

Volume III: Jurisdiction Addenda

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City of Canby Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: City of Canby

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The City of Canby

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August 7, 2024 (Resolution # 1418)
September 18, 2019, (Resolution # 1327)
2013
2009



This Natural Hazard Mitigation Plan was prepared by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

RESOLUTION NO. 1418

A RESOLUTION ADOPTING THE CITY OF CANBY REPRESENTATION IN THE UPDATES TO THE CLACKAMAS COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

WHEREAS, the City of Canby recognizes the threat that natural hazards pose to people, property, and infrastructure within our community;

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

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

WHEREAS, the City of Canby has fully participated in the FEMA prescribed mitigation planning process to prepare the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities;

WHEREAS, the City of Canby has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of Canby to the impacts of future disasters within the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*;

WHEREAS, these proposed projects and programs have been incorporated into the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County;

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, May 29, 2024) contingent upon this official adoption of the participating governments and entities;

WHEREAS, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP;

WHEREAS, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

WHEREAS, the City of Canby adopts the NHMP and directs the City Administrator to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

NOW, THEREFORE, BE IT RESOLVED, that the City of Canby adopts *the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan; and

BE IT FURTHER RESOLVED, the City of Canby will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

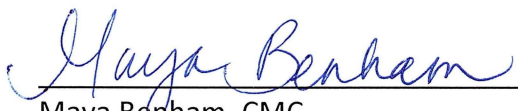
This Resolution will take effect on August 7, 2024.

ADOPTED this 7th day of August 2024, by the Canby City Council.



Brian Hodson, Mayor

ATTEST:



Maya Benham, CMC
City Recorder

Purpose

This is an update of the Canby addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Canby's addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Canby adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on August 7, 2024. FEMA Region X approved the Clackamas County NHMP and the City's addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), Plan Adoption, and 44 CFR 201.6(a)(3), Participation.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Canby to update their NHMP.

The Clackamas County NHMP, and Canby addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Canby HMAAC guided the process of developing the NHMP.

Convener

The Canby Economic Development Director and Communications Specialist serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Canby HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Canby HMAC was comprised of the following representatives:

- Convener Jamie Stickel, Economic Development Director & Communications Specialist
- Jerry Nelzen, Public Works Director
- Jorge Tro, Canby Police Chief
- Eileen Stein, City Administrator

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Molalla addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the Molalla NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses and policy makers. Where possible, Canby will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and applied. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Canby to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., structural building codes, stormwater master plan update, etc.). Note: The City is currently updating its Comprehensive Plan as noted.

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards. Canby addresses Statewide Planning Goal 7 Natural Hazards as part of their Comprehensive Plan Element, Natural Hazards. This plan was originally adopted in 1984. Chapter 4, Environmental Concerns, includes findings related to natural hazards. This chapter establishes the H overlay zone, which restricts development in areas of identified flood hazards. Other hazards discussed are steep slopes (along riverbanks), expansive soils, high water tables, and shallow topsoil.

The City of Canby is pursuing updating this Comprehensive Plan in 2023-2024, following the adoption of new Housing Needs and Economic Opportunity analyses in 2023.

Planned updates to the jurisdiction's Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community's long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

Canby Development Code

[Chapter 16.40 Hazard Overlay Zone \(H\)](#) assures that the development will not result in an unacceptable level of risk because of hazardous conditions. It is intended to be applied only to those specific properties which have been identified as having steep slopes or potential for flooding. It utilizes the flood insurance study, including the flood insurance rate map, dated June 17, 2008.

[Chapter 15.12 Flood Hazard Protection Ordinance](#) complies with federal and state regulations related to flood hazard protection. It was last updated in 2008 and is based upon the Oregon Model Flood Hazard Prevention code of that time and includes provisions addressing substantial improvement/substantial damage.

The Planning Division is responsible for processing all land use applications within the City of Canby which includes subdivisions, partitions, and site and design review. We also provide development services, zoning reviews, and provide the public with information on all property-related issues within the City limits. City approval is required before Clackamas County can issue a building permit.

They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

[Clackamas County](#) currently issues all building, plumbing, and electrical permits for the City of Canby. The Clackamas County Building Department administers and enforces the 2022 Oregon Structural Specialty Code and the 2022 Oregon Fire Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

Public Works

The City of Canby Public Works Department is responsible for streets, including street lighting, storm drains, parks, building maintenance, Zion Memorial Cemetery, and the Wastewater Treatment Plant. Water and electric are administered by Canby Utility.

Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

2019 Canby Public Works Standards

The [Canby Public Works Standards](#) provide guidance for the development of public infrastructure (streets, sanitary sewer, and storm drainage).

City Administration

The City Council of Canby has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Policies and Programs

This Plan directs Canby and Clackamas County to explore integration into other planning documents and processes. Canby has made progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

Housing Needs Analysis, 2023

The [Housing Needs Analysis](#) deducted the following lands from the residential land inventory:

- Open water of at least one-half acre in size.
- Land within the 100-year floodplains. This includes lands in flood-hazard areas as identified by the Flood Prone classification of Canby's Comprehensive Plan
- Wetlands identified by the City and identified in the Comprehensive Plan as a barrier for future development
- Land within Metro's ORCA (Outdoor Recreation & Conservation Areas) data set
- Land in public ownership with no development potential
- Land with slopes greater than 25%

The Housing Need Analysis found that population growth in Canby will require the addition of 2,286 new dwelling units between 2023 and 2043. After removing constrained lands from the vacant land inventory, the current Canby UGB is not sufficient to accommodate these future housing needs.

