weed Control District implements county-level control and monitoring plans for priority noxious weeds. Some priority noxious weeds may be feasible to contain or eradicate in the county or are not known to occur in Union County but are present in adjacent counties and likely to occur in Union County in the future. Weeds of economic importance are locally abundant in Union County and adjacent counties and are controlled at either the county or regional level. Weeds of economic importance within agricultural areas are controlled or monitored within those areas and rights of way.

Table 3-11. Union County Designated Noxious Weeds

Noxious Weed	Growth Form
Priority	
Black henbane (*Hyoscyamus niger*)	Annual or biennial forb
Common bugloss (*Anchusa officinalis*)	Perennial forb
Common tansy (*Tanacetum vulgare*)	Perennial forb
Common crupina (*Crupina vulgaris*)	Annual forb

Noxious Weed	**Growth Form**
Dyer's woad (*Isatis tinctoria*)	Annual, biennial, or short-lived perennial forb
Garlic mustard (*Alliaria petiolata*)	Perennial forb
Giant foxtail (*Silene faberi*)	Biennial or short-lived perennial forb
Hawkweeds: king-devil, meadow, mouse-ear, orange, yellow (*Hieracium piloselloides, pratense, pilosella, aurantiacum, and floribundum*)	Perennial forb
Hoary alyssum (*Berteroa incana*)	Biennial forb
Knotweeds: giant, Japanese, Himalayan, hybrid or Bohemian (*Polygonum sachalinense, cuspidatum, polystachyum,* and *x bohemicum*)	Perennial forb
Leafy spurge (*Euphorbia esula*) (more than one mile from the Grande Ronde River)	Perennial forb
Meadow knapweed (*Centaurea pratensis*) (outside the Cove area)	Perennial forb
Mediterranean sage (*Salvia aethiopis*)	Biennial forb
Musk thistle (*Carduus nutans*)	Biennial forb
Myrtle spurge *(Euphorbia myrsinites*) (outside residential areas)	Perennial forb
Perennial pepperweed (*Lepidium latifolium*)	Perennial forb
Plumeless thistle (*Carduus acanthoides*)	Biennial forb
Ravenna grass (*Saccharum ravennae*)	Perennial grass
Rose campion (*Silene coronari*a) (outside residential areas)	Perennial forb
Rush skeletonweed (*Chondrilla juncea*)	Perennial forb
Russian knapweed (*Acroptilon repens*) (Cove area, High Valley, and Medical Springs)	Perennial forb
Scotch broom (*Cytisus scoparius*)	Shrub
Tansy ragwort (*Senecio jacobaea*)	Biennial or short-lived perennial
Turkish thistle (*Carduus cinereus*)	Annual forb
Velvet leaf (*Abutilon theophrasti*)	Annual forb
Viper's bugloss (*Echium vulgare*)	Annual or biennial forb
Whitetop or hoary cress (*Lepidium draba*) (within the Grande Ronde Basin and Wolf Creek drainage)	Perennial forb
Yellow starthistle (*Centaurea solstitalis*) (outside established containment areas)	Annual forb
Yellow toadflax (*Linaria vulgaris*)	Perennial forb
Weeds of Economic Importance	
Armenian or Himalayan blackberry (*Rubus armeniacus*)	Shrub
Bittersweet nightshade (*Solanum dulcamara*)	Perennial vine or shrub
Buffalo burr (*Solanum rostratum*)	Annual forb
Canada thistle (*Cirsium arvense*)	Perennial forb
Dalmatian toadflax (*Linaria dalmatica*)	Perennial forb
Diffuse knapweed (*Centaurea diffusa*)	Biennial forb
Dog rose (*Rosa canina*)	Shrub

Noxious Weed	Growth Form
Houndstongue (*Cynoglossum officinale*)	Biennial or short-lived perennial forb
Jointed goatgrass (*Aegilops cylindrica*)	Annual grass
Leafy spurge (*Euphorbia esula*) (within one mile of Grande Ronde River)	Perennial forb
Medusahead rye (*Taeniatherum canput-medusae*)	Annual grass
Oxeye daisy (*Chrysanthemum leucanthemum*) (outside residential areas)	Perennial forb
Poison hemlock (*Conium maculatum*)	Biennial forb
Puncturevine (*Tribulus terrestris*)	Annual forb
Purple loosestrife (*Lythrum salicaria*)	Perennial forb
Saltcedar (*Tamarisk ramosissima*)	Tree or shrub
Scotch thistle (*Onopordum acanthium*)	Annual or biennial forb
Spotted knapweed (*Centaurea stoebe*)	Short-lived perennial forb
Sulfur cinquefoil (*Potentilla recta*)	Perennial forb
Sweet Briar rose *(Rosa rubiginosa*)	Shrub
Ventenata *(Ventenata dubia*)	Annual grass
Whitetop or hoary cress (*Lepidium draba*) (within Powder River basin)	Perennial forb
Wild carrot (*Daucus carota*)	Biennial forb
Yellow flag iris (*Iris pseudocorus*)	Perennial aquatic
Yellow starthistle (*Centaurea solstitalis*) (within containment areas)	Annual forb
Weeds of Economic Importance in Agricultural Areas	
Catchweed bedstraw (*Galium aparine*)	Annual forb
Common or wild sunflowers (*Helianthus annus*)	Annual forb
Creeping bentgrass (*Agrostis stolonifera* var. *palustris*)	Perennial grass
Horseweed or mares tail *(Conyza canadensis*)	Annual or biennial forb
Kochia (*Bassia scoparia*)	Annual forb
Quackgrass (*Elymus repens*)	Perennial grass

Sources: Dalton et al., 2023

Oregon iMapInvasives is an online, GIS-based data management system that assists citizen scientists and natural resource managers working to protect natural resources from the threat of invasive species. Oregon iMapInvasives collate data from a variety of sources (such as iNaturalist!) to build a statewide picture of invasive species – plants and insect pests – locations and management actions.

Insect Pests: The extent and severity of insect pests of timber species is monitored by both the Oregon Department of Forestry (ODF) and the US Department of Agriculture through the US Forest Service (USFS) including Forest Insect and Disease Conditions Reports and Forest Health Highlights. Additionally, ODF conducts aerial surveys annually to collect information on tree mortality due to insect pest infestations.

Oregon State University Extension Service has the Oregon Forest Pest Detectors (OFPDs) program where citizens are trained to recognize the signs and symptoms of invasive forest insects. The OFPDs apply skills in their day-to-day activities as arborists, parks managers, foresters, community tree stewards, Master Gardeners and other roles.

The Animal and Plant Health Inspection Service of the USDA helps protect the agricultural interests related to non-native plants, animals, insects and diseases as well as monitoring and managing existing agricultural pests and diseases. They regulate, monitor, and manage numerous pests.

As noted above, Oregon iMapInvasives is a GIS-based data management system that assists citizen scientists and natural resource managers working to protect natural resources from the threat of invasive species. It tracks data from a variety of sources to build a statewide picture of invasive species – plants and insect pests – locations and management actions.

History

The region has been facing the challenge of invasive weeds long before the formation of the Tri-County Cooperative Weed Management Area in 1994[13]. There is the challenge of tracking hundreds of potential new and existing invaders across millions of acres of farms, forests, urban areas, and waterways. Aside from the reporting methods noted above in the Location and Extent section and the arrival of the Emerald Ash Borer to Oregon in June 2022, historical documentation of significant weed and pest infestations is unavailable for the city and county. Nevertheless, the following is a historical summary of what is in place now. This information is in addition to that presented in the Location and Extent section.

The Oregon Department of Forestry (ODF) maintains a Forest Health program that helps maintain and improve the health of Oregon's private and state-owned forests. Forest health professionals conduct aerial and ground surveys to monitor forest insects and tree diseases. The Oregon Department of Forestry has been collaborating with the USFS and other partners to evaluate and report on forest health issues since 1998 as available on the Forest Health Highlights site.

Management considerations for insect pests requires a coordinated approach particularly considering the overlapping impact to susceptibility to wildfire that damage by insect pests and noxious weeds can create. Coordination is supported through collaboration among local and state governments and regional private nonprofits.

It is the Union County Weed Board's mission to serve as stewards protecting and conserving agricultural lands, natural resources, wildlife habitat, and wilderness areas from the spread of noxious weeds. The Union County Weed Control Division works to establish and maintain an integrated vegetation management approach toward the control of noxious weeds within the county boundaries. Union County complies with statewide management plans or implements county-level control and monitoring plans for priority noxious weeds. Union County also established a list of noxious weeds, designating them based on priority and economic importance (Table 3-11).

[13] Local governments of Baker, Union, and Wallowa Counties, along with the Bureau of Land Management, U.S. Forest Service, Oregon Dept. of Fish and Wildlife, and Boise Cascade agreed to form a cooperative weed management area. In December of 1994, Tri-County Cooperative Weed Management Area was formed by an Intergovernmental Agreement. Tri-County CWMA manages over 35 different projects, covering nearly 8 million acres. The Tri-County CWMA has published *A field Guide to Northeast Oregon's Noxious Weeds*, a field identification guide of 34 plants including location and level of distribution in the region (and state).

The City of La Grande's Community Forestry Program began in 1992 and in 2003, the city established a land development code requiring street trees. Prior to development code regulations, Victory Way became a tree-lined parkway commemorating the end of the First World War and which includes Oregon Heritage Trees. Throughout the years, there have been numerous community tree plantings and in 1985, the Ron Rohweder Memorial Arboretum was established. The city has been a Tree City USA since the 1990. The city began work on an urban forestry plan in 1992, followed by the formation of the Community Landscape and Forestry Commission in 1995, and the first Community Landscape and Forestry Master Plan in 1996. In 2019 a full-time urban forester position was created to administer the Community Forestry Program. In 2021, a GIS-based public tree inventory was completed to guide the management of the city's community forest. Having this inventory will allow for real-time understanding of the inventory and needs of the urban forest.

A thriving urban forest offers many advantages to communities including absorption of traffic sounds, cooler temperatures for neighborhoods, reduce energy costs, improving mental and physical health with green space, and mitigating effects of climate change as trees absorb carbon dioxide in the atmosphere (The Arbor Day Foundation). La Grande's Urban Forestry Division mission states, "preserve and protect the beautiful, majestic trees we have and to plant more, up to 100 a year, so that we keep the marvelous tree-lined streets and wonderful parks that we love today, and our grandchildren will enjoy in the future." La Grande's Community Forestry Ordinance, Ordinance 3244 (Series 2019) established policies, regulations and standards to ensure that the city will continue to receive benefits provided by its community forest. This ordinance includes pest control. Further, the Community Forestry Program forms the basis for mitigation of aspects of the natural hazard at the city level.

Future Climate Variability

Changes in climate and atmospheric concentrations of carbon dioxide can affect the distribution and population dynamics of native and non-native species of animals and plants that are considered to be invasive or pests in natural and agricultural systems. Non-native invasive plants in Union County are likely to become more prevalent in response to projected increases in temperature and the frequency, duration, and severity of drought. However, many of these responses are uncertain, are likely to vary locally, and may change over time. (Dalton et al., 2023)

Probability Assessment

Based on the available data and research for La Grande the NHMP Steering Committee determined the **probability of experiencing invasive species and insect pests' activity is "medium,"** meaning one incident is likely within the next 35 to 75-year period.

Vulnerability Assessment

The forest managers and ranchers of Northeast Oregon recognize the risk to timber and pasture resources as well as animal health from the spread of noxious weeds and insect pests to timber species.

Noxious weeds have become so thoroughly established and spreading rapidly on private, state, county, and federally owned lands and thus declared a threat to public welfare, according to ODA (2022). Depending on the species and location, invasive plants can affect food chain dynamics; change habitat composition; increase wildfire risk; reduce productivity of commercial forestlands, farmlands, and rangelands; modify soil chemistry; accelerate soil erosion; and reduce water quality.

According to the U.S. Department of Agriculture, insects, diseases, and other disturbance agents cause significant tree mortality, growth loss, and damage in Oregon forests each year. Large outbreaks can affect the function and resilience of forest ecosystems and may contribute to hazardous forest fire conditions. However, these agents also play a critical role in maintaining healthy, functioning forests by contributing to decomposition, nutrient cycling, and creating openings that enhance forest diversity and wildlife habitat. A healthy forest is dynamic and includes insects, diseases, and natural wildfire cycles. However, in recent years climate change impacts such as ongoing hot droughts have increased susceptibility to opportunistic insect and disease agents.

When it comes to insect pests, the EAB has caused over $2 billion in damages in the eastern U.S. Most of the costs are from losses in residential property values, tree removal and replanting in urban areas. EAB moves quickly; it can cause nearly complete mortality of ash trees within about 10 years after detection.

Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of a natural disaster, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies and organizations. These activities and resources are highlighted in the Mitigation Strategy (Chapter 4).

Severe Weather

Significant Changes Since Previous Plan:

The Severe Weather hazard encompasses three different hazards – extreme heat, windstorm, and winter storm. This section has been reformatted and updated to include new history and additional information, since the last plan.

Causes and Characteristics

Severe Weather hazards are common in La Grande and can include extreme temperatures (heat and cold), windstorms, and winter storms.

Extreme Heat

Northeast Oregon can be a place of extreme temperatures events. From extreme cold spells to extreme heat waves, extreme temperatures events have the potential to inflict serious health damage. According to FEMA, in extreme temperature environments the body must work harder to maintain a normal temperature, these conditions can induce health related illnesses, particularly among vulnerable people. Extreme heat is addressed here under the Extreme Temperature heading while extreme cold is addressed under Winter Storm.

North American summers are hot; most summers see heat waves in one or more parts of the United States. East of the Rockies, they tend to combine both high temperature and high humidity; although some of the worst heat waves have been catastrophically dry, according to NOAA's *Heat Wave: A Major Summer Killer*. Temperatures in Union County, including La Grande, fluctuate greatly between seasons as well as day versus night temperature. Summer temperatures can reach a maximum of more than 100 degrees, with averages of 75-86 degrees from June through August.

According to the *Fifth Oregon Climate Assessment* (2021), "Extreme (H)eat (t)he frequency and magnitude of days that are warmer than 90°F is increasing across Oregon. During summer, relative increases in nighttime minimum temperatures have been greater than those in daytime maximum temperatures. The frequency, duration, and intensity of extreme heat events is expected to increase throughout the state during the twenty-first century."

The definition of extreme heat varies by region; however, in general a heat wave is a prolonged period of extreme heat for several days to several weeks. High temperatures are also often combined with excessive humidity, according to FEMA's *Are You Ready? 2.6 Extreme Heat*. Heat is considered the silent killer, affecting the lives and health of people across the country. According to the Centers for Disease Control and Prevention, an average of 702 heat-related deaths occurs each year in the U.S (NOAA, Excessive heat, a 'silent killer', 2014). Heat is the number one weather-related killer in the United States, resulting in hundreds of fatalities each year. In fact, on average, excessive heat claims more lives each year than floods, lightning, tornadoes and hurricanes combined (NOAA, *Heat Wave: A Major Summer Killer*).

According to NOAA's Heat Index, heat waves form when high pressure aloft (approximately 10,000 to 25,000 feet above the earth surface) strengthens and remains over a region for several days up to several weeks. This is common in summer. Weather patterns in the summer are slower to change compared to winter, and thus the mid-level high pressure also moves slowly. Under high pressure, the air subsides or sinks toward the earth's surface. This sinking air acts as a dome capping the atmosphere. This cap then traps heat instead of allowing it to rise, which limits convection. The result is a build-up of heat at the earther's surface.

Windstorm

Extreme winds occur throughout Oregon and can occur in summer and winter. A windstorm is a short duration event involving straight-line winds and/or gusts more than 50 mph. The most persistent high winds take place along the Oregon Coast and in the Columbia River Gorge, with the Columbia River Gorge being the most significant east-west gap in the Cascade Range between California and Canada. Extreme weather events, however, occur in all regions of Oregon, according to the *2020 Oregon NHMP*. West winds generated from the Pacific Ocean are strongest along the coast and slow down inland due to the obstruction of the Oregon Coast Range. Prevailing winds in Oregon vary with the seasons. In summer, the most common wind directions are from the west or northwest; in winter, they are from the south and east. Local topography, however, plays a major role in affecting wind direction.

Types of Windstorms

The NOAA National Severe Storms Laboratory's *Severe Weather 101* site describes the following eight types of damaging winds.

Straight-line wind: Straight-line wind is a term used to define any thunderstorm wind that is not associated with rotation and is used to differentiate from tornadic winds.

Downdraft: A downdraft is a small-scale column of air that rapidly sinks toward the ground.

Macroburst: A macroburst is an outward burst of strong winds at or near the surface with horizontal dimensions larger than 4 km (2.5 mi) and occurs when a strong downdraft reaches the surface. Macroburst winds may begin over a smaller area and then spread out over a wider area, sometimes producing damage like a tornado. Although usually associated with thunderstorms, macrobursts can occur with showers too weak to produce thunder.

Microbrust: A microburst is a small, concentrated downburst that produces an outward burst of strong winds at or near the surface. Microbursts are small — less than 4 km across — and short-lived, lasting only five to 10 minutes, with maximum windspeeds sometimes exceeding 100 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.

Downburst: A downburst is the general term used to broadly describe macro and microbursts. Downburst is the general term for all localized strong wind events that are caused by a strong downdraft within a thunderstorm, while microburst simply refers to an especially small downburst that is less than 4 km across.

Gust Front: A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.

Derecho: Derecho is a widespread, long-lived windstorm that is associated with a band of rapidly moving showers or thunderstorms. A typical derecho consists of numerous microbursts, downbursts, and downburst clusters. If the wind damage swath extends more than 240 miles (about 400 kilometers) and includes wind gusts of at least 58 mph (93 km/h) or greater along most of its length, then the event may be classified as a derecho.

Haboob: A haboob is a wall of dust that is pushed out along the ground from a thunderstorm downdraft at high speeds.

Tornadoes

The NOAA National Severe Storms Laboratory's site, identifies tornadoes as the following:

A tornado is a narrow, violently rotating column of air that extends from a thunderstorm to the ground. Because wind is invisible, it is hard to see a tornado unless it forms a condensation funnel made up of water droplets, dust and debris. Tornadoes can be among the most violent phenomena of all atmospheric storms we experience.

Although rare, tornados can and do occur in Oregon. Tornadoes are the most concentrated and violent storms produced by the earth's atmosphere. They are created by a vortex of rotating winds and strong vertical motion, which possess remarkable strength and cause widespread damage. Wind speeds more than 300 mph have been observed within tornadoes, and it is suspected that some tornado winds exceed 400 mph. The low pressure at the center of a tornado can destroy buildings and other structures.

Tornadoes are most common in the Midwest and are more infrequent and generally small west of the Rockies. Nonetheless, Oregon and other western states have experienced tornadoes on occasion, many of which have produced significant damage and occasionally injury or death. Oregon's tornadoes can be formed in association with large Pacific storms arriving from the west. Most of them, however, are caused by intense local thunderstorms. These storms also produce lightning, hail, and heavy rain, and are more common during the warm season from April to October (Taylor et al., 1996). The relatively low population in Northeast Oregon may cause many tornadoes to go unreported.

Table 3-12. Estimating Wind Speeds with Visual Clues

Estimating Wind Speeds with Visual Clues			
Beaufort number	Description	Speed	Visual Clues and Damage Effects
0	Calm	Calm	Calm wind. Smoke rises vertically with little if any drift.
1	Light Air	1 to 3 mph	Direction of wind shown by smoke drift, not by wind vanes. Little if any movement with flags. Wind barely moves tree leaves.
2	Light Breeze	4 to 7 mph	Wind felt on face. Leaves rustle and small twigs move. Ordinary wind vanes move.
3	Gentle Breeze	8 to 12 mph	Leaves and small twigs in constant motion. Wind blows up dry leaves from the ground. Flags are extended out.
4	Moderate Breeze	13 to 18 mph	Wind moves small branches. Wind raises dust and loose paper from the ground and drives them along.
5	Fresh Breeze	19 to 24 mph	Large branches and small trees in leaf begin to sway. Crested wavelets form on inland lakes and large rivers.
6	Strong Breeze	25 to 31 mph	Large brances in continous motion. Whistling sounds heard in overhead or nearby power and telephone lines. Umbrellas used with difficulty.
7	Near Gale	32 to 38 mph	Whole trees in motion. Inconvenience felt when walking against the wind.
8	Gale	39 to 46 mph	Wind breaks twigs and small branches. Wind generally impedes walking.
9	Strong Gale	47 to 54 mph	Structural damage occurs, such as chimney covers, roofing tiles blown off, and television antennas damaged. Ground is littered with many small twigs and broken branches.
10	Whole Gale	55 to 63 mph	Considerable structural damage occurs, especially on roofs. Small trees may be blown over and uprooted.
11	Storm Force	64 to 75 mph	Widespread damage occurs. Larger trees blown over and uprooted.
12	Hurricane Force	over 75 mph	Severe and extensive damage. Roofs can be peeled off. Windows broken. Trees uprooted. RVs and small mobile homes overturned. Moving automobiles can be pushed off the roadways.

Sources: National Weather Service Weather Forecast Office Portland, OR

Winter Storm

Winter storms occur over Northeastern Oregon regularly during December through February (Taylor et al., 1999) and the region is known for cold, snowy winters. Three basic ingredients are necessary to make a winter storm, according to NOAA National Severe Storms Laboratory.

- **Cold air**. Below freezing temperatures in the clouds and near the ground are necessary to make snow and/or ice.
- **Lift**. Something to raise the moist air to form the clouds and cause precipitation. An example of lift is warm air colliding with cold air and being forced to rise over the cold dome. The boundary between the warm and cold air masses is called a front. Another example of lift is air flowing up a mountainside.

- **Moisture**. To form clouds and precipitation. Air blowing across a body of water, such as a large lake or the ocean, is an excellent source of moisture.

With the three basic ingredients necessary to have a winter storm, there are then three types of winter precipitation that can be created, which include snow, sleet, and freezing rain.

Types of Winter Storms

The principal types of winter storms that occur include the following:

Snowstorms. Snowstorms require three ingredients of cold air, moisture, and air disturbance. The result is snow, small ice particles that fall from the sky. In Oregon, the further inland and north one moves, the more snowfall can be expected. Blizzards are included in this category.

Ice storms. Ice storms are a type of winter storm that forms when a layer of warm air is sandwiched by two layers of cold air. Frozen precipitation melts when it hits the warm layer and refreezes when hitting the cold layer below the inversion. Ice storms can include sleet (when the rain refreezes before hitting the ground) or freezing rain (when the rain freezes once hitting the ground). Of these, freezing rain can be the most damaging of ice formations. An ice storm is significant with ice accumulations of 0.25 inches or greater, according to FEMA's National Risk Index.

Extreme Cold. Dangerously low temperatures accompany many winter storms. This is particularly dangerous because snow and ice storms can cause power outages, damage agricultural crops, create breaks in water lines that serve schools, businesses, industry and individual homes.

Location and Extent

Extreme Heat

The most severe impact of extreme heat affects peoples' health directly. Most heat disorders occur because the victim has been overexposed to heat or has over-exercised for his or her age and physical condition. Older adults, young children, and those who are sick, or overweight are more likely to succumb to extreme heat (FEMA, *Are You Ready? 2.6 Extreme Heat)*.

According to the FEMA, "[C]onditions that can induce heat-related illnesses include stagnant atmospheric conditions and poor air quality. Consequently, people living in urban areas may be at greater risk from the effects of a prolonged heat wave than those living in rural areas. Also, asphalt and concrete store heat longer and gradually release heat at night, which can produce higher nighttime temperatures known as the "urban heat island effect" (FEMA, *Are You Ready? 2.6 Extreme Heat)*.

With respect to extreme heat, the *Fifth Oregon Climate Assessment* (2021) by OCCRI states,

> The frequency and magnitude of days that are warmer than 90°F is increasing across Oregon. During summer, relative increases in nighttime minimum temperatures have been greater than those in daytime maximum temperatures. The frequency, duration, and intensity of extreme heat events is expected to increase throughout the state during the twenty-first century.

Windstorm

Extreme winds occur throughout Oregon. The most persistent high winds take place along the Oregon Coast and in the Columbia River Gorge. However, extreme weather events occur in all regions of Oregon. West winds generated from the Pacific Ocean are strongest along the coast and slow down inland due to the obstruction of the Coastal Mountain range. Prevailing winds in Oregon vary with the seasons. The most common wind directions in summer months are from the west or northwest; in winter, they are from the south and east. Local topography, however, plays a major role in affecting wind direction.

Union County doesn't see persistent high winds; however, valley areas of the county commonly experience high wind. For example, the residents of Union County's Grande Ronde Valley caution newcomers about living in the vicinity of Ladd Canyon, known for its high winds (2020 Oregon NHMP). In addition, tornado occurrences in Oregon are rare and usually weak, classified as Enhanced Fujita (EF)-0 or EF-1, with Oregon never experiencing a fatal tornado (James, 2023). However, as recent as 2022, Eastern Oregon experienced two tornadoes in Umatilla County, which is northwest of La Grande and Union County. The two tornadoes, classified as EF-1 tornadoes, damaged a manufactured home and a farm building (Arden, 2022). Although windstorms can affect the entirety of the city, they are especially dangerous in developed areas with significant tree stands and major infrastructure, especially above ground utility lines. A windstorm will frequently knock down trees and power lines, damage homes, businesses, public facilities, and create tons of storm related debris.

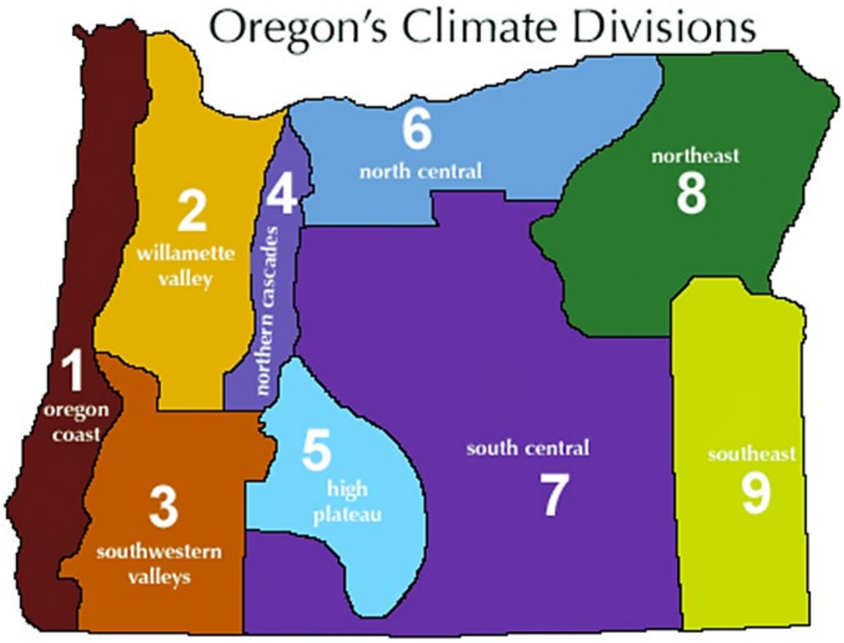
Winter Storm

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. Winter storms occur over Northeastern Oregon regularly from December through February. Northeast Oregon is known for cold, snowy winters. This is advantageous in at least one respect: in general, the region is prepared, and those visiting the region during the winter usually come prepared. However, there are occasions when preparation cannot meet the challenge. Drifting and blowing snow have often brought highway traffic to a standstill. Further, windy, icy conditions have often closed mountain passes and canyons to certain classes of truck traffic. In these situations, travelers must seek accommodation, sometimes in communities where lodging is very limited. Residents also experience issues during winter storms. Power outages, heating, food, and care of livestock and farm animals are a regular concern.

The National Climatic Data Center has established climate divisions in the United States for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the Pacific Ocean give the state diversified climates. Most of Northeast Oregon is in Climate Division 8: Northeast as seen in Figure 3-28. The climate in Division 8 generally consists of snowy winters and dry and hot summers.

Regardless of the Climate Divisions, ice storms can occur anywhere in Oregon. Like snow, ice storms are comprised of cold temperatures and moisture, but subtle changes can result in varying types of ice formation, including freezing rain, sleet, and hail. Freezing rain can be the most damaging of ice formations. While sleet and hail can create hazards for motorists when it accumulates, freezing rain can cause the most dangerous conditions within a community. Ice buildup can bring down trees, communication towers, power lines and wires creating hazards for property owners, motorists, and pedestrians. Snowstorms are common in Eastern Oregon. While snowfall varies by elevation, the average annual snowfall in Union County is 32 inches.

Figure 3-28. Oregon's Climate Divisions



Source: Oregon Climate Service

Identifying Severe Weather

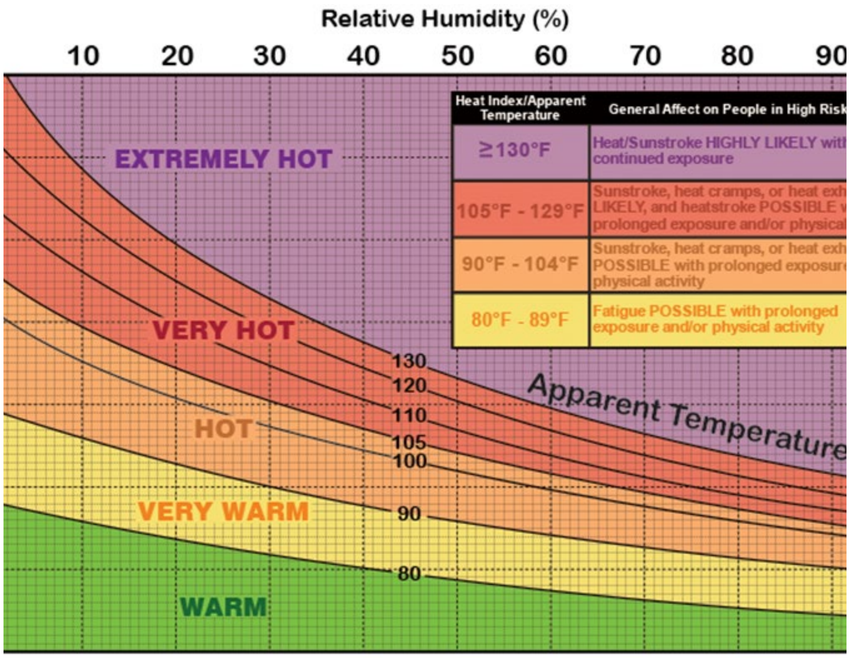
Extreme Heat

NOAA's heat alert procedures are based on Heat Index Values. The Heat Index, sometimes referred to as the apparent temperature, is given in degrees Fahrenheit. The Heat Index is a measure of how hot it really feels when relative humidity is factored with the actual air temperature.

To find the NOAA Heat Index temperature, look at the Heat Index chart below. These values are for shady locations only. Exposure to full sunshine can increase heat index values by up to 15°F (8°C). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous as the wind adds heat to the body. As an example, if the air temperature is 96°F and the relative humidity is 65%, the heat index--how hot it feels--is 121°F. The National Weather Service will initiate alert procedures when the Heat Index is expected to exceed 105˚-110˚F (depending on local climate) for at least two consecutive days (NOAA, Heat Wave: A Major Summer Killer).

NOAA issues excessive heat outlooks for periods of 3-7 days and 8-14 days in advance and provides hourly forecasts, advisories, watches and warnings when dangerous heat becomes or imminent.

Figure 3-29. Heat Index



Source: National Oceanic and Atmospheric Administration, 2023

Windstorms

Windstorms occur frequently in the La Grande area and throughout the year. Incidents occur frequently in the valley with one such example of roofs having been peeled back. It is not unusual to have 30 to 50 mph wind. Their extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain. The NOAA National Severe Storms Laboratory uses weather forecast models to predict oncoming windstorms, while monitoring storms with weather stations in protected valley locations throughout Oregon. Thunderstorms can bring high winds during the warmer months, April to October. Tornadoes are the most violent of windstorms and are occasionally caused by intense local thunderstorms, which are more common during the warm season.

Detection of Damaging Winds: According to the NOAA National Severe Storms Laboratory, severe and damaging wind events are difficult to forecast because any type of thunderstorm – even one that is dying – can produce them. With the doppler radar, meteorologists look for signals in mid and upper levels of thunderstorms. They also look for signals in the environment surrounding the storms, and the behavior of storms. In addition, forecasters must also study the existing atmospheric environment and look for the amounts of dry air, moist air, strength of the updraft, and storm motion.

Detection of Tornadoes: According to the NOAA National Severe Storms Laboratory, when trying to identify a tornado, storm spotters look for a variety of characteristics. These characteristics include inflow bands, beaver's tail, wall cloud, rear flank downdraft, and condensation funnel. In addition, the strength of a tornado is determined by examining the damage caused, which can then estimate wind speed. The Enhanced Fujita (EF) scale is used to rate tornado intensity based on the severity of the damage a tornado causes (Wikipedia, 2023). For more information on these tornado characteristics, visit NOAA National Severe Storms Laboratory's site https://www.nssl.noaa.gov/education/svrwx101/tornadoes/. There are two types of tornado warnings: tornado watch and tornado warning.

Winter Storm

The magnitude or severity of severe winter storms is determined by several meteorological factors including the amount and extent of snow or ice, air temperature, wind speed, and event duration. Precipitation, an additional element of severe winter storms, is measured by gauging stations. The National Weather Service monitors the stations and provides public warnings on storm, snow, and ice events as appropriate.

Detection of Winter Storms: According to the NOAA National Severe Storms Laboratory, winter weather and storms use a variety of tools to forecast winter weather and storms. As identified on NOAA National Severe Storms Laboratory's Severe Weather 101 site, these tools are satellite images, radar, NWS's dual-polarized radars, doppler radar, radar velocities, and automated surface observing systems.

The following is a list from NOAA National Severe Storms Laboratory's Severe Weather 101 site: blizzard warning, winter storm warning, winter storm watch, winter storm outlook, winter weather advisories, lake effect snow warning, lake effect snow advisory, wind chill warning, wind chill advisory, dense fog advisory, snow flurries, snow showers, and blowing snow.

History

Severe weather incidents have historically been a threat to Union County, including La Grande. The following lists the most significant severe weather storms to impact Northeast Oregon (Region 7 of the *2020 Oregon NHMP*).

Table 3-13. Historic Severe Weather in Region 7

Year	Location	Description
Extreme Heat		
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.
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 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 between 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.
Aug. 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.

Year	Location	Description
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.
June-July 2021	Statewide	Record high temperatures in Pacific Northwest for multiple days has been attributed to several deaths.
July-Aug. 2022	Statewide	Across the region, multiple areas in the lower elevations reached critical thresholds for heat risk, while many mountain zones saw consecutive days with high temperatures exceeding 95 degrees Fahrenheit.
Windstorm		
Apr. 1931	Northeast Oregon	Unofficial wind speeds reported at 78 mph; damage to fruit orchards and timber
Nov. 10-11, 1951	Statewide	Widespread damage; transmission and utility lines; wind speed 40–60 mph; gusts 75–80 mph
Dec. 1951	Statewide	Wind speed 60 mph in Willamette Valley; 7-mph gusts; damage to buildings and utility lines
Dec. 1955	Statewide	Wind speeds 55–65 mph with 69-mph gusts; considerable damage to buildings and utility lines
Nov. 1958	Statewide	Wind speeds at 51 mph with 71-mph gusts; every major highway blocked by fallen trees
Oct. 1962	Statewide	Columbus Day Storm; Oregon's most destructive storm to date; 116-mph winds in Willamette Valley; estimated 84 houses destroyed, with 5,000 severely damaged; total damage estimated at $170 million
Mar. 1971	Most of Oregon	Greatest damage in Willamette Valley; homes and power lines destroyed by falling trees; destruction to timber in Lane County
Jan. 1986	Northeast Oregon	Wind gusts 80–90 mph; heavy drifting snow in Ladd Canyon (Union County)
Dec. 1990	Wallowa County	Severe windstorm
Mar. 1991	Northeast Oregon	Severe windstorm
Dec. 1991	Northeast Oregon	Severe windstorm
Dec. 1992	Northeast Oregon mtns.	Severe windstorm
May 2003	Union County	$1,000 in property damage
June 2003	Wallowa County	$1,000 in property damage
July 2003	Union County	$30,000 in property damage
Oct. 2003	Wallowa County	$1,000 in property damage
Oct. 2003	Union County	$2,000 in property damage
Jan. 2004	Grant and Wallowa Counties	$500 in property damage
Feb. 2004	Union	$1,000 in property damage
Mar. 2004	Union County	$200 in property damage
July 2004	Union County	$300,000 in property damage
Nov. 2004	Union County	$1,000 in property damage
Jan. 2005	Union County	$10,000 in property damage
Nov. 2005	Union County	$100 in damages from a strong windstorm
Nov. 2006	Union and Wallowa Counties	$35,000 in damages from a windstorm with wind speeds measured at 80 mph; Morrow and Umatilla Counties also affected, causing a total storm damage of $70,000
Nov. 2007	Wallowa County	$500,000 in damages from a windstorm near Wallowa Lake State Park

Year	Location	Description
July 2011	Union County	$2,000 in property damage
July 2014	Northeast Oregon	Upper-level low moved further inland providing strong to isolated severe weather across northeast Oregon. Wind damage reported near La Grande with this storm.
Dec. 2014	Grande Ronde Valley	Strong wind throughout central and eastern Oregon including the Blue Mountain and Grande Ronde Valley. A gust of 60 mph across the Grand Ronde Valley in Ladd and Pyles Canyon was reported.
May 2015	Union County	Severe thunderstorms, main threats include wind (64-68 mph) and large hail (0.88-1.75 inches). Funnel cloud spotted 3 miles north of La Grande.
Jan. 2017	Grande Ronde Valley	High winds and blizzard conditions associated with severe winter storm
Feb. 2018	Northeast Oregon	A Pacific storm system moved across the region causing strong winds over a good portion of the area.
April 2018	Grande Ronde Valley	High winds, dust storm
Dec. 2018	Grande Ronde Valley	Strong winds created localized areas of significant damaging winds in the foothills of the Blue Mountains and Grande Ronde Valley. Interstate 84 was closed for several hours between Pendleton and La Grande after a tractor trailer was blown over coming off the Blue Mountains toward Pendleton (winds were about 90 mph about the time of accident).
Apr. 2019	Curry, Douglas, Linn, Wheeler, Grant, and Umatilla	FEMA-4452-DR: Severe storms, straight-line winds, flooding, landslides, and mudslides
Dec. 2019	Grande Ronde Valley	Strong gradient winds produced gust more than 60 mph at the La Grande Airport.
Feb. 2020	Regions 5 and 7: Umatilla, Union, Wallowa Counties	FEMA-4519-DR: Severe storms, tornadoes, straight-line winds and flooding
Dec. 2022	Northeast Oregon mtns	Deep low-pressure system accompanied by a strong low-level jet causing widespread strong wind gusts
Winter Storm		
Dec. 1861	Statewide	Storm produced 1–3 feet of snow throughout Oregon
Dec. 1892	Northern Oregon Counties	15–30 inches of snow fell throughout the northern counties
Jan. 1916	Statewide	Two storms; heavy snowfall, especially in mountainous areas
Jan. and Feb. 1937	Statewide	Deep snow drifts
Jan. 1950	Statewide	Record snowfalls; property damage throughout state.
Mar. 1960	Statewide	Many automobile accidents; two fatalities
Jan. 1969	Statewide	Heavy snow throughout state
Jan. 1980	Statewide	Series of string storms across state; many injuries and power outages
Feb. 1985	Statewide	2 feet of snow in northeast mountains; downed power lines; fatalities reported
Feb. 1986	Northeast Oregon mtns,	Heavy snow; school closures; traffic accidents; broken power lines
Dec. 1988	Northeast Oregon mtns	Three blizzards in a 4-week period; 15-foot drifts; wind over 60 mph
Feb. 1990	Statewide	Heavy snow throughout state

Year	Location	Description
Jan. 1994	Northeast Oregon mtns	Heavy snow throughout region
Jan. 1998	Northeast Oregon	Heavy snow throughout region
Winter 1998-99	Statewide	One of the snowiest winters in Oregon history (snowfall at Crater Lake: 586 inches)
Dec.28, 2003 – Jan. 9, 2004	Statewide	DR-1510. Grant, Union, and Wallowa Counties declared in Region 7. The most significant winter storm in several years brought snowfall to most of Oregon. 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. 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.
Jan. 2004	Union County	Severe winter storm, one fatality
Jan. 2 – Feb. 9, 2008	Union, Grant, and Baker, Counties	Heavy snow and freezing rain across eastern Oregon; 5–13 inches of snow
Nov. 2014	Central and Eastern Oregon	Heavy snow and ice from freezing rain. Significant accumulation in parts of the region.
Dec. 2014	Northeast Oregon	Heavy snow and significant accumulation.
Dec. 6-23, 2015	Statewide	DR-4258. Clatsop, Columbia, Multnomah, Clackamas, Washington, Tillamook, Yamhill, Polk, Lincoln, Linn, Lane, Douglas, Coos, and Curry Counties declared. Several pacific storm systems moved across the region over the Dec 12-13 weekend. 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 9.0" 6 miles east-southeast of Granite. 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 in Wallowa County.
Dec. 2016- Jan. 2017	Northeast Oregon	Heavy snow
Jan. 2017	Northeast Oregon	Severe winter storms including significant snow, high winds and blizzard conditions. Union County declared an emergency due to severe winter conditions that made many roads impassable for extended periods of time due to blowing and drifting snow. Several buildings also experienced structural failure due to snow loading.
Feb. 8-9, 2017	Grant County (Central Oregon, Ochoco-John Day Highlands)	A strong Pacific storm system brought snow, sleet, and freezing rain to many areas of the Interior Northwest February 7th through 9th.
Dec. 2017	Northeast Oregon	Heavy snow
Jan. 2019	Northeast Oregon	Heavy snow in Blue Mountains and the Grande Ronde Valley. Highway 395 between Pilot Rock and John Day was closed for several hours due to very heavy snowfall rates and poor visibility.

Year	Location	Description
Feb. 22-26, 2019	Grant, Baker, and Union Counties (Central Oregon, Blue Mountains, Grand Ronde Valley, John Day Basin)	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 enhanced over central Oregon with the proximity of a nearly stationary surface boundary where snowfall rates were more than 1 inch per hour. 26 inches in Meacham, 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.
Dec. 2019	Northeast Oregon	Heavy snow. Localized blizzard in Grand Ronde Valley with strong winds 50-55 mph.
Feb. 2020	Northeast Oregon	Heavy snow, significant accumulation. This was the precursor to significant flooding that occurred later that week when the snow melted due to warm-up and heavy rains.
Feb. 2021	Northeast Oregon	Heavy snow, several storms throughout the month, significant accumulation.
Dec. 2021	Northeast Oregon	Heavy snow
Jan. 2022	Eastern Oregon and Washington	Prolonged storms lead to moderate to heavy snow storms each day. Some freezing rain at lower elevations. Strong winds. I-84 and several state and U.S. highways in Oregon and Washington closed for extended periods of time.
Apr. 2022	Eastern Oregon and Washinton	Significant snow accumulations in some mountain zones.
Nov. 2022	Northeast Oregon	Moderate to heavy snow accumulations primarily in mountain zones.

Sources: *2020 Oregon NHMP*; *2022 Union County NHMP;* National Oceanic and Atmospheric Administration Storm Search

La Niña / El Niño

El Niño Southern Oscillation (ENSO) weather patterns can increase the frequency and severity of drought. La Niña is an oceanic and atmospheric phenomenon that is the colder counterpart of El Niño, as part of the broader El Niño–Southern Oscillation (ENSO) climate pattern. El Niño and La Niña can be indicators of weather changes across the globe. El Niño is discussed more in the Drought Hazard.

La Niña is the cold phase of the broader El Niño–Southern Oscillation (ENSO) weather phenomenon, as well as the opposite of El Niño weather pattern. The movement of so much heat across a quarter of the planet, and particularly in the form of temperature at the ocean surface, can have a significant effect on weather across the entire planet. During the La Niña period, the sea surface temperature across the eastern equatorial part of the central Pacific Ocean will be lower than normal. La Niña causes above-average precipitation across the Pacific Northwest's southern and eastern regions. The appearance of La Niña often persists for longer than five months. La Niña events have been observed for hundreds of years and occurred on a regular basis during the early parts of both the 17th and 19th centuries. More recently, La Niña events have occurred during the following years since the last NHMP update: 2016, 2017–18, and 2020–23 (Wikipedia, 2023).

Future Climate Variability

Extreme Heat

The OCCRI *Future Climate Projections Union County, Oregon* report projects that the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Union County, the number of extremely hot days (where temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s. Compared to the 1971-2000 historical baselines, the number of days per year with temperatures 90°F or higher is projected to increase an average of 20 (range 7–35) by the 2050s. The temperature on the hottest day of the year is projected to increase by an average of about 7.8°F (range 3.1–10.8°F) by the 2050s.

Heatwaves are extremely dangerous and the leading cause of weather-related deaths in the United States. Extreme heat events have increased in Oregon, while many residents do not have air conditioning in their homes. This lack of air conditioning leaves these residents more vulnerable to heat-related illnesses and possible death. More vulnerable populations include children, the elderly, or economically disadvantaged communities. Projected demographic changes, such as an increase in the proportion of older adults, will increase the number of people in some populations that are most vulnerable to extreme heat.

Windstorm

The OCCRI *Future Climate Projections Union County, Oregon* report projects that while mean wind speeds and frequency of strong easterly winds during peak wildfire season will decrease, extreme winter wind speeds may increase. These changes in wind patterns will affect natural disturbances, the provision of electricity, transportation safety, and contribute to the spread of wildfires and pollutants.

Winter Storm

The OCCRI *Future Climate Projections Union County, Oregon* report projects cold extreme to become less frequent and intense as the climate warms. However, the frequency of cold extremes decreases at a slower rate than the increase of heat extremes. Cold extremes will diminish as winter temperatures warm and become less variable. It is estimated that the number of cold days (maximum temperature 32°F or lower) per year in Union County will decrease by an average of 19 (range 11-28) by the 2050s, while the temperature on the coldest night of the year is projected to increase by an average of 9.4°F (range 0.6–17.2°F). The number of county residents vulnerable to extreme cold is likely to grow, although the decrease in incidence of cold extremes may offset a percentage of residents affected.

Probability Assessment

Extreme Heat

Based on the available data and research for La Grande the NHMP Steering Committee determined the **probability of experiencing an extreme heat event is “medium,”** meaning one incident is likely within the next 35 to 75-year period

Windstorm

Windstorms in Union County and La Grande occur throughout the year, and their extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain. Summer thunderstorms may also bring high winds along with heavy rain and/or hail. Winter storms may bring high winds along with heavy snow fall and blizzard conditions. The National Weather Service uses weather forecast models to predict oncoming windstorms, while monitoring storms with weather stations in protected valley locations throughout Oregon.

Table 3-14 shows the wind speed probability intervals that structures 30 feet above the ground would expect to be exposed to within a 25, 50 and 100-year period. The 100-year event for a windstorm in Region 7 is 1-minute average winds of 90 mph. A 50-year event has average winds of 80 mph. A 25-year event has average winds speeds of 70 mph.

Table 3-14. Probability of Severe Wind Events (Region 7)

Location	25-Year Event *(4% annual probability)*	50-Year Event *(2% annual probability)*	100-Year Event *(1% annual probability)*
Region 7 - Northeast Oregon	70 mph	80 mph	90 mph

Source: 2020 Oregon NHMP
Note: One-minute average, 30 feet above the ground

Based on the available data and research for La Grande the NHMP Steering Committee determined the **probability of experiencing a windstorm is “medium,”** meaning one incident is likely within the next 35 to 75-year period.

Winter Storm

Winter storms occur annually in Union County and La Grande. Based on historical data, severe winter storms could occur about every year in this region. It is expected that annual storm events in this region will continue. However, there is no solid statistical data available upon which to base these judgments. There is no statewide program to study the past, present, and potential impacts of winter storms in the state of Oregon currently.

Based on the available data and research for La Grande the NHMP Steering Committee determined the **probability of experiencing a winter storm is “high,”** meaning one incident is likely within the next 35-year period.

Vulnerability Assessment

Extreme Heat

Vulnerability is defined as the combination of sensitivity to extreme heat and level of adaptive capacity in response to extreme heat. Extreme heat requires the body to work extra hard to maintain a normal temperature, which can lead to death. Extreme heat is responsible for the highest number of annual deaths among all weather-related hazards. Older adults, children and sick or overweight individuals are at greater risk from extreme heat, according to FEMA.

Extreme temperature events have frequently occurred in Union County. However, extreme heat events in the past caused few minor injuries to the health and safety of La Grande residents. However, the potential for injuries or deaths in future events could escalate increasing the occurrence and seriousness of possible injuries or death. During the June 2021 extreme heat event, a total of 123 heat related deaths in the Pacific Northwest were reported resulting from limited access to air-conditioning and an increase in the number of drownings when residents sought relief in bodies of water. Widespread business closures and event postponements occurred. It is estimated that approximately 1 to 10% of La Grande's population would be physically displaced by an extreme heat event, likely those individuals who seek refuge in a cooling center, and there would be mild impact on community social networks.

According to the Agency for Toxic Substances and Disease Registry (in collaboration with the Center for Disease Control and Prevention) 2020 Social Vulnerability Index (SVI), Union County has low levels of social vulnerability. Vulnerability in Union County is driven by a higher poverty rate, the share of multi-unit structures, the percentage of people living in institutionalized group quarters, and the percentage of occupied housing units with more people than rooms

Adaptive capacity to extreme heat is defined here as the percentage of homes with air conditioning; however, the authors note that this measure has its flaws. First, it assumes that people who have access to cooling systems are able to afford to use them. Second, the data only includes single-family homes, which omits populations living in multi-family housing or who are house-less.

Although Union County has experienced extreme heat, many people may not be accustomed or prepared in terms of air conditioning when an extreme heat event occurs. According to Northwest Energy Efficiency Alliance, in Cooling Zones 1 and 2, which include Union County, just over half of single-family homes have air-conditioning (https://neea.org/img/uploads/Residential-Building-Stock-Assessment-II-Single-Family-Homes-Report-2016-2017.pdf).

The *2020 Oregon NHMP* found that the relative vulnerability to extreme heat by Union County residents was "moderate." including adding the rankings for sensitivity (social vulnerability) and adaptive capacity (air conditioning).[14] The *2020 Oregon NHMP* states,

> **Region 7 counties did not rank vulnerability to extreme heat.**
>
> As with drought, prolonged elevated temperatures pose risks to agriculture, involving the health and welfare of farmers and other farm workers, crops and livestock. In hotter conditions, crops, livestock and humans require more water. For example, on average, for each degree Fahrenheit increase in temperature, plants use 2.5% - 5% more water. High temperature and insufficient water stunt plant growth and cause areas of crops to wither. Some livestock, especially dairy

[14] The 2020 Oregon NHMP states,

> The relative vulnerability of Oregon counties to extreme heat was determined by adding the rankings for sensitivity (social vulnerability) and adaptive capacity (air conditioning). The sum of the two components ranged from 1 to 10. Rankings were determined as follows: total vulnerability scores of 1–2 earned a ranking of 1 (very low); scores of 3–4 earned a ranking of 2 (low); scores of 5–6 earned a ranking of 3 (moderate); scores of 7–8 earned a ranking of 4 (high); and scores of 9–10 earned a ranking of 5 (very high). Rankings for NHMP regions are averages of the counties within a region and rounded to the nearest whole number.

cattle, are also sensitive to heat. Milk production decreases and susceptibility to death increases during and for some time after a heat wave. Since risks to human health and welfare are also elevated during heat waves, Oregon and the federal government have regulations and guidelines to help prevent injury to those who work on farms.

Also, like drought, impacts of drought on state-owned facilities related to agriculture may include impacts to research conducted in outdoor settings, such as at extension stations and research farms. However, the appropriate data are not available to assess impacts of heat waves on agriculture and subsequent effects on the state economy.

State-Owned/Leased Buildings and Critical Facilities and Local Critical Facilities

According to the *2020 Oregon NHMP*, the value of state-owned and leased buildings and critical facilities in Region 7 is approximately $186,973,000 representing the total potential for loss of state assets due to extreme heat. The value of locally owned critical facilities is $751,328,000. Because extreme heat could impact the entire region, these figures together represent the maximum potential loss to state assets and local critical facilities due to extreme heat. FEMA funds are rarely used to cover damage to state assets from natural hazards because the state is self-insured. It is unclear from the Oregon Department of Administrative Services'(DAS) records how many losses to state facilities were sustained in Region 7 since the beginning of 2015. Nevertheless, none of the recorded losses was due to extreme heat.

Windstorm

Many buildings, utilities, and transportation systems within Union County, including La Grande, are vulnerable to wind damage. This is especially true in open areas, such as natural grasslands or farmlands. It is also true in forested areas, along tree-lined roads and electrical transmission lines, and on residential parcels where trees have been planted or left for aesthetic purposes. Structures most vulnerable to high winds include insufficiently anchored manufactured homes and older buildings in need of roof repair or roof structures not designed for anticipated wind loads.

Fallen trees are especially troublesome. They can block roads and rails for long periods of time, impacting emergency operations. In addition, up rooted or shattered trees can down power and/or utility lines and effectively bring local economic activity and other essential facilities to a standstill. Much of the problem may be attributed to a shallow or weakened root system in saturated ground.

Windstorms in the past caused multiple minor injuries or a major injury. However, the potential for injuries or deaths from past events or from similar events in other communities could escalate resulting in multiple major injuries or possible death. La Grande estimates that 1 to 10% of the city's population could be physically displaced by a windstorm, accounting for the number of homes that lose power or properties with downed trees; and there would be mild impact on community social networks.

Social Vulnerability

According to the CDC Social Vulnerability Index, Union County has a low level of social vulnerability. Vulnerability in Union County is driven by a higher poverty rate, the share of multi-unit structures, the percentage of people living in institutionalized group quarters, and the percentage of occupied housing units with more people than rooms (*2020 Oregon NHMP*).

Based on information in the *2020 Oregon NHMP*, Union County is vulnerable to damages from windstorms. The people living in institutionalized group quarters in Union County increase the county vulnerability to windstorms. Union, together with Wallowa County is considered the most vulnerable to windstorms in Region 7, followed by Baker County, then Grant County.

State-Owned/Leased Buildings and Critical Facilities and Local Critical Facilities

According to the *2020 Oregon NHMP*, the value of state-owned and leased buildings and critical facilities in Region 7 is approximately $186,973,000 representing the total potential for loss of state assets due to windstorms. The value of locally owned critical facilities is $751,328,000. Because windstorms could impact the entire region, these figures together represent the maximum potential loss to state assets and local critical facilities due to windstorms. Because the state is self-insured, FEMA funds are rarely used to cover damage to state assets from natural hazards. It is unclear from DAS records how many losses to state facilities due to windstorms were sustained in Region 7 since the beginning of 2015. There were two totaling just under $6,500, and possibly two others, one for about $6,200 and the other not yet settled.

The La Grande NHMP Steering Committee rated the city as having a **“moderate” vulnerability to windstorm hazards**, meaning that between 1 to 10% of the city’s population or assets would be affected by a major disaster.

Winter Storm

Union County and La Grande are known for cold, snowy winters. This region is a gateway for neighboring states Washington and Idaho and for the commodity flow to those states. In general, the county is prepared for winter storm events, and those visiting the region during the winter usually come prepared. However, there are occasions when preparation cannot meet the challenge. Drifting and blowing snow have often brought highway traffic to a standstill. Also, windy, icy conditions have often closed mountain passes and canyons to certain classes of truck traffic. In these situations, travelers must seek accommodation, sometimes in communities where lodging is very limited. For residents, heating, food, and the care of livestock and farm animals are everyday concerns. Access to farms and ranches can be extremely difficult and present a serious challenge to local emergency managers.

Winter storms, particularly east of the Cascades where snowstorms are typically more intense, bring larger amounts of snow and last longer. The storms can strand livestock in pastures, leaving them without food and water and exposed to extreme cold for long periods of time. Consequently, substantial losses in livestock from starvation, dehydration and freezing significantly impact producers, and state and local economies. In addition, water quality and health hazards develop when dead livestock are not retrieved until roads are cleared and vehicles can be used to remove the carcasses. Livestock buried under snow may not be found until the snow melts. The snowmelt may carry the carcasses to streams and wash them downstream.

Social Vulnerability

According to the CDC Social Vulnerability Index, Union County has a low level of social vulnerability. Vulnerability in Union County is driven by a higher poverty rate, the share of multi-unit structures, the percentage of people living in institutionalized group quarters, and the percentage of occupied housing units with more people than rooms. While social vulnerability is generally low in this region and the population is prepared for moderate to heavy snowfall, the county has specific vulnerabilities that indicate their populations are more sensitive to the adverse impacts of winter storms. (*2020 Oregon NHMP*).

State-Owned/Leased Buildings and Critical Facilities and Local Critical Facilities

According to the *2020 Oregon NHMP*, the value of state-owned and leased buildings and critical facilities in Region 7 is approximately $186,973,000 representing the total potential for loss of state assets due to winter storms. The value of locally owned critical facilities is $751,328,000. Because winter storms could impact the entire region, these figures together represent the maximum potential loss to state assets and local critical facilities due to windstorms. FEMA funds are rarely used to cover damage to state assets from natural hazards because the state is self-insured. It is unclear from DAS records how many losses to state facilities due to winter storms were sustained in Region 7 since the beginning of 2015. Thirteen losses were due to winter storms statewide. Of those, it is possible that up to four may have been in the Region 7. These claims totaled a little over $72,000.

The La Grande NHMP Steering Committee rated the city as having a **"high" vulnerability to winter storm hazards**, meaning that greater than 10% of the city's population or assets would be affected by a major disaster.

Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of a natural disaster, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies and organizations. These activities and resources are highlighted in the Mitigation Strategy (Chapter 4).

Volcanic Event

Significant Changes Since Previous Plan:

The Volcanic Event Hazard section has been reformatted and expanded with additional information since the previous plan.

Causes and Characteristics

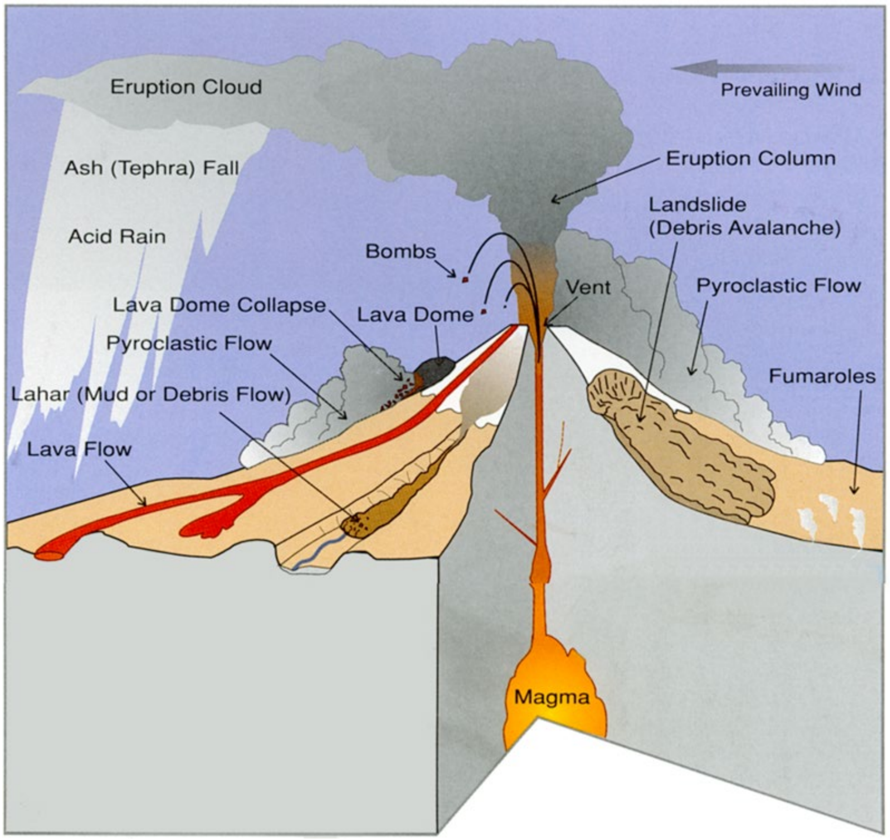
The Pacific Northwest, including Union County and La Grande, lies within the “ring of fire,” an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the ring of fire, in part because of the movement of the Earth’s tectonic plates. The Earth’s outermost shell, the lithosphere, is broken into a series of slabs known as tectonic plates. These plates are rigid, but they float on a hotter, softer layer in the Earth’s mantle. As the plates move about on the layer beneath them, they spread apart, collide, or slide past each other. Volcanoes occur most frequently at the boundaries of these plates and volcanic eruptions occur when molten material, or magma, rises to the surface.

The primary threat to lives and property from active volcanoes is from violent eruptions that unleash tremendous blast forces, generate mud and debris flows, or produce flying debris and ash clouds. The immediate danger area in a volcanic eruption generally lies within a 20-mile radius of the blast site. The following section outlines the specific hazards posed by volcanoes.

According to the USGS General Interest Publication, Volcanoes (Tillings, 1999), volcanoes are commonly conical hills or mountains built around a vent that connect with reservoirs of molten rock below the surface of the earth. Some younger volcanoes may connect directly with reservoirs of molten rock, while most volcanoes connect to empty chambers. Unlike most mountains, which are pushed up from below, volcanoes are built up by an accumulation of their own eruptive products: lava or ash flows and airborne ash and dust. When pressure from gases or molten rock becomes strong enough to cause an upsurge, eruptions occur. Gases and rocks are pushed through the opening and spill over or fill the air with lava fragments. Figure 3-30 diagrams the basic features of a volcano.

Volcanic eruptions often involve several distinct types of hazards to people and property, as well evidenced by the Mount St. Helens eruption. Major volcanic hazards include eruption columns and clouds, volcanic gases, lava flows and domes, pyroclastic flows, volcanic landslides, and lahars, which are described below. Some of these hazards (e.g., lava flows) only affect areas very near the volcano. Other hazards may affect areas 10 to 20 miles away from the volcano, while ash falls may affect areas many miles downwind of the eruption site.

Figure 3-30. Volcanic Hazard from a Composite Type Volcano



Source: Walder, et al., 2000

Eruption Columns and Clouds: An explosive eruption blasts solid and molten rock fragments called tephra and volcanic gases into the air with tremendous force. The largest rock fragments, called bombs, usually fall back to the ground within two miles of the vent. Small fragments (less than 0.1 inch across) of volcanic glass, mineral and rock (ash) rise high into the air forming a huge, billowing eruption column. Eruption columns creating an eruption cloud can grow rapidly and reach more than 12 miles above a volcano in less than 30 minutes. Volcanic ash clouds can pose serious hazards to aviation. Several commercial jets have nearly crashed because of engine failure from inadvertently flying into ash clouds.

Large eruption clouds can extend hundreds of miles downwind resulting in ash fall over enormous areas. Ash from the May 18, 1980 Mt. St. Helens eruption fell over an area of 22,000 square miles in the western U.S. Heavy ash fall, particularly when mixed with rain, can collapse buildings and even a minor ash fall can damage crops, electronics, and machinery.

Ash/Tephra: Tephra consists of volcanic ash (sand-sized or finer particles of volcanic rock) and larger fragments. During explosive eruptions, tephra together with a mixture of hot volcanic gas are ejected rapidly into the air from volcanic vents. Larger fragments fall near the volcanic vent while finer particles drift downwind as a large cloud. When ash particles fall to the ground, they can form a blanket-like deposit, with finer grains carried further away from the volcano. In general, the thickness of ash fall deposits decreases in the downwind direction. Tephra hazards include impact of falling fragments, suspension of abrasive fine particles in the air and water, and burial of structures, transportation routes and vegetation.

According to the *2020 Oregon NHMP*, during an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. The predominant wind pattern over the Cascades is from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes.

Volcanic Gases: Volcanoes emit gases during eruptions. Even when a volcano is not erupting, cracks in the ground allow gases to reach the surface through small openings called fumaroles. More than 90% of all gas emitted by volcanoes is water vapor (steam), most of which is heated ground water. Other common volcanic gases are carbon dioxide, sulfur dioxide, hydrogen sulfide, hydrogen and fluorine. In higher concentrations, these gases can cause corrosion, contaminate domestic water supplies and harm or even kill vegetation, livestock, and people.

Lava Flows and Domes: Lava flows are streams of molten rock that erupt relatively non-explosively from a volcano and move downslope, causing extensive damage or destruction by burning, crushing, or burying everything in their paths. Secondary effects can include forest fires, flooding, and permanent reconfiguration of stream channels, according to the *2020 Oregon NHMP*.

Pyroclastic Flows and Surges: Pyroclastic flows are avalanches of rock and gas at temperatures of 600 to 1500 degrees Fahrenheit. They typically sweep down the flanks of volcanoes at speeds of up to 150 miles per hour. Pyroclastic surges are a diluted 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 sometimes have enough momentum to overtop hills or ridges in their paths. 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 a combination of rock bombs and ash and is termed *ignimbrite.* These deposits may accumulate to hundreds of feet thick and can harden to resistant rock. The climactic eruption of Mount St. Helens generated a series of explosions that formed a huge pyroclastic surge which destroyed an area of 230 square miles and leveled trees six feet in diameter as far as 15 miles from the volcano.

Volcanic Landslides/Debris Avalanches: Volcanic eruptions can be triggered by seismic activity or earthquakes can occur during or after a volcanic eruption. Earthquakes produced by stress changes are called volcano-tectonic earthquakes. These earthquakes, typically small to moderate in magnitude, occur as rock is moving to fill in spaces where magma is no longer present and can cause land to subside or produce large ground cracks (Riley). In addition to being generated after an eruption and magma withdrawal, these earthquakes also occur as magma is intruding upward into a volcano, opening cracks and pressurizing systems (Scott, 2001). Volcano-tectonic earthquakes do not indicate that the volcano will be erupting but can occur at any time and cause damage to manmade structures or provoke landslides. (Wright & Pierson, 1992)

Lahars and Debris Flows: Lahar is an Indonesian term that describes a hot or cold mixture of water and rock fragments flowing down the slopes of a volcano or river valley, according to the USGS Cascades Volcano Observatory. Lahars typically begin when floods related to volcanism are produced by melting snow and ice during eruptions of ice-clad volcanoes like Mount Shasta, and by heavy rains that may accompany eruptions. Floods can also be generated by eruption-caused waves that could overtop dams or move down outlet streams from lakes.

Lahars react much like flash flood events in that a rapidly moving mass moves downstream, picking up more sediment and debris as it scours out a channel. This initial flow can also incorporate water from rivers, melting snow and ice. By eroding rock debris and incorporating additional water, lahars can easily grow to more than ten times their initial size. But as a lahar moves farther away from a volcano, according to USGS Cascades Volcano Observatory, it will eventually begin to lose its heavy load of sediment and decrease in size.

Lahars often cause serious economic and environmental damage. According to USGS, the direct impact of a lahar's turbulent flow front or from the boulders and logs carried by the lahar can easily crush, abrade, or shear off at ground level about anything in the path of a lahar. Even if not crushed or carried away by the force of a lahar, buildings and valuable land may become partially or completely buried by one or more cement-like layers of rock debris. By destroying bridges and key roads, lahars can also trap people in areas vulnerable to other hazardous volcanic activity, especially if the lahars leave deposits that are too deep, too soft, or too hot to cross.

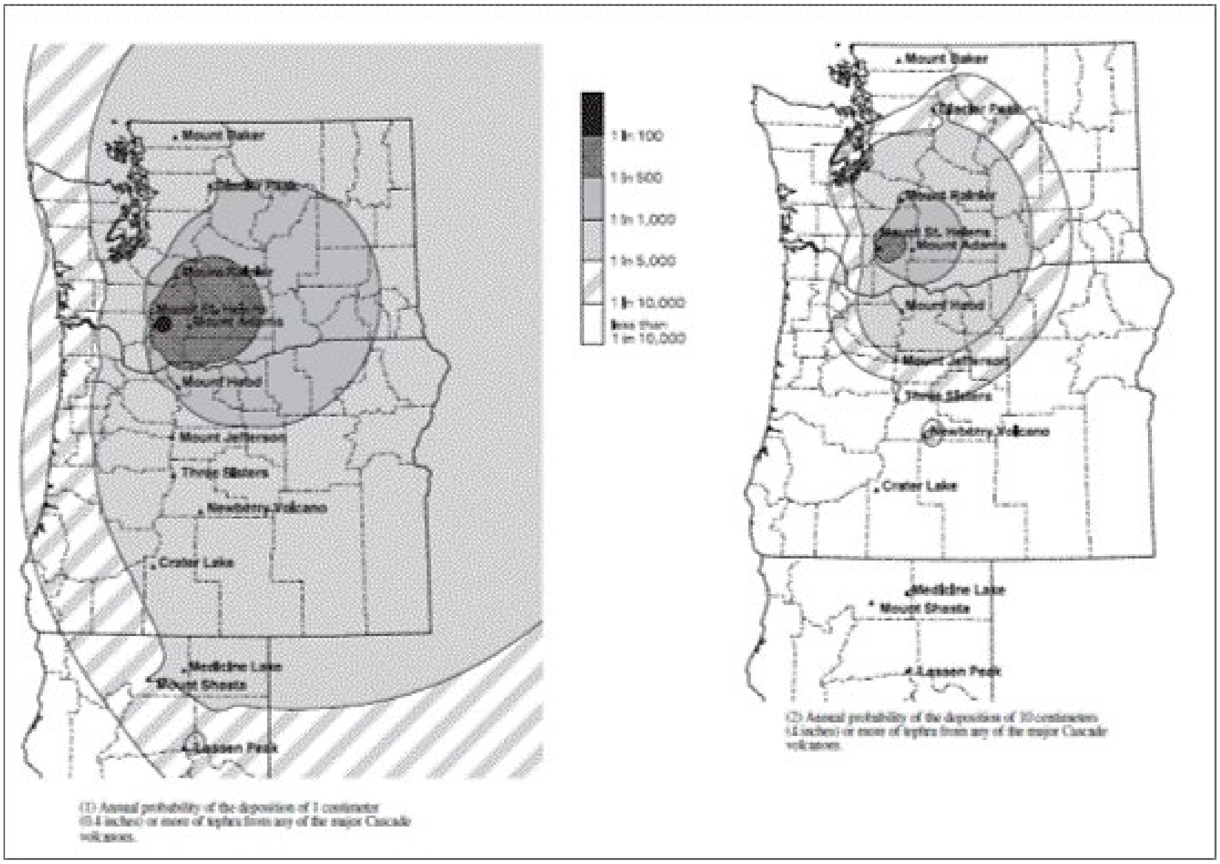
Earthquakes: Volcanic eruptions can be triggered by seismic activity or earthquakes can occur during or after a volcanic eruption. Earthquakes produced by stress changes are called volcano-tectonic earthquakes. These earthquakes, typically small to moderate in magnitude, occur as rock is moving to fill in spaces where magma is no longer present and can cause land to subside or produce large ground cracks (Riley). In addition to being generated after an eruption and magma withdrawal, these earthquakes also occur as magma is intruding upward into a volcano, opening cracks and pressurizing systems (Scott, 2001). Volcano-tectonic earthquakes do not indicate that the volcano will be erupting but can occur at any time and cause damage to manmade structures or provoke landslides.

Location and Extent

Volcanic eruption is not an immediate threat to the residents of La Grande, as there are no active volcanoes within the city. Nevertheless, the secondary threats caused by volcanoes in the Cascade region must be considered. Volcanic ash can contaminate water supplies, cause electrical storms, create health problems, and collapse roofs.

Scientists use wind direction to predict areas that might be affected by volcanic ash; during an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. The predominant wind pattern over the Cascades originates from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes. Regional tephra fall shows the annual probability of ten centimeters or more of ash accumulation from Pacific Northwest volcanoes. Figure 3-31 depicts the potential and geographical extent of volcanic ash fall more than ten centimeters from a large eruption of Mount St. Helens.

Figure 3-31. Regional Tephra-fall Maps



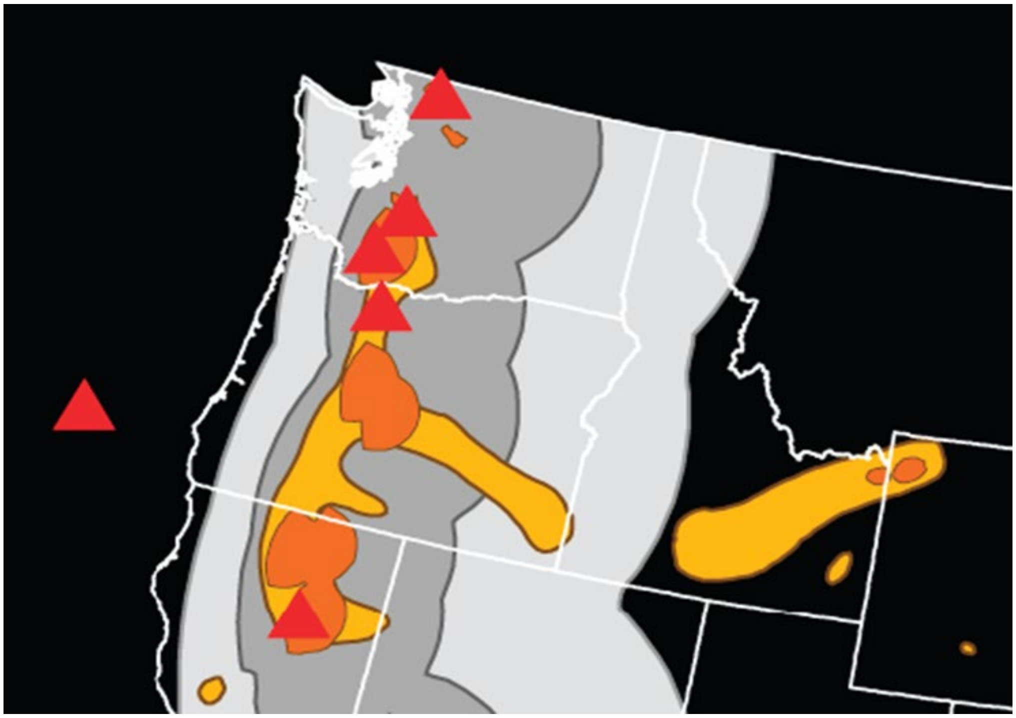
Source: Walder, et al., 2000

Identifying Volcanoes

Communities that are closer to volcanoes may be at risk of the proximal hazards – ash fall, debris avalanches, pyroclastic flows, lahars, and lava flows – as well as the distal hazards – lahars, lava flows, and ash fall. The communities that are farther away are most likely only at risk from the distal hazards (ash fall). Figure 3-32 shows the locations of some of the Cascade Range volcanoes (red triangles) with relative volcanic hazard zones. The dark orange areas have a higher volcanic hazard; light-orange areas have a lower volcanic hazard. Dark-grey areas have a higher ash fall hazard; light-grey areas have a lower ash fall hazard.

Geologic hazard maps have been created for most of the volcanoes in the Cascade Range by the USGS Volcano Program at the Cascade Volcano Observatory in Vancouver, WA and are available at http://vulcan.wr.usgs.gov/Publications/hazards_reports.html.

Figure 3-32. National Volcanic Hazard Map



Source: Image modified from U.S. Geological Survey, 2006
Note: The red triangles are volcano locations. Dark-orange areas have a higher volcanic hazard; light-orange areas have a lower volcanic hazard. Dark-gray areas have a higher ash fall hazard; light-gray areas have a lower ash fall hazard. The information is based on data from the past 10,000 years.

Scientists also use wind direction to predict areas that might be affected by volcanic ash. During an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. The predominant wind pattern over the Cascade Range originates from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes.

Regional tephra fall shows the annual probability of ten centimeters or more of ash accumulation from Pacific Northwest volcanoes. Figure 3-32 above, depicts the potential and geographic extent of volcanic ash fall from several volcanoes in the Pacific Northwest.

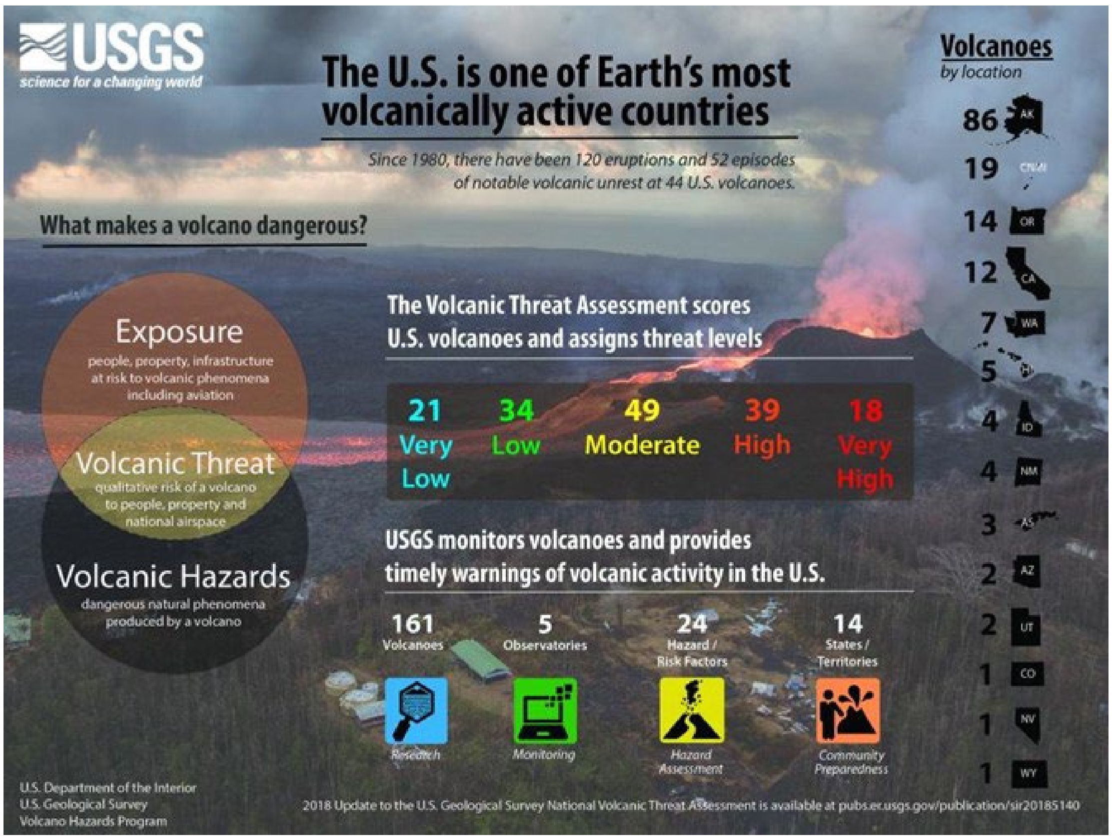
An excellent resource on volcanoes is published by USGS, most recently in 2018, which is called the *National Volcanic Threat Assessment*. The USGS assesses active and potentially active volcanoes in the U.S., focusing on history, hazards and the exposure of people, property and infrastructure to harm during the next eruption. They use 24 factors to obtain a score and threat ranking for each volcano that is deemed potentially eruptible, according to USGS.