Urban Growth Boundary Expansion

The City has identified a need for a potential Urban Growth Boundary (UGB) expansion in the next five years, to add approximately 100 acres for housing and 440 acres for employment to the City's planning area. The Preliminary UGB expansion study area includes 1,600 acres of land surrounding the current UGB. Known hazards will be reviewed as part of this study to help determine the most resilient areas for expansion/development.

Stormwater Master Plan Update, 2023

This Stormwater Master Plan updates Canby's guiding principles for stormwater system design, the 2014 Capital Improvement Plan, and all project costs, and provides guidance for compliance with the Water Pollution Control Facility Permit issued to the City of Canby. The existing conveyance systems throughout the City are comprised of gravity storm drainage pipes, open drainage ways or ditches, trench drains, and UICs.

The City of Canby does not currently have stormwater water quality treatment requirements and the City is not a "regulated" small Municipal Storm Sewer System (MS4) subject to the EPA Phase II Stormwater Rule. The primary basis for adopting a Capital Improvement Plan for the City of Canby is to improve stormwater collection and disposal deficiencies in the system.¹ This plan identifies stormwater

areas of concern, including localized/urban flooding, and recommends projects to address these issues (through 2043), including some long-range projects in anticipation of future classification as an EPA regulated MS4.

Parks and Recreation Master Plan, 2022

This update to the 2002 Parks Master Plan addresses a growing need for recreational resources within the community. It includes acquisition and development goals that include protection and restoration of sensitive riparian resources and wetlands along the Molalla River (“Molalla River Greenway” concept).

Community Wildfire Protection Plan (2024)

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The NHMP will also be integrated into the City’s Capital Improvement Plan, to be adopted by early 2024.

Personnel

The following Canby personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Jorge Tro, Police Chief

Public Information Officer: Jamie Stickel, Economic Development Director | Communications Specialist

Floodplain Manager: Planning Director

Grant writing (for Public Works or emergency management): Jamie Stickel, Economic Development Director | Communications Specialist

Capital improvement planning: Jerry Nelzen, Public Works Director

Capital improvement execution: Jerry Nelzen, Public Works Director

Canby does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Canby has implemented recommendations from the last NHMP into its capital improvement projects over the last 5 years, including:

The following mitigation-related or resilience projects have been completed since 2018:

Ongoing projects that enhance the City’s resilience include:

- Emergency Operations Plan Update (expected 2024)

Proposed projects that relate to hazard mitigation and resilience within the next five years include:

- Wastewater Treatment Plant site improvements
- New wastewater treatment pump station
- Storm water system upsizing/capacity projects

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)¹.

FEMA Funded Mitigation Successes

- 2014: PDMC-PJ-10-OR-2011-001, Canby Water Reservoir Seismic Retrofit
- 2007: DR-1510-0005-R, Highway 99E Undergrounding Project, Canby Utility Board
- 2004: PDMC-PJ-10-OR-2003-003, City of Canby/Canby Telephone Central Offices Seismic Upgrade

Seismic Rehabilitation Grant Program Mitigation Successes

- none identified.

Capital Resources

Canby maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Critical facilities with power generators for use during emergency blackouts: Canby Public Works, Canby Police Department, and Canby Fire Station (main station and northside station). NOTE: Planned upgrades to emergency power to the Canby Civic Center and the Canby Adult Center. Schools: Trost Elementary School, Baker Prairie Middle School, and Canby Highschool

Warming/Cooling Shelters: Canby Public Library, Zoar Lutheran Church, the Canby Center, Canby Adult Center, Denny's Restaurant – open hours and days vary by location.

Food pantries: The Canby Center serves as the food pantry in Canby. NOTE: The Canby Center is expanding and the plans are consolidate the food pantry to a single location at the Canby Center, so I have removed St. Patrick's Church

Fueling storage: Public Works has plans to upgrade the City of Canby's fueling storage in 2024 to include 12,000 gallons of diesel, 12,000 gas.

Findings

Several important findings from this capability assessment informed the design of the Plan's mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Canby staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Canby operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and

¹ The Seismic Rehabilitation Grant Program (SRGP) 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.

federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City's ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAc reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAc, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3(iv), Mitigation Strategy.

The City’s mitigation strategy (action items) were first developed during the 2003 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAC assessed the City’s risk, identified potential issues, and developed a mitigation strategy (action items). During the 2023 update process the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting what accomplishments had been made and whether the actions were still relevant; any new action items were identified at this time (see Attachment A for more information on changes to action items).