In a description on the USGS website "the update names 18 very high threat, 39 high threat, 49 moderate threat, 34 low threat, and 21 very low threat volcanoes. The volcanoes are in Alaska, Arizona, California, Colorado, Hawaii, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, American Samoa and the Commonwealth of the Northern Mariana Islands. The threat ranking is not an indication of which volcano will erupt next. Rather, it indicates how severe the impacts might be from future eruptions at any given volcano."

The USGS website further states, “Since 1980, there have been 120 eruptions and 52 episodes of notable volcanic unrest at 44 U.S. volcanoes. When erupting, all volcanoes pose a degree of risk to people and infrastructure. However, the risks are not equivalent from one volcano to another because of differences in eruptive style and geographic location.”

The USGS describes that the volcanic threat assessment “helps prioritize U.S. volcanoes for research, hazard assessment, emergency planning, and volcano monitoring. It is a way to help focus attention and resources where they can be most effective, guiding the decision-making process on where to build or strengthen volcano monitoring networks and where more work is needed on emergency preparedness and response.”

Figure 3-33. Volcanic Threat Assessment Statistics

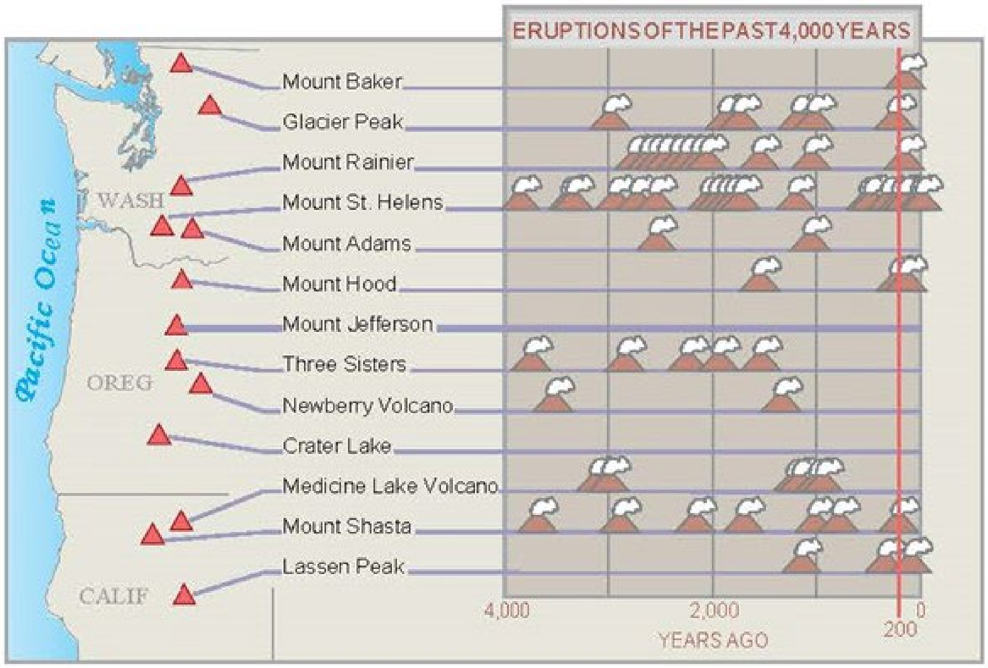


Source: U.S. Geological Survey

History

Although there have been no recent volcanic events in the Marion and Polk County areas, it is important to note the area is active and susceptible to eruptive events since the region is a part of the volcanically active Cascade Range. The 1980 explosion of Mount Saint Helens in southern Washington State is the latest on record. Figure 3-34 displays the potentially active volcanoes of the western United States as identified by the USGS.

Figure 3-34. Potentially Active Volcanoes in the Western United States



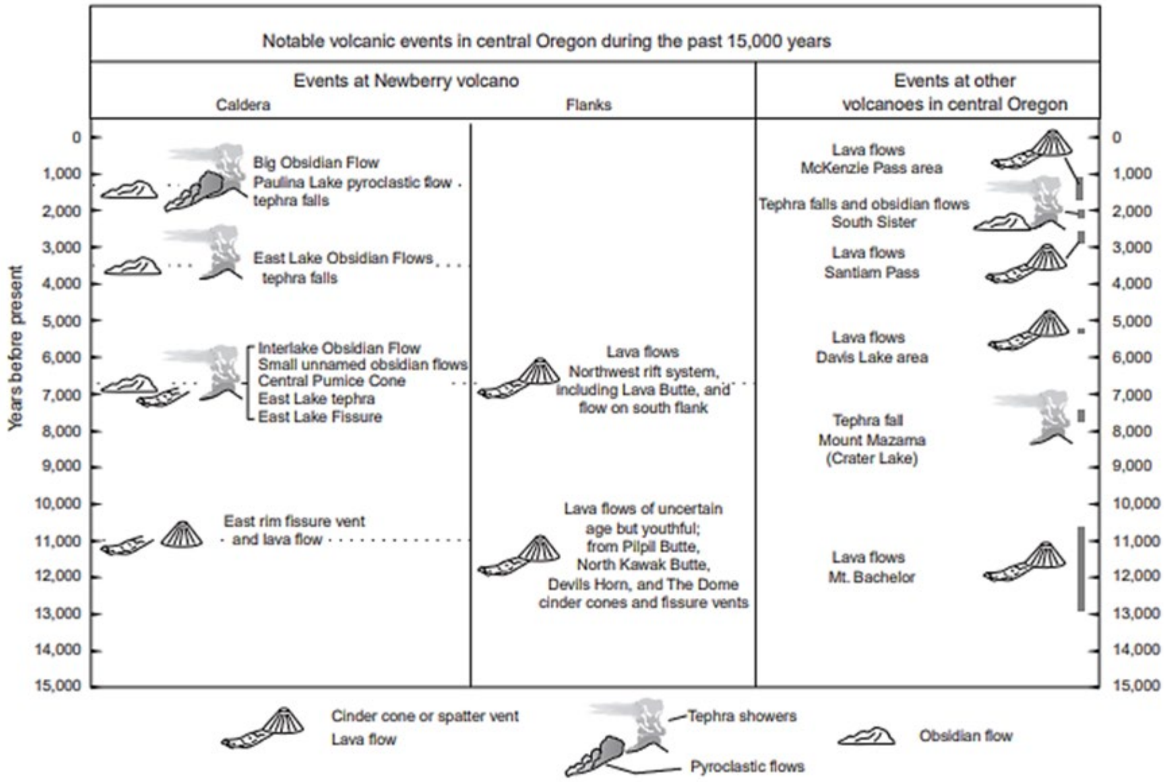
Of the 13 potentially active volcanoes in the Cascade Range of the Pacific Northwest, 11 have erupted in the past 4,000 years. More than 100 eruptions, most of which were explosive, have occurred during that period, making the volcanoes of the Cascade Range some of the most hazardous in the United States. Each eruption symbol in the diagram represents from one to several eruptions closely spaced in time at or near the named volcano. Eruptions have also occurred from other vents (not shown) scattered throughout the Cascade Range, especially in central Oregon and southwestern Washington.

Source: Dzurisin et al., 2008

There are active volcanic areas that could potentially impact La Grande and the broader region. The regional volcanoes identified as very high threat include Mount Rainer, Mount Saint Helens, Mount Hood, Newbery Volcano, Three Sisters (North, Middle, and South Sister), Mount Mazama/Crater Lake, and Mount Shasta. Mount Bachelor falls within the moderate threat category, while Mount Jefferson, Blue Lake Crater, and Belknap Crater are a low threat (Ewert et al., 2018).

Volcanoes in the Cascade Range have been erupting for hundreds of thousands of years. Newberry Volcano, for example, has had many events in the last 15,000 years as shown in Figure 42. The Three Sisters region has also had some activity during this time while the last major eruptive activity at Mount Mazama occurred approximately 7,700 years ago, forming Crater Lake in its wake. Some of the most recent events include Big Obsidian Flow at Newberry Volcano. All the Cascade Range volcanoes are characterized by long periods of quiescence and intermittent activity. And these characteristics make predictions, recurrence intervals, or probability very difficult to ascertain.

Figure 3-35. Notable Volcanic Events in Central Oregon during the Past 15,000 Years



Source: Sherrod et al.,1997

In addition to the many online sources of information, a detailed report of the Pacific Northwest's catastrophic hazards and history written by Rick Gore appears in the May 1998 National Geographic, Vol. 193, No. 5. Table 3-15 describes volcanic events in Oregon and Washington.

Table 3-15. Significant Historic Volcanic Events

Date	Location	Description
Approximate Years: 18,000 to 7,7000 years before present (YBP)	Mount Bachelor, central Cascades	Cinder cones and lava flows.
20,000 to 13,000 YBP	Polallie eruptive episode, Mount Hood	Lava dome, pyroclastic flows, lahars, and tephra.
13,000 YBP	Lava Mountain, south central Oregon	Lava Mountain field and lava flows.
13,000 YBP	Devils Garden, south central Oregon	Devils Garden field and lava flows.
13,000 YBP	Four Craters, south central Oregon	Four Craters field and lava flows.
7,780 to 15,000 YBP	Cinnamon Butte, Southern Cascades	Balsatic scaria cone and lava flows.

Date	Location	Description
7,700 YBP	Crater Lake Caldera	Formation of Crater Lake caldera, pyroclastic flows, and widespread ashfall.
7,7000 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.
10,000 to <7,7000 YBP	Cones south of Mount Jefferson; Forked Butte and South Cinder Peak	Lava flows.
4,000 to 3,000 YBP	Sand Mountain, central Cascades	Lava flows and cinder cones in Sand Mountain field.
<3,2000 YBP	Jordan Craters, eastern Oregon	Lava flows and tephra in Jordan Craters field.
3,000 to 1,5000 YBP	Belknap Volcano, central Cascades	Lava flows and tephra.
2,000 YBP	South Sister Volcano	Rhyolite lava flow.
1,500 YBP	Timberline eruptive period, Mount Hood	Lava dome, pyroclastic flows, lahars, and tephra.
1,300 YBP	Newberry Volcano, central Oregon	Eruption of Big Obsidian flow.
1,300 YBP	Blue Lake Crater	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 and tephra falls.
1907 (?)	Crater Rock on Mount Hood	Steam explosions.
1980	Mount St. Helens (Washington)	Mt. St. Helens erupts: Debris avalanche, ashfall, and flooding on Columbia River. 57 people died.
1981-1986	Mount St. Helens (Washington)	Lava dome growth, steam, and lahars.
1989-2001	Mount St. Helens (Washington)	Hydrothermal explosions.
2004-2008	Mount St. Helens (Washington)	Lava dome growth, steam, and ash.

Sources: U.S. Geological Survey; Wolfe & Pierson, 1995; Scott et al., 1997; University of Oregon; 2020 Oregon NHMP; Federal Emergency Management Agency

Additional background information on Oregon and Washington volcanoes and volcanoes in general is available on several websites, including:

- United States Geological Survey (USGS) Volcano Hazards Program: Volcano Hazards | U.S. Geological Survey (usgs.gov) (http://volcanoes.usgs.gov/)
- Department of Geology and Mineral Industries (DOGAMI) Volcano Hazards in Oregon: DOGAMI Volcano Hazards | Oregon Department of Geology and Mineral Industries (oregongeology.org)

Future Climate Variability

The causal risk of a volcanic eruption is unrelated to future climate variability, but the potential impact of a volcanic eruption is elevated due to climate-related impacts of drought and wildfire on air quality. That is, air quality trends are expected to be negatively impacted by climate change, so vulnerable populations would be at greater risk of health problems resulting from ashfall or toxic air emissions from an eruption.

Probability Assessment

Mount St. Helens remains a probable source of airborne ash. It has repeatedly produced voluminous amounts of this material and has erupted much more frequently in recent geologic times than any other Cascade volcano. It blanketed Yakima and Spokane, Washington during the 1980 eruption and in 2004.

The eruptive history of the Cascade volcanoes can be traced to late Pleistocene times (approximately 700,000 years ago) and will no doubt continue. But the central question remains: When? The most recent series of events at Newberry Volcano, which occurred about 1,300 years ago, consisted of lava flows and ashfall. Newberry Volcano's recent history also includes pyroclastic flows and numerous lava flows. Volcanoes in the Three Sisters region, such as Middle and South Sister, and at Crater Lake have also erupted explosively in the past. These eruptions have produced pyroclastic flows, lava flows, lahars, debris avalanches, and ash. Any future eruptions at these volcanoes would resemble those that have occurred in the past.

Geoscientists have provided some estimates of future activity in the vicinity of Newberry Caldera and its adjacent areas. They estimate a 1 in 3,000 chance that some activity will take place in a 30-year period. The estimate for activity at Crater Lake for the same period is significantly smaller at 0.003 to 0.0003. In the Three Sisters region, the probability of future activity is roughly 1 in 10,000 but any restlessness would increase this estimate.

The location, size, and shape of the area affected by ash are determined by the vigor and duration of the eruption and the wind direction. Because wind direction and velocity vary with both time and altitude, it is impossible to predict the direction and speed of ash transport more than a few hours in advance (Walder, Gardner, Conrey, Fisher, & Schilling, 1999). Mount St. Helens is about 250 air miles from the City of Enterprise (Wallowa County), consequently placing that community at risk. Mount Jefferson, located about 150 miles west of the City of John Day, is a possible but unlikely source. The annual probability of 1 cm or more of ash accumulation within Union County and La Grande, from any Cascade volcano, is about 1 in 5,000 (Sherrod et al., 1997).

Based on the available data and research for La Grande the NHMP Steering Committee determined the **probability of experiencing volcanic activity is "low,"** meaning one incident is likely within the next 75 to 100-year period.

Vulnerability Assessment

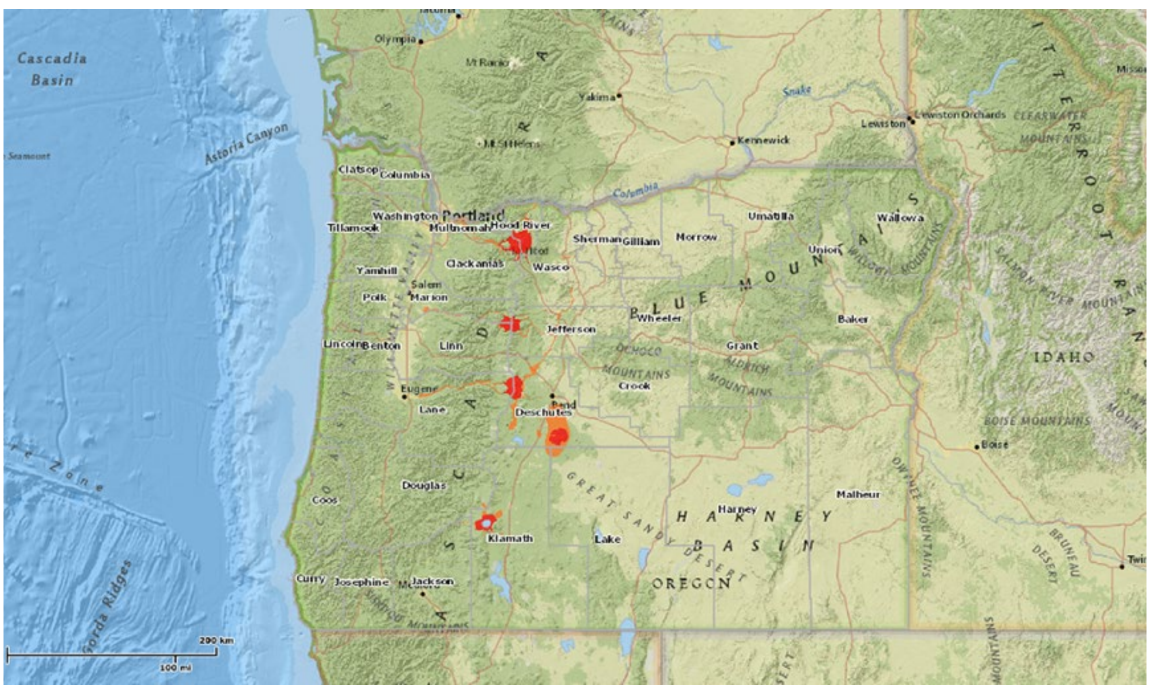
The Pacific Northwest region is vulnerable to impacts from volcanic activity. Like the rest of Oregon, La Grande has some risk of being impacted by volcanic activity in the Cascade Range. The very high threat volcanoes in the region include Mount Rainer, Mount Saint Helens, Mount Hood, Newbery Volcano, Three Sisters (North, Middle, and South Sister), Mount Mazama/Crater Lake, and Mount Shasta.

Because of its geographic distance from these volcanic sites, La Grande is not at risk for proximal hazards such as lava flows. However, it is at risk for distal hazards, primarily ash fall (tephra). The location, size, and shape of the area affected by tephra fall is determined by both the vigor and duration of the eruption and the wind direction at the time of eruption, making prediction of the area to be affected impossible more than a few hours in advance. The vulnerability to ash fallout is multi-pronged. For example, ash can disrupt the engines of motor vehicles, reduce visibility, and exacerbate or induce respiratory illnesses.

While a quantitative vulnerability assessment – an assessment that describes number of lives or amount of property exposed to the hazard – has not yet been conducted for La Grande volcanic eruption events, there are many qualitative factors – issues relating to what is in danger within a community – that point to potential vulnerability.

Figure 3-36 shows that that La Grande is not within an identified high or moderate volcanic event hazard zone. DOGAMI used data from the USGS Cascades Volcano Observatory for this web application. The Cascades Volcano Observatory maintains proximal and distal hazard zone data for volcanic areas in the Western Cascades of Oregon. These areas include but are not limited to Mount St. Helens, Mount Hood, Crater Lake, Newberry, Mount Jefferson, and the Three Sisters. HazVu shows two hazard zones: the high hazard zone (proximal zone) and moderate hazard zone (distal zone). Mount Bachelor, which is listed as a moderate threat by the USGS (Ewert et al.,2018), is a dormant volcano monitored by the Jaffe Group at the University of Washington at Bothell.

Figure 3-36. Map of Generalized Vulnerability of the Region



Source: Oregon Department of Geology and Mineral Industries, HazVu

Risks for La Grande associated with regional volcanic activity would be ash fall, air quality, and possible economic or social disruption due to air traffic issues due to the ash cloud.

Though unlikely, the impacts of a significant ash fall are substantial. Persons with respiratory problems are endangered, transportation, communications, and other lifeline services are interrupted, drainage systems become overloaded/clogged, buildings can become structurally threatened, and the economy takes a major hit. Any future eruption of a nearby volcano (occurring during a period of easterly winds would have adverse consequences for the city.

Volcanic eruptions in the past caused multiple minor injuries or a major injury to the health and safety of residents. The potential for future injuries or deaths is anticipated to remain similar to historic events. It is estimated that less than 1% of the City's population would be physically displaced by a volcanic eruption, considering the primary volcanic hazard that could impact La Grande is ash fallout, and there would be moderate impact on community social networks.

State-Owned/Leased Buildings and Critical Facilities and Local Critical Facilities

According to the *2020 Oregon NHMP*, DOGAMI analyzed the potential dollar loss from volcanic hazards to state-owned and –leased buildings and critical facilities as well as to local critical facilities in the region and concluded that no state buildings, state or local critical facilities are in volcanic hazard areas.

Historic Resources

The *2020 Oregon NHMP* found that none of the 1,246 historic buildings in Region 7 are exposed to volcanic hazards.

Social Vulnerability

According to the CDC Social Vulnerability Index, Union County has a low level of social vulnerability. Vulnerability in Union County is driven by a higher poverty rate, the share of multi-unit structures, the percentage of people living in institutionalized group quarters, and the percentage of occupied housing units with more people than rooms (*2020 Oregon NHMP*). The *2020 Oregon NHMP* vulnerability analysis states,

> Most of the region's people and infrastructure are located in the major cities along I-84, US-26, and US-395. The communities most vulnerable to volcano-related hazards in the region are La Grande, Baker City, and John Day. The social vulnerability scores are low for Baker, Union, and Wallowa Counties; very low for Grant County.

As such, the NHMP Steering Committee rated the city as having a **"low" vulnerability to volcanic activity**, meaning that less than 1% of the city's population or assets would be affected by a major disaster (volcanic ash).

Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of a natural disaster, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies and organizations. These activities and resources are highlighted in the Mitigation Strategy (Chapter 4).

Wildfire

Significant Changes Since Previous Plan:

The Wildfire Hazard section has been reformatted and expanded with additional information since the previous plan.

Causes and Characteristics

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

Contributing Conditions

The following four factors contribute significantly to wildfire behavior and can be used to identify wildfire hazard areas.

Topography: Topography influences the movement of air and directs a fire's course. Slope and hillsides are key factors in fire behavior. Hillsides with steep topographic characteristics are often also desirable areas for residential development. In parts of La Grande, some of the topography is hilly or mountainous which can exacerbate wildfire hazards. These areas can cause a wildfire to spread rapidly and burn larger areas in a shorter period, especially if the fire starts at the bottom of a slope and migrates uphill as it burns. Wildfires tend to burn more slowly on flatter lying areas, but this does not mean these areas are exempt from a rapidly spreading fire. Hazards that can affect these areas after the fire has been extinguished include landslides (debris flows), floods, and erosion.

Fuel: Fuel is the material that feeds a fire. Fuel is classified by volume and type. The type and condition of vegetation plays a significant role in the occurrence and spread of wildfires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire (referred to as the "fuel load"). The ratio of living to dead plant matter is also important. The risk of fire is increased significantly during periods of prolonged drought as the moisture content of both living and dead plant matter decreases. The fuel's continuity, both horizontally and vertically, is also an important factor.

Weather: The most variable factor affecting wildfire behavior is weather. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme wildfire activity. By contrast, cooling and higher humidity often signals reduced wildfire occurrence and easier containment.

The frequency and severity of wildfires is also dependent upon other hazards, such as lightning, drought, equipment use, railroads, recreation use, arson, and infestations. If not promptly controlled, wildfires may grow into an emergency or disaster. Even small fires can threaten lives and resources and destroy improved properties. In addition to affecting people, wildfires may severely affect livestock and pets. Such events may require emergency watering/feeding, evacuation, and shelter.

The indirect effects of wildfires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thereby enhancing flood potential, harming aquatic life, and degrading water quality. Lands stripped of vegetation are also subject to increased debris flow hazards, as described above.

Development: The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element and can sweep through vegetation that is adjacent to a combustible home. New residents in remote locations are often surprised to learn that in moving away from urban areas, they have left behind readily available fire services providing structural protection. Rural locations may be more difficult to access and or simply take more time for fire protection services to get there. Looking at important climate projections described in the *2020 Oregon NHMP*, it is likely these situations are exacerbated by changes in the climate.

Location and Extent

Wildfire hazard areas are commonly identified in regions of the Wildland Urban Interface (WUI). The WUI occurs where wildland and developed areas meet or intermingle with both vegetation and structural development combining to provide fuel. If left unchecked, it is likely that fires in these areas will threaten lives and property. The interface between urban or suburban areas and the resource lands has significantly increased the threat to life and property from fires. Responding to fires in the expanding WUI area may tax existing fire protection systems beyond original design or current capability.

Ranges of the wildfire hazard are further determined by the ease of fire ignition due to natural or human conditions and the difficulty of fire suppression. The wildfire hazard is also magnified by several factors related to fire suppression/control, such as the surrounding fuel load, weather, topography, and property characteristics.

Fire susceptibility throughout the city dramatically increases in late summer and early autumn as summer thunderstorms with lightning strikes increases and vegetation dries out, decreasing plant moisture content and increasing the ratio of dead fuel to living fuel. However, various other factors, including humidity, wind speed and direction, fuel load and fuel type, and topography can contribute to the intensity and spread of wildfire. In addition, common causes of wildfires include arson and negligence from industrial and recreational activities.

While La Grande does not have a specific wildfire management plan, the city is included in the *2016 Union County Community Wildfire Protection Plan* (CWPP). One of the core elements of a CWPP is developing an understanding of the risk of potential losses to life, property, and natural resources during a wildfire.

The *2016 Union County CWPP* addresses the concerns of the National Fire Plan and embraces the 2014 National Cohesive Wildfire Strategy. The National Fire Plan goals are to:

- Ensure sufficient firefighting resources for the future.
- Rehabilitate and restore fire-damaged and fire-adaptive ecosystems.
- Reduce fuels (combustible forest materials) in forests and rangelands at risk, especially near communities.
- Work with residents to reduce fire risk and improve fire protection.

The *2016 Union County CWPP* emphasizes that a high degree of coordination between federal, state, and local agencies, as well as with citizens directly, is necessary for maximal prevention and management of wildfire.

All references to wildfire risk and mitigation in the *2023 La Grande NHMP* are based on the *2016 Union County CWPP* as the primary source of wildfire information and mitigation actions for the county and La Grande. The *2023 La Grande NHMP* also draws on the *2020 Oregon NHMP* and ongoing updates to statewide analysis of wildfire risk and mitigation strategies

Community Wildfire Protection Plan

The Healthy Forests Restoration Act of 2003 (HFRA) provides the impetus for wildfire risk assessment and planning at the county and community level. The HFRA refers to this level of planning as Community Wildfire Protection Plans (CWPP). The minimum requirements for a CWPP as described in the HFRA are:

- Collaboration: A CWPP must be collaboratively developed by local and state government representatives, in consultation with federal agencies and other interested parties. Prioritized Fuel Reduction: A CWPP must identify and prioritize areas for hazardous fuel reduction treatments and recommend the types and methods of treatment that will protect one or more at-risk communities and essential infrastructure.
- Treatment of Structural Ignitability: A CWPP must recommend measures that homeowners and communities can take to reduce the ignitability of structures throughout the area addressed by the plan.

The CWPP allows a community to evaluate its current situation with regards to wildfire risk and plan ways to reduce risk for protection of human welfare and other important economic, social or ecological values. The CWPP may address issues such as community wildfire risk, structure flammability, hazardous fuels and non-fuels mitigation, community preparedness, and emergency procedures. The CWPP should be tailored to meet the needs of the community.

The 2016 *Union County CWPP* provides detailed information on the vulnerability and history of wildfire in the county and identifies mitigation actions the county can implement to reduce the impact of wildfire. The plan contains 32 mitigation actions divided into three categories (Wildfire Response – 14 Mitigation Actions, Fire Adapted Communities – 11 Mitigation Actions, and Restore and Maintain Landscapes – 7 Mitigation Actions).

Among the concepts utilized in the *2016 Union County CWPP* are that of the Wildland Urban Interface (WUI) and Communities at Risk (CAR) to identify higher areas of risk for wildfire.

Wildland Urban Interface (WUI) areas are where the human developed areas meet the undeveloped areas. The 2005 Union County CWPP identified 16 separate WUI areas. In 2016 revision merged all neighboring WUI areas into one larger WUI Zone while leaving outlying WUIs as separate small WUI Zones. The new WUI Zones encompass the "middle ground" referenced in the Cohesive Wildfire Strategy, areas between communities and the more distant wildlands.[15] Figure 3-37 Union County WUI Zone near La Grande, Oregon

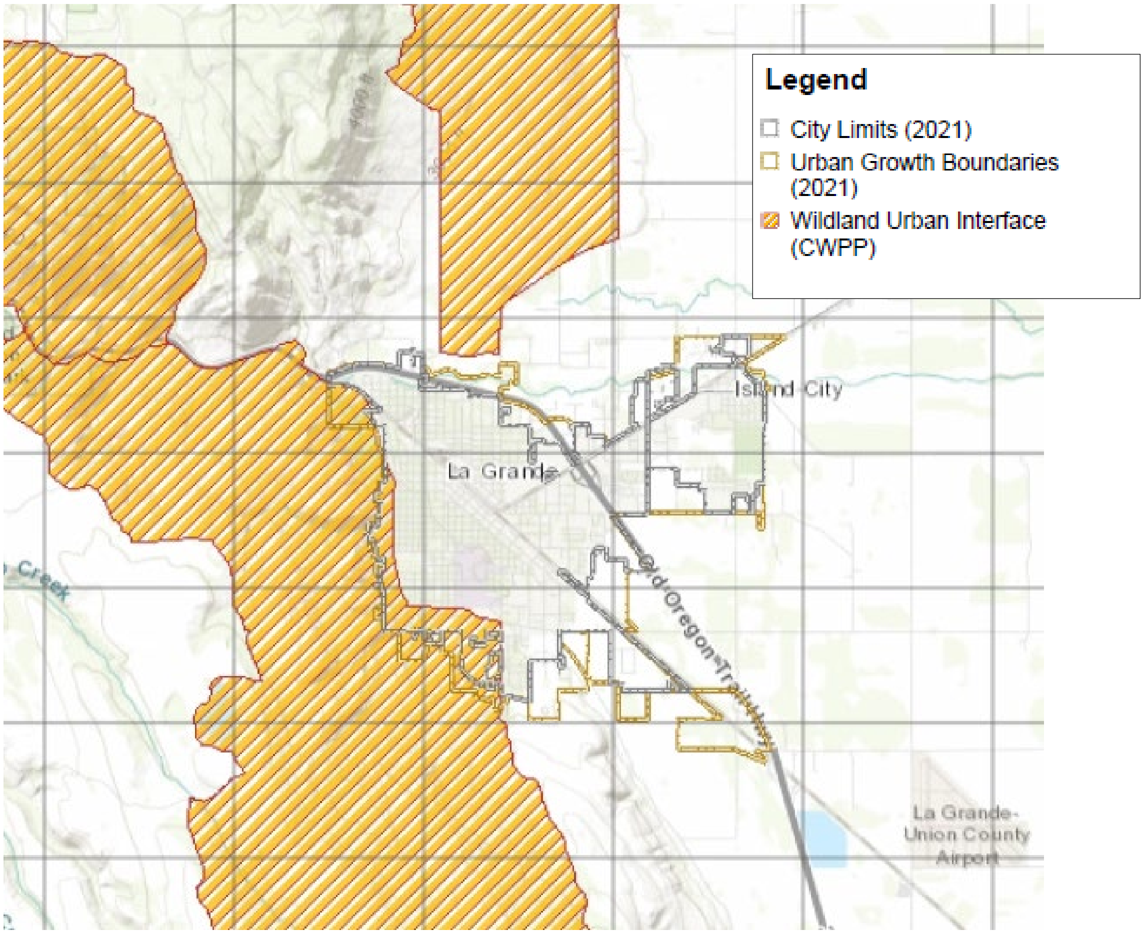
The 2016 revision recognizes the need, based on "middle ground" landscape treatment concepts, to reassess the concepts behind WUI areas as well as their size and number of WUI areas. If the population in Union County grows, development in the WUI may increase. Concern is warranted when development patterns increase the threat of wildfire to life and property. Of the nearly 1.8 million tax lots (with or without homes) in Oregon, it is estimated that 4.4% of the states' land area is in the WUI (approximately 956,496 tax lots). Of those tax lots located in the WUI, approximately 120,276 tax lots, or 8% are of high or extreme wildfire risk and of those 120, 276 tax lots, approximately 80,000 have a structure on them. (KTVZ, 2022)

The total area of Union County is 1,304,523 square acres (2,038 square miles). The entire WUI Zone in Union County is approximately 503,573 acres. According to the 2016 Union County CWPP, 21% or 107,850 acres is under rural protection, the largest of which is of the La Grande Rural Fire District (RFD), at 49,427 acres.

The *2016 Union County CWPP* steering committee found that previous individual WUIs were rated against each other, resulting in competition for funding between wildland urban interfaces. This new approach recognizes that although some communities may be of higher risk and need, it does not eliminate opportunities for landowners in moderate or low risk areas to initiate or continue to promote risk reduction measures. It also allows for specific attributes that contribute to fire risk to share funding with other communities with similar mitigation needs.

[15] Cohesive Wildfire Strategy, April 2014. The National Strategy: The Final Phase in the Development of the National Cohesive Wildland Fire Management Strategy. A collaborative effort by Federal, State, Local, Tribal Governments, nongovernment partners, and public stakeholders.

Figure 3-37. Wildland Urban Interface Zone near La Grande, OR



Source: Oregon Explorer

The Communities-At-Risk (CAR) scoring system was developed by the National Association of State Foresters and the Oregon Department of Forestry (Wolf, 2004). The CAR methodology for wildfire hazard assessment considers a range of rating factors. These include the likelihood of fire, topographic hazard, total fuel hazard, overall fire protection capability, weather factor, and values at risk. A CAR is further defined as a group of homes or other structures with basic infrastructure (such as shared transportation routes) and services within or near federal land. A WUI area surrounds a community-at-risk, including that community's infrastructure or water source, and may extend 1.5 miles or more beyond that community.

The *2016 Union County CWPP* provides for a comprehensive approach to wildfire hazard mitigation planning. The CAR assessment provides a wildfire risk ranking of relative comparison for each community (Table 3-16), and the expanded area of the WUI Zones allow managers to take a holistic approach in wildfire risk mitigation at a landscape level.

Table 3-16. Wildland Urban Interface Zone near La Grande, OR

	Wildland Fire Potential								Fire Protection and Fire structure vulnerability							
Communities At Risk	Fire Occurrence	Flame Lengths	Rate of Fire Spread	Probability of Canopy Fire	Fire Threat	Fire Effects	Fire Risk	Sub Total Score	Protection - Structures to Sq. mile ratio	Protected verse non-protected	Wildland Development Area	Values Impacted	Level of Community Preparedness	Suppression Difficulty	Sub Total Score	Grand Total
Anthony Lakes	3/H	4/E	2/M	4/E	4/E	2/M	4/E	23	3/H	4/E	2/M	3/H	4/E	2/M	18	41
Blue Springs	3/H	2/M	2/M	4/E	2/M	1/L	2/M	16	4/E	4/E	1/L	2/M	2/M	2/M	15	30
Camp Elkanah	3/H	2/M	2/M	1/L	2/M	2/M	3/H	15	3/H	4/E	1/L	3/H	4/E	1/L	16	31
Cove	3/H	2/M	2/M	4/E	4/E	2/M	4/E	21	4/E	2/M	3/H	2/M	4/E	3/H	17	38
Elgin, Palmer Junction	2/M	4/E	2/M	4/E	2/M	3/H	3/H	20	4/E	2/M	3/H	4/E	4/E	2/M	19	39
Hilgard, Perry	3H	2/M	2/M	3/H	4/E	4/E	4/E	22	2/M	4/E	2/M	4/E	4/E	3/H	19	41
Imbler, Summerville	3/H	4/E	2/M	4/E	4/E	3/H	4/E	24	3/H	2/M	3/H	2/M	4/E	3/H	17	41
Island City, La Grande	3/H	2/M	2/M	1/L	3/H	4/E	3/H	18	4/E	2/M	4/E	4/E	4/E	1/L	19	37

	Wildland Fire Potential								Fire Protection and Fire structure vulnerability							
Communities At Risk Issues	Fire Occurrence	Flame Length	Rate of Fire Spread	Probability of Canopy Fire	Fire Threat	Fire Effects	Fire Risk	Sub Total Score	Protection – Structures to Sq. Mile Ratio **	Available Structure Protection **	Wildland Development Areas	Values Impacted	Level of community Preparedness	Suppression Difficulty	Sub Total Score	Grand Total
Kamela	3/H	3/H	2/M	4/E	1/L	4/E	3/H	20	2/M	4/E	1/L	3/H	4/E	2/M	16	36
Medical Springs	1/L	2/M	2/M	4/E	2/M	2/M	3/H	16	2/M	2/M	2/M	2/M	4/E	2/M	14	30
Mount Emily (mention MERA and recreation use)	3/H	4/E	2/M	4/E	3/H	2/M	4/E	22	3/H	3/H	3/H	2/M	4/E	3/H	18	40
North Powder	3/H	2/M	2/M	2/M	2/M	2/M	2/M	15	2/M	2/M	2/M	4/E	4/E	1/L	15	30
Spout Springs	1/L	4/E	3/H	4/E	4/E	4/E	4/E	24	3/H	4/E	2/M	3/H	4/E	4/E	20	44
Union	1/L	2/M	2/M	1/L	2/M	2/M	2/M	12	3/H	2/M	3/H	3/H	4/E	2/M	17	28

Figure VII – 1. CAR Rating Chart. Identified communities at risk and their corresponding attribute rankings. ** Does not have a corresponding map for this attribute.

Source: *2016 Union County Community Wildfire Protection Plan*

Note: Nomenclature ratings of Low through Extreme breakouts are assigned corresponding to 1 through 4 numerical values respectively in order to compare communities at risk against one another (Low = 1/L, Medium = 2/M, High=3/H, and Extreme=4/E)

The rating output in Table 3-16 provides insight on both overall conditions and specific issues facing each community analyzed. The La Grande/Island City urban area has an overall high risk rating score of 37. Rating scores provide a means of relative comparison for the CAR, however using only the final rating as a rationale in approaching fire risk would result in missed opportunities to address underlying causes. All attributes rated under the Wildland Fire Potential were accessed from the West-Wide Risk Assessment (WWRA) of 2013. The Community at Risk and WUI Zone Rankings section of the *2016 Union County CWPP* provides the following summary (part),

> CARs are scattered across Union County both in and out of the WUI Zone. Recognizing that these communities, regardless of location, are challenged by their own set of wildfire issues gives protection agencies and landowners tools to create fire adapted communities and build upon existing or create new fire response programs. Distinguishing between structure protection authorities and land protection authorities allows for collaborative efforts in fire protection. Condition indicators and issues facing the CARs can be addressed together or as standalone treatment approaches for fire protection. CARs are delineated to meet management direction and to identifying protection capabilities yet recognizing that mitigation measures do not stop at property lines. This is important for successfully meeting fire adapted communities goal in Union County.

Additional information regarding these is and other information regarding the WUI Zones, refer to the *2016 Union County CWPP*. In addition, Union County will begin to update their CWPP in 2023-2024.

The impact on communities from wildfire can be enormous. Reporting by *The Oregonian* stated that in 2017, more than 1.1 million acres were scorched by wildfire in Oregon and Washington. Then, 2018 was even worse, with 1.3 million acres of forest and fields going up in flame. That represents an area close to the size of Delaware state up in smoke each year. Fighting wildfires cost Oregon and Washington more than a $1 billion in 2017 and 2018 combined, according to the Northwest Interagency Coordination Center (Williams, 2019). Although the fire season in 2019 was less destructive, just over 200,000 acres were scorched across both states, a nearly 84% drop from the two previous years, the 2020 fire season once again witnessed devastating wildfires in and near urban areas in western Oregon.

Identifying Wildfire

The first phase of wildfire-hazard assessment is identification. Hazard identification identifies the geographic extent of areas subject to wildfire, expected intensity of a wildfire event at different locations, and probability of occurrence of wildfire events. In addition, the level of wildfire hazard is determined by the ease of fire ignition, natural or human cause, and difficulty of fire suppression. Wildfire hazard can be magnified by several fire suppression and control factors, such as the fuel load, weather, topography, and property characteristics.

The use of Geographic Information System (GIS) tools and improved data can assist in fire hazard assessment, allowing further integration of fuels, weather, topography, and development data for fire behavior prediction, watershed evaluation, developing mitigation strategies, and hazard mapping.

According to the National Wildfire Coordinating Group (NWCG) *Glossary of Wildland Fire Terminology* (2012), wildfire can be divided into three main categories: interface, wildland, and firestorms. These descriptions are provided for a brief but comprehensive understanding of wildfire.

Interface or Wildland Urban Interface (WUI) Fires: An interface fire occurs where wildland and developed areas, structures and other human development, meet or intermingle with both vegetation and structural development combining to provide fuel. According to the *2016 Union County CWPP*, the entire WUI for the county is approximately 503,573 acres, with La Grande Rural Fire District accounting for the largest area of rural protection with 49,427 acres. Figure 3-37 above illustrates higher risk areas of La Grande's WUI Zone. This information was developed from the ODF wildfire risk classification data.

Wildland Fires: Wildland is an area where development is essentially non-existent, except for roads, railroads, powerlines, and similar transportation facilities. Structures, if any, are widely scattered. A wildland fire's main fuel source is natural vegetation. Often referred to as forest or rangeland fires, these fires occur in national forests and parks, private timberland, and on public and private rangeland. A wildland fire can become an interface fire if it encroaches on developed areas. Three distinct types of wildland fire include wildfire, wildland fire use, and prescribed fire, and are further defined in NWCG *Glossary of Wildland Fire Terminology* (2012).

Fire Storms: A fire storm is a very intense and destructive fire usually accompanied by high winds. As defined by NWCG, "Violent convection caused by a large continuous area of intense fire. Often characterized by destructively violent surface indrafts, near and beyond the perimeter, and sometimes by tornado-like whirl."

History

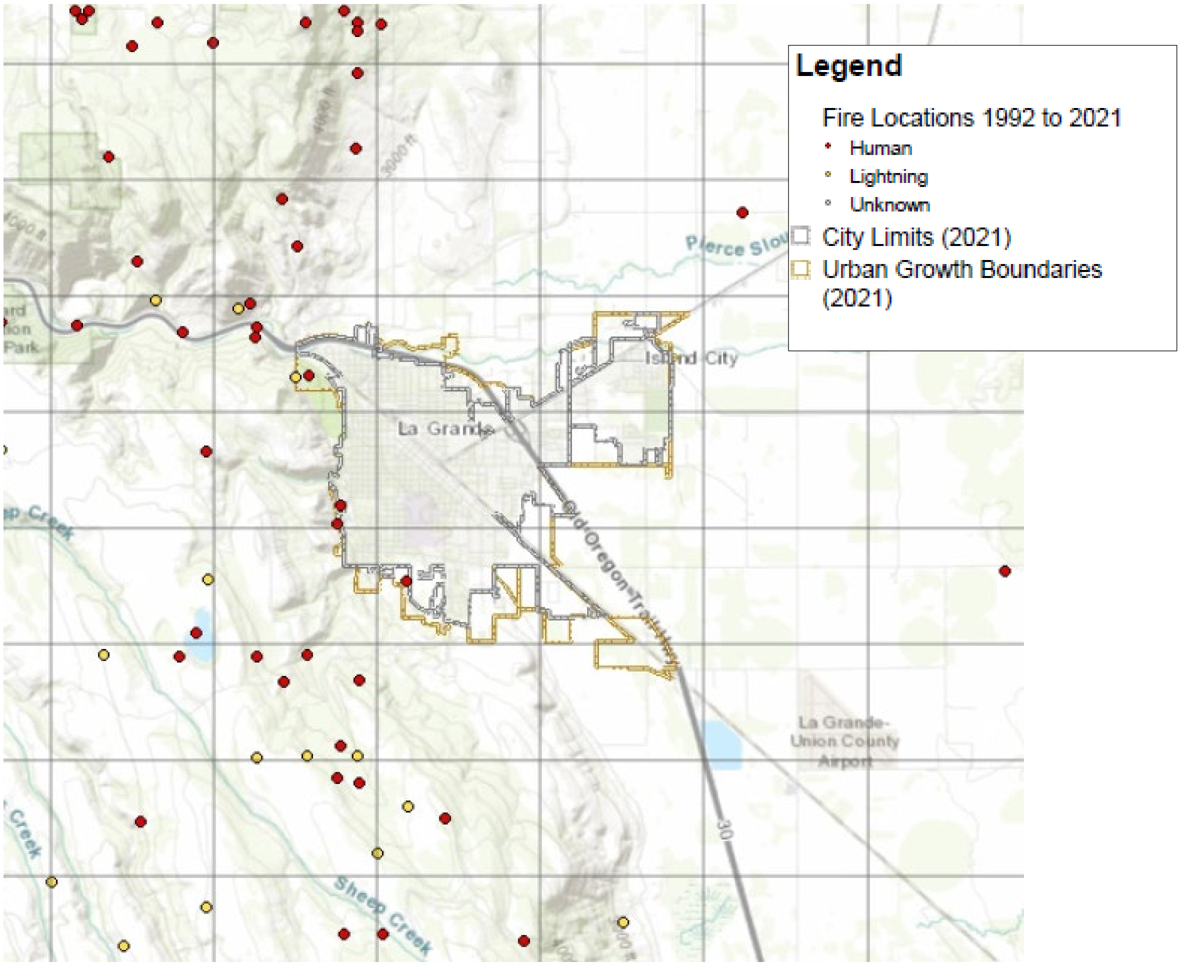
According to the *2020 Oregon NHMP*, the Northeast Oregon Region 7 has a significant history of human-caused fires in addition to a prevalence of summer thunderstorms. These thunderstorms in the mountainous and timbered regions of Eastern Oregon suggest the potential for lightning-caused fires. Most areas of this region do not have structural fire protection available or wildland fire protection. The *2020 Oregon NHMP* states,

> While the rates of urban and rural residential development have declined statewide, they have increased in Eastern Oregon's non-federal forests, potentially impacting fire protection capability. There are now 3 times as many dwellings on non-federal wildland forest in Eastern Oregon as in 1975. Dwelling density is increasing at a faster rate in Eastern Oregon's fire-prone forests than in western Oregon's. Development ranges from homes with city services to seasonal-use recreational cabins. Many isolated clusters of private timberland have been bought and developed into home sites and recreational communities.

The climate of Union County is relatively dry with an average annual rainfall of 14 to 16 inches. Shifts in temperature based on local data are correlated with increasing length of wildfire season and an increase of fire frequency, occurring predominately between 5500 and 8500 feet in elevation. The bulk of wildfires typically occur between July and mid-August accounting for 65% of all annual fires and are both human and lightning caused fires. The size of fire is not limited to small acreage, with four of the seven recorded large fires occurring since 2001 with the largest being the 2015 Phillips Creek Fire at 2,601 acres and including road closures and evacuation notices. (*2016 Union County CWPP*)

Figure 3-38 shows geographic distribution of fires that occurred in the La Grande vicinity between 1992 and 2021 that were caused either by lightning or human. According to the *2016 Union County CWPP*, the bulk of fire ignition were lightning cause (62%) than humans (38%). However, in this illustration, a higher occurrence of human-caused fires over those started by lightning.

Figure 3-38. Fire Locations 1992-2021 near La Grande, OR

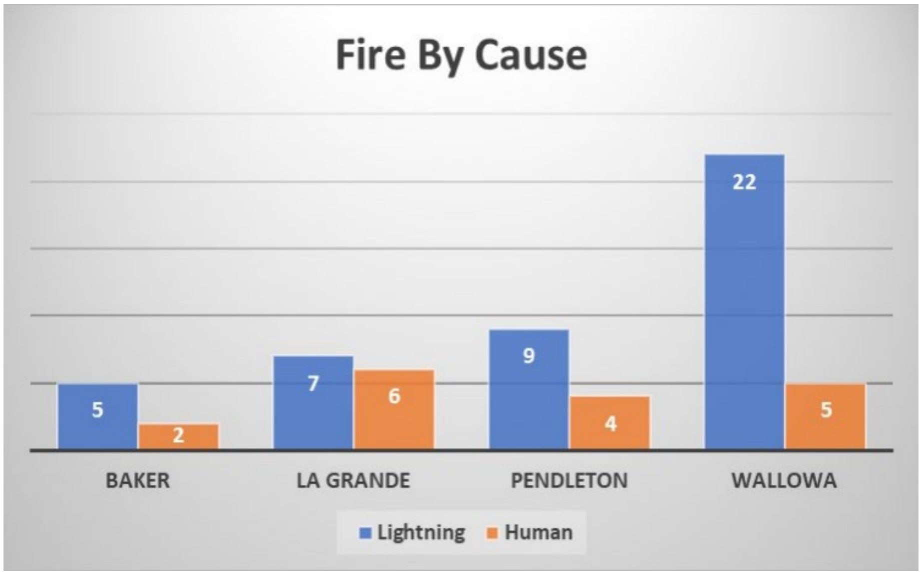


Source: Oregon Explorer

According to ODF (2023), between 2013 and 2022, of the 1,025 fires (10 year average annual) occurring in Oregon during that time, 22% were caused by lightning and 74% were caused by humans. However, as illustrated in Figure 3-39, ODF's *Northeast Oregon District 2022 Statistical Report* shows that lightning-caused fires were slightly higher than human-caused for the La Grande District. Table 3-17 identifies historic wildfire events[16] that impacted Union County Oregon.

[16] According to the Blue Mountain Interagency Fire Center (USFS Wallowa Whitman National Forest), there were numerous lightning and human caused fires between 2015-2023 in and near Union County (Gilbert, 2023). However, only those fires over 50 acres are identified in **Table 2-16**.

Figure 3-39. ODF Northeast Oregon District 2022 Fire by Cause



Source: Oregon Department of Forestry, 2022

Table 3-17. Wildfires in or near Union County, Oregon

Year	Name of Fire	Location	Acres Burned	Remarks
1973	Rooster Peak	Union	6,400	Lightning caused; burned 6 structures close to La Grande's southwest limits
1981	Mt Harris	Union	850	Human caused
1983	Frizzel	Union	250	Lightning caused; Mt Emily WUI
1986	Clear	Baker, Union, Grant	6,000	Lightning caused (?)
1988	Turner	Baker, Union, Grant	8,000	
2001	Boulevard	Union	150	Lightning caused; threatened La Grande watershed
2003	Craig Loop	Union	43	Human caused; Mt Emily WUI
2014	Mt Harris	Union		Part of nine fires in region (41,500 acres)
2015	Phillips Creek	Union	2,601	Human caused
2015	Merry-go-round	Union	80	Lightning caused
2017	Indian Lake	Union, Umatilla	221.8	Human caused
2017	Clarks Creek	Union	309	Human caused
2018	Beaver Creek	Union	75	Lightning caused
2020	Rysdom Canyon	Union, Wallowa	79	Lightning caused
2021	Spring Creek	Union	131	Lightning caused
2023	Jones Butte	Union	115	Human caused

Sources: *2020 Oregon NHMP*; *2016 Union County CWPP*; Gilbert, 2023

Future Climate Variability

In the *Fifth Oregon Climate Assessment*, the report concludes,

> Wildfire dynamics are affected by climate change, past and contemporary land management and human activity, and expansion of non-native invasive grasses. From 1984 through 2018, annual area burned in Oregon increased considerably. Over the next 50 to 100 years, area burned, and fire frequency are projected to increase substantially, initially east of the crest of the Cascade Range and then in the western Cascade Range. Over the long term, depending on how vegetation and fire weather shift with climatic changes and fuel and fire management, fire severity also may increase" (Dalton et al., 2021).

Following decades of fire suppression that coincided with a cool and wet climate, the density and flammability of many low- to mid-elevation dry forests and woodlands in Oregon has increased. For example, fire suppression in low elevation, historically open ponderosa pine (*Pinus ponderosa*) forests led to dense fuels and establishment of shade-tolerant tree species, such as grand fir (*Abies grandis*) and white fir (*A. concolor*), throughout the tree canopy, connecting fuels vertically from the ground to the crown. As a result, the intensity and severity of fires in the last three to four decades has increased. Due to changes in climate and fire severity, some dry forests and woodlands at low to intermediate elevations in eastern Oregon may not be able to reestablish naturally and could transition to more flammable shrublands or grasslands. (Dalton et al., 2021)

Increases in fire severity have also been observed in arid shrubsteppe in central and eastern Oregon. In these ecosystems, the rapid expansion of non-native invasive grasses, such as cheatgrass (*Bromus tectorum*) and ventenata grass (*Ventenata dubia*), has increased fine-fuel biomass and spatial continuity of fuels. Formerly sparse sagebrush ecosystems continue to be colonized by cheatgrass, which has resulted in increases in area burned of up to 200% since 1980. Expansion of cheatgrass leads to a positive feedback loop in which increases in fire frequency and extent facilitate further increases in the distribution and density of cheatgrass. Any ground disturbance, whether from livestock grazing, tree thinning, or fire, can facilitate the colonization and increase in abundance of cheatgrass. (Dalton et al., 2021)

Over the last several decades, warmer and drier conditions during the summer months have contributed to an increase in fuel aridity and enabled more frequent large fires, an increase in the total area burned, and a longer fire season across the western United States, particularly in forested ecosystems. The lengthening of the fire season is largely due to declining mountain snowpack and earlier spring snowmelt.

In Summary, the OCCRI *Future Climate Projections Union County, Oregon* report projects that wildfire frequency, intensity, and extent will continue to increase across the Northwest. In part due to growing drought conditions, increased number of extreme heat events, and growing development in the Wildland Urban Interface (WUI), wildfire risk – expressed as the average number of days per year on which fire danger is very high – is projected to increase by 16 days (range -4–38). It has also been estimated that due to anthropogenic emissions, the likelihood of extreme fire weather during autumn increased by about 40% over the western United States and about 50% over western Oregon, largely through drier vegetation in autumn and warmer temperatures during dry wind events. With increased wildfire intensity and occurrence, health issues related to smoke will likely grow, as will other vulnerable populations health and safety.

Probability Assessment

Certain conditions must be present for significant interface fires to occur. The most common are hot, dry, and windy weather; the inability of fire protection forces to contain or suppress the fire; the occurrence of multiple fires that overwhelm committed resources; and a large fuel load (dense vegetation). Once a fire has started, several conditions influence its behavior, including fuel, topography, weather, drought, and development.

A significant number of lightning storms pass through during the summer and fall months, starting many fires that can easily strain wildland firefighting resources. With fuels and low relative humidity, the probability for large fires can significantly increase during lightning events. The number of days per season that these conditions exist is also important to consider.

Most of all fire starts in the region are attributed to lightning, with a higher percentage of lightning starts on public lands than on private lands. Oregon Department of Forestry reports a slightly higher percentage of human-caused fires where human activity is more prevalent. (*2020 Oregon NHMP*)

Based on the available data and research for La Grande the NHMP Steering Committee determined the **probability of experiencing a wildfire in the city is "moderate,"** meaning one incident is likely within the next 35 to 75-year period.

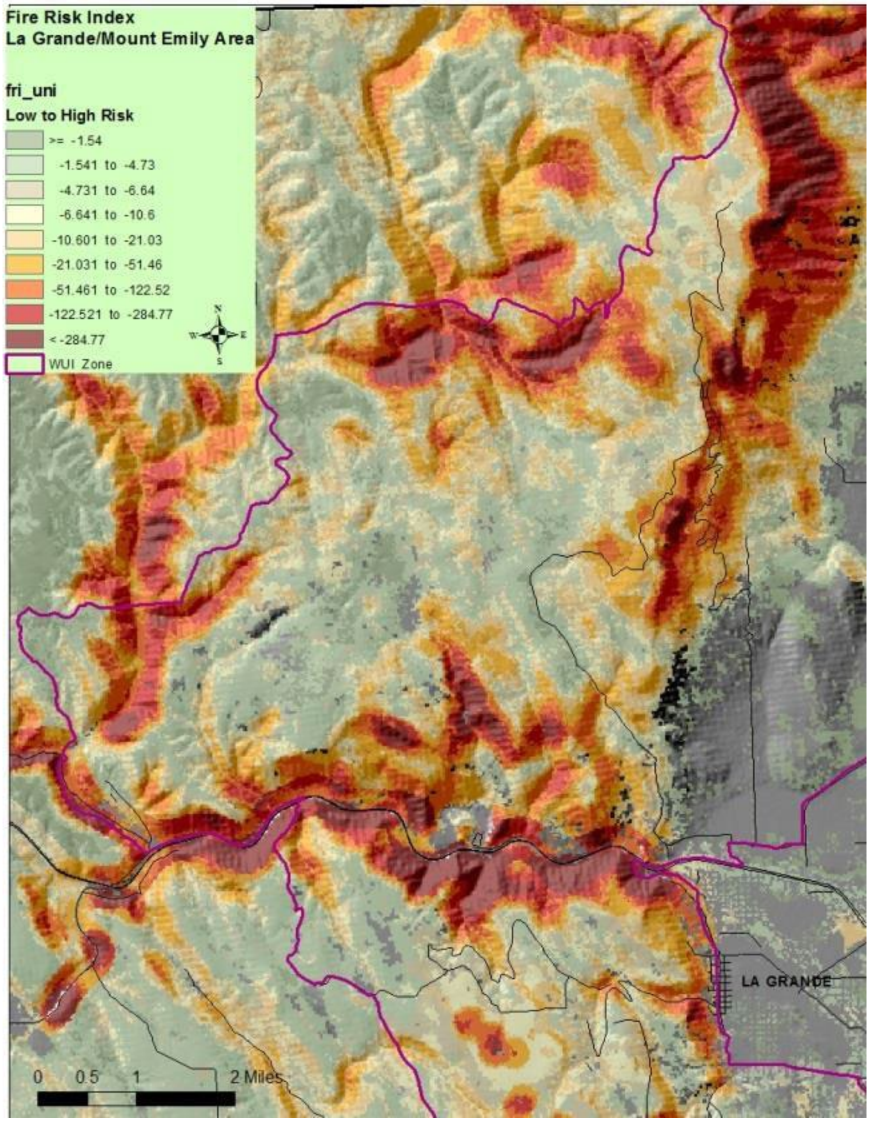
Vulnerability Assessment

Wildfires are a natural part of forest and grassland ecosystems. Past forest practices included the suppression of all forest and grassland fires. This practice, coupled with hundreds of acres of dry brush or trees weakened or killed through insect infestation, has fostered a dangerous situation. Present state and national forest practices include the reduction of understory vegetation through thinning and prescribed (controlled) burning.

Each year a significant number of people build homes within or on the edge of the forest (urban/ wildland interface), thereby increasing wildfire hazards. Many Oregon communities (incorporated and unincorporated) are within or abut areas subject to serious wildfire hazards, complicating firefighting efforts and significantly increasing the cost of fire suppression.

Wildfires in the past have caused no personal injury or death. However, the potential for injuries or deaths from past events or from similar events in other communities could escalate resulting in multiple minor injuries or possible major injury. La Grande estimates that less than 10% of the city's population could be physically displaced by a wildfire, considering the proximity of residential housing to WUI vulnerable areas; and there would be mild impact on community social networks. The west and south areas of the city are the most vulnerable based on the WUI identified in the CWPP (Figure 3-37).

Figure 3-40. Overall Fire Risk Index near La Grande, Oregon



Source: *2016 Union County CWPP*

The *2016 Union County CWPP*, assessed values that have the potential negative fire effects included the following:

- **Infrastructure** – Key infrastructure such as schools, airports, hospitals, roads, and railroads that are susceptible to adverse effects from wildfire.
- **Wildland Development Areas** - Locations of people living in wildland areas, represented by the number of housing units on given acreage of land parcel.
- **Drinking Water Importance Areas** – Crucial areas to sustaining quality of drinking water, DEQ sub-basins with drinking water intakes, and Union County dependence on water such as protection, water rights for commercial and business.

- **Forest Assets** – Vegetation susceptibility to wildfire in terms of how they respond ecologically: sensitive, resilient, adaptive. According to the 2016 Union County CWPP, 84% of the County is resilient supporting fire tolerant species.
- **Riparian Assets** – Two primary functions of riparian; water quality and quantity.

Loss or damage to these values would have significant undesirable impacts to the community if wildfire damage were to occur.

To better display the final risk of a single area in the county the vicinity of the town of La Grande was used to zoom in and display the following conditions:

- Fire occurrence (fire start history and weather influence zones) (*2016 Union County CWPP*, Figure VI – 28)
- Fire Threat Index (Fire Occurrence, Fire Behavior, Fire Suppression Effectiveness) (*2016 Union County CWPP*, Figure VI – 29)
- Fire Effects Index (Values Impacted and Suppression Difficulty) (*2016 Union County CWPP*, Figure VI – 30)
- Final Fire Risk Index (*2016 Union County CWPP*, Figure VI – 31, and shown in Figure 3-40)

The *2016 Union County CWPP* provides the following narrative regarding the community's vulnerabilities:

> Wildfires in the west are increasingly costly in many aspects from suppression efforts to stop the fire, to the loss of life and property that is occurring annually. Suppression costs alone have increased over the last 30 years from $240 million to $2.1 billion in 2015 (NIFC 2015). This does not take into account the loss of life, homes, resource values, and infrastructure…. Oregon, Washington, and Idaho also experienced a number of wildfires involving structures, such as the Lawyer Complex in Idaho that lost 50 homes and 75 outbuildings while the Okanogan Complex in Washington destroyed 154 structures and cost three firefighters their lives. Oregon's Canyon Creek Complex near the town of John Day also lost over 89 structures while over 900 residences were threatened.
>
> Union County was no exception in 2015. Several wildfires plagued northeast Oregon including the Phillips Fire, which started on August 1. At approximately 2,600 acres, the fire threatened approximately 200 structures, the town of Elgin, and miscellaneous structures dispersed in the Sanderson Road area north of the town of Summerville and west of Elgin. Evacuation levels were put at "ready" with an estimated fire cost of $7.5 million dollars.

The *2020 Oregon NHMP* reviewed state-owned or leased buildings and critical facilities as well as local critical facilities and summarized the regions potential loss to wildfire of about $52M in state building and critical facility assets, around a third of it in each of Union and Grant Counties, and around 20% in each of Baker and Wallowa Counties. There is a greater potential loss in local critical facilities of about $75.6M; Union County with 16% of that loss. Grant County contains the most (43%) followed by Baker County with 30%, and Wallow County with 11%.

Wildfire can affect natural resources and other infrastructure, which affects the economy. Economically, losses to natural resources and infrastructure can have significant impacts to businesses, water delivery systems, municipal watersheds, power supplies, and transportation systems, in addition to impacting the health and wellbeing of local communities, according to the *2016 Union County CWPP*. Moreover, "Environmental conditions in combination with effects of expanding WUI areas underlie four broad areas of risk: risk to firefighters and civilian safety, ecological risks, social risks, and economic risks (CWS 2014)." (Union County CWPP, 2016). One aspect of fire effects that cannot be measured is the emotional and societal impacts especially where personal loss occurs. Each situation is relative to the individual and community being impacted.

The *2016 Union County CWPP* provides the following regarding other important aspects such as recreation economy, ranching, and timber to the Union County community,

Recreation Economy

Large fires in Union County and adjacent areas can have a high economic impact for several reasons. First, the Northeast Oregon tri-county areas of Baker, Union, and Wallowa Counties have a strong economy base in natural resources and timber, agriculture, and tourism. Leisure and Hospitality is responsible for nearly 12% of direct employment, including rich cultural heritage, national historic sites, scenic beauty, and numerous outdoor recreation opportunities. Recreation can be further divided into hiking, bicycling, swimming, and rafting, as well as fowl and big game hunting. For example, bicycle tourism alone contributes up to $15 million for the Eastern Region of Oregon. Travel expenditures to Union County from 2000 to 2012 have increased by $5.4 million dollars, with earnings in 2012 of $9 million (NEOEDD 2013).

Travel impacts and visitor volume for Union County have made an impact on the local economy. The annual percent change in travel trends from 1991 to 2014 in spending and earnings was 1.2% and 1.1%, respectively, with 2014 being preliminary (p) results. The change from 2013 to 2014p in spending and earnings was 5.5% and 5.1% increase (Runyan).

Visitor spending for travelers on different overnight accommodations for Union County has increased in all categories except for Vacation Home. All numbers reflect changes from 2013 – 2014p in ($Million): Hotel, Motel 10.4 – 11.6; Private Home 5.1 – 5.4; Campground 5.4 – 5.5; Vacation Home 0.4 – 0.4: Day Travel 5.8 – 6.2; Spending at Destination 27.2 – 29.1 (Runyan). Destination spending includes accommodations, food service, food stores, local transportation and gas, arts/entertainment/recreation, and retail sales.

Recreation spending does not only include typical family vacation visits, but also accounts for seasonal visits of non-locals for hunting fowl, bear, turkey and big game as well as steelhead fishing.

The local forests also provide for numerous opportunities economically in terms of gathering of forest products, livestock forage, and lumber. Forest products gathered in the Blue Mountains of eastern Oregon are numerous, with some providing major commercial enterprises on a seasonal basis.

Ranching

Local ranching and beef production is another common use of the local forests. Rangeland on public lands of the Wallowa-Whitman National Forest varies from low elevation meadow bottoms to high alpine lands. Approximately 1.2 million acres of the 2.3 million acres of national forest are currently grazed by livestock. The Wallowa-Whitman National Forest currently has 93 term grazing permits issued on 110 grazing allotments, providing forage for an estimated 23,800 head of cattle and 3,300 head of sheep.

Timber

Timber products are another commodity used by the local residents and businesses. Winter temperatures and harsh conditions have caused many local residents to maintain a secondary heating source in their homes, which often is in the form of a woodstove. Firewood is a key source of heating during the winter months.

Several of the fire mitigation vegetation treatments conducted since 2005 have relied on the local timber and biomass infrastructure. Local mills are necessary to maximize funding, create utilization opportunities resulting in reduced smoke emissions from burning, and provide revenue through local jobs. These infrastructures can only be maintained through a regular supply from private and public land sources. Cost of doing business will increase if these infrastructures are not supported, resulting in high transportation costs, which may reduce the type and amount of fire risk mitigation work to be accomplished.

The timber industry in the region has declined since the 1980s. Currently, more timber is being removed from private lands compared to public lands. In 2012, approximately 36,849 thousand board feet of timber was harvested from private land and 3,119 from public land (NEOEDD 2013). The Oregon Labor Market Information System shows timber-related employment in Union County supporting approximately 438 jobs with a total payroll of $39,844,592 of which only $3,635,591 listed as Forestry and logging. Other industries included in timber-related employment are agriculture and forestry support activities, truck transportation, and federal and state government natural resources and mining.

Because Union County relies heavily on both private and public forests to help sustain its local economy, large, damaging wildfires could have significant negative economic impacts. This is particularly true for Handcock Forest Management that owns over a third of the private lands and is the largest timber supplier in the county. Since the bulk of private lands are within the WUIZ, a wildfire burning into the WUIZ could have major implications toward local economy in terms of timber-related dollars. Impacts to recreation could also be significant, resulting in reduced local revenue for multiple years post fire.

The NHMP Steering Committee rated the city as having a **“moderate” vulnerability to wildfire hazards**, meaning that 1 to 10% of the city’s population or assets would be affected by a major disaster.

Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of a natural disaster, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies and organizations. These activities and resources are highlighted in the Mitigation Strategy (Chapter 4).

Chapter 4 MITIGATION STRATEGY

4.1 Introduction

The Mitigation Strategy establishes a policy framework and implementation pathway for reducing risk from natural hazards over the long term. This chapter outlines La Grande's strategy to reduce or avoid long-term vulnerabilities to the identified hazards. Specifically, this section presents a mission, goals, and mitigation actions to reduce the risk of damage from these hazards. The NHMP Steering Committee reviewed and updated the mission, goals and action items documented in this plan. Additional planning process documentation is Planning Process (Chapter 5).

4.2 Mitigation Mission

The plan mission states the purpose and defines the primary functions of La Grande's NHMP. It is intended to be adaptable to any future changes to the plan and need not change unless the community's environment or priorities change.

The mission of the 2023 La Grande NHMP is:

> ***Empowering Our Community Through Collaborative Hazard Mitigation****: Together, we envision a resilient future where our community proactively identifies, prepares for, and mitigates hazards, safeguarding lives, critical infrastructure, and property. Through informed planning, innovative strategies, and a commitment to collaboration, we strive to build a safer and more sustainable environment for current and future generations*

The La Grance NHMP Steering Committee reviewed the previous plans mission statement and agreed to revise the mission to align with other community objectives. Moreover, the revision of the mission statement intends to include the whole community. The Steering Committee believes the concise nature of the mission statement allows for a comprehensive approach to mitigation planning.

4.3 Mitigation Goals

Mitigation plan goals are more specific statements of direction that La Grande citizens, and public and private partners can take while working to reduce the city's risk from natural hazards. These statements of direction form a bridge between the broad mission statement and particular action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Public participation was a key aspect in developing the plan goals. Meetings with the project Steering Committee, stakeholder interviews and public workshops all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss for natural hazards in La Grande.

The La Grande NHMP Steering Committee reviewed the previous plan goals in comparison to the *2020 Oregon NHMP* and *2022 Union County NHMP* goals. Like the mission statement revision, the Steering Committee determined they would revise and expand their existing goals based on the consideration and sensitivity of the whole community.

All the plan goals are important and are listed below in order of priority. Establishing community priorities within action items neither negates nor eliminates any goals, but it establishes which action items to consider implementing first, should funding become available. The *2024 La Grande NHMP* goals are as follows:

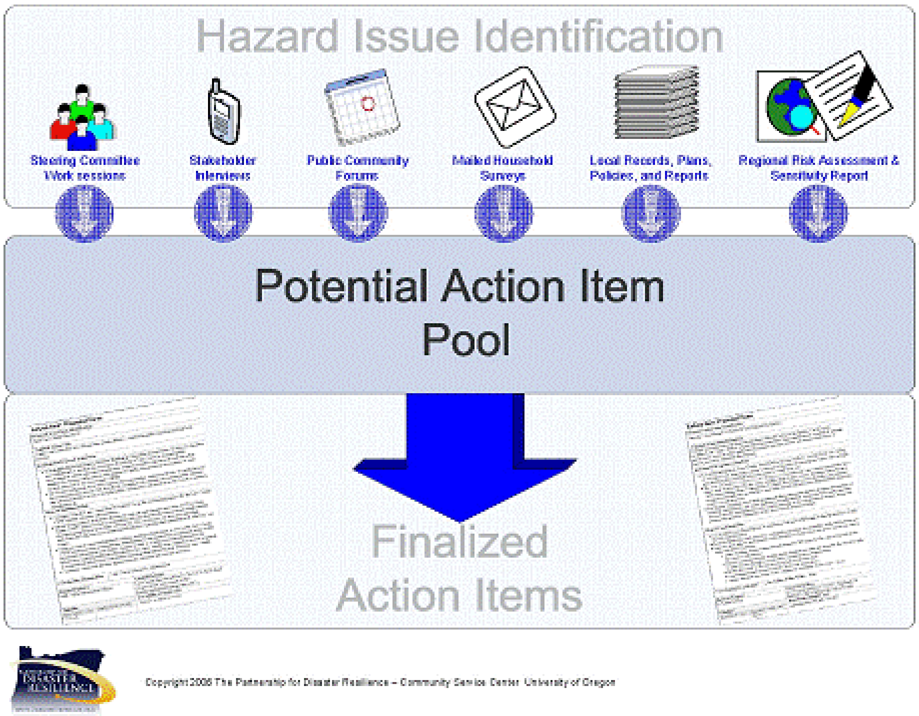
> ***Goal 1: Protect Lives****. Develop and implement safety measures to protect human welfare, property, and natural resources.*
>
> ***Goal 2: Structural Mitigation****. Strive to protect existing buildings and infrastructure from the impacts of natural hazards.*
>
> ***Goal 3: Coordination****. Increase cooperation and coordination among private entities, local agencies, state agencies, and federal agencies.*
>
> ***Goal 4: Awareness****. Provide ongoing opportunities to increase hazard risk and mitigation understanding through community education and outreach.*
>
> ***Goal 5: Economy****. Enhance community resilience, including economic continuity and recovery, to reduce the impacts of natural hazards and promote efficient and effective recovery.*
>
> ***Goal 6: Natural Resources****. Preserve and rehabilitate natural systems to serve natural hazard mitigation functions and protect natural resources.*

4.4 Mitigation Actions

Development Process

Mitigation actions are specific actions, projects, activities, or processes that La Grande is considering implementing to reduce risk to people, property, and the environment from the impacts of natural hazard events. Therefore, mitigation actions identified through the planning process are an important part of the NHMP. The development of action items was a multi-step, iterative process that involved brainstorming, discussion, review, and revisions. Action items can be developed through several sources. Figure 4-1 illustrates some of these sources.

Figure 4-1. Development of Action Items



Some of the action items were first created during the *2014 Northeast Oregon Regional NHMP* planning processes. Additional actions were created during the current NHMP review process. Much of this work occurred during the fifth and sixth Steering Committee meetings held on August 30, 2023 and September 19, 2023. During these processes, the Steering Committees considered growth and changes in development patterns, considered local vulnerable populations, facilities, and infrastructure with respect to each identified hazard. Discussions involved potential actions to mitigate impacts to the vulnerable areas. Oregon DLCD provided guidance in the development of action items by presenting and discussing actions that were used in other communities. DLCD also took note of ideas that came up in Steering Committee meetings and drafted specific actions that met the intent of the Steering Committee. All actions were then reviewed by the Steering Committee, discussed at length, and revised as necessary before becoming a part of this document.

One of the first steps was to discuss the status of the mitigation actions from the 2014 *Northeast Oregon Regional NHMP*. The Steering Committee went through each mitigation action and ascertained if the action was completed or in progress.

- *Completed mitigation actions* are accomplished and were removed from the table.
- *Mitigation actions were removed* from the table due to resource constraints or other factors.
- *Mitigation actions that were retained* were retained in full or modified to reflect the current situation more accurately.
- During this process, *new mitigation actions* were also identified.

Table 4-1 lists each of the 2024 mitigation actions along with prioritization. Table 4-2 lists the status of each of the *2014 Northeast Oregon Regional NHMP* mitigation actions that were assigned to the City of La Grande. The 2024 mitigation actions are detailed in mitigation action item worksheets located in

Appendix 8.1, Mitigation Action Worksheets. These worksheets identify the rationale for the project ideas for implementation, and potential coordinating and partner organizations. The action items worksheets are intended to assist plan holders to seek grant funding by summarizing mitigation actions in a manner that summarizes each project.

Action Item Worksheets

The mitigation actions identified in Table 4-1, have a corresponding action item form describing the activity, identifying the rationale for the project, identifying potential ideas for implementation, and assigning coordinating and partner organizations. The action item forms can assist the community in pre-packaging potential projects for grant funding. The form components are described below and are in Appendix 8.1, Mitigation Action Worksheets.

Action Item

Each action item includes a brief description of the proposed action and an associated action identifying number. There are numerous actions identified, some of which are within the following hazard categories:

- Multi-Hazard (MH)
- Air Quality (AQ)
- Drought (DR)
- Earthquake (EQ)
- Flood (FL)
- Invasive Species/Pests (IS)
- Severe Weather (SW)
- Volcanic (VO)
- Wildfire (WF)

Priority Status

The *2024 La Grande NHMP* includes a priority for each action. Priority status is identified as 1 (high), 2 (medium), and 3 (low), which is defined below under the 2024 Actions section.

Background/Issue

Action items should be fact-based and tied directly to issues or needs identified throughout the planning process. Action items can be developed at any time during the planning process and can come from several sources, including participants in the planning process, noted deficiencies in local capability, or issues identified through the risk assessment. The rationale for proposed action items is based on the information documented in the Risk Assessment (Chapter 3) and elsewhere in this plan.

Ideas for Integration

For each mitigation action, the Mitigation Action Form provides ideas for implementation and integration, which serve as the starting point for taking action. This information offers a transition from theory to practice. Ideas for implementation could include: (1) collaboration with relevant organizations, (2) alignment with the community priority areas, (3) applications to new grant programs, (4) tax incentives, (5) human resources, (6) education and outreach, (7) research, and (8) physical manipulation of buildings and infrastructure. This component of the mitigation action is dynamic, since some ideas may prove to not be feasible, and new ideas may be added during the plan maintenance process. When a mitigation action is implemented, more work may be needed to determine the exact course of action.

Plans and policies already in existence have support from residents, businesses, and policy makers. Many land use, comprehensive, and strategic plans are updated regularly, and can adapt easily to changing conditions and needs. Implementing the NHMP's mitigation actions through such plans and policies increases their likelihood of being supported and implemented. La Grande will work to incorporate the mitigation actions into existing programs and procedures such as comprehensive land use plans, capital improvements plans, mandated standards, and building codes.

Responsible Agency

The responsible agency is a public agency with the regulatory responsibility to address natural hazards, or that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation.

Partners

The internal and external organizations listed in the forms are potential partners recommended by the project Steering Committee but not necessarily contacted during the development of the plan. The coordinating organization should contact the identified partner organizations to see if they are capable of and interested in participation. This initial contact is also to gain a commitment of time or resources toward completion of the action items.

Internal partner organizations are departments within the city that may be able to assist in the implementation of action items by providing relevant resources to the coordinating organization.

External partner organizations can assist the coordinating organization in implementing the action items in various functions and may include local, regional, state, or federal agencies, as well as local and regional public and private sector organizations (special districts, etc.).

Potential Funding

The Steering Committee has identified potential funding sources for most action items. Example funding sources can include: the Building Resilient Infrastructure and Communities, Flood Mitigation Assistance Programs; state funding sources such as the Oregon Seismic Rehabilitation Grant Program; or local funding sources such as capital improvement or general funds. An action item may also have multiple funding sources.

Cost Estimate

Where possible, an estimate of the cost for implementing the action item is included. The cost estimate is identified as low, medium, and high.

Timeline

Action items include short, mid-, and long-term activities. Each action item includes an estimate of the timeline for implementation. ***Short-term action items*** are activities that may be implemented with existing resources and authorities within 1 to 5 years. ***Long-term action items*** may require new or additional resources and/or authorities and will occur after the next NHMP update cycles (five or more years to implement). ***Ongoing*** action items signify that work has begun and will either exist over an indefinite timeline, or an extended timeline, where possible specific measurable objectives are included.

Action Item Status

As action items are implemented or new ones are created during the plan maintenance process, it is important to indicate the status of the action item—whether it is **new** (created during this plan update cycle), **ongoing** (created in a previous planning process with some work accomplished), **progressing** (these actions are in progress), or **complete** (these actions are considered accomplished). Documenting the status of the action will make reviewing and updating the mitigation Plan easier during the plan's five-year update and can be used as a benchmark for progress.

Notes

Each action will include status that will identify whether the action item is new to the NHMP or has been carried over, with revisions, from the previous NHMP.

Mitigation Action Tables

The Mitigation Actions Tables portray the overall action plan framework and identify links between the plan goals, partnerships (coordination and partner organizations), and actions. The tables document a description of the action, the level of priority, the coordinating organization, partner organizations, and timeline. Refer to Mitigation Action Worksheets (Appendix 8.1) for detailed information about each mitigation action.

For the *2024 La Grande NHMP*, mitigation action priority was evaluated based on the mitigation goals and risk assessment results and with consideration and sensitivity of the whole community.

2024 Actions

Action items identified through the planning process are an important part of the mitigation plan. Action items are detailed recommendations for activities that local departments, citizens, and others could engage in to reduce risk. The La Grande NHMP Steering Committee established a three-tiered priority – high, medium, and low – for the 2024 mitigation actions. Most of these actions are carried forward from prior versions of this plan.

Level 1: This high-level priority places the focus on an achievable set of high leverage and urgent activities to build community resilience.

Level 2: This moderate level focus is the action's necessity to build community resilience. Pre-planning is anticipated for some of these actions. The Level 2 priority actions are available for local consideration as resources, capacity, technical expertise, and/or political will become available.

Level 3: These are desirable priority actions with the focus on local consideration as resources, capacity, technical expertise, and/or political will become available.