Action Items

Table CA-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAC decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five years. Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table CA-1 Action Items

Action Item #	Statement	Impacted Hazard										Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/Partners	Timeline	Potential Funding Source	Estimated Cost	
1	Update and revise the Canby Emergency Operations Plan.	X	X	X	X	X	X	X	X	X	X	City of Canby/Canby Fire District, Canby Utility	Short	Local Resources. DLCD TA	Low
2	Ensure there are adequate shelter facilities in hazard-free zones to serve Canby residents. Identify potential shelter sites and evaluate their relative structural risks/structural deficiencies. Seek funding for upgrades on shelter sites if needed.		X	X	X	X		X	X	X	Hazard Mitigation Advisory Committee (HMAC)/ Public Works, Planning, Building	Short	Local Resources	Low	
3	Develop, enhance, and implement education programs designed to reduce the losses from natural hazards.	X	X	X	X	X	X	X	X	X	HMAC/ Canby Fire District, Canby Utility, Administration	Medium	Local Resources. DLCD TA, FEMA HMA	Low	
4	Integrate the goals and action items from the Canby Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	HMAC/ Planning, Public Works	Medium	Local Resources. DLCD TA, FEMA HMA-C&CB	Low to High	
5	Identify, plan, and establish an alternate potable water source on the Willamette River.	X			X	X					Canby Utility/ HMAC	Short	Local, State, Federal Grants FEMA HMA-C&CB	High	

Table CA-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/Partners	Timeline	Potential Funding Source	Estimated Cost
6	Conduct seismic evaluations and upgrades on identified critical and essential facilities (e.g., Public Works Center, Canby Adult Center) and infrastructure for implementing appropriate structural and non-structural mitigation strategies.		X								HMAC/ Administration, Planning, Public Works, Police, Canby Fire District, Canby Utility	Long	Local, State and Federal Grants and BRIC	High
7	Evaluate and upgrade surface water management infrastructure when expanding the UGB and identify appropriate mitigation strategies.	X			X			X			Public Works/ Planning, Administration	Medium	Local, State, Federal Grants FEMA HMA-C&CB	High
8	Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.				X						Planning/ Public Works	Ongoing	Local Resources. DLCDC TA, FEMA HMA (FMA)	Low
9	Reduce the vulnerability of property owners in landslide-prone areas.					X					Planning/ Public Works	Long	Local Resources, FEMA HMA	Medium
10	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.							X			Canby Fire District/ Public Works, Planning	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low to High

Source: Canby NHMP HMAC, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure CA-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure CA-1 Understanding Risk



Hazard Analysis

The Canby HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Molalla, which are discussed throughout this addendum. Table CA-2 shows the HVA matrix for Molalla

listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) and two chronic hazards (winter storm and flood) rank as the top hazard threats to the City (Top Tier). Landslide, wildfire, extreme heat, and drought comprise the next highest ranked hazards (Middle Tier), while windstorm and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table CA-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Earthquake - Cascadia	4	45	100	49	198	1	Top Tier
Earthquake - Crustal	6	50	100	21	177	2	
Winter Storm	18	30	70	49	167	3	
Flood	16	20	70	56	162	4	
Landslide	14	35	30	63	142	5	Middle Tier
Wildfire	12	25	70	21	128	6	
Extreme Heat Event	16	15	40	56	127	7	
Drought	10	15	50	42	117	8	Bottom Tier
Windstorm	14	15	30	42	101	9	
Volcanic Event	2	15	50	7	74	10	

Source: Canby HMAC, 2023.

Community Characteristics

Table CA-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Canby has grown substantially since its incorporation in 1893 and has an area today of about 4 square miles. Canby lies in the heart of very productive agricultural lands.

Canby’s climate is consistent with the Marine west coast climate zone, with warm summers and cool, wet winters. Canby receives most of its rainfall between October and May, and averages 45 inches of rain.² Snowfall is rare but can occur annually.

The City of Canby is located on a relatively flat terrain and, with few exceptions, has only gentle changes in the topography of less than 30 feet within the city limits and Urban Growth Boundary (UGB), between 140 to 170 feet above mean sea level. The southwest portion of the city drops abruptly at the Molalla River to an elevation of approximately 80 feet. At the northern border of the UGB, the topography gradually slopes to the Willamette River, dropping from an elevation of approximately 130 feet to 100 feet at the city’s wastewater treatment facility. To the east of Canby, the topography changes very little until beyond the urban growth boundary, where the ground has undulating gentle hills in the southeastern areas and steep rocky cliffs in the northeastern areas along the Willamette River.

² [“Monthly Average for Canby, OR”](#) The Weather Channel Interactive, Inc. Retrieved April 11, 2019.

Population, Housing, and Income

Between 2016 and 2022 the City grew by 2,559 people (16%; as of 2022 the population was 18,979). Between 2022 and 2045 the population is forecast to grow by 22% to 23,104.

Most of the population is White/Caucasian (76%) and about 18% of the population is Hispanic or Latino. The poverty rate is 9% (8% of children under 18, 7% for people 65 and older), 9% do not have health insurance, and 51% of renters pay more than 30% of their household income on rent (35% for owners). About 29% of the population has a bachelor's degree or higher (10% do not have a high school degree). Approximately 14% of the population lives with a disability (34% of population 65 and older), and 22% are either below 15 (24%) or over 65 (19%) years of age. About 11% of the population are 65 or older and living alone and 9% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 72% of housing units are single-family, 23% are multifamily, and 5% are mobile homes. Less than one-fifth of homes (16%) were built before 1970 and 52% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Two-thirds (66%) of housing units are owner occupied, 32% are renter occupied, and 2% are vacant.