2014 Action Status

Table 4-2 is a summary of changes that includes the status and explanation of the *2014 Northeast Oregon Regional NHMP* La Grande-specific mitigation actions as provided by the NHMP Steering Committee during the planning process. The decisions to retain, modify, or remove the mitigation actions were also discussed at Steering Committee meetings. Follow up review of the actions occurred by email. This table has been refined to include an overall summary of the discussions. There is a column entitled “Priority” which identifies the priority of the mitigation actions in the *2014 Northeast Oregon Regional NHMP*. In that NHMP, several of them were listed with high priority rating.

Table 4-1. 2024 La Grande Mitigation Actions

2024 Action Items	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline
Multi-Hazard					
MH #1	1	Develop and maintain a Continuity of Operations Plan (COOP) or Emergency Operations Plan (EOP).	City of La Grande	Relevant Public Works and Emergency Services / Emergency Management, Law Enforcement, Fire Department, Department of Homeland Security, County and City Roads Departments, ODOT, Island City, relevant private industries, OEM	Short Term
MH #2	2	Ensure city planning documents and regulations align with regard to natural hazards mitigation and the actions in the Natural Hazards Mitigation Plan, particularly State Planning Goal 7.	City of La Grande Planning and Public Works Departments	DLCD, OEM, FEMA	Short Term
MH #3	2	Inform public officials about mitigation awareness and the Natural Hazards Mitigation Plan and review Mitigation Actions with the Steering Committee on an annual basis	La Grande NHMP Steering Committee Convener	Relevant Public Works and Emergency Services, Law Enforcement, Fire Department, Road Department, ODOT, ODF, relevant private industries	Short Term
MH #4	2	Develop, implement, and maintain education and outreach programs to increase public awareness of the risk associated with natural hazards. Specifically target underserved communities and socially vulnerable populations.	City of La Grande	Relevant Public Health Departments, Island City, Eastern Oregon Head Start, Chambers of Commerce, American Red Cross, Oregon Education Association, Families First, Oregon Rural Action, OSU Extension Service, Eastern Oregon Medical Associates, Girl Scouts of the USA, Kayak, Community Connections of Northeast Oregon, Union County Safe Communities Coalition	Short Term
MH #5	1	Assist in maintaining and enhancing the local alert and warning system and emergency evacuation protocol. Specifically target underserved communities and socially vulnerable populations.	City of La Grande, Union County Emergency Management	Community Connections of Northeast Oregon, American Red Cross, Kayak, Assisted living facilities, public libraries, National Organization on Disability, Union County Safe Communities Coalition	Ongoing
MH #6	3	Develop and maintain partnerships/capacity with local jurisdictions, and other regional and community entities to develop emergency management planning and community resilience.	City of La Grande Community Development, Public Works, Fire and Police Departments	Eastern Oregon University, Island City, Union County Emergency Services, American Red Cross, private and public utilities, Internet Service Providers, ODOT, Community Connections of Northeast Oregon, Relevant Public Health Departments, Grande Ronde Hospital, Kayak, Union County Safe Communities Coalition	Ongoing

Table 4-1. 2024 La Grande Mitigation Actions (continued)

2024 Action Items	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline
MH #7	3	Secure funding to improve water supply and delivery systems within the Beaver Creek Watershed, La Grande's backup water supply.	City of La Grande Public Works	City of La Grande Planning Department, Union County Water Master, Oregon Water Resources Department	Long Term
MH #8	3	Increase community resiliency to reduce and mitigate hazard-related power outages.	City of La Grande, Union County Emergency Management	City of La Grande Public Works, Island City, American Red Cross, Relevant Utility Companies	Short Term
MH #9	3	Identify and plan for a network of regional resilience hubs, indoor gathering places that can function as but not limited to community centers, warming and cooling centers, food distribution, places to access electricity during power outages, and evacuation sites.	City of La Grande, Union County Emergency Management	Relevant City and County Departments, Community Connections of Northeast Oregon, Center for Human Development, Union County Warming Station, La Grande School District, Northeast Oregon Regional Food Bank, Kayak, Northeast Oregon Public Transportation, DHS	Long Term
Air Quality					
No specific action item developed for this hazard. See multi-hazard actions for applicable mitigation strategies.					
Drought					
DR #1	2	Promote water conservation to protect potable water supply and reduce impacts during drought through existing conservation programs and plans, as well as any new identified initiatives.	City of La Grande Public Works	Relevant Utility Companies, Island City, wastewater treatment facilities, US Environmental Protection Agency's WAVE program	Ongoing
DR #2	3	Develop community drought contingency plan and policies, or similar.	City of La Grande Public Works	Water Resources Departments, Island City, Union County, Relevant County and City Planning Departments, Public Works Departments,-Natural Resources Conservation Service, Relevant Irrigation Districts, OSU Extension Service, US Department of Agriculture	Long Term
DR #3	1	Conduct an aquifer (groundwater) study for the Grande Ronde Valley	Grande Ronde Model Watershed Council, Union County Commissioners	City of La Grande, Union County Planning Department, Public Works, and Water Master, Oregon Department of Water Resources, United States Geological Survey, Union Soil and Water Conservation District	Long Term

Table 4-1. 2024 La Grande Mitigation Actions (continued)

2024 Action Items	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline
Earthquake					
EQ #1	3	Perform an earthquake risk evaluation in critical buildings not listed in the DOGAMI RVS report	Union County Emergency Management, City of La Grande	Eastern Oregon University, Island City, Business Oregon, Relevant Utility Companies, DOGAMI	Long Term
EQ #2	1	Identify, inventory, and mitigate (as prioritization and resources allow) critical facilities and utilities that require seismic-retrofit. Consider both structural and non-structural retrofit options.	City of La Grande Public Works, Union County Emergency Management	Relevant City Departments, Island City, Business Oregon, La Grande School District, Eastern Oregon University, DOGAMI, OEM, FEMA, ODE	Long Term
EQ #3	3	Collaborate with the school district plans about the identification and prioritization of school distric facility retrofts and upgrades.	City of La Grande, Union County Emergency Management	La Grande School District, Relevant City of La Grande departments, Business Oregon, DOGAMI, OEM, FEMA, ODE	Long Term
Flood					
FL #1	3	Scope flood mitigation opportunities for homes and critical facilities subject to flooding.	City of La Grande Community Development Department	Union County, Island City, City of La Grande Public Works, FEMA, ACOE, ODFW, DSL, ODOT	Ongoing
FL #2	3	Scope the costs and benefits for participation in the NFIP's Community Rating System	City of La Grande Community Development Department	Union County Emergency Management, City of La Grande Public Works, Silver Jackets, FEMA, DLCD	Short Term
FL #3	3	Increase awareness concerning the NFIP program.	City of La Grande Community Development Department	Union County Emergency Management, Island City, NFIP Floodplain Coordinator (DLCD), insurers, realtors, FEMA, OSU Extension Service, Eastern Oregon Medical Associates, Girl Scouts of the USA , Community Connections of Northeast Oregon (any community organizations capable of distributing information), ACOE	Short Term

Table 4-1. 2024 La Grande Mitigation Actions (continued)

2024 Action Items	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline
FL #4	3	Update and maintain the local FEMA Flood Insurance Rate Maps.	City of La Grande Community Development Department	Union County~~,~~ City of La Grande Public Works~~,~~ ACOE, DOGAMI, DAS-GEO, elected officials	Long Term
FL #5	1	Implement recommended action items created in the Morgan Lake Study. This includes modifying the dam or its potential breach flow path so that any breach does not flow down Deal Canyon as an extremely rapid debris flood though most of the City of La Grande	City of La Grande Public Works Director	City of La Grande Parks and Recreation Department, Union County Emergency Management, Silver Jackets, USACE, FEMA,	Short Term
Invasive Species/Pests					
IS #1	2	Support efforts to control insect pests of timber species	City of La Grande, ODF	OSU Extension Service, ODA, USFS	Short Term
IS #2	3	Increase awareness concerning invasive species and insect pests.	City of La Grande	OSU Extension Service, Union County Weed Board, Tri-County Cooperative Weed Management Area, ODF, ODA, USFS	Short Term
Severe Weather (extreme temps, windstorm, winter storm)					
No specific action item developed for this hazard. See multi-hazard actions for applicable mitigation strategies.					
Volcanic Event					
No specific action item developed for this hazard. See multi-hazard actions for applicable mitigation strategies.					
Wildfire					
WF #1	2	Assist with the planning and implementation of the actions identified in the Union County Community Wildfire Protection Plan.	City of La Grande NHMP Steering Committee Convener	Union County~~-~~Emergency Management~~,~~ Local Public Safety Coordinating Council (LPSCC), ODF, BLM, La Grande Fire Department, OSU Extension Services, USFS, Union Soil and Water Conservation District, ODFW, Homeowners in Wildland/Urban Interface zones	Ongoing

Table 4-2. 2014 Northeast Oregon Regional NHMP Actions, La Grande: Status

2014 Action Items	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	2023 Status
MH #1	High	Complete Continuity of Operations Plans (COOPs) within all interested municipalities and counties.	Interested City Managers and/or City Council; County Commissioners, Emergency Management	Relevant Public Works and Emergency Services / Emergency Management, Law Enforcement, Fire Department, Department of Homeland Security, County Roads Departments, ODOT, relevant private industries, OEM	Short Term	Ongoing; retain and revise
MH #2		Incorporate the Natural Hazards Mitigation Plan into the Comprehensive Plan (in particular Goal 7)	County/ City Planning Department	Department of Land Conservation and Development, Oregon Office of Emergency Management, Federal Emergency Management Agency	Short Term	No progress; retain and revise
MH #3		Inform public officials about mitigation awareness and the Natural Hazards Mitigation Plan.	County Steering Committee Convener	Counties and participating cities in Region 7	Short Term	Ongoing; retain and revise
MH #4		Develop and implement education and outreach programs to increase public awareness of the risk associated with natural hazards. Specifically target vulnerable populations	Emergency Services / Emergency Management; Baker City; City of La Grande, Relevant Public Health Department	Eastern Oregon Head Start, Chambers of Commerce, American Red Cross, Oregon Education Association, Families First, Grant and Harney County Casa, Oregon Rural Action, Baker County Children and Families, County Extension Offices, Eastern Oregon Medical Associates, Elks Lodge, Girl Scouts of the USA, Greater Prairie City Community Association, People Mover, Community Connections of Northeast Oregon	Short Term	Ongoing; retain and revise
MH #9		Develop a warning and emergency evacuation protocol for vulnerable populations	Emergency Services / Emergency Management	Community Connections of Northeast Oregon, American Red Cross, People Mover, Assisted living facilities, Elks lodge, public libraries, National Organization on Disability	Deferred	Completed; retain and revise

Table 4-2. 2014 Northeast Oregon Regional NHMP Actions, La Grande: Status (continued)

2014 Action Items	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	2023 Status
MH #11		Build partnerships with local jurisdictions to develop emergency management planning for Eastern Oregon University	Eastern Oregon University	Union County Emergency Services, La Grande Fire Department, La Grande Planning Department, Union County Planning Department, American Red Cross, Oregon Trail Electric Co-op, Internet Service Providers, Oregon Department of Transportation	Ongoing	Revise to include whole community
MH #12	High	Update city and County addresses within the County's GIS database.	Union County Planning Department/GIS	City of La Grande, Union County Emergency Services, Union City, Community Connections of Northeast Oregon	Short Term	Completed; remove
MH #16 (La Grande)		Secure funding to filter water within the Beaver Creek Watershed, La Grande's backup water supply	City of La Grande Public Works	City of La Grande Planning Department, Union County Water Master, Oregon Water Resources Department	Long Term	No progress; retain and revise
Drought						
DR #2		Identify incentive programs to Increase water efficiency among municipal water users	Participating Cities	Relevant utility companies, city public works departments, County, wastewater treatment facilities, Wallowa Lake County Service District, US Environmental Protection Agency's WAVE program	Ongoing	Ongoing; retain and revise
DR #3		Develop community drought emergency plans and policies	County Emergency Services / Emergency Management; Interested Cities	Water Resources Departments, County and City Governments, County and City Planning Departments, Public Works Departments, Enterprise, City of La Grande, Baker City, John Day, Halfway, Natural Resources Conservation Service, Wallowa Lake Service District, Baker County Cattleman's Association, Relevant Irrigation Districts, OSU Extension Office, US Department of Agriculture	Long Term	Ongoing; retain and revise
DR #5	High	Conduct an aquifer (groundwater) study for the Grande Ronde Valley	Grande Ronde Model Watershed Council, Union County Commissioners	The City of La Grande, Union County Planning Department, Union County Public Works, Union County Water Master, Oregon Department of Water Resources, United States Geological Survey	Short Term	No progress; retain

Table 4-2. 2014 Northeast Oregon Regional NHMP Actions, La Grande: Status (continued)

2014 Action Items	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	2023 Status
Earthquake						
EQ #1		Perform an earthquake risk evaluation in critical buildings not listed in the DOGAMI RVS report	Emergency Management	Eastern Oregon University, County Public Works Departments, Region 7 Counties, Interested Cities, Business Oregon, Relevant utility companies, DOGAMI	Long Term	Ongoing; retain
EQ #16		Seismically retrofit the Grande Ronde Hospital to reduce the building's vulnerability to seismic hazards. Consider both structural and non-structural retrofit options	The Grande Ronde Hospital, Emergency Management	County Public Works Departments, The City of La Grande, Business Oregon, DOGAMI, OEM, FEMA, ODE	Long Term	Completed
EQ #17		Seismically retrofit the La Grande City Police Department to reduce the building's vulnerability to seismic hazards. Consider both structural and non-structural retrofit options	City of La Grande, Emergency Management	County Public Works Departments, Business Oregon, DOGAMI, OEM, FEMA, ODE	Long Term	Ongoing; retain and rewrite as new action to include all critical facilities
EQ #18		Seismically retrofit Willow Elementary School to reduce the building's vulnerability to seismic hazards. Consider both structural and non-structural retrofit options	La Grande SD 1, Emergency Management	County Public Works Departments, City of La Grande, Business Oregon, DOGAMI, OEM, FEMA, ODE	Long Term	Progressing; rewrite into one action for schools
EQ #19		Seismically retrofit La Grande High School to reduce the building's vulnerability to seismic hazards. Consider both structural and non-structural retrofit options	La Grande SD 1, Emergency Management	County Public Works Departments, City of La Grande, Business Oregon, DOGAMI, OEM, FEMA, ODE	Long Term	Progressing; rewrite into one action for schools
EQ #20		Seismically retrofit Greenwood Elementary School to reduce the building's vulnerability to seismic hazards. Consider both structural and non-structural retrofit options	La Grande SD 1, Emergency Management	County Public Works Departments, City of La Grande, Business Oregon, DOGAMI, OEM, FEMA, ODE	Long Term	Progressing; rewrite into one action for schools

Table 4-2. 2014 Northeast Oregon Regional NHMP Actions, La Grande: Status (continued)

2014 Action Items	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	2023 Status
Flood						
FL #1		Explore flood mitigation opportunities for homes and critical facilities subject to flooding.	Relevant City and County Public Works Departments / Emergency Services and Emergency Management	County Roads Departments, Public Works Departments, County Planning Departments; City of John Day, City of La Grande, Baker City, City of Halfway, Silver Jackets, Relevant water treatment facilities, Federal Emergency Management Agency, Homeowner, Army Corps of Engineers, Oregon Department of Fish and Wildlife, Department of State Lands, ODOT	Ongoing	Ongoing; retain and revise
FL #2		Explore the costs and benefits for participation in the NFIP's Community Rating System	Interested Cities and Counties	County and city planning departments, county emergency services / emergency management, county public works, Silver Jackets, FEMA, DLCD	Short Term	Ongoing; retain and revise
FL #3		Increase awareness concerning the NFIP program and specifically the Biggert Waters Flood Insurance Reform Act of 2012.	Local flood plain managers, County Emergency Managers	City Planning Departments, Emergency Services / Emergency Management, NFIP Floodplain Coordinator (DLCD), insurers, realtors, FEMA, Baker County Children and Families, County Extension Offices, Eastern Oregon Medical Associates, Elks Lodge, Girl Scouts of the USA , Greater Prairie City Community Association, People Mover, Community Connections of NEOR (Any community organizations capable of distributing information), Blue Mountain Eagle, ACOE	Short Term	Ongoing
FL #4		Update the County and City FEMA Flood Insurance Rate Maps and digitize the updated maps.	Relevant City and County Public Works Departments, Emergency Management, City Managers, County Planning Departments	County Roads Departments, Public Works Departments, City of John Day, City of La Grande, Baker City, City of Halfway, Army Corps of Engineers, DOGAMI, DAS-GEO, elected officials	Long Term	Progressing; retain and revise
FL #7 (La Grande)		Incorporate recommended action items created in the Morgan Lake Study	City of La Grande Parks Director	The City of La Grande, Union County Emergency Management, Silver Jackets, USACE, FEMA,	Short Term	Progressing; retain and revise for HHPD

Table 4-2. 2014 Northeast Oregon Regional NHMP Actions, La Grande: Status (continued)

2014 Action Items	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	2023 Status
Landslide						
LS #1		Identify, obtain, and evaluate detailed risk assessments in landslide prone areas and develop mitigation strategies to reduce the likelihood of a potential hazardous event.	County Public Works Department	County Planning Department, City of La Grande, ODOT, EOU, DOGAMI, USGS, irrigation district	Long Term	Remove
Severe Weather (extreme temps, windstorm, winter storm)						
No Actions Identified for this hazard. This is a low concern for the region.						
Volcanic Event						
No Actions Identified for this hazard. This is a low concern for the region.						
Wildfire						
WF #1		Advocate for the implementation of the actions identified in each county's Community Wildfire Protection Plan.	County Steering Committee Convener, Emergency Management	County Emergency Services / Emergency Management, County Planning Departments, City of Baker City, City of Halfway, Local Public Safety Coordinating Council (LPSCC), Oregon Department of Forestry, Bureau of Land Management, local fire departments, OSU Extension Services, US Forest Service, Soil and Water Conservation Districts, Oregon Department of Fish and Wildlife; Homeowners in Wildland/Urban Interface zones; Hells Canyon Preservation Council	Ongoing	Ongoing; retain and revise

Integration

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

Governmental and Institutional Capacity

In addition to the Emergency Management department, most departments within County and City governance structures have some degree of responsibility in building overall community resilience. Each plays a role in ensuring that jurisdiction functions and normal operations resume after an incident, and the needs of the population are met. La Grande has the capacity for mitigation action through the following departments.

Fire Department: The City of La Grande Fire Department operates within their protection area and is an all-hazard response agency that has been trained to mitigate emergencies involving fire, hazardous materials, and technical rescue (including rope rescue, water, confined space building collapse, and trench rescue). Emergency medical services and medical response are also a fundamental responsibility of the La Grande Fire Department, and providers respond to a wide variety of medical calls, ranging from minor medical assistance to life-threatening events.

Police Department: The La Grande Police Department provides law enforcement and public safety services to the City of La Grande. As an agency, the Police Department holds high standards and pride themselves on maintaining excellent training, professional development and competency. Moreover, they enjoy support and collaboration with many community partners and share critical law enforcement mission with the Union County Sheriff's Office and Oregon State Police. As part of their jurisdiction, they also provide law enforcement services to Eastern Oregon University.

Community Development Department: The Community Development Department works to ensure the strength of the La Grande community at the neighborhood level and citywide through support for planning and civic involvement, permitting, inspecting and, where needed, protecting historic community resources. The Community Development Department includes the Planning and Building Division. The Planning Division aims to enhance the quality of life for residents and to promote a livable, vibrant city by facilitating and implementing the community's vision for La Grande. City Planners can also provide information about protection of vegetation and trees along riparian areas and wetlands and development within the mapped floodplain. The Building Division is responsible for the consistent application of building codes in construction and remodeling.

Public Works Department: La Grande's Public Works Department consists of six divisions that include Engineering, Motor Pool, Streets, Water, Wastewater Collection and Wastewater Treatment. The Public Works Department plans, constructs, and maintains the City's infrastructure including water supply systems, stormwater drainage system, wastewater treatment system, and transportation systems.

Economic Development Department: The Economic Development Division oversees the implementation of the Urban Renewal Plan, the Economic Development Plan and the Main Street program; and works in partnership with other local, regional and statewide economic partners to develop a strong and resilient local economy for the city.

Parks and Recreation Department: The Parks & Recreation Department consists of four different divisions including; 1) Aquatics (Veterans' Memorial Pool), 2) Recreation, 3) Parks Maintenance, and 4) Urban Forestry. This department provides and maintains parks and recreation programs and services for the citizens of La Grande, which include the community's parks system, open space, community forest, trails, recreation facilities, Safe Routes to School, and other programs and services.

La Grande Schools District: The district includes the communities of La Grande and Island City. Educating approximately 2,200 students in 5 schools. They also offer La Grande Virtual Learning Academy and Home Link options. They hold institutional capacity for resilience to natural hazards through their facilities management personnel under the guidance of their elected School Boards.

Existing Plans and Policies

The City of La Grande has existing authorities, policies, programs and resources in place. Integrating the existing capacity of local governments into the planning process improves the ability of local governments to implement the NHMP and to reduce the risk of damage from natural hazards.

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports or studies. Plans and policies already in existence have support from residents, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt to changing conditions and needs.

The *2024 La Grande NHMP* includes a range of recommended Mitigation Actions that, when implemented, may reduce La Grande's vulnerability to natural hazards. These recommendations are intended to be consistent with the goals and objectives of the city's existing plans, policies and programs. Linking existing plans and policies to the NHMP helps identify what resources already exist that can be used to implement the Mitigation Actions identified in the *2024 La Grande NHMP*. Implementing Mitigation Actions through existing plans, policies and programs increases their likelihood of being supported and maximizing the city's resources. Incorporating the NHMP into the Comprehensive Plan strengthens the provisions within the plan. Revising zoning regulations to identify hazardous areas through overlay zones where proscribed standards for safe development are required is another method of utilizing existing methods of regulating development to implement the Mitigation Actions of the NHMP.

Table 5-1 (Chapter 5, Planning Process) identifies the existing types of plans and implementing codes into which natural hazard mitigation goals, objectives, and actions may be integrated.

Community Organizations and Programs

In planning for natural hazard mitigation, it is important to know what social systems exist within the community because of their existing connections to the public. The counties and cities can use existing social systems as resources for implementing such communication-related activities because these service providers already work directly with the public on several issues, one of which could be natural hazard preparedness and mitigation. The Community Profile (Chapter 2) provides a comprehensive list of community organizations and programs and offers a more thorough explanation of how existing community organizations and programs can be utilized for hazard mitigation.

Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of a natural disaster, according to the *Planning for Natural Hazards: Oregon Technical Resource Guide*. The following are existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, and federal agencies and organizations. These activities and resources are categorized by hazard, as identified in the *2024 La Grande NHMP*. In addition to what is identified here, the Grants appendix (Appendix 8.3), provides a comprehensive list of other mitigation resources.

Federal

Multi-Hazard

Federal Emergency Management Agency

FEMA recommends preparing the home and the person for natural hazard events. (https://www.ready.gov/).

FEMA also recommends having a safe room in homes or small businesses to prevent residents and workers from "dangerous forces" of extreme winds to avoid injury or death. (https://www.fema.gov/fema-p-320-taking-shelter-storm-building-safe-room-your-home-or-small-business

National Oceanic and Atmospheric Administration

According to the NOAA National Severe Storms Laboratory, severe weather and storms use a variety of tools to forecast weather and storms. The National Severe Storms Laboratory is a major contributor to the scientific and engineering development of dual-polarized weather radar, which is now installed on the NWS weather radars. Dual-polarization radar can clearly identify rain, hail, snow, or ice pellets inside the clouds. In addition to observing a wide network of satellites, Doppler radars and automated surface observing systems, forecasters use their experience, together with computer forecast models to write and issue forecasts on what will happen next regarding weather and storms.

National Weather Service

The Portland Office of the National Weather Service issues severe winter storm watches and warnings when appropriate to alert government agencies and the public of possible or impending weather events. Four NWS offices cover Oregon: Portland (NW), Medford (SW), Pendleton (NE), and Boise (East and SE). The watches and warnings are broadcast over NOAA weather radio and are forwarded to the local news media for retransmission using the Emergency Alert System.

The Oregon landslide warning system was developed in direct coordination with the Portland NWS office and state agencies (Burns et al., 2021), such as DOGAMI.

Hazard Mitigation Grant Program

Following a major disaster declaration, the FEMA Hazard Mitigation Grant Program provides funding for long-term hazard mitigation projects and activities to reduce the possibility of damages from all future fire hazards and to reduce the costs to the nation for responding to and recovering from the disaster.

Air Quality

Environmental Protection Agency

The Clean Air Act of 1970 and the U.S. Environmental Protection Agency established health-based National Ambient Air Quality Standards (NAAQS) for six air pollutants: carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and lead (Pb). The areas that fail to meet the standards are designated "nonattainment" and are required to develop plans to come into compliance with the standards. Once compliant, a maintenance plan is developed to ensure that air quality will not be compromised in the future.

According to EPA's *Process of Reviewing the National Ambient Air Quality Standards* website, the Clean Air Act established two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings. The Clean Air Act requires periodic review of the science upon which the level of the standards is based and determine if changes to the level of the standards are warranted.

Drought

NOAA National Integrated Drought Information System

The National Integrated Drought Information System (NIDIS) program was authorized by Congress in 2006 (Public Law 109-430) and reauthorized in 2014 and 2019 with an interagency mandate to coordinate and integrate drought research, building upon existing federal, tribal, state, and local partnerships in support of creating a national drought early warning information system to make climate and drought science accessible and useful for decision makers and stakeholders.

Earthquake

USGS National Earthquake Information Center

The USGS National Earthquake Information Center (NEIC) operates a 24-hour-a-day service to determine the location and magnitude of significant earthquakes in the United States and around the world as rapidly and accurately as possible. This information is communicated to federal and state government agencies who are responsible for emergency response, to government public information channels, to national and international news media, to scientific groups (including groups planning aftershock studies), and to private citizens who request information. The NEIC issues rapid reports for those earthquakes with magnitudes at least 3.0 in the eastern United States and 3.0 in the western United States.

In addition, the USGS ShakeAlert Earthquake Early Warning System detects earthquakes quickly so alerts can be delivered to people before they feel shaking. ShakeAlert is a warning system for the west coast of the United States and can be directly integrated into healthcare facility communication and control systems, such as intercoms, to warn people and protect patients and staff. ShakeAlert does not predict earthquakes, rather it detects an earthquake moments after it begins, so that alerts can be sent to people in the affected area. Because information travels faster than earthquake waves, alerts can reach people quickly, even before they begin to feel shaking. ShakeAlert can be enabled on most cell phones.

FEMA and National Earthquake Hazards Reduction Program

FEMA administers several grant programs intended to reduce the risks to people and property posed by earthquakes. Although FEMA's programs are not dedicated exclusively to earthquakes, they can be valuable sources of funding for risk reduction efforts targeting earthquakes or earthquakes and other hazards at state or local levels.

The National Earthquake Hazards Reduction Program (NEHRP) leads the federal government's efforts to reduce the fatalities, injuries and property losses caused by earthquakes. The NEHRP is a coordination of complementary activities between these four federal agencies Federal Emergency Management Agency (FEMA), National Institute of Standards and Technology (NIST), National Science Foundation (NSF), and U.S. Geological Survey (USGS).

NEHRP also partners with state and local governments, universities, research centers, professional societies and trade associations and businesses.

FEMA's National Earthquake Hazards Reduction Program (NEHRP) Earthquake State Assistance Grant Program was created to increase and enhance the effective implementation of earthquake risk reduction at the local level. NEHRP has two separate funding opportunities: Individual State Earthquake Assistance and Multi-State and National Earthquake Assistance funding opportunities, both of which are designed to increase and enhance the effective implementation of earthquake risk reduction at the national, state and local level.

Flood

National Resources Conservation Service

The NRCS provides a suite of federal programs designed to assist state and local governments and landowners in mitigating the impacts of flood events. Since flood events can trigger landslide events, the NRCS programs provide a nexus. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource or that experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance to clearing debris from clogged waterways, restoring vegetation, and stabilizing riverbanks. The measures taken under EWP must be environmentally and economically sound and benefit more than one property.

Federal Emergency Management Agency Programs

FEMA resulted from the consolidation of five federal agencies that dealt with different types of emergencies. FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for flood mitigation projects, and technical assistance.

The National Flood Insurance Program, Flood Insurance Rate Maps, Flood Insurance Study, and the Community Rating System are discussed in the Risk Assessment (Chapter 3) under the Flood hazard. In addition to the NFIP and associated programs, the following are flood-related federal resources.

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) plays a major role in a coordinated and complex system to reduce flood risks and provide water for hydropower generation, fish and wildlife enhancement, navigation, recreation, and other uses. Portland District's primary water management mission is to save lives and reduce property damage by reducing flood risks with measures both structural (such as dams) and non- structural (such as improving the natural function of floodplains).

Environmental Protection Agency

According to the EPA, the Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the Act was significantly reorganized and expanded in 1972. "Clean Water Act" became the Act's common name with amendments in 1972.

The Water Quality Standards Regulation (40 CFR 131) establishes the requirements for states and tribes to review, revise and adopt water quality standards. It also establishes the procedures for EPA to review, approve, disapprove and promulgate water quality standards pursuant to section 303 I of the Clean Water Act.

Congress passed the Safe Drinking Water Act (SDWA) in 1974 to protect public health, including by regulating public water systems. The EPA has established protective drinking water standards for more than 90 contaminants, including drinking water regulations issued since the 1996 amendments to SDWA that strengthen public health protection. Over 92 percent of the population supplied by community water systems receives drinking water that meets all health-based standards all the time. EPA requires community water systems to deliver a Consumer Confidence Report, also known as an annual drinking water quality report, to their customers. These reports provide Americans information about their local drinking water quality.

Severe Weather - Extreme Heat

National Oceanic and Atmospheric Administration

As part of the interagency National Integrated Heat Health Information System, NOAA launched Heat.gov in 2022, which is a website that provides clear, timely, and science-based information to understand and reduce the health risks of extreme heat. Heat.gov is intended for the public, decision-makers, and news media. This website provides real time updates regarding the percentage of the country is under extreme heat advisories, watches, and warnings. The information provided on the website includes heat forecasts from NOAA's National Weather Service, Department of Health and Human Services monthly Climate and Health Outlook, and CDC's Heat and Health Tracker.

Regarding heat monitoring and forecasting, NOAA issues outlooks for excessive heat 8-14 days, as well as 3-7 days in advance and provides hourly forecasts, advisories, watches and warnings when dangerous heat becomes likely or imminent.

Volcano

U.S. Geological Survey

A major existing strategy to address volcanic hazards is to publicize and distribute volcanic hazard maps and information through USGS and state agencies, such as DOGAMI.

The volcanoes most likely to constitute a hazard to Oregon communities have been the subject of USGS research. Open-file reports address the geologic history of these volcanoes and lesser-known volcanoes in their immediate vicinity. These reports also cover associated hazards, the geographic extent of impacts, and mitigation strategies. They are available for the active volcanoes such as Mount St. Helens, the Three Sisters, Newberry Volcano, and Crater Lake. While there is not an Open-file reports for Mount Bachelor, there are other resource materials that provide considerable information.

Of note, after the 1980 eruption of Mount St. Helens, Congress provided increased funding that enabled the USGS to establish a volcano observatory for the Cascade Range. Located in Vancouver, Washington, the David A. Johnston Cascades Volcano Observatory was named for a USGS scientist killed at a forward observation post by the May 18, 1980, eruption (https://pubs.usgs.gov/fs/1997/fs165-97/fs165-97.pdf).

For more information, please refer to USGS at https://www.usgs.gov/programs/VHP.

Wildfire

The proposed role of the federal land managing agencies, such as the U.S. Forest Service and the Bureau of Land Management, in the wildland/urban interface is diverse. Their roles include reducing fuel hazards on the lands they administer; cooperating in prevention and education programs; providing technical and financial assistance; and developing agreements, partnerships, and relationships with property owners, local protection agencies, states, and other stakeholders in wildland/urban interface areas. These relationships focus on activities before a fire occurs, which render structures and communities safer and better able to survive a fire.

For more information, refer to the joint USDI and USDA site, *Forest and Rangelands* at https://www.forestsandrangelands.gov/.

Federal Emergency Management Agency Programs

FEMA is directly responsible for providing fire suppression assistance grants and, in certain cases, major disaster assistance and hazard mitigation grants in response to fires. The role of FEMA in the wildland/urban interface is to encourage comprehensive disaster preparedness plans and programs, increase the capability of state and local governments, and provide for a greater understanding of F'MA's programs at the federal, state, and local levels.

Fire Suppression Assistance Grants

FEMA's Fire Suppression Assistance Grants may be provided to a state only if the state has an approved hazard mitigation plan for the suppression of a forest or grassland fire that threatens to become a major disaster on public or private lands. These grants are provided to protect life and improved property, encourage the development and implementation of viable multi-hazard mitigation measures, and provide training to clarify F'MA's programs.

The grant may include funds for equipment, supplies, and personnel. A Fire Suppression Assistance Grant is the form of assistance most often provided by FEMA to a state for a fire. The grants are cost-shared with states. Once the federal grant money is provided to the state, it is passed along to local jurisdictions. This money would be passed along to Marion or Polk Counties to be applied to projects. The U.S. Fire Administration (USFA) provides public education materials addressing wildland/urban interface issues, and the U'FA's National Fire Academy provides training programs.

National Wildland/Urban Interface Fire Protection Program

Federal agencies can use the National Wildland/Urban Interface Fire Protection Program to focus on wildland/urban interface fire protection issues and actions. The Western Governors' Association can act as a catalyst to involve state agencies, as well as local and private stakeholders, with the objective of developing an implementation plan to achieve a uniform, integrated national approach to hazard and risk assessment and fire prevention and protection in the wildland/urban interface. The program helps states develop viable and comprehensive wildland fire mitigation plans and performance-based partnerships.

U.S. Forest Service

The U.S. Forest Service (USFS) implements a fuel-loading program to assess fuels and reduce hazardous buildup on federal forestlands.

The USFS has a fuel-loading program to assess fuels and reduce hazardous buildup on U.S. forestlands. The USFS is a cooperating agency and, it has an interest in preventing fires in the WUI, as fires often burn up the hills and into the higher elevation U.S. forestlands.

According to USFS *Wildland Fire* website, the USFS and other federal, tribal, state, and local government agencies work together to respond to tens of thousands of wildfires annually. Each year, an average of more than 73,000 wildfires burns approximately 7 million acres of federal, tribal, state, and private land and more than 2,600 structures.

The USFS recognizes the wildland fire management environment has profoundly changed. Longer fire seasons, bigger fires and more acres burned on average each year, more extreme fire behavior, and wildfire suppression operations in the WUI have become the norm. To address the challenges, the USFS and its federal, tribal, state, and local partners have developed and are implementing a *National Cohesive Wildland Fire Management Strategy* that has three key components: Resilient Landscapes, Fire Adapted Communities, and Safe and Effective Wildfire Response.

For more information, refer to https://www.fs.fed.us/managing-land/fire.

Bureau of Land Management

The Bureau of Land Management (BLM) is responsible for "managing public lands for a variety of uses such as energy development, livestock grazing, recreation, and timber harvesting while ensuring natural, cultural, and historic resources are maintained for present and future use." According to their website, the BLM manages 1/10 of the nation's surface area and 30% of the nation's mineral and soils (https://www.blm.gov/about/our-mission).

In Oregon, BLM is responsible for fire protection for all federal agencies. They also provide fire protection on Oregon Department of State Lands (DSL) land and on some Oregon State Parks' lands. BLM has a memorandum of agreement with Oregon to provide support to the Rangeland Fire Protection Associations (RFPA) (Crouch, 2019).

There is a program through the BLM, called the Rural Fire Readiness Program. It's a separate cooperative agreement that a RFPA can sign with BLM; it removes them from the statewide memorandum of agreement with Oregon. The cooperative agreement provides more money to the RFPAs for training and equipment (Crouch, 2019). See the descriptions of Rangeland Fire Protection Associations, ODF, and the US Forest Service for additional information.

Firewise

Firewise is a program developed within the National Wildland/Urban Interface Fire Protection Program and is the primary federal program addressing interface fire. It is administered through the National Wildfire Coordinating Group whose extensive list of participants includes a wide range of federal agencies. The program is intended to empower local planners and decision makers. Through conferences and information dissemination, Firewise increases support for interface wildfire mitigation by educating professionals and the public about hazard evaluation and policy implementation techniques.

Firewise offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences. The interactive home page allows users to ask fire protection experts questions, and to register for new information as it becomes available.

For more information on the Firewise program, contact Wildland/Urban Interface Fire Program C/o The National Fire Protection Association 1 Batterymarch Park, Quincy, MA 02269 and http://www.firewise.org.

FireFree Program

FireFree is a unique private/public program for interface wildfire mitigation involving partnerships among an insurance company and local government agencies. It is an example of an effective non-regulatory approach to hazard mitigation. Originating in Bend, Oregon the program was developed in response to that city's Skeleton Fire of 1996, which burned over 17,000 acres and damaged or destroyed 30 homes and other structures. Bend sought to create a new kind of public education initiative that emphasized local involvement. SAFECO Insurance Corporation was a willing collaborator in this effort.

The success of the program helped to secure $300,000 in FEMA "Project Impact" matching funds. By fostering local community involvement, FireFree also has the potential for building support for sound interface wildfire policy. For information on FireFree, contact: SAFECO Plaza T-8, Seattle, WA 98185, (206) 545-6188 https://www.firefree.org/

State

Multi-Hazard

Statewide Planning Goals

There are 19 Statewide Planning Goals that guide land use in the State of Oregon. These became law via Senate Bill 100 in 1973. Goal 7, Areas Subject to Natural Disasters and Hazards, requires local governments to identify hazards and adopt appropriate safeguards for land use and development. Goal 7 advocates the continuous incorporation of hazard information in local land use plans and policies. The jurisdiction participating in this *2024 La Grande NHMP* has approved comprehensive plans that include information pertinent to Goal 7.
https://www.oregon.gov/lcd/OP/Pages/Goals.aspx

Oregon Department of Emergency Management

OEM is involved in many programs that mitigate the effects of natural hazards including the Hazard Mitigation Grant Program, co-sponsoring and participating in training workshops. Also, as part of its warning responsibilities, OEM notifies local public safety agencies and keeps them informed of potential and actual hazard events so prevention and mitigation actions can be taken.

Planning for Natural Hazards: Oregon Technical Resource Guide

This guide describes basic mitigation strategies and resources related to coastal hazards, floods, and other natural hazards, including examples from communities in Oregon.
https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

Oregon Department of Transportation

Oregon Department of Transportation (ODOT) travel information site, TripCheck, provides road conditions, weather information, and travel information. This website also provides information to help the public detour away from hazard areas during times of emergency. The TripCheck link also has road camera images to inform the public of road conditions prior to making a trip.
https://tripcheck.com/

State Natural Hazard Risk Assessment

The risk assessment in the *2020 Oregon Natural Hazards Mitigation Plan* provides an overview of all the identified natural hazards in Oregon (in the State NHMP but not necessarily all the locally identified natural hazards) and identifies the most significant hazards in Oregon's recorded history. It has overall state and regional information and includes mitigation actions for the entire state.
https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

Oregon State Building Code Standards

Oregon's Building Codes Division adopts statewide standards for building construction that are administered by the state, cities and counties throughout Oregon. The codes apply to new construction and to the alteration of, or addition to, existing structures. The following are hazard-specific standards:

- Six levels of design and engineering specifications are applied to areas according to the expected degree of ground motion and site conditions that a given area could experience during an earthquake. There are site-specific seismic hazard reports required for projects involving critical facilities and special occupancy structures. The Dwelling Code incorporates prescriptive requirements for foundation reinforcement and framing connections based on the applicable seismic zone for the area.
- Building Codes standards (both residential and other codes) are set to withstand 80 mph winds.
- Building Codes standards (both residential and other codes) are set to withstand specific snow loads.
- Building Code standards for structures within floodplain and in landslide areas.

Local building officials are responsible for enforcing these codes. Although there is no statewide building code for substandard structures, local communities have the option of adopting a local building code to mitigate hazards in existing buildings. Oregon Revised Statutes allow municipalities to create local programs to require seismic retrofitting of existing buildings within their communities. The building codes do not regulate public utilities or facilities constructed in public right-of-way, such as bridges.

The *2017 Oregon Residential Special Code* (*ORSC*) contains requirements for one- and two-family dwellings (https://codes.iccsafe.org/content/document/1018?site_type=public).

The *2019 Oregon Structural Special Code* (*OSSC*) contains provisions for grading and site preparation for the construction of building foundations (https://codes.iccsafe.org/content/OSSC2019P1).

Roadway Maintenance

ODOT is responsible for performing precautionary measures to maintain the safety and operability of major roads during storm conditions. The road maintenance programs are designed to provide the best use of limited resources to maximize the movement of traffic within the community during inclement weather.

During storm events, most agencies at the county and city level focus on clearing major arterial and collector streets first, and then respond to residential connector streets, school zones, transit routes, and steep residential streets as resources become available. The state, counties, and cities, may have agreements, including mutual aid agreements, about road maintenance responsibilities during day-to-day operations and who does what in storm situations. In general, highways receive more attention. For those routes on the National Highway System network, primary interstate expressways, and primary roadways will be cleared more quickly and completely than other roads.

Air Quality

Department of Environmental Quality

DEQ is a regulatory agency with the responsibility to protect and enhance the quality of Oregon's environment. DEQ is "responsible for providing accurate scientific data concerning the State of Oregon's air quality to ensure that the state meets the National Ambient Air Quality Standards as required by the Federal Clean Air Act."

Department of Energy

The Oregon Department of Energy (ODOE) partners with other Oregon state agencies to develop policy options to reduce greenhouse gas emissions. The agency also provides technical assistance for greenhouse gas planning and mitigation programs in other state agencies, cities, and counties.

Planning for Natural Hazards: Oregon Technical Resource Guide

This guide describes basic mitigation strategies and resources related to coastal hazards, floods, and other natural hazards, including examples from communities in Oregon. https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

Drought

Water Supply Availability Committee and Drought Readiness Council

Oregon Revised Statute (ORS) Chapter 536 identifies authorities available during a drought. To trigger specific actions from the Water Resources Commission and the Governor, a "severe and continuing drought" must exist or be likely to exist. Oregon relies upon two interagency groups to evaluate water supply conditions, and to help assess and communicate potential drought related impacts, the Water Supply Availability Committee and the Drought Readiness Council.

The Water Supply Availability Committee (WSAC) is a technical committee chaired by the OWRD. The WSAC provides the scientific foundation that decision-makers need to identify and respond appropriately to drought. The Committee consists of state and federal science and emergency preparedness agencies.

The WSAC meets early and often throughout the year to evaluate the potential for drought conditions. If drought development is likely, monthly meetings occur shortly after release of NRCS Water Supply Outlook reports for that year (second week of the month beginning as early as January) to assess conditions. The following are indicators used by the WSAC for evaluating drought conditions as identified in the OEM *Comprehensive Emergency Management Plan, Incident Annex 01 Drought*:

- Snowpack
- Precipitation
- Temperature anomalies
- Long range temperature outlook
- Long range precipitation outlook
- Current stream flows and behavior

- Spring and summer streamflow forecasts
- Ocean surface temperature anomalies (El Nino, La Nina)
- Storage in key reservoirs
- Soil and fuel moisture conditions
- NRCS Surface Water Supply Index

The other group that Oregon relies upon to evaluate water conditions is the Drought Readiness Council (DRC), which is co-chaired by the OWRD and OEM. The council consists of state agencies with natural resources management, public health, or emergency management expertise. The role of the DRC is to review local requests for assistance and make recommendations to the Governor regarding the need for state drought declarations.

Oregon Department of Environmental Quality

DEQ uses water quality standards to assess whether the quality of the state's rivers and lakes is adequate for fish and other aquatic life, recreation, drinking, agriculture, industry and other uses. DEQ also uses the standards as regulatory tools to prevent pollution of the state's waters. More information regarding DEQ's role in water quality can be found at https://www.oregon.gov/deq/wq/Pages/default.aspx.

Included in DEQ's water quality protection is Total Maximum Daily Load (TMDL), which is a clean water plan used to clean up polluted water so that it meets state water quality standards. A TMDL defines the amount of a pollutant that can be present in a waterbody without causing water quality criteria to be exceeded. In December 2002, Oregon's Environmental Quality Commission adopted Oregon Administrative Rule (OAR) Chapter 340, Division 42, commonly referred to as the TMDL rule. The rule defines DEQ's responsibilities for developing, issuing, and implementing TMDLs as required by the CWA.

A Water Quality Management Plan (WQMP) is one of the 12 TMDL elements called for in OAR 340-042-0040. The WQMP is a general plan and framework for implementation of the TMDL. The WQMP framework is designed to work in conjunction with detailed plans and analyses provided in sector-specific or source-specific implementation plans. TMDLs, the WQMP, and associated implementation plans and activities are designed to restore water quality to comply with water quality standards. In this way designated beneficial uses, such as aquatic life, drinking water supplies, and water contact recreation, will be protected.

The EPA approved the Upper Grande Ronde Subbasin TMDL on May 3, 2000. Included in this plan is the *Upper Grande Ronde Subbasin Water Quality Management Plan*.

Water Supply Availability Committee and Drought Readiness Council

Oregon Revised Statute Chapter 536 identifies authorities available during a drought. To trigger specific actions from the Water Resources Commission and the Governor, a "severe and continuing drought" must exist or be likely to exist. Oregon relies upon two interagency groups to evaluate water supply conditions, and to help assess and communicate potential drought related impacts, the Water Supply Availability Committee (WSAC) and the Drought Readiness Council (DRC).

The WSAC is a technical committee chaired by the OWRD. The WSAC provides the scientific foundation that decision-makers need to identify and respond appropriately to drought. The Committee consists of state and federal science and emergency preparedness agencies.

The DRC, which is co-chaired by the OWRD and OEM, consists of state agencies with natural resources management, public health, or emergency management expertise. The role of the DRC is to review local requests for assistance and make recommendations to the Governor regarding the need for state drought declarations.

Oregon Water Resources Department

OWRD serves the public by practicing and promoting responsible water management by directly addressing Oregon's water supply needs; in addition to, restoring and protecting stream flows and watersheds to ensure the long-term sustainability of Oregon's ecosystems, economy, and quality of life. OWRD has several programs including water rights; groundwater and wells; streams, lakes and dams; drought, and wildfire recovery. For more information on OWRD programs, refer to https://www.oregon.gov/owrd/programs/Pages/default.aspx.

OWRD evaluates applications for Aquifer Storage and Recovery authorization for proposed projects and their potential effects on the groundwater resource and other water users. ASR-related statutes (ORS 537.531 to 537.534) and rules (OAR 690-350-010 to 690-350-030) provide a legal framework for water users to store water underground during times of low demand and then recover it through wells during high demand periods. Extensive water quality and water quantity monitoring and reporting is part of all projects. Water quality issues are addressed through coordination with DEQ and OHA Drinking Water Services, according to OWRD Aquifer Storage and Recovery program.

Earthquake

Business Oregon, Infrastructure Finance Authority

Business Oregon's Infrastructure Finance Authority supports the Seismic Rehabilitation Grant Program (SRGP). This program is a State of Oregon competitive grant program that provides funding for the seismic rehabilitation of critical public buildings, particularly public schools and emergency services facilities. Public K-12 school districts, community colleges, and education service districts are eligible for the grant program. For emergency services facilities, the emphasis is on first responder buildings. This includes hospital buildings with acute inpatient care facilities, fire stations, police stations, sheriff's offices, 9-1-1 centers, and Emergency Operations Centers (EOCs).

Oregon Department of Emergency Management

September is National Preparedness Month, a time to raise awareness about preparing for disasters and emergencies before they happen. In addition, the Great Oregon ShakeOut occurs in October. OEM coordinates activities such as earthquake drills related to Great Oregon ShakeOut and encourages individuals to prepare for earthquakes by strapping down computers, heavy furniture and bookshelves in homes and offices.

Flood

Oregon Water Resources Department

The OWRD is the state authority for dam safety with specific authorizing laws and implementing regulations. OWRD coordinates on but does not directly regulate the safety of dams owned by the United States or most dams used to generate hydropower. The OWRD has been striving to inspect over 900 dams under its authority. The Dam Safety Program meets the minimum FEMA standard for Emergency Action Plans and sometimes exceeds FEMA guidance for dam safety inspections on schedule and for condition classification.

OWRD is the Oregon Emergency Response System contact in the event of a major emergency involving a state-regulated dam, or any dam in Oregon if the regulating agency is unknown. The Dam Safety Program also coordinates with the National Weather Service and the OEM on severe flood potential that could affect dams and other infrastructure.

State of Oregon Removal/Fill Law

The Oregon Removal/Fill Law, which is administered by the Oregon Department of State Lands (DSL), requires a permit for activities that would remove or fill 50 cubic yards or more of material in waters of the state (e.g., streams, lakes, wetlands). The City of La Grande is a cooperating partner with DSL by maintaining waterway and wetlands maps for public use, referring affected owners to DSL, and coordinating permit activities.

Oregon’s Wetlands Protection Program

Oregon’s Wetlands Protection Program was created in 1989 to integrate federal and state rules concerning wetlands protection with the Oregon Land Use Planning Program. The Wetlands Program has a mandate to work closely with local governments and DSL to improve land use planning approaches to wetlands conservation. A local wetlands inventory is one component of that program. DSL also develops technical manuals, conducts wetlands workshops for planners, provides grant funds for wetlands planning, and works directly with local governments on wetlands planning tasks. La Grande has compiled a local wetlands inventory for lands where development is likely to occur and identified those wetlands that provide the greatest benefit to the community. These significant wetlands are commonly found in flood-prone areas.

Silver Jackets

The Silver Jackets program is a joint state-federal-local flood mitigation subcommittee, which is tied to a national USACE initiative. In Oregon, Silver Jackets provides a forum where DLCD, DOGAMI, OEM, USACE, FEMA, U.S. Geological Survey (USGS), and additional federal, state and sometimes local and Tribal agencies can come together to collaboratively plan and implement flood mitigation, optimizing multi-agency utilization of federal assistance by leveraging state/ local/ Tribal resources, including data/ information, talent and funding, and preventing duplication among agencies.

Oregon established Silver Jackets as a subcommittee to the Interagency Hazard Mitigation Team (IHMT), with the primary intents of strengthening interagency relationships and cooperation, optimizing resources, and improving risk communication and messaging. The Oregon Silver Jackets act as a catalyst in developing comprehensive and sustainable solutions to state flood hazard challenges.

For more information regarding the Oregon Silver Jackets, refer to https://www.iwr.usace.army.mil/Silver-Jackets/State-Teams/Oregon/.

Oregon Health Authority

Access to safe drinking water is essential to human health. Oregon Health Authority (OHA) *Drinking Water Services* helps to keep drinking water safe for Oregonians. The Drinking Water Services administers and enforces drinking water quality standards for public water systems in the state of Oregon. It also focuses resources in the areas of highest public health benefit and promotes voluntary compliance with state and federal drinking water standards with an emphasis on prevention of contamination through source water protection. They also provide technical assistance to water systems and provide water system operator training.

Oregon Department of Geology and Mineral Industries

Regarding current landslide warning system in Oregon, DOGAMI's *History of Oregon Landslide Warning System* (2021) states,

> The current landslide warning system developed over years with additions and modifications to the language and changes to system responsibilities. As of 2019, a notice about the potential for landslides or debris flows starts with NWS, by using unique language in their flood watch products. After receiving NWS flood watches with landslide language via an RSS feed, DOGAMI posts on its website an alert message including a link to the NWS flood watch message, sends out a press release to the affected areas, and responds to media inquiries. OEM broadcasts the alert through the Oregon Emergency Response System (OERS). ODOT turns on highway warning signs at the appropriate locations and posts alerts on the TripCheck website (https://tripcheck.com/) The current process was outlined in a June 2018 DOGAMI internal communication document on landslide/debris flow alerts, developed by Bill Burns and then DOGAMI Communications Director Ali Hansen.…

Severe Weather – Extreme Heat

Oregon Health Authority

Heat-related deaths and illness are preventable, yet annually many people succumb to extreme heat. The Oregon Health Authority (OHA) website provides accessible resources for members of the public, local health departments, and other organizations to assist ongoing outreach efforts to those most vulnerable to extreme heat events.

Volcano

Oregon Department of Geology and Mineral Industries

A major existing strategy to address volcanic hazards is to publicize and distribute volcanic hazard maps and information through DOGAMI and USGS, as discussed above.

The volcanoes most likely to constitute a hazard to Oregon communities have been the subject of DOGAMI and USGS research. Open-file reports address the geologic history of these volcanoes and lesser-known volcanoes in their immediate vicinity. These reports also cover associated hazards, the geographic extent of impacts, and mitigation strategies. They are available for the active volcanoes such as Mount St. Helens, the Three Sisters, Newberry Volcano, and Crater Lake. While there is not an Open-file reports for Mount Bachelor, there are other resource materials that provide considerable information.

For more information, refer to DOGAMI at https://www.oregon.gov/dogami/volcano/Pages/volcanoes.aspx.

Wildfire

Oregon Revised Statute 215.730

ORS 215.730, Additional Criteria for Forestland Dwellings, provides criteria for approving dwellings located on lands zoned for forest and mixed agriculture/forest use. Under its provisions, county governments must require, as a condition of approval, that single-family dwellings on lands zoned as forestland meet the following requirements:

1. Dwelling has a fire-retardant roof;
2. Dwelling will not be sited on a slope of greater than 40%;
3. Evidence is provided that the domestic water supply is from a source authorized by OWRD and not from a Class II stream as designated by the State Board of Forestry;
4. Dwelling is located upon a parcel within a fire protection district or is provided with residential fire protection by contract;
5. If dwelling is not within a fire protection district, the applicant provides evidence that the applicant has asked to be included in the nearest such district;
6. If dwelling has a chimney or chimneys, each chimney has a spark arrester; and
7. The dwelling owner provides and maintains primary fuel-free break and secondary break areas on land surrounding the dwelling that is owned or controlled by the owner.

If a governing body determines that meeting the fourth requirement is impractical, local officials can approve an alternative means for protecting the dwelling from fire hazards.

Oregon Revised Statute 477.015-061

Provisions in ORS 477.015-061, Urban Interface Fire Protection, were established through efforts of the ODF, the Office of the State Fire Marshal, fire service agencies from across the state, and the Commissioners of Deschutes, Jefferson, and Jackson Counties. It is innovative legislation designed to address the expanding interface wildfire problem within ODF Fire Protection Districts. Full implementation of the statute will occur on or after January 1, 2002. The statute does the following:

1. Directs the State Forester to establish a system of classifying forestland-urban interface areas;
2. Defines forestland-urban interface areas;
3. Provides education to property owners about fire hazards in forestland-urban interface areas. Allows for a forestland- urban interface county committee to establish classification standards;
4. Requires maps identifying classified areas to be made public;
5. Requires public hearings and mailings to affected property owners on proposed classifications;
6. Allows property owners appeal rights;
7. Directs the Board of Forestry to promulgate rules that set minimum acceptable standards to minimize and mitigate fire hazards within forestland-urban interface areas; and

8. Creates a certification system for property owners meeting acceptable standards. Establishes a $100,000 liability limit for the cost of suppressing fires if certification requirements are not met.

Senate Bill 360

Senate Bill 360, passed in 1997, is state legislation put in place to address the growing wildland/urban interface problem. The bill has three purposes:

1. To provide an interface fire protection system in Oregon to minimize cost and risk and maximize effectiveness and efficiency;
2. To promote and encourage property owners' efforts to minimize and mitigate fire hazards and risks; and
3. To promote and encourage involvement of all levels of government and the private sector in interface solutions.

The bill has a five-year implementation plan that includes public education and outreach, and the development of rules, standards, and guidelines that address landowner and agency responsibilities. The success of Senate Bill 360 depends upon cooperation among local and regional fire departments, fire prevention cooperatives, and the ODF, which means that interagency collaboration, is vital for successful implementation of the bill. This cooperation is important in all aspects of wildland firefighting. Resources and funding are often limited, and no single agency has enough resources to tackle a tough fire season alone. The introductory language of Senate Bill 360 states, "The fire protection needs of the interface must be satisfied if we are to meet the basic policy of the protection of human life, natural resources, and personal property. This protection must be provided in an efficient and effective manner, and in a cooperative partnership approach between property owners, local citizens, government leaders, and fire protection agencies."

Oregon Wildfire Programs – Senate Bills 762, 80, and 644

In 2021, the Oregon legislature passed Oregon's first comprehensive wildfire preparedness and resiliency bill, Senate Bill (SB) 762. This legislation created Wildfire Programs with a goal to advance fire protection in Oregon by mitigating the catastrophic impacts of wildfire on lives and property through three key strategies: creating fire-adapted communities, developing safe and effective responses, and increasing the resiliency of Oregon's landscapes. The Wildfire Programs include a 19-member advisory council appointed by the Legislature, a director appointed by the Governor, and 11 state agencies with wildfire-related programmatic responsibilities, ranging from wildfire hazard mapping, defensible space, building codes, and land use to forest management, electric utilities, air quality, and public health. Investments totaled $195 million during 2021-2023 biennium.

In 2023, the legislature continued the Wildfire Programs with a variety of adjustments, expanding some program areas and reducing others. The legislature passed two primary wildfire bills during the 2023 session to advance fire protection in Oregon: Senate Bill 80 and Senate Bill 82. SB 80 is the 2023 biennia's wildfire omnibus bill that made a variety of improvements to the Wildfire Programs including: wildfire hazard mapping updates, expanding philanthropy pathways to the community risk reduction fund, creating the landscape resiliency fund, expanding clean air space authorities to nonprofits, administrative updates to the advisory council, and advanced prescribed fire through a liability program. SB 82 partners with Oregon's insurance industry to ensure transparency in rating and underwriting decisions by insurers, as it relates 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.

Also passed in 2023, Senate Bill 644, amends requirements relating to wildfire hazard mitigation for development of accessory dwelling units (ADU) 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) regardless of location in the absence of the statewide wildfire hazard map.

Oregon Department of Forestry

ODF is involved with local fire chiefs and local fire departments to provide training. Local firefighters can get a range of experience from exposure to wildland firefighting. Local firefighters can also obtain their red card (wildland fire training documentation) and attend extensive workshops combining elements of structural and wildland firefighting, defending homes, and operations experience (Wolf, 2001). ODF has been involved with emergency managers to provide support during non-fire events and for years, ODF has worked with industrial partners (big timber companies) to share equipment in the case of extremely large fires (Wolf, 2001).

Local

Air Quality

The “Air, Water, and Land Resources Quality” (Statewide Planning Goal 6) is a detailed part of the *La Grande Comprehensive Plan*. The objective, according to said plan, is to “maintain and improve the quality of the air, water and land resources of La Grande. Achievement of a natural resource use pattern which gives as much importance to providing for tomorrow's needs and the protection of the natural environment as to providing for the needs of today.”

Multi-Hazard

National Weather Service and Union County Emergency Management

The NWS can predict severe weather events that may trigger prolonged or flash flood events, landslide, and other severe weather. The NWS can issue notices to response agencies and to the public via television, radio, internet and Weather Radios (formerly Tone Alert Radios) when the potential for flooding is likely, for example. Union County Emergency Management, La Grande Police, and the La Grande Fire Department coordinate with NWS when notices may be required to inform response agencies and the public of potential hazard events.

La Grande Area Comprehensive Plan

The *La Grande Comprehensive Plan* (2022), is the long-range plan for guiding development in the La Grande urban area for the next 20 years. The Natural Resource goal of the La Grande

Comprehensive Plan is "To conserve open space, protect natural, historic, cultural and scenic resources, and to protect life and property from natural disasters and hazards."

La Grande Community Development

The Community Development Department works to ensure the strength of the La Grande community at the neighborhood level and citywide through support for planning and civic involvement, permitting, inspecting and, where needed, protecting historic community resources. The Community Development Department primarily includes the Planning Division. The La Grande Development Code includes Chapter 2, Land Use Zones; Chapter 3, Special Use Standards which addresses geological hazards, riparian protection, and flood plain. The La Grande Development Code also addresses housing code, historic preservation, and comprehensive planning.

La Grande Community Forestry Program

The La Grande Community Forestry Program (2019) recognizes that trees provide multiple economic, environmental, and social benefits. The Community Forestry Program provides education and guidance for the preservation, planting and care of trees in public spaces to ensure a healthy urban forest and a vibrant community. The *2024 La Grande NHMP* public survey results show a direct correlation between the education and outreach efforts and the overall community comprehension of the risk of certain hazards (e.g., invasive species/pests and wildfire).

La Grande and Union County – Transportation Routes

La Grande's Public Works Department plans, constructs and maintains the infrastructure to meet the needs of La Grande. The *2022 Union County NHMP* identifies the following critical transportation routes[17]:

- Interstate-84
- Highway 82 – Connects La Grande to Island City, Imbler, Summerville, and Elgin
- Highway 203 – Connects La Grande to Union
- Highway 237 – Connects Union, Cove, North Powder and La Grande

Transportation options other than those involving a personal vehicle include Greyhound Bus Lines and the La Grande/Union County Airport. There is also a limited route of public transportation within the City of La Grande that is operated by Northeast Oregon Public Transportation and Kayak Public Transit (Confederated Tribes of the Umatilla Indian Reservation).

La Grande Transportation System Plan (TSP)

The La Grande *Transportation System Plan* (1999), and the subsequent 2007 *Pedestrian and Bicycle Improvement Plan*, provides a framework of goals, objectives, and policies that guides La Grande's transportation system and recommends how La Grande invest its resources in future transportation

[17] La Grande, together with the surrounding area, is in a unique location where critical transportation routes close regularly due to severe weather conditions (e.g., windstorms and winter storms). Once these primary transportation routes are closed, alternative travel routes are limited because they are not suitable to handle the large volume of semi-trailer truck traffic or passenger vehicles being diverted. Since such alternative routes are not suitable, it is common to simultaneously close them when the primary route is closed. Only emergency vehicles may use such alternative routes.

programs and infrastructure to meet anticipated travel demands. The TSP includes related information on critical transportation routes.

La Grande Public Facilities Plan

The La Grande Public Facilities Plan (Statewide Planning Goal 11) is a detailed part of the *La Grande Comprehensive Plan*. The plan includes multiple policies that address the urban services of water, sewer, storm drainage, services and transportation infrastructure. The plan presents and directs the management of existing public facilities, as well as the design and implementation of future public facilities for the 20-year planning period.

Other Existing Strategies and Programs

Existing strategies and programs at the state level are usually performed by the Oregon Public Utility Commission (OPUC), Building Code Division (BCD), ODF, OEM, and the Oregon Department of Transportation.

The Oregon Emergency Response System (OERS) coordinates and manages state resources in response to natural and technological emergencies and civil unrest involving multi-jurisdictional cooperation between all levels of government and the private sector (https://www.oregon.gov/oem/emops/Pages/OERS.aspx).

Oregon Public Utility Commission ensures operators manage, construct and maintain their utility lines and equipment in a safe and reliable manner. These standards are listed on this website: http://www.puc.state.or.us/PUC/safety/index.shtml. OPUC promotes public education and requires utilities to maintain adequate tree and vegetation clearances from high voltage utility lines and equipment.

Drought

Future Stewards Day

A one-day education program established in 2009, the "Future Stewards Day", includes water conservation and air quality topics. The La Grande Air Quality Commission and Public Works staff developed a program that consisted of topics covering what water conservation is, how to practice water conservation, the meaning of the Air Quality Index, what air pollution is and why it is bad, the circle of life and the effects of pollution on animals.

Earthquake

La Grande School District

Oregon Public Schools conduct earthquake drills regularly throughout Oregon and teach students how to respond when an earthquake event occurs.

The La Grande School District is currently under contract for a seismic evaluation district-wide, which was funded by an Oregon Technical Assistance Program (TAP) grant (Glover, 2023). The district is also applying for a seismic retrofit grant for the La Grande Middle School gymnasium (Mendoza, 2023). The La Grande School District has also done some seismic upgrades to Greenwood

Elementary School and La Grande High School since the *2014 Northeast Oregon Regional NHMP* was approved (Carpenter, 2023). Regarding completed projects, sections of the La Grande High School gymnasium and auditorium underwent a seismic retrofit and the entire Greenwood Elementary School building underwent a seismic retrofit (Mendoza, 2023).

Grande Ronde Hospital

Based on the DOGAMI scores shown in Table 3-7, three of the four Grande Ronde Hospital buildings are rated as very high risk of collapse. In 2018, a seismic study was conducted for the hospital. The study deemed most of the hospital campus able to withstand a local earthquake; however, the south wing, a single-story portion of the hospital built in the early 1970s, was one exception. The south wing is used for administration and clinic space not for patient care.

Located in the Hillside Development Zone, where the purpose is to reduce development in areas with a slope greater than or equal to 25%, or in hillside areas where there has been a history of slope failure and designated as Geological Hazard areas in the La Grande Comprehensive Plan, all or part of the hospital campus is also designated as Geological Hazard area with known and measurable ground movement. Work began on an expansion of the main hospital building in 2022 that included multiple levels on sloping terrain. The expansion includes a new emergency room and surgery center, along with several other supporting elements. To accommodate the city zoning and geological hazard development standards, the new addition has 39 – 65-foot-deep I-beams with three tie backs of 120 feet on each at three different levels for a total of nine tie backs on each beam (LaRochelle, 2023). Completion of the hospital expansion is expected in 2024 (Grande Ronde Hospital and Clinics).

Flood

La Grande Community Development

Community participation in the NFIP requires the adoption and enforcement of a local floodplain management ordinance that controls development in the floodplain. Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent.

The City of La Grande is currently updating their flood plain maps in the city, with an intention to accurately identify and define the 100-year regulatory floodplain boundaries using modern technology, such as Lidar data and 3D modeling. Figure 3-23 illustrates the existing and proposed floodplain in La Grande and surrounding areas.

Morgan Lake Dam

The *2024 La Grande NHMP* public survey results show a direct correlation between the education and outreach efforts and the overall community comprehension of the risk of certain hazards (e.g., invasive species/pests and wildfire). However, community comprehension was limited with hazards that could significantly impact residents such potential flooding in the event the Morgan Lake Dam breach. La Grande NHMP Steering Committee agrees that public education and outreach benefits the community and continuing as such with special attention to the lesser-known hazards that could significantly impact the community. Mitigation actions MH #3 and MH #4 focus public awareness at the public official level and the community, including underserved communities and socially vulnerable populations.

La Grande has the goal of mitigation to modify the Morgan Lake Dam or its potential breach flow path so that any breach does not flow down Deal Canyon as an extremely rapid debris flood though most of the city. Mitigation action alternatives include the following:

- Alternative 1: Construct a flow redirection berm and trench. There is a preliminary design for this work, and inundation analysis of the existing and proposed work. This alternative will be ready for construction by the end of 2023. Cost: $1,200,000.00
- Alternative 2: Remove the dam. This option is not ready. Cost: $1,200,000.00
- Alternative 3: Rebuild a new dam after removal. This option is not ready. Cost $7,500,000.00
- Alternative 4: Continue current level of maintenance and operation. There is no change in costs for this option

The following alternative was selected as the most appropriate activity to mitigate a dam failure of Morgan Lake Dam. Implementation plan and steps are included below.

Alternative 1**:** Construct a flow redirection berm and trench. There is a preliminary design for this work, and inundation analysis of the existing and proposed work.

Responsibility**:** Public Works Director

Timeframe**:** As soon as summer 2024, if easement acquired and funding available

Steps will include 1) acquire easement, 2) finish design, 3) determine if permits are needed, and 4) construct berm.

Elevation Certificate Maintenance

Elevation certificates are administered by La Grande's Community Development Department.

As floodplain-specific projects come in, the Planning Division will work with the developer on their floodplain development permit (Boquist, 2023). As part of construction and the building permit process, the developer works with a local surveyor on preparing completing an elevation certificate, which is filed with building permit (Boquist and Fischer, 2023). The certificates are required for buildings constructed in the floodplain to demonstrate that the building is elevated adequately to protect it from flooding. The elevation certificate is an important administrative tool of the NFIP. It is used to determine the proper flood insurance premium rate; it can be used to document elevation information necessary to ensure compliance with community floodplain management regulations; and it may be used to support a request for a Letter of Map Amendment (LOMA), or Letter of Map Revision based on fill (LOMR-F). The City of La Grande has elevation certificates on file for many developed properties.

Wildfire

City of La Grande, Wildland Urban Interface Information

Since fire season requires residents to be at an increased awareness for the dangers of wildfire, La Grande Fire Department provides the community with risk reduction resources including how to protect homes and the community from wildfire. The information includes three vegetative zones – immediate, intermediate, and extended zone – surrounding a building. It also provides evacuation information and additional resource links. La Grande Fire Department also provides a community risk reduction resource page that includes information on burn regulations, fire inspections and investigations, and juvenile fire setting intervention.

La Grande Community Development

All development within the City of La Grande must comply with the fire protection construction standards in the Uniform Building Code (UBC) and the City of La Grande Land Development Code, as well as additional standards set forth by the applicable fire protection districts.

Mutual Aid Agreements

Mutual Aid Agreements exist among the various fire authorities for support and help as needed. Each authority has its regulations and limitations, which dictates its fire management activity. La Grande has mutual aid agreements with Cove Rural Fire Department (Station 1), Elgin Rural Fire District (Station 2), Imbler Rural Fire District (Station 3), La Grande Rural Fire District (Island City Station 5), North Powder Rural Fire District (Station 6), and Union Rural Fire District (Station 7). These agreements provide additional human power and fire suppression apparatus in the event of a large structure fire event. (City of La Grande)

La Grande Fire Department information can be found here: https://www.cityoflagrande.org/fire-department

Severe Weather - Winter Storm

La Grande Snow and Ice Control Plan

The La Grande *Snow and Ice Control Plan* (2010) establishes policies, procedures, and training to meet specified levels of service and is routinely reviewed.

The *2024 La Grande NHMP* public survey results show a direct correlation between the education, outreach efforts, and lived experience, and the overall community comprehension of the risk of certain hazards, such as winter storms.

Chapter 5 PLANNING PROCESS

5.1 Introduction

The Planning Process chapter details the formal process that will ensure that the City of La Grande's NHMP remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the plan semi-annually, as well as producing an updated plan every five years. This section describes how the city will integrate public participation throughout the plan maintenance process. This chapter includes an explanation of how the City of La Grande government intends to incorporate the mitigation strategies outlined in the plan into existing planning mechanisms.

This chapter also describes the process of updating the plan, how the plan was prepared, who was involved, and specific changes made to the *2014 Northeast Oregon Regional NHMP* (the 2014 NHMP included Baker, Grant, Union, and Wallowa Counties) during the plan update process that resulted in the *2024 La Grande NHMP*. Major changes are documented by the plan section.

5.2 Plan Implementation

The success of the City of La Grande NHMP depends on how well the outlined action items are implemented. To ensure that the activities identified are implemented, the following steps will be taken: 1) the plan will be formally adopted, 2) a convener shall be designated, 3) a coordinating body will be assigned, 4) the identified activities will be prioritized and evaluated, and 5) the plan will be implemented through existing plans, programs, and policies.

Plan Adoption

The *2024 La Grande NHMP* was developed and will be implemented through a collaborative process. After the plan is locally reviewed and deemed complete, the DLCD Project Manager, with approval from the Plan Convener, will submit the plan to the Mitigation Planner at the Oregon Department of Emergency Management (OEM). OEM reviews the plan and returns it for edits. The DLCD Project Manager will make those edits or consult with the Plan Convener and Steering Committee as needed, and then re-submits the plan to FEMA-Region X for review. This review addresses the federal criteria outlined in the FEMA Interim Final Rule 44 CFR Part 201.

Upon pre-approval by FEMA, indicated by a letter provided from FEMA to City of La Grande called the "Approvable Pending Adoption" (APA), the city will then adopt the NHMP via resolution. There are no other participating plan holder jurisdictions that will need to adopt the NHMP. Once the resolution is executed at the local level and documentation is provided to FEMA, the plan is formally acknowledged by FEMA, as evidenced by the issuance of the final FEMA plan approval letter. Once this letter is received, the DLCD Project Manager will finalize the plan draft with the final FEMA approval documents and the city will re-establish eligibility for the FEMA Hazard Mitigation Assistance funding, which includes the following programs: Building Resilient Infrastructure and Communities Program (BRIC), Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA), Fire Management

Assistance Grant (FMAG) Program, Public Assistance (PA) Grant Program[18], Rehabilitation of High Hazard Potential Dam (RHHPD) Grant Program, and Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Revolving Loan Fund.

The accomplishment of the *2024 La Grande NHMP* goals and mitigation actions depends upon regular NHMP Coordinating Body participation and support from the city's leadership. Thorough familiarity with this NHMP will result in the efficient and effective implementation of mitigation actions, and the integration of the NHMP into plans, policies, and programs. This will result in a reduction in the risk and the potential for loss from future natural hazard events.

A copy of the resolution of approval from La Grande will be included in the *2024 La Grande NHMP* once it is received. Copies of the FEMA APA and final approval letters will also be included in the *2024 La Grande NHMP* in Word and PDF formats.

Convener and Coordinating Body

The La Grande Community Development Director (formerly the Public Works Director)[19], as Convener, will take responsibility for plan implementation. They will facilitate the Hazard Mitigation Coordinating Body meetings and assign tasks such as updating and presenting the plan to the rest of the members of the Coordinating Body. Plan implementation and evaluation will be a shared responsibility among the assigned Natural Hazard Coordinating Body Members. The Convener's responsibilities include:

- Coordinate Natural Hazard Coordinating Body meeting dates, times, locations, agendas, and member notification;
- Document the discussions and outcomes of committee meetings;
- Serve as a communication conduit between the Coordinating Body and the public/stakeholders;
- Identify emergency management-related funding sources for natural hazard mitigation projects; and
- Utilize the Risk Assessment to prioritize proposed natural hazard risk reduction projects.

Coordinating Body

The La Grande Convener will form a Natural Hazard Coordinating Body for updating and implementing the NHMP. The Coordinating Body's responsibilities include:

- Attend plan maintenance and update meetings (or designate a representative to serve in your place);
- Serve as the local evaluation committee for funding programs such as the Building Resilient Infrastructure and Communities, Hazard Mitigation Grant, and Flood Mitigation Assistance program funds;
- Prioritize and recommend funding for natural hazard risk reduction projects;

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[18] The PA Grant Program requires a FEMA-approved state, not local, NHMP.

[19] The La Grande NHMP Steering Committee decided to change the convener from the Public Works Director to the Community Development Director.

- Evaluate and update the NHMP in accordance with the prescribed maintenance schedule;
- Develop and coordinate ad hoc and standing subcommittees as needed; and
- Coordinate public involvement activities.

Members

The following authorities, agencies, or organizations were represented and served on the Steering Committee during the development of the 2*024 La Grande NHMP* (for a list of individuals, see Planning and Public Process (Section 5.4):

City of La Grande

- Building Division
- Community Development
- Economic Development
- La Grande Fire
- La Grande Police
- Parks and Recreation Department
- Public Works

Partner Agencies and Organizations

- American Red Cross
- Eastern Oregon University
- Grande Ronde Hospital & Clinics
- Island City
- Oregon Department of Emergency Management
- Oregon Department of Forestry
- Union County Emergency Management
- Union County Soil & Water Conservation District
- Ziply Fiber Telecommunications

As noted previously, the La Grande Convener will form a Natural Hazard Coordinating Body for updating and implementing the NHMP. As it relates to Plan Maintenance (Section 5.3), the La Grande NHMP Steering Committee agreed to have this coordinating body be City of La Grande Department Directors, who will ensure that this plan will maximize the city's efforts to reduce the risks posed by natural hazards. To make the coordination and review of the *2024 La Grande NHMP* as broad and useful as possible, the Coordinating Body will engage other stakeholders and relevant hazard mitigation organizations and agencies, such as the partner agencies and organizations identified above, to implement the identified action items. Specific organizations have been identified as internal or external partners on Appendix 8.1, Mitigation Action Worksheets.

Implementation through Existing Programs

The *2024 La Grande NHMP* includes a range of action items that, when implemented, will reduce loss from hazard events in the city. Within the plan, FEMA requires identifying existing programs that might be used to implement these action items. La Grande addresses statewide planning goals and legislative requirements through their comprehensive land use plan, capital improvement plans, mandated standards, and building codes. To the extent possible, La Grande will work to incorporate the recommended mitigation action items into existing programs and procedures.

Many of the recommendations in the NHMP are consistent with the goals and objectives of the city's existing plans and policies. Where possible, La Grande should implement the recommended actions in the NHMP through existing plans and policies. Plans and policies already in existence often have support from residents, businesses, and policymakers. Many land-use, comprehensive, and strategic plans get updated regularly and can adapt easily to changing conditions and needs. Implementing the action items in the NHMP through such plans and policies increases their likelihood of being supported and implemented.

Examples of plans, programs, or agencies that may be used to implement mitigation activities include:

- City Budget
- Community Wildfire Protection Plans
- Comprehensive Land Use Plans
- Economic Development Action Plans
- Emergency Operations Plans
- Zoning Ordinances and Building Codes

The specific plans that presently exist related to this NHMP and the FEMA requirements are listed in Table 5-1; these are the same plans listed in Community Profile (Chapter 2).

Table 5-1. City of La Grande NHMP Supported Plans and Policies

Document	Year
Natural Hazards Mitigation Plan	2024, 2014 previous
Desktop Assessment of Subsurface Cultural Resources for the City of La Grande, Union County, Oregon	2018
La Grande Emergency Operations Plan	1991, update expected fiscal year 2024-2025
La Grande Emergency Alert and Evacuation Plan	2018
La Grande Comprehensive Plan	2022, 2013 previous
La Grande Land Development Code	2023
Article 3.4 – Geological Hazards	
Article 3.5 – Historic Buildings and Sites	
Article 3.6 – Archaeological Resources	
Article 3.9 – Riparian Protection Area	
Article 3.10 – Dust Control Standards	
Article 3.12 – Flood Plains	Update forthcoming based on FEMA approval of revised FIRMs (pg. 123, 144 and Figure 3-23)
La Grande Commercial Historic District Design Standards	2022
La Grande Community Forestry Ordinance	2019

Document	Year
La Grande Community Landscape and Forestry Master Plan	1996
La Grande/Island City Transportation System Plan, 1999	1999, update anticipated
La Grande Pedestrian and Bicycle Improvement Plan	2007, 1999 previous
La Grande Parks Master Plan	2022
La Grande Economic Development Plan, 2010-2013	2010
La Grande Urban Renewal Plan	2014
La Grande Housing Needs Analysis	2021
La Grande Housing Production Strategy	2021
La Grande Stormwater Master Plan	2013
La Grande Water Management and Conservation Plan	2008, update in process
La Grande Water System Master Plan	2013
La Grande Wastewater Facilities Plan	1998
Snow and Ice Control Plan	2010
Morgan Lake Dam Emergency Action Plan	2013
Morgan Lake Dam Floodplain Management Plan	2023, draft submitted to FEMA
Union County Emergency Operation Plan	2023
Union County Continuity of Operations Plan	2012, update in 2024
Union County Community Wildfire Protection Plan	2016, update in process

Sources: 2024 La Grande NHMP Steering Committee

5.3 Plan Maintenance

Plan maintenance is a critical component of the NHMP. Proper maintenance of the plan ensures that this plan will maximize the city's efforts to reduce the risks posed by natural hazards. OPDR developed this section for the *2014 Northeast Oregon Regional NHMP* and which was retained for the *2024 La Grande NHMP*. The section includes a process to ensure that a regular review and update of the plan occurs. The coordinating body and local staff are responsible for implementing this process and maintaining and updating the plan through a series of meetings outlined in the maintenance schedule below.

Meetings

The committee will meet on a semi-annual (twice per year) basis to complete the tasks described below. However, instead of committing to holding a meeting in late spring and early fall, as noted in the *2014 Northeast Oregon Regional NHMP*, the La Grande NHMP Steering Committee decided that the meetings will be evenly spaced throughout the year. Moreover, instead of separating out the tasks for the first and second meetings, as noted in the previous NHMP, tasks will be discussed throughout the year.

The La Grande NHMP Steering Committee agreed to have the Coordinating Body be the City of La Grande Department Directors, who will ensure that this plan will maximize the city's efforts to reduce the risks posed by natural hazards. La Grande's Department Directors hold weekly meetings throughout the year. The Convener will coordinate the semi-annual meeting dates and agendas based on Department Directors meetings.

The semi-annual meetings in coordination with the Coordinating Body will review the following:

- Review existing action items to determine appropriateness for funding;
- Educate and train new members on the plan and mitigation in general;
- Identify issues that may not have been identified when the plan was developed;
- Prioritize potential mitigation projects using the methodology described below;
- Review existing and new risk assessment data;
- Discuss methods for continued public involvement; and
- Document successes and lessons learned during the year.

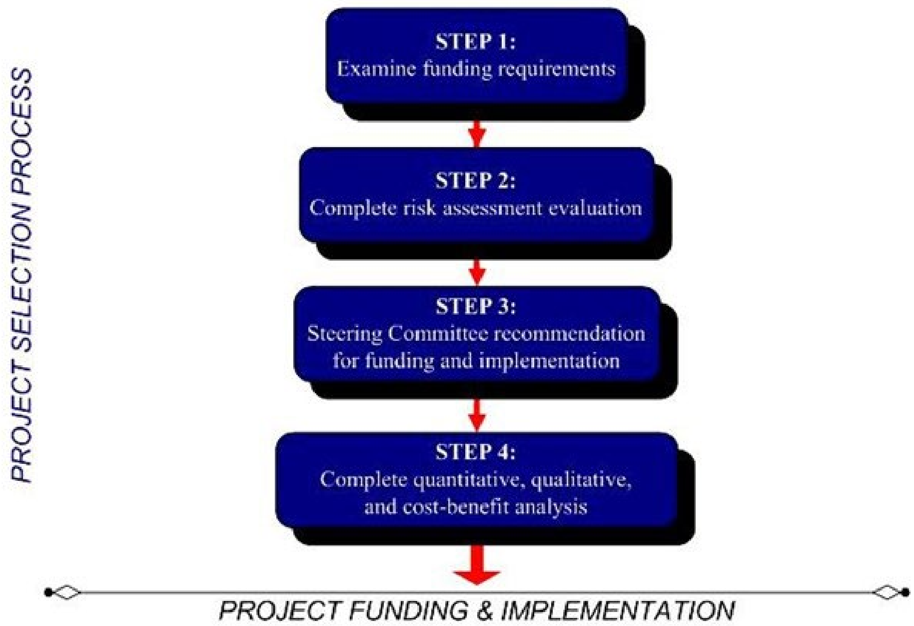
These meetings are an opportunity for the city to report progress that has been made towards the NHMP components.

The Convener will be responsible for documenting the outcome of the semi-annual meetings discussed herein. The process the Coordinating Body will use to prioritize mitigation projects is detailed in the section below. The plan’s format allows the city to review and update sections when new data becomes available. New data can be easily incorporated, resulting in an NHMP that remains current and relevant to the city.

Project Prioritization Process

The Disaster Mitigation Act of 2000 requires that jurisdictions identify a process for prioritizing potential actions. Potential mitigation activities often come from a variety of sources; therefore, the project prioritization process needs to be flexible. Committee members, local government staff, other planning documents, or the risk assessment may identify projects. Figure 5-1 illustrates the project development and prioritization process.

Figure 5-1. Project Prioritization Process



Source: Oregon Partnership for Disaster Resilience, 2008

Step 1: Examine funding requirements

The first step in prioritizing the plan's action items is determining which funding sources are available for application. Several funding sources may be appropriate for the city's proposed mitigation projects. Examples of mitigation funding sources include but are not limited to FEMA Hazard Mitigation Assistance funding, which includes the following three programs: Building Resilient Infrastructure and Communities Program, Hazard Mitigation Grant Program, and Flood Mitigation Assistance. Other funding may include National Fire Plan (NFP), Community Development Block Grants (CDBG), local general funds, and private foundations, among others. Please see Appendix 8.3, Grant Programs and Resources, for a more comprehensive list of potential grant programs.

Because grant programs open and close on differing schedules, the Coordinating Body will examine upcoming funding streams' requirements to determine eligible mitigation activities. The Coordinating Body may consult with the funding entity, Oregon Department of Emergency Management, or other appropriate state or regional organizations about project eligibility requirements. This examination of funding sources and requirements will happen during the Coordinating Body's semi-annual plan maintenance meetings.

Step 2: Risk assessment evaluation

The second step in prioritizing the plan's action items is to examine which hazards the selected actions are associated with and where these hazards rank in terms of community risk. The Coordinating Body will determine whether the plan's risk assessment supports the implementation of eligible mitigation activities. This determination will be based on the location of the potential activities, their proximity to known hazard areas, and whether community assets are at risk. The Coordinating Body will additionally consider whether the selected actions mitigate hazards that are likely to occur in the future or are likely to result in severe/catastrophic damages.

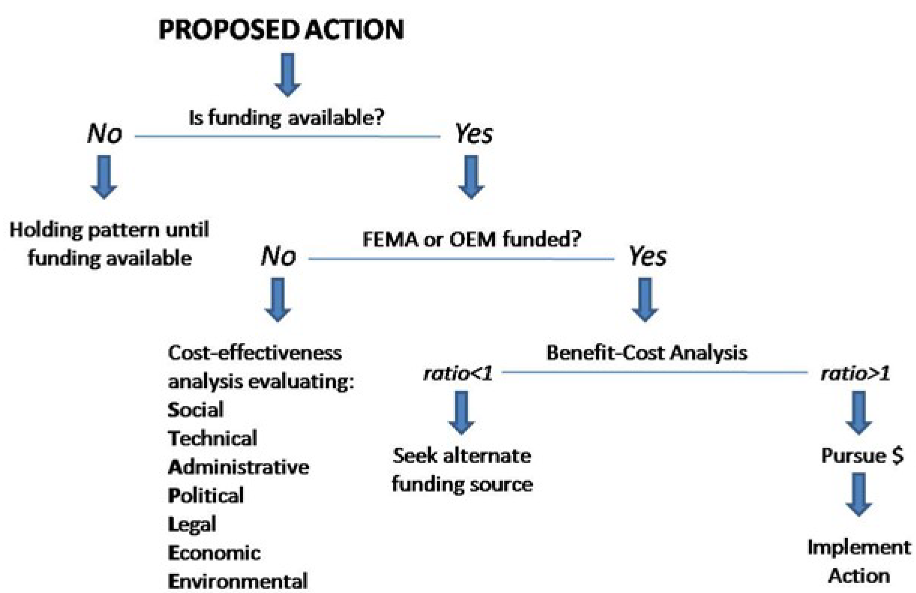
Step 3: Coordinating Body Recommendation

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

Step 4: Quantitative and qualitative assessment and economic analysis

The fourth step is identifying the costs and benefits associated with the selected natural hazard mitigation strategies, measures, or projects. Two categories of analysis that are used in this step are (1) benefit/cost analysis and (2) cost-effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity assists in determining whether a project is worth undertaking now to avoid disaster-related damages later. Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects. Figure 5-2 shows the decision criteria for selecting the appropriate method of analysis.

Figure 5-2. Benefit Cost Decision Criteria



Source: Oregon Partnership for Disaster Resilience, 2010

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

A qualitative assessment will be completed for non-federally funded or nonstructural projects to determine their cost-effectiveness. The Coordinating Body may use a multivariable assessment technique called STAPLE/E to prioritize these actions. STAPLE/E stands for Social, Technical, Administrative, Political, Legal, Economic, and Environmental. Assessing projects based upon these seven variables can help define a project's qualitative cost-effectiveness. OPDR at the University of Oregon's Institute for Policy Research and Engagement in the School of Planning, Public Policy and Management has tailored the STAPLE/E technique for use in natural hazard action item prioritization. See Appendix 8.28.2, Economic Analysis of Natural Hazard Mitigation Projects, for a description of the STAPLE/E evaluation method.

Continued Public Involvement and Participation

The participating jurisdictions are dedicated to involving the public directly in continually reshaping and updating the *2024 La Grande NHMP*. Although members of the Coordinating Body represent the public, the public will also have the opportunity to continue to provide feedback about the plan.

To ensure that these opportunities will continue, the city will:

- Post copies of the *2024 La Grande NHMP* on the city's website;
- Place articles in the local newspaper directing the public where to view and provide feedback;
- Use existing newsletters such as schools and utility bills to inform the public where to view and provide feedback; and
- Use internet and social media tools.

The *2024 La Grande NHMP* will be on the La Grande website at: La Grande, OR | (cityoflagrande.org). The NHMP may be archived and posted on the University of Oregon Libraries' Scholar's Bank Digital Archive at https://scholarsbank.uoregon.edu and on the Oregon Department of Land Conservation and Development's website at Department of Land Conservation and Development : Welcome Page : State of Oregon.

Five-Year Review of Plan

This plan will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. **With FEMA approval granted in 2024, the La Grande NHMP would be due for an update in 2029**. The Convener, the City of La Grande Community Development Director, or their designated delegates, will organize the Coordinating Body to address plan update needs. The Coordinating Body will be responsible for updating any deficiencies found in the plan and for meeting the Disaster Mitigation Act of 2000's plan update requirements.

Table 5-2 is a 'toolkit' that can help the Convener in deciding which plan update activities can be discussed during regularly scheduled plan maintenance meetings and which activities require additional meeting time and the formation of sub-committees.

Table 5-2. Natural Hazards Mitigation Plan Update Toolkit

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

Sources: Oregon Partnership for Disaster Resilience, 2010

5.4 Planning and Public Process

La Grande partnered with DLCD through funding by FEMA to update La Grande-specific sections of the *2014 Northeast Oregon Regional NHMP*. The Disaster Mitigation Act of 2000 requires communities to update their mitigation plans every five years to remain eligible for FEMA Hazard Mitigation Assistance funding, which includes the following programs: Building Resilient Infrastructure and Communities Program (BRIC), Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA), Fire Management Assistance Grant (FMAG) Program, Public Assistance (PA) Grant Program[20], Rehabilitation of High Hazard Potential Dam (RHHPD) Grant Program, and Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Revolving Loan Fund. DLCD Project Manager met with members of the La Grande steering committee to update their NHMP. DLCD Project Manager and the committee made several changes to the previous NHMP. Major changes are documented and summarized in this chapter.

DLCD staff worked with City of La Grande's Public Works Director, to form the La Grande NHMP Steering Committee (the Steering Committee) intended to represent the whole community. The Steering Committee included representatives from the various city departments, police and fire departments (including the La Grande Rural Fire Protection District), public transportation service, public utility companies (electric, natural gas, and internet services), La Grande public school district, Eastern Oregon University, state agencies, neighboring jurisdictions (Island City and Union County), a soil and conservation district, Union County Warming Station, and Red Cross. Numerous other community organizations were contacted and invited to join the process, not all were able to participate directly.

The DLCD Natural Hazards Planner, Cynthia Smidt, managed the project and met with members of the Steering Committee seven times and conducted individual phone conversations and email conversation to guide Steering Committee work on the plan update. The Steering Committee included regular participation from city departments and the interested parties noted above. A list of the Steering Committee members and other participants can be found below in the Public Participation Process section.

2024 Plan Update Changes

The *2014 Northeast Oregon Regional NHMP* included four counties – Baker, Grant, Union, and Wallowa – and five respective city jurisdictions, including the City of La Grande. The regional NHMP was not updated. Rather, individual counties updated their own NHMP. Although the City of La Grande participated in the *2022 Union County NHMP*, they are not a plan holder. The City of La Grande opted to develop their own NHMP, separate from Union County. However, if the city chooses, they can be included in the Annex Section of the *2022 Union County NHMP*.

The *2024 La Grande NHMP* incorporated much of the *2014 Northeast Oregon Regional NHMP* that related to City of La Grande and Union County. Some regional information was also incorporated where county or city specific information may have been lacking. The overall format of the NHMP changed with the *2024 La Grande NHMP*. Other changes include the replacement or deletion of large portions of text,

[20] The PA Grant Program requires a FEMA-approved state, not local, NHMP.

changes to the plan's organization, updated hazard risk and vulnerability assessment, and new mitigation action items. If a section is not addressed in this section, then it can be assumed that no significant changes occurred.

Front Pages

1. The plan's cover has been updated.
2. Acknowledgements have been updated to include the 2023-2024 project partners and planning participants.
3. The FEMA approval letter, review tool, and city resolution of adoption are included.

Chapter 1: Plan Summary

This chapter provides an overview of the federal and state requirements the plan addresses and an introduction that briefly describes the citywide mitigation planning efforts and the methodology used to develop the plan.

Chapter 2: Community Profile

The community profile has been updated to conform with the DLCD template and includes information for La Grande.

Chapter 3: Risk Assessment

Chapter 3, Risk Assessment, consists of three phases: hazard identification, vulnerability assessment, and risk analysis. Hazard identification involves the identification of hazard causes and characteristics, geographic location and extent, identification of said hazard, history, future climate variability, probability of occurrence, and vulnerability assessment. The second phase attempts to predict how different types of property and population groups will be affected by the hazard. The third phase involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period. Changes to Chapter 3 include:

- Some of the hazard chapters of the *2014 Northeast Oregon Regional NHMP* have been integrated into this section.
- Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities were updated, including the addition of two other hazards (Air Quality and Invasive Species/Inspect Pests) and the removal of the Landslide hazard[21]. Information previously provided in the *2014 Northeast Oregon Regional NHMP* hazard chapters is placed in this section. Additional information was added for each identified hazard including future climate variability. Some extraneous information may have been removed and links to technical reports were added as a replacement.

[21] The La Grande NHMP Steering Committee decided to remove Landslide as an individually identified hazard. Although the city has a geohazard area specific to landslides that includes some building restrictions, the consensus was that the city's risk was extremely low and thus did not warrant a section devoted to said hazard. Notwithstanding this decision, landslide hazards are addressed in the Earthquake and Flood hazard sections. Moreover, the mitigation success of Grande Ronde Hospital addition is highlighted since the retrofit focuses on earthquake and landslide hazards (the hospital is in the geohazard area of the city).

- Links to new specific hazard studies and data are embedded directly into the plan where relevant and available.
- National Flood Insurance Program (NFIP) information was updated.
- Hazard Vulnerability Assessment was reviewed and updated.

Chapter 4: Mitigation Strategy

This chapter provides the basis and justification for the mission, goals, and mitigation actions identified in the NHMP. Major changes to include the following:

- Mission and Goals were reviewed and updated by the *2024 La Grande NHMP* Steering Committee to align with other community objectives.
- The revision of existing actions and coordinating and partner organization designations were revised as applicable (as shown in Table 4-1 and Table 4-2, as well as in Appendix 8.1).
- A list of prioritized actions for La Grande, Table 4-1 (including new action item forms in Appendix 8.1).
- The Steering Committee met to review the previous NHMP action items. Steering Committee members and stakeholders provided updates and edits to the actions where applicable.
- New action items are based upon continuous community needs, the identification of new hazards, deferred action items, and current needs based upon the community risk assessment. They are designed to be feasibly accomplished within the next five years and can be found in Appendix 8.1.
- Integration and the Existing Plans and Policies sections were updated with current information, including Table 2-18 (see also Table 5-1).
- Mitigation Activities and Resources section added to show federal, state, and local mitigation resources, activities, and successes.

Chapter 5: Planning Process

The Plan Implementation, Plan Maintenance, and the 2023 Planning Process were combined into one chapter. This chapter reflects changes made to the La Grande NHMP and documents the 2023 planning and public process. There is no record that the Steering Committee (also referred to as the Coordinating Body in this section) formally met once between 2014-2022, after FEMA approval of *2014 Northeast Oregon Regional NHMP*. Progress towards action items is documented in the action item section below and in Appendix 8.1, Mitigation Action Worksheets. The Steering Committee agreed to meet semi-annually, and the La Grande Community Development Director will be the plan convener. The steering committee will discuss options to integrate the NHMP into other planning documents during their semi-annual meetings.

Chapter 6: Acronyms

This new reference chapter includes common state and federal acronyms.

Chapter 7: References

All cited material found in the *2024 La Grande NHMP* are listed in this chapter.

Chapter 8: Appendices

Appendix 8.1: Mitigation Action Worksheets

Action item forms or worksheets were created for new actions, others have been updated to account for new information. The worksheets reference the status of the action item, timeline, rationale, implementation measures, coordinating and partner organizations, and potential funding sources. In Table 4-2, it shows progress made towards previous plans' actions.

Appendix 8.2: Economic Analysis of Natural Hazard Mitigation Projects

Updates are provided for the economic analysis of natural hazard mitigation projects.

Appendix 8.3: Grant Programs

The grant programs and resources have been updated, expanded, and reformatted to illustrate the numerous federal, state, and local programs and resources available in Oregon.

Appendix 8.4: OCCRI Future Climate Projections Union County, Oregon

This appendix contains the Future Climate Projections Union County, Oregon (2023) report by the Oregon Climate Change Research Institute (OCCRI).

Appendix 8.5: Morgan Lake Dam Floodplain Management Plan

This appendix contains the final draft of the *Morgan Lake Dam Floodplain Management Plan*. This final draft is currently with FEMA for review. Once this dam floodplain management plan has been approved by FEMA, the approved plan will replace the final draft in this appendix.

Appendix 8.6: FEMA Review Tool

This appendix contains the FEMA Review Tool.

Public Participation Process

2023-2024 NHMP Update

The City of La Grande is dedicated to directly involving the public in the review and update of the NHMP. Although members of the Steering Committee represent the public, La Grande community members were also given the opportunity to provide feedback about the NHMP through personal communication by representatives on the Steering Committee, through the webpage dedicated to NHMP updates located on the La Grande's Public Works Department webpage and through community surveys. In addition, the public will be involved during the semi-annual implementation and maintenance.

As described in Sections 4.2, Plan Implementation, and Section 4.3, Plan Maintenance, the NHMP will undergo formal review on a semi-annual basis (twice per year).

The City of La Grande's Public Works Director posted notification of the NHMP update on the department's webpage. Associated with the draft risk assessment, a flyer was developed by the Project Manager and provided at Farmers' Market and with a community survey. Participation by the public and feedback on the NHMP update was solicited by a community survey prior to final submission to FEMA Region X and Oregon Department of Emergency Management.

Public Involvement Summary

La Grande involved the community through an email news and online survey, information table at the local farmers' market, and a social media announcement. The public involvement included the following details that provided an opportunity for the community to learn more about the NHMP update and comment (see also Table 5-3, La Grande NHMP Important Dates):

September 19, 2023	La Grande sent out an informational email to approximately 1,814 community members to inform the public about the current NHMP update and provide an opportunity to submit comments via survey. Union County Emergency Management also sent out the La Grande NHMP informational survey to approximately 22 individuals who were members of the *2022 Union County NHMP* update steering committee.
September 19, 2023	La Grande Steering Committee members and city staff provided information at the local farmers' market on September 19 and 23, 2023. Over the two-day period, contact was made with approximately 100 people.
September 20, 2023	La Grande sent out an informational email to all city employees (118 individuals) to inform them of the current NHMP update and provide an opportunity to take a survey.
September 22, 2023	Elkhorn Media Group picked up the NHMP update story and posted on their social media (see Figure 5-3).
September 23, 2023	La Grande Steering Committee members and city staff provided information at the local farmers' market on September 19 and 23, 2023. Over the two-day period, contact was made with approximately 100 people. See Figure 5-4 below.

As noted above, opportunities for the public to comment were provided during the draft risk assessment as a community survey, which was sent out to 1,814 emails on the La Grande Parks and Recreation Departments listserv. A majority of the emails were assigned to individuals in the community. However, the listserv included emails to the following entities:

- 1 Animal care facility
- 30 Businesses including landscaping, food service, recreation, fire suppression, and general services.
- 10 Churches, most of which are in La Grande and one in a neighboring community
- 13 Community clubs that involve women and girls, boys, children (generally), recreation, and agriculture
- 1 Community center
- 1 Correctional facility
- 4 Organizations that work with disabled individuals in the community[22]

[22] These include Autism Society of Oregon, Rising Stars, Rise Services Inc, and Special Olympics.

- 3 Government agencies including a city, county, and state agency
- 13 Health organizations that involved general and public health, rural health care, long-term care, child abuse, and overall mental, social, and safety health of the community[23]
- 6 Infrastructure providers including roads, railroad, electric, and sanitation
- 1 Military service
- 3 Rural agricultural resources for the community
- 9 Schools
- 1 Shelter for victims of violence and abuse
- 6 Sports clubs
- 1 Transportation service

In addition, Union County Emergency Management sent out the La Grande NHMP informational survey to 22 individuals that served on the *2022 Union County NHMP* steering committee. Those 22 individuals represented the following:

- American Red Cross
- Avista Natural Gas
- Center for Human Development[24]
- Cities of Union, Cove, Elgin, Imbler, and La Grande
- Grande Ronde Hospital
- Oregon Department of Forestry
- Oregon Department of Transportation
- Union County
- Ziply Fiber (telecommunications)

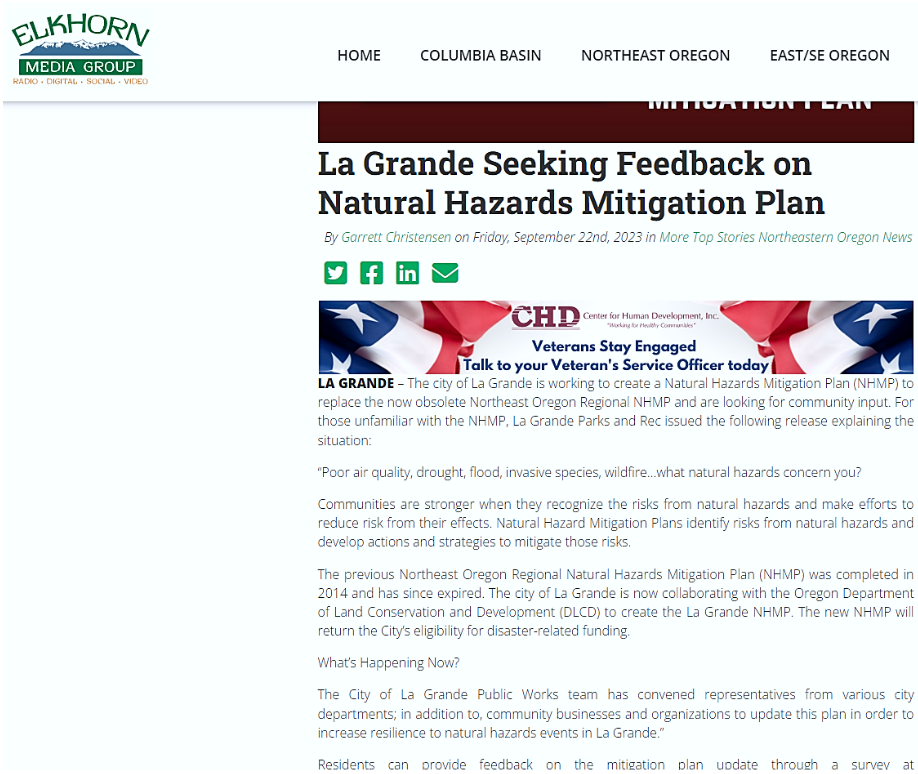
There were 43 comments received during the public review period for the La Grande NHMP update. The Steering Committee reviewed the comments during their September 26, 2023 meeting and provided edits and ideas on how to incorporate the comments into the NHMP as reflected in the final document.

The Public Survey Results showed a direct correlation between the education, outreach efforts, and lived experience, and the overall community comprehension of the risk of certain hazards, such as poor air quality, wildfire, winter storms, and invasive species/pests. However, community comprehension was limited with hazards that could significantly impact residents such potential flooding in the event the Morgan Lake Dam breach. La Grande NHMP Steering Committee agreed that public education and outreach benefits the community and continuing as such with special attention to the lesser-known hazards that could significantly impact the community. Mitigation actions MH #3 and MH #4 focus public awareness at the public official level and the community, including underserved communities and socially vulnerable populations.

[23] Such organizations include Union County Care, CASA of Eastern Oregon, Oregon Dept. of Human Services, Office of Long Term Care Ombudsman, New Day Enterprises, American Red Cross, Northeast Oregon Area Health Education Center, Union County Safe Communities Coalition, Greenwood Elem Wellness Activity, Center for Human Development, and Union County WIC-CHD

[24] The Center for Human Development (CHD) is a private, nonprofit health organization that provides alcohol and drug, environmental health, mental health, public health, developmental disabilities, prevention, and veterans services to the residents of Union County in Eastern Oregon.

Figure 5-3. Elkhorn Media Group Social Media Post (part)



ELKHORN MEDIA GROUP
RADIO • DIGITAL • SOCIAL • VIDEO

HOME COLUMBIA BASIN NORTHEAST OREGON EAST/SE OREGON

La Grande Seeking Feedback on Natural Hazards Mitigation Plan

By Garrett Christensen on Friday, September 22nd, 2023 in More Top Stories Northeastern Oregon News

LA GRANDE – The city of La Grande is working to create a Natural Hazards Mitigation Plan (NHMP) to replace the now obsolete Northeast Oregon Regional NHMP and are looking for community input. For those unfamiliar with the NHMP, La Grande Parks and Rec issued the following release explaining the situation:

"Poor air quality, drought, flood, invasive species, wildfire…what natural hazards concern you?

Communities are stronger when they recognize the risks from natural hazards and make efforts to reduce risk from their effects. Natural Hazard Mitigation Plans identify risks from natural hazards and develop actions and strategies to mitigate those risks.

The previous Northeast Oregon Regional Natural Hazards Mitigation Plan (NHMP) was completed in 2014 and has since expired. The city of La Grande is now collaborating with the Oregon Department of Land Conservation and Development (DLCD) to create the La Grande NHMP. The new NHMP will return the City's eligibility for disaster-related funding.

What's Happening Now?

The City of La Grande Public Works team has convened representatives from various city departments; in addition to, community businesses and organizations to update this plan in order to increase resilience to natural hazards events in La Grande."

Residents can provide feedback on the mitigation plan update through a survey at

Source: Christensen, 2023

Figure 5-4. La Grande Farmers' Market, September 23, 2023

Source: La Grande NHMP Steering Committee

La Grande NHMP Steering Committee Members

Keeping in mind the importance of representing the whole community, the La Grande NHMP Steering Committee was assembled by Kyle Carpenter, City of La Grande Public Works Director and Cynthia Smidt, DLCD Natural Hazards Planner. A broad range of city departments, agencies, and other organizations were solicited for potential participation. Opportunity to participate as a member of the Steering Committee was extended via email or phone call, to representatives of Union County, Island City, educational institutions, public transportation, utility companies, medical facilities, warming shelter, and other local and state agencies involved in hazard mitigation and agencies that have the authority to regulate development. The members of the Steering Committee volunteered their time to provide edits and updates to the NHMP during meetings and on an individual basis.

The following representatives served as Steering Committee members for the *2024 La Grande NHMP* update process. Kyle Carpenter, La Grande Public Works Director, was the convener of the Steering Committee.

Oregon Department of Land Conservation and Development

Cynthia Smidt Natural Hazards Planner, Planning Manager
Dawn Hert Regional Representative

City of La Grande

Kyle Carpenter Public Works, Director, Convener
Michael J. Boquist Community Development, Director
Stu Spence Parks and Recreation Department, Director
Emmitt Cornford La Grande Fire, Chief
Gary Bell La Grande Police, Chief
Joe Fisher Building Division, Building Official

Island City

Karen Howton City Recorder

Union County

Nick Vora Union County Emergency Manager

Union Soil & Water Conservation District

Aaron Bliesner Senior Project Manager

Eastern Oregon University

Jim Hoffman Safety & Security Director

American Red Cross

Barbara Wales Disaster Action Teams Volunteer

Grande Ronde Hospital & Clinics

Elaine LaRochelle Director of Facilities

Ziply Fiber Telecommunications

Diana Anderson Local Manager

Oregon Department of Forestry

Logan McCrae Unit Forester
Joshua Brock Wildland Fire Supervisor

Oregon Department of Emergency Management

Joseph Murray Mitigation Planning

Oregon Department of Transportation

Sean Rohan Region 5 Striping Manager/EOC

Summary of Participation and Outreach

The following pages include copies of meeting agendas and approved meeting notes from the La Grande NHMP Steering Committee meetings. In addition, below there are website screenshots, flyers, and other information that demonstrate the outreach efforts made during the NHMP update process. Included here is the Elkhorn Media Group social media post shown in Figure 5-3 and the farmers' market information table shown in Figure 5-4. Table 5-3 highlights important dates of the planning process.

Table 5-3. La Grande NHMP Important Dates

Dates	Description of Event or Activity
April 5, 2023	La Grande City Council receive NHMP project report, agree to sign IGA
June 14, 2023	Steering Committee Meeting #1
July 13, 2023	Steering Committee Meeting #2
July 26, 2023	Steering Committee Meeting #3
August 9, 2023	Steering Committee Meeting #4
August 30, 2023	Steering Committee Meeting #5
September 1, 2023	NHMP-specific webpage established
September 19, 2023	Steering Committee Meeting #6
September 19-26, 2023	Community survey; public comments requested and received
September 19 and 23, 2023	Farmers' Market NHMP information table
September 22, 2023	Elkhorn Media Group social media posting
September 26, 2023	Steering Committee Meeting #7

Steering Committee Meeting Agendas and Notes

Meeting #1

La Grande Natural Hazard Mitigation Plan

Steering Committee Kick-off Meeting

AGENDA

Wednesday, June 14, 2023

Time: 1:30 PM – 3:00 PM

Online via Zoom

Welcome and Introductions	
• Welcome • Introductions	Kyle Carpenter, City of La Grande All
NHMP Purpose & Process	
• Purpose of NHMP updates • Project Components • Draft project schedule	Cynthia Smidt, DLCD
Roles of Participants	
• DLCD and City of La Grande • Steering Committee –La Grande Department representatives • Interested Parties – Who will represent community members? • Cost Share • Box	Cynthia Smidt, DLCD
Public Engagement Strategy	
• Draft Project Schedule • Outreach and public engagement discussion	Cynthia Smidt, DLCD All
Risk Assessment	
• Hazard Identification & Discussion • Natural Hazard Events & Discussion	All
Next Steps	
• Meeting schedule: Let's decide Steering Committee days/times • NHMP Review: Please review previous NHMP • Box: Get familiar with BOX program	All

City of La Grande Natural Hazard Mitigation Plan

Steering Committee Kick-off Meeting

NOTES

Wednesday, June 14, 2023

Time: 1:30 PM – 3:00 PM

Online via Zoom

Attendance:

City of La Grande:
- Kyle Carpenter, Public Works Director
- Michael Boquist, Community Development Director
- Stu Spence, Parks and Recreation Department Director
- Gary Bell, Chief of Police
- Joe Fisher, Building Division Director

Stakeholders and Interested Parties:
- Joseph Murray, OEM
- Nick Vora, Union County Emergency Management
- Diana Anderson, Ziply Fiber Telecommunications
- Logan McCrae, Oregon Department of Forestry[1]

DLCD staff included:
- Cynthia Smidt, Natural Hazards Planner
- Dawn Hert, Regional Representative

Introduction and Meeting Objectives

Cynthia started the meeting with introductions orally. The committee members provided their name and affiliation in the Zoom chat (attached).

Cynthia reviewed the meeting objectives which included the following:

- NHMP Purpose and Process
- Roles of Participants
- Public Engagement Strategy
- Risk Assessment
- Next Steps

NHMP Purpose & Process

Cynthia provided a presentation going over the purpose of a NHMP update, project components, and schedule.

The purpose included defining hazard mitigation (and mitigation planning) and its benefits. These include engaging the whole community, considering solutions to reduce risk, creating an effective action plan for implementation of the NHMP, building partnerships by involving people, organizations, and businesses from the

[1] Willie Crippen, ODF, will also be a NHMP contact for this committee. Willie Crippen is also working with Union County on their Community Wildfire Protection Plan (CWPP).

community, increasing education and awareness, communicating priorities to state and federal officials, and aligning risk reduction with other community goals.

The project components include the following: Planning Process, Risk Assessment, Mitigation Strategy, Plan Maintenance, Plan Update, and Plan Adoption.

The project schedule is on a very short timeline. There are grant funds available for Morgan Dam, but they cannot be released until La Grande has a FEMA approved NHMP.

Roles of Participants

Cynthia provided an overview of the roles and responsibilities of the project lead/convener, project manager, steering committee, and stakeholders/interested parties. In addition, Cynthia spoke to the intergovernmental agreement between DLCD and La Grande for this grant project, which the city council approved prior to this first meeting. There was a brief discussion about what other participants could be invited. Suggested interested community partners include the following:

- Island City
- Eastern Oregon University (Jim Hoffman)
- Red Cross
- Pacific Islanders representatives
- Center for Human Development (CHD)
- Public transportation
- Oregon DHS
- Rural Fire Department
- City Fire Department
- Oregon Dept of Forestry (Willie Crippen and Logan)
- Grande Ronde Hospital (*Contact: Elaine LaRochelle, GRH Facilities Director, 541-963-1554, exl01@grh.org*)
- OTAK
- School District
- Warming Shelters
- Utilities

Cynthia also discussed the typical process for grant cost share, however, due to the generosity of the Oregon Legislature (House Bill 5006 enacted in the 2021 Regular Session), the participants do not need to provide documentation of match to DLCD for this grant. However, staff recommended checking in with Kyle to find out whether they should be accounting for their time on this project.

Cynthia briefly touched on the Box program. She will be sending out two emails with an invitation to Box.

Public Engagement Strategy

Cynthia provided an overview of public engagement and then requested ideas. She mentioned that because of the short timeline for this project, they will expect to provide an opportunity for the public to comment when the draft Risk Assessment and draft Mitigation Strategy are completed. Moreover, OEM has been invited to participate in the process throughout and will be attending the steering committee meetings.

The committee suggested the following ideas:

1. Outreach to specific groups such as Chamber of Commerce board, La Grande Main Street, Farmers Market, other service clubs
2. Invite Isabella (name?) from The Observer to a meeting or pitch the topic to them for a news article
3. Facebook
4. Website page

Risk Assessment: Hazard Identification

Cynthia provided an overview of the hazards identified in the 2014 NHMP for the Northeast Oregon Regional NHMP. She then compared those hazards to those identified in the 2020 Oregon NHMP (Region 7), 2022 Union County NHMP and 2022 Wallowa County NHMP. The committee then discussed what hazards they wanted to include in the updated city plan.

The committee agreed keep the hazards that were included in the 2014 Northeast Oregon Regional NHMP with the following changes:

- Air Quality. Add Air Quality as a primary hazard (although air quality will be addressed as secondary to other primary hazards such as wildfire and volcanic events, it will be added as a primary hazard to the city's NHMP).[2]
- Invasive Species/Pests. Add this as a primary hazard (Wallowa County NHMP included such a hazard).
- Severe Weather.
    - Retain the Severe Weather main hazard heading instead of separating out the individual sub-hazards (extreme temps, windstorm, winter storm).
    - Remove Dust Storm from the Severe Weather hazard.
- Volcanic Event. Although they felt the impacts may be minimal in this region of the state, the committee decided to keep it as an identified hazard.

Risk Assessment: Natural Hazard Events

Cynthia mentioned that the plan needs to identify historic events that have occurred in the last 5+ years. At a minimum this shall include State Emergency Disaster Declarations and Federal Major Disaster Declarations that occurred in the planning area, regardless of whether that event affected the city. The plan can identify any reported event and city-specific events.

As a comparison, Cynthia showed the NOAA Storm Event Database reported events for the past five years (6/1/2014 to 6/1/2023) for Union County. Union County had 190 reported events. Cynthia also showed the number of identified FEMA Federal Declarations since 2014. Union County had 3 declarations.

The committee discussed generally wind and flooding events, in addition to air quality from wildfires. Also mentioned where some winter and windstorm events.

Next Steps

Kyle will be sending out invitation for upcoming meetings. Once Cynthia sends out invitations to Box, participants should get familiar with the program. In addition, it was advised to get familiar with the 2014 Northeast Oregon Regional NHMP and 2022 Union County NHMP, both of which are in the Box program. The next meeting focus will be on the Hazard Vulnerability Assessment.

Attachments:
1. Zoom Chat
2. PowerPoint presentation

[2] Nick mentioned that DEQ, City of La Grande, and Eastern Oregon University worked on a Community Response Plan for Air Quality.

Meeting #2

La Grande Natural Hazard Mitigation Plan

Steering Committee Meeting #2

AGENDA

Thursday, July 13, 2023

Time: 2:00 PM – 3:30 PM

Online via Zoom

Welcome and Introductions	**3 min**

- Introductions

Project Updates	**15 min**

- Meeting Notes
- BOX Assistance
- Stakeholder/Interested Parties Roster
- Public Engagement Plan

Risk Assessment – *General*	**15 min**

- Community Profile Information

Risk Assessment – *Hazard Vulnerability Assessment (HVA)*	**45 min**

- HVA Introduction
- Hazards Review

Next Steps	**3 min**

- Next Meetings: July 26, Aug. 9, Aug. 30
- OCCRI Presentation: July 26
- Mitigation Strategy
- Public Engagement and Outreach, if any

Local Mitigation Planning Guide (revised April 19, 2022)

https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-policy-guide_042022.pdf

City of La Grande Natural Hazard Mitigation Plan
Steering Committee Meeting #2
NOTES

Thursday, July 13, 2023
Time: 2:00 PM – 3:30 PM

Online via Zoom

Attendance:

City of La Grande:
- Emmitt Cornford, La Grande Fire Chief
- Kyle Carpenter, Public Works Director
- Gary Bell, Chief of Police

Stakeholders and Interested Parties:
- Aaron Bliesner, Union County Soil & Water Conservation District
- Barbara Wales, Red Cross
- Diana Anderson, Ziply Fiber Telecommunications
- Elaine LaRochelle, Grande Ronde Hospital & Clinics
- Jim Hoffman, Eastern Oregon University
- Joseph Murray, Oregon Department of Emergency Management
- Karen Howton, Island City
- Logan McCrae, Oregon Department of Forestry
- Nick Vora, Union County Emergency Management

DLCD staff included:
- Cynthia Smidt, Natural Hazards Planner

Introduction and Meeting Objectives

Cynthia opened the meeting at approximately 2:02 p.m. The committee members provided their name and affiliation in the Zoom chat.

Cynthia reviewed the meeting objectives which included the following:

- Introductions
- Project Updates
- Risk Assessment
  - General
  - Hazard Vulnerability Assessment
- Next Steps

Project Updates:

Meeting Notes: The committee received the meeting notes from the June 14, 2023 meeting for review. Cynthia requested an approval of the meeting notes. Gary moved to adopt the meeting notes and Kyle seconded the motion.

<u>Box</u>: Cynthia reminded the committee about Box. Another round of invitations to Box will go out to committee members who were not present at the first meeting.

<u>Stakeholders/Interested Parties</u>: Kyle provided an update on other participants to the NHMP committee.

<u>Public Engagement</u>: Cynthia went over the draft public engagement plan. She also requested input and status updates for some of the plan.

Kyle provided an update on the website. He indicated that it was underway. However, he would rather not upload meeting recordings on the website. Instead, he suggested having the meeting notes. Cynthia will let Kyle know when approved meeting notes are uploaded to Box so he can post them online.

Cynthia inquired about whether the city will initiate a social media posting (via Facebook) when the website it launched. No feedback was provided.

Kyle said that he has not gotten as far as pitching the NHMP update to The Observer news outlet. Once Kyle gets the website live, Cynthia will talk with Kyle about pitching the plan update to the paper.

Regarding outreach to specific groups (e.g., Chamber of Commerce board, La Grande Main Street, Farmers Market), Kyle said that once we start moving forward on the plan and we have more information such as the Hazard Vulnerability Assessment, he thought about reaching out to those clubs.

Risk Assessment - General

Part of the Risk Assessment is providing a community profile.

<u>Existing plans, studies, reports, technical data and information</u>. Cynthia requested any local information from the city that may address natural hazards. She is looking for existing plans, studies, reports, technical data and information for Risk Assessment that address the hazards listed below. This information should be uploaded to Box or given to Cynthia another way by early August.

- Air Quality
- Drought
- Earthquake
- Flood
  - Dam Safety – Morgan Dam EAP
- Invasive Species/Pest
- Severe Weather
  - Extreme Temps
  - Windstorm
  - Winter Storm
- Volcanic Event
- Wildfire

<u>Community Profile – Assets, Capabilities, Changes, NFIP</u>. Cynthia also went over other community profile data the plan will need to address. The NHMP will look at assets that are important to the character and function of the city. Assets include critical facilities, people, structures, community lifelines, natural resources, historic and cultural resources, economy, other activities. Things to consider are assets in existing hazard areas (flood zone, landslide zone, age of structure, tourism and farming, and seasonal activities.

Capabilities are the tools available to the city that will help increase the city resilience. Consider the range of resources, including staff and data, that support understanding of the natural hazards. However, capabilities may not be hazard specific, but they should be able to meet the challenges posed by those hazards. Cynthia also mentioned that we need to keep equity in mind when looking at capabilities. There are four main categories of capabilities:

- Planning and regulatory
- Administrative and technical (staff, skills, tools)
- Financial (taxes, general fund, utility fees)
- Educational and outreach (safety and awareness programs)

Cynthia will also need a write-up about changes in land use and development in the last 5+ years and forecasting into the future. This will include commercial, industrial, residential, and open space lands, for example. The NHMP will also be looking at changes in population and Cynthia will be using PSU population forecasts. However, Cynthia requests any local specific information, if available. Lastly, the NHMP needs to provide an update on the National Flood Insurance Program for La Grande.

Cynthia wanted the committee to consider what gives the La Grande community resilience to natural hazard events. This may include community connections, facilities for refuge, safe evacuation routes, professional responders and caregivers. Outside resources may include funds for projects to reduce risk of damage from natural hazard events. La Grande will want to add this information to the NHMP and include a list of the community critical facilities (defined as a facility that is critical for the health and welfare of the population and is especially important following hazard events). Some critical facilities and physical infrastructure are identified in the following two plans:

- 2014 NE Oregon NHMP, La Grande Addenda, page LG-10
- 2022 Union County NHMP, page 22

In considering the critical facilities, La Grande can look at FEMA's list of community lifelines.

Risk Assessment – Hazard Vulnerability Assessment

Cynthia gave an overview of the Oregon Department of Emergency Management's (OEM's) Hazard Vulnerability Assessment (HVA). The HVA benefits include a focus on the greatest risk to the community, it helps establish community priorities, guide mitigation action priorities, and educate the public on natural hazards. The HVA is very data driven; however, absent significant data, the review becomes subjective. The OEM methodology factors include history, probability, vulnerability, and maximum threat, which are further described as the following:

- *History* is a record of previous occurrences of natural hazards[1].
- *Probability* is the likelihood of future occurrence within a specific period of time.
- *Vulnerability* is the percentage of population and property likely to be affected under an "average" occurrence of the hazard.
- *Maximum Threat* is the highest percentage of population and property that could be impacted under a worst-case scenario.

Cynthia mentioned that each factor is weighted differently; however, the reason behind the weight is unclear to DLCD staff. The OEM documentation does not explain this information. Cynthia showed the HVA ratings from the *2014 Northeast Oregon Regional NHMP*, including the La Grande Addendum. Also shown were the HVA ratings from the *2022 Union County NHMP* (which is also found in the 2023 Union County Emergency Operations Plan) and the *2019 Integrated Water Resources Needs and Vulnerability Report*. The 2022 Wallowa County NHMP was also shared with the focus on the air quality and invasive species ratings.

[1] Historic event requirements include 1) Emergency Operations Center or alternate was activated; 2) Emergency Operations Plan, 3) Three or more functions were implemented, 4) Extraordinary multi-jurisdictional response required, or 5) Local or Tribal Emergency was declared.

The committee felt it was a good idea to work from the most recent and thought-out assessment that is be applicable to their city. Joseph suggested that the committee focus on where there are more extreme differences between the county and the city. Significant differences are likely found with the percentage of population and property affected by the hazard. Two such examples are dam safety and flooding. The committee decided to adopt most of the *2022 Union County NHMP* ratings with a few exceptions – air quality, invasive species, drought, extreme heat, and dam safety.

The committee adopted the following 2022 Union County NHMP ratings (factor weights are not applied here):

HAZARD	HISTORY	PROBABILITY	VULNERABILITY	MAX THREAT
Earthquake	2	7	8	2
Flood	7	5	6	6
Severe Weather (avg)				
Windstorm	4	4	5	5
Winter Storm	8	8	9	8
Wildfire	6	5	5	5

The committee conducted the HVA for Drought Extreme Heat, and Dam Failure during this meeting. The following are the committee's ratings (factor weights are not applied here):

HAZARD	HISTORY	PROBABILITY	VULNERABILITY	MAX THREAT
Drought	10	10	1	4
Flood				
High Hazard Potential Dams	1	8	9	9
Severe Weather (avg)				
Extreme Temps	3	5	5	5

Kyle will circulate the Wallowa County's Air Quality and Invasive Species ratings to the committee and get their thoughts on whether to adopt or revise these ratings. Volcanic Event will need an HVA because Union County NHMP does not include Volcanic Event. The HVA review will continue at a future meeting.

Next Steps

Kyle will be sending out invitation for upcoming meetings. Meeting Schedule includes July 26, 2023, August 9 and 30, 2023. All meetings are scheduled from 2:00 pm to 3:30 pm

Next Meeting Focus will include a presentation by Oregon Climate Change Research Institute and work will begin on the Mitigation Strategy.

Attachments:

1. PowerPoint presentation

Meeting #3

Saved to this PC

CITY of LA GRANDE
THE HUB OF NORTHEASTERN OREGON

La Grande Natural Hazard Mitigation Plan
Steering Committee Meeting #3
AGENDA
Thursday, July 26, 2023
Time: 2:00 PM – 3:30 PM

Online via Zoom

OREGON
Department of Land Conservation & Development

Welcome and Introductions	**3 min**
• Introductions	All
Project Updates	**3 min**
• Meeting Notes	Cynthia Smidt
Presentation	**30 min**
• OCCRI Future Projections Report for Union County	Erica Fleishman, OSU
Risk Assessment – *Hazard Vulnerability Assessment (HVA)*	**5 min**
• Review Results	Cynthia Smidt
Mitigation Strategy	**30 min**
• Mission Statement • Goals • 2016 Actions	Cynthia Smidt & All
Next Steps	**3 min**
• Next Meetings: Aug. 9, Aug. 30 • Mitigation Strategy, *continued* • Public Engagement and Outreach	

2023 Douglas County NHMP Mitigation Goals

GOAL A: Develop and implement mitigation activities to protect human life, property, and the natural environment.

GOAL B: Protect existing buildings and infrastructure from the impacts of natural hazards.

GOAL C: Build resilience to the impacts of natural hazards on the local economy.

GOAL D: Educate public and raise awareness of the impacts of natural hazards.

GOAL E: Increase preparedness of communities and agencies.

City of La Grande Natural Hazard Mitigation Plan

Steering Committee Meeting #3

NOTES

Thursday, July 26, 2023

Time: 2:00 PM – 3:30 PM

Online via Zoom

Attendance:

City of La Grande:
- Joe Fisher, Building Official
- Kyle Carpenter, Public Works Director
- Michael Boquist, Community Development Director

Stakeholders and Interested Parties:
- Aaron Bliesner, Union County Soil & Water Conservation District
- Diana Anderson, Ziply Fiber Telecommunications
- Elaine LaRochelle, Grande Ronde Hospital & Clinics
- Erica Fleishman, Oregon Climate Change Research Institute
- Logan McCrae, Oregon Department of Forestry

DLCD staff included:
- Cynthia Smidt, Natural Hazards Planner
- Dawn Hert, Regional Representative

Introduction and Meeting Objectives

Cynthia opened the meeting at approximately 2:02 p.m. The committee members provided their name and affiliation in the Zoom chat.

Cynthia reviewed the meeting objectives which included the following:

- Introductions
- Project Updates
- OCCRI Presentation
- Risk Assessment
  - Hazard Vulnerability Assessment
- Mitigation Strategy
  - Mission, goals, actions
- Next Steps

Project Updates:

Meeting Notes: The previous meeting notes were not completed in time of this meeting.

OCCRI Presentation

Erica Fleishman with Oregon Climate Change Research Institute (OCCRI) presented the draft Union County Future Climate Projections Report. Erica went over climate data and terminology, climate models, and the downscaling of climate modes. The report will focus on impacts to the following assets: people (including vulnerable groups), buildings, and other infrastructure. The assets will be based on the best available data, which can vary throughout the state.

The report's executive summary states,

> *Climate change is expected to increase the occurrence of many climate-related natural hazards and to increase climate-related risks to assets, such as people, buildings, and infrastructure. Confidence that the risk of heat waves will increase is very high (Table 1) given strong evidence in the peer-reviewed literature, consistency among the projections of different global climate models, and robust scientific principles that explain why temperatures increase in response to ongoing emissions of greenhouse gases. In areas where the human population is growing, and especially where it is aging, both the absolute number and the proportion of people at risk of negative health outcomes from heat exposure is increasing. Confidence that the risk of many other natural hazards will increase as climate changes is high or medium (Table 1), reflecting moderate to strong evidence and consistency among models. The latter risks are influenced by multiple factors in addition to increasing temperatures. Confidence that the risk of windstorms will change is low given that projections suggest relatively few to no changes and evidence is limited.*

	Low Confidence	Medium Confidence	High Confidence	Very High Confidence
Risk Increasing		Drought Expansion of Non-native Invasive Species Reduced Air Quality Loss of Wetlands	Heavy Precipitation Flooding Wildfire	Heat Waves
Risk Unchanging	Windstorms			
Risk Decreasing				Cold Waves

Erica is looking for comments and feedback on the presentation and written draft report. The steering committee will have until August 9, 2023 to provide Cynthia with comments.

Erica is also looking for data for report regarding buildings in the floodplain. Michael doesn't believe this is readily available. It would easier to do an GIS analysis for tax lots in the floodplain but to break it down to the building/structure level, it would be difficult because La Grande doesn't have a GIS layer with that data.

The committee discussed whether to include additional wildfire data, which is not in the draft report but was presented orally. The additional wildfire data, which can include number, size, and causes of wildfires, is new to the OCCRI report and it depends on what the community wants to see in their report. Kyle and others didn't know if the data would be needed at the local level. However, Cynthia requested a simple presentation of the data in the report would be good as it may tie into some of the FEMA requirements.

Mitigation Strategy

Mission statement: The committee reviewed the mission statement from of the 2014 Northeast Oregon Regional NHMP and decided that it would be a good idea to revise the statement, making it more specific to La Grande. Cynthia presented some examples, including: "Promote sound public policy designed to protect citizens, critical facilities, infrastructure, and property from natural hazards…" which some members liked. Cynthia will provide Kyle with examples to discuss in a smaller subcommittee and then return with options to the August 9 meeting.

Goals: Cynthia went over mitigation strategy goals. The goals are what the community wants to achieve by carrying out their NHMP and are clear and the basis for prioritizing mitigation actions. Goals must also be consistent with the hazards identified and described in the risk assessment. Cynthia mentioned that the committee should consider the following when creating goals: risk assessment findings, outreach findings, community goals, and state hazard mitigation goals. Cynthia provided the following that goals commonly include:

- Minimize loss of life, injury and damage to property, the economy and the environment from natural hazards.
- Build and enhance local mitigation capabilities to ensure the safety and resilience of all community members.
- Reduce damage to public buildings and ensure continuity of emergency services.
- Maintain the jurisdiction's natural and man-made systems that protect against natural hazards.
- Increase cooperation and coordination among private entities, local agencies, state agencies and federal agencies.
- Protect natural, historic and cultural resources.

Union County NHMP retained the goals from the 2014 Northeast Orgon Regional NHMP, which are:

GOAL 1: Protect human welfare, property, and natural resources.
GOAL 2: Increase the resilience of local and regional economies.
GOAL 3: Motivate mitigation activity against the effects of natural hazards through education, outreach, and awareness.
GOAL 4: Strengthen organizational and community capacity.

Like the mission statement revision, the committee will review goals in more detail. The consensus is that the regional goals are too broad for the city and that they could use the common goals to use create goals that would fit the La Grande community. Cynthia will provide Kyle with the list of existing goals, the common goals (above) and other examples. Cynthia also noted that the number of goals varies and that it is up to the community.

Next Steps

Kyle will be sending out invitation for upcoming meetings. Meeting Schedule includes August 9 and 30, 2023. All meetings are scheduled from 2:00 pm to 3:30 pm

Next meeting focus will include continuing with mitigation strategy (mission statement, goals, and actions) and review of the hazard vulnerability assessment.

Attachments:
1. PowerPoint presentation

Meeting #4

La Grande Natural Hazard Mitigation Plan

Steering Committee Meeting #4

AGENDA

Thursday, August 9, 2023
Time: 2:00 PM – 3:30 PM

CITY of LA GRANDE
THE HUB OF NORTHEASTERN OREGON

OREGON
Department of Land Conservation & Development

In-person at the La Grande Council Chambers and online via Zoom

Welcome and Introductions	**3 min**
• Introductions	
Project Updates	**5 min**
• Meeting Notes • Public Engagement and Outreach	
Risk Assessment – Hazard Vulnerability Assessment	**40 min**
• Air Quality, Invasive Species, Volcano • Review Results	
Mitigation Strategy	**40 min**
• Mission Statement • Goals • 2014 Actions	
Next Steps	**3 min**
• Next Meetings: Aug. 30 • Mitigation Actions, continued • Plan Implementation and Mitigation • Public Engagement and Outreach	

Local Mitigation Planning Guide (revised April 19, 2022)

https://www.fema.gov/sites/default/files/documents/fema_local-mitigation-planning-policy-guide_042022.pdf

City of La Grande Natural Hazard Mitigation Plan

Steering Committee Meeting #4

NOTES

Wednesday, August 9, 2023
Time: 2:00 PM – 3:30 PM

In-person and online via Zoom

Attendance:

City of La Grande:
- Emmitt Cornford, La Grande Fire Chief
- Gary Bell, Chief of Police
- Joe Fisher, Building Official
- Kyle Carpenter, Public Works Director
- Michael Boquist, Community Development Director
- Stu Spence, La Grande Parks and Recreation

Stakeholders and Interested Parties:
- Diana Anderson, Ziply Fiber Telecommunications
- JB Brock, Oregon Department of Forestry
- Joseph Murray, Oregon Department of Emergency Management
- Karen Howton, Island City
- Logan McCrae, Oregon Department of Forestry
- Nick Vora, Union County Emergency Management

DLCD staff included:
- Cynthia Smidt, Natural Hazards Planner
- Dawn Hert, Regional Representative

Introduction and Meeting Objectives

Cynthia opened the meeting at approximately 2:02 p.m. The committee members provided their name and affiliation in the Zoom chat.

Cynthia reviewed the meeting objectives which included the following:

- Introductions
- Project Updates
- Risk Assessment
  - Hazard Vulnerability Assessment
- Mitigation Strategy
  - Mission, goals, actions
- Next Steps

Project Updates:

Meeting Notes: The committee received the notes from the July 13 and July 26, 2023 meetings for review. Cynthia requested an approval of the meeting notes. Kyle moved to adopt the meeting notes and Joe seconded the motion.

Public Engagement: Kyle provided a status of the NHMP website. At this time, the website was not established yet.

Risk Assessment – Hazard Vulnerability Assessment

Cynthia refreshed the committee of the OEM Hazard Vulnerability Assessment, which includes the factors of history, probability, vulnerability, and maximum threat of a natural hazard. The committee worked through each factor of the assessment for the following hazards: volcanic event, air quality, and invasive species (shown in red font in table below). As noted in a previous meeting, the committee decided to adopt most of the *2022 Union County NHMP* ratings (shown in blue font in table below) with a few exceptions – air quality, invasive species, drought, extreme heat, and dam safety. The committee conducted the HVA for Drought, Extreme Heat, and Dam Failure during the July 13, 2023 meeting (shown in black font). The following are the committee's ratings for all hazards (factor weights are not applied here):

HAZARD	HISTORY	PROBABILITY	VULNERABILITY	MAX THREAT
Air Quality	10	10	5	10
Drought	10	10	1	4
Earthquake	2	7	8	2
Flood	7	5	6	6
High Hazard Potential Dams	1	8	9	9
Invasive Species/ Pests	1	4	4	10
Severe Weather				
Extreme Temps	3	5	5	5
Windstorm	4	4	5	5
Winter Storm	8	8	9	8
Volcanic Event	1	1	1	10
Wildfire	6	5	5	5

Severe Weather hazard includes three sub-hazards – extreme heat, windstorm, and winter storm. Cynthia wanted to know if the committee wanted the main hazard as an average of the three sub-hazards. The committee did not support having an average. They felt it important to have each sub-hazard ranked separately.

Mitigation Strategy

Mission statement: At the July 26, 2023 meeting, the committee decided it would be good to revise the mission statement from what was contained in the 2014 Northeast Oregon Regional NHMP. Prior to the meeting, Kyle provided five options for the mission statement. During this meeting, the committee reviewed the options and provided feedback.

Kyle suggested the following mission statement options.

1. *Empowering Our Community Through Collaborative Hazard Mitigation: Together, we envision a resilient future where our community proactively identifies, prepares for, and mitigates hazards, safeguarding lives, property, and our way of life. Through informed planning, innovative strategies, and a commitment to inclusivity, we strive to build a safer and more sustainable environment for current and future generations.*
2. *Reduce the risk that natural hazards pose to the citizens of La Grande and its property and infrastructure.*
3. *Promote sound public policy designed to protect the La Grande community from natural hazards.*
4. *Identify and minimize the risks and impacts attributed to natural hazards on the citizens, critical facilities, infrastructure, and property of the La Grande Community.*
5. *A secure and resilient La Grande with the capabilities required to identify, prevent, protect against, respond to, and recover from the threats and outcomes of natural hazards.*

After discussion, the consensus of the committee was option 1, with edits. The final mission statement for the 2023 La Grande NHMP is the following:

> *Empowering Our Community Through Collaborative Hazard Mitigation: Together, we envision a resilient future where our community proactively identifies, prepares for, and mitigates hazards, safeguarding lives, critical infrastructure, and property. Through informed planning, innovative strategies, and a commitment to collaboration, we strive to build a safer and more sustainable environment for current and future generations.*

Goals: Also, during the July 26 meeting, the committee decided to revise the mitigation goals found in the contained in the 2014 Northeast Oregon Regional NHMP. Prior to the meeting, Kyle provided two options for mitigation goals. During this meeting, the committee reviewed the options and provided feedback. One option included six goals while the other options included 10 in-depth goals. The consensus of the committee was to go with the brief goals identified in the first option.

Goal 1: Protect Lives
Develop and implement safety measures to protect human welfare, property, and natural resources.

Goal 2: Structural Mitigation
Strive to protect existing buildings and infrastructure from the impacts of natural hazards.

Goal 3: Coordination
Increase cooperation and coordination among private entities, local agencies, state agencies, and federal agencies.

Goal 4: Awareness
Provide ongoing opportunities to increase hazard risk and mitigation understanding through community education and outreach.

Goal 5: Economy
Enhance community resilience, including economic continuity and recovery, to reduce the impacts of natural hazards and promote efficient and effective recovery.

Goal 6: Natural Resources
Preserve and rehabilitate natural systems to serve natural hazard mitigation functions and protect natural resources.

Actions: Cynthia provided an overview of mitigation actions. This included going over the types of actions, action development, authorities, examples, and funding. Cynthia discussed the development of problem statements for SMART (Specific, Measurable, Actionable, Realistic and Time Sensitive) mitigation actions that would be fundable by FEMA HMA grant programs. Working outward from existing capacity and focusing on a few priority actions were points that Cynthia made during this agenda item topic. Cynthia identified several key areas of authority FEMA expects jurisdictions or special districts to utilize including those of the Emergency Management, Public Works and infrastructure authorities as well as Planning and growth management authorities within development code.

The committee will need to review the mitigation actions in the 2014 Northeast Oregon Regional NHMP and provide a status report for each action. Cynthia will send out an email to the committee regarding action review. Cynthia also suggested to think about new actions for the city.

Next Steps

Next meeting is scheduled for August 30, 2023, from 2:00 – 3:30 p.m. Kyle will send out an invitation.

Next meeting focus will include continuing with mitigation strategy (actions) and review of the hazard vulnerability assessment.

Attachments:

1. PowerPoint presentation

Meeting #5

La Grande Natural Hazard Mitigation Plan

Steering Committee Meeting #5

AGENDA

Thursday, August 30, 2023

Time: 2:00 PM – 3:30 PM

CITY of LA GRANDE
THE HUB OF NORTHEASTERN OREGON

OREGON
Department of Land Conservation & Development

In-person at the La Grande Council Chambers and online via Zoom

Welcome and Introductions	**3 min**
• Introductions	
Project Updates	**3 min**
• Meeting Notes	
Risk Assessment – Hazard Vulnerability Assessment	**7 min**
• Review Results	
Mitigation Strategy	**60 min**
• 2014 Actions • 2023 Actions	
Next Steps	**3 min**
• Next Meetings: September 19, morning • Plan Implementation and Mitigation • Public Engagement and Outreach	

2023 La Grande NHMP, Mission Statement & Goals

Empowering Our Community Through Collaborative Hazard Mitigation: *Together, we envision a resilient future where our community proactively identifies, prepares for, and mitigates hazards, safeguarding lives, critical infrastructure, and property. Through informed planning, innovative strategies, and a commitment to collaboration, we strive to build a safer and more sustainable environment for current and future generations*

Goal 1: Protect Lives. *Develop and implement safety measures to protect human welfare, property, and natural resources.*

Goal 2: Structural Mitigation. *Strive to protect existing buildings and infrastructure from the impacts of natural hazards.*

Goal 3: Coordination. *Increase cooperation and coordination among private entities, local agencies, state agencies, and federal agencies.*

Goal 4: Awareness. *Provide ongoing opportunities to increase hazard risk and mitigation understanding through community education and outreach.*

Goal 5: Economy. *Enhance community resilience, including economic continuity and recovery, to reduce the impacts of natural hazards and promote efficient and effective recovery.*

Goal 6: Natural Resources. *Preserve and rehabilitate natural systems to serve natural hazard mitigation functions and protect natural resources.*

CITY of LA GRANDE
THE HUB OF NORTHEASTERN OREGON

City of La Grande Natural Hazard Mitigation Plan

Steering Committee Meeting #5

NOTES

Wednesday, August 30, 2023

Time: 2:00 PM – 3:30 PM

In-person and online via Zoom

OREGON
Department of Land Conservation & Development

Attendance:

City of La Grande:
Joe Fisher, Building Official
Kyle Carpenter, Public Works Director
Stu Spence, Parks and Recreation

Stakeholders and Interested Parties:
Diana Anderson, Ziply
Elaine LaRochelle, Grande Ronde Hospital & Clinics
Logan McCrae, Oregon Department of Forestry
Nick Vora, Union County Emergency Management

DLCD staff included:
Cynthia Smidt, Natural Hazards Planner
Dawn Hert, Regional Representative

Introduction and Meeting Objectives

Cynthia opened the meeting at approximately 2:02 p.m. The committee members provided their name and affiliation in the Zoom chat.

Cynthia reviewed the meeting objectives which included the following:

- Introductions
  - Cynthia discussed why the next meeting is proposed for September 19. Dawn Hert and Cynthia will be attending in-person.
- Project Updates
- Risk Assessment
- Mitigation Strategy
- Next Steps

Project Updates:

Meeting Notes: The committee received the notes from the August 9, 2023 meetings for review. Cynthia requested an approval of the meeting notes. Nick moved to adopt the meeting notes and Joe seconded the motion.

Public Engagement: Cynthia mentioned that the public engagement schedule needs to shift a bit since she is behind on getting the draft Risk Assessment completed. Moreover, we only have a month to get this out to the public. Prior to this meeting, Cynthia and Kyle discussed plans, which were also discussed here.

Public engagement going forward will include the following:

- Kyle will publish the website and populate it by Friday (Sept. 1)
- Stu will help put together a public survey and have his Safe Routes 2 School staff also had out the flyer and survey at the upcoming Farmers Markets (the Saturday market)
- Social media posting will be sent out to city mailing list. Elaine said she can send it out to her list (primarily staff).
- Other things suggested included putting a paper copy in public facing offices

Risk Assessment – Hazard Vulnerability Assessment

Cynthia showed the committee the results of the HVA, which are shown below.

HAZARD	HISTORY	PROBABILITY	VULNERABILITY	MAX THREAT	RISK SCORE
Air Quality	10	10	5	10	215
Severe Weather: Winter Storm	8	8	9	8	197
High Hazard Potential Dams	1	8	9	9	193
Invasive Species/Pests	1	4	4	10	150
Flood	7	5	6	6	139
Drought	10	10	1	4	135
Severe Weather: Extreme Heat	3	5	5	6	126
Wildfire	6	5	5	5	122
Volcanic Event	1	1	1	10	114
Earthquake	2	7	8	2	113
Severe Weather: Windstorm	4	4	5	5	111

The committee discussed the low Windstorm ranking given how windstorms are occurring more often in the area. The committee originally adopted the Windstorm ranking from the 2022 Union County NHMP. However, during this meeting the committee agreed to revise the probability and vulnerability scores to 6, which raised its Risk Score to 130 and just above Extreme Heat. The revised HVA results are below.

HAZARD	HISTORY	PROBABILITY	VULNERABILITY	MAX THREAT	RISK SCORE
Air Quality	10	10	5	10	215
Severe Weather: Winter Storm	8	8	9	8	197
High Hazard Potential Dams	1	8	9	9	193
Invasive Species/Pests	1	4	4	10	150
Flood	7	5	6	6	139
Drought	10	10	1	4	135
Severe Weather: Windstorm	4	6	6	5	130
Severe Weather: Extreme Heat	3	5	5	6	126
Wildfire	6	5	5	5	122
Volcanic Event	1	1	1	10	114
Earthquake	2	7	8	2	113

The committee also supported having only three Risk Levels (high is red, medium is orange, and low is yellow) instead of four as shown in the image above. Cynthia noted that the Risk Levels separations were just natural break points. This adjustment to the HVA is also shown above in the second figure.

Mitigation Strategy

Actions: Cynthia provided an overview of mitigation actions with the focus of reviewing the 2014 actions and considering new actions for the new plan

The committee reviewed most the 2014 NHMP mitigation actions. Included changes are refinements, revisions, and additions that Cynthia made based on conversations. Nick will also review the list again and provide his feedback soon.

The committee also discussed potential new actions that are described here and included as new actions:

- Increasing community resiliency to reduce and mitigate hazard/weather-related power outages. Since most of the community relies on electricity for household appliances, the potential of a power outage could impact a large part of the city population. Moreover, propane supplies may be limited at the time of need. Having an action that would encourage the community to look at alternative back-up sources, especially for heat during a severe storm. Implementation ideas may include solar power, back-up generator, natural gas appliances, woodstove change-outs to an EPA certified woodstove, and developing a Woodstove Ordinance requiring such woodstove changes upon sale of a house. This action could apply to the severe weather and air quality hazard.
- Identify city and regional resilience hubs. Although there are some facilities in the community such as the Community Resource Center (Center for Human Development) and the Union County Warming Shelter, there was the idea establishing others. Union County purchased the old Riveria Elementary School with plans of developing it into some sort of community hub. Union County is still in the planning phases including identifying its future use and needed improvements.

Next Steps

Next meeting is scheduled for September 19, 2023, at 9:00 or 10:00 a.m. Kyle will send out an invitation.

Next meeting focus will include continuing with mitigation strategy (actions), plan implementation, and review of any public comments.

Attachments:

1. PowerPoint presentation

Meeting #6

CITY of LA GRANDE
THE HUB OF NORTHEASTERN OREGON

La Grande Natural Hazard Mitigation Plan
Steering Committee Meeting #6
AGENDA

Tuesday, September 19, 2023
Time: 9:00 – 11:00 AM

OREGON
Department of Land Conservation & Development

In-person at the La Grande Council Chambers and online via Zoom

Welcome and Introductions	**3 min**
• Introductions	
Project Updates	**10 min**
• Meeting Notes • Public Engagement & Outreach	
Plan Maintenance	**15 min**
• Who, When, What, How	
Plan Implementation	**15 min**
• What	
Mitigation Strategy	**60 min**
• 2023 Actions • Action Prioritization	
Next Steps	**3 min**
• Next Meetings: September 26? • Public Outreach Review	

2023 La Grande NHMP, Mission Statement & Goals

Empowering Our Community Through Collaborative Hazard Mitigation: *Together, we envision a resilient future where our community proactively identifies, prepares for, and mitigates hazards, safeguarding lives, critical infrastructure, and property. Through informed planning, innovative strategies, and a commitment to collaboration, we strive to build a safer and more sustainable environment for current and future generations*

Goal 1: Protect Lives. *Develop and implement safety measures to protect human welfare, property, and natural resources.*

Goal 2: Structural Mitigation. *Strive to protect existing buildings and infrastructure from the impacts of natural hazards.*

Goal 3: Coordination. *Increase cooperation and coordination among private entities, local agencies, state agencies, and federal agencies.*

Goal 4: Awareness. *Provide ongoing opportunities to increase hazard risk and mitigation understanding through community education and outreach.*

Goal 5: Economy. *Enhance community resilience, including economic continuity and recovery, to reduce the impacts of natural hazards and promote efficient and effective recovery.*

Goal 6: Natural Resources. *Preserve and rehabilitate natural systems to serve natural hazard mitigation functions and protect natural resources.*

CITY of LA GRANDE
THE HUB OF NORTHEASTERN OREGON

City of La Grande Natural Hazard Mitigation Plan
Steering Committee Meeting #6
NOTES

Tuesday, September 19, 2023
Time: 9:00 AM – 11:00 AM

In-person and online via Zoom

OREGON
Department of Land Conservation & Development

Attendance:

City of La Grande:
- Emmitt Cornford, La Grande Fire Chief
- Gary Bell, La Grande Chief of Police
- Joe Fisher, Building Official
- Kyle Carpenter, Public Works Director
- Michael Boquist, Community Development Director
- Stu Spence, Parks and Recreation Director

Stakeholders and Interested Parties:
- Nick Vora, Union County Emergency Management
- Joseph Murray, Oregon Department of Emergency Management

DLCD staff included:
- Cynthia Smidt, Natural Hazards Planner
- Dawn Hert, Regional Representative

Introduction and Meeting Objectives

Cynthia opened the meeting at approximately 9:02 a.m. Cynthia reviewed the meeting objectives which included the following:

- Introductions
- Project Updates
  - Meeting Notes
  - Public Engagement
- Plan Maintenance
- Plan Implementation
- Mitigation Strategy
  - Actions
- Next Steps

Project Updates:

Meeting Notes: The committee received the notes from the August 30, 2023 meetings for review. Cynthia requested an approval of the meeting notes. Gary moved to adopt the meeting notes and Kyle seconded the motion.

<u>Public Engagement</u>: Cynthia requested a status update on public engagement. As previously discussed, the following was planned for public engagement:

- Kyle will publish the website and populate it by Friday (Sept. 1)
- Stu will help put together a public survey and have his Safe Routes 2 School staff also had out the flyer and survey at the upcoming Farmers Markets (the Saturday market)
- Social media posting will be sent out to the city mailing list. Elaine said she can send it out to her list (primarily staff).
- Other things suggested included putting a paper copy in public facing offices

The website was established on September 1, 2023. However, nothing else had been completed. Cynthia had previously provided Kyle with a flyer and sample survey questions to use. Stu and Kyle were going to work on getting something to the September 19 and 23 Farmers Market. Also, Cynthia suggested Kyle post online the flyer and/or the draft Risk Assessment. The group agreed to meet on September 26 to discuss any comments submitted. Because of this delay, the group also agreed to extend the deadline to get the NHMP submitted to OEM to **October 6**.

Plan Maintenance

The committee discussed the plan for maintenance for the NHMP. This includes the who, when, what, and how the city plans to maintain the NHMP

<u>Who</u>: The committee agreed to change the convener to Michael Boquist, CDD Director. The Public Works Director, Kyle Carpenter, will be secondary to Michael.

<u>When</u>: The committee agreed to keep it as a semi-annual review. However, two changes were made to the process.

- The NHMP review meetings will be held during the city directors' weekly meetings. The directors meet once a week. Twice a year, however, the meetings will include a discussion on the NHMP.
- The committee decided to remove the designated Spring meeting (meeting one) and Fall meeting (meeting two) timelines and left it at two times a year with sufficient time separating the two.

<u>What</u>: The previous NHMP separated out topics for each meeting. The committee agreed that the list would be combined and discussed at either the first or second meeting that year. Those topics include the following:

- Review existing action items to determine appropriateness for funding;
- Educate and train new members on the plan and mitigation in general;
- Identify issues that may not have been identified when the plan was developed; and
- Prioritize potential mitigation projects using the methodology described below.
    - Examine funding
    - Risk Assessment evaluation
    - Committee recommendation
    - Quantitative and qualitative assessment and economic analysis
- Review existing and new risk assessment data;
- Discuss methods for continued public involvement; and
- Document successes and lessons learned during the year.

How: The committee agreed to keep the existing ideas listed for continued public involvement and participation.

- Post copies of the plan on the website;
- Place articles in the local newspaper directing the public where to view and provide feedback; and
- Use existing newsletters such as schools and utility bills to inform the public where to view and provide feedback.

Plan Implementation

The committee went over planning mechanisms that were listed in the past NHMP and what was missing. The previous plan included the following:

What: Process to integrate the ideas, information and strategy of the mitigation plan into other planning mechanisms?

- La Grande Comprehensive Plan
- Morgan Lake Study
- Article 3.12, Land Development Code for Floodplain
- Community Wildfire Protection Plans
- Economic Development Action Plans
- City and County Budgets

The committee added the La Grande Emergency Alert and Evacuation Plan (2018). Cynthia also obtained needed information about the La Grande Emergency Operations Plan (1991, proposed update in the 2024-25 fiscal year) and the Union County CWPP, contract to complete by May 2024.

Mitigation Strategy – Actions

The committee went through the changes Cynthia made to the mitigation actions, including actions removed, revised, completely rewritten, and new. The committee also made minor changes to the action worksheets/forms that have background information and ideas for implementation. The committee also established a prioritization of those actions, which includes the following three tiers:

Level 1: High priority actions that have an element of urgency
Level 2: Moderate priority actions that may require some pre-planning
Level 3: Desirable priority actions that are dependent on available resources and time

The final mitigation action list is attached.

Next Steps

Next meeting is scheduled for September 26, 2023, at 9:00. Kyle will send out an invitation. Next meeting focus will include review of any public comments and how to incorporate those comments into the NHMP.

Attachments:
1. 2024 Mitigation Actions
2. PowerPoint presentation

Meeting #7

La Grande Natural Hazard Mitigation Plan

Steering Committee Meeting #7

AGENDA

Tuesday, September 26, 2023

Time: 9:00 – 11:00 AM

CITY of LA GRANDE
THE HUB OF NORTHEASTERN OREGON

OREGON
Department of Land Conservation & Development

In-person at the La Grande Council Chambers and online via Zoom

Welcome and Introductions	**3 min**
• Introductions	
Project Updates	**5 min**
• Meeting Notes	
Public Engagement & Outreach	**30+ min**
• Review public comments • Integration	
Next Steps	**3 min**
• Review any sections of NHMP, if necessary • Cynthia will submit NHMP to OEM by October 6	

City of La Grande Natural Hazard Mitigation Plan
Steering Committee Meeting #7
NOTES

Tuesday, September 26, 2023
Time: 9:00 AM – 11:00 AM

In-person and online via Zoom

Attendance:

City of La Grande:
- Emmitt Cornford, La Grande Fire Chief
- Joe Fisher, Building Official
- Kyle Carpenter, Public Works Director
- Michael Boquist, Community Development Director
- Stu Spence, Parks and Recreation Director

Stakeholders and Interested Parties:
- Barbara Wales, American Red Cross
- Elaine LaRochelle, Grande Ronde Hospital & Clinics
- Karen Howton, Island City
- Sean Rohan, Oregon Department of Transportation

DLCD staff included:
- Cynthia Smidt, Natural Hazards Planner
- Dawn Hert, Regional Representative

Introduction and Meeting Objectives

Cynthia opened the meeting at approximately 9:05 a.m. Cynthia reviewed the meeting objectives which included the following:

- Introductions
- Project Updates
    - Meeting Notes
- Public Engagement and Outreach
- Next Steps

Project Updates:

Meeting Notes: The committee received the notes from the September 19, 2023 meetings for review. Cynthia requested clarification on the action plan and prioritization. Kyle moved to adopt the meeting notes as discussed and adjusted.

Public Engagement and Outreach

Stu provided an overview of the public engagement and outreach efforts in the last weeks. The survey went out to about 2,000 people and Elkhorn Media Group had a social media posting about the efforts. Forty-three (43) people responded to the survey. The Steering Committee reviewed and discussed the results. The following are ways the committee wanted to incorporate the results:

- Highlight results in the Risk Assessment and applicable identified hazard
- Illustrate the correlation between those hazards the community expressed higher concern about and the existing education efforts underway in the community (e.g., wildfire and invasive species)
    - This correlation was also evident in the results of what industry/economic drivers that are vulnerable to a natural hazard event.
- For the hazards that the community expressed less concern (unaware of the risk) such as flood and dam failure, this can be where the city can focus new public education.

Of the 43 participants in the survey, 8 individuals provided comments. The committee discussed these comments. The following is one topic that will be incorporated into the NHMP:

- Alternate routes when the freeway closes. La Grande is a very isolated area and when freeways close, alternate routes are limited or nonexistent, especially due to the amount of semi-truck traffic. This is an ongoing issue that ODOT continually evaluates. ODOT has conducted tabletop exercises, which has helped plan for big emergencies. For example, the best alternate route to the Willamette Valley from Eastern Oregon is Highway 20 through Burns and Bend. However, in other situations, this may not be the best alternate route. When main transportation routes are closed, it affects everything including the supply route for the hospital and other health care. It was also noted that if there were an earthquake, all bridges would be out of commission, seriously affecting all transportation routes.