Transportation/Infrastructure

Canby is accessible by state highway 99E, running north to south on the city's west side. Congestion on 99E can result in the diversion of traffic onto City streets. Canby is also bisected by the Union Pacific Railroad main line, which separates the North side from the South; passenger service is provided by Amtrak.

Motor vehicles represent the dominant mode of travel through and within Molalla. Ten percent (10%) of renters and 2% of owners do not have a vehicle. Most workers drive alone to work (73%); 6% carpool, 2% use public transit, 4% either walk or use a bicycle, and 10% work at home.

The City's public transit is provided by the Canby Area Transit system, which provides shuttle transportation to scheduled route locations within Canby. The Canby Ferry, one of three ferries still in operation on the Willamette River, can transport nine vehicles per trip across the Willamette River. The availability and quality of pedestrian and bicycling facilities (sidewalks, bike lanes, and pathways) is inconsistent, generally newer neighborhoods have facilities.

Economy

Canby is a relatively self-sufficient city that operates its own electric and water service (uncommon in Oregon). The business district includes a thriving downtown core as well as flourishing businesses along Highway 99E. The Canby area has a multitude of attractions tied to the bountiful nursery industry, which attract thousands of visitors annually. In Clackamas County, 75% of the nursery acreage is in the vicinity of Canby.

To a certain extent, Canby has been a "bedroom" community for Portland and Salem, though the City hopes to moderate this trend by increasing industrial development. The City is accessible by rail and highway and is located outside of the Portland Air Quality Maintenance area (AQMA). About 49% of the resident population 16 and over is in the labor force (8,873 people) and are employed in a variety of occupations including management, business, and financial (19%), professional and related (16%), office and administrative (12%), construction, extraction, and maintenance (11%), and sales related (10%) occupations.

Most workers residing in the city (84%, 7,049 people) travel outside of the city for work primarily to Portland and surrounding areas.³ A significant population of people travel to the city for work, (82% of the workforce, 6,277 people) primarily from Portland and surrounding areas.⁴

³ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 19, 2023 at <https://onthemap.ces.census.gov>.

⁴ Ibid.

Table CA-3 Community Characteristics

Population Characteristics		Population	Household Characteristics	
		Growth		
2016 Population Estimate	16,420		Housing Units	
2022 Population Estimate	18,979	16%	Single-Family (includes duplexes)	4,882 72%
2045 Population Forecast*	23,104	22%	Multi-Family	1,567 23%
Race			Mobile Homes (includes RV, Van, etc.)	374 5%
American Indian and Alaska Native		< 1%	Household Type	
Asian		1%	Family Household	4,814 72%
Black/ African American		1%	Married couple (w/ children)	1,696 25%
Native Hawaiian and Other Pacific Islander		0%	Single (w/ children)	623 9%
White		76%	Living Alone 65+	737 11%
Some Other Race		0%	Year Structure Built	
Two or More Races		4%	Pre-1970	1,109 16%
Hispanic or Latino/a (of any race)		18%	1970-1989	2,188 32%
Limited or No English Spoken	1,430	8%	1990-2009	2,867 42%
Vulnerable Age Groups			2010 or later	659 10%
Less than 5 Years	745	4%	Housing Tenure and Vacancy	
Less than 15 Years	3,211	18%	Owner-occupied	4,478 66%
65 Years and Older	3,010	17%	Renter-occupied	2,183 32%
85 Years and Older	371	2%	Seasonal	0 0%
Age Dependency Ratio		0.52	Vacant	162 2%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)	
Total Disabled Population	2,485	14%	No Vehicle (owner occupied)	73 2%
Children (Under 18)	136	3%	Two+ vehicles (owner occupied)	3,680 82%
Working Age (18 to 64)	1,346	12%	No Vehicle (renter occupied)	219 10%
Seniors (65 and older)	1,003	34%	Two+ vehicles (renter occupied)	976 45%
Income Characteristics			Employment Characteristics	
Households by Income Category			Labor Force (Population 16+)	
Less than \$15,000	485	7%	In labor Force (% Total Population)	8,873 49%
\$15,000-\$29,999	673	10%	Unemployed (% Labor Force)	259 3%
\$30,000-\$44,999	522	8%	Occupation (Top 5) (Employed 16+)	
\$45,000-\$59,999	818	12%	Management, Business, & Financial	1,637 19%
\$60,000-\$74,999	488	7%	Professional & Related	1,446 16%
\$75,000-\$99,999	1,295	19%	Office & Administrative	1,023 12%
\$100,000-\$199,999	1,831	28%	Construction, Extraction, & Maint.	941 11%
\$200,000 or more	549	8%	Sales & Related	917 10%
Median Household Income		\$83,948	Health Insurance	
Gini Index of Income Inequality		0.40	No Health Insurance	1,597 9%
Poverty Rates (Percent age cohort)			Public Health Insurance	6,472 36%
Total Population	1,647	9%	Private Health Insurance	12,364 69%
Children (Under 18)	348	8%	Transportation to Work (Workers 16+)	
Working Age (18 to 64)	1,088	10%	Drove Alone	6,388 73%
Seniors (65 and older)	211	7%	Carpooled	565 6%
Housing Cost Burden (Cost > 30% of household income)			Public Transit	158 2%
Owners with a Mortgage	1,101	35%	Motorcycle	0 0%
Owners without a Mortgage	263	20%	Bicycle/Walk	313 4%
Renters	1,105	51%	Work at Home	853 10%