Next Steps

Cynthia let everyone know that this is the last formal meeting. There may be a chance that the committee will need to reconvene depending on what comments are requested by OEM and FEMA. Otherwise, if Cynthia has any other questions, she will email members directly. Also, she may send along other parts of the NHMP for review. Cynthia plans to submit the NHMP to OEM by October 6.

Attachments:

1. 2024 NHMP Survey Results

La Grande NHMP Webpage

City of La Grande OREGON

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City of La Grande Natural Hazard Mitigation Plan

In order to prepare for the long term effects from natural hazards, the City of La Grande has begun work on the development and adoption of a Natural Hazards Mitigation Plan (NHMP). While it is impossible to accurately predict the timing, nature, and magnitude of natural hazards, careful planning and collaboration among public agencies, private sector organizations, and citizens can increase the resiliency of the community.

News

City Council Work Session September 25

La Grande Risk Assessment Flyer (front|back)

CITY of LA GRANDE

DLCD

City of La Grande
Natural Hazards Mitigation Plan Update
September 2023

Poor Air Quality, Drought, Flood, Invasive Species, Wildfire…

What Natural Hazards Concern You?

Communities are stronger when they recognize the risks from natural hazards and make efforts to reduce risk from their effects.

Natural Hazard Mitigation Plans identify risks from natural hazards and develop actions and strategies to mitigate those risks.

The previous ***Northeast Oregon Regional Natural Hazards Mitigation Plan*** (NHMP) was completed in 2014 and has since expired. The City of La Grande is now collaborating with the Oregon Department of Land Conservation and Development (DLCD) to create the ***La Grande NHMP***. The new NHMP will return the City's eligibility for disaster-related funding.

What's Happening Now?
The City of La Grande Public Works team has convened representatives from various city departments; in addition to, community businesses and organizations to update this plan in order to increase resilience to natural hazards events in La Grande.

**Is La Grande vulnerable to natural hazards?
Let us here from you!**

For more information contact:
Kyle Carpenter, City of La Grande
Public Works Director
kcarpenter@cityoflagrande.org
Or
Cynthia Smidt, DLCD Natural Hazards Planner
Cynthia.Smidt@dlcd.Oregon.gov

Find out more by visiting the NHMP update webpage:
City of La Grande Natural Hazard Mitigation Plan | La Grande, OR

Photos credits: "Trucks on I-84" by OregonDOT is licensed under CC BY 2.0.; Riverside Park Pavilion 2011, La Grande Rural Fire Protection District

City of La Grande's Natural Hazards

- Air Quality
- Drought
- Earthquake
- Extreme Heat
- Flood
- Dam Failure
- Invasive Species/Pests
- Windstorm
- Winter Storm
- Wildfire
- Volcano

Public Information Session: Risk Assessment

What hazards are new to the 2023 NHMP Risk Assessment? The Steering Committee agreed to add Air Quality and Invasive Species to the 2023 NHMP hazards list.

What else changed in the 2023 NHMP Risk Assessment? Each of the 11 identified hazards have been updated and expanded to include more information in the following categories: causes and characteristics, location and extent, hazard event standards, history, future climate variability, probability assessment, community vulnerability, and mitigation activities and resources.

City of La Grande
2023 Natural Hazard Vulnerability Assessment

HAZARD	RISK SCORE
Air Quality	215
Severe Weather: Winter Storm	197
High Hazard Potential Dams	193
Invasive Species/Pests	150
Flood	139
Drought	135
Severe Weather: Windstorm	130
Severe Weather: Extreme Heat	126
Wildfire	122
Volcanic Event	114
Earthquake	113

Completed by the City of La Grande NHMP update Steering Committee during meetings held on July 19, August 9, and August 30, 2023.

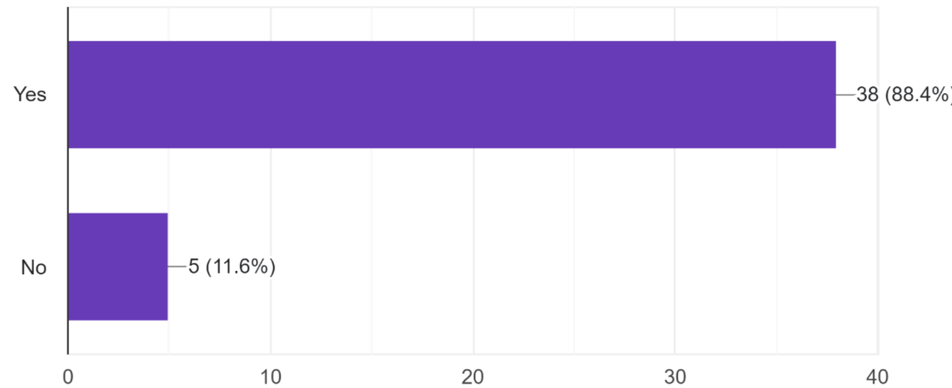
Participation

As part of the Natural Hazards Mitigation Plan (NHMP) update for the City of La Grande, the Steering Committee conducted an exercise based on the Oregon Department of Emergency Management and FEMA's methodology to evaluate the risk of damage and displacement from the range of natural hazards identified. The evaluation of the hazards was based on four factors: Historical Frequency, Probability, Vulnerability, and Maximum Threat. The table above is the result of that exercise. **Does it reflect your perception of the risk posed by these natural hazards?**

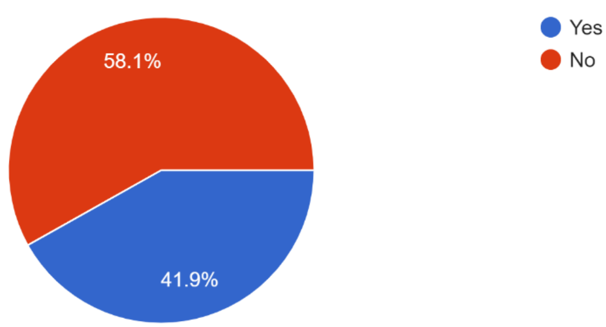
The Steering Committee will now turn its attention toward actions intended to reduce risk from these hazards. **Would you like to learn more?** If so, please visit the City of La Grande's Public Works webpage on Hazard Mitigation at this link: City of La Grande Natural Hazard Mitigation Plan | La Grande, OR

Public Survey Results

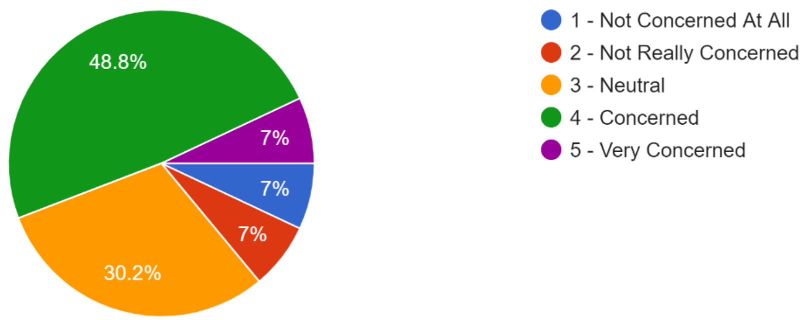
Do you live in the City of La Grande, Oregon?
43 responses



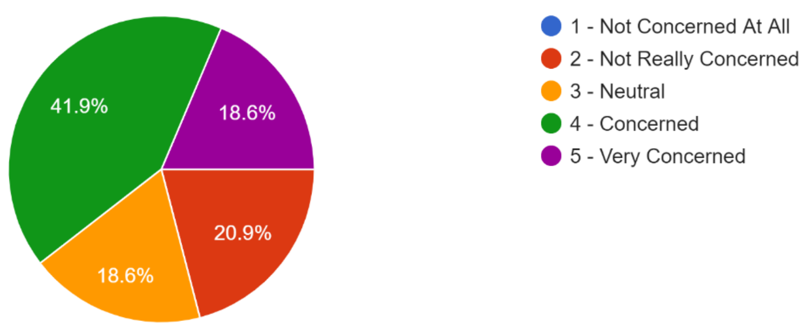
Have you, your family, or your property ever been directly AFFECTED by a natural hazard event in La Grande?
43 responses



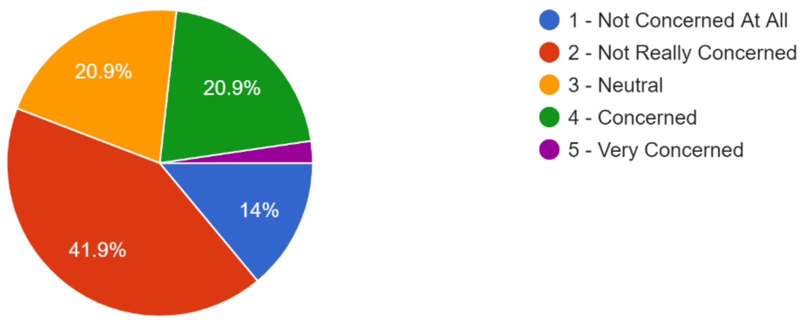
What is your level of concern regarding an air quality event affecting you, your family , and/or your property?
43 responses



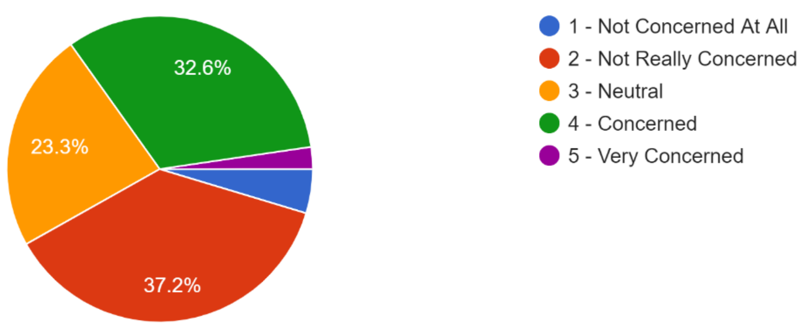
What is your level of concern regarding a winter storm event affecting you, your family , and/or your property?
43 responses



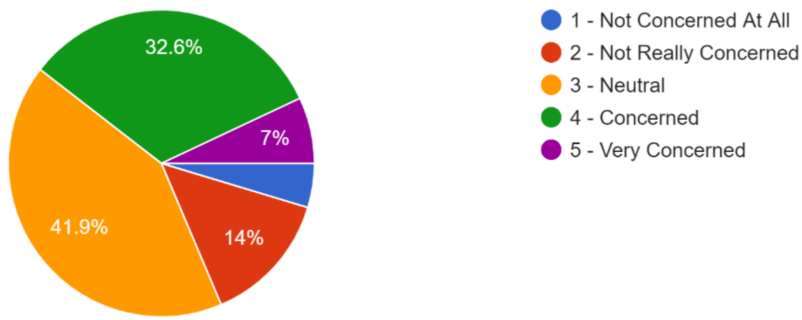
What is your level of concern regarding the failure of a dam affecting you, your family , and/or your property?
43 responses



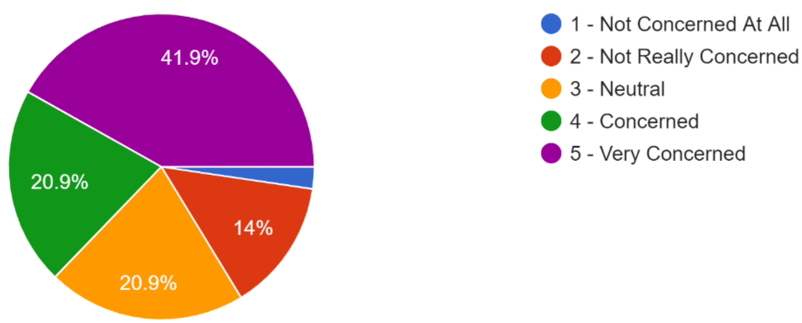
What is your level of concern regarding invasive species/pests affecting you, your family , and/or your property?
43 responses



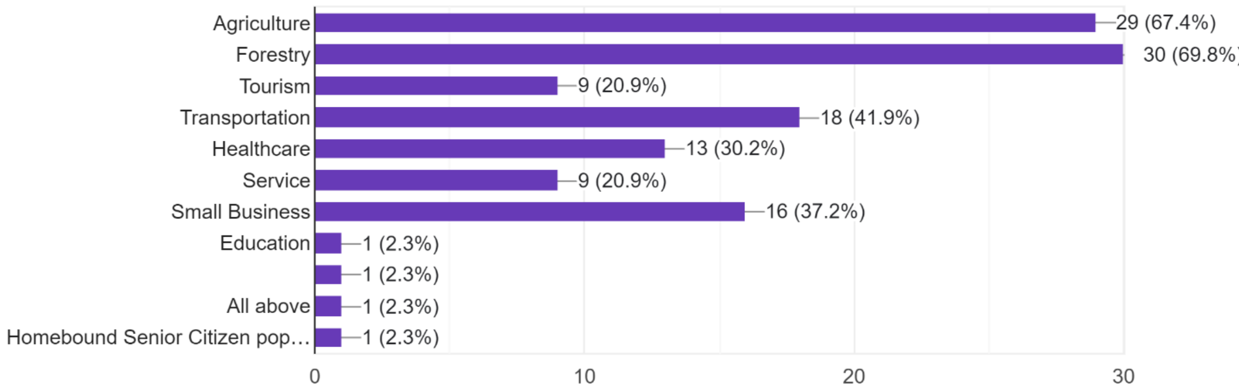
What is your level of concern regarding a flood event affecting you, your family , and/or your property?
43 responses



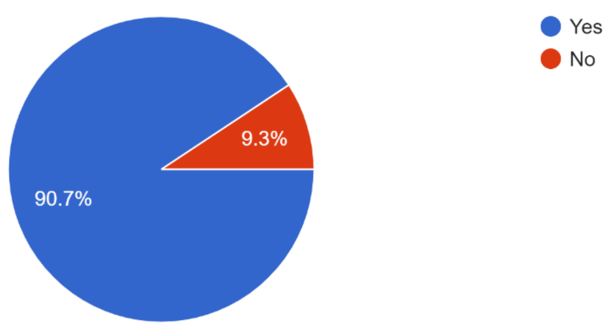
What is your level of concern regarding a wildfire event affecting you, your family , and/or your property?
43 responses



Which of the following Industries/economic drivers do you believe is most vulnerable to a natural hazard event?
43 responses



Do you feel that natural resources in La Grande (e.g. Forest land, Farm Land, Waterways, Wetlands, Etc.) are vulnerable to a natural hazards event?
43 responses



COMMENTS:

Let's mention the elephant in the room. What about war in our country?? This should be discussed or will we just wait until then?

The B2H project will greatly increase risk for fires and slides for the city of La Grande. The state of Oregon shamefully prioritized an out of state company's profits over the safety of its citizens.

I don't know enough to judge vulnerability. Air quality has been very poor in recent summers (except this year).

Seems like a limited field of view on union county hazards.

The Grande Rond Valley needs some type of flood control system to protect farms and roads from annual flood damage that occurs. Also, can you please tell me why there is so much money being put into a hospital that people can't access in the winter due to it being placed on an icy (and geologically unstable) mountainside? They could have built an entirely new hospital in the La Grande business park for far less than the cost of this latest renovation.

My concern for air quality is the smoke that we get from wildfires during the summer months. My concern for wildfire is more the smoke, than for my property. There are certainly parts of La Grande that are vulnerable to the actual fire. Winter storm events are part of living here. They are inconvenient but are something we should expect to happen from time to time. All of the segments of commerce that are listed, would be affected by a natural disaster.

When the freeway closes and alternate routes i.e.; Tollgate are not open travel is a challenge for medical transportation. When the freeway closes the trucks park on both sides of the hyw 203 by Flying J and overpass causing major congestion. Safety lights are not always on during this time and truck drives are walking in between the trucks causing safety issue. Trucks park in the turning lane making passing under the overpass impossible. Small cars can't even get through. How is a rescue, fire, ambulance, police to get through.

Wildfire mitigation on the hill behind La Grande MUST be addressed, especially with B2H coming through!

Chapter 6 ACRONYMS

6.1 Oregon

The following are acronyms and abbreviations specific to Oregon state and used in this NHP. However, this is by no means an exhaustive list.

AGC	Associated General Contractors
AOC	Association of Oregon Counties
BCD	Building Codes Division (Department of Consumer and Business Services)
BPA	Bonneville Power Administration
CPW	Community Planning Workshop (University of Oregon)
DAS	Department of Administrative Services
DCBS	Department of Consumer and Business Services
DEQ	Department of Environmental Quality
DHS	Department of Human Services
DLCD	Department of Land Conservation and Development
DOE	Department of Energy
DOGAMI	Department of Geology and Mineral Industries
DSL	Division of State Lands
ESD	Education Service District
HB	House Bill (State of Oregon)
IHMT	Interagency Hazard Mitigation Team
NRO	Natural Resources Office
LCDC	Land Conservation and Development Commission (State of Oregon)
LOC	League of Oregon Cities
OAIRS	Oregon All Incident Reporting System (State Fire Marshal)
OAR	Oregon Administrative Rules
OCAR	Oregon Climate Assessment Report
OCCRI	Oregon Climate Change Research Institute
OCMP	Oregon Coastal Management Program
OCS	Oregon Climate Service
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
OEM	Oregon Department of Emergency Management
OEMA	Oregon Emergency Management Association
OERS	Oregon Emergency Response System
OHCS	Oregon Housing and Community Services
OHIRA	Oregon Hazard Identification and Risk Assessment
OPDR	Oregon Partnership for Disaster Resilience
OPRD	Oregon Parks and Recreation Department
ORP	Oregon Resilience Plan
ORS	Oregon Revised Statues
OSFM	Office of State Fire Marshal
OSP	Oregon State Police
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
PSU	Portland State University
UGB	Urban Growth Boundary
UO	University of Oregon
UO-IPRE	University of Oregon – Institute for Policy Research and Engagement
PUC	Public Utility Commission
SB	Senate Bill (State of Oregon)
SEAO	Structural Engineers Association of Oregon
SHMO	State Hazard Mitigation Officer
WRD	Water Resources Department

6.2 Federal

The following are federal or national-specific acronyms and abbreviations and used in this NHMP. However, this is not considered as an exhausted list.

AASHTO	American Association of State Highway and Transportation Officials
APA	American Planning Association

APCO	Association of Public Safety Communications Officials
ARES	Amateur Radio Emergency Service
ASFPM	Association of State Floodplain Managers
ATC	Applied Technology Council
BCA	benefit/cost analysis BCA
BFE	Base Flood Elevation
BLM	Bureau of Land Management
BRIC	Building Resilient Infrastructure and Communities Program
BPA	Bonneville Power Administration
BSSC	Building Seismic Safety Council
CAP	Community Assistance Program (NFIP)
CAP-SSSE	Community Assistance Program — State Support Services Element (NFIP)
CAV	Community Assistance Visit (NFIP)
CDBG	Community Development Block Grant Programs (HUD Program)
DMA	Disaster Mitigation Act of 2000 (federal)
DMA2K	Disaster Mitigation Act of 2000
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
CRS	Community Rating System
CSZ	Cascadia Subduction Zone
CTP	Cooperating Technical Partner (NFIP)
CVO	Cascade Volcano Observatory (USGS)
CWPP	Community Wildfire Protection Plan
EAP	Emergency Action Plan
EAS	Emergency Alert System
EDA	Economic Development Administration
EIA	Energy Information Administration (U.S.)
EIS	Environmental Impact Statement
EMPG	Emergency Management Performance Grant
EPA	Environmental Protection Agency
ER	Emergency Relief
EWP	Emergency Watershed Protection (NRCS Program)
FAS	Federal Aid System

FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance (FEMA Program)
FMAG	Fire Management Assistance Grant Program
FTE	Full Time Equivalent
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Sciences (International)
GSA	General Services Administration
HAZUS	Hazards U.S. (HAZUS-MH is Hazards U.S. – Multi-Hazard)
HMGP	Hazard Mitigation Grant Program
HMST	Hazard Mitigation Survey Team
HUD	Housing and Urban Development (U.S. Department of)
IBHS	Institute of Business and Home Safety
ICC	Increased Cost of Compliance
IPCC	Intergovernmental Panel on Climate Change (United Nations)
LWI	Local Wetlands Inventory
M_W	Moment earthquake magnitude scale
NCDC	National Climate Data Center
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NGO	Non-Governmental Organization
NID	National Inventory of Dams
NHMP	Natural Hazard Mitigation Plan
NIBS	National Institute of Building Sciences
NIFC	National Interagency Fire Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	National Resource Council
NRCS	Natural Resources Conservation Services
NWI	National Wetlands Inventory
NWS	National Weather Service
PA	Public Assistance Grant Program

PDSI	Palmer Drought Severity Index
PM_{10}	Particulate Matter less than 10 micrometers in diameter
RHHPD	Rehabilitation of High Hazard Potential Dam Grant Program
SBA	Small Business Administration
SEDS	State Energy Data System
STORM	Safeguarding Tomorrow through Ongoing Risk Mitigation Revolving Loan Fund
TDR	Transfer of Development Rights
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
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
USFA	United States Fire Administration
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WSSPC	Western States Seismic Policy Council
WUI	Wildland-Urban Interface

Chapter 7 REFERENCES

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Table S1501 Educational Attainment. 2021 American Community Survey 5-Year Estimates. https://data.census.gov/table/ACSST5Y2021.S1501?g=160XX00US4140350

Table S1601 Language Spoken at Home. 2021 American Community Survey 5-year Estimates. https://data.census.gov/table?q=La+Grande+city,+Oregon&tid=ACSST5Y2021.S1601

Table S1701 Poverty Status in the Past 12 Months 2021 American Community Survey 5-year Estimates. https://data.census.gov/table?q=la+Grande,+oregon&tid=ACSST5Y2021.S1701

Table S1810 Disability Characteristics. 2021 American Community Survey 1-year Estimates. https://data.census.gov/table?q=la+Grande,+oregon&tid=ACSST5Y2021.S1810

Table S1901 Income in the Past 12 Months (in 2021 Inflation-Adjusted Dollars). 2021 American Community Survey 1-year Estimates. https://data.census.gov/table?q=la+Grande,+oregon&tid=ACSST5Y2021.S1901

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Chapter 8 APPENDICES

8.1 Mitigation Action Worksheets

Table 4-1. Chapter 4, Mitigation Strategy, lists the Mitigation Actions for the *2024 La Grande NHMP*. This appendix contains the associated action worksheets for each action identified in Table 4-1 and some of those found in Table 4-2. Each worksheet provides areas to rank priority status, background issue and ideas for integration. In addition, a cost, timeline, responsible and partner agencies, and other pertinent information is provided. Status as determined by the La Grande NHMP Steering Committee. Those details which were not determined during the 2023 update process should be addressed during the plan maintenance phase.

Multi-Hazard #1	Priority Status: 1 or High
Proposed Action Item	**Develop and maintain a Continuity of Operations Plan (COOP) or Emergency Operations Plan (EOP).**
Background/Issue	• **Applicable to the following hazards**: earthquake, flood (including dam failure), severe weather, volcanic event, and wildfire. • Union County has a very basic COOP available but is pursuing the development of a more comprehensive plan. • City of La Grande expects to update their EOP during the 2024-25 fiscal year. • City and County services in the region are typically relegated to one central building; should an earthquake or any other natural disaster interrupt the functioning of these buildings, municipal operations would cease to function. • A COOP establishes policy and guidance to ensure the execution of the organization's most essential functions in any event that requires the relocation of selected personnel and functions to an alternate facility (Oregon Natural Hazards Workgroup. Cannon Beach Case Study Report. July 2006. Community Service Center, University of Oregon. Eugene, OR). • Research has shown that staff turnover is likely to occur after a disaster, and veteran staff are critical after a disaster. Developing a continuity of operations plan will help reduce turnover so that existing personnel do not have to take on extra responsibilities during an already stressful time. In addition, continuity planning can help lessen turnover by ensuring competitive salaries and benefits and by reducing the amount of stress that staff will have to endure (Source: Oregon Natural Hazards Workgroup. Cannon Beach Case Study Report. July 2006. Community Service Center, University of Oregon. Eugene, OR). • The City of La Grande has concerns regarding the provision of redundancy of information.
Ideas for integration	• Recommend that public sector employees take the FEMA Independent Study Program: Continuity of Operations Course (online). The course provides a fundamental understanding of continuity of operations plans,

	terms, objectives, and benefits to public sector departments and agencies. It also provides information on how a COOP event might affect employees, the department/agency and an employee's family. • Union County is in the process of reviewing existing COOP and begin to develop a more detailed plan. • City of La Grande expects to update their EOP during the 2024-25 fiscal year.
Responsible Agency	City of La Grande
Partners	Relevant Public Works and Emergency Service, Law Enforcement, Fire Department, Department of Homeland Security, county and city roads departments, ODOT, Island City, Relevant Private Industries, OEM
Potential Funding	FMA, HMGP, BRIC, EMPG, SRGP, La Grande General Fund, La Grande GO Bond
Cost Estimate	**Timeline**
Medium	Short-Term
Notes	Ongoing, revised action MH #1 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Multi-Hazard #2	Priority Status: 2 or Medium
Proposed Action Item	**Ensure city planning documents and regulations align with regard to natural hazards mitigation and the actions in the Natural Hazards Mitigation Plan, particularly State Planning Goal 7.**
Background/Issue	• **Applicable to the following hazards**: air quality, drought, earthquake, flood (including dam failure), severe weather, volcanic event, and wildfire. • The vision, goals, and policies of the comprehensive plan are routinely implemented through other local planning instruments such as zoning ordinances, subdivision regulations, and capital improvement programs. Integrating hazard mitigation into the local comprehensive plan thereby establishes resilience as an overarching value of a community and provides the opportunity to continuously manage development in a way that does not lead to increased hazard vulnerability. (FEMA). • The Natural Hazards Mitigation Plan's current actions have no regulatory or statutory requirements for compliance. Requiring the incorporation would make the plan stronger. • The Disaster Mitigation Act of 2000 requires that mitigation plans provide a comprehensive range of actions and projects to mitigate against natural hazards [201.6(c)(3)(ii)], such as actions that protect natural resources. Encouraging the implementation of existing action items with the Comprehensive Plan will help to ensure that the actions are implemented.
Ideas for integration	• NHMP adoption as an amendment to the Comprehensive Plan Goal 7 element.
Responsible Agency	La Grande Planning and Public Works Departments
Partners	DLCD, OEM, FEMA
Potential Funding	HMGP, BRIC, DLCD Community Assistance Grants, La Grande General Fund, Building and Planning Fees, Americorps/ Resource Assistance for Rural Environments (RARE) Program
Cost Estimate	**Timeline**
Low	Short-Term
Notes	Ongoing, revised action MH #2 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Multi-Hazard #3	Priority Status: 2 or Medium
Proposed Action Item	**Inform public officials about mitigation awareness and the Natural Hazards Mitigation Plan and review Mitigation Actions with the Steering Committee on an annual basis**
Background/Issue	• **Applicable to the following hazards**: air quality, drought, earthquake, flood (including dam failure), invasive species and insect pests, severe weather, volcanic event, and wildfire. • The turnover for public officials in Northeast Oregon is high; newcomers should be briefed on community capacity, existing plans and policies, and personnel capabilities. • Before a crisis occurs, public officials can prepare communities, risk managers, government spokespersons, public health officials, the news media, physicians, and hospital personnel with appropriate messages that can help build public confidence in public officials and the measures they recommend. • The *2024 La Grande NHMP* survey found that the overall community comprehension of the risk was prevalent for certain hazards; however, community comprehension was limited with hazards that could significantly impact residents. The Steering Committee agreed that public education and outreach benefits the community and continuing as such with special attention to the lesser-known hazards that could significantly impact the community, including underserved communities and socially vulnerable populations. • The Disaster Mitigation Act of 2000 requires that the Natural Hazard Mitigation plan includes a method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle [201.6(c)(4)(i)]. When public officials are more informed about the mitigation plan, it is more likely that the plan will be implemented and maintained on a regular basis, and that any methods and schedules for monitoring, evaluating, and updating the plan are continued.
Ideas for integration	• Develop public official information kit that can be distributed to elected officials and community decision makers. The kit should include pertinent information regarding the Natural Hazards Mitigation Plan as well as the risk La Grande faces. • Publicize the NHMP and send a copy to public officials. • Create a brief memo for public officials that lists pertinent information regarding the NHMP. Within the memo, create a list of persons involved in developing and/or implementing the plan, prioritized mitigation actions, and funding source descriptions. • Bring mitigation awareness training to public officials, city planning and public works staff, GIS technicians, and persons responsible for maintaining or implementing the NHMP. • Provide a briefing to relevant public officials regarding the specifics of the plan to the community.
Responsible Agency	La Grande NHMP Steering Committee Convener
Partners	Relevant Public Works and Emergency Services, Law Enforcement, Fire Department, Road Department, ODOT, ODF, Relevant Private Industries

Potential Funding	BRIC, La Grande General Fund, Salem GO Bond, Building and Planning Fees,
Cost Estimate	**Timeline**
Low	Short-Term
Notes	Ongoing, revised action MH #3 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Multi-Hazard #4	**Priority Status: 2 or Medium**
Proposed Action Item	**Develop, implement, and maintain education and outreach programs to increase public awareness of the risk associated with natural hazards. Specifically target underserved communities and socially vulnerable populations.**
Background/Issue	• **Applicable to the following hazards**: air quality, drought, earthquake, flood (including dam failure), invasive species and insect pests, severe weather, volcanic event, and wildfire. • To build and capitalize upon the self-sufficiency and individual capacity of Northeast Oregon inhabitants • Community organizations that serve elderly or disadvantaged populations are concerned with the transportation and services available to special-needs groups • The high percentage of elderly individuals require special consideration due to their sensitivities to heat and cold, their reliance upon transportation for medications, and their comparative difficulty in making home modifications that reduce risk to hazards. • Young people represent a vulnerable segment of the population. Special consideration should be given to younger populations and schools, where children spend much of their time, during the natural hazard mitigation process. Children are more vulnerable to heat and cold, have fewer transportation options, and require assistance to access medical facilities. • The Disaster Mitigation Act of 2000 requires that communities continue to involve the public beyond the original planning process [201.6(c)(4)(iii)]. Developing public education and outreach strategies to raise awareness of the risk natural hazard pose will help to keep the public informed of, and involved in, awareness of natural hazards and potential mitigation activities the public can implement. Targeting vulnerable populations and organizations that help people with special needs will help to reduce the impact of a natural hazard event on these populations. • Public education and outreach can be inexpensive and can provide information that results in safer households, workplaces, and public areas. Some outreach materials include informational brochures about community seismic risks and mitigation techniques, public forums, newspaper articles, training classes and television advertisements. • Mitigation is a shared responsibility between local, state, and federal government; citizens; businesses; nonprofit organizations; and others. Informing the public of their role in a community's mitigation efforts not only increases the public's awareness of a community's hazard risks, but also helps a community reduce its risk to the hazards addressed by the NHMP. Targeting underserved communities and socially vulnerable populations and organizations that help such populations will also help to reduce the impact of a natural hazard event on these populations • The *2024 La Grande NHMP* survey found that the overall community comprehension of the risk was prevalent for certain hazards; however, community comprehension was limited with hazards that could significantly impact residents. The Steering Committee agreed that public education and outreach benefits the community and continuing as such with special attention to the lesser-known hazards that could significantly impact the community, including underserved communities and socially vulnerable populations.

Ideas for integration	• Develop and distribute Natural Hazard Community Resource Maps and risk reduction tips that include instructions about how to prepare and reduce risks posed by natural hazards. • Institute for Business and Home Safety (IBHS) offers materials that address winter storms, flooding, windstorms, wildfire and earthquake for homes and businesses. Encourage implementation of non-structural earthquake retrofits in homes, businesses, and medical and care facilities. (Distribute the IBHS Homeowners Guide to Non-structural Retrofit) • Research ways to create and disseminate a message that will cause people to act to reduce individual risk. Target education and outreach actions to reach underserved populations and socially vulnerable populations. • Bring emergency management and response training to community organizations, such as Head Start and Community Connections of Northeast Oregon. • Determine which media avenue is most effective for local outreach; online sites, social media, local TV and radio, mailings, posters, flyers, presentations by local officials, etc. • Create mailing packet and online literature that is hazard-specific and information on impacts of hazards, mitigation activities and preparedness. • Print and post online relevant hazard-related articles in local newspaper and other local publications with tips on mitigation actions. • Have informational brochures and packets available at identified partner's office locations and online. • Fire-wise brochures can be used in the spring to address wildfire. • Union County uses the Union County Safe Communities Coalition apparatuses to carry out education and outreach about various natural hazards to vulnerable populations.
Responsible Agency	City of La Grande
Partners	Relevant Public Health Departments, Island City, Eastern Oregon Head Start, Chambers of Commerce, American Red Cross, Oregon Education Association, Families First, Oregon Rural Action, OSU Extension Service, Eastern Oregon Medical Associates, Girl Scouts of the USA, Kayak, Community Connections of Northeast Oregon, Union County Safe Communities Coalition
Potential Funding	BRIC, EMPG, Oregon SPIRE, La Grande General Fund, Building and Planning Fees, La Grande GO Bond
Cost Estimate	**Timeline**
Low	Short-Term
Notes	Ongoing, revised action MH #4 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Multi-Hazard #5	Priority Status: 1 or High
Proposed Action Item	**Assist in maintaining and enhancing the local alert and warning system and emergency evacuation protocol. Specifically target underserved communities and socially vulnerable populations.**
Background/Issue	• **Applicable to the following hazards**: air quality, earthquake, flood (including dam failure), severe weather, volcanic event, and wildfire. • Community organizations that serve underserved communities and socially vulnerable populations are concerned with the transportation and services available to persons with special needs. • Northeast Oregon is projected to maintain a stable population over the next 20 years, but the average age of this region's population will increase. • Impacts, in terms of loss and the ability to recover, vary among population groups following a disaster. Historically, 80% of the disaster burden falls on the public. Of this number, a disproportionate burden is placed upon special needs groups, particularly minorities, and the poor. • Low-income populations may require additional assistance following a disaster because they may not have the savings to withstand economic setbacks, and if work is interrupted, housing, food, and necessities become a greater burden. Additionally, low-income households are more reliant upon public transportation, public food assistance, public housing, and other public programs, all which can be impacted in the event of a natural disaster. • The high percentage of elderly individuals require special consideration due to their sensitivities to heat and cold, their reliance upon transportation for medications, and their comparative difficulty in making home modifications that reduce risk to hazards. • Young people also represent a vulnerable segment of the population. Special consideration should be given to young populations and schools, where children spend much of their time, during the natural hazard mitigation process. Children are more vulnerable to heat and cold, have fewer transportation options, and require assistance to access medical facilities. • According to the American Red Cross and National Organization on Disability (NOD), natural hazards pose special problems for disabled residents, elderly, and special needs populations in hazard-prone areas. • The NOD/Harris Surveys found that people with disabilities are less prepared and, correspondingly, more anxious than our non-disabled counterparts. A 2004 N.O.D./Harris Survey of emergency managers across the country found a continued need to include people with disabilities in preparedness plans. • No current policy/procedure in place, but there are general and informal practices/protocols for underserved communities and socially vulnerable populations.
Ideas for integration	• Create a voluntary registration for underserved communities and socially vulnerable populations who may need emergency assistance in evacuating. • Reverse 911 was successfully implemented in neighboring Baker County and helped with the water disease crypto outbreak consider using this in other counties/cities
Responsible Agency	City of La Grande, Union County Emergency Management

Partners	Community Connections of Northeast Oregon, American Red Cross, Kayak, Assisted living facilities, public libraries, National Organization on Disability, Union County Safe Communities Coalition
Potential Funding	EMPG, Oregon SPIRE, La Grande General Fund
Cost Estimate	**Timeline**
Low	Ongoing
Notes	Ongoing, revised action MH #9 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Multi-Hazard #6	Priority Status: 3 or Low
Proposed Action Item	**Develop and maintain partnerships with local jurisdictions, and other regional and community entities to develop emergency management planning and community resilience.**
Background/Issue	• **Applicable to the following hazards**: air quality, drought, earthquake, flood (including dam failure), invasive species and insect pests, severe weather, volcanic event, and wildfire. • Engage faith communities, social service agencies, nonprofits and neighborhood associations in building community resilience. • Targeted communication/engagement can help ensure emergency preparedness/resiliency messaging is reaching the greatest number of people (including underserved communities and socially vulnerable populations) most impacted by natural hazards. Can help La Grande and partners collect critical feedback on concerns and needs in the community. • Age of buildings and hazard-readiness throughout the community • Lack of coordination between regional and community entities and the City of La Grande regarding hazard mitigation and response.
Ideas for integration	• Prepare response teams in La Grande for potential earthquake-induced hazardous material releases. • Evaluate the abilities of regional and community entities to respond to a variety of disasters and to accommodate its various resident's needs.
Responsible Agency	La Grande Community Development, Public Works, Fire and Police Departments
Partners	Eastern Oregon University, Island City, Union County Emergency Services, American Red Cross, private and public utilities, Internet Service Providers, ODOT, Community Connections of Northeast Oregon, Relevant Public Health Departments, Grande Ronde Hospital, Kayak, Union County Safe Communities Coalition
Potential Funding	BRIC, CDBG, CDBG-MIT, HMA, HOME Investments Partnership Program, Nonprofit Security Grant Program, RARE Program, Meyer Memorial Trust
Cost Estimate	**Timeline**
Low	Ongoing
Notes	Ongoing, revised action MH #11 from *2014 Northeast Oregon Regional NHMP* as an ongoing action. The previous action MH #11 was centered around Eastern Oregon University. The La Grande NHMP Steering Committee wanted to expand to include other public and private entities.

Multi-Hazard #7	Priority Status: 3 or Low
Proposed Action Item	**Secure funding to improve water supply and delivery systems within the Beaver Creek Watershed, La Grande's backup water supply.**
Background/Issue	• **Applicable to the following hazards**: drought, earthquake, and flood. • The City of La Grande is concerned about aquifer capacities, should growth continue. The amount of water within the Grande Ronde Valley is currently unknown. • The City of La Grande's water is supplied by wells. The Beaver Creek Watershed provides secondary backup, but it currently does not meet water quality standards.
Ideas for integration	• Seek funding to filter the City's backup water supply • Action is to be contingent upon an aquifer and/or groundwater study done for the Grande Ronde Valley
Responsible Agency	City of La Grande Public Works
Partners	City of La Grande Planning Department, Union County Water Master, Oregon Water Resources Department
Potential Funding	BRIC, CWSRF, WaterSMART, Emergency Watershed Protection (EWP), EPA Safe Drinking Water Act Resilience Grants, EPA Emergency Response for Drinking Water and Wastewater Utilities, EPA Funding for Water and Wastewater Utilities in National Disasters, Partners for Fish and Wildlife, La Grande Water and Sewer Fees
Cost Estimate	Timeline
Medium	Long-Term
Notes	Ongoing, revised action MH #16 (La Grande) from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Multi-Hazard #8	Priority Status: 3 or Low
Proposed Action Item	**Increase community resiliency to reduce and mitigate hazard-related power outages.**
Background/Issue	• **Applicable to the following hazards**: earthquake, severe weather, and wildfire. • This new action is focused on addressing power outages during severe weather events and other natural hazards where power outages may occur. • Support projects that increase redundancy and grid resilience. • The La Grande NHMP Steering Committee wishes to promote diversifying the sources of power in the city so that loss of electric service does not put people at risk.
Ideas for integration	• Develop and distribute risk reduction tips that include how to prepare and reduce risks posed by natural hazards. • Develop an incentive program to encourage community members to replace uncertified woodstoves with an EPA certified woodstove. • Research ways to create and disseminate a message that will cause people to act to reduce individual risk. Target education and outreach actions to reach underserved populations and socially vulnerable populations. • Develop and distribute outreach material via online sites, social media, local TV and radio, mailings, posters, flyers, and presentations. • Work with public and private utilities • Develop and implement a city ordinance requiring removal of an uncertified woodstove upon sale of a private property.
Responsible Agency	City of La Grande, Union County Emergency Management
Partners	City of La Grande Public Works, Island City, American Red Cross, Private and Public Utilities,
Potential Funding	HMGP, BRIC, STORM, GRIP, Oregon Dept. Human Services Grants and Supports for Emergency Shelter, Meyer Memorial Trust, La Grande General Fund, Building and Planning Fees, La Grande GO Bond, La Grande Urban Renewal Fund
Cost Estimate	**Timeline**
Low	Short-Term
Notes	New action

Multi-Hazard #9	Priority Status: 3 or Low
Proposed Action Item	**Identify and plan for a network of regional resilience hubs, indoor gathering places that can function as but not limited to community centers, warming and cooling centers, food distribution, places to access electricity during power outages, and evacuation sites.**
Background/Issue	• **Applicable to the following hazards**: air quality, drought, earthquake, flood (including dam failure), severe weather, volcanic event, and wildfire. • Planning and collaboration with agency/community partners can help to identify locations and potential operational needs for establishing facilities across the city where people can access vital services in times of emergency • Similar facilities include the Community Resource Center (Center for Human Development) and Union County Warming Shelter
Ideas for integration	• Union County purchased the former Riveria Elementary School with plans of developing it into some sort of community hub. Union County is still in the planning phases including identifying its future use and needed improvements.
Responsible Agency	City of La Grande, Union County Emergency Management
Partners	Relevant City and County Departments, Community Connections of Northeast Oregon, Center for Human Development, Union County Warming Station, La Grande School District, Northeast Oregon Regional Food Bank, Kayak, Northeast Oregon Public Transportation, DHS
Potential Funding	HMGP, BRIC, STORM, USDA Food and Nutrition Service Disaster Resources, EPA Wildfire Smoke Preparedness in Community Buildings Grant Program, Oregon Dept. Human Services Grants and Supports for Emergency Shelter, Oregon Resilience Hubs and Networks Grant, Meyer Memorial Trust, La Grande General Fund, Building and Planning Fees, La Grande GO Bond
Cost Estimate	Timeline
Medium	Long-Term
Notes	New action

Drought #1	Priority Status: 2 or Medium
Proposed Action Item	**Promote water conservation to protect potable water supply and reduce impacts during drought through existing conservation programs and plans, as well as any new identified initiatives.**
Background/Issue	• 1985-1997 was a dry period capped by statewide droughts in 1992 and 1994 (1992 drought emergency declaration). Negative externalities included forest fires and insect problems. • 2001: Baker, Union and Wallowa Counties were issued a declaration of a local drought emergency • 2003: Baker, Union, and Wallowa Counties were issued a declaration of a local drought emergency • 2007: Baker, Grant, Union, and Wallowa Counties were issued a declaration of a local drought emergency • The probability that Union County and La Grande will experience future droughts is high • A strong water conservation incentive program will help to raise public consciousness and participation in water saving habits and lifestyles. • Drought can affect all segments of a jurisdiction's population, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). 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 are also vulnerable. • Water-efficiency measures can reduce water and sewer costs by up to 30%. Significant savings in energy, chemical and maintenance expenses are also possible. Some general benefits of water conservation include energy savings (by using less energy for heating, pumping, and treating water), financial savings, less wastewater, and environmental benefits including increased water availability to local streams, wetlands, and the natural inhabitants of both environments. • The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that reduce the effects of a hazard on the community [201.6(c)(3)(ii)], such as actions protecting natural resources. Installing water efficient devices can significantly reduce the impact of drought by conserving the critical water resources in the community. • La Grande has water availability concerns.
Ideas for integration	• Create a water-conservation committee within interested counties and/or cities to develop incentive programs, educational programs, and voluntary and/or mandatory restrictions on water use. • Distribute conservation literature online and with the regular mailing of bills. Local service organizations can be asked to disseminate water conservation promotional information. • Investigate water pricing schemes (i.e., peak pricing and excess use charges) that discourage water use. • Initiate a water conservation program in high-use facilities such as schools and colleges, hospitals and institutions, involving a retrofit of existing plumbing fixtures with water saving models and the dissemination of water conservation literature. • Promote a campaign of household leak detection. Provide leak detection

	tips on billing cards. Distribute dye tablets to customers to encourage toilet leak checks. Direct meter readers to inform customers with unusually high recorded use to check for household water leaks. • Speak to local civic organizations (Boy Scouts, volunteer fire companies, etc.) on water conservation and suggest the sale of water-saving devices as a fund-raising activity. • Encourage the wise use and management of water during peak use summer periods by restricting lawn/garden watering to non-daylight hours. • The city should provide technical support; the relevant local electric companies should provide water efficiency apparatus (e.g., OTEC has water efficiency programs such as a water efficient shower head).
Responsible Agency	City of La Grande Public Works
Partners	Relevant Utility Companies, Island City, wastewater treatment facilities, US Environmental Protection Agency's WAVE program
Potential Funding	BRIC, WaterSMART, CWSRF, Emergency Watershed Protection (EWP), EPA Emergency Response for Drinking Water and Wastewater Utilities, EPA Funding for Water and Wastewater Utilities in National Disasters, Partners for Fish and Wildlife, La Grande General Fund,
Cost Estimate	**Timeline**
Low	Ongoing
Notes	Ongoing, revised action DR #2 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Drought #2	Priority Status: 3 or Low
Proposed Action Item	**Develop community drought contingency plan and policies, or similar.**
Background/Issue	• 1985-1997 was a dry period capped by statewide droughts in 1992 and 1994 (1992 drought emergency declaration). Negative externalities included forest fires and insect problems. • 2001: Baker, Union and Wallowa Counties were issued a declaration of a local drought emergency • 2003: Baker, Union, and Wallowa Counties were issued a declaration of a local drought emergency • 2007: Baker, Grant, Union, and Wallowa Counties were issued a declaration of a local drought emergency • The probability that Union County and La Grande will experience future droughts is high • Drought can affect all segments of a jurisdiction's population, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). 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 are also vulnerable. • The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that reduce the effects of hazards on the community [201.6(c)(3)(ii)], such as actions addressing emergency services. Developing community drought emergency plans and policies will help the community to prepare for future drought events and reduce any impact of a future drought. • La Grande has water availability concerns
Ideas for integration	• Review existing plans and look for improvement opportunities • Identify new and/or build upon existing emergency water supplies • Develop emergency water surcharge schedule rules • Adopt orders, rules and regulations for the purpose of implementing and enforcing the provisions of any Executive Orders issued pertaining to a drought emergency. • Impose restrictions upon the non-essential use of water, including the use of water conservation devices, as may be necessary. • Encourage cities without a water curtailment plan/and or drought emergency plan to produce one • Inform public of drought conditions via newspaper and/ or local radio advertisement • Develop education strategies regarding conservation for elementary school students
Responsible Agency	City of La Grande Public Works
Partners	Water Resources Departments, Island City, County and City Planning Departments, Public Works Departments, Natural Resources Conservation Service, Relevant Irrigation Districts, OSU Extension Service, US Department of Agriculture

Potential Funding	BRIC, WaterSMART, CWSRF, Emergency Watershed Protection (EWP), EPA Emergency Response for Drinking Water and Wastewater Utilities, EPA Funding for Water and Wastewater Utilities in National Disasters, Partners for Fish and Wildlife, La Grande General Fund, La Grande GO Bond, La Grande Water and Sewer Fees
Cost Estimate	**Timeline**
Medium	Long-Term
Notes	Ongoing, revised action DR #3 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Drought #3	Priority Status: 1 or High
Proposed Action Item	**Conduct an aquifer (groundwater) study for the Grande Ronde Valley**
Background/Issue	• Over-exploitation of aquifers may exceed the practical sustained yield in the future; • Unknown capacities within aquifers may limit future development. • 1985-1997: dry period capped by statewide droughts in 1992 and 1994 (1992 drought emergency declaration). Negative externalities included forest fires and insect problems. • 2001: Union County was issued a declaration of a local drought emergency • 2003: Union County was issued a declaration of a local drought emergency • 2007: Union County was issued a declaration of a local drought emergency • A better knowledge of the hydrodynamic conditions and characteristics of the groundwater is essential for the well-being of the population and the economic development of the region • Drought can affect all segments of a jurisdiction's population, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). 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 are also vulnerable. The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that reduce the effects of hazards on the community [201.6(c)(3)(ii)], such as actions protecting natural resources. Conducting an aquifer study will help determine the capacity of the Grande Ronde aquifer and help the county to plan for the effects of a potential drought. • The City of La Grande is concerned about aquifer capacities, should growth continue. The amount of water within the Grande Ronde Valley is currently unknown. • The City of La Grande's water is supplied by wells. The Beaver Creek Watershed provides secondary backup. • The Grande Ronde Model Watershed Council produced the Upper Grande Ronde River Watershed Storage Feasibility Study in 2013. The purpose of the study is to evaluate whether managed underground storage alternatives can be used for subsurface storage in the Grande Ronde River watershed. (Upper Grande Ronde River Watershed Storage Feasibility Study, 2013)

Ideas for integration	• The study is intended to do the following:
	  ○ Improve the understanding of hydrodynamic conditions
	  ○ Estimate recharge trends over past decades to study potential impacts of climate change.
	  ○ Evaluate the vulnerability of water supply
	  ○ Characterize the groundwater quality
	• Most issues related to groundwater management are handled by state agencies under the authority of state law. Communication for the aquifer study should begin with the Oregon Water Resources Department or other relevant state agencies.

Responsible Agency	Grande Ronde Model Watershed Council, Union County Commissioners
Partners	City of La Grande, Union County Planning Department, Union County Public Works, Union County Water Master, Oregon Department of Water Resources, United States Geological Survey
Potential Funding	BRIC, WaterSMART, CWSRF, USACOE Water Resources Projects for Small or Disadvantaged Communities, EPA Water Research Grants, Emergency Watershed Protection (EWP), EPA Emergency Response for Drinking Water and Wastewater Utilities, EPA Funding for Water and Wastewater Utilities in National Disasters, Partners for Fish and Wildlife, La Grande General Fund, La Grande Water and Sewer Fees, La Grande GO Bond
Cost Estimate	**Timeline**
Medium	Long-Term
Notes	Ongoing, revised action DR #5 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Earthquake #1	Priority Status: 3 or Low
Proposed Action Item	**Perform an earthquake risk evaluation in critical buildings not listed in the DOGAMI RVS report**
Background/Issue	• Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities, including schools. The Steering Committee identified a potentially vulnerable building not listed in the survey including La Grande City Hall. • Fuel and oil pipelines, as well as electricity, natural gas, telephone, internet, and cable companies are essential resources to residents. Infrastructural redundancy does not exist for any community. • Buildings, bridges, highways and utilities that are better able to withstand earthquakes not only save lives but also enable critical activities to continue with less disruption. • The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)]. Implementing structural and non-structural retrofitting programs will reduce the seismic vulnerability of public buildings, historically important structures, and critical facilities and infrastructure, and assist a community in reducing its overall earthquake risk
Ideas for integration	• Inventory existing facilities to determine future demands for maintenance, repair, rehabilitation or replacement; and to determine adequacy of existing facilities to meet future needs. • Identify historic structures that represent a significant cultural resource for the community, focusing especially on un-reinforced masonry buildings, and identify mitigation measures to protect them from natural hazards. • Provide both structural and non-structural retrofits to at risk buildings as required by the risk evaluations.
Responsible Agency	Union County Emergency Management, City of La Grande
Partners	Eastern Oregon University, Island City, Business Oregon, Relevant Utility Companies, DOGAMI
Potential Funding	HMGP, BRIC, RCPGP, SRGP, Community Facilities Program Disaster Repair Grants, La Grande Parks and Recreation SDCs, La Grande GO Bond, RARE Program, Meyer Memorial Trust
Cost Estimate	**Timeline**
Medium	Long-Term
Notes	Ongoing, revised action EQ #1 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Earthquake #2	Priority Status: 1 or High
Proposed Action Item	**Identify, inventory, and mitigate (as prioritization and resources allow) critical facilities and utilities that require seismic retrofit. Consider both structural and non-structural retrofit options.**
Background/Issue	• The La Grande NHMP Steering Committee noted that certain critical facilities have a high vulnerability for seismic events. Seismically retrofitting these facilities will significantly reduce their vulnerability in the event of an earthquake. • Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities, including schools. This assessment determined that the Union County Law Enforcement Facility has buildings with a very high collapse potential. The Union County Law Enforcement Facility houses 911 dispatch, La Grande Police, Union County Sheriff, Union County Jail, and Union County Emergency Operations Center. • Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (American Planning Advisory Service Report Number 483/484) • Union County has high vulnerability for seismic hazards. Retrofitting the Union County Law Enforcement Facility will significantly reduce the building's vulnerability to seismic hazards and improve the safety of employees and community members • The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6 (c)(3)(ii)]. Seismically retrofitting critical facilities will reduce its vulnerability and ensure the viability of this critical facility.
Ideas for integration	• Conduct a detailed structural evaluation that outlines recommendations for building deficiencies, and provides a cost estimate, incorporate DOGAMI's seismic assessment data to assist in retrofitting the Union County Law Enforcement Facility and other critical facilities • Conduct structural evaluation and make recommendations (structural and non-structural) for fix.
Responsible Agency	City of La Grande, Union County Emergency Management
Partners	Relevant City Departments, Island City, Business Oregon, La Grande School District, Eastern Oregon University, DOGAMI, OEM, FEMA, ODE
Potential Funding	HMGP, BRIC, SRGP, La Grande General Fund, La Grande Parks and Recreation SDCs, Building and Planning Fees, La Grande GO Bond
Cost Estimate	Timeline
High	Long-Term
Notes	New action created by revising actions EQ #17 from *2014 Northeast Oregon Regional NHMP.*

Earthquake #3	Priority Status: 3 or Low
Proposed Action Item	**Collaborate with the school district plans about the identification and prioritization of school district facility retrofits and upgrades.**
Background/Issue	• Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities, including schools. This assessment determined that Willow School (formerly Willow Elementary School) has two buildings with a very high collapse potential, La Grande High School has three buildings with a very high collapse potential, and Greenwood Elementary School has two buildings with a very high collapse potential. The La Grande NHMP Steering Committee identified the schools noted here as critical facilities. • Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (American Planning Advisory Service Report Number 483/484) • Union County has high vulnerability for seismic hazards. Retrofitting Willow School, La Grande High School, and Greenwood Elementary School will significantly reduce the school vulnerability to seismic hazards and improve the safety of students, teachers, and community members that use the school • The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6 (c)(3)(ii)]. Seismically retrofitting Willow School will reduce its vulnerability and ensure the viability of this critical facility.
Ideas for integration	• Complete a detailed structural evaluation that outlines recommendations for building deficiencies, and provides a cost estimate, incorporate DOGAMI's seismic assessment data to assist in retrofitting Willow School, La Grande High School, and Greenwood Elementary School. • Conduct structural evaluation and make recommendations (structural and non-structural) for fix • Align project with School District Maintenance Plan.
Responsible Agency	City of La Grande, Union County Emergency Management
Partners	La Grande School District, Relevant City Departments, Business Oregon, DOGAMI, OEM, FEMA, ODE
Potential Funding	HMGP, BRIC, SRGP, La Grande General Fund, Building and Planning Fees
Cost Estimate	**Timeline**
Low	Long-Term
Notes	New action created by combining actions EQ #18, #19, and #20 from the *2014 Northeast Oregon Regional NHMP*.

Flood #1	**Priority Status: 3 or Low**
Proposed Action Item	**Scope flood mitigation opportunities for homes and critical facilities subject to flooding.**
Background/Issue	• The City of La Grande was affected by a flood in 2011, which did not occur in the flood plain. Debris in streams from homes and landscaping were the primary reasons for the flood. La Grande is prone to flash floods. • Flooding is a potential hazard for many of the region's water treatment facilities. The City of La Grande's wastewater treatment facility is in the Ladd Creek watershed. • There is concern about a potential dam failure on the Morgan Lake Dam. • The Disaster Mitigation Act of 2000 requires communities to identify mitigation actions that address existing buildings and infrastructure [201.6(c)(3)(ii)]. Exploring flood mitigation opportunities for homes will reduce the effect of a flood hazard on the community and help to protect existing buildings from natural hazard events. Eliminating or limiting development in hazard prone areas, such as floodplains, can reduce vulnerability to hazards
Ideas for integration	• Assess flooding hazards within each county to determine where mitigation efforts are most needed. Identify suitable mitigation projects for each scenario. • Develop acquisition and management strategies to preserve parks, trails, and open space in the floodplain • Elevate repeat-loss properties at the head of Wallowa Lake • Identify water and wastewater treatment facilities that need flood-proofing (mechanical or structural fixes). • Assess each plant's necessity for retrofit, identifying those that could benefit from immediate help. • Implement mechanical and structural fixes during planned upgrades/expansions. Possibly elevate properties. • Seek qualification for the Flood Mitigation Assistance Program (FMA). Identify the number of buildings and/or structures in the floodplain. • Explore multi-objective stream enhancement projects. • Seek Silver Jackets assistance in completion of mitigation projects
Responsible Agency	La Grande Community Development Department
Partners	Union County, Island City, City of La Grande Public Works, FEMA, ACOE, ODFW, DSL, ODOT
Potential Funding	FMA, BRIC, DLCD Technical Assistance Grant, DLCD Community Grant, La Grande General Fund, La Grande Parks and Recreation SDCs, Building and Planning Fees
Cost Estimate	**Timeline**
Low	Ongoing
Notes	Ongoing, revised action FL #1 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Flood #2	**Priority Status: 3 or Low**
Proposed Action Item	**Scope the costs and benefits for participation in the NFIP's Community Rating System.**
Background/Issue	• The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, insurance premiums under the NFIP are discounted to reflect the reduced flood risk resulting from the community actions. • CRS rewards communities that undertake floodplain activities beyond the requirements of the NFIP. The CRS is a point system program that reduces flood insurance premiums for the citizens of the participating communities. • The current amount insurance in force for each county is a substantial amount of money. Participating in the CRS program could reduce this amount. • The Disaster Mitigation Act of 2000 requires communities to identify mitigation actions that address existing buildings and infrastructure [201.6(c)(3)(ii)]. Improving the CRS ratings for communities in Northeast Oregon helps decrease vulnerability to floods.
Ideas for integration	• Assess current community activities to determine whether the city or county is already eligible to apply for a CRS classification better than 10. • Determine the CRS classification your community would like to obtain and take steps towards reaching that goal. • Work towards obtaining higher CRS class ratings (1 being the highest rating obtainable; 10 being a non-participating community). Activities that reduce flood insurance premiums fall under four categories: Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness. • Seek Silver Jackets assistance for CRS credit completion
Responsible Agency	City of La Grande Community Development Department
Partners	Union County Emergency Management, City of La Grande Public Works, Silver Jackets, FEMA, DLCD
Potential Funding	La Grande General Fund, Building and Planning Fees
Cost Estimate	**Timeline**
Low	Short-Term
Notes	Ongoing, revised action FL #2 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Flood #3	Priority Status: 3 or Low
Proposed Action Item	**Increase awareness concerning the NFIP program.**
Background/Issue	• The market penetration of flood insurance is low within Union County and La Grande, participants in this NHMP. • The Disaster Mitigation Act of 2000 requires communities to include a process for continued public involvement in the maintenance of the plan [201.6(c)(4)(iii)]. Increasing public awareness of the National Flood Insurance Program (NFIP) will allow continued public involvement and will inform residents and businesses of the benefits of the NFIP program and how the NFIP can protect their property. • The Biggert Waters Flood Insurance Reform Act of 2012 removed subsidized rates (pre-FIRM rates) on October 1st, 2013, for the following classes of structures and allows rates to increase by 25% per year until actuarial rates are achieved: ○ Any residential property that is not the primary residence of an individual ○ Any severe repetitive loss property ○ Any property that has incurred flood related damages that cumulatively exceed the fair market value of the property ○ Any business property ○ Any property that after the date of the Bill has incurred substantial damage or has experienced "substantial improvement exceeding 30% of the fair market value of the property. ○ Any new policy for which the owner has refused a FEMA mitigation offer under HMGP, or for a repetitive loss property or severe repetitive loss property. (Summary of Biggert-Waters Flood Insurance Reform Act of 2012)
Ideas for integration	• Distribute information to current and future homeowners/renters in flood-prone areas. • Communicate information regarding the Biggert-Waters Flood Insurance Reform Act of 2012 and its implications on (pre-FIRM) NFIP properties. Communicate these changes to NFIP insured property owners, prospective buyers, surveyors, real-estate agents, and the public at large. Seek assistance from the state flood plain manager. • Increase awareness for current homeowners and prospective buyers of property about floodplain issues on their property and actions they can implement to mitigate the impacts of a flood
Responsible Agency	City of La Grande Community Development Department
Partners	Union County Emergency Management, Island City, NFIP Floodplain Coordinator (DLCD), insurers, realtors, FEMA, OSU Extension Service, Eastern Oregon Medical Associates, Girl Scouts of the USA, Community Connections of Northeast Oregon (Any community organizations capable of distributing information), ACOE
Potential Funding	La Grande General Fund, Building and Planning Fees
Cost Estimate	**Timeline**
Low	Short-Term
Notes	Ongoing, revised action FL #3 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Flood #4	**Priority Status: 3 or Low**
Proposed Action Item	**Update and maintain the local FEMA Flood Insurance Rate Maps.**
Background/Issue	• Flood Mitigation Assistance funds require that the plan describe the community's vulnerability to flood in terms of the types and numbers of existing buildings (including repetitive loss structures), infrastructure, and critical facilities located in the identified hazard areas. • Currently, communities in Northeast Oregon are only able to identify the number of NFIP claims that have been made since FIRM adoption. • Like many locations in Eastern Oregon, FEMA has not updated the Flood Insurance Rate Maps (FIRMS). Due to their age, and technology used to create them, the maps may not accurately represent present flood conditions. Additionally, some maps are not digital. • City of La Grande is in the process of updating their flood plain maps, with an intention to identify and define the 100-year regulatory floodplain boundaries using modern technology more accurately.
Ideas for integration	• Hire a person to physically count the number of buildings and/or structures in the floodplain. Assess the types and numbers of existing buildings (including repetitive loss structures), infrastructure, and critical facilities located in the identified flood hazard areas. • Update the Flood Insurance Rate Maps. Collect topological maps, road maps, base elevation data and a description of at-risk populations/structures. La Grande is currently in the process of updating their maps. • Convert then updated maps to digital maps. Using GIS, overlay digital FIRM maps against current property maps. Count and document the number of structures lying within the floodplain. • Determine the locations of flood-prone areas not identified by the FIRMs.
Responsible Agency	City of La Grande Community Development Department
Partners	Union County, City of La Grande Public Works, ACOE, DOGAMI, DAS-GEO, elected officials
Potential Funding	BRIC, FMA, La Grande General Fund, Building and Planning Fees
Cost Estimate	**Timeline**
Medium	Long-Term
Notes	Progressing and ongoing, revised action FL #4 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

Flood #5	Priority Status: 1 or High
Proposed Action Item	**Implement recommended action items created in the Morgan Lake Study. This includes modifying the dam or its potential breach flow path so that any breach does not flow down Deal Canyon as an extremely rapid debris flood though most of the City of La Grande**
Background/Issue	• A study conducted by La Grande Parks and Recreation Director has been conducted and includes mitigation actions to improve the resilience of La Grande from a Morgan Lake flood event. • As a result of the heavy rains during the latter part of May 2011, the small saddle dam on the west side of Morgan Lake began to seep. The Parks Director at the time implemented temporary measures to stabilize the dam. • The CalPac Company constructed the dam in 1903 for electricity generation.
Ideas for integration	• Include people who created the Morgan Lake Study at semi-annual meetings. • Incorporate Morgan Lake Study identified action items into the project prioritization process. • Mitigation Goal: Modify the dam or its potential breach flow path so that any breach does not flow down Deal Canyon as an extremely rapid debris flood though most of the City of La Grande • Alternatives include: ○ Alternative 1: Construct a flow redirection berm and trench. There is a preliminary design for this work, and inundation analysis of the existing and proposed work. This alternative will be ready for construction by the end of 2023. Cost: $1,200,000.00 ○ Alternative 2: Remove the dam. This option is not ready. Cost: $1,200,000.00 ○ Alternative 3: Rebuild a new dam after removal. This option is not ready. Cost $7,500,000.00 ○ Alternative 4: Continue current level of maintenance and operation There is no change in costs for this option • Mitigation Action and Implementation: ○ Alternative 1: Construct a flow redirection berm and trench. There is a preliminary design for this work, and inundation analysis of the existing and proposed work. ○ Timeframe: as soon as summer 2024 if easement acquired and funding available ○ Steps: 1) Acquire easement, 2) Finish design, 3) Determine if permits are needed, 4) Construct berm
Responsible Agency	City of La Grande Public Works Director
Partners	City of La Grande Parks and Recreation Department, Union County Emergency Management, Silver Jackets, USACE, FEMA,
Potential Funding	FEMA Rehabilitation of High Hazard Potential Dam Grant Program, Dam Emergencies CTA Program, HMA, BRIC, La Grande Parks and Recreation SDCs, La Grande General Fund, La Grande Go Bond
Cost Estimate	**Timeline**
High	Short-Term
Notes	Progressing, revised action FL #7 (La Grande) from *2014 Northeast Oregon Regional NHMP* as a progressing action and incorporated HHPD information.

Invasive Species/Pests #1	Priority Status: 2 or Medium
Proposed Action Item	**Support efforts to control insect pests of timber species**
Background/Issue	• This new action is focused on addressing insect pests, in particular the Emerald Ash Borer (EAB). • The La Grande NHMP Steering Committee wishes to promote community awareness of the impacts that EAB and other insect pests can have on an area. • EAB was detected in Oregon on June 30, 2022, in Forest Grove. • City of La Grande has extensive ash tree population in its urban forest. • According to ODF, "Oregon ash occurs on both lands zoned for forestry and for agriculture. Oregon ash is widely used for stream restoration plantings due to its ability to stabilize soil, control sediment, and moderate stream temperatures. It is assumed that widespread death of Oregon ash will lead to ecological changes in water quality, stream temperatures and riparian plant communities." • Other susceptible EAB hosts in Oregon include common landscape ash species: green, white, narrow-leafed, and European ash. EAB is also known to feed on botanical relatives of ash.
Ideas for integration	• Develop and distribute education and awareness information via online sites, social media, local TV and radio, mailings, posters, flyers, and presentations. • Enforce pest control standards identified in La Grande's Community Forestry Ordinance. • To protect the region and state from new pests, encourage the purchase of locally sourced nursery stock and do not move firewood, which could contain tree-killing insects and diseases. • Encourage firewood gatherers and producers should cover fresh-cut ash trees or kiln-dry wood (most effective method for killing EAB is 60 min at 140°F). • Cities and homeowners should start planning now for replacement tree species used in restoration projects, street tree programs and other urban landscapes while choosing native and climate-adapted tree species above others. • Establish or encourage a community-based monitoring plan by using existing monitoring programs.
Responsible Agency	City of La Grande, ODF
Partners	OSU Extension Service, ODA, USFS, USDA
Potential Funding	USFS State and Private Forestry Program, USDA Plant Pest and Disease Management and Disaster Prevention Program
Cost Estimate	**Timeline**
Low	Short-Term
Notes	New action

Invasive Species/Pests #2	**Priority Status: 3 or Low**
Proposed Action Item	**Increase awareness concerning invasive species and insect pests.**
Background/Issue	• This new action is focused on addressing invasive species and insect pests. • The La Grande NHMP Steering Committee wishes to promote community awareness of the impacts invasive species and insect pests can have on an area.
Ideas for integration	• Develop and distribute education and awareness information via online sites, social media, local TV and radio, mailings, posters, flyers, and presentations. • Encourage community awareness of the Union County designated list of priority noxious weeds, weeds of economic importance, and weeds of economic importance within agricultural areas. • Support the Union County Weed Board and Tri-County Cooperative Weed Management Area and other agencies.
Responsible Agency	City of La Grande
Partners	OSU Extension Service, Union County Weed Board, Tri-County Cooperative Weed Management Area, ODF, ODA, USFS, USDA
Potential Funding	USDA Plant Pest and Disease Management and Disaster Prevention Program, La Grande General Fund, La Grande Parks and Recreation SDCs
Cost Estimate	**Timeline**
Low	Short-Term
Notes	New action

Wildfire #1	Priority Status: 2 or Medium
Proposed Action Item	**Assist with the planning and implementation of the actions identified in the Union County Community Wildfire Protection Plan.**
Background/Issue	• The Disaster Mitigation Act of 2000 requires that mitigation plans provide a comprehensive range of actions and projects to mitigate against natural hazards [201.6(c)(3)(ii)], such as actions that protect natural resources. Encouraging the implementation of existing action items with the Counties' Community Wildfire Protection Plans will help to ensure that wildfire mitigation remains a cooperative priority in Northeast Oregon • The Union County CWPP developed extensive risk assessments and identified mitigation actions. The CWPP should be considered as a supplement to the Wildfire section of this NHMP as it contains accurate, updated and extensive information about the vulnerability, risk, and mitigation actions than this NHMP. • Union County is in the process of updating their CWPP (contract completion date of May 2024). • Action items included within the CWPPs should be referred to and coordinated as a component of this NHMP
Ideas for integration	• Include persons who created and/or maintain the CWPP at semi-annual meetings. Incorporate CWPP actions into the project prioritization process.
Responsible Agency	La Grande NHMP Steering Committee Convener
Partners	Union County Emergency Management, Local Public Safety Coordinating Council (LPSCC), City of La Grande Fire Department, OSU Extension Service, USFS, Union Soil and Water Conservation District, Homeowners in Wildland/Urban Interface zones, ODFW, ODF, BLM,
Potential Funding	La Grande General Fund, La Grande Parks and Recreation SDCs
Cost Estimate	**Timeline**
Low	Ongoing
Notes	Ongoing, revised action WF #1 from *2014 Northeast Oregon Regional NHMP* as an ongoing action.

8.2 Economic Analysis of Natural Hazard Mitigation Projects

This appendix was originally developed by the Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Community Service Center (now the Institute for Policy Research and Engagement or IPRE) and included many of the NHMPs that OPDR/IPRE did with local jurisdictions. It has been reviewed and accepted by the Federal Emergency Management Agency (FEMA) as a means of documenting how the prioritization of actions shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

The appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects.

- Benefit/Cost Analysis
- Cost-Effective Analysis
- STAPLE/E Approach

The appendix describes the importance of implementing mitigation actions, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies.

Information in this section is derived in part from the Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon Department of Emergency Management, 2000), and FEMA Publication 331, *Report on Costs and Benefits of Natural Hazard Mitigation*. This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how an economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation actions reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs. Evaluating possible natural hazard mitigation actions provides decision-makers with an understanding of the potential benefits and costs, as well as a basis upon which to compare alternative projects.

Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables such as these three.

- Natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, law enforcement, utilities, and schools.
- While some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars.
- Many of the impacts of such events produce "ripple-effects" throughout the community, increasing the disaster's social and economic consequences.

While not easily accomplished, there is value from a public policy perspective in assessing the positive and negative impacts from mitigation actions and obtaining an instructive benefit/cost comparison.

Mitigation Strategy Economic Analyses Approaches

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into three general categories: benefit/cost analysis, cost-effectiveness analysis and the STAPLE/E approach.

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by OEM, FEMA, and other state and federal agencies in evaluating hazard mitigation projects and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

Benefit/cost analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation action. A benefit/cost analysis for a mitigation action can assist communities in determining whether a project is worth undertaking now, to avoid disaster-related damages later.

Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoiding future damage, and risk. In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented. A project must have a benefit/cost ratio greater than 1 (the net benefits will exceed the net costs) to be eligible for FEMA funding.

Cost-Effectiveness Analysis

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

Investing in Public Sector Mitigation Actions

Evaluating mitigation strategies in the public sector is complicated because it involves estimating all the economic benefits and costs regardless of who realizes them, and potentially to many people and economic entities. Some benefits cannot be evaluated monetarily, but still affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions which involve a diverse set of beneficiaries and non-market benefits.

Investing in Private Sector Mitigation Actions

Private sector mitigation projects may occur based on one or two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether a private entity or a public agency, required to conform to a mandated standard may consider the following options:

- Request cost sharing from public agencies;
- Dispose of the building or land either by sale or demolition;
- Change the designated use of the building or land and change the hazard mitigation compliance requirement; or

- Evaluate the most feasible alternatives and initiate the most cost-effective hazard mitigation alternative.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to prospective purchases. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of a sale regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

STAPLE/E Approach

Considering detailed benefit/cost or cost-effectiveness analysis for every possible mitigation action could be very time consuming and impractical. There are some alternate approaches for conducting a quick evaluation of the proposed mitigation actions which could be used to identify those mitigation actions that merit more detailed assessment. One of those methods is the STAPLE/E approach.

Using STAPLE/E criteria, mitigation actions can be evaluated quickly by steering committees in a synthetic fashion. This set of criteria requires the committee to assess the mitigation actions based on the Social, Technical, Administrative, Political, Legal, Economic and Environmental (STAPLE/E) constraints and opportunities of implementing the particular mitigation item in your community.

The second chapter in FEMA's *How-To Guide Developing the Mitigation Plan – Identifying Mitigation Actions and Implementation Strategies* as well as the *State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process* outline some specific considerations in analyzing each aspect. The following are suggestions for how to examine each aspect of the STAPLE/E approach from the S*tate of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process.*

Social: Community development staff, local nonprofit organizations, or a local planning board can help answer these questions.

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- Will the action cause social disruption?

Technical: The city or county public works staff and building department staff can help answer these questions.

- Will the proposed action work?
- Will it create more problems than it solves?
- Does it solve a problem or only a symptom?
- Is it the most useful action considering other community goals?

Administrative: Elected officials or the city or county administrator can help answer these questions.

- Can the community implement the action?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political: Consult the mayor, city council or city board of commissioners, city or county administrator, and local planning commissions to help answer these questions.

- Is the action politically acceptable?
- Is there public support both to implement and to maintain the project?

Legal: Include legal counsel, land use planners, risk managers, and city council or county planning commission members, among others, in this discussion.

- Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
- Are there legal side effects? Could the activity be construed as a taking?
- Is the proposed action allowed by the comprehensive plan, or must the comprehensive plan be amended to allow the proposed action?
- Will the community be liable for action or lack of action?
- Will the activity be challenged?

Economic: Community economic development staff, civil engineers, building department staff, and the assessor's office can help answer these questions.

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs considered?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, nonprofit, and private?)
- How will this action affect the fiscal capability of the community?
- What burden will this action place on the tax base or local economy?
- What are the budget and revenue effects of this activity?
- Does the action contribute to other community goals, such as capital improvements or economic development?
- What benefits will the action provide? (This can include dollar amount of damages prevented, number of homes protected, credit under the CRS, potential for funding under the HMGP or the FMA program, etc.)

Environmental: Watershed councils, environmental groups, land use planners and natural resource managers can help answer these questions.

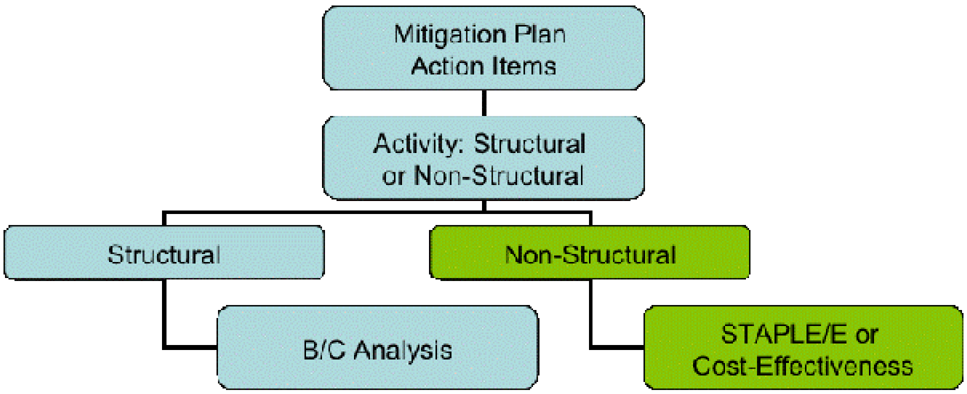
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

The STAPLE/E approach is helpful for doing a quick analysis of mitigation projects. Most projects that seek federal funding and others often require more detailed benefit/cost analyses.

When to use the Various Approaches

It is important to realize that various funding sources require different types of economic analyses. The following figure serves as a guideline for when to use the various approaches.

Figure 8-1. Economic Analysis Flowchart



Source: Oregon Partnership for Disaster Resilience, 2005

Implementing the Approaches

Below is a framework that could be used in further analyzing the feasibility of implementing prioritized actions after determining – using one of the economic analysis approaches described above – whether to implement the mitigation action.

1. Identify the Actions

Actions for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation projects can assist in minimizing risk to natural hazards but do so at varying economic costs.

2. Calculate the Costs and Benefits

Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate actions. Potential economic criteria to evaluate alternatives include:

- ***Determine the project cost***. This may include initial project development costs, and repair and operating costs of maintaining projects over time.
- ***Estimate the benefits***. Projecting the benefits, or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment. This is difficult to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing

alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.

- ***Consider costs and benefits to society and the environment***. These are not easily measured but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.
- ***Determine the correct discount rate***. Determination of the discount rate can just be the risk-free cost of capital, but it may include the decision maker's time preference

3. Analyze and Rank the Actions

Once costs and benefits have been quantified, economic analysis tools can rank the possible mitigation actions. Two methods for determining the best actions given varying costs and benefits include net present value and internal rate of return.

- ***Net present value***. Net present value is the value of the expected future returns of an investment minus the value of the expected future cost expressed in today's dollars. If the net present value is greater than the projected costs, the project may be determined feasible for implementation. Selecting the discount rate and identifying the present and future costs and benefits of the project calculates the net present value of projects.
- ***Internal rate of return***. Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the internal rate of return is greater than the total costs of the project. Once the mitigation projects are ranked based on economic criteria, decision-makers can consider other factors, such as risk, project effectiveness, and economic, environmental, and social returns in choosing the appropriate project for implementation.

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to buildings or landowners because of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of mitigation should consider reductions in physical damages and financial losses. A partial list follows:

- Building damages avoided
- Content damages avoided
- Inventory damages avoided
- Rental income losses avoided
- Relocation and disruption expenses avoided
- Proprietor's income losses avoided

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change because of a large natural disaster. These are usually termed “indirect” effects, but they can have a very direct effect on the economic value of the owner’s building or land. They can be positive or negative, and include changes in the following:

- Commodity and resource prices
- Availability of resource supplies
- Commodity and resource demand changes
- Building and land values
- Capital availability and interest rates
- Availability of labor
- Economic structure
- Infrastructure
- Regional exports and imports
- Local, state, and national regulations and policies
- Insurance availability and rates

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate the total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters to calculate the benefits of a mitigation action. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation actions.

Additional Considerations

Conducting an economic analysis for potential mitigation actions can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation actions.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. Opportunity arises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

Resources

These items support the development and funding of hazard mitigation actions:

Federal Emergency Management Agency. (2007, March). *Appendix D: Determining Cost Effectiveness*; From FEMA Publication 551, *Selecting Appropriate Mitigation Measures for Floodprone Structures*. Available at https://www.fema.gov/sites/default/files/2020-08/fema_551.pdf

Federal Emergency Management Agency. (2017, January). Benefit Cost Toolkit Version 6.0 Available at https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis

Federal Emergency Management Agency. (2019, February). *Fact Sheet Public Assistance Management Costs Interim Policy*. Available at https://www.fema.gov/sites/default/files/2020-07/fema_DRRA-1215-management-costs-public-assistance-fact-sheet.pdf

Federal Emergency Management Agency. (2023, March). *Hazard Mitigation Assistance Program and Policy Guide*. Available at https://www.fema.gov/sites/default/files/documents/fema_hma-program-policy-guide_032023.pdf

Goettel, K. (2016, November). *Benefit-Cost Analysis of the Proposed Seismic Retrofit Ordinanc*e. Goettel and Associates for the City of Portland, Oregon.

Lehman, D. and S. Loper. (1996). *Report on the Costs and Benefits of Natural Hazards Mitigation*. Prepared by Woodward-Clyde Federal Services for FEMA. Available at https://www.fema.gov/media-library-data/20130726-1511-20490-6222/haz_cost.pdf

Rose, A., K. Porter, N. Dash, J. Bouabid, et al. (2007). Benefit-Cost Analysis of FEMA Hazard Mitigation Grants. Natural Hazards Review. 8. 97-111. 10.1061/(ASCE)1527-6988(2007)8:4(97). https://www.researchgate.net/publication/4729207_Benefit-Cost_Analysis_of_FEMA_Hazard_Mitigation_Grants. Accessed January 23, 2020.

VSP Associates, Inc., A Benefit/Cost Model for the Seismic Rehabilitation of Buildings, Volumes 1 & 2, Federal Emergency management Agency, FEMA Publication Numbers 227 and 228, 1991. https://www.fema.gov/media-library/assets/documents/96200.

8.3 Grant Programs and Resources

Introduction

There are numerous local, state, and federal funding sources available to support natural hazard mitigation projects and planning. The following section includes a list of common funding sources utilized by local jurisdictions in Oregon. Because grant programs often change, it is important to periodically review available funding sources for current guidelines and program descriptions.

Grant Programs and Resources

Federal: Pre-/Post-Disaster

Building Resilient Infrastructure and Communities (BRIC) Grant Program, FEMA

https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

The BRIC Grant Program provides funds to states, territories, tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. BRIC grants are available on an annual basis. Applicants need to submit a letter of interest to the State Hazard Mitigation Officer, annually in September. FEMA administers the grant.

Climate Resilience Regional Challenge, NOAA

https://coast.noaa.gov/funding/ira/resilience-challenge/

Approximately $575 million will be available for projects that build the resilience of coastal communities to extreme weather (e.g., hurricanes and storm surge) and other impacts of climate change (e.g., sea level rise, drought). Funding is made possible by the Inflation Reduction Act, a historic, federal government-wide investment that is advancing NOAA’s efforts to build Climate-Ready Coasts. This new, competitive grant program provides the opportunity to collaboratively implement transformational regional projects that build immediate and long-term resilience in coastal areas.

Community Development Block Grant (CDBG) Program

https://www.hud.gov/program_offices/comm_planning/cdbg-dr

The CDBG Program, administered by HUD, promotes viable communities by providing decent housing, quality living environments, and economic opportunities, especially for low- and moderate-income persons. Eligible activities most relevant to natural hazards mitigation include acquisition of property for public purposes, construction/reconstruction of public infrastructure, and community planning activities. Under special circumstances, CDBG funds also can be used to meet urgent community development needs arising in the last 18 months which pose immediate threats to health and welfare. Grants are awarded based on specific projects as they are identified.

Community Development Block Grant Mitigation Program (CDBG-MIT)

https://www.hud.gov/program_offices/comm_planning/cdbg-dr/cdbg-mit

The CDBG-MIT Program funds pose a unique opportunity for eligible grantees to use this assistance in areas impacted by recent disasters to carry out strategic and high-impact activities to mitigate disaster risks and reduce future losses. The CDBG-MIT defines mitigation as activities that increase resilience to disasters and reduce or eliminate the long-term risk of loss of life, injury, damage to and loss of property, and suffering and hardship by lessening the impact of future disasters. CDBG-MIT activities should align with other federal programs that address hazard mitigation to create a more cohesive effort at the federal, state, and local level.

Dam Emergencies Collaborative Technical Assistance (CTA) Program, FEMA

https://www.fema.gov/emergency-managers/risk-management/dam-safety/technical-assistance

FEMA is offering a Collaborative Technical Assistance (CTA) series to help communities at risk of dam-related flooding to better understand their risk landscape and the potential consequences of dam-related emergencies. The CTA will include planning for emergencies related to operational discharges or dam-related infrastructure failure.

Disaster Loan Assistance, SBA

http://www.sba.gov/category/navigation-structure/loans-grants/small-business-loans/disaster-loans

There are four types of loans available from the U.S. Small Business Administration (SBA): home and personal property loans; business physical disaster loans; economic injury loans; and military reservist injury loans. When physical disaster loans are made to homeowners and businesses following disaster declarations by the SBA, up to 20% of the loan amount can go towards specific measures taken to protect against recurring damage in similar future disasters.

Disaster Resources, HUD

https://www.hud.gov/disaster_resources

The U.S. Department of Housing and Urban Development (HUD) provides a variety of disaster resources listed below. We also partner with Federal and state agencies to help implement disaster recovery assistance. Under the National Response Framework, FEMA and the Small Business Administration (SBA) offer initial recovery assistance.

Emergency Management Performance Grants (EMPG), FEMA

https://www.fema.gov/grants/preparedness/emergency-management-performance

Emergency Management Performance Grant program helps state and local governments to sustain and enhance their all-hazards emergency management programs.

Flood Mitigation Assistance (FMA) Program, FEMA

http://www.fema.gov/flood-mitigation-assistance-program

The overall goal of the FMA Program is to fund cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other National Flood Insurance Program (NFIP) insurable structures. This specifically includes:

- Reducing the number of repetitively or substantially damaged structures and the associated flood insurance claims;
- Encouraging long-term, comprehensive hazard mitigation planning;
- Responding to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development activities; and
- Complementing other federal and state mitigation programs with similar, long-term mitigation goals.

Food and Nutrition Service (FNS) Disaster Resources, USDA

https://www.fns.usda.gov/disaster/disaster-assistance

The FNS coordinates with state, local, and voluntary organizations to provide nutrition assistance to those most affected by a disaster or emergency. USDA Foods are currently stored in every state and U.S. territory and may be used by state agencies or local disaster relief organizations to provide food to shelters or people who are sheltering in place. If retail food stores are operating in the impacted area, state agencies may request to operate a Disaster Supplemental Nutrition Assistance Program (D-SNAP).

Grid Resilience and Innovation Partnerships (GRIP) Program, U.S. Department of Energy

https://www.energy.gov/gdo/grid-resilience-and-innovation-partnerships-grip-program

The U.S. Department of Energy's Grid Deployment Office is administering a $10.5 billion Grid Resilience and Innovation Partnerships (GRIP) Program to enhance grid flexibility and improve the resilience of the power system against growing threats of extreme weather and climate change. The programs will help accelerate the deployment of transformative projects that will ensure the reliability of the power sector's infrastructure, so all American communities have access to affordable, reliable, clean electricity anytime, anywhere. The program includes three funding mechanisms: Grid Resilience Utility and Industry Grants, Smart Grid Grants, and Grid Innovation Program.

Hazard Mitigation Assistance (HMA), FEMA

https://www.fema.gov/grants/mitigation

Detailed program and application information for federal disaster and non-disaster programs can be found in the Hazard Mitigation Assistance Program and Policy Guide, dated March 23, 2023, note that guidance regularly changes. Verify that you have the most recent edition. Flood mitigation assistance is usually offered annually; applications are submitted online. Applicants need a user profile approved by the State Hazard Mitigation Officer (SHMO), which should be garnered well before the application period opens.

For Oregon Department of Emergency Management (OEM) grant guidance on Federal Hazard Mitigation Assistance, visit: https://www.oregon.gov/OEM/emresources/Grants/Pages/HMA.aspx

Contact: Anna Feigum, State Hazard Mitigation Officer (SHMO), anna.r.feigum@oem.oregon.gov

Hazard Mitigation Grant Program (HMGP), FEMA

https://www.fema.gov/grants/mitigation/hazard-mitigation

The HMGP provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP involves a paper application which is first offered to the counties with presidentially declared disasters within the past year, then becomes available statewide if funding is still available. FEMA administers the grant.

HOME Investments Partnerships Program (IPP), HUD

https://www.hud.gov/program_offices/comm_planning/home

The HOME IPP provides grants to states, local government and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons.

National Dam Safety Program (NDSP) State Assistance Grant Program, FEMA

https://www.fema.gov/emergency-managers/risk-management/dam-safety/grants

The primary purpose of the NDSP State Assistance Grant Program is to provide financial assistance to the states for strengthening their dam safety programs. The states use NDSP funds for the following types of activities:

- Dam safety training for state personnel
- Increase in the number of dam inspections
- Increase in the submittal and testing of Emergency Action Plans
- More timely review and issuance of permits
- Improved coordination with state emergency preparedness officials
- Identification of dams to be repaired or removed
- Conduct dam safety awareness workshops and creation of dam safety videos and other outreach materials

National Estuary Program Watersheds Grant, Restore America's Estuaries

Restore America's Estuaries, in close coordination with and financial support from EPA, administers the National Estuaries Program (NEP) Watersheds Grants. This grant program funds projects within one or more of the NEP boundary areas and supports the following Congressionally set priorities:

- Loss of key habitats resulting in significant impacts on fisheries and water quality such as seagrass, mangroves, tidal and freshwater wetlands, forested wetlands, kelp beds, shellfish beds, and coral reefs;
- Coastal resilience and extreme weather events including flooding and coastal erosion related to sea level rise, changing precipitation, warmer waters, or salt marsh, seagrass, or wetland degradation or loss and accelerated land loss;

- Impacts of nutrients and warmer water temperatures on aquatic life and ecosystems, including low dissolved oxygen conditions in estuarine waters;
- Stormwater runoff which not only can erode stream banks but can carry nutrients, sediment, and trash into rivers and streams that flow into estuaries;
- Recurring harmful algae blooms;
- Unusual or unexplained marine mammal mortalities; and
- Proliferation or invasion of species that limit recreational uses, threaten wastewater systems, or cause other ecosystem damage.

Neighborhood Stabilization Program (NSP), HUD

https://www.hud.gov/program_offices/comm_planning/nsp

The NSP was established for the purpose of providing emergency assistance to stabilize communities with high rates of abandoned and foreclosed homes, and to assist households whose annual incomes are up to 120% of the area median income.

Preparedness Grants, FEMA

https://www.fema.gov/grants/preparedness

FEMA's Preparedness grants support citizens and first responders to ensure we work together as a nation to build, sustain and improve our capability to prepare for, protect against, respond to, recover from and mitigate terrorism and other high-consequence disasters and emergencies.

Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT), FHWA

https://www.fhwa.dot.gov/environment/protect/discretionary/

The vision of the PROTECT Discretionary Grant Program is to fund projects that address the climate crisis by improving the resilience of the surface transportation system, including highways, public transportation, ports, and intercity passenger rail. Projects selected under this program should be grounded in the best available scientific understanding of climate change risks, impacts, and vulnerabilities.

Public Assistance (PA) Grant Program, FEMA

http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

The objective of the FEMA Public Assistance Grant Program is to aid state, tribal and local governments, and certain types of Private Nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.

Regional Catastrophic Preparedness Grant Program (RCPGP), FEMA

www.fema.gov/grants

The RCPGP plays an important role in the implementation of the National Preparedness System. RCPGP supports the building of core capabilities essential to achieving the National Preparedness Goal of a secure and resilient nation by providing resources to close known capability gaps in Housing and Logistics and Supply Chain Management, encouraging innovative regional solutions to issues related to catastrophic incidents, and building on existing regional efforts.

Housing was added as a strategic priority for this grant program in 2023 to accompany equity, climate resilience, and readiness. Priority will also be given to projects that address the needs of disadvantaged communities that might be at special risk because of current and/or future hazards, including those associated with climate change.

Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program, FEMA

https://www.fema.gov/emergency-managers/risk-management/dam-safety/rehabilitation-high-hazard-potential-dams

The Rehabilitation of HHPD awards provide technical, planning, design and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. A state or territory with an enacted dam safety program, the State Administrative Agency, or an equivalent state agency, is eligible for the grant.

Rural Development Assistance – Utilities, USDA

https://www.rd.usda.gov/about-rd/agencies/rural-utilities-service

USDA's Rural Utilities Service (RUS) provides much-needed infrastructure or infrastructure improvements to rural communities. These include water and waste treatment, electric power and telecommunications services. All these services help to expand economic opportunities and improve the quality of life for rural residents.

Rural Development Assistance – Housing, USDA

https://www.rd.usda.gov/about-rd/agencies/rural-housing-service

USDA's Rural Housing Service (RHS) offers a variety of programs to build or improve housing and essential community facilities in rural areas. We offer loans, grants and loan guarantees for single- and multifamily housing, childcare centers, fire and police stations, hospitals, libraries, nursing homes, schools, first responder vehicles and equipment, housing for farm laborers and much more. The RHS also provide technical assistance loans and grants in partnership with nonprofit organizations, Indian tribes, state and federal government agencies, and local communities.

Safeguarding Tomorrow Revolving Loan Fund Program, FEMA

https://www.fema.gov/grants/mitigation/storm-rlf

The Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Act became law on January 1, 2021, and authorizes FEMA to provide capitalization grants to states, eligible federally recognized tribes, territories and the District of Columbia to establish revolving loan funds that provide hazard mitigation assistance for local governments to reduce risks from natural hazards and disasters. These low interest loans will allow jurisdictions to reduce vulnerability to natural disasters, foster greater community resilience and reduce disaster suffering.

Water Research Grants, EPA

https://www.epa.gov/research-grants/water-research-grants

The EPA funds water research grants to develop and support the science and tools necessary to develop sustainable solutions to current water resource problems, ensuring water quality and availability in order to protect human and ecosystem health.

Water Resources Projects for Small or Disadvantaged Communities, USACOE

https://www.usace.army.mil/Missions/Civil-Works/Project-Planning/Legislative-Links/wrda_2020/

The U.S. Army Corps of Engineers is launching a pilot program to fully fund small water resources projects for economically disadvantaged communities. Project proposals are due by October 20, 2023. A more detailed description of the requirements for a project proposal can be found in the WRDA 2020 Section 165 policy guidance issued on June 12, 2023.

WaterSMART Grants, USBR

https://www.usbr.gov/watersmart/

Through WaterSMART Grants, the U.S. Bureau of Reclamation (USBR) provides financial assistance to water managers for projects that seek to conserve and use water more efficiently, implement renewable energy, investigate and develop water marketing strategies, mitigate conflict risk in areas at a high risk of future water conflict, and accomplish other benefits that contribute to sustainability in the western United States. Cost-shared projects that can be completed within two or three years are selected annually through a competitive process. Three categories of WaterSMART Grants are offered through separate funding opportunities: Water and Energy Efficiency Grants; Small-Scale Water Efficiency Projects; and Water Marketing Strategy Grants.

Federal: Fire Resources

Assistance to Firefighters Grant (AFG) Program Resources, FEMA

https://www.fema.gov/grants/preparedness/firefighters/assistance-grants

FEMA's Assistance to Firefighters Grant Program provides a variety of resources listed below. The purpose of the grant is to provide equipment, protective gear, emergency vehicles, training, and other resources needed to protect the public and emergency personnel from fire and related hazards. The funds are available to fire departments, non-affiliated emergency medical services organizations, and state fire training academies. The funds enhance operations efficiencies, foster interoperability, and support community resilience.

Community Wildfire Defense Grant (CWDG) Program, USDA-FS

https://www.fs.usda.gov/managing-land/fire/grants

The CWDG is intended to help at-risk local communities and Tribes; plan for and reduce the risk of wildfire. The program, which was authorized by the Bipartisan Infrastructure Law, prioritizes at-risk communities in an area identified as having high or very high wildfire hazard potential, are low-income, or have been impacted by a severe disaster that affects the risk of wildfire. The program provides funding to communities for two primary purposes:

- Develop and revise Community Wildfire Protection Plans (CWPP).
- Implement projects described in a Community Wildfire Protection Plan that is less than ten years old.

The CWDG also helps communities in the wildland urban interface (WUI) implement the three goals of the National Cohesive Wildland Fire Management Strategy.

Fire Management Assistance Grant (FMAG) Program, FEMA

https://www.fema.gov/assistance/public/fire-management-assistance

Fire Management Assistance Grant (FMAG) Program is available to states, local and tribal governments, for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands, which threaten such destruction as would constitute a major disaster.

Fire Prevention and Safety (FP&S), FEMA

https://www.fema.gov/grants/preparedness/firefighters/safety-awards

The FP&S grant property is part of the AFG program noted above and supports projects that enhance the safety of the public and firefighters from fire and related hazards. The primary goal is to reduce injury and prevent death among high-risk populations.

National Fire Plan (NFP), USDA/USDOI

http://www.forestsandrangelands.gov/

The NFP provides technical, financial, and resource guidance and support for wildland fire management across the United States. This plan addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability.

Staffing For Adequate Fire and Emergency Response (SAFER)

https://www.fema.gov/grants/preparedness/firefighters/safer

The SAFER program was created to provide funding directly to fire departments and volunteer firefighter interest organizations to help them increase or maintain the number of trained, "front line" firefighters available in their communities.

Wildfire Smoke Preparedness in Community Buildings Grant Program, EPA

https://www.epa.gov/indoor-air-quality-iaq/wildfire-smoke-preparedness-community-buildings-grant-program?utm_content=&utm_medium=email&utm_name=&utm_source=govdelivery&utm_term=#Eligible

Wildfire Smoke Preparedness in Community Buildings is a new federal grant program to support enhancing community wildfire smoke preparedness. It provides grants and cooperative agreements to states, federally recognized tribes, public pre-schools, local educational agencies, and nonprofit organizations for the assessment, prevention, control, and/or abatement of wildfire smoke hazards in community buildings and related activities.

Federal: Hazard Mapping and Technical Support

Decision, Risk and Management Science Program (DRMS), National Science Foundation

https://new.nsf.gov/funding/opportunities/decision-risk-management-sciences-drms

Supports scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society. Disciplinary and interdisciplinary research, doctoral dissertation research, and workshops are funded in the areas of judgment and decision making; decision analysis and decision aids; risk analysis, perception, and communication; societal and public policy decision making; management science and organizational design. The program also supports small grants for exploratory research of a time-critical or high-risk, potentially transformative nature.

Clean Water State Revolving Fund (CWSRF), EPA

https://www.epa.gov/cwsrf

The EPA administers this fund. The purpose is to fund water quality projects, including all types of nonpoint source projects, watershed protection or restoration projects, estuary management projects, and more traditional municipal wastewater treatment projects. Grant awards are based on specific projects as they are identified.

Community Action for a Renewed Environment (CARE), EPA

https://www.epa.gov/international-cooperation/community-action-renewed-environment-care-roadmap-10-step-plan-improve

The administrator of this funding source is the EPA. The purpose is to fund the removal or reduction of toxic pollution. The grant award is based on specific projects as they are identified.

Cooperating Technical Partners (CTP), FEMA

https://www.fema.gov/flood-maps/guidance-partners/cooperating-technical-partners

The CTP mission is to strengthen the effectiveness of the NFIP and support FEMA's mitigation objectives. The CTP Program leverages partnerships to deliver high-quality hazard identification and risk assessment products, provide outreach support and empower communities to take action to reduce risk based on informed, multi hazard-based data and resources.

Earthquake Resilience Guide for Water and Wastewater Utilities

There are three steps in this guide: Step 1 – Understand the Earthquake Threat. Step 2 – Identify Vulnerable Assets and Determine Consequences. Step 3 – Pursue Mitigation and Funding Options.

Emergency Response for Drinking Water and Wastewater Utilities, EPA

https://www.epa.gov/waterutilityresponse

The Environmental Protection Agency (EPA) has a variety of tools and guidance to support drinking water and wastewater utility preparedness and response. Resources include:

Emergency Watershed Protection (EWP) Program, USDA-NRCS

https://www.nrcs.usda.gov/programs-initiatives/ewp-emergency-watershed-protection

The EWP Program provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events.

Federal Funding for Water and Wastewater Utilities in National Disasters, EPA

https://www.epa.gov/fedfunds

The Federal Funding for Water and Wastewater Utilities in National Disasters (Fed FUNDS website gives utilities information about federal disaster funding programs. Although Fed FUNDS focuses on major disasters, you can use the information for any incident that disrupts water or wastewater services or damages critical infrastructure.

Federal Land Transfer / Federal Land to Parks Program, USDOI-NPS

http://www.nps.gov/ncrc/programs/flp/index.htm

The National Park Service Identifies, assesses, and transfers available federal real property for acquisition for state and local parks and recreation, such as open space.

National Coastal Zone Management (CZM) Program, NOAA

https://coast.noaa.gov/czm/

The National CZM Program comprehensively addresses the nation's coastal issues through a voluntary partnership between the federal government and coastal and Great Lakes states and territories. Authorized by the Coastal Zone Management Act of 1972, the program provides the basis for protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources. The CZM Program provides grants for planning and implementation of non-structural coastal flood and hurricane hazard mitigation projects and coastal wetlands restoration.

National Earthquake Hazard Reduction Program (NEHRP), National Science Foundation

http://www.nehrp.gov/

Through broad based participation, the NEHRP attempts to mitigate the effects of earthquakes. Member agencies in NEHRP include the US Geological Survey (USGS), National Science Foundation (NSF), Federal Emergency Management Agency (FEMA), and National Institute for Standards and Technology (NIST). The agencies focus on research and development in areas such as the science of earthquakes, earthquake performance of buildings and other structures, societal impacts, and emergency response and recovery.

National Flood Insurance Program (NFIP), FEMA

https://www.fema.gov/flood-insurance

The NFIP provides insurance to help reduce the socio-economic impact of floods. The NFIP insurance is made available to residents of communities that adopt and enforce minimum floodplain management requirements.

NFIP Flood Maps, FEMA

https://www.fema.gov/flood-maps

Floods occur naturally and can happen anywhere. They may not even be near a body of water, although rivers and coastal flooding are two of the most common types. Heavy rains, poor drainage, and even nearby construction projects can put the community at risk for flood damage. Flood maps (referred to as Flood Insurance Rate Maps or "FIRM") are one tool that communities use to know which areas have the highest risk of flooding. FEMA maintains and updates data through flood maps and risk assessments.

North American Wetland Conservation (NAWC), USDOI-FWS

https://www.fws.gov/program/north-american-wetlands-conservation

NAWC fund provides cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats. The grant funds projects for wetlands conservation in the United States, Canada, and Mexico.

Partners for Fish and Wildlife (PFW), USDOI-FWS

https://www.fws.gov/program/partners-fish-and-wildlife

The PFW program provides financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats.

Secure Rural Schools and Community Self-Determination Act of 2000, USDA-FS

https://www.fs.usda.gov/working-with-us/secure-rural-schools

Reauthorized for the fiscal year 2022, it was originally enacted in 2000 to provide five years of transitional assistance to rural counties affected by the decline in revenue from timber harvests on federal lands. Funds have been used for improvements to public schools, roads, and stewardship projects. Money is also available for maintaining infrastructure, improving the health of watersheds and ecosystems, protecting communities, and strengthening local economies.

USGS Natural Hazards

https://www.usgs.gov/mission-areas/natural-hazards

The USGS Natural Hazards Mission Area includes six science programs including Coastal & Marine Geology, Earthquake Hazards, Geomagnetism, Global Seismographic Network, Landslide Hazards, and Volcano Hazards. Through these programs, the USGS provides alerts and warnings of geologic hazards and interactive maps and data.

Wetlands Reserve Easements (WRE), USDA-NCRS

https://www.nrcs.usda.gov/programs-initiatives/wre-wetland-reserve-easements

The WRE program provides assistance to protect and restore wetlands through easements and restoration agreements.

State

AmeriCorps/Resource Assistance for Rural Environments (RARE), University of Oregon

https://rare.uoregon.edu/

The mission of the RARE AmeriCorps Program 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. Members assist communities and agencies in the development and implementation of plans for achieving a sustainable natural resource base and improving rural economic conditions while gaining community building and leadership skills.

Coastal Grants, DLCD

https://www.oregon.gov/lcd/OCMP/Pages/Grants.aspx

The Oregon Coastal Management Program (OCMP) at Oregon Department of Land Conservation and Development (DLCD) is pleased to announce a new National Oceanic and Atmospheric Administration (NOAA) funding opportunity designed to build a Climate Ready Nation under the 2021 Bipartisan Infrastructure Law (also known as the Infrastructure Investment and Jobs Act (IIJA)) and available only through coastal management programs. The objective of this initiative is to increase resilience through landscape-scale habitat restoration and conservation in coastal ecosystems nationwide and promote coastal resilience in underserved coastal communities as well as those most vulnerable to climate impacts.

Community Risk Reduction Grants, OSFM

https://www.oregon.gov/osp/programs/sfm/Pages/OSFM-Grants.aspx

The Oregon State Fire Marshall (OSFM) grant programs provides the following funding sources.

<u>Community Wildfire Risk Reduction Grant</u>

This grant program is open to local governments, special districts, structural fire service agencies, and non-governmental organizations. This grant funds wildfire risk reduction projects, equipment, and staff.

<u>Oregon Fire Service Capacity Program</u>

The Fire Service Capacity Program is for small- to medium-sized agencies that need more permanent positions for firefighters and fire prevention staff. This grant is available to Oregon's local fire districts and departments for funds to support up to two firefighters and two fire prevention personnel.

Engine Program

This $25-million program is purchasing and strategically placing new firefighting equipment across Oregon. The OSFM is purchasing type 3, type 6, and tactical tenders to assist local host agencies in keeping fires small and away from communities.

Community Wildfire Protection Plan (CWPP) Investments

In February 2023, the OSFM made a strategic one-time $2.7 million investment at the local and county levels through CWPP. Projects will happen in 25 CWPP planning areas located in 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 counties. Projects include promoting wildfire-specific community risk reduction efforts, community education, defensible space projects, home assessments, media campaigns, signage, fuel mitigation programs, and grant funds.

Community Grants, DLCD

https://www.oregon.gov/lcd/cpu/pages/community-grants.aspx

The DLCD Community Services Division offers grants to empower local and tribal governments to improve planning. The grants can pay to update comprehensive plans, modernize land use ordinances, or augment other planning activities. The general fund grant program, administered by the community services division, is funded by the Oregon legislature. Changes to the grant program can arise based on changes in state priorities, the economy, and other factors. In general, the funding follows the state's two-year budget cycle and is part of DLCD's agency budget.

Grants and Supports for Emergency Shelter, ODHS

https://www.oregon.gov/dhs/EmergencyManagement/Pages/emergency-shelter.aspx

Oregon Department of Human Services (ODHS) proves assistance for local governments, Tribal Nations and public education providers to address shelter needs for:

- Cleaner air shelters during wildfire smoke and other poor air quality events
- Cooling and warming shelters

Oregon Senate Bill 80 (SB 762 fixes) proposes to extend eligibility to nonprofits and faith-based organizations.

Landscape Resiliency Program, ODF

https://www.oregon.gov/odf/pages/landscape-resiliency-program.aspx

This grant program funded landscape-scale projects that reduce wildfire risk on public and private forestlands and rangelands, and in communities near homes and critical infrastructure through restoration of landscape resiliency and reduction of hazardous fuels. Oregon Department of Forestry (ODF), with input from the Landscape Resiliency Project work group and the public, has awarded $20 million for nine projects during the 2021–23 biennium.

Oregon Watershed Enhancement Board (OWEB)

http://www.oregon.gov/OWEB/Pages/index.aspx

While OWEB's primary responsibilities are implementing projects addressing coastal salmon restoration and improving water quality statewide, these projects can sometimes also benefit efforts to reduce flood and landslide hazards. In addition, OWEB conducts watershed workshops for landowners, watershed councils, educators, and others, and conducts a biennial conference highlighting watershed effort statewide. Funding for OWEB programs comes from the general fund, state lottery, timber tax revenues, license plate revenues, angling license fees, and other sources. OWEB awards approximately $20 million in funding annually.

Resilience Hubs and Networks Grant, ODHS

https://www.oregon.gov/odhs/emergency-management/Pages/about.aspx

Oregon Department of Human Services (ODHS), Office of Resilience and Emergency Management, is developing a new program to provide grants, support and technical assistance to communities for planning and establishing resilience hubs and networks in Oregon, per HB 3409 (2023), effective date July 27, 2023. ODHS staff anticipate having the program established winter 2023-2024.

Seismic Rehabilitation Grant Program (SRGP), Business Oregon

https://www.oregon.gov/biz/programs/SRGP/Pages/default.aspx

The Seismic Rehabilitation Grant Program (SRGP) provides state funds to strengthen public schools and emergency services buildings so they will be less damaged during an earthquake. Reducing property damage, injuries, and casualties caused by earthquakes is the goal of the SRGP.

Small Forestland Grant Program, ODF

https://www.oregon.gov/odf/pages/small-forestland-grant-program.aspx

The Small Forestland Grant Program (SFGP) offered the following two funding opportunities: the Small Forestland Grant and the Firewise Community Grant. Both opportunities require grant dollars are spent reducing the risk of high severity wildfire through the reduction of hazardous fuel on small forestland owner properties. Both opportunities were scored prioritizing high-risk watersheds, but lower risk watersheds were not excluded from applying. All invoices from both program components must be submitted by successful recipients no later than June 15, 2023.

Smoke Management-Community Response Plan Grant, DEQ

https://www.oregon.gov/deq/aq/Pages/Smoke-Resources.aspx

Communities throughout Oregon are at various stages of planning and preparing for the potential impacts from prescribed fire and wildfire smoke. To create a successful community response plan for smoke, communities need to partner with local stakeholders and apply the best practices and resources to meet the needs of their residents. In 2022, Oregon Department of Environmental Quality (DEQ) awarded grants to 20 local and tribal governments to develop comprehensive community response plans for smoke management and to three local entities and businesses to pilot projects promoting alternatives to open burning. Once the grant period is completed, DEQ will share community response plans and best practices from the grant awardees.

State Interagency Hazard Mitigation Team (IHMT)

http://www.oregon.gov/oem/Councils-and-Committees/Pages/IHMT.aspx

Find IHMT meeting dates and locations, agendas, minutes and meeting materials. The State of Oregon's IHMT is made up of about 18 state agencies involved with natural hazards and meets quarterly to understand losses arising from natural hazards, coordinate recommended strategies to mitigate loss of life, property, and natural resources, and maintain the Oregon Natural Hazards Mitigation Plan.

State Preparedness and Incident Response Equipment (SPIRE), OEM

https://www.oregon.gov/oem/emresources/Grants/Pages/Spire.aspx

Oregon House Bill 2687 became effective in August 2017. It established a grant program to distribute emergency preparedness equipment to local governments and other recipients to be used to decrease risk of life and property resulting from an emergency. Items purchased must qualify as capital assets, meaning individual items must cost at least $5,000. A total of $5,000,000 is available to procure emergency preparedness equipment to help Oregon communities prepare, respond, and recover from emergencies. During the 2021 Legislative Session, HB 2426 added Urban Search and Rescue (USAR) equipment to the list and required that USAR equipment receive the highest priority. The contact for the SPIRE program is Carole Sebens, Grants Coordinator, Carole.L.Sebens@oem.oregon.gov/

Local

Local funding depends on the funding mechanisms your jurisdiction has authority to use. A few common types of funding for hazard mitigation projects include:

Capital Improvement Project (CIP)

Many jurisdictions put together a set of their big-ticket items into a budget package called a CIP budget or 'Capital Projects' budget. These projects usually have been on the organizational 'to do' list for some time or have gained priority status through another mechanism such as a planning, design, or strategic planning process. Once a project moves into this status, an array of budget tools is deployed.

Deferred and Lifetime Maintenance Funding

Other considerations about how to use lines of funding amount to either a future line of funding or a deficit (such as an unfunded mandate or deferred maintenance). Lifetime Maintenance funding is a component of a project that can be included in a CIP or other project budget. This includes the expected operations and maintenance (O&M) costs of the project, and it rolls those costs into the upfront costs so there is a budget available for them. The alternative to this is a piece of equipment or other asset that does not receive the maintenance it needs due to budget cuts, which then has a shorter life and thus a higher annual cost to the jurisdiction and its customers.

General Obligation Bond (GO Bond)

A general obligation bond, or GO Bond, is a municipal bond backed solely by the credit and taxing power of the issuing jurisdiction rather than the revenue from a given project. General obligation bonds are issued with the belief that a municipality will be able to repay its debt obligation through taxation or revenue from projects. No assets are used as collateral. In Oregon Revised Statutes, the rules for issuing GO Bonds are regulated by type of entity. For example, sanitary and water districts have a discrete set of rules specific to their authorities in 2020 ORS, Vol. 12, Chapter 450: https://www.oregonlaws.org/ors/chapter/450.

Road Fund

A "county road fund" means a separate fund in the county treasury designated to receive deposit of revenues that are dedicated to roads or road improvements. The county road fund must be used in establishing, laying out, opening, surveying, altering, improving, constructing, maintaining and repairing county roads and bridges on county roads (with exceptions). See 2020 ORS, Vol. 10, Ch.238, Section 238.705: https://www.oregonlaws.org/ors/368.705

Pursuant to ORS 373.240, the "general road fund" of any city shall consist of the road money set apart for the city as a road district or otherwise, under the laws of the state, out of the road tax levied by the county, which the county treasurer shall pay to the city, and any other money placed in the road fund of the city by the orders of the city governing body.

Special Tax District

Some districts, like Ports, may have authority to create special tax levies, such as a "bond sinking fund," that is "a special tax upon all taxable real and personal property situated within the port. Such annual levy shall not exceed one-tenth of one percent." See 2020 ORS, Vol. 19, Ch. 777, Section 777.520. https://www.oregonlaws.org/ors/777.520

City of La Grande

Local funding depends on the jurisdiction's funding mechanisms. The following includes additional and common funding mechanisms that may contribute to funding hazard mitigation projects in La Grande.

- The General Fund is the primary funding resource for the City of La Grande. This Fund comprises various revenue sources, such as property taxes, sales taxes, and grants.
- Transportation maintenance and operations funding predominantly relies on gas tax revenue but is further supported by a dedicated transportation fund that is generated through a monthly Street User Fee in La Grande.
- "Buy-in Fee" is a fee associated with water and sewer service that must be paid for property that has not historically had service. The funds generated by assessments are more flexible than system development charges (SDCs) and could be used for any mitigation project that would be related to the operation of the water and sewer departments. City of La Grande is currently looking at establishing SDCs and anticipate they will be in place for water, sewer, storm sewer, and transportation in 2023-2024.
- Infrastructure construction is financed through a combination of resources like grants, General Fund dollars, gas tax proceeds, a Street User Fee, and bonds, with a primary goal of minimizing General Fund dollar usage.
- The utility department operates independently through its fee structure. La Grande has stormwater utility fees to fund winter storm and flooding response, stormwater management

projects and maintenance, and flood control projects. These fees are assessed on property owners through the monthly water bill and can be earmarked for mitigation actions. Water and sewer funds are applicable to be utilized on mitigation projects if there is a water or sewer service component to the mitigation.

- The Park and Recreation Department collects SDCs (per new dwelling unit) for improvements. This SDC is charged prior to the issuance of zoning approval and building permits for the construction any new residential dwelling unit within the La Grande's city limits and Urban Growth Boundary. This SDC is essential for supporting growth-related capital improvements, including mitigation actions, which are vital to maintaining La Grande's level of service in Parks and Recreation facilities.
- The Building and Safety department is self-sustained by fee collections.
- The Planning Department, although generating a portion of its revenue, is predominantly supported from the General Fund to ensure its sustainability.
- The Urban Renewal fund is an account division that utilizes a special taxing district to generate funds for capital projects in the downtown corridor. These funds are strictly devoted to the district in which the tax was collected and cannot be used for maintenance. However, if there was a capital project that qualified as a mitigation project, La Grande may be able to utilize this funding source.

Foundational

Meyer Memorial Trust (MMT)

https://mmt.org/

Since 1982, the MMT has awarded grants and program-related investments totaling more than $814 million to more than 3,380 organizations around the Pacific Northwest. Today, MMT focuses on work in Oregon in four areas Oregonians have identified as crucial to making the state better for all its residents: housing, education, the environment and building stronger communities.

Oregon Community Foundation (OCF)

https://oregoncf.org

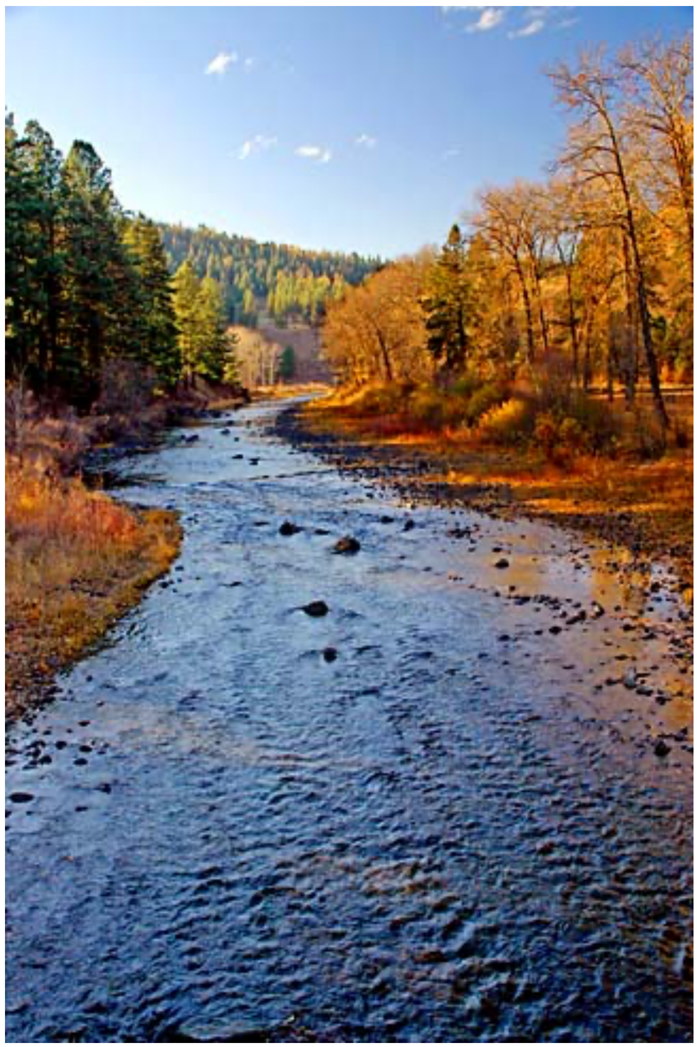
The OCF provides grants and scholarships across Oregon. As a statewide community foundation, they work alongside donors, stewarding their priorities into strategic giving to support diverse communities across Oregon, creating lasting, transformative change. They have five offices and professional advisors to assist donors in setting up advised funds to serve seven areas of impact.

8.4 OCCRI Future Climate Projections, Union County, Oregon

Future Climate Projections
Union County, Oregon

August 2023

Oregon Climate Change Research Institute



Future Climate Projections: Union County, Oregon

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August 2023

Cover Photograph: The Grande Ronde River at Hilgard, Union County, Oregon

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Executive Summary

Climate change is expected to increase the occurrence of many climate-related natural hazards and to increase climate-related risks to assets, such as people, buildings, and infrastructure. Confidence that the risk of heat waves will increase is very high (Table 1) given strong evidence in the peer-reviewed literature, consistency among the projections of different global climate models, and robust scientific principles that explain why temperatures increase in response to ongoing emissions of greenhouse gases. In areas where the human population is growing, and especially where it is aging, both the absolute number and the proportion of people at risk of negative health outcomes from heat exposure is increasing. Confidence that the risk of many other natural hazards will increase as climate changes is high or medium (Table 1), reflecting moderate to strong evidence and consistency among models. The latter risks are influenced by multiple factors in addition to increasing temperatures. Confidence that the risk of windstorms will change is low given that projections suggest relatively few to no changes and evidence is limited.

Table 1. Projected direction and level of confidence in changes in the risks of climate-related natural hazards and associated risks to assets. Very high confidence means that the direction of change is consistent among nearly all global climate models and there is robust evidence in the peer-reviewed literature. High confidence means that the direction of change is consistent among more than half of models and there is moderate to robust evidence in the peer-reviewed literature. Medium confidence means that the direction of change is consistent among more than half of models and there is moderate evidence in the peer-reviewed literature. Low confidence means that the direction of change is small compared to the range of model responses or there is limited evidence in the peer-reviewed literature.

	Low Confidence	Medium Confidence	High Confidence	Very High Confidence
Risk Increasing		Drought Expansion of Non-native Invasive Species Reduced Air Quality Loss of Wetlands	Heavy Precipitation Flooding Wildfire	Heat Waves
Risk Unchanging	Windstorms			
Risk Decreasing				Cold Waves

In this report, we present climate projections for Union County that are relevant to specified natural hazards for the 2020s (2010–2039) and 2050s (2040–2069) relative to the 1971–2000 historical baseline. The projections are based on multiple global climate models for both a lower greenhouse gas emissions scenario (RCP 4.5) and a higher emissions scenario (RCP 8.5). Unless otherwise noted, all projections in this executive summary refer to the 2050s, relative to the historical baseline, under the higher emissions scenario. Projections for both time periods and emissions scenarios, and potential consequences for assets given current demographic data and projected population trends, are included in the main report.

Heat Waves

The number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Union County, the number of extremely hot days (those on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower and higher emissions scenarios. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 24 (range 7–35) by the 2050s under the higher emissions scenario. The temperature on the hottest day of the year is projected to increase by an average of about 8°F (range 3–11°F) by the 2050s. Projected demographic changes, such as an increase in the proportion of older adults, will increase the number of people in some of the populations that are most vulnerable to extreme heat.

Cold Waves

Cold extremes will become less frequent and intense as the climate warms. The number of cold days (maximum temperature 32°F or lower) per year in Union County is projected to decrease by an average of 19 (range 11–28). The temperature on the coldest night of the year is projected to increase by an average of 9°F (range 1–17°F). The number of county residents vulnerable to extreme cold is likely to grow, although this increase may be offset somewhat by the decrease in incidence of cold extremes.

Heavy Precipitation

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Union County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. Nevertheless, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 15% (range 3–26%) and 10% (range 0–25%), respectively. The number of days per year that exceed a threshold for landslide risk that is based on prior 18-day precipitation accumulation is projected to increase by 1 (range 0–4). However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

River Flooding

Winter flood risk at intermediate to low elevations in Union County, where temperatures are near freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow.

Drought

Drought, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is projected to become more frequent in Union County. The incidence of related negative physical and mental health outcomes, especially among low income, tribal, rural, and agricultural communities, is likely to increase.

Wildfire

Wildfire frequency and area burned are projected to continue increasing in the Northwest, and wildfire intensity is projected to increase. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Union County by 16 days (range -4–38). The average number of days per year on which vapor pressure deficit is extreme is projected to increase by 31 (range 12–44).

Reduced Air Quality

Climate change is expected to reduce outdoor air quality. The risks to human health from wildfire smoke in Union County are projected to increase. From 2004–2009 to 2046–2051, under a moderate emissions scenario, the number of days per year with poor air quality due to elevated concentrations of wildfire-derived fine particulate matter is projected to increase by 68%. The concentration of fine particulate matter on those days is projected to increase by 129%.

Loss of Wetlands

Projected effects of climate change on wetlands in the Northwest include reductions in water levels and hydroperiod duration. If withdrawals of ground water do not increase, then wetlands that are fed by ground water rather than surface water may be more resilient to climate change.

Windstorms

Wind patterns affect provision of electricity, transportation safety, and the spread of wildfires and pollutants. Mean wind speeds in Oregon are projected to decrease slightly, but extreme winter wind speeds may increase, especially in western Oregon. The frequency of strong easterly winds during summer and fall, however, is projected to decrease slightly.

Expansion of Non-native Invasive Species

In general, non-native invasive plants in Union County are likely to become more prevalent in response to projected increases in temperature and the frequency, duration, and severity of drought. However, many of these responses are uncertain, are likely to vary locally, and may change over time.

Introduction

Industrialization has increased the amount of greenhouse gases emitted worldwide, which is causing Earth's atmosphere, oceans, and lands to warm (IPCC, 2021). Climate change and its effects already are apparent in Oregon (Dalton *et al.*, 2017; Mote *et al.*, 2019; Dalton and Fleishman, 2021; Fleishman, 2023). Climate change is expected to increase the likelihood of natural hazards such as heat waves, heavy precipitation, flooding of rivers and streams, drought, wildfires, and poor air quality, and to decrease the likelihood of cold waves.

We analyzed the influence of climate change on natural hazards in Union County, Oregon, and explored potential effects of those natural hazards on the county's assets. Products of our analysis include county-specific data, graphics, and narrative summaries of climate projections related to ten climate-related natural hazards (Table 2). This information will be integrated into the county's Natural Hazards Mitigation Plan and can be used in other county plans, policies, and programs.

Table 2. Selected natural hazards and related climate metrics.

Heat Waves Hottest Day, Warmest Night Hot Days, Warm Nights	**Cold Waves** Coldest Day, Coldest Night Cold Days, Cold Nights
Heavy Precipitation Wettest Day, Wettest Five Days Wet Days, Landslide Risk Days	**River Flooding** Annual Maximum Daily Flows Atmospheric Rivers Rain-on-Snow Events
Drought Summer Flow, Spring Snow Summer Soil Moisture Summer Precipitation	**Wildfire** Fire Danger Days Extremely Dry Air Days
Reduced Air Quality Days with Unhealthy Smoke Levels	**Loss of Wetlands**
Windstorms	**Expansion of Non-native Invasive Species**

In 2022, an estimated 26,673 people lived in Union County (PRC, 2023a). The county's population is projected to increase by 3% by 2040, and by another 4% (or 7% relative to 2020) by 2069 (PRC, 2023b). Social factors affect the probability that natural hazards will negatively affect individuals and communities. For example, inequities in housing, education, income, and transportation access affect how different populations respond to heat, drought, and other extremes (Ho *et al.*, 2021). The U.S. Centers for Disease Control and Prevention developed and maintains a social vulnerability index for use in planning and response to hazardous events (Flanagan *et al.*, 2011; ATSDR, 2022). The index encompasses 16 variables, which are aggregated into four themes: socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation. The number of single-parent households in Union County from 2016–2020 (Table 3) was among the highest 10% relative to other counties in Oregon; higher values indicate higher vulnerability (ATSDR, 2022).

Table 3. Measures of social vulnerability in Union County, Oregon, as estimated on the basis of the 2016–2020 American Community Survey (ATSDR, 2022). Housing cost burden is defined as an occupied housing unit with a household annual income below $75,000 and monthly housing costs that equal or exceed 30 percent of annual income. Single-parent households include one or more children under the age of 18. Racial and ethnic minority status includes individuals who identify as Hispanic, Latino (of any race), Black, African American, American Indian, Alaska Native, Asian, Native Hawaiian, Pacific Islander, two or more races, and other non-White races. Multi-unit housing refers to housing structures with ten or more units. Crowded housing is defined as an occupied housing unit with more people than rooms. Number of households without a broadband internet subscription is not included in calculation of the overall social vulnerability index. CI, confidence interval. Percentage, percentage of population or number. Percentages for some variables do not correspond exactly to raw values.

Social vulnerability metric	Population or number	CI	Percentage	CI
Total population	26,502			
Number of housing units	11,863	11,765–11,961		
Number of households	10,785	10,590–10,980		
Socioeconomic status				
Below 150% poverty	6547	5931–7163	25.4	23.0–27.8
Unemployed	655	517–793	5.4	4.3–6.5
Number of cost-burdened housing units	2736	2446–3026	25.4	22.8–28.0
No high school diploma	1263	1047–1479	7.1	5.9–8.3
No health insurance	1821	1539–2103	6.9	5.8–8.0
Household characteristics				
Aged 65 or older	5457	5418–5496	20.6	20.5–20.7
Aged 17 or younger	5855		22.1	
Civilian with a disability	4200	3819–4581	16.0	14.5–17.5
Single-parent household	807	649–965	7.5	6.0–9.0
Speaks English less than well	101	12–190	0.4	0–0.8
Racial and ethnic minority status				
Minority	3061	2841–3281	11.6	10.8–12.4
Housing type and transportation				
Number of multiple-unit homes	702	536–868	5.9	4.5–7.3
Number of mobile homes	1702	1476–1928	14.3	12.4–16.2
Number of crowded housing units	311	188–434	2.9	1.8–4.0
Number of households with no vehicle	618	461–775	5.7	4.3–7.1
People in group quarters	781	532–1030	2.9	2.0–3.8
People in households without a broadband internet subscription	3376	2810–3942	13.1	13.0–13.2

In 2018, 17% of households in Union County had a disaster plan and 16% had a family disaster plan (GRH, 2019). Four percent of households indicated that they had no disaster preparedness supplies, whereas 64% and 40% had a three-day supply of nonperishable food and water, respectively, for all household members (GRH, 2019). Ninety-two percent of households had a cellular telephone, and 87% of households had a cellular telephone with texting capacity (GRH, 2019).

Future Climate Projections Background

Introduction

The county-specific future climate projections presented here are derived from 10–20 global climate models and two scenarios of future global emissions of greenhouse gases. The spatial resolution of projections from global climate models has been increased through downscaling to better represent local conditions. County-level summaries of changes in climate metrics (Table 2) are projected to the beginning and middle of the twenty-first century relative to a historical baseline. More information about the data sources is in the appendix.

Global Climate Models

Global climate models are 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 are grounded in the fundamental laws of physics and are the most sophisticated tools for understanding Earth's climate. However, they still necessarily simplify the climate system. Because there are several ways to simplify climate in a global model, different climate models yield somewhat different projections. Accordingly, the scientific community usually examines projections from multiple global climate models.

Over time, the spatial resolution of GCMs has increased and more physical, chemical, and biological processes, such as wildfire emissions and vegetation change, have been included (Figure 1). The climate models from the sixth phase of the Coupled Model Intercomparison Project (CMIP6), the climate modeling foundation of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), generally have higher resolution, better represent Earth system processes, and improve simulation of recent mean values of climate change indicators relative to climate models from fifth phase of the Coupled Model Intercomparison Project (CMIP5) (IPCC, 2021). However, some CMIP6 models overestimate observed temperatures in the twentieth century, likely because they yielded a greater increase in temperature in response to modeled changes in cloud patterns (Dalton *et al.*, 2021; IPCC, 2021). Consequently, the IPCC ranked climate models on the basis of their ability to reproduce twentieth-century temperatures, and used only the most accurate models to project warming given different scenarios of greenhouse gas emissions (Hausfather *et al.*, 2022).

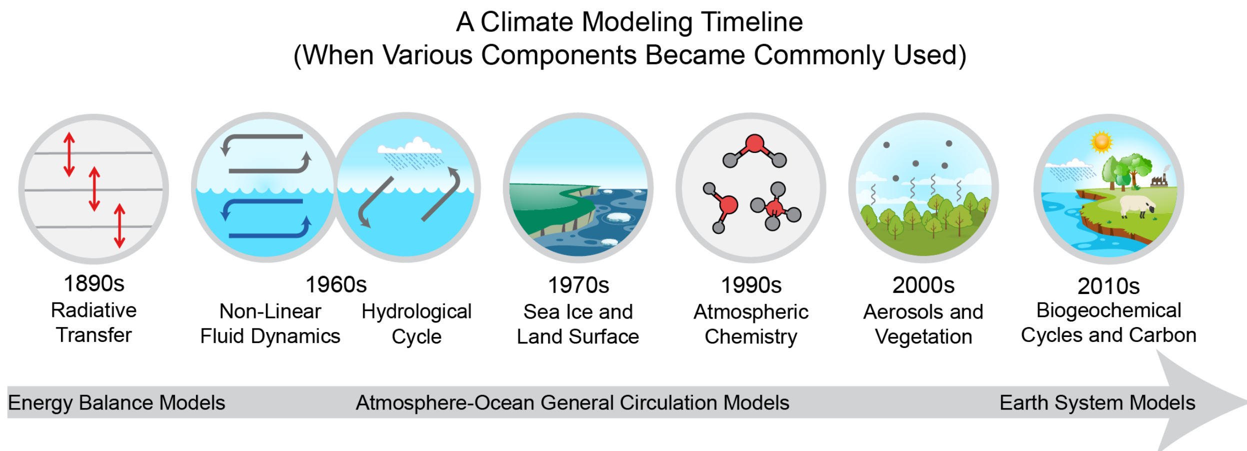

Figure 1. As scientific understanding of climate has evolved over the last 120 years, increasing amounts of physics, chemistry, and biology have been incorporated into global climate calculations. Over the second half of the twentieth century, as computing resources became available, such knowledge also was incorporated into global climate models. (Source: science2017.globalchange.gov)

Differences in simulations of Oregon's projected average temperature between CMIP5 and CMIP6 were estimated in the fifth Oregon Climate Assessment (Dalton *et al.*, 2021). The group of CMIP6 models generally projected greater warming over Oregon than the group of CMIP5 models. This outcome was due to the inclusion of several of the CMIP6 models that produce greater warming than most models given the same concentration of greenhouse gases.

One measure of climate sensitivity, the equilibrium climate sensitivity (ECS), is an estimate of the increase in global temperature after it stabilizes over hundreds to thousands of years following a doubling of carbon dioxide concentrations from pre-industrial levels. On the basis of observations, paleoclimate data, and other evidence, the ECS of Earth was estimated to be within 4.5–7.2°F (66% likelihood) or 3.6–9.0°F (90% likelihood) (Forster *et al.*, 2021). The scientific community typically evaluates climate model outputs on the basis of how close they are to this range of ECS. ECS in all CMIP5 models was less than 9°F, whereas about one-fifth of the CMIP6 models had an ECS above 9°F (Hausfather *et al.*, 2022). Although there is a 5% likelihood that Earth's ECS is above 9°F, the CMIP6 climate models with ECS >9°F overestimate the observed warming and therefore are considered less valid and reliable than those with ECS ≤9°F. Consequently, use of the average and range of the CMIP6 model ensemble likely will yield inaccurate projections of future climate (Hausfather *et al.*, 2022).

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). In this report, we rely on projections from 10–20 CMIP5 models (see *Appendix*), all of which have realistic climate sensitivities and are still considered valid and useful in evaluating future climate (Dalton and Bachelet, 2023). Additionally, locally relevant, high-resolution projections from these models are readily available. It will be advantageous to consider CMIP6 climate projections after the scientific community has further evaluated the projections and associated impacts and high-resolution projections are vetted for geographic regions with different characteristic climates (Dalton and Bachelet, 2023).

Greenhouse Gas Emissions

Gases that contribute to climate change. The major gases in the atmosphere that contribute to climate change are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (EPA, 2023). These gases absorb energy radiated by Earth's sun-heated surface, then redirect a portion of that energy back to the surface, causing further warming. Water vapor traps heat in the same manner. CO_2, CH_4, N_2O, and water vapor exist naturally in the atmosphere and are essential for maintaining Earth's temperature within a range that is habitable by living organisms. This is called the greenhouse effect. Human activities are increasing the quantities of CO_2, CH_4, N_2O, and fluorinated gases in the atmosphere, enhancing the greenhouse effect by trapping additional energy (heat). As concentrations of CO_2, CH_4, N_2O, and fluorinated gases increase, the oceans warm and more water evaporates into the atmosphere, exacerbating increases in temperature that are caused by emissions of the former gases.

Carbon dioxide (CO_2) in the atmosphere is produced by natural processes, such as plant respiration and volcanic eruptions, and by human activities. Increases in atmospheric concentrations of CO_2 account for about 65% of climate change since 1750 (Table 4) (Forster *et al.*, 2021). Nearly all of those increases result from human activities, especially consumption of coal, gasoline, and other fossil fuels (Lindsey, 2022). CO_2 also is released to the atmosphere during production of cement (Andrew, 2019) and when forests are harvested for timber or burned and converted to agricultural, industrial, or residential uses.

Ice cores document that for at least 400,000 years before present, the atmospheric concentration of CO_2 ranged from about 180–280 parts per million (ppm) (Bauska, 2022). During the late 1700s, as the Industrial Revolution began, CO_2 concentrations were around 280 ppm. By 2000, the concentration approached 370 ppm. As of 2022, the concentration was 417 ppm (Table 4). Therefore, the rate at which human activities are adding CO_2 to the atmosphere is increasing. Current concentrations of CO_2 are similar to those during the mid-Pliocene, more than 4 million years ago. At that time, the average global temperature was 7˚F higher than during the mid 1700s and sea levels were about 75 feet higher than today. Because CO_2 in the atmosphere persists for 300–1000 years (Buis, 2019), the process and effects of climate change cannot easily be reversed, even if human behavior and emissions change rapidly.

Table 4. Current values, trends, and other metrics of atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) and percentage of global emissions and contributions to climate change. Ppm, parts per million. Ppb, parts per billion. Total anthropogenic greenhouse gas emissions in 2019 were 59 gigatonnes of CO_2-equivalent.

Metric	CO_2	CH_4	N_2O
Atmospheric concentration, 2022 (NOAA, 2023)	417 ppm	1912 ppb	336 ppb
Percentage increase, 1750–2019 (Forster *et al.*, 2021; Gulev *et al.*, 2021)	47	156	23
Global warming potential over 100 years, relative to CO_2 (Smith *et al.*, 2021)	1	28	273
Atmospheric lifetime (years) (Smith *et al.*, 2021)	300–1000 (Buis, 2019)	12	109
Percentage of net global sources of each gas that was produced by human activities during the years noted (Canadell *et al.*, 2021)	100 (2010–2019)	51–65 (2008–2017)	43 (2007–2016)
Percentage of total anthropogenic greenhouse gas emissions, 2019 (Dhakal *et al.*, 2022)	75 (64 fossil fuel combustion and industrial processes; 11 land use, land use change, and forestry)	19	5
Contribution to climate change (percentage of total effective radiative forcing, 1750–2019) (Forster *et al.*, 2021)	65	16	6

Net emissions of methane (CH_4), of which 51–65% are produced by human activity (Canadell *et al.*, 2021), account for about 16% of climate change since the Industrial Revolution (Table 4) (Forster *et al.*, 2021). The primary natural cause of CH_4 emissions is decomposition of plants in wetlands (EPA, 2023). Among human sources of CH_4, agriculture is the greatest contributor, followed closely by use of fossil fuels (IEA, 2023). Rice farming and digestion and excretion by livestock generate considerable volumes of CH_4. Production and transportation of oil, gas, coal, and bioenergy produce almost as much

CH_4 as agriculture. Decomposition of materials in landfills, biomass burning, and other sources also emit CH_4.

The atmospheric concentration of CH_4 has increased by more than 150% since the start of the Industrial Revolution (Table 4). The concentration of CH_4 in the atmosphere is much lower than that of CO_2—currently more than 1900 parts per billion (1.9 ppm) (Table 4) (Gulev *et al.*, 2021). However, each molecule of CH_4 traps about 28 times more heat than each molecule of CO_2 over 100 years. CH_4 in the atmosphere persists for about 12 years (Smith *et al.*, 2021).

Forty-three percent of net global sources of nitrous oxide (N_2O) is produced by human activity (Canadell *et al.*, 2021), primarily production and use of nitrate in conventional and organic agricultural fertilizers (Tian *et al.*, 2020). N_2O also is produced by burning of fossil fuels and vegetation. Atmospheric concentrations of N_2O increased by 23% from 1750–2019 (Gulev *et al.*, 2021), and accounted for about 6% of climate change during that period (Table 4) (Forster *et al.*, 2021). A molecule of N_2O persists in the atmosphere for about 109 years and, over 100 years, traps about 273 times more heat than a molecule of CO_2 (Table 4) (Smith *et al.*, 2021).

Nearly all fluorinated gases are produced by humans. The major classes of fluorinated gases are hydrofluorocarbons, perfluorocarbons, sulfur hexafluorine (SF_6), and nitrogen trifluorine (NF_3). Among fluorinated gases, hydrofluorocarbons are the greatest contributors to climate change. Hydrofluorocarbons are used as refrigerants, solvents, fire retardants, and to propel aerosols and foam (EPA, 2023). A molecule of most hydrofluorocarbons can trap hundreds to thousands of times more heat than a molecule of CO_2 over 100 years, and some hydrofluorocarbons persist in the atmosphere for up to 228 years (Smith *et al.*, 2021). Substitutions that will not contribute to climate change are being developed.

Perfluorocarbons are generated during aluminum production and are necessary for manufacture of semiconductors (EPA, 2023). They can persist in the atmosphere for thousands to tens of thousands of years, and some trap as much as 12,400 times more heat per molecule than CO_2 (Smith *et al.*, 2021). SF_6 and NF_3 also are used to manufacture semiconductors. In addition, SF_6 is used in magnesium production, to trace gas leaks, and to insulate electricity transmission systems (EPA, 2023). SF_6 persists for about 1000 years and traps 24,300 times more heat per molecule than CO_2 over 100 years. NF_3 persists for about 569 years and traps about 17,400 times more heat per molecule than CO_2 over 100 years (Smith *et al.*, 2021).

Climate models and emissions scenarios. When scientists use global climate models to project climate, they make assumptions about the future volume of global emissions of greenhouse gases. The models then simulate the effects of those emissions on the atmosphere, oceans, and land over the coming centuries. Because the precise amount of greenhouse gases that will be emitted in the future is unknown, scientists use multiple scenarios of greenhouse gas emissions that correspond to plausible societal trajectories.

The CMIP5 models used scenarios called Representative Concentration Pathways (RCPs), which describe concentrations of greenhouse gases, aerosols, and other factors through the year 2100. These concentrations affect the level of outgoing long-wave radiation from Earth's surface, thus radiative forcing. 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. The higher the volume of global emissions, the greater the radiative forcing and projected increase in global temperature (Figure 2).

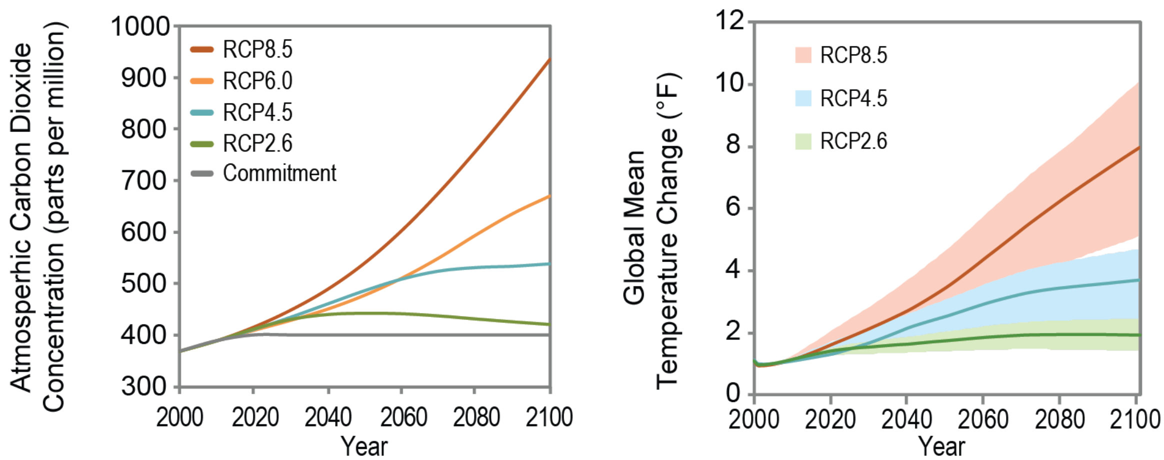

Figure 2. Future scenarios of atmospheric carbon dioxide concentrations (left) and projections of global temperature change (right) resulting from several different emissions scenarios, called Representative Concentration Pathways (RCPs), that were considered in the fourth National Climate Assessment (Hayhoe *et al.*, 2017). In the left plot, the gray line represents a scenario in which atmospheric carbon dioxide concentrations remain constant upon reaching 400 parts per million; this concentration was exceeded in 2013 and continues to increase. In the right plot, the solid line and shading represent the mean and range of simulations from global climate models included in CMIP5. (Source: science2017.globalchange.gov/chapter/4/)

CMIP6 models used scenarios called Shared Socio-economic Pathways (SSPs). The SSPs reflect assumptions about future population, technological, and economic growth that were paired with the different levels of emissions associated with the CMIP5 RCPs (IPCC, 2021). Projections in this report are based on both a lower emissions pathway (RCP 4.5) and a higher emissions pathway (RCP 8.5) that are often described as representing moderate reductions and business-as-usual increases in greenhouse gas emissions, respectively (Hayhoe *et al.*, 2017). These two RCPs are the most common scenarios in the peer-reviewed literature, and high-resolution data representing the effects of these scenarios on local climate are available.

Downscaling

Global climate models simulate the climate across large, contiguous grid cells. One to three grid cells cover the state of Oregon. To make these coarse-resolution simulations more locally relevant, outputs are combined statistically with historical observations, yielding higher-resolution projections. This process is called statistical downscaling. The future climate projections in this report were statistically downscaled to a resolution of about 2.5 by 2.5 miles (Abatzoglou and Brown, 2012). More information about downscaling is in the appendix.

Future Time Periods

When analyzing global climate model projections, it is best practice to compare the average of simulations across at least 30 future years to the average of simulations across at least 30 recent past years. The average over those 30 past years is called the *historical baseline*. We present projections averaged over two future 30-year periods, 2010–2039 (2020s) and 2040–2069 (2050s), relative to the historical baseline from 1971–2000 (Table 5). The 2020s projections reflect changes that have occurred or will occur in the coming decade. Projections for the 2050s reflect conditions a few decades into the future that potentially can be addressed by current planning efforts.

Table 5. Historical and future time periods over which projections were averaged.

Historical Baseline	2020s	2050s
1971–2000	2010–2039	2040–2069

Because each of the 20 CMIP5 models from which we obtained projections is based on slightly different assumptions, each yields a slightly different value for the historical baseline. Therefore, we do not present the average and range of projected absolute values of variables. Instead, we present the average and range of projected changes in values of climate variables relative to each model's historical baseline. We also present the average of the 20 historical baselines to aid in understanding the relative magnitude of projected changes. The average projected change can be added to the average historical baseline to infer the average future value of a given variable. The average projected change and historical baseline are included in the tables.

How to Use the Information in this Report

Because the observational record may not include plausible future values of some climate variables or the plausible future frequency of some extreme events, one cannot reliably anticipate future climate by considering only past climate. Future projections from GCMs enable exploration of a range of plausible outcomes given the climate system's complex response to increasing atmospheric concentrations of greenhouse gases. Projections from GCMs should not be interpreted as predictions of the weather on a given date, but rather as projections of climate, which is the long-term statistical aggregate of weather (Walsh *et al.*, 2014).

The projected direction and magnitude of change in values of climate variables in this report are best interpreted relative to the historical climate under which a particular system or asset evolved or was designed to operate. For this reason, considering the projected changes between historical and future periods allows one to envision how natural and human systems may respond to future climate conditions that are different from past conditions. In some cases, the projected change may be small enough for the existing system to accommodate. In other cases, the projected change may be large enough to require adjustments, or adaptations, to the existing system. However, engineering or design projects would require an analysis that is more detailed than we present in this report.

The information in this report can be used to

- Explore a range of plausible future outcomes that reflect the climate system's complex response to increasing concentrations of greenhouse gases
- Envision how current systems may respond to climate conditions different from those under which the systems evolved or were designed to operate
- Inform evaluation of potential mitigation actions within hazard mitigation plans
- Inform assessment of the likelihood of occurrence of a particular climate-related hazard

Average Temperature

Oregon's annual average temperature warmed at a rate of 2.2°F per century from 1895 through 2021 (Fleishman, 2023). Average temperature is expected to continue increasing during the twenty-first century; the rate of warming depends on the level of emissions (IPCC, 2021). By the 2050s (2040–2069), relative to the 1970–1999 historical baseline, Oregon's average temperature is projected to increase by 3.6°F (range 1.8–5.4°F) under a lower emissions scenario (RCP 4.5) and by 5.0°F (range 2.9–6.9°F) under a higher emissions scenario (RCP 8.5) (Dalton *et al.*, 2017, 2021; Fleishman, 2023). Summers are projected to warm more than other seasons (Dalton *et al.*, 2017, 2021; Fleishman, 2023).

Annual average temperature in Union County increased at a rate of 2.0°F per century from 1895 through 2022 (NCEI, 2023). The simulated average temperature over the 1971–2000 baseline period (44.0°F) is consistent with observations over the same time period (43.9°F). During the twenty-first century, average temperature in the county is projected to warm at a rate similar to that of Oregon as a whole (Figure 3). Projected increases in average temperature in the county, relative to the historical baseline in each global climate model (GCM), range from 0.9–4.0°F by the 2020s and 1.9–7.7°F by the 2050s, depending on emissions scenario and GCM (Table 6).

Over the 13 years for which observations overlap the 2020s projections (2010–2022), the average temperature was projected to increase by 1.8°F, relative to the historical baseline, under the lower emissions scenario and by 2.0°F under the higher emissions scenario (Table 6). The observed change over these 13 years was 1.2°F, and observed total CO_2 emissions fell between the two emissions scenarios (Burgess *et al.*, 2020).

Table 6. Projected changes in annual temperature in Union County between the 1971–2000 baseline period and future periods. Values are averages across 20 global climate models (range in parentheses). The 20-model average and range of temperature averaged over the historical baseline period (1971–2000) was 44.0°F (43.2–44.4).

Emissions Scenario	**Past**		**Future**	
	Baseline (1971–2000 average)	Recent Past (2010–2022 average)	2020s (2010–2039 average)	2050s (2040–2069 average)
Observations	43.9°F	+1.2°F		
Lower (RCP 4.5)		+1.8°F (0.3–3.3)	+2.4°F (0.9–4.0)	+4.3°F (1.9–6.0)
Higher (RCP 8.5)		+2.0°F (0.7–3.2)	+2.7°F (1.5–4.0)	+5.7°F (2.8–7.7)

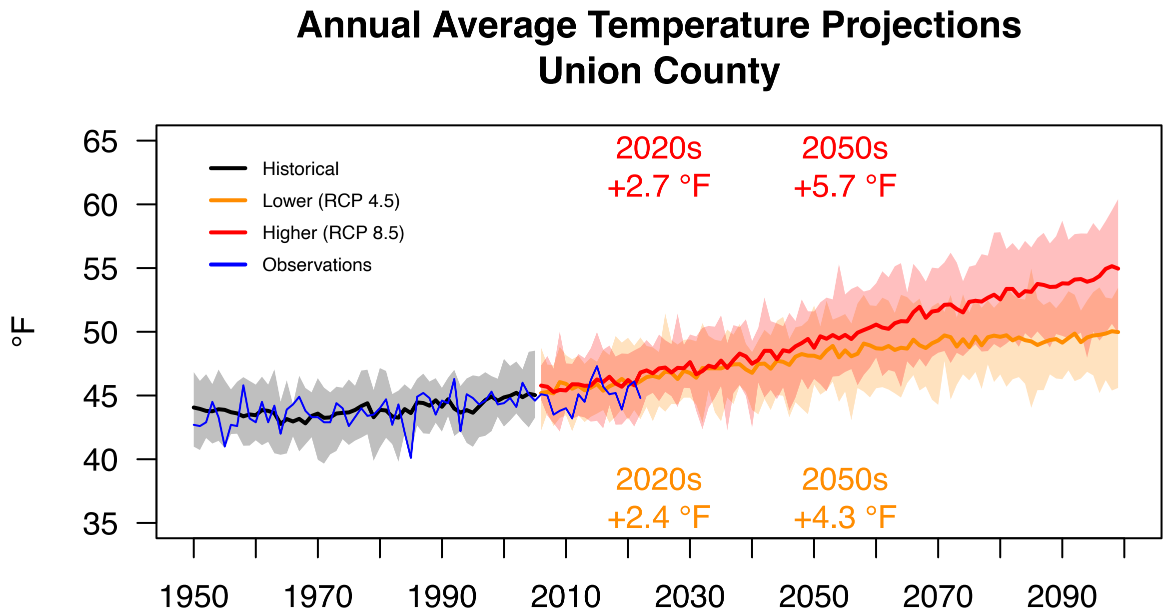

Figure 3. Projected annual average temperature in Union County as simulated by 20 downscaled global climate models under a lower (RCP 4.5) and a higher (RCP 8.5) greenhouse gas emissions scenario. Solid lines and shading represent the 20-model mean and range, respectively. The figure shows the multiple-model mean differences between the historical baseline period (1971–2000) and the 2020s (2010–2039 average) and 2050s (2040–2069 average). Observations (blue line) are from the National Oceanic and Atmospheric Administration's National Centers for Environmental Information Climate at a Glance, www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/time-series.

Heat Waves

Heat is the leading cause of weather-related deaths in the United States (Khatana *et al.*, 2022). Extreme heat and home air conditioning are less common in Oregon than in many other parts of the country, leaving residents more vulnerable when extreme heat occurs. For example, record-breaking heat in June 2021 caused more than 100 deaths in Oregon, mostly inside homes without air conditioning (O'Neill *et al.*, 2023). Dangerous heat is almost always associated with a weather event called a heat wave: multiple consecutive days on which maximum or minimum temperatures are above a threshold or a probability (O'Neill *et al.*, 2023). Heat waves occur periodically as a result of natural variability in temperature, but human-caused climate change is increasing their frequency and intensity (Vose *et al.*, 2017; IPCC, 2021). In the absence of human-caused climate change, the intensity of the June 2021 heat wave would have been virtually impossible (Philip *et al.*, 2022). Additionally, the period over which heat waves occur is lengthening. For example, in Portland, Oregon, the duration of the heat wave season increased by 7 days per decade from 1961–2010 (Habeeb *et al.*, 2015). This trend is exemplified by the heat wave in May 2023, which broke several high-temperature records for the same date and month across the northwestern United States and Canada. High-pressure ridges caused both the June 2021 and May 2023 heat waves (earthobservatory.nasa.gov/images/151349/summer-temperatures-arrive-early).

Extreme heat can refer to extremely warm daytime highs or overnight lows (days on which maximum or minimum temperatures are above a threshold or a probability relative to past decades), seasons in which temperatures are well above average, and heat waves. In the Pacific Northwest, a day on which the maximum temperature is at least 90°F often is considered to be an extremely warm day. The number of such days increased significantly across Oregon since 1951 (O'Neill *et al.*, 2023). The heat index is a measure of perceived heat that reflects both temperature and relative humidity and is more relevant to human health than temperature alone. As relative humidity increases, a given temperature can feel hotter. The National Weather Service issues heat warnings when the heat index exceeds given local thresholds. Across Oregon, heat waves rarely are humid (Rastogi *et al.*, 2020), and the heat index generally is similar to the actual temperature. Nevertheless, the average number of hours per year in Oregon with a heat index of at least 90°F increased significantly since 1981 (O'Neill *et al.*, 2023).

The number of extremely warm nights is also increasing. In western Oregon, nights on which the minimum temperature was at least 65°F were rare before 1990, but the number of such nights has increased significantly in some areas during the past two decades (O'Neill *et al.*, 2023). In addition, evidence of increases in the number of summer extreme heat events that are defined by nighttime minimum temperatures is stronger than evidence of increases in the number of those defined by maximum temperatures (Dalton and Loikith, 2021).

The number, duration, and intensity of extreme heat events in Oregon is projected to increase due to continued increases in mean temperatures (Dalton and Loikith, 2021; O'Neill *et al.*, 2023). Climate models generally agree that changes in temperature extremes largely are linearly correlated with changes in the mean temperature. However, some mechanisms, which are the subject of active research, might cause a more substantial increase in extreme temperature than mean temperature (O'Neill *et al.*, 2023). For example, Arctic amplification (increasing similarity of temperatures from the equator to the North pole, caused in part by the melting of Arctic sea ice) may alter the shape and position of the midlatitude jet stream, thereby contributing to an increase in the number of summer heat waves in Oregon (O'Neill *et al.*, 2023; Rupp and Schmittner, 2023). In addition, dry soils can amplify extreme heat through their relative lack of evaporative cooling (O'Neill *et al.*, 2023).

Here, we present projected changes in three metrics of extreme daytime heat (maximum temperature) and nighttime heat (minimum temperature) (Table 7).

Table 7. Metrics and definitions of heat extremes.

Metric	Definition
Hot Days	Number of days per year on which maximum temperature is 90°F or higher
Warm Nights	Number of days per year on which minimum temperature is 65°F or higher
Hottest Day	Highest value of maximum temperature per year
Warmest Night	Highest value of minimum temperature per year
Daytime Heat Waves	Number of events per year in which the maximum temperature on at least three consecutive days is 90°F or higher
Nighttime Heat Waves	Number of events per year in which the minimum temperature on at least three consecutive days is 65°F or higher

In Union County, the number of hot days and warm nights, and the temperature on the hottest day and warmest night, are projected to increase by the 2020s (2010–2039) and 2050s (2040–2069) under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 8, Figure 4, Figure 5). For example, by the 2050s under the higher emissions scenario, the number of hot days, relative to each GCM's 1971–2000 historical baseline, is projected to increase by 7–35. The average number of hot days per year is projected to be 24 more than the average historical baseline of 8 days. The average number of days per year with a heat index of 90°F or higher is projected to be 17 more than the average historical baseline of 3 days (Dalton and Loikith, 2021). The average number of warm nights per year is projected to be 5 more than the average historical baseline of 0.

Under the higher emissions scenario, the temperature on the hottest day of the year is projected to increase by 3.1–10.8°F by the 2050s relative to the GCMs' historical baselines. The average projected increase in temperature on the hottest day is 7.8°F above the average historical baseline of 92.1°F. The average projected increase in temperature on the warmest night is 6.5°F above the average historical baseline of 59.9°F.

Under the higher emissions scenario, the numbers of daytime and nighttime heat waves are projected to increase by 1.1–3.9 and 0–1.5, respectively, by the 2050s relative to the GCMs' historical baselines. The average number of daytime and nighttime heat waves is projected to increase by 2.7 and 0.6, respectively, above the average historical baselines of 1.1 and 0 (Table 8, Figure 6).

Table 8. Projected future changes in extreme heat metrics in Union County. Changes from the 1971–2000 baseline were calculated for each of 20 global climate models and averaged across the 20 models (range in parentheses) for a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario and for the 2020s (2010–2039 average) and 2050s (2040–2069 average). The average projected change can be added to the average historical baseline to infer the average projected future value of a given variable.