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", 2016 & 2022; Portland State University, Population Research Center, "Population Forecast Tables", (2023, [Preliminary](#)).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Molalla. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table CA-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table CA-4 Critical Facilities in Canby

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
Critical Facilities by Community	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Ackerman Middle School	-	X	X	-	-
Baker Prairie Middle School	-	X	X	-	-
Canby Fire District 62	-	-	X	-	-
Canby Fire District Northside Station					
Canby High School	-	X	X	-	-
Canby Police Department	-	-	-	X	-
Canby Public Works	-	X	X	-	-
Canby Sewage Treatment	-	X	X	-	-
Cecile Trost Elementary School	-	-	X	-	-
Howard Eccles Elementary School	-	X	X	-	-
Legacy Medical Group - Canby	-	X	X	-	-
Philander Lee Elementary School	-	X	X	-	-
Willamette Falls Health Center	-	-	X	-	-
William Knight Elementary School	-	-	X	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-15.

Note: Canby Fire District Northside Station was not included in the DOGAMI analysis.

Additional Critical Facilities not included in the DOGAMI Risk Report

Critical Facilities and Infrastructure

Infrastructure that provides necessary services for emergency response include:

- 4 Power Substations
- Canby Adult Center
- Canby Area Transit (CAT)
- Canby Utility Business Offices
- City Hall Complex/Library
- Public Works Building (EOC #3)
- Telephone Central Station
- Wastewater Treatment Facilities
- Canby Police Department (EOC #2)
- Fire Station #362 (EOC #1)
- Fire Station #365 (south of Canby)

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public's ability to recover from the emergency. These facilities may include: community gathering places, churches, and other public facilities such as school fields.

- Ackerman Elementary School
- Baker Prairie School
- Canby High School
- Canby Christian Church
- Clackamas County Event Center
- Four Square Church
- Medical Clinics
- Old Canby Library Building
- St. Patricks Church
- United Methodist Church
- Student Transportation

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic, and functional ecosystem services for the community include:

- Canby City Parks
- Canby Utility Bottom Lands
- Emerald Park
- Molalla River State Park
- Willow Creek

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely.

Populations that have special needs or require special consideration include:

- Adult Foster Homes
- Canby Adult Center
- Countryside Living (assisted living)
- Hope Village (senior living and rehab)
- Providence Health Center
- Rackleff House (assisted living)
- Riverside RV Park
- Village on the Lochs

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered "critical." Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include:

- American Steel
- BBC Steel
- Johnson Controls Inc.
- JV Northwest
- Pacific Pride Fuel Storage Tanks
- Railroad
- SR Smith
- Wastewater Treatment Facility
- Water Treatment Facility
- Wilco

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Canby. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers and are a concern during evacuation/notification.

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

An example of the types of properties that should be considered before, during, and after an event include the following properties identified on the National Register of Historic Places within Canby:

- William Knight House, 525 SW 4th Avenue
- Kraft-Brades-Culbertson Farmstead, 2525 N Baker Drive
- Macksburg Lutheran Church, 10190 S Macksburg Road
- Herman Anthony Farm, 10205 S New Era Road

Other important historic resources:

- Canby Chapel
- Canby Depot Museum
- Canby Ferry
- Cemeteries
- Clackamas County Event Center

Hazard Characteristics

Drought

The HMAC determined that the City's probability for drought is **moderate** and that their vulnerability to drought is **low**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

The City of Canby currently obtains its potable water from the Molalla River with an intake pump station capacity of 7.9 million gallons a day (mgd). The primary groundwater source is the Springs Gallery with a seasonally varied capacity up to 1.4 mgd, though low pH and moderate nitrate

concentrations limit the use of it as the primary source. The Canby Utility water system includes surface and groundwater sources, treatment facilities, 66 miles of piping, four storage reservoirs with total usable capacity of 5.5 million gallons, and three pump stations. The Water System Master Plan was last updated in Summer 2023 to provide long-term guidance for the development of the City’s water system, which is a supporting document for the Comprehensive Plan.

Vulnerability Assessment

Due to insufficient data and resources, Canby is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table CA-4.

Mitigation Activities

Canby Utility has a Water Supply Shortage Contingency Plan that details voluntary and non-voluntary actions to be taken in the event of a water shortage. Additional drought hazard mitigation activities are conducted at the county, regional, state, and federal levels and are described in the Clackamas County NHMP.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁵ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Canby as well. The causes and characteristics of an earthquake event are appropriately described within the Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Canby as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek-Newberg-Mt. Angel Structural Zone (discussed in the crustal earthquake section). Figure CA-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas near rivers and streams will experience severe (light red) to violent (dark red) shaking in a CSZ event.

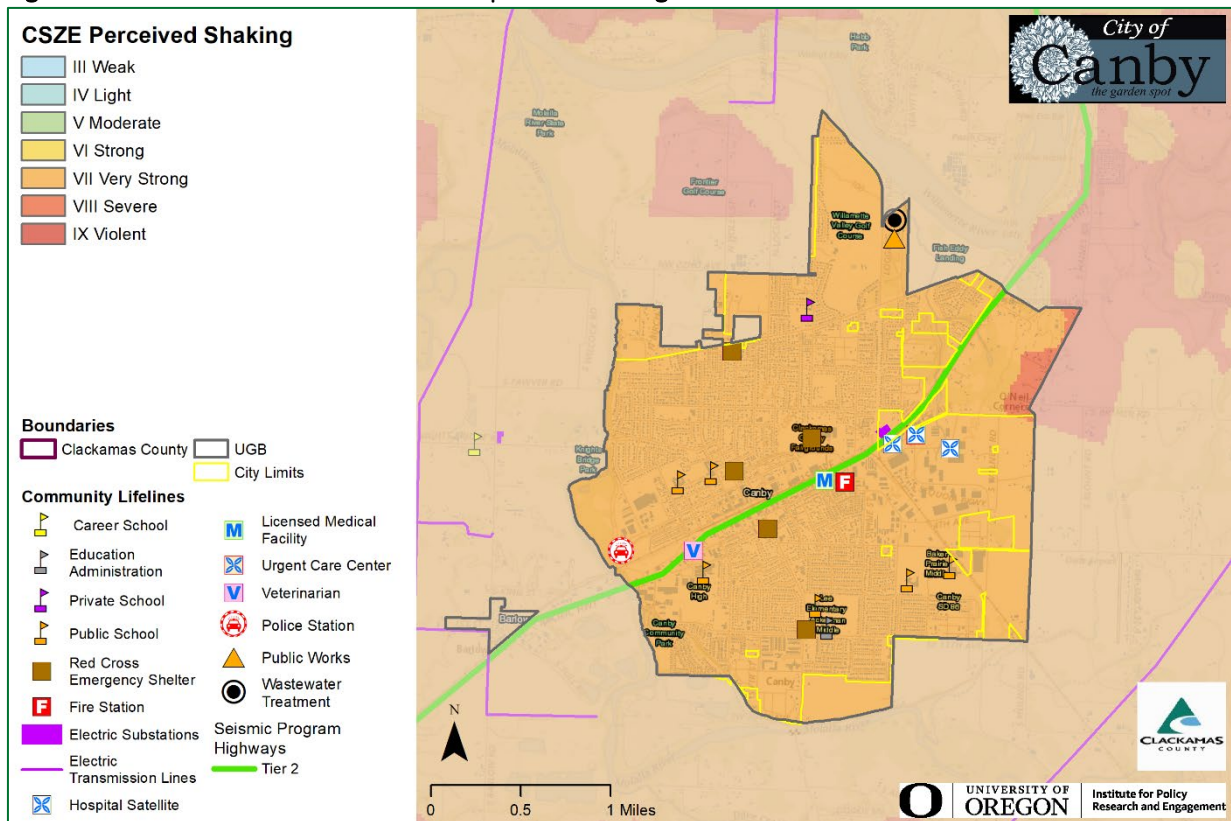
⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.⁶

The city’s proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the “Valley Zone” (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

Figure CA-2 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

⁶ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

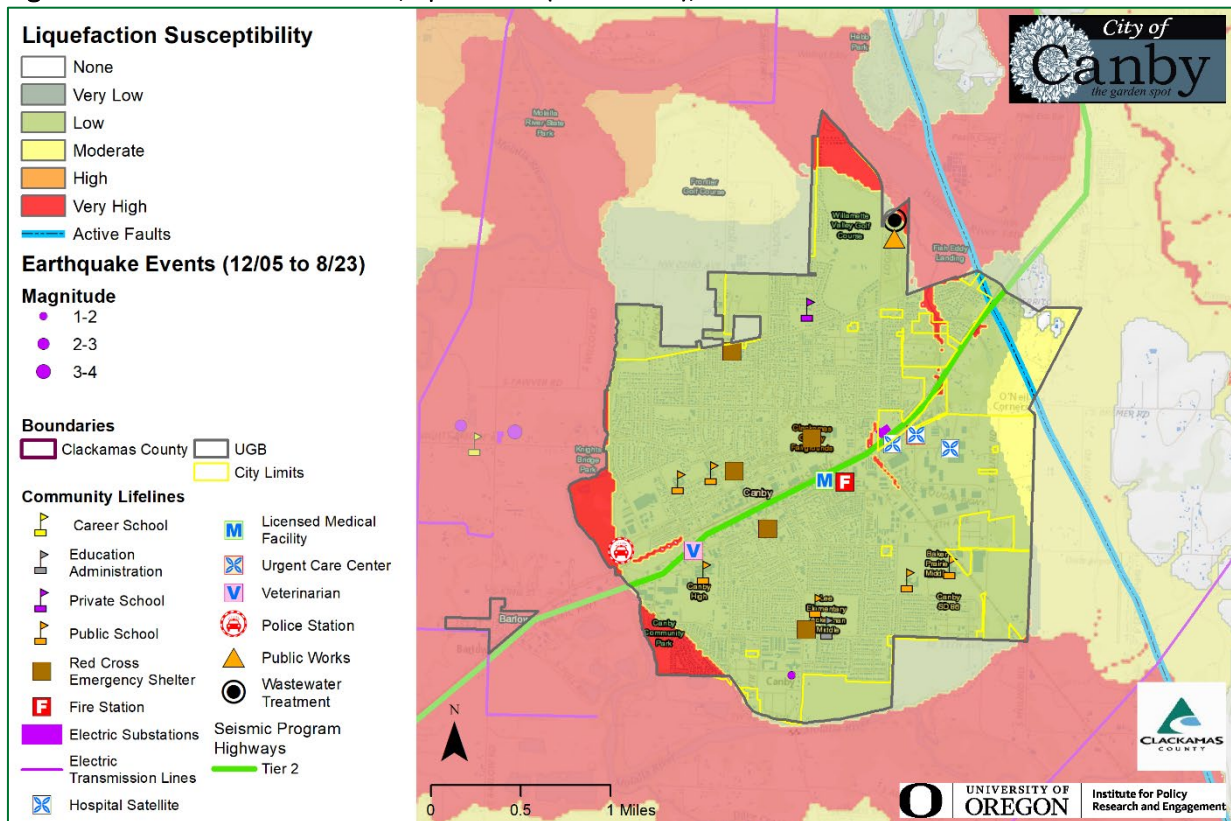
Earthquake (Crustal)