	Average Historical Baseline	2020s		2050s	
		Lower	Higher	Lower	Higher
Hot Days	7.5 days	7.8 days (2.3-11.6)	9.3 days (3.3-13.2)	16.1 days (5.3-24.1)	23.9 days (7.3-34.9)
Warm Nights	0.1 days	0.6 days (0.1-1.4)	0.7 days (0.2-1.3)	2 days (0.1-5.4)	4.9 days (1.2-12.5)
Hottest Day	92.1°F	3.3°F (1.2-4.9)	3.7°F (1.4-5.4)	5.8°F (2.3-8)	7.8°F (3.1-10.8)
Warmest Night	59.9°F	2.6°F (1-4.5)	2.9°F (1.6-4)	4.6°F (1.5-7.4)	6.5°F (3.6-9.6)
Daytime Heat Waves	1.1 events	1.1 events (0.4-1.7)	1.3 events (0.6-1.7)	2 events (0.9-3.1)	2.7 events (1.1-3.9)
Nighttime Heat Waves	0 events	0.1 events (0-0.2)	0.1 events (0-0.2)	0.2 events (0-0.7)	0.6 events (0-1.5)

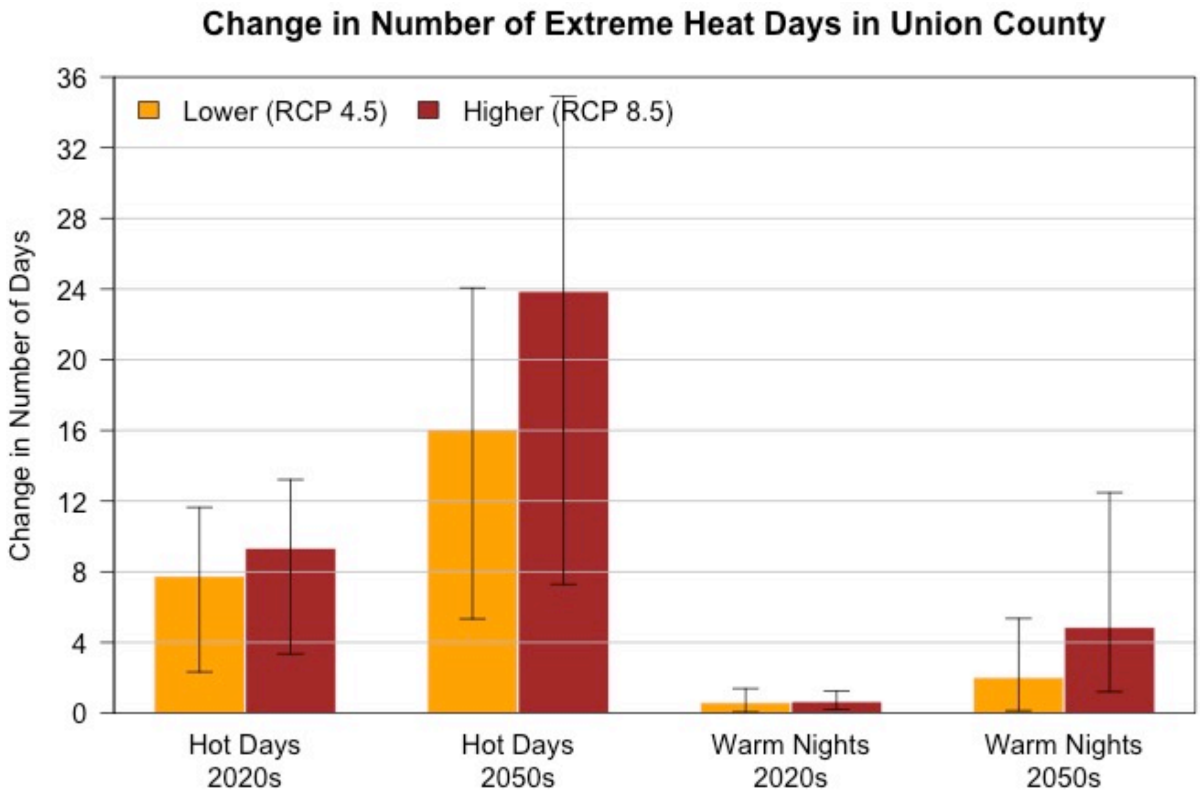

Figure 4. Projected changes in the number of hot days (left two sets of bars) and warm nights (right two sets of bars) in Union County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 20 models. Hot days are those on which the maximum temperature is 90°F or higher; warm nights are those on which the minimum temperature is 65°F or higher.

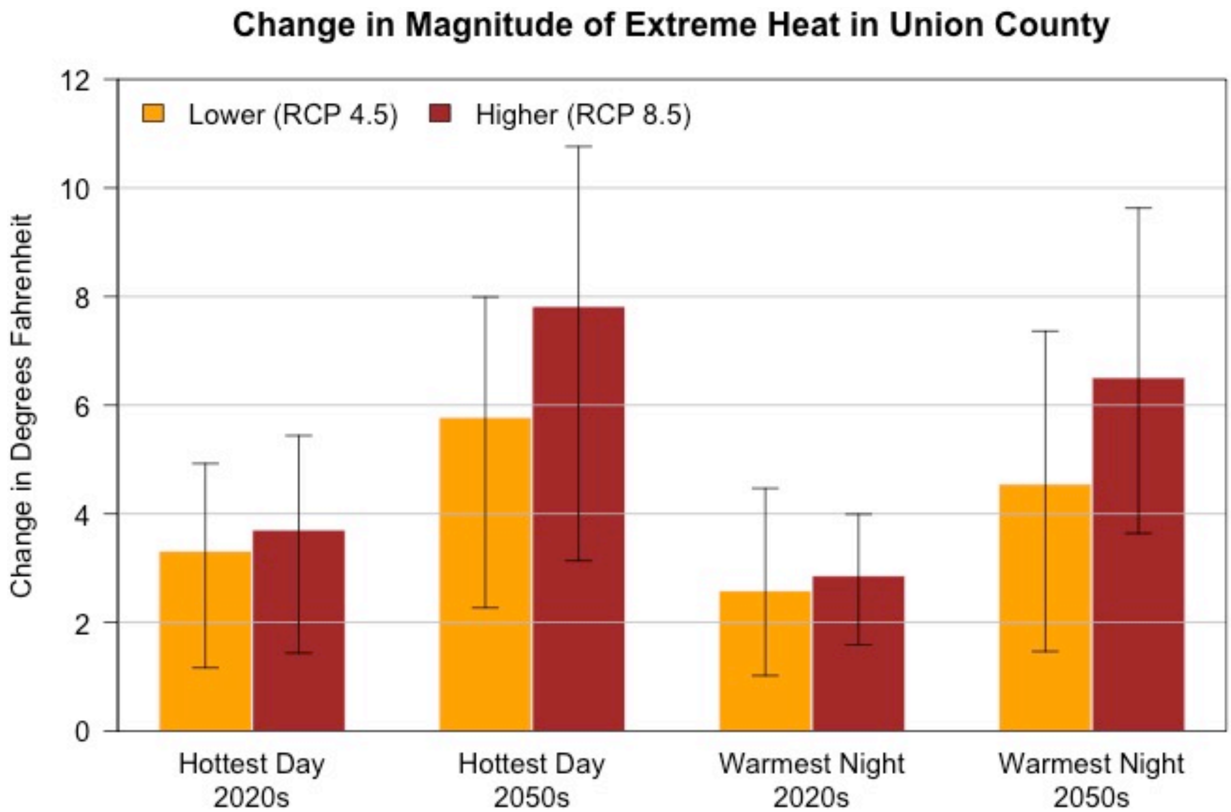

Figure 5. Projected changes in the temperature on the hottest day of the year (left two sets of bars) and warmest night of the year (right two sets of bars) in Union County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 20 models.

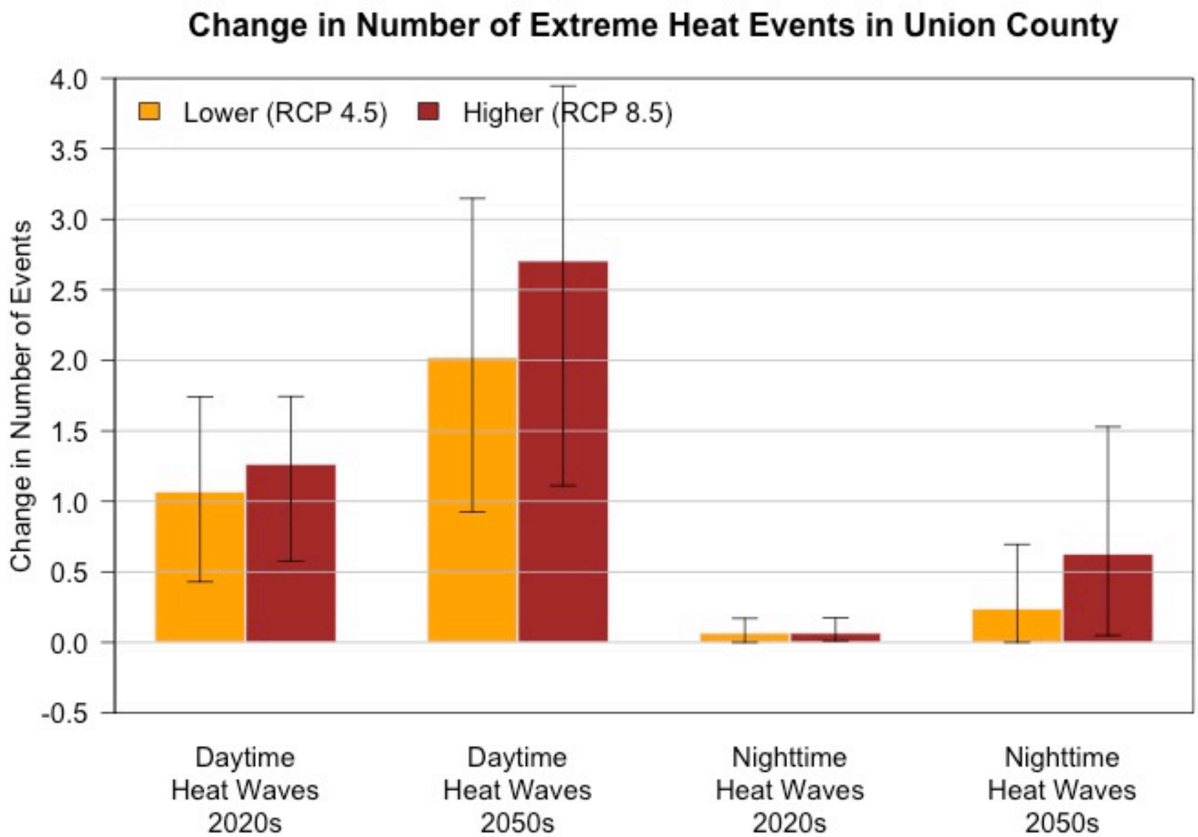

Figure 6. Projected changes in the number of daytime heat waves (left two sets of bars) and nighttime heat waves (right two sets of bars) in Union County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 20 models. Daytime heat waves are defined as three or more consecutive days on which the maximum temperature is 90°F or higher; nighttime heat waves are three or more consecutive days on which the minimum temperature is 65°F or higher.

Potential Effects of Extreme Heat on People

Certain populations are considered especially vulnerable to heat-related illness and death; extreme heat also exacerbates interpersonal violence (Miles-Novelo and Anderson, 2019; Stechemesser *et al.*, 2022). These 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 women; older adults; children; low-income communities; and communities of color (York *et al.*, 2020; Ho *et al.*, 2021).

Outdoor workers. The U.S. Bureau of Labor Statistics does not track occupational employment and wages in Union County, However, the Oregon Employment Department includes Baker, Grant, Harney, Malheur, Morrow, Umatilla, Union, and Wallowa Counties in its Eastern Oregon employment data and projections (OED, 2023). Within Eastern Oregon in 2021, an estimated 4359 individuals were employed in farming, fishing, and forestry and 4125 were employed in construction and extraction. Employment in those two sets of occupations was projected to increase by 5% and 15%, respectively, by 2031. As of 2012, an estimated 365 migrant farmworkers (including those producing livestock) and 725 seasonal farmworkers were employed in Union County (Rahe, 2018). The counties in which people are employed and reside are not always the same.

Urban areas. As of 2020, about 77% of Union County's population (20,466 people) lived within the urban growth boundaries of Cove, Elgin, Imbler, Island City, La Grande, North Powder, Summerville, and Union (PRC, 2023b). A projected 78% and 79% of the county's residents will live within urban growth boundaries by 2040 and 2069, respectively (PRC, 2023b). Population densities in cities in Union County generally are not considered high, so urban heat island effects on human health may not be extreme.

Preexisting conditions. In 2018, about 33% of adults in Union County were limited because of a physical, mental, or emotional problem (GRH, 2019). In 2020, Union County's age-adjusted prevalence of many preexisting conditions that could be exacerbated by extreme heat ranged from about 7% to 37% (Table 9). Age-adjusted prevalence data allow for comparisons in space or time as age distributions vary. These data were provided by the PLACES project, a collaboration between the U.S. Centers for Disease Control and Prevention (CDC) and Robert Wood Johnson Foundation. PLACES reports measures of chronic diseases at the county level across the United States (chronicdata.cdc.gov/500-Cities-Places/PLACES-Local-Data-for-Better-Health-County-Data-20/swc5-untb). Data are derived from the Behavior Risk Factor Surveillance System (BRFSS), sponsored by the CDC's National Center for Chronic Disease Prevention and Health Promotion, other CDC centers, and federal agency partners; and the U.S. Census.

Table 9. Prevalence of preexisting conditions among adults (aged 18 and older) in Union County, Oregon, in 2020 (blood pressure data are from 2019). Data source: PLACES project.

Preexisting condition	Age-adjusted prevalence (%)	
	Value	Range
Chronic obstructive pulmonary disease	10.1	8.8–11.4
Coronary heart disease	7.3	6.7–8.0
Current asthma	11.0	10.3–11.7
Fair or poor self-rated health status	19.2	16.7–21.6
Physical health not good for ≥14 days	14.5	13.1–16.0
High blood pressure	36.7	35.3–38.1
Depression	28.9	27.3–30.6
Mental health not good for ≥14 days	19.0	17.7–20.4

Without housing or air conditioning. As of 2017, an estimated 43people in Union County (1.6 per 1000 residents) were unhoused (OHA, 2019). A separate estimate indicated that 42.3

per 1000 students enrolled in kindergarten through grade 12, or about 168 children, were unhoused (OHA, 2019). Statewide, an estimated 34% of housing units did not have air conditioning in 2020 (EIA, 2022).

Vulnerable life stage or age class. Twenty-five percent of women aged 19 and older in Union County were pregnant from 2013–2018 (GRH, 2019). About 18% of pregnancies did not receive prenatal care from a physician during the first trimester (GRH, 2019). The percentage of Oregon residents of reproductive age (15–44) is projected to decrease from an estimated 39% in 2020 to 36% in 2045 (PRC, 2023c). If 50% of Union County's population in that age range is female (U.S. Census Bureau, 2023), and about 5% of women of reproductive age are pregnant at any given time (CDC, n.d.), then the estimated annual number of pregnant women in Union County will decrease by about 10 (4%) from 2020 to 2045 (PRC, 2023b).

The percentage of Union County residents aged 65 and older from 2016–2020, about 21% (Table 3), is higher than the statewide estimate of 19% in 2020. The percentage of older residents likely will continue to increase (PRC, 2023c). Statewide, the percentage of residents under the age of 15 is projected to decrease from 17% in 2020 to 14% in 2045 (PRC, 2023c). If trends in Union County are similar, then the projected number of residents aged 15 and younger will decrease by 515 (13%) from 2020 to 2045 (PRC, 2023b).

Low income. In 2016, about 16% (90% confidence interval 13.2–18.8%) of Union County residents and 19.9% of those aged 17 and younger (15.6–24.2%) were living in poverty (GRH, 2019). By comparison, 13.4% (13.1–13.7%) of Oregon residents and 17.2% (16.3–18.1%) of Oregon residents aged 17 and younger were living in poverty.

Communities of color. An estimated 13.1% of Union County's population identify as non-White (U.S. Census Bureau, 2023).

Summary

The number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Union County, the number of extremely hot days (those on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower and higher emissions scenarios. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 24 (range 7–35) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the hottest day of the year is projected to increase by an average of about 8°F (range 3–11°F) by the 2050s. Projected demographic changes, such as an increase in the proportion of older adults, will increase the number of people in some of the populations that are most vulnerable to extreme heat.

Cold Waves

Extremely cold temperatures in Oregon generally occur when Arctic air moves into the state from the north and east (O'Neill *et al.*, 2023). As a result of human-caused climate change, Arctic air is warming more rapidly than the global mean temperature. Therefore, the intensity and frequency of cold extremes in the Northwest and worldwide decreased over the past century (Vose *et al.*, 2017; IPCC, 2021; O'Neill *et al.*, 2023). At many locations across Oregon, the annual number of days on which the minimum temperature is below freezing has decreased significantly since 1940 (O'Neill *et al.*, 2023).

The frequency of cold extremes is expected to continue decreasing (Vose *et al.*, 2017; IPCC, 2021), although more slowly than the frequency of heat extremes will increase (O'Neill *et al.*, 2023). Extreme cold will still be possible during the next several decades, but will become increasingly rare as winter temperatures warm and become less variable (O'Neill *et al.*, 2023; Rupp and Schmittner, 2023).

Older adults, infants and children, rural residents, unhoused individuals, and people with preexisting cardiovascular or respiratory conditions are considered most susceptible to extreme cold (Conlon *et al.*, 2011; NCHH, 2022). Recent and projected estimates of these populations are summarized in *Heat Waves*.

Here, we present projected changes in three metrics of extreme daytime cold (maximum temperature) and nighttime cold (minimum temperature) (Table 10).

Table 7. Metrics and definitions of cold extremes.

Metric	Definition
Cold Days	Number of days per year on which the maximum temperature is 32°F or lower
Cold Nights	Number of days per year on which the minimum temperature is 0°F or lower
Coldest Day	Lowest value of maximum temperature per year
Coldest Night	Lowest value of minimum temperature per year
Daytime Cold Waves	Number of events per year in which maximum temperature on at least three consecutive days is 32°F or lower
Nighttime Cold Waves	Number of events per year in which minimum temperature on at least three consecutive days is 0°F or lower

The number of cold days and nights in Union County is projected to decrease by the 2020s (2010–2039) and 2050s (2040–2069) under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 11, Figure 7). For example, climate models projected that by the 2050s under the higher emissions scenario, the number of cold days will decrease by 11–28 relative to each GCM's 1971–2000 historical baseline. The average projected number of cold days per year is 19 less than the average historical baseline of 32 days. The average projected number of cold nights per year is 2 less than the average historical baseline of 3 days. The average projected number of daytime cold waves is 2 less than the average historical baseline of 4 events. Nighttime cold waves are rare in Union County (Table 11, Figure 7, Figure 9).

Similarly, the temperatures on the coldest day and night are projected to increase by the 2020s and 2050s under both emissions scenarios (Table 11, Figure 8). For example, by the 2050s under the higher emissions scenario, the temperature on the coldest night of the year is projected to increase by 0.6–17.2°F relative to the GCMs' historical baselines. The average projected increase in the temperature on the coldest night is 9.4°F above the average historical baseline of -3.2°F. The average projected increase in the temperature on the coldest day is 6.7°F above the average historical baseline of 15.7°F (Table 11, Figure 8).

Table 8. Projected future changes in extreme cold metrics in Union County. Changes from the 1971–2000 baseline were calculated for each of 20 global climate models and averaged across the 20 models (range in parentheses) for a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario and for the 2020s (2010–2039 average) and 2050s (2040–2069 average). The average projected change can be added to the average historical baseline to infer the average projected future value of a given variable.

	Average Historical Baseline	2020s		2050s	
		Lower	Higher	Lower	Higher
Cold Days	31.6 days	-9.7 days (-17.9 - -1.7)	-11.6 days (-17.7 - -2.8)	-16.2 days (-21.6 - -7.4)	-19.2 days (-27.7 - -10.9)
Cold Nights	2.5 days	-0.9 days (-2 - 0.4)	-1.3 days (-2.4 - -0.2)	-1.7 days (-3 - -0.4)	-1.8 days (-2.8 - -0.4)
Coldest Day	15.7°F	2°F (-2.2 - 5.8)	3.5°F (-0.2 - 8.8)	5.4°F (0.7 - 9)	6.7°F (0.5 - 12.7)
Coldest Night	-3.2°F	3.3°F (-2.2 - 9.6)	5.2°F (0.4 - 12.1)	7.6°F (1 - 13.8)	9.4°F (0.6 - 17.2)
Daytime Cold Waves	3.9 events	-1.1 events (-2.2 - -0.2)	-1.3 events (-2.2 - -0.4)	-1.9 events (-2.7 - -1)	-2.3 events (-3.4 - -1.3)
Nighttime Cold Waves	0.3 events	-0.1 events (-0.3 - 0.1)	-0.2 events (-0.3 - 0.1)	-0.2 events (-0.4 - 0)	-0.2 events (-0.4 - 0)

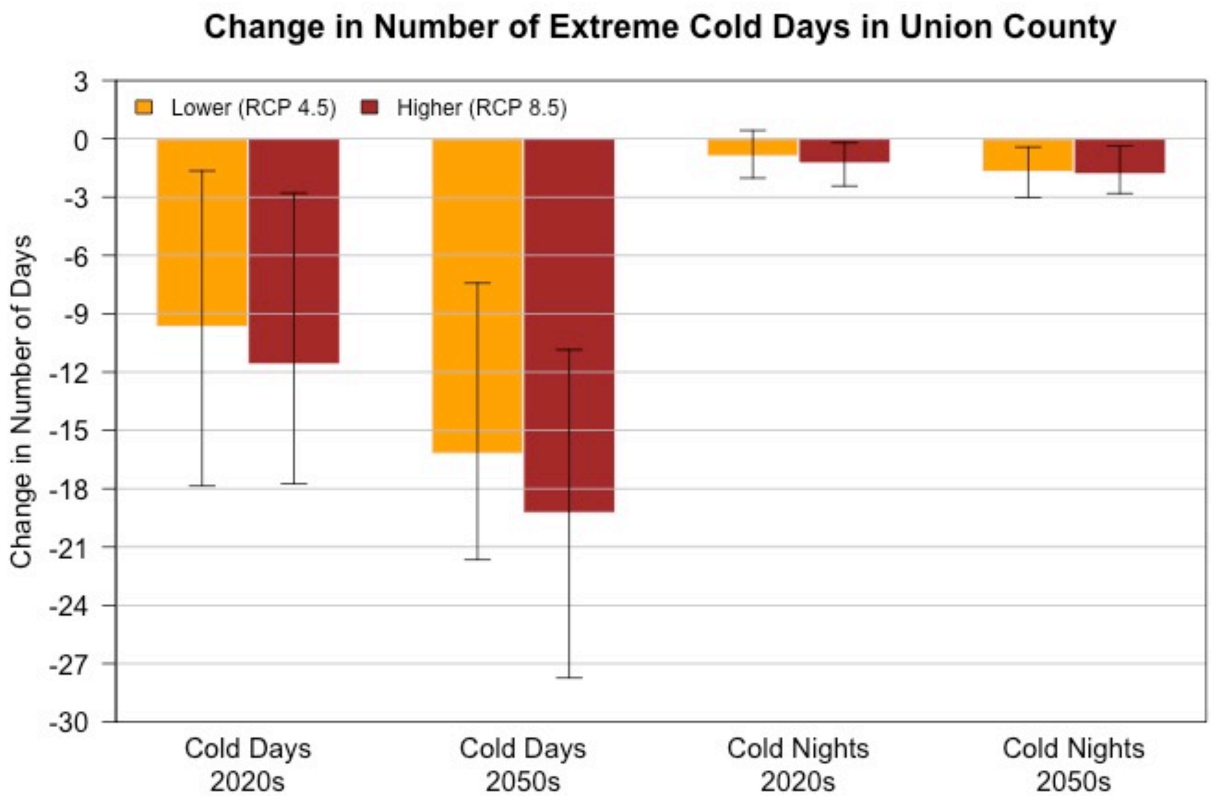

Figure 7. Projected changes in the number of cold days (left two sets of bars) and cold nights (right two sets of bars) in Union County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 20 models. Cold days are those on which the maximum temperature is 32°F or lower; cold nights are those on which the minimum temperature is 0°F or lower.

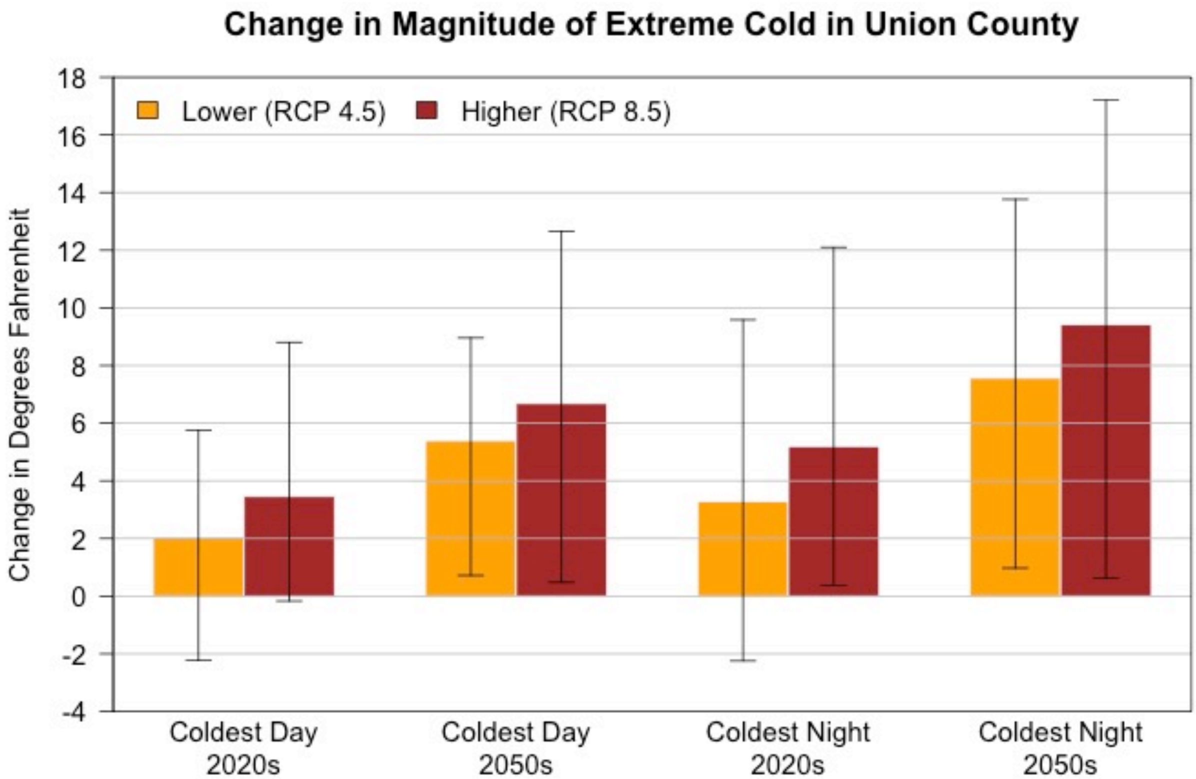

Figure 8. Projected changes in the temperature on the coldest day of the year (left two sets of bars) and coldest night of the year (right two sets of bars) in Union County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 20 models.

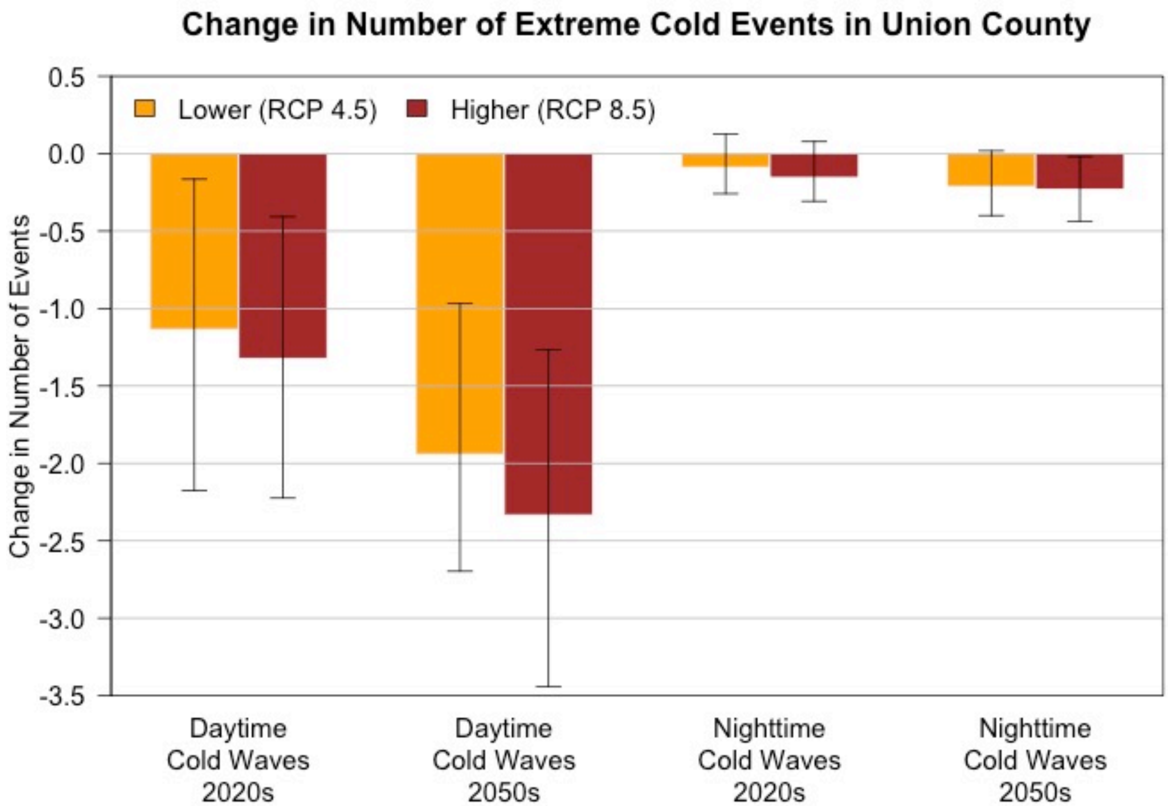

Figure 9. Projected changes in the number of daytime cold waves (left two sets of bars) and nighttime cold waves (right two sets of bars) in Union County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 20 models. Daytime cold waves are defined as three or more consecutive days on which the maximum temperature is 32°F or lower; nighttime cold waves are three or more consecutive days on which the minimum temperature is 0°F or lower.

Freezing Rain and Ice Accretion

Freezing rain forms when water droplets that are super-cooled, or that remain liquid even at temperatures below freezing, freeze on contact with a surface (Degelia *et al.*, 2016). Ice accretion refers to the process by which a layer of ice accumulates on solid objects that are exposed to freezing rain, drizzle, or fog. Because freezing rain intensities tend to be low, only long-duration events typically lead to appreciable ice accretion on surfaces (McCray *et al.*, 2019).

Published observations of ice loads from freezing rain on structures are rare (Changnon and Creech, 2003). The frequency of freezing rain is projected to increase over most of Canada and decrease over most of the eastern and central United States during the twenty-first century (Lambert and Hansen, 2011; Klima and Morgan, 2015; Jeong and Sushama, 2018; McCray *et al.*, 2022). Little change or some increase in the frequency of freezing rain, even under high warming scenarios, is projected in the Intermountain West, including parts of eastern Oregon. In coastal Oregon and Washington, by contrast, the projected frequency of freezing rain declines in the future (Jeong *et al.*, 2018; McCray *et al.*, 2022). Even so, whether the amount of freezing rain will increase or decrease is unclear, and varies among climate models, emissions scenarios, and temporal extents (Jeong *et al.*, 2018). One analysis projected decreases in the amount of ice accretion with a 50-year return period (a 2% probability of occurring in any given year) over southwestern and central-western Oregon, but no change in northern Oregon (Jeong *et al.*, 2019). Moreover, published projections of freezing rain trends usually have been provided as maps covering extensive areas (e.g., the conterminous United States or Canada, the United States, and northern Mexico), making it difficult to quantify county-level average projections.

Summary

Cold extremes will become less frequent and intense as the climate warms. The number of cold days (maximum temperature 32°F or lower) per year in Union County is projected to decrease by an average of 19 (range 11–28) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the coldest night of the year is projected to increase by an average of 9°F (range 1–17°F) by the 2050s. The number of county residents vulnerable to extreme cold is likely to grow, although this increase may be offset somewhat by the decrease in incidence of cold extremes.

Heavy Precipitation

Projections of future precipitation are less certain than projections of future temperature. Precipitation has high natural variability, and the atmospheric patterns that influence precipitation are represented differently among GCMs. Globally, mean precipitation is likely to decrease in many dry regions in the subtropics and mid-latitudes and to increase in many mid-latitude wet regions (IPCC, 2013; Stevenson *et al.*, 2022). Because the location of the boundary between mid-latitude increases and decreases in precipitation varies among GCMs, some models project increases and others decreases in precipitation in Oregon (Mote *et al.*, 2013).

Observed annual precipitation in Oregon is highly variable and has not changed significantly over the period of record. Annual precipitation in Oregon is projected to increase somewhat over the twenty-first century, although natural variability will continue to dominate this trend (Dalton *et al.*, 2017, 2021; Fleishman, 2023). On average, summers in Oregon are projected to become drier and other seasons to become wetter. However, some models project increases and others decreases in each season (Dalton *et al.*, 2017, 2021; Fleishman, 2023). In addition, regional climate models project larger increases in winter precipitation east of the Cascade Range than west of the Cascade Range, which suggests a weakened rain shadow effect in winter (Mote *et al.*, 2019).

Extreme precipitation in the Northwest is governed by atmospheric circulation and its interaction with complex topography (Parker and Abatzoglou, 2016). Atmospheric rivers—long, narrow swaths of warm, moist air that carry large amounts of water vapor from the tropics to mid-latitudes—generally result in extreme precipitation across large areas west of the Cascade Range, and are associated with the majority of fall and winter extreme precipitation events in Oregon. By contrast, low pressure systems that are not driven by westerly flows from offshore often lead to locally extreme precipitation east of the Cascade Range (Parker and Abatzoglou, 2016).

The frequency and intensity of heavy precipitation has increased across most continents since the 1950s (IPCC, 2021). Observed trends in the frequency of extreme precipitation across Oregon vary among locations, time periods, and metrics, but overall, the frequency has not changed substantially. As the atmosphere warms, it holds more water vapor. As a result, the frequency and intensity of extreme precipitation is expected to increase (Dalton *et al.*, 2017, 2021; Kossin *et al.*, 2017). Regional climate models project a larger percentage increase in precipitation extremes east of the Cascade Range than west of the Cascade Range (Mote *et al.*, 2019; Rupp *et al.*, 2022). Additionally, the projected percentage increase in extreme precipitation tends to be larger on the leeward side of the Coast and Cascade Ranges than on the windward side (Rupp *et al.*, 2022). Climate models also project an increase in the number of days on which an atmospheric river is present, and an increase in the proportion of total annual precipitation across the Northwest that is delivered by atmospheric rivers (Dalton *et al.*, 2021).

Here, we present projected changes in four metrics of precipitation extremes (Table 12).

Table 9. Metrics and definitions of precipitation extremes.

Metric	Definition
Wettest Day	Highest one-day precipitation total per water year (1 October–30 September)
Wettest Five Days	Highest consecutive five-day precipitation total per water year
Wet Days	Number of days per water year on which precipitation exceeds 0.75 inches
Landslide Risk Days	Number of days per water year that exceed the landslide threshold developed by the US Geological Survey for Seattle, Washington (see https://pubs.er.usgs.gov/publication/ofr20061064). P3/(3.5-.67*P15)>1, where ▪ P3 = Precipitation accumulation on prior days 1–3 ▪ P15 = Precipitation accumulation on prior days 4–18

In Union County, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase on average by the 2020s (2010–2039) and 2050s (2040–2069), relative to the 1971–2000 historical baseline, under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 13, Figure 10). Some models project decreases in these metrics for certain time periods and scenarios.

Climate models project that by the 2050s under the higher emissions scenario, the amount of precipitation on the wettest day of the year, relative to each GCM's 1971–2000 historical baseline, will increase by 2.5–26.2% (Figure 10). The average projected amount of precipitation on the wettest day of the year is 14.5% greater than the average historical baseline of 1.2 inches.

By the 2050s under the higher emissions scenario, the amount of precipitation on the wettest consecutive five days of the year is projected to increase by 0.1–25.2% (Figure 10). The average projected amount of precipitation on the wettest consecutive five days is 9.7% above the average historical baseline of 2.7 inches.

Table 10. Projected future changes in extreme precipitation metrics in Union County. Changes from the 1971–2000 baseline were calculated for each of 20 global climate models and averaged across the 20 models (range in parentheses) for a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario and for the 2020s (2010–2039 average) and 2050s (2040–2069 average). The average projected change can be added to the average historical baseline to infer the average projected future value of a given variable.

	Average Historical Baseline	2020s		2050s	
		Lower	Higher	Lower	Higher
Wettest Day	1.2 inches	9.9% (0.8-19.2)	7.8% (-1.2-20.8)	12.1% (-0.6-20)	14.5% (2.5-26.2)
Wettest Five-Days	2.7 inches	6.2% (-5.5-19.4)	3.7% (-7.2-17.3)	7.3% (-3-14.9)	9.7% (0.1-25.2)
Wet Days	4.4 days	0.4 days (-0.2-1)	0.2 days (-0.4-1.3)	0.7 days (0-1.3)	0.9 days (0-1.9)
Landslide Risk Days	5.8 days	0.6 days (-0.5-1.9)	0.5 days (-1.3-2.3)	0.9 days (-0.3-1.9)	1.3 days (-0.1-3.8)

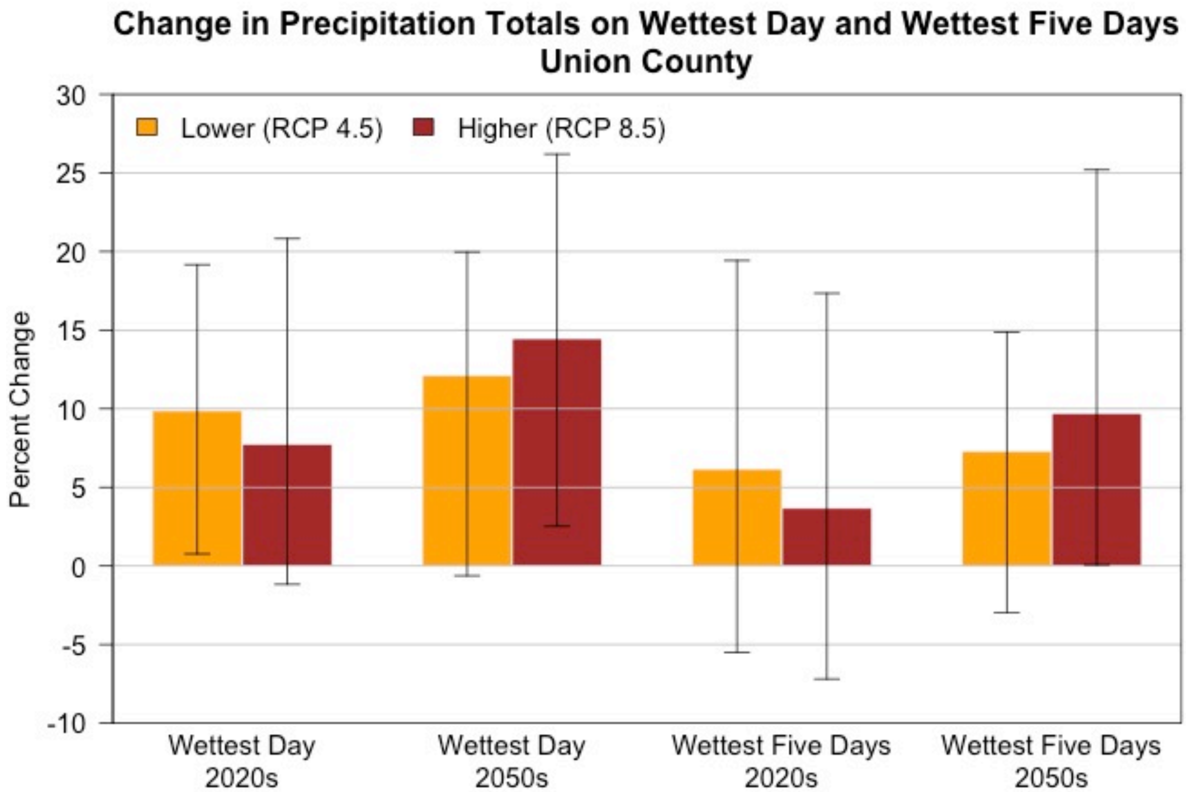

Figure 10. Projected percent changes in the amount of precipitation on the wettest day of the year (left two sets of bars) and wettest consecutive five days of the year (right two sets of bars) in Union County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 20 models.

The average number of days per year on which precipitation exceeds 0.75 inches is not projected to change substantially (Figure 11). For example, by the 2050s under the higher emissions scenario, the number of wet days per year is projected to increase by 0.9 (range -0.0–1.9). The historical baseline is an average of 4.4 days per year.

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, we present a threshold based on recent rainfall (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation during the 15 days prior to the previous 3 days). By the 2050s under the higher emissions scenario, the average number of days per year in Union County on which the landslide risk threshold is exceeded is projected to increase by 1.3 (range -0.1–3.8) (Figure 11). The historical baseline is an average of 5.8 days per year. Landslide risk depends on multiple site-specific factors, and this metric does not reflect all aspects of the hazard. Also, the landslide risk threshold was developed for Seattle, Washington, and may be less applicable to other locations.

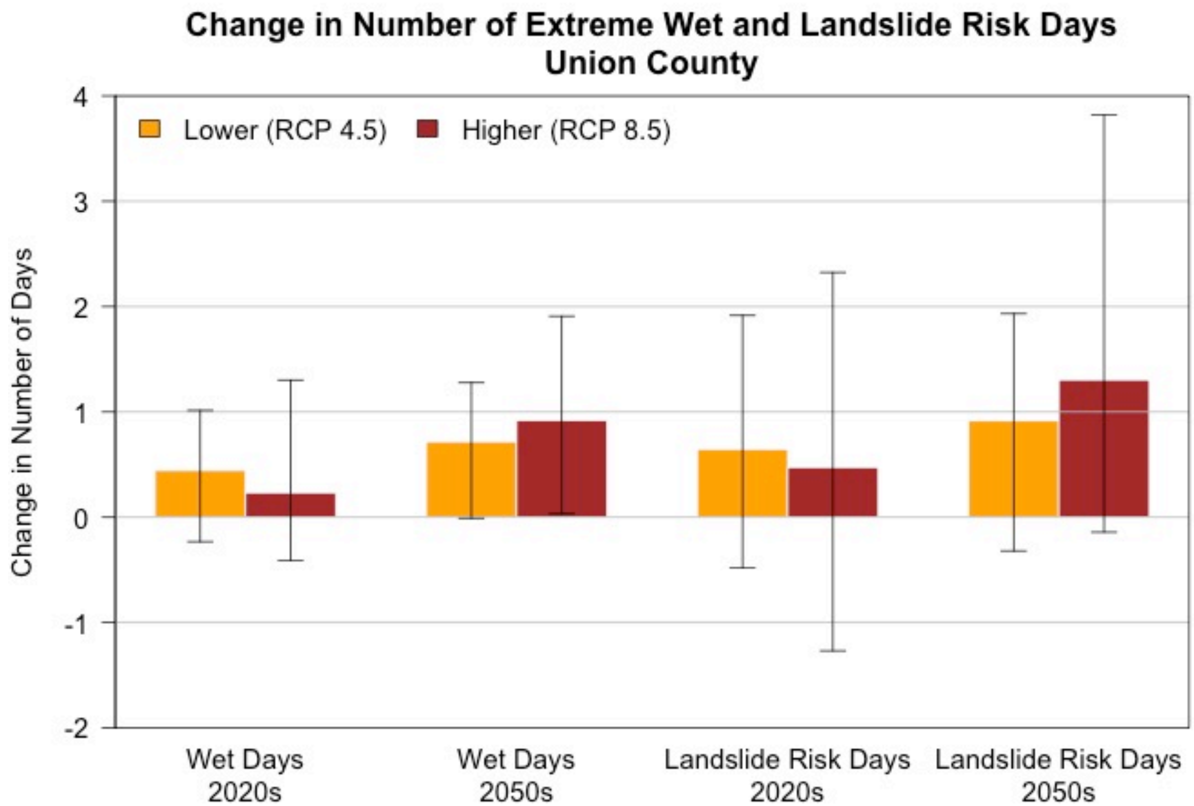

Figure 11. Projected changes in the number of wet days (left two sets of bars) and landslide risk days (right two sets of bars) in Union County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 20 models.

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% from 1980–2005 to 2100 under the higher emissions scenario (Touma *et al.*, 2022). Similarly, projections suggested that by 2100, 90% of extreme fire-weather events across Oregon and Washington are likely to be succeeded within five years by three or more extreme rainfall events (Touma *et al.*, 2022). Although fire weather is not synonymous with wildfire, these results highlight the increasing likelihood of compounded climate extremes that elevate the risk of natural hazards.

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, and children and pregnant women (York *et al.*, 2020; Ho *et al.*, 2021). Recent and projected estimates of populations that are older, younger, and of childbearing age are included in previous sections. 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).

Summary

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Union County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. Nevertheless, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 15% (range 3–26%) and 10% (range 0–25%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The number of days per year on which a threshold for landslide risk, which is based on prior 18-day precipitation accumulation, is exceeded is projected to increase by 1 (range 0–4). However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

River Flooding

Streams in the Northwest are projected to shift toward higher winter runoff, lower summer and fall runoff, and earlier peak runoff, particularly in snow-dominated regions (Raymondi *et al.*, 2013; Naz *et al.*, 2016). These changes are expected 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 project increases in extreme high flows throughout most of the Northwest, especially west of the Cascade crest (Salathé *et al.*, 2014; Najafi and Moradkhani, 2015; Naz *et al.*, 2016). One study that used a single climate model projected an increase in flood risk in fall due to earlier, more extreme storms, including atmospheric rivers; and an increase in the proportion of precipitation falling as rain rather than snow (Salathé *et al.*, 2014). Rainfall-driven floods are more sensitive to increases in precipitation than snowmelt-driven floods. Therefore, the projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region (Chegwidden *et al.*, 2020).

The Grande Ronde River is within a snow-dominated basin in which flow peaks during late spring snowmelt. By the 2050s (2040–2069), under both emissions scenarios, streamflow in the Grande Ronde River at Troy is projected to peak earlier in spring as warmer temperatures cause the snowpack to melt earlier (Figure 12). In addition, winter streamflow is projected to increase due to increased winter precipitation and a greater percentage of precipitation falling as rain rather than snow. Mean monthly flows do not translate directly to flood risk because floods occur over shorter periods of time. However, increases in monthly flow may imply increases in flood likelihood, particularly if increases are projected to occur during months in which flood occurrence historically has been high.

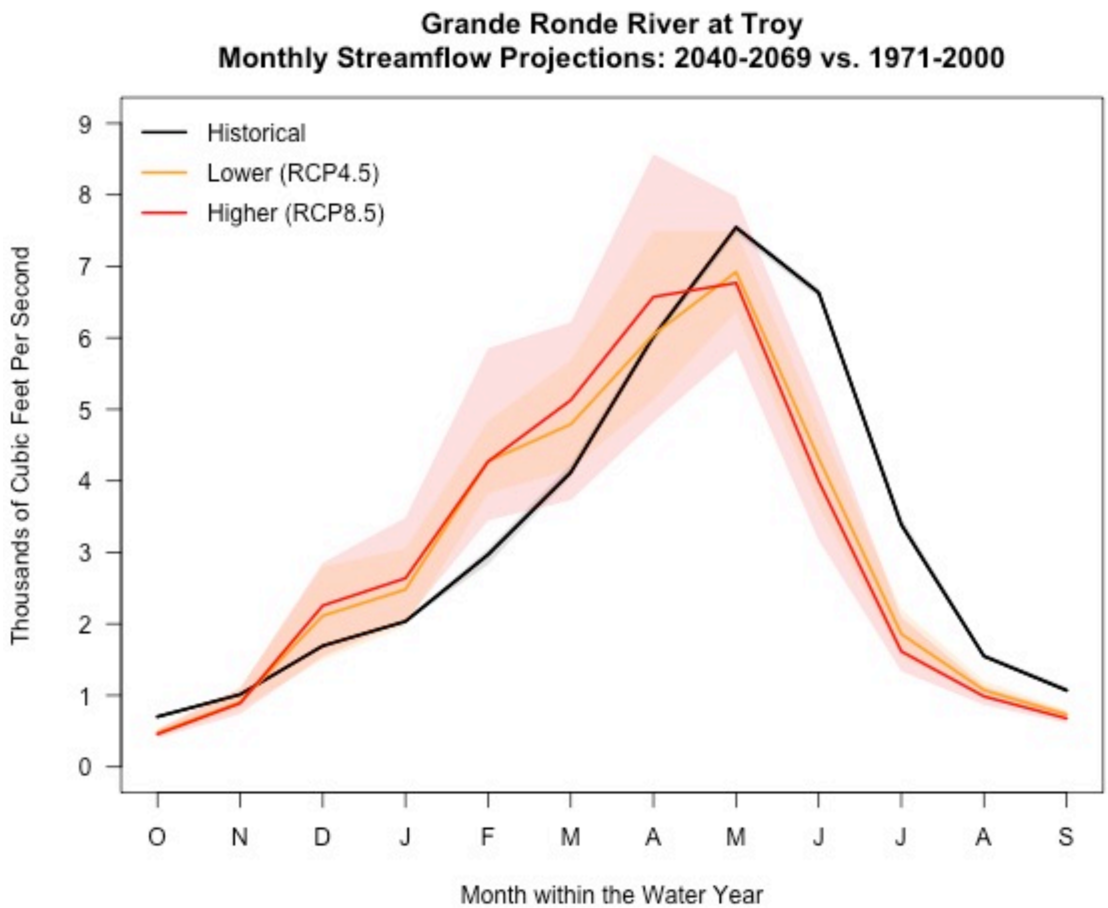

Figure 12. Simulated monthly, bias-corrected, non-regulated streamflow at the Grande Ronde River at Troy from 2040–2069 compared to 1971–2000. Solid lines and shading represent the mean and range across ten global climate models. (Data source: Integrated Scenarios of the Future Northwest Environment, climatetoolbox.org/tool/future-streamflows)

Across the western United States, the average magnitudes of major floods are projected to increase by 14–19% by 2010–2039, 21–30% by 2040–2069, and 31–43% by 2070–2099, compared to the 1971–2000 historical baseline, under the 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% probability that this daily flow magnitude will be exceeded in a given year). Peak flow magnitudes with 25-year and 100-year return periods along the Grande Ronde River at Troy were projected to increase by about 12% and 17%, respectively (Maurer *et al.*, 2018).

Within the Columbia River basin, projected major flood magnitudes by 2050–2099, compared to 1950–1999, increased nearly everywhere and varied by dominant precipitation type (Queen *et al.*, 2021). On the Grande Ronde River at Troy, flood levels with 10-year and 100-year return periods (10% and 1% probability, respectively, that this daily flow magnitude will be exceeded in a given year) were projected to increase on average by 48% and 68%, respectively, from 1950–1999 to 2050–2099 under the higher emissions scenario (Queen *et al.*, 2021).

We estimated projected changes in the average magnitude of single-day flood levels with 2-year, 10-year, and 25-year return periods (50%, 10%, and 4% probability, respectively, that this daily flow magnitude will be exceeded in a given year) along the Grande Ronde River at Troy (Table 14). We then compared flood magnitudes between 1961–2010 and 2031–2080. Under the higher emissions scenario, the average magnitudes of single-day floods with 2-year, 10-year, and 25-year return periods were projected to increase by 17%, 32%, and 37%, respectively (Table 14, Figure 13). Some models projected no change or decreases in the magnitude of maximum daily flows for each return period. These results can be interpreted as either an increase in flood magnitude given a flood frequency, or an increase in flood frequency given a flood magnitude. These analyses were exploratory and should not be applied to engineering or design.

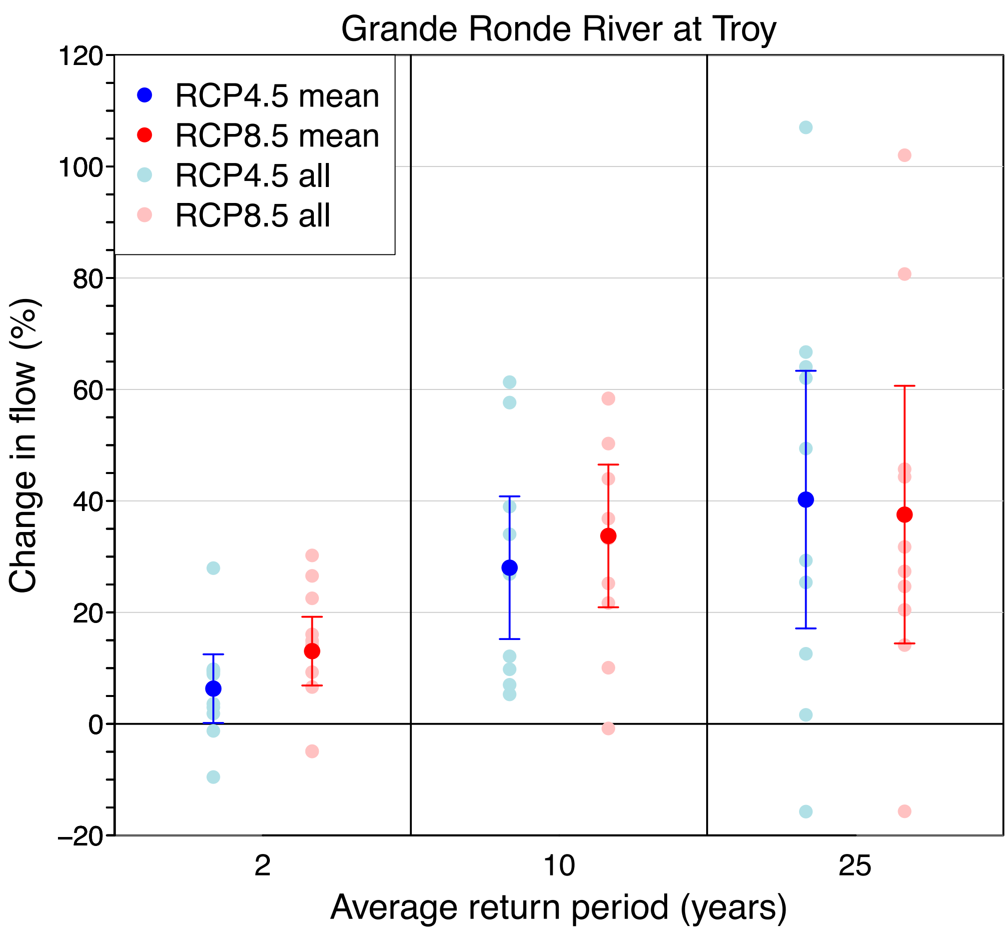

Figure 12. Projected change in water-year maximum daily, non-regulated streamflows with 2-year, 10-year, and 25-year return periods along the Grande Ronde River at Troy from 1961–2010 to 2031–2080 under lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. Larger blue and red dots and bars represent the mean and two standard errors across ten global climate models. Only ten of the full set of 20 models that were used to project temperature and precipitation simulated future hydrology (see *Appendix*). Smaller light

blue and light red dots represent projections from individual models. (Data source: Integrated Scenarios of the Future Northwest Environment, climate.northwestknowledge.net/IntegratedScenarios/)

Table 14. Percentage change in peak flow associated with multiple return periods for the Grande Ronde River at Troy under the higher emissions scenario.

Return Period (Probability that this level will be exceeded in a given year)	Average Percentage Change in Flow	Time Periods Compared	Source
2-year (50%)	17	2031–2080 vs. 1961–2010	This report
10-year (10%)	48	2050-2099 vs. 1950-1999	Queen et al. (2021)
	32	2031–2080 vs. 1961–2010	This report
25-Year (4%)	12	2070–2099 vs. 1971–2000	Maurer et al. (2018)
	37	2031–2080 vs. 1961–2010	This report
100-Year (1%)	17	2070–2099 vs. 1971–2000	Maurer et al. (2018)
	68	2050-2099 vs. 1950-1999	Queen et al. (2021)

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). Wildfires and shifts in vegetation that affect soil properties also will likely affect water transport, but hydrological models generally have not accounted for these processes (Bai *et al.*, 2018; Wang *et al.*, 2020; Williams *et al.*, 2022).

Potential Effects of Projected Flooding on Infrastructure

First Street Foundation (2023) estimated that 5501 properties in Union County (52%) have a >26% probability of being severely affected by flooding by 2053. Severe flooding corresponds to a 1-in-100 year flood, or a flood with a 1% probability of occurring in a given year, and such an event as a 26% probability of occurring one or more times during a 30-year mortgage period. Among the structures that may be affected by flooding are 5389 residences (58%) and 330 commercial properties (73%) at major risk and 11 critical infrastructure facilities (e.g., hospitals; police, fire, and power stations; and water treatment facilities) (48%) and 36 (62%) social facilities (schools, houses of worship, museums, and government or historic buildings) at moderate risk (Table 15). Of the 7314 miles of roads in Union County, 2075 (28%) were estimated to be at severe risk of flooding (First Street Foundation, 2023).

Table 15. 30-year cumulative probability of flooding to different depths and First Street Foundation's associated risk characterizations.

		30-year cumulative probability					
		≤0.06	>0.06–0.12	>0.12–0.27	>0.27–0.47	>0.47–0.96	>0.96
Flood depth	0–3"	Low	Moderate	Moderate	Major	Major	Severe
	>3–6"	Low	Moderate	Moderate	Major	Major	Severe
	>6–9"	Moderate	Moderate	Major	Major	Severe	Extreme
	>9–12"	Moderate	Moderate	Major	Severe	Severe	Extreme
	>12–24"	Moderate	Major	Major	Severe	Extreme	Extreme
	>24"	Major	Major	Severe	Extreme	Extreme	Extreme

Summary

Winter flood risk at intermediate to low elevations in Union County, where temperatures are near freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow.

Drought

Drought can be defined in many ways (Table 16), but most fundamentally is insufficient water to meet needs (Redmond, 2002; O'Neill *et al.*, 2021; O'Neill and Siler, 2023). Drought is common in the Northwest, particularly because seasonal precipitation is lowest during the warmest season (O'Neill and Siler, 2023). The incidence, extent, and severity of drought increased over the last 20 years relative to the twentieth century, and this trend is expected to continue (O'Neill *et al.*, 2021; O'Neill and Siler, 2023).

Table 16. Definitions and characteristics of various drought classes. (Sources: O'Neill *et al.*, 2021; O'Neill and Siler, 2023; Fleishman *et al.*, unpublished)

Drought Class	Definition and Characteristics
Meteorological	• lack of precipitation • evaporative demand that exceeds precipitation for 90 days or longer
Hydrological	• extended periods of meteorological drought that affect surface or subsurface water supply, such as streamflow, reservoir and lake levels, or ground water levels • tends to evolve more slowly than meteorological drought and to persist for longer than six months
Agricultural	• occurs when lack of surface or subsurface water adversely affects agricultural production • reflects precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced availability of water for irrigation
Socioeconomic	• occurs when meteorological, hydrological, or agricultural drought reduces the supply of an economic or social good or service • often affects issuance of state and federal drought declarations
Ecological	• undesirable changes in ecological state caused by deficits in water availability • usually caused by meteorological or hydrological drought • sensitivity to water limitation varies among species and life stages
Flash	• rapid-onset period of elevated surface temperature, low relative humidity, precipitation deficit, and a rapid decline in soil moisture • tends to develop and intensify rapidly within a few weeks, and may be generated or magnified by prolonged heat waves
Snow	• snowpack—or snow water equivalent (SWE)—is below average for a given point in the water year, traditionally 1 April • often presages hydrological drought during the ensuing spring and summer in snowmelt-dominated watersheds • warm snow drought refers to below-average snowpack that results primarily from above-average winter temperatures • dry snow drought refers to below-average snowpack that results primarily from below-average winter precipitation

Drought often affects human health indirectly, such as through food scarcity and the increased incidence of infectious, chronic, and vector-borne diseases. Moreover, drought affects both physical and mental health (Vins *et al.*, 2015). Low income, tribal, rural, and farming and farmworker communities are especially susceptible to negative health effects as a result of drought and associated water scarcity and poor water quality (York *et al.*, 2020; Ho *et al.*, 2021). Recent and projected estimates of low income, rural, and some farmworker populations are presented in previous sections.

By 2100, annual mean precipitation in Oregon is projected to increase by 5–10% (O'Neill and Siler, 2023). However, summers in the state are expected to become drier and warmer (Dalton *et al.*, 2021; Fleishman, 2023). As winters become warmer, snowpack across Oregon is projected to decline by approximately 25% by 2050 relative to 1950–2000 (Siirila-Woodburn *et al.*, 2021). The decline in snowpack across the western United States is projected to reduce summer soil moisture in the mountains (Gergel *et al.*, 2017). Climate change is also expected to reduce summer streamflows in snow-dominated and mixed rain and snow basins across the Northwest as snowpack melts earlier and summer precipitation decreases (Dalton *et al.*, 2017; Mote *et al.*, 2019). For example, summer flow is projected to decrease in the Grande Ronde River by the 2050s (Figure 12). As mountain snowpack declines, seasonal drought will become less predictable and snow droughts will increase the likelihood of hydrological and agricultural drought during the following spring and summer (Dalton and Fleishman, 2021; Fleishman, 2023).

We present projected changes in four variables indicative of drought: low spring (April 1) snowpack (snow drought), low summer (June–August) soil moisture from the surface to 55 inches below the surface (agricultural drought), low summer runoff (hydrological drought), and low summer precipitation (meteorological drought). We present drought in terms of a change in the probability of exceeding the magnitude of seasonal conditions for which the historical annual probability of exceedance was 20% (5-year return period) (Figure 14).

Summer soil moisture, spring snowpack, summer runoff, and summer precipitation in Union County are projected to decline by the 2050s under both lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. Therefore, seasonal drought will occur more frequently by the 2050s (Figure 14). By the 2050s under the higher emissions scenario, the annual probability of low summer soil moisture is projected to be about 49% (2-year return period). The annual probabilities of low spring snowpack, low summer runoff, and low summer precipitation are projected to be about 60% (1.7-year return period), 55% (1.8-year return period), and 33% (3.1-year return interval), respectively.

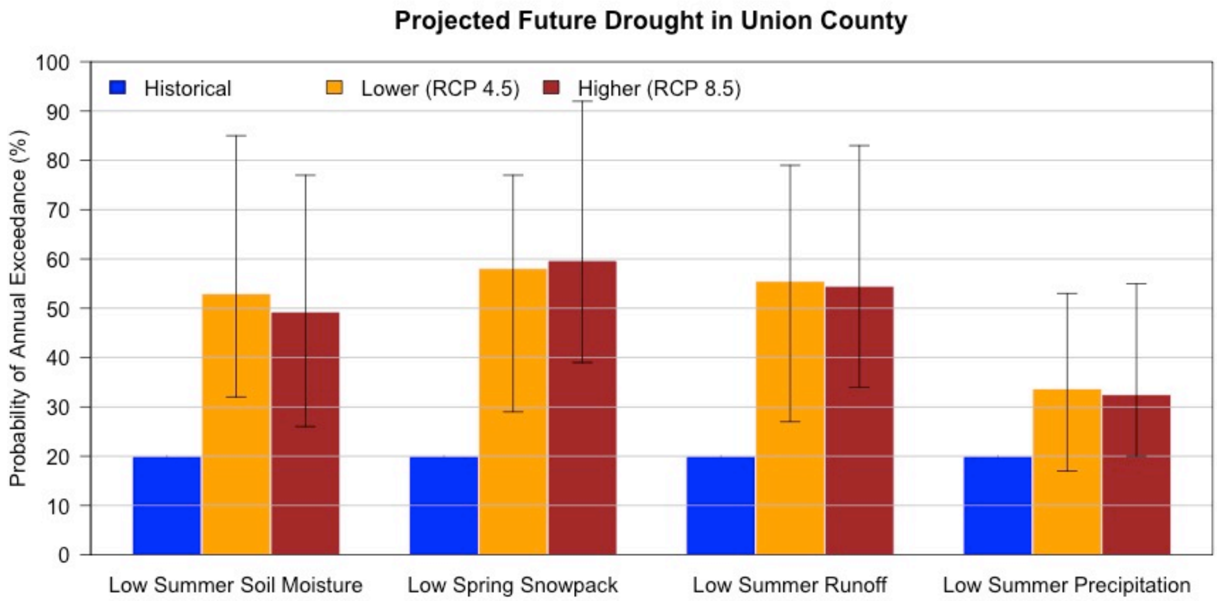

Figure 14. Projected probability of exceeding the magnitude of seasonal drought conditions for which the historical annual probability of exceedance was 20%. Projections are for the 2050s (2040–2069), relative to the historical baseline (1971–2000), under two emissions scenarios. Seasonal drought conditions include low summer soil moisture (average from June through August), low spring snowpack (April 1 snow water equivalent), low summer runoff (total from June through August), and low summer precipitation (total from June through August). The bars and whiskers represent the mean and range across ten global climate models. (Data source: Integrated Scenarios of the Future Northwest Environment, climate.northwestknowledge.net/IntegratedScenarios/)

Summary

Drought, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is projected to become more frequent in Union County by the 2050s. The incidence of related negative physical and mental health outcomes, especially among low income, tribal, rural, and agricultural communities, is likely to increase.

Wildfire

Projection of contemporary wildfire risk requires an understanding of interactions among plant physiology, climate, and human activities.

Aridity, Heat, Insects, and Wildfire Risk

Drought across the western United States has been exacerbated by warmer winters and springs, which drive an overall decline in mountain snowpack and earlier snowmelt (Westerling, 2016), and by longer summers. Extreme heat in June 2021 (Heeter *et al.*, 2023) caused mortality of seedlings and saplings in plantations while scorching the canopy of mature trees (Still *et al.*, 2023). 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. If tall trees cannot draw enough water from the soil, they may be at risk of embolism (Olson *et al.*, 2018; Anfodillo and Olson, 2021) and more likely to die. Dry dead or living vegetation is more likely to burn than wet vegetation. Because concurrent heat and drought are becoming more common (Alizadeh *et al.*, 2020), the volume of stressed or dead vegetation and wildfire risk are increasing.

Trees that become drought-stressed generally are more vulnerable to outbreaks of native and non-native insects and pathogens that can lead to the trees' death. For example, densities of mountain pine beetles (*Dendroctonus ponderosae*), which are native to eastern Oregon, generally are low, but eruptions can result in 60% stand-level mortality over tens to hundreds of square miles (Abrams *et al.*, 2021). The insects primarily feed on lodgepole, ponderosa, western white, sugar, and whitebark pine (*Pinus contorta*, *ponderosa*, *monticola*, *lambertiana*, and *albicaulis*). Mountain pine beetles carry fungi that can hasten tree death, especially during a drought, by disrupting water transport. The beetles usually have one generation per year, but may be able to reproduce twice per year as temperatures increase.

Western spruce budworm (*Choristoneura freemani*) and Douglas-fir tussock moth (*Orgyia pseudotsugata*) are moths native to Oregon. They feed on the foliage of Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), white fir (*Abies concolor*), Englemann spruce (*Picea engelmannii*), and other conifers, reducing tree growth and increasing the trees' susceptibility to other insects and pathogens and the likelihood of mortality (Flower *et al.*, 2014). In 1991, for example, 6250 square miles were defoliated by the budworm (Oester *et al.*, 1992). The effects of these insects on trees generally are greatest during hot, dry summers.

The dryness of the air, also called evaporative demand, is characterized by the vapor pressure deficit (VPD). The VPD is the difference in atmospheric pressure between the current amount of water vapor in the air and the maximum amount of water the air can hold at a given temperature (dew point). VPD is increasing globally, and CMIP6 climate models indicate that human emissions of greenhouse gases explained 68% of the observed VPD increase from 1979 through 2020 (Zhuang *et al.*, 2021). These models also project that across the western United States, given a higher emissions scenario, warm season VPD over the next 30 years will increase at a rate similar to that observed from 1979 through 2020 (Zhuang *et al.*, 2021). Area burned is more strongly correlated with VPD than with other drought indices or variables, such as temperature and precipitation (Sedano and

Randerson, 2014; Williams *et al.*, 2014; Seager *et al.*, 2015; Rao *et al.*, 2022). CMIP5 models projected that increases in VPD will contribute substantially to wildfire risk in Oregon (Ficklin and Novick, 2017; Chiodi *et al.*, 2021) and across the West (Abatzoglou *et al.*, 2021a; Zhuang *et al.*, 2021; Juang *et al.*, 2022).

From 1985 through 2017, the annual area burned by high-severity fires across forests in the western United States increased eightfold (Parks and Abatzoglou, 2020). The frequency of large wildfires in forests has also increased: such fires now occur nearly every year in the Northwest (Rupp and Holz, 2023). About half of the observed increase in vegetation dryness in the western United States from 1984 through 2015—again, driven mainly by the dryness of the air—and 16,000 square miles of burned area were attributable to human-caused climate change (Abatzoglou and Williams, 2016).

Historically, wildfires were less active overnight, and the probability of fire expansion generally was evaluated on the basis of daytime conditions. However, across the western United States, the number of nights during which atmospheric conditions are conducive to burning has increased by 45% since 1979 (Balch *et al.*, 2022). 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).

Land Use and Wildfire Risk

Projections that include concurrent increases in aridity, temperature, and intensification of land use (which leads to an increase in human ignitions; see below) 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). Under the lower emissions scenario, the average annual area burned in Oregon's forests is expected to increase by at least 50% over the next several decades (Rupp and Holz, 2023). In addition, a 3.6°F increase above the average annual temperature from 2002–2020 was projected to double the annual number of extreme, single-day spreading wildfires in the western United States (Coop *et al.*, 2022). The interactions among housing development, the growth of tourism in forested areas, and increasing atmospheric dryness suggest that past projections of changing wildfire risk in the West may be underestimates (Rao *et al.*, 2022).

Extreme wildfires often occur when vegetation is dry and weather conditions conducive to fire, including high temperatures, aridity, and wind speeds (Reilly *et al.*, 2022), coincide. These fires can cause widespread loss of structures and the loss of human lives (Abatzoglou *et al.*, 2021b). The 2020 Labor Day fires in the western Cascade Range (Higuera and Abatzoglou, 2021) were enabled in part by a warm and dry summer (as is typical in Oregon) that caused vegetation to dry, strong east winds that carried extremely dry air, and human-caused ignitions.

Human activities have modified fire dynamics in western forests through fragmentation and exploitation of these ecosystems; increased recreational activity; the introduction of highly flammable, non-native annual grasses; and replacement of indigenous or lightning-ignited fires by extensive fire suppression and vegetation management. Over 60% of Union County is classified as evergreen forest, about equally distributed across private and public lands (Oregon Explorer, 2023). Seventeen percent of the county is classified as agricultural and two percent as urban.

Over 80% of ignitions in the United States are now human-caused (Balch *et al.*, 2017), and human-caused ignitions accounted for 35% of the fire starts in Union County from 1992 through 2020 (Short, 2022; Figure 15). As detailed below, longer summers and human activities have increased the temporal and geographic extent of the fire season (Balch *et al.*, 2017; Bowman *et al.*, 2020; Jones *et al.*, 2022), increasing the probability that an ignition in late summer could spread across large areas of timberland and remnants of old growth.

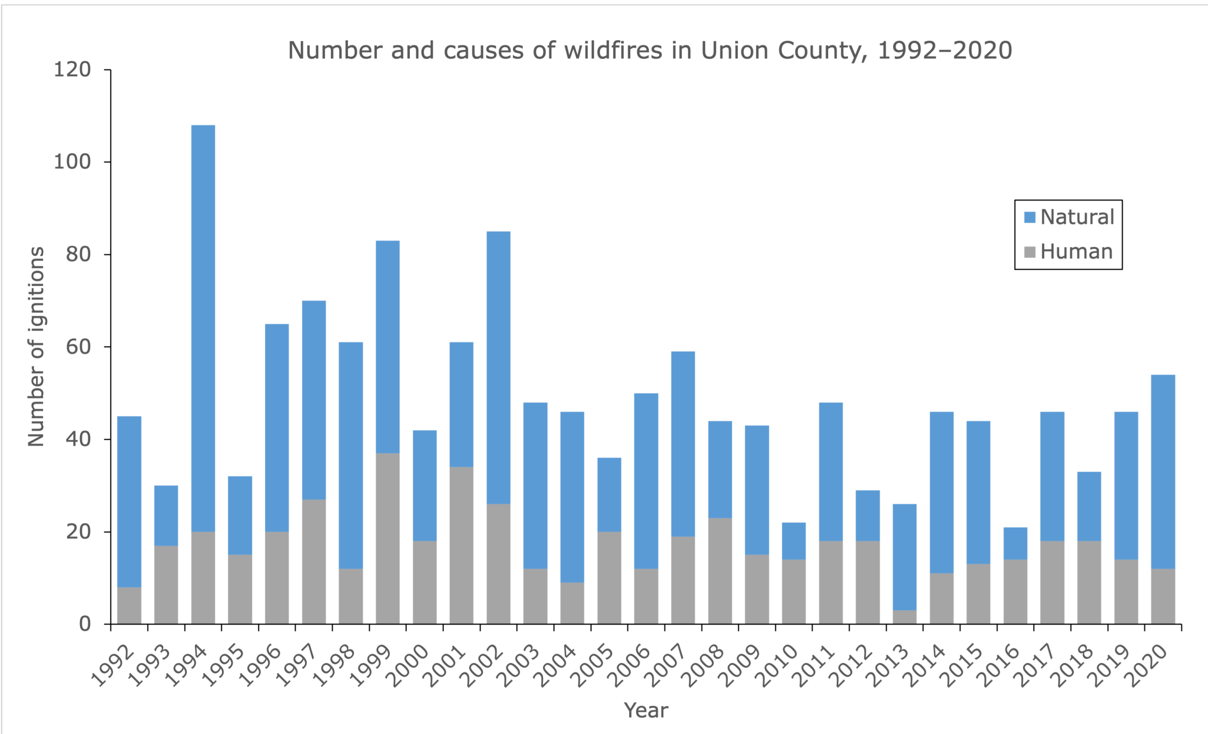

Figure 15. Causes of ignitions that led to wildfires in Union County from 1992–2020. (Data source: Short, 2022.)

Management practices likely affected the severity of the 2020 wildfires in Oregon (Allen *et al.*, 2019; Downing *et al.*, 2022). Uniform canopy structure, which is common in forest plantations on private lands, can lead to subcanopy winds that transport moisture out of the watershed (Drake *et al.*, 2022). Crowning and torching associated with dry trees may increase the potential for long-distance spot fires that can cause rapid expansion of the fire front and overwhelm suppression efforts (Rothermel, 1991; Koo *et al.*, 2010; Storey *et al.*, 2020). Firebrands can be carried far by strong winds: in September 2017, embers from the Eagle Creek fire jumped across the Columbia River and started some spot fires on the Washington side.

Duration and Magnitude of Wildfire Risk

The duration of the wildfire season is increasing across the western United States (Dennison *et al.*, 2014; Jolly *et al.*, 2015; Westerling, 2016; Williams and Abatzoglou, 2016), and the duration of the fire weather season in forests of the Northwest increased by 43% from 1979 through 2019 (Jones *et al.*, 2022). Accelerated warming and drying at higher elevations has made wildfire possible in an additional 11% of forests in mountains of the western United States (Alizadeh *et al.*, 2021). Anthropogenic emissions increased the likelihood of extreme fire weather during fall by about 40% over the western United States and about 50% over western Oregon, largely because vegetation in fall is becoming drier and warmer temperatures are coinciding with dry winds (Hawkins *et al.*, 2022). Similarly, the number of days per year on which fire danger was extreme increased by 166% from 1979 through 2019 (Jones *et al.*, 2022). Extreme fire danger was defined as the highest 5% of values of the Canadian Fire Weather Index, which is based on estimates of fuel moisture derived from temperature, precipitation, humidity, and wind (Van Wagner, 1987; Jones *et al.*, 2022).

The Northwest Interagency Coordination Center (gacc.nifc.gov/nwcc/) uses the 100-hour fuel moisture (FM100) index to predict fire danger. FM100 is a measure of the percentage of moisture in dead vegetation of 1–3 inch diameter and is calculated from precipitation, temperature, and relative humidity according to the equations in the National Fire Danger Rating System (Bradshaw *et al.*, 1984). A majority of climate models project that FM100 will decline by the 2050s (2040–2069) under the higher emissions scenario (Gergel *et al.*, 2017), increasing fire danger across Oregon. Projections of the Keetch–Byram Drought Index, a common fire index that is based on the response of vegetation moisture to precipitation and temperature, suggested that within the Northwest, the area with high fire danger in summer will increase by 345% from 1996–2004 to 2086–2094 under the higher emissions scenario (Brown *et al.*, 2021). All of these methods project 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 (Brown *et al.*, 2021).

Projected Wildfire Risk in Union County

Here, we estimate the future change in wildfire risk with two metrics, FM100 and VPD, that are proxies for extreme fire danger, or conditions under which wildfire is likely to spread. We present projected changes in the average annual number of days on which FM100 is very high and VPD is extreme for two future periods, both of which we compare to the historical baseline (1971–2000 average), under two emissions scenarios. We define a day with very high fire danger as one on which the FM100 value (moisture on the forest floor or at the base of other vegetation) is comparable to the lowest (driest) 10% of values within the historical baseline period. Historically, fire danger was very high on 36.5 days per year. By the 2050s under the higher emissions scenario, the average number of days per year on which fire danger is very high in Union County is projected to increase by 16 (range -4–38) (Figure 16).