The HMAC determined that the City’s probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Canby as well. Figure 3 shows a generalized geologic map of the Canby area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

There are two potential crustal faults and/or zones near the City that can generate high- magnitude earthquakes. These include the Gales Creek-Mt. Angel Structural Zone and Portland Hills Fault Zone (discussed in greater detail below). Other faults include the Canby- Molalla fault (running through the city’s east edge intersecting Highway 99E) and Oatfield fault (just to the east of the city on the eastern side of the Willamette River), and the Mt. Hood Fault in eastern Clackamas County. Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Figure CA-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Canby-Molalla Fault Zone

The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Molalla in northern Oregon.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 11 miles northeast of Canby.

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

The city has overall moderate vulnerability to an earthquake, which includes the essential and critical facilities. Canby's infrastructure is particularly vulnerable to earthquake damage. All of the city's water facilities are all within the moderate hazard zone. Highway 99E crosses over the Molalla River and runs along the Willamette River, which are seismically vulnerable areas and might affect the ability of outside assistance in the case of an earthquake. During a major earthquake, emergency responders may have difficulty performing their duties because their buildings could be impacted by the event. The Canby Fire District 62 Station, and the Police Department's headquarters are in the moderate to high hazard zones. Areas near the Willamette and Molalla Rivers are likely comprised of softer soils prone to liquefaction. This can be very destructive to underground utilities such as water and sewer lines. Buildings and water lines can sink into the liquefied ground while sewer pipes, manholes and pump stations (assets partially filled with air) may float to the surface. After the earthquake, the liquefied soil will re-solidify, locking tilted buildings and broken pipe connections into place. In 2017, the Canby Fire District Station #62 was awarded a Seismic Rehabilitation Grant for \$233,256 and retrofitted their main fire station. For a list of facilities and infrastructure vulnerable to this hazard, see the Community Assets Section and Table CA-4.

Vulnerable populations such as children could be significantly impacted, as many schools lie in the moderate hazard zone. The data gathered from the statewide DOGAMI inventory should be used to prioritize school buildings in Canby for seismic hazard retrofitting.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 48% of residential buildings were built prior to 1990, which increases the City's vulnerability to the earthquake hazard. Information on specific public buildings' (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table CA-5; each "X" represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), none have a very high (100% chance) or high (greater than 10% chance) collapse potential. *Note: one fire station has been rebuilt and the police department moved to a newly constructed location.*

Table CA-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Ackerman Center (350 SE 13 th Ave)	Clac_sch54	X			
Eccles Elementary (562 NW 5 th Ave)	Clac_sch55	X			
Knight Elementary (501 N Grant St)	Clac_sch53	X			
Lee Elementary (1110 S Ivy St)	-	Not assessed as part of the 2007 RVS			
Trost Elementary (800 S Redwood St)	Clac_sch76	X			
Baker Prairie Middle (1859 S Township Rd)	-	Not assessed as part of the 2007 RVS			
Canby High (721 SW 4 th Ave)	Clac_sch66	X			
Fire Facilities					
Canby Fire District Main Station 62 (221 S Pine St)	Clac_fir39	X			
See Mitigation Successes					
Canby Fire District Station 65 (26815 S Hwy 170) (Outside City)	Clac_fir48	X			
Law Enforcement Facilities					
Canby Policy Department (1175 NW 3 rd Ave)	-	Built at current site in 2012			

Source: [DOGAMI 2007. Open File Report O-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)

“*” – Site ID is referenced on the [RVS Clackamas County Map](#)

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Their study focused on damage to buildings, and the people that occupy them, and to two key infrastructure sectors: electric power transmission and

emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and night time (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damaged varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios, however, the impact is considerably less than it is to the transportation routes. Additionally, capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table CA-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Table CA-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	5,559	5,559	5,559	5,559
Building Value (\$ Million)	1,890	1,890	1,890	1,890
Building Repair Cost (\$ Million)	58	61	159	231
Building Loss Ratio	3%	3%	8%	12%
Debris (Thousands of Tons)	34	36	76	103
Long-Term Displaced Population	78	159	202	874
Total Casualties (Daytime)	38	40	109	172
Level 4 (Killed)	1	1	5	8
Total Casualties (Nighttime)	14	20	41	93
Level 4 (Killed)	0	0	1	2

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

The City of Canby is expected to have a 3% building loss ratio with a repair cost of \$58 million under the CSZ “dry” scenario, and a 3% building loss ratio with a repair cost of \$61 million under the CSZ “wet” scenario.⁷ The city is expected to have around 38 daytime or 14 nighttime casualties during the CSZ “dry” scenario and 40 daytime or 20 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 78 for the CSZ “dry” scenario and 159 for the CSZ “wet” scenario.⁸ (See Risk Report content for additional information.)

Portland Hills Fault Scenario

The City of Canby is expected to have a 8% building loss ratio with a repair cost of \$159 million under the CSZ “dry” scenario, and a 12% building loss ratio with a repair cost of \$231 million under the CSZ “wet” scenario. The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 109 daytime or 41 nighttime casualties during the Portland Hills Fault “dry” scenario and 172 daytime or 93 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 202 for the Portland Hills Fault “dry” scenario and 874 for the Portland Hills Fault “wet” scenario.

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table MO-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))⁹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone event (M9.0 Deterministic): 477 buildings, and (8 critical facilities), are expected to be damaged for a total potential loss of \$186 million (a loss ratio of about 7%). About 516 residents may potentially be displaced (about 3% of the population).

Crustal event (Canby-Molalla fault M6.8 Deterministic): 2,210 building are expected to be damaged (12 critical facilities), for a total potential loss of \$811 million (a loss ratio of about 31%). About 3,017 residents may be displaced (about 17% of population).

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

⁷ DOGAMI, *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, O-18-02), Tables 12-8 and 12-9.

⁸ Ibid, Tables 12-8 and 12-9.

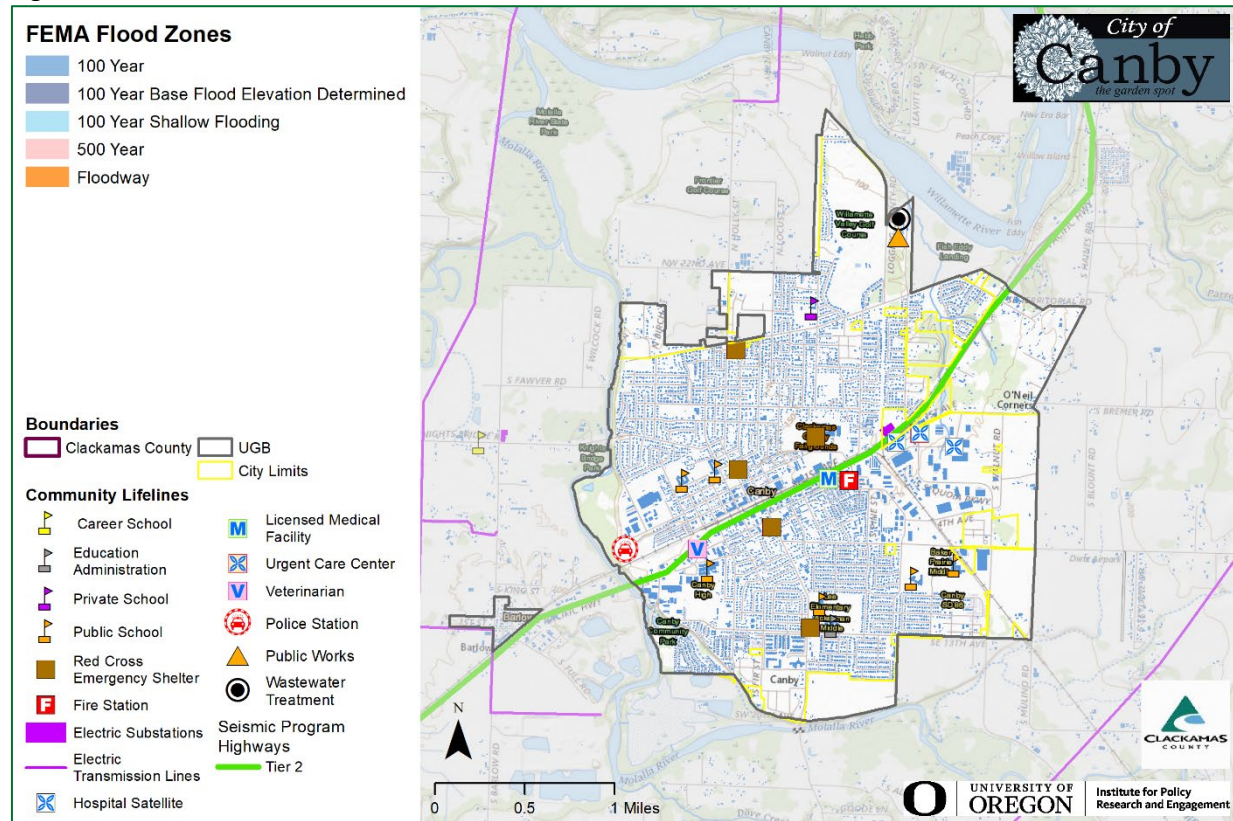
⁹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-14.

Flood

The HMAC determined