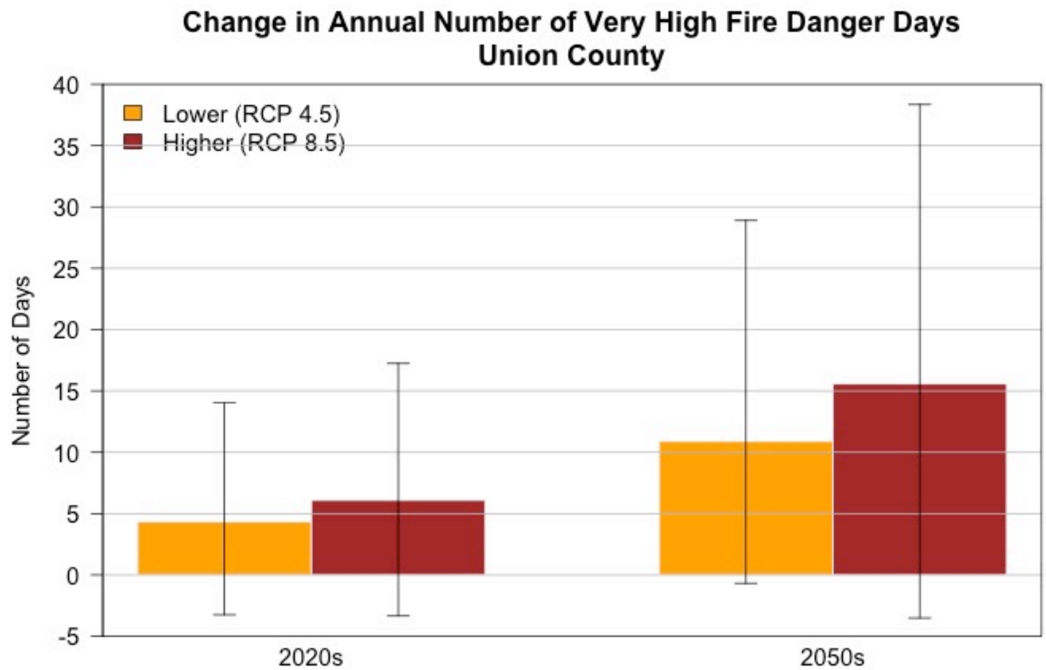

Figure 16. Projected changes by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the 1971–2000 historical baseline and under two emissions scenarios, in the number of days on which fire danger in Union County is very high. Changes were calculated for each of 18 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 18 models. Eighteen of the full set of 20 models that were used to project temperature and precipitation included the data necessary to estimate fire danger. (Data source: Climate Toolbox, climatetoolbox.org/tool/Climate-Mapper)

Similarly, we define a day with extreme VPD (dry air) as a day within the warm season (March–October) on which VPD is comparable to the highest (driest) 10% of values within the historical baseline period. Historically, VPD was extreme on 24.5 days per year. Under the higher emissions scenario, the average number of days per year on which VPD is extreme in Union County is projected to increase by 31 (range 12–44) by the 2050s (Figure 17).

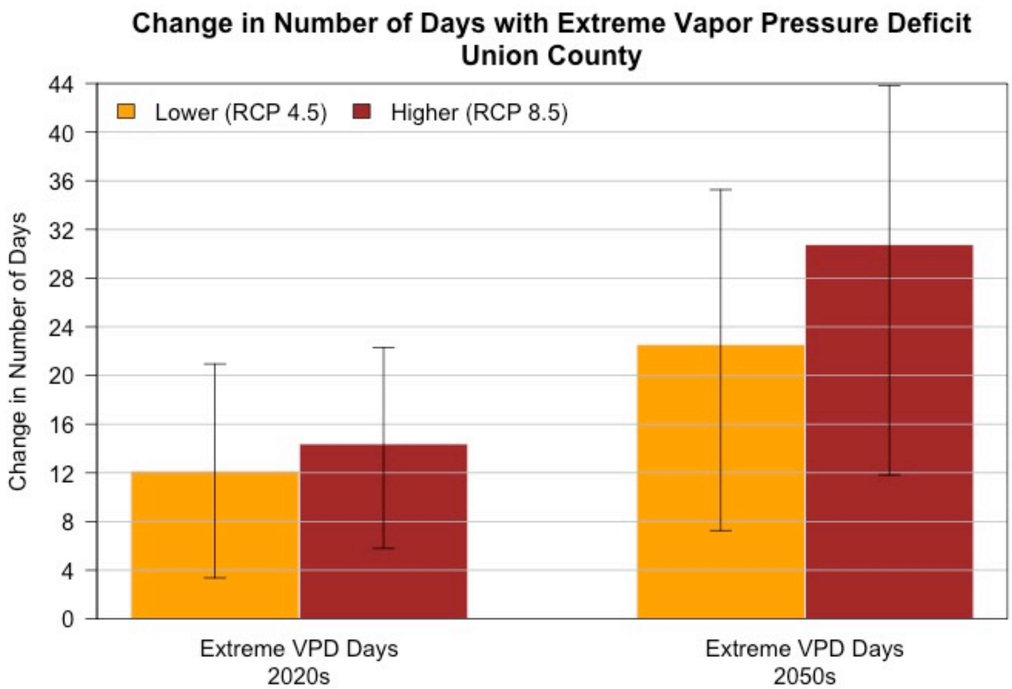

Figure 17. Projected changes by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the 1971–2000 historical baseline and under two emissions scenarios, in the number of days on which vapor pressure deficit in Union County is extreme. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged. Whiskers represent the range of changes across the 20 models. (Data source: Climate Toolbox, climatetoolbox.org/tool/Climate-Mapper)

Summary

Wildfire frequency and area burned are projected to continue increasing in the Northwest, and wildfire intensity is projected to increase. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Union County by 16 days (range -4–38) by the 2050s. The average number of days per year on which vapor pressure deficit is extreme is projected to increase by 31 (range 12–44) by the 2050s.

Reduced Air Quality

Climate change is expected to reduce outdoor air quality. Warmer temperatures may cause an increase in ground-level ozone concentrations, while more numerous and intense wildfires generate higher concentrations of fine particulate matter (particles less than 2.5 micrometers in diameter [$PM_{2.5}$]) and other pollutants (Rohlman *et al.*, 2023). Moreover, increases in pollen abundance and the duration of the pollen season are likely to increase concentrations of airborne allergens.

Poor air quality is expected to exacerbate allergy and asthma conditions and increase the incidence of respiratory and cardiovascular illnesses and death (Fann *et al.*, 2016). Excess asthma events due to $PM_{2.5}$ from wildfire smoke are 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 women, 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). Recent and projected estimates of many of these populations are presented in previous sections.

Wildfire Smoke

Over the past several decades, the wildfire season has become longer. Wildfire severity, often defined as the percentage of vegetation mortality within a fire perimeter, also may increase, especially in relatively wet ecosystems and at high elevations (Rogers *et al.*, 2011; Creutzburg *et al.*, 2017; Halofsky *et al.*, 2020). These changes are a result of factors including traditional forest management practices (Downing *et al.*, 2022), increasing human population density in areas with high fire risk (Radeloff *et al.*, 2018), and climate change (Sheehan *et al.*, 2015). 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 $PM_{2.5}$ 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). Woodstove smoke and diesel emissions, especially under winter inversion layers, also contribute to poor air quality in Oregon (DEQ, 2016; Liu and Peng, 2019). Fine particulate matter from vehicles, woodstoves, and power plants can be regulated, but it is much more difficult to control wildfires. From 2013–2022, the U.S. Environmental Protection Agency's Air Quality Index (AQI) in La Grande was unhealthy for sensitive groups or worse as a result of wildfire smoke on an average of 3.5 days per year, as compared to an average of 0.5 from 2003–2012 and 1.0 from 1993–2002 (DEQ, 2023).

Across the western United States, $PM_{2.5}$ concentrations from wildfires are projected to increase 160% by 2046–2051, relative to 2004–2009, under a moderate emissions scenario (SRES A1B) (Liu *et al.*, 2016). The SRES A1B scenario, which is from a generation of emissions scenarios that preceded CMIP5, is most similar to RCP 6.0 (Figure 2). CMIP6 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 (SSP5-4.5) emissions scenario and triple under a higher (SSP5-8.5) 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, because exposure to $PM_{2.5}$ increases susceptibility to viral respiratory infections, exposure to wildfire smoke is likely to increase susceptibility to and the severity of reactions from COVID-19 (Henderson, 2020). During 2020, in 18 of 19 Oregon counties analyzed, the number of reported COVID-19 cases increased on days with active wildfire smoke (Zhou *et al.*, 2021). Active wildfire smoke was defined as concentrations of $PM_{2.5}$ that exceeded 21 $\mu g\ m^{-3}$, a value within the moderate category of the AQI. Furthermore, wildfire smoke can disrupt outdoor recreational and social activities, in turn affecting physical and mental health (Nolte *et al.*, 2018). For example, on September 11, 2020, Portland's air quality deteriorated to hazardous and was the worst among major cities worldwide, causing many park closures and halting most outdoor activities (Green, 2020). The same year, wildfire smoke caused three days of very unhealthy and five days of unhealthy air in La Grande (DEQ, 2023).

Wildfires emit ozone precursors that in hot and sunny conditions react with other pollutants to increase the concentration of ozone. From 2000 through 2020, the frequency, duration, and area of co-occurrence of $PM_{2.5}$ and ozone increased in the western United States (Kalashnikov *et al.*, 2022), including the Pacific Northwest (Buchholz *et al.*, 2022). The population exposed to persistent extreme $PM_{2.5}$ and ozone levels in the West increased by 25 million person-days per year over the period 2001–2020 (Kalashnikov *et al.*, 2022; Rupp and Holz, 2023).

Projected Changes in Air Quality in Union County

We present projections of future air quality that are based on $PM_{2.5}$ from wildfire smoke. Smoke wave days are defined as two or more consecutive days on which simulated, county-averaged, wildfire-derived $PM_{2.5}$ values are in the highest 2% of simulated daily values from 2004 through 2009 (Liu *et al.*, 2016). Smoke wave intensity is defined as the concentration of $PM_{2.5}$ on smoke wave days. Liu *et al.* (2016) projected mean number of smoke wave days and mean smoke wave intensity for two six-year periods, 2004–2009 and 2046–2051, under a moderate emissions scenario. More information about their methods is in the appendix. The number of smoke wave days in Union County is projected to increase by 68% and the intensity of smoke on those days is projected to increase by 129% (Figure 18).

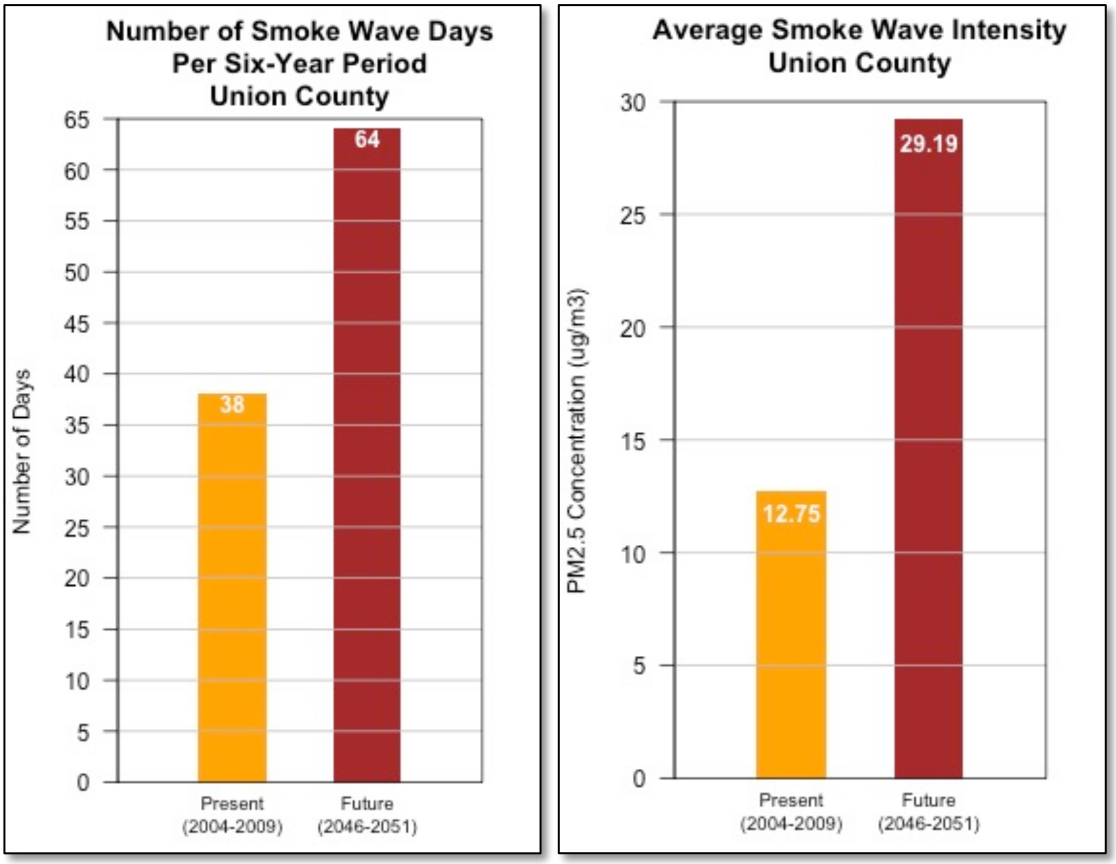

Figure 18. Simulated present (2004–2009) and future (2046–2051) number (left) and intensity (right) of smoke wave days in Union County under a moderate emissions scenario. Values represent the average among 15 global climate models. (Data source: Liu et al. 2016, khanotations.github.io/smoke-map/)

Allergens and Other Airborne Organic Materials

Many plants are responding to changes in climate and atmospheric concentrations of carbon dioxide by producing more pollen, and by producing it earlier in spring and for longer periods of time (Ziska *et al.*, 2009). From 1990 through 2018, the duration of pollen seasons increased by about 20 days and pollen concentration increased by 21% in the conterminous United States (Anderegg *et al.*, 2021), including northern California (Paudel *et al.*, 2021).

Fungal spores could also become more abundant following extreme floods or droughts, which are expected to become more common. The period during which outdoor airborne mold spores are detectable increased in the last 20 years as a result of increasing concentrations of carbon dioxide and changes in climate and land use (Paudel *et al.*, 2021). Furthermore, because both ozone and fine particulate matter affect the sensitivity of respiratory systems to airborne allergens, the combined effects of climate change, air pollution, and changes in vegetation phenology will likely increase the severity of respiratory diseases and allergies (D'Amato *et al.*, 2020).

Summary

Climate change is expected to reduce outdoor air quality. The risks to human health from wildfire smoke in Union County are projected to increase. From 2004–2009 to 2046–2051, under a moderate emissions scenario, the number of days per year with poor air quality due to elevated concentrations of wildfire-derived fine particulate matter is projected to increase by 68%. The concentration of fine particulate matter on those days is projected to increase by 129%.

Loss of Wetlands

In the United States, wetlands are defined under the Clean Water Act as “areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.” Wetlands also may be associated with the edges of lakes and with streams and rivers (Halofsky *et al.*, 2019).

Wetlands and their associated plants and animals are likely to be affected by increases in air temperature, which generally are correlated with increases in freshwater temperature; decreases in snowpack and summer stream flows; and increases in evapotranspiration (Lee *et al.*, 2015). Projected effects in the Northwest include reductions in water levels and hydroperiod duration, and may be most pronounced in wetlands that become temporary in dry years (Lee *et al.*, 2015). Wetlands along low-gradient, wide valley bottoms that are dominated by riparian trees and understory species may be most susceptible to decreases in flow and water volume, in part because recruitment of some riparian plant species depends on seasonal flooding (Dwire *et al.*, 2018). Wetlands that are fed primarily by ground water may have more consistent temperature, water chemistry, and water levels than wetlands that are fed primarily by surface water (Halofsky *et al.*, 2019). However, effects of climate change on ground water aquifers that are recharged by snowpack are uncertain (Dwire *et al.*, 2018). Moreover, where increasing aridity leads to greater demand for ground water, decreases in ground water availability may affect wetlands.

The 6000-acre (2430-hectare) Ladd Marsh Wildlife Area, established in 1949 to conserve and enhance habitat for waterfowl and to provide a public hunting area, is one of the largest remaining wetlands in northeastern Oregon, and encompasses the region’s most extensive remnant hardsteam bulrush wetland. In 2006 and 2007, the End Creek Restoration Project, a public–private–tribal partnership, restored another 550 acres (225 hectares) of wetlands and stream channels near La Grande. The Upper Grande Ronde River Watershed Partnership, which includes more than 25 organizational and individual participants, also may contribute to wetland planning and management.

Summary

Projected effects of climate change on wetlands in the Northwest include reductions in water levels and hydroperiod duration. If withdrawals of ground water do not increase, then wetlands that are fed by ground water rather than surface water may be more resilient to climate change.

Windstorms

Wind patterns in the northwestern United States affect natural disturbances, public health, and multiple sectors. For example, variability in wind speed affects generation of wind power and, via downed power lines, the reliability of electricity transmission. Changes in wind speed and direction also affect the safety of transportation by air, land, and sea and the spread of wildfires and pollutants, including wildfire smoke and allergens. In Oregon, average near-surface wind speeds are expected to decrease slightly in response to global climate change (Pryor *et al.*, 2012; Jeong and Sushama, 2019; Chen, 2020; Mass *et al.*, 2022). However, a decrease in the average wind speed may not translate to a decrease in the speed of strong 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). Such increases are not projected in eastern Oregon. An extreme wind refers to an annual maximum wind speed with a given average return period, such as 20 or 50 years (annual exceedance probability of 5% or 2%, respectively).

Oregon's location accounts for some of the uncertainty in the response of strong winds to human-caused emissions of greenhouse gases. The state's 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). Future changes in wind speeds in extratropical cyclones are expected to be small, but the projected poleward shift in the tracks of these cyclones could lead to substantial changes in extreme wind speeds in some regions (Seneviratne *et al.*, 2021). One study indicated that by 2081–2099 relative to 1981–1999, assuming the higher emissions scenario, extratropical cyclones that generate severe winds will shift northward by an average of 2.2° over the North Pacific Ocean (Seiler and Zwiers, 2016). Therefore, these extratropical 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, although Seiler and Zwiers (2016) did not examine the landfall location of severe cyclones, it is uncertain whether the frequency of severe landfalling extratropical cyclones and the distribution of wind speeds will change in Oregon.

The intensity of strong offshore (easterly) winds, which are most common in summer and in fall before the onset of the rainy season, typically is lower than that of winter windstorms. Nevertheless, offshore winds play a major role in summer heat waves in Oregon, including the record-breaking June 2021 heat wave (Chang *et al.*, 2021), because they displace cooler marine air west of the Cascade Range (Brewer and Mass, 2016). Projections from global climate models, assuming the higher emissions scenario, suggest a decrease in the frequency of strong offshore winds over western Oregon and Washington in July and August, with about a 50% reduction from 1970–1999 to 2071–2100 in the number of days with easterly wind speeds greater than approximately 11 miles per hour (5 meters per second) measured at approximately 5000 feet (1.5 km or 850-hPa) above Earth's surface (Brewer and Mass, 2016).

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, valley, and coastal winds, sea breezes, and winds associated with mesoscale convective systems (Doblas-Reyes *et al.*, 2021). Large numbers of simulations from multiple high-resolution (1 to 10 km [0.6 to 6 mi]) regional climate models ultimately will be required to estimate changes in these types of winds across Oregon with high confidence.

Summary

Wind patterns affect provision of electricity, transportation safety, and the spread of wildfires and pollutants. Mean wind speeds in Oregon are projected to decrease slightly, but extreme winter wind speeds may increase, especially in western Oregon. The frequency of strong easterly winds during summer and fall, however, is projected to decrease slightly.

Expansion of Non-native Invasive Species

Changes in climate and atmospheric concentrations of carbon dioxide can affect the distribution and population dynamics of native and non-native species of animals and plants that are considered to be invasive or pests in natural and agricultural systems. Species-environment relations are not static (MacDonald, 2010; Walsworth *et al.*, 2019). Therefore, even when the current ecology of a species is well understood, it often is difficult to predict with confidence how the species will respond to projected changes in climate, especially when climate change interacts with land-use change or other environmental changes. Species adapt not only in response to climate change but in response to all types of environmental change, including management actions (Thomas *et al.*, 1979; Skelly *et al.*, 2007; Winter *et al.*, 2016). These responses may be rapid, on the order of years or decades, particularly among organisms with short generation times (Boughton, 1999; MacDonald *et al.*, 2008; Willis and MacDonald, 2011; Singer, 2017). Adaptive capacity also is affected by whether individuals can move freely or whether habitat fragmentation and other barriers impede movement (Thorne *et al.*, 2008; Willis and MacDonald, 2011; Fleishman and Murphy, 2012). Monocultures, dense populations, and even-aged populations of animals or plants generally are more susceptible to pests and pathogens than individuals in areas with higher species richness or populations with greater demographic diversity.

The Union County Commissioners designate priority noxious weeds, weeds of economic importance, and weeds of economic importance within agricultural areas (Table 17). The county's Weed Control District complies with statewide management plans or implements county-level control and monitoring plans for priority noxious weeds. Some priority noxious weeds may be feasible to contain or eradicate in the county, or are not known to occur in Union County but are present in adjacent counties and likely to occur in Union County in the future. Weeds of economic importance are locally abundant in Union County and adjacent counties, and are controlled at either the county or regional level. Weeds of economic importance within agricultural areas are controlled or monitored within those areas and rights of way.

Although little is known about how many of these species may to respond to climate change, some evidence suggests how others may be affected. In general, non-native invasive plants in Union County are likely to become more prevalent in response to projected changes in climate. However, many of these responses are uncertain, and are likely to vary locally. Moreover, the responses may change over time.

Table 17. Noxious weeds, weeds of economic importance, and weeds of economic importance within agricultural areas in Union County.

Noxious weeds	**Growth form**
Black henbane (*Hyoscyamus niger*)	Annual or biennial forb
Common bugloss (*Anchusa officinalis*)	Perennial forb
Common tansy (*Tanacetum vulgare*)	Perennial forb
Common crupina (*Crupina vulgaris*)	Annual forb
Dyer's woad (*Isatis tinctoria*)	Annual, biennial, or short-lived perennial forb
Garlic mustard (*Alliaria petiolata*)	Perennial forb

Giant foxtail (*Silene faberi*)	Biennial or short-lived perennial forb
Hawkweeds: king-devil, meadow, mouse-ear, orange, yellow (*Hieracium piloselloides*, *pratense*, *pilosella*, *aurantiacum*, and *floribundum*)	Perennial forb
Hoary alyssum (*Berteroa incana*)	Biennial forb
Knotweeds: giant, Japanese, Himalayan, hybrid or Bohemian (*Polygonum sachalinense*, *cuspidatum*, *polystachyum*, and x *bohemicum*)	Perennial forb
Leafy spurge (*Euphorbia esula*) (more than one mile from the Grande Ronde River)	Perennial forb
Meadow knapweed (*Centaurea pratensis*) (outside the Cove area)	Perennial forb
Mediterranean sage (*Salvia aethiopis*)	Biennial forb
Musk thistle (*Carduus nutans*)	Biennial forb
Myrtle spurge (*Euphorbia myrsinites*) (outside residential areas)	Perennial forb
Perennial pepperweed (*Lepidium latifolium*)	Perennial forb
Plumeless thistle (*Carduus acanthoides*)	Biennial forb
Ravenna grass (*Saccharum ravennae*)	Perennial grass
Rose campion (*Silene coronaria*) (outside residential areas)	Perennial forb
Rush skeletonweed (*Chondrilla juncea*)	Perennial forb
Russian knapweed (*Acroptilon repens*) (Cove area, High Valley, and Medical Springs)	Perennial forb
Scotch broom (*Cytisus scoparius*)	Shrub
Tansy ragwort (*Senecio jacobaea*)	Biennial or short-lived perennial
Turkish thistle (*Carduus cinereus*)	Annual forb
Velvet leaf (*Abutilon theophrasti*)	Annual forb
Viper's bugloss (*Echium vulgare*)	Annual or biennial forb
Whitetop or hoary cress (*Lepidium draba*) (within the Grande Ronde Basin and Wolf Creek drainage)	Perennial forb
Yellow starthistle (*Centaurea solstitalis*) (outside established containment areas)	Annual forb
Yellow toadflax (*Linaria vulgaris*)	Perennial forb
Weeds of economic importance	**Growth form**
Armenian or Himalayan blackberry (*Rubus armeniacus*)	Shrub
Bittersweet nightshade (*Solanum dulcamara*)	Perennial vine or shrub
Buffalo burr (*Solanum rostratum*)	Annual forb
Canada thistle (*Cirsium arvense*)	Perennial forb
Dalmatian toadflax (*Linaria dalmatica*	Perennial forb
Diffuse knapweed (*Centaurea diffusa*)	Biennial forb
Dog rose (*Rosa canina*)	Shrub

Houndstongue (*Cynoglossum officinale*)	Biennial or short-lived perennial forb
Jointed goatgrass (*Aegilops cylindrica*)	Annual grass
Leafy spurge (*Euphorbia esula*) (within one mile of Grande Ronde River)	Perennial forb
Medusahead rye (*Taeniatherum canput-medusae*)	Annual grass
Oxeye daisy (*Chrysanthemum leucanthemum*) (outside residential areas)	Perennial forb
Poison hemlock (*Conium maculatum*)	Biennial forb
Puncturevine (*Tribulus terrestris*)	Annual forb
Purple loosestrife (*Lythrum salicaria*)	Perennial forb
Saltcedar (*Tamarisk ramosissima*)	Tree or shrub
Scotch thistle (*Onopordum acanthium*)	Annual or biennial forb
Spotted knapweed (*Centaurea stoebe*)	Short-lived perennial forb
Sulfur cinquefoil (*Potentilla recta*)	Perennial forb
Sweet Briar rose (*Rosa rubiginosa*)	Shrub
Ventenata (*Ventenata dubia*)	Annual grass
Whitetop or hoary cress (*Lepidium draba*) (within Powder River basin)	Perennial forb
Wild carrot (*Daucus carota*)	Biennial forb
Yellow flag iris (*Iris pseudocorus*)	Perennial aquatic
Yellow starthistle (*Centaurea solstitalis*) (within containment areas)	Annual forb
Weeds of economic importance in agricultural areas	**Growth form**
Catchweed bedstraw (*Galium aparine*)	Annual forb
Common or wild sunflowers (*Helianthus annus*)	Annual forb
Creeping bentgrass (*Agrostis stolonifera* var. *palustris*)	Perennial grass
Horseweed or mares tail (*Conyza canadensis*)	Annual or biennial forb
Kochia (*Bassia scoparia*)	Annual forb
Quackgrass (*Elymus repens*)	Perennial grass
Russian thistle (*Salsola tenuifolia*)	Annual forb

Carbon Dioxide, Nitrogen, and Ozone Concentrations

Increasing concentrations of carbon dioxide affect some plants' primary productivity, water-use efficiency, and nutrient content. Increases in photosynthesis in response to increases in carbon dioxide are more common in plants with C3 metabolism than in plants with C4 metabolism. C4 metabolism has evolved multiple times, usually as an adaptation to hot, dry climate. Plants with C4 metabolism lose considerably less water per unit of carbon dioxide absorbed, and tend to photosynthesize more efficiently, than plants with C3 metabolism. By contrast, tolerance of the herbicide glyphosate tends to increase more in C4 than in C3 plants as carbon dioxide increases (Chen *et al.*, 2020).

Experiments suggested that the photosynthetic rate and biomass of Canada thistle, and the number and length of the species' spines, are likely to increase as ambient concentrations of carbon dioxide increase throughout the twenty-first century, and may have increased during the twentieth century (Ziska, 2002). Whether the root biomass of Canada thistle responds positively to increases in carbon dioxide concentrations, especially independent of increases in temperature, is unclear (Ziska *et al.*, 2004; Tørresen *et al.*, 2020), and may vary in space.

Changes in climate, ongoing human additions of nitrogen to the environment, and their interactions affect the growth and competitive relations among plant and animal species (Greaver *et al.*, 2016). The competitive advantage of non-native forbs and grasses over native species of plants may be strongest in relatively warm and dry areas, which often coincide with lower elevations (Dodson and Root, 2015). Additionally, non-native invasive plants generally gain a competitive advantage from nitrogen deposition. For example, the size of yellow starthistle plants increased substantially in response to experimentally increased nitrogen deposition, whereas co-occurring native plants responded less strongly (Dukes *et al.*, 2011). Japanese knotweed, too, may gain a competitive advantage over native species when nitrogen availability is variable or episodic (Parepa *et al.*, 2013). Nevertheless, how field experiments with supplemental nitrogen relate to changes in nitrogen deposition or availability as a result of climate change is uncertain. Japanese knotweed also is fairly tolerant of high temperatures, drought, saturated soils, and fire (Clements and DiTommaso, 2012).

As tropospheric concentrations of ozone continue to increase, productivity of native and agricultural plants generally is expected to decrease. However, ozone tolerance in weedy, vegetatively reproducing species may increase relatively quickly, allowing them to gain a competitive advantage over some crops (Grantz and Shrestha, 2006).

Heat

Many non-native invasive plants tolerate high temperature. For example, increases in mean monthly temperature and maximum daily temperature, and reduction in the number of spring days with minimum temperatures below 32°F, may lead to earlier seedling emergence and increase reproduction and recruitment of garlic mustard (Blossey *et al.*, 2017; Anderson *et al.*, 2021). Saltcedar may expand across relatively warm areas as climate continues to change (Kerns *et al.*, 2009; Ikeda *et al.*, 2014), although some models suggested that projected changes in temperature are unlikely to affect the species' distribution (Bradley *et al.*, 2009).

Responses to interactions between temperature and other climate variables can be complex. For instance, garlic mustard also may flower earlier as temperature increases (Fox and Jönsson, 2019). Yet germination of garlic mustard seeds currently requires winter chilling, and increases in winter temperature may limit the species' expansion until it evolves tolerance of higher winter temperatures (Footitt *et al.*, 2018). Increases in temperature also can present opportunities for controlling non-native invasive plants.

The flowering phenology of purple loosestrife, which readily colonizes wetlands, is adapted to the duration of the growing season. At northern latitudes, including Oregon, purple loosestrife flowers early, at a small size; at southern latitudes, it flowers later, at a larger size (Colautti and Barrett, 2013). Early flowering limits reproductive growth of purple loosestrife, and northern plants generally produce fewer seeds and have less population-level genetic variation than southern plants (Colautti *et al.*, 2010). Climate change is expected to prolong the growing season, and therefore to increase the long-term viability of purple loosestrife, although local adaptation may be relatively slow due to genetic constraints of flowering time (Colautti *et al.*, 2010, 2017).

Cold

Responses of invasive plants to changes in temperature are diverse, even within the same species. For example, although it appears that photosynthesis in Japanese knotweed is constrained by temperatures below freezing (Baxendale and Tessier, 2015), the range of the species is expanding northward, perhaps reflecting evolution of frost tolerance (Clements and DiTommaso, 2012). Therefore, Japanese knotweed may become more widespread or abundant as minimum temperatures increase.

Scotch broom usually is not highly tolerant of frost in autumn, although populations can become more frost-tolerant over time (Strelau *et al.*, 2018; Winde *et al.*, 2020).

Precipitation and Drought

Changes in the amount and timing of precipitation may contribute to expansion or contraction of different non-native invasive plants. Normal to high precipitation can decrease the viability of certain non-native invasive plants, at least in some contexts. In forests in western Oregon, occurrence of Canada thistle was associated negatively with annual precipitation (Gray, 2005).

Spotted knapweed may be outcompeted by some native grasses (e.g., bluebunch wheatgrass [*Pseudoroegneria spicata*]) during drought, but may have a competitive advantage when precipitation is closer to average (Pearson *et al.*, 2017). Monocultures of spotted knapweed appear to be less affected by drought (Pearson *et al.*, 2017). Kochia also has high drought tolerance.

Yellow starthistle is somewhat sensitive to drought and can be outcompeted by natives that are more tolerant of dry conditions (Dlugosch *et al.*, 2015; Young *et al.*, 2017). Evidence of drought tolerance in Scotch broom is equivocal, especially in the field rather than in greenhouse experiments (Potter *et al.*, 2009; Hogg and Moran, 2020). The growth and survival of Scotch broom in relatively open woodlands and forests may increase as snow depths decrease, especially during the winter after germination (Stevens and Latimer, 2015). Whether drought limits vegetative growth of purple loosestrife is unclear. Increased spring temperatures and decreased precipitation associated with the El Niño–Southern Oscillation in some parts of the species' range were associated with early flowering and aboveground biomass accumulation, but not with total aboveground biomass, inflorescence lengths (an indicator of reproductive output), or timing of senescence (Dech and Nosko, 2004). Although whitetop tends to grow in moderately moist soils, its extensive and deep roots can capitalize on ground water and facilitate colonization of relatively arid shrublands and perennial grasslands (Hinz *et al.*, 2012).

Summary

In general, non-native invasive plants in Union County are likely to become more prevalent in response to projected increases in temperature and the frequency, duration, and severity of drought. However, many of these responses are uncertain, are likely to vary locally, and may change over time.

Appendix

We projected future climate and hydrology on the basis of outputs from twenty global climate models (GCM) and two emissions scenarios (Representative Concentration Pathway [RCP] 4.5 and RCP 8.5) from the fifth phase of the Coupled Model Intercomparison Project (CMIP5) (Table A1).

Table A1. The 20 global climate models (GCMs) from the fifth phase of the Coupled Model Intercomparison Project (CMIP5) represented in this report. Asterisks (*) indicate the ten GCMs used as inputs to the Variable Infiltration Capacity hydrological model in the Integrated Scenarios of the Future Northwest Environment project. Carets (^) indicate the GCMs that do not include daily relative humidity.

Model Name	Modeling Center
BCC-CSM1-1 BCC-CSM1-1-M*	Beijing Climate Center, China Meteorological Administration
BNU-ESM	College of Global Change and Earth System Science, Beijing Normal University, China
CanESM2*	Canadian Centre for Climate Modeling and Analysis
CCSM4*^	National Center for Atmospheric Research, USA
CNRM-CM5*	National Centre of Meteorological Research, France
CSIRO-Mk3-6-0*	Commonwealth Scientific and Industrial Research Organization/Queensland Climate Change Centre of Excellence, Australia
GFDL-ESM2G GFDL-ESM2M	NOAA Geophysical Fluid Dynamics Laboratory, USA
HadGEM2-CC* HadGEM2-ES*	Met Office Hadley Center, UK
INMCM4	Institute for Numerical Mathematics, Russia
IPSL-CM5A-LR IPSL-CM5A-MR* IPSL-CM5B-LR	Institut Pierre Simon Laplace, France
MIROC5* MIROC-ESM MIROC-ESM-CHEM	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies, Japan

MRI-CGCM3	Meteorological Research Institute, Japan
NorESM1-M*^	Norwegian Climate Center, Norway

MACA Downscaling

The coarse horizontal resolution of the GCM outputs (100–300 km) was statistically downscaled to a resolution of about 6 km with the Multivariate Adaptive Constructed Analogs (MACA) statistical downscaling method, which is skillful in complex terrain (Abatzoglou and Brown, 2012). A detailed description of the MACA method is at climate.northwestknowledge.net/MACA/MACAmethod.php. The MACA method uses gridded observational data to train the downscaling. It applies bias corrections and matches the spatial patterns of observed coarse-resolution to fine-resolution statistical relations. The downscaled variables include daily maximum and minimum temperature, maximum and minimum relative humidity, specific humidity, precipitation, wind, and downward solar radiation at the surface from 1950 through 2099. All simulated climate data were bias-corrected with quantile mapping, which adjusts simulated values by comparing the cumulative probability distributions of simulated and observed values. In practice, the simulated and observed values of a variable over the historical time period are sorted and ranked, and each value is assigned a probability of exceedance. The bias-corrected value of a given simulated value is assigned the observed value that has the same probability of exceedance as the simulated value. The historical bias in the simulations is assumed to be constant. Therefore, the relations between simulated and observed values in the historical period were applied to the future scenarios. Climate data in the MACA outputs reflect quantile mapping relations for each non-overlapping 15-day window in the calendar year.

Climate and Fire Danger Variables

We used MACA-downscaled minimum and maximum temperature and precipitation data to characterize heat waves, cold waves, and heavy precipitation. We characterized wildfire risk on the basis of vapor pressure deficit (VPD) and 100-hour fuel moisture (FM100), which were computed by the Integrated Scenarios of the Future Northwest Environment project (climate.northwestknowledge.net/IntegratedScenarios/) with the MACA climate variables according to the equations in the National Fire Danger Rating System (Bradshaw *et al.*, 1984). FM100 projections are only available for 18 GCMs because two models (CCSM4 and Nor-ESM1-M) do not include relative humidity at a daily time step. Calculation of FM100 requires daily relative humidity data.

Hydrological Simulations and Variables

The Integrated Scenarios project used MACA downscaled climate data as the inputs to their simulations of hydrology, which they ran with the Variable Infiltration Capacity (VIC) hydrological model (VIC version 4.1.2.l; Liang *et al.*, 1994 and updates). VIC was applied to ten GCMs and run on a 1/16° x 1/16° (6 km) grid (Table A1). We used the hydrological simulations of snow water equivalent (SWE), runoff, and soil moisture to project drought. The Integrated Scenarios project bias-corrected hydrology variables (except SWE) for each month with quantile mapping. The project estimated daily streamflow by routing daily runoff from VIC grid cells to selected locations along the stream network. Where records of naturalized flow were available, the daily streamflow estimates were bias-corrected for each month with quantile mapping. As a result, their statistical distributions matched those of the naturalized streamflows. We used streamflow data from the Integrated Scenarios project to characterize changes in the timing of seasonal streamflow, which affects the likelihood of drought and flooding, and changes in extreme flood magnitudes.

Air Quality Data

Our projections of air quality are based on smoke wave data from Liu et al. (2016), which are available at khanotations.github.io/smoke-map/. We used two variables, "Total # of SW days in 6 yrs" and "Average SW Intensity". The former is the number of days within each time period on which the concentration of fine particulate matter ($PM_{2.5}$), averaged within the county, exceeded the 98th quantile of the distribution of daily, wildfire-specific $PM_{2.5}$ values from 2004 through 2009 (smoke wave days). The latter is the average concentration of $PM_{2.5}$ across smoke wave days within each time period. Liu et al. (2016) used 15 GCMs from the third phase of the Coupled Model Intercomparison Project under a moderate emissions scenario (SRES-A1B) as inputs to a fire prediction model and the GEOS-Chem three-dimensional global chemical transport model. The available data include only the multiple-model mean value (not the range), which should be interpreted as the direction of projected change rather than the actual expected value.

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8.5 Morgan Lake Dam Floodplain Management Plan

DRAFT

Floodplain Management Plan – Morgan Lake Dam

High Hazard Potential Dam Grant Program
Prepared for City of LaGrande by the OWRD Dam Safety Program, to be reviewed and modified as needed
August 29, 2023

Introduction

This Floodplain Management Plan (FMP) is prepared by Oregon Water Resources Department (OWRD) Dam Safety in accordance with Section 5.6 of *Rehabilitation of High Hazard Potential Dams – Grant Program Guidance* (FEMA, 2020). This FMP was completed as part of the fiscal year 2020 High Hazard Potential Dam (HHPD) grant scope of work as Oregon Task 4. Task 4 is the final task for FY 20 HHPD work plan and was dependent on grant funding remaining after completion of tasks 1-3. Emphasis will be on population exposed and likelihood that floodplain management plan will reduce casualties. A completed Floodplain Management Plan and is a requirement to apply for construction funding related to the Morgan Lake dam for mitigation berm construction project described below.

Objective

The objective of a FMP is to reduce the impacts, if any, of future flood events in the area protected by the project, with necessary actions until the dam is rehabilitated to a fully safe condition or removed to restore pre-dam flood functions. This FMP is prepared to address the following requirements:

- Potential measures, practices, and policies to reduce loss of life, injuries, damage to property and facilities, public expenditures, and other adverse impacts of flooding in the area protected by the project
- Plans for flood fighting
- Evacuation
- Public education and awareness of flood risks

Project Description

Morgan Lake dam (OR00653) is located above Deal Canyon approximately 2 miles and 1500 feet in elevation from the middle of LaGrande, Oregon. The reservoir impounds up to 780 acre-feet and is managed by the City of LaGrande and the Oregon Department of Fish and Wildlife.

Morgan Lake is constructed of earthen embankment with a maximum height of 22 feet, spanning approximately 1000 feet across a non-channelized depression. Morgan Lake dam is a High Hazard Dam because there are people at risk (PAR) in the flood inundation zone resulting from a breach. Morgan Lake dam is of special concern because of its age (around 120 years old), the lack of any design for construction or record of how it was construction, and that it has a conduit made of material that could not be identified that has possibly been pressurized for the entire life span of the dam.

The reservoir and dam are off channel very close to the drainage divide that could divert a breach flow away from LaGrande. The proposed project is construction of a berm to direct water into Sheep Creek and prevent significant flow to the top of Deal Canyon where the existing breach would flow. Deal Canyon is a steep and narrow canyon that empties directly into the City of LaGrande and has no capacity for any flooding, yet alone a dam breach flood. The conceptual design for this project is compete. Upon completion of the diversion berm there will be very significant changes in the dam breach inundation as a result of this project. The project will reduce the PAR by a factor of 1000, will protect infrastructure, homes, and businesses, and also provide additional warning time. The project has no effect on non-dam failure floods as described later in this floodplain management plan.

Existing Dam Risks

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 Phase 1 inspection exists for this dam, but this report did not investigate the conduit condition, and had no evaluation of internal erosion risk. The dam was 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, it is not operable, and it is likely pressurized. Engineering consultant analysis including preliminary design work for an out of channel berm to divert potential dam breach flows from the City have been completed.

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. In 2008, a Dam Breach Analysis was completed for the dam. The results of the analysis indicated that if the dam were to fail, approximately 24,000 cubic feet per second of water would flow down Deal Canyon which enters the City on the south and flows through the City to the north. The resulting flood would cover the greater portion of the City, placing over 10,000 residents at risk. 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 the risk analysis of this dam as shown below. With the berm project the PAR is reduced to approximately 10, most of whom will have warning prior to inundation.

Notices and Enforcement: The dam safety program sent a formal notice dated March 17, 2021

The non-functional conduit and the unknown conduit condition result in a Potentially Unsafe condition at Morgan Lake Dam. The Department has been working with the City, and has funded a project to conduct an engineering analysis and risk mitigation work for Morgan Lake Dam. The purpose of this analysis contracted project is to mitigate the risk associated with a potential breach of the dam. Diverting water from a dam breach away from Deal Canyon and into Sheep Creek will significantly reduce the risk to residents of La Grande. This work has been completed.

The conceptual design includes all drawings necessary of a ditch and berm sufficient to divert water from the Deal Canyon drainage into the Sheep's Creek drainage, and also includes a full dam breach inundation analysis of the proposed design that reduces the number of persons affected by a breach by 3 orders of magnitude.

Risk Assessment Results: Formal approximately quantitative risk assessment has been completed for this dam. The mean annual risk of failure of this dam is 2.0E-04 plus or minus 2 orders of magnitude with on an annual loss of life basis is approximately 3.5E-01 plus or minus 2 orders of magnitude. This is an extreme risk.

Breach Inundation Analysis

The results of a flood inundation analysis resulting from a dam breach PAR estimates were based on dam breach inundation analysis as described below. Figures 1 though 4 show inundation with and without the proposed safety berm.

Flood Modeling and Mapping

The construction of an out of natural stream breach berm does not affect the hydraulics of the area downstream. As a result, no flood modeling was done related to this project. The FEMA Flood Insurance Rate Maps for the affected areas are provided as Figure 5 at the end of this document. Therefore, for this plan the only flood of concern is a dam breach flood.

Morgan Lake naturally drains into Deal Creek which flows through the City of La Grande then Southeast out of the City. This project completed by West Consultants looked at diverting the natural flow into the adjacent Sheep Creek which combines with Little Rock Creek to form Rock Creek. Rock Creek flows into Grande Ronde River which continues along the Northern edge of La Grande. The total model length was approximately 16 miles when running from the reservoir through Sheep and Rock Creeks and 7.5 miles when running from the reservoir through Deal Canyon. Throughout the length of the model there are a total of five (5) inflows that enter the system. Three flood conditions for these inflows were modeled, with the lowest flood condition, the 2 year or 50% annual exceedance probability (AEP), being used in the following inundation maps. The hydraulic characteristics of the reservoir, dam, and downstream topography were defined using the U.S. Army Corps of Engineers Hydraulic Engineering Center's River Analysis

System software (HEC-RAS, version 6.3.1). The unsteady flow model developed for this analysis consisted of a 2-dimensional (2D) segment. The dam was represented by a boundary condition which passed the breach hydrograph into the 2D area. Flows through La Grande go through storm drain systems or areas where the LiDAR did not pick up the main channel. Therefore, the flows simulated in the model are based on the assumption that the main channel or storm drain system can safely convey up to the 10-year return or 10 % AEP flood event. When assessing the potential flood risk to property downstream of the dams, neglecting small bridges and culverts from the analysis produces the most conservative results and were not included in the model.

Existing Conditions Flood

The existing conditions flood is shown on the current (1980) flood maps (Figure 5)

Post- Diversion Structure/Spillway stability design flood

The post-dam removal flood conditions for non-breach floods will not change as a result of this project.

Timeframe for project

Project completion of the final berm design is expected by the *fall of 2024* if there is partial funding support for the project.

Effects of Repair, Reconstruction or Removal

There are no effects on normal flood flows from Morgan Lake resulting from this project. As a result, additional mitigation measures are not needed.

Additional Measures to reduce Adverse Impacts of Flooding

There is no change in base flows as a result of this project. The project only reduces the flow direction and downstream impacts in a dam breach/risk of a dam breach failure.

Flood identification, evacuation and fighting

The inundation map from a prior breach analysis is included as Figures 1 and 3. Flood fighting is to prevent dam failure or reduce the risk of failure while dam is in place.

The project will not result in a change to base flood risk. However, since the dam is still at risk of breaching until completion of the removal project, the following measures will be taken to reduce the risk to loss of life.

- Monitor freeboard during and after high precipitation events
- Inspect the dam immediately following any significant seismic event

Public Awareness and Understanding

Public meetings will be held prior to the commencement of construction. The goals of the public meetings will be to ensure the public understand the project, the current risk, and risk after the project is completed. The meetings will also allow the public to share their view on consequences, need for additional information, and view on the risk before and after the project.

Reference

Federal Emergency Management Agency (FEMA), 2020. Rehabilitation of High Hazard Potential Dams – Grant Program Guidance

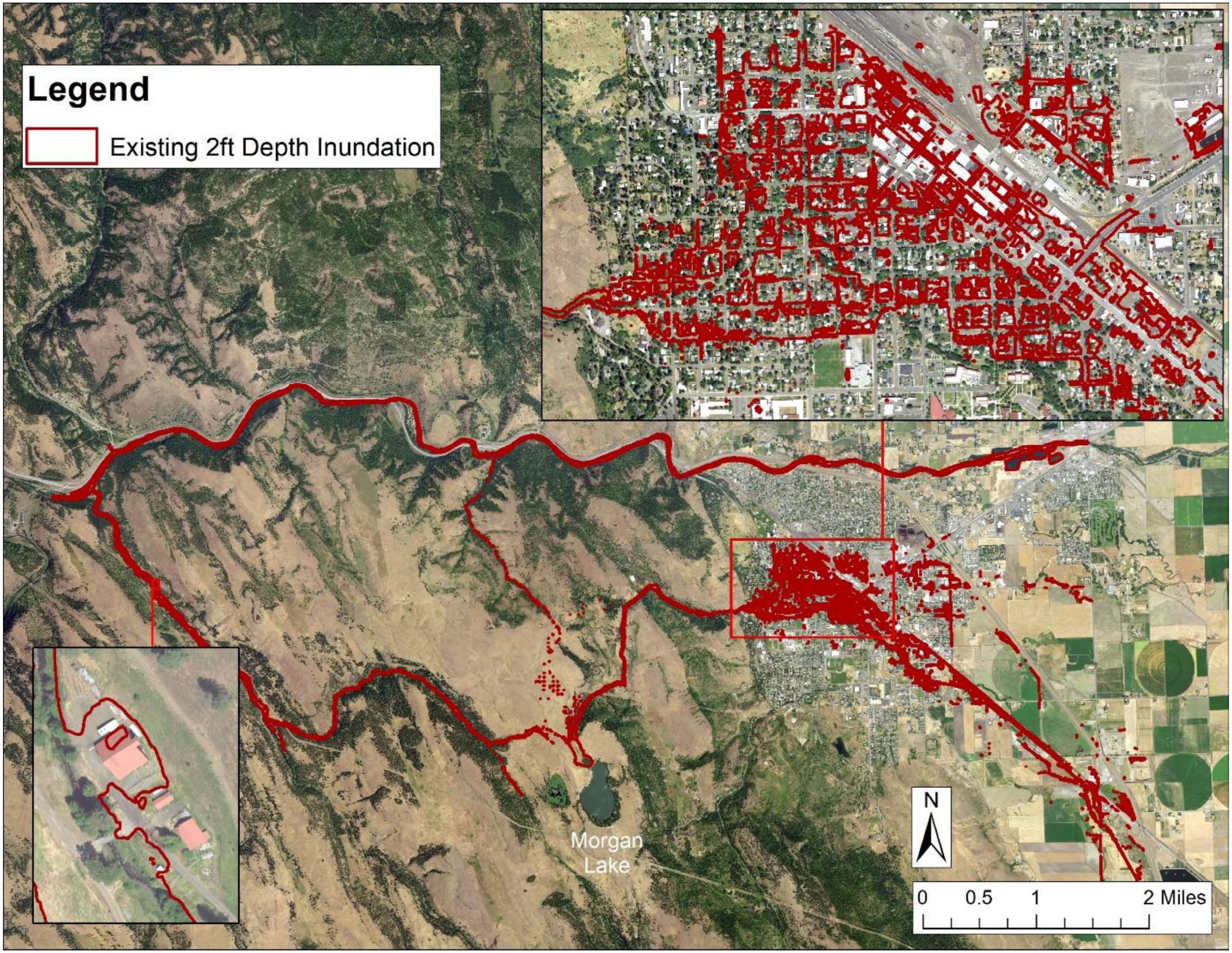

Figure 1:2-foot inundation depth of Morgan Lake breach current condition- no berm, 50 % AEP (2-year return interval) inflows from river and creeks

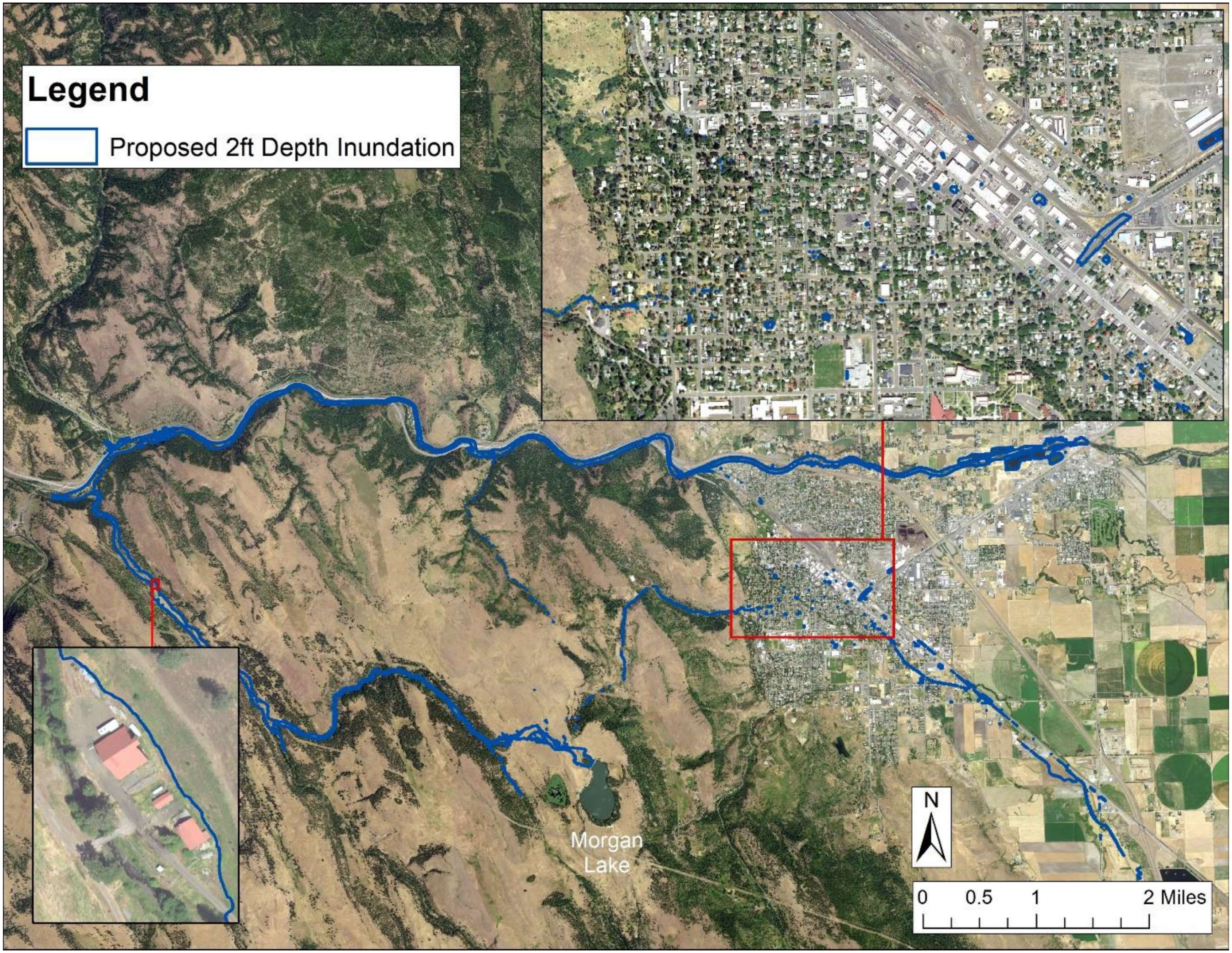

Figure 2:2-foot inundation depth of Morgan Lake breach proposed condition- berm, 50 % AEP (2-year return interval) inflows from river and creeks

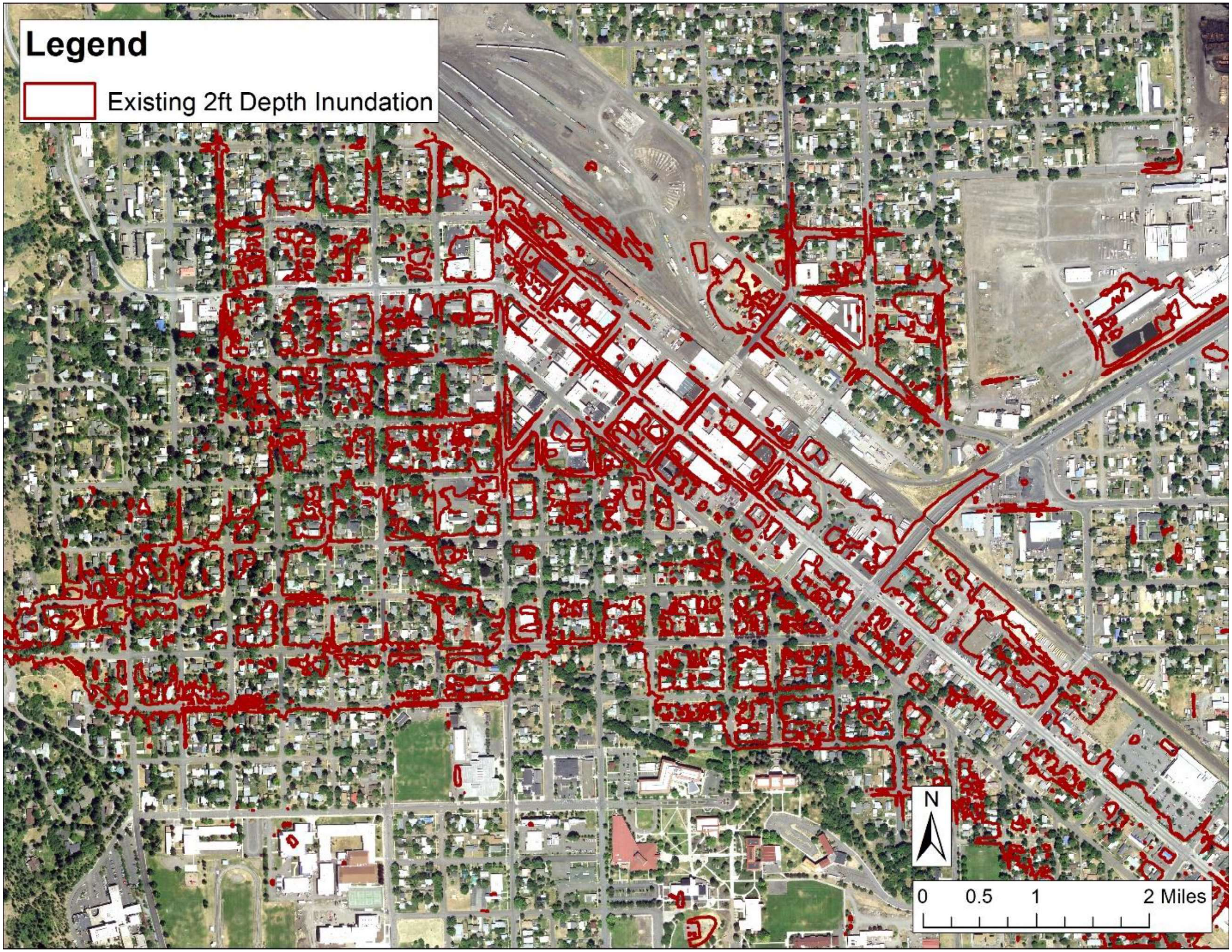

Figure 3:Detailed 2-foot inundation depth of Morgan Lake breach current condition- no berm, 50 % AEP (2-year return interval) inflows from river and creeks

Figure 4:Detailed 2-foot inundation depth of Morgan Lake breach proposed condition- berm, 50 % AEP (2-year return interval) inflows from river and creeks

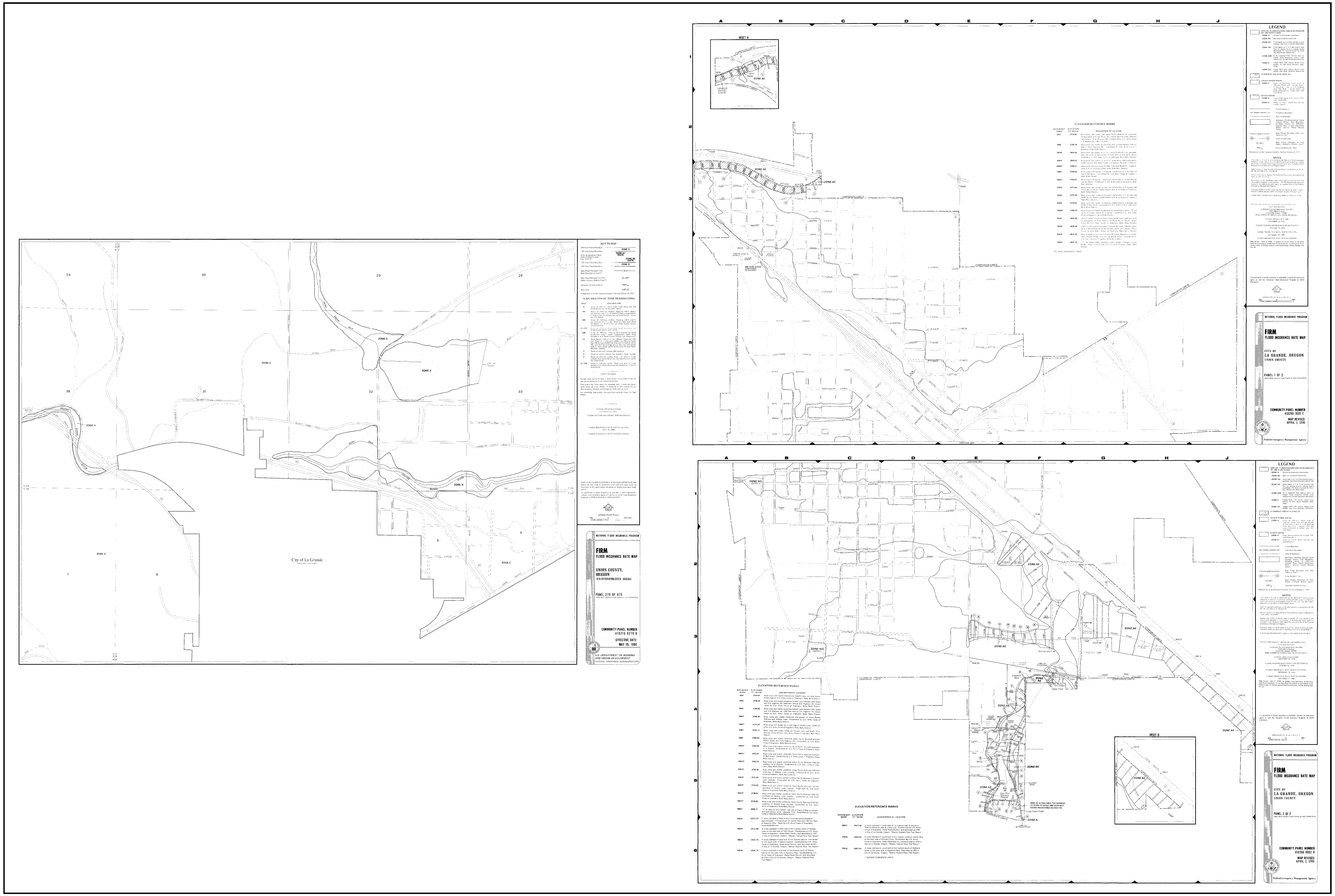

Figure 5: FEMA Flood Insurance Rate Maps (FIRMs) for the Grande Ronde River and the City of La Grande

8.6 FEMA Review Tool

Local Mitigation Plan Review Tool

Cover Page

The Local Mitigation Plan Review Tool (PRT) demonstrates how the local mitigation plan meets the regulation in 44 CFR § 201.6 and offers states and FEMA Mitigation Planners an opportunity to provide feedback to the local governments, including special districts.

1. The Multi-Jurisdictional Summary Sheet is a worksheet that is used to document how each jurisdiction met the requirements of the plan elements (Planning Process; Risk Assessment; Mitigation Strategy; Plan Maintenance; Plan Update; and Plan Adoption).
2. The Plan Review Checklist summarizes FEMA's evaluation of whether the plan has addressed all requirements.

For greater clarification of the elements in the Plan Review Checklist, please see Section 4 of this guide. Definitions of the terms and phrases used in the PRT can be found in Appendix E of this guide.

Plan Information	
Jurisdiction(s)	City of La Grande
Title of Plan	City of La Grande Natural Hazards Mitigation Plan
New Plan or Update	Update
Single- or Multi-Jurisdiction	Single-jurisdiction
Date of Plan	11/15/2023
Local Point of Contact	
Title	Kyle Carpenter
Agency	City of La Grande Public Works Department
Address	800 X Avenue, La Grande, Oregon 97850
Phone Number	(541) 962-1325
Email	kcarpenter@cityoflagrande.org

Additional Point of Contact	
Title	Michael Boquist
Agency	City of La Grande Community Development Department
Address	1000 Adams Avenue, La Grande, Oregon 97850
Phone Number	(541) 962-1307
Email	mboquist@cityoflagrande.org

Review Information	
State Review	
State Reviewer(s) and Title	Joseph Murray
State Review Date	Click or tap to enter a date.
FEMA Review	
FEMA Reviewer(s) and Title	Francesca Zito, CERC Erin Cooper, Mitigation Planning Section Chief
Date Received in FEMA Region	11/20/2023
Plan Not Approved	Click or tap to enter a date.
Plan Approvable Pending Adoption	12/28/2023
Plan Approved	1/8/2024

Multi-Jurisdictional Summary Sheet

In the boxes for each element, mark if the element is met (Y) or not met (N).

#	Jurisdiction Name	A. Planning Process	B. Risk Assessment	C. Mitigation Strategy	D. Plan Maintenance	E. Plan Update	F. Plan Adoption	G. HHPD Requirements	H. State Requirements
1	City of La Grande	Y	Y	Y	Y	Y	Y	Y	N/A
2									
3									
4									
5									
6									
7									
8									
9									
10									

Plan Review Checklist

The Plan Review Checklist is completed by FEMA. States and local governments are encouraged, but not required, to use the PRT as a checklist to ensure all requirements have been met prior to submitting the plan for review and approval. The purpose of the checklist is to identify the location of relevant or applicable content in the plan by element/sub-element and to determine if each requirement has been "met" or "not met." FEMA completes the "required revisions" summary at the bottom of each element to clearly explain the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is "not met." Sub-elements in each summary should be referenced using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each element and sub-element are described in detail in Section 4: Local Plan Requirements of this guide.

Plan updates must include information from the current planning process.

If some elements of the plan do not require an update, due to minimal or no changes between updates, the plan must document the reasons for that.

Multi-jurisdictional elements must cover information unique to all participating jurisdictions.

Element A: Planning Process

Element A Requirements	Location in Plan (section and/or page number)	Met / Not Met
A1. Does the plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement 44 CFR § 201.6(c)(1))		
A1-a. Does the plan document how the plan was prepared, including the schedule or time frame and activities that made up the plan's development, as well as who was involved?	Ch. 1, p. 15 Ch. 5, pp. 254-289	Met
A1-b. Does the plan list the jurisdiction(s) participating in the plan that seek approval, and describe how they participated in the planning process?	Ch. 5, pp. 254-289	Met

Element A Requirements	Location in Plan (section and/or page number)	Met / Not Met
A2. Does the plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development as well as businesses, academia, and other private and non-profit interests to be involved in the planning process? (Requirement 44 CFR § 201.6(b)(2))		
A2-a. Does the plan identify all stakeholders involved or given an opportunity to be involved in the planning process, and how each stakeholder was presented with this opportunity?	Ch. 5, pp. 254-257	Met
A3. Does the plan document how the public was involved in the planning process during the drafting stage and prior to plan approval? (Requirement 44 CFR § 201.6(b)(1))		
A3-a. Does the plan document how the public was given the opportunity to be involved in the planning process and how their feedback was included in the plan?	Ch. 5, pp. 254-257	Met
A4. Does the plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement 44 CFR § 201.6(b)(3))		
A4-a. Does the plan document what existing plans, studies, reports and technical information were reviewed for the development of the plan, as well as how they were incorporated into the document?	Ch. 2, pp. 53, 64 ; Ch. 3, pp. 122-123 Ch. 7, pp. 301-320 References throughout the plan	Met

ELEMENT A REQUIRED REVISIONS
Required Revision**:** n/a

Element B: Risk Assessment

Element B Requirements	Location in Plan (section and/or page number)	Met / Not Met
B1. Does the plan include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction? Does the plan also include information on previous occurrences of hazard events and on the probability of future hazard events? (Requirement 44 CFR § 201.6(c)(2)(i))		
B1-a. Does the plan describe all natural hazards that can affect the jurisdiction(s) in the planning area, and does it provide the rationale if omitting any natural hazards that are commonly recognized to affect the jurisdiction(s) in the planning area?	Overall: p. 68; p. 77 Table 3-2; Chapter 3 AQ: p. 80 Drought: pp. 91-92 EQ: pp. 103-108 Flood: pp. 119-122 Invasive Species: pp. 145-146 SW: pp. 153-157 Volcanic: pp. 172-175 Wildfire: pp. 185-186	Met
B1-b. Does the plan include information on the location of each identified hazard?	Overall: Chapter 3 AQ: Chapter 3, p. 81 (Figure 3-6) Drought: pp. 92-94 EQ: p. 108; Figures 3-17 through 3-20 Flood: pp. 122-123; Figure 3-23 Invasive Species: pp. 146-150 SW: pp. 157-158 Volcanic: pp. 175-178 Wildfire: pp. 186-191	Met

Element B Requirements	Location in Plan (section and/or page number)	Met / Not Met
B1-c. Does the plan describe the extent for each identified hazard?	Overall: Chapter 3 AQ: pp. 81-84, Table 3-4 (p. 84) Drought: pp. 95-96; Figures 3-13 and 3-14). EQ: 103 - 118 Flood: p. 122 Invasive Species: pp. 146-150 SW: pp. 159-161, Figure 3-29, Table 3-12 Volcanic: pp. 177-178 Wildfire: pp. 187-192	Met
B1-d. Does the plan include the history of previous hazard events for each identified hazard?	Disaster Declarations: Chapter 3, p. 79 (Table 3-3) AQ: pp. 84-85 Drought: pp. 96-98; Figure 3-15 EQ: pp. 111-112 Flood: pp. 129-130 Invasive Species: pp. 150-151 SW: pp. 161-165 Volcano: pp. 178-181 Wildfire: pp. 192-194	Met

Element B Requirements	Location in Plan (section and/or page number)	Met / Not Met
B1-e. Does the plan include the probability of future events for each identified hazard? Does the plan describe the effects of future conditions, including climate change (e.g., long-term weather patterns, average temperature and sea levels), on the type, location and range of anticipated intensities of identified hazards?	Overall: Chapter 3, p. 68, Figure 3-4 AQ: pp. 85-87 Drought: pp. 98-100 EQ: p. 112 Flood: pp. 130-132 Invasive Species: p. 151 SW: pp. 166-167 Wildfire: pp. 194-196	Met
B1-f. For participating jurisdictions in a multi-jurisdictional plan, does the plan describe any hazards that are unique to and/or vary from those affecting the overall planning area?	N/A – Single Jurisdictional Plan	Choose an item.
B2. Does the plan include a summary of the jurisdiction's vulnerability and the impacts on the community from the identified hazards? Does this summary also address NFIP-insured structures that have been repetitively damaged by floods? (Requirement 44 CFR § 201.6(c)(2)(ii))		
B2-a. Does the plan provide an overall summary of each jurisdiction's vulnerability to the identified hazards?	Overall: Chapter 3 AQ: pp. 85-87 Drought: pp. 100-102 EQ: pp. 113-118 Flood: pp.132-140 Invasive Species: pp. 151-152 SW: pp. 167-171 Volcano: pp. 182 Wildfire: pp. 196-200	Met

Element B Requirements	Location in Plan (section and/or page number)	Met / Not Met
B2-b. For each participating jurisdiction, does the plan describe the potential impacts of each of the identified hazards on each participating jurisdiction?	Overall: Chapter 3 AQ: pp. 85-87 Drought: pp. 100-102 EQ: pp. 113-118 Flood: pp. 132-140 Invasive Species: pp. 151-152 SW: pp. 167-171 Volcano: pp. 182-184 Wildfire: pp. 196-200	Met
B2-c. Does the plan address NFIP-insured structures within each jurisdiction that have been repetitively damaged by floods?	Ch. 3, p. 142, Table 3-9 (No RL/SRL)	Met

ELEMENT B REQUIRED REVISIONS
Required Revision: n/a

Element C: Mitigation Strategy

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met
C1. Does the plan document each participant's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement 44 CFR § 201.6(c)(3))		
C1-a. Does the plan describe how the existing capabilities of each participant are available to support the mitigation strategy? Does this include a discussion of the existing building codes and land use and development ordinances or regulations?	Ch. 2, pp. 49-65 Ch. 4, pp. 217-240	Met
C1-b. Does the plan describe each participant's ability to expand and improve the identified capabilities to achieve mitigation?	Ch. 2, pp. 49-65 Ch. 4, pp. 217-240	Met

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met
C2. Does the plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement 44 CFR § 201.6©(3)(ii))		
C2-a. Does the plan contain a narrative description or a table/list of their participation activities?	Ch. 3, pp. 141-144	Met
C3. Does the plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement 44 CFR § 201.6(c)(3)(i))		
C3-a. Does the plan include goals to reduce the risk from the hazards identified in the plan?	Ch. 4, pp. 201-202	Met
C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C4-a. Does the plan include an analysis of a comprehensive range of actions/projects that each jurisdiction considered to reduce the impacts of hazards identified in the risk assessment?	Ch. 4, pp. 202-204; Appendix 8.2	Met
C4-b. Does the plan include one or more action(s) per jurisdiction for each of the hazards as identified within the plan's risk assessment?	Ch. 4, pp. 208-211; Appendix 8.1 (Mitigation Action Worksheets)	Met
C5. Does the plan contain an action plan that describes how the actions identified will be prioritized (including a cost-benefit review), implemented, and administered by each jurisdiction? (Requirement 44 CFR § 201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))		
C5-a. Does the plan describe the criteria used for prioritizing actions?	Ch. 4, p. 206; Ch. 5, pp. 246-249	Met
C5-b. Does the plan provide the position, office, department or agency responsible for implementing/administrating the identified mitigation actions, as well as potential funding sources and expected time frame?	Appendix 8.1 (Mitigation Action Worksheets)	Met

ELEMENT C REQUIRED REVISIONS
Required Revision: n/a

Element D: Plan Maintenance

Element D Requirements	Location in Plan (section and/or page number)	Met / Not Met
D1. Is there discussion of how each community will continue public participation in the plan maintenance process? (Requirement 44 CFR § 201.6(c)(4)(iii))		
D1-a. Does the plan describe how communities will continue to seek future public participation after the plan has been approved?	Ch. 5, p. 249	Met
D2. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a five-year cycle)? (Requirement 44 CFR § 201.6(c)(4)(i))		
D2-a. Does the plan describe the process that will be followed to track the progress/status of the mitigation actions identified within the Mitigation Strategy, along with when this process will occur and who will be responsible for the process?	Ch. 5, pp. 241-246	Met
D2-b. Does the plan describe the process that will be followed to evaluate the plan for effectiveness? This process must identify the criteria that will be used to evaluate the information in the plan, along with when this process will occur and who will be responsible.	Ch. 5, pp. 241-246	Met
D2-c. Does the plan describe the process that will be followed to update the plan, along with when this process will occur and who will be responsible for the process?	Ch. 5, pp. 249-250	Met
D3. Does the plan describe a process by which each community will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement 44 CFR § 201.6(c)(4)(ii))		
D3-a. Does the plan describe the process the community will follow to integrate the ideas, information and strategy of the mitigation plan into other planning mechanisms?	Ch. 5, pp. 243 -245	Met

Element D Requirements	Location in Plan (section and/or page number)	Met / Not Met
D3-b. Does the plan identify the planning mechanisms for each plan participant into which the ideas, information and strategy from the mitigation plan may be integrated?	Ch. 5, pp. 244-245 Appendix 8.1 (in each worksheet)	Met
D3-c. For multi-jurisdictional plans, does the plan describe each participant's individual process for integrating information from the mitigation strategy into their identified planning mechanisms?	N/A – Single Jurisdiction	Choose an item.
ELEMENT D REQUIRED REVISIONS		
Required Revision**:** n/a		

Element E: Plan Update

Element E Requirements	Location in Plan (section and/or page number)	Met / Not Met
E1. Was the plan revised to reflect changes in development? (Requirement 44 CFR § 201.6(d)(3))		
E1-a. Does the plan describe the changes in development that have occurred in hazard-prone areas that have increased or decreased each community's vulnerability since the previous plan was approved?	Ch. 2, p. 51	Met
E2. Was the plan revised to reflect changes in priorities and progress in local mitigation efforts? (Requirement 44 CFR § 201.6(d)(3))		
E2-a. Does the plan describe how it was revised due to changes in community priorities?	Ch. 5, pp. 251-254	Met
E2-b. Does the plan include a status update for all mitigation actions identified in the previous mitigation plan?	Ch. 4, pp. 212-216	Met
E2-c. Does the plan describe how jurisdictions integrated the mitigation plan, when appropriate, into other planning mechanisms?	N/A	Choose an item.

ELEMENT E REQUIRED REVISIONS
Required Revision: n/a

Element F: Plan Adoption

Element F Requirements	Location in Plan (section and/or page number)	Met / Not Met
F1. For single-jurisdictional plans, has the governing body of the jurisdiction formally adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F1-a. Does the participant include documentation of adoption?	Click or tap here to enter text.	Met
F2. For multi-jurisdictional plans, has the governing body of each jurisdiction officially adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F2-a. Did each participant adopt the plan and provide documentation of that adoption?	n/a	Choose an item.
ELEMENT F REQUIRED REVISIONS		
Required Revision: n/a		

Element G: High Hazard Potential Dams (Optional)

HHPD Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD1. Did the plan describe the incorporation of existing plans, studies, reports and technical information for HHPDs?		
HHPD1-a. Does the plan describe how the local government worked with local dam owners and/or the state dam safety agency?	Ch. 3, pp. 123-126	Met
HHPD1-b. Does the plan incorporate information shared by the state and/or local dam owners?	Ch. 3, pp. 123-128	Met

HHPD Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD2. Did the plan address HHPDs in the risk assessment?		
HHPD2-a. Does the plan describe the risks and vulnerabilities to and from HHPDs?	Ch. 3, pp. 127-126	Met
HHPD2-b. Does the plan document the limitations and describe how to address deficiencies?	Ch. 3, pp. 126-129	Met
HHPD3. Did the plan include mitigation goals to reduce long-term vulnerabilities from HHPDs?		
HHPD3-a. Does the plan address how to reduce vulnerabilities to and from HHPDs as part of its own goals or with other long-term strategies?	Ch. 4, pp. 201-202	Met
HHPD3-b. Does the plan link proposed actions to reducing long-term vulnerabilities that are consistent with its goals?	Ch. 4, pp. 201-202	Met
HHPD4-a. Did the plan include actions that address HHPDs and prioritize mitigation actions to reduce vulnerabilities from HHPDs?		
HHPD4-a. Does the plan describe specific actions to address HHPDs?	Ch. 3, pp. 128-129 Ch. 4, p. 215	Met
HHPD4-b. Does the plan describe the criteria used to prioritize actions related to HHPDs?	Ch. 4, p. 207	Met
HHPD4-c. Does the plan identify the position, office, department or agency responsible for implementing and administering the action to mitigate hazards to or from HHPDs?	Ch. 3, pp. 128-129	Met

HHPD Required Revisions
Required Revision**:** n/a

Element H: Additional State Requirements (Optional)

Element H Requirements	Location in Plan (section and/or page number)	Met / Not Met
This space is for the State to include additional requirements.		
Click or tap here to enter text.	n/a	Choose an item.

Plan Assessment

These comments can be used to help guide your annual/regularly scheduled updates and the next plan update.

Strengths

- The list-serv for outreach to individuals and organizations is expansive and inclusive of many groups of people, including socially vulnerable and underserved residents.

Opportunities for Improvement

- When speaking of social vulnerability, the plan notes “the social vulnerability is low” but does not give a number. Future plan updates could include the numerical social vulnerability score to better illustrate the vulnerability.
- Additional detail on how this plan was informed by the previous Northeastern Regional mutli-jurisdictional hazard mitigation plan could be beneficial for plan integration and implementation.

Element B. Risk Assessment

Strengths

- The discussion of both the effective and preliminary FIRMs greatly added to the Flood profile. It is helpful to see how the floodplain may change in the future and the impacts this might have through the lens of future development.

Opportunities for Improvement

- [insert comments]

Element C. Mitigation Strategy

Strengths

- The Mitigation Action Worksheets provide important detail and create a necessary connection to the community’s vulnerabilities.

Opportunities for Improvement

- [insert comments]

Element D. Plan Maintenance

Strengths

- The five step project prioritization process uses both qualitative and quantitative inputs to prioritize and implement the mitigation strategy.

Opportunities for Improvement

- There are opportunities to add more detail to the maintenance schedule as far as when meetings would occur.

Element G. HHPD Requirements (Optional)

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

Element H. Additional State Requirements (Optional)

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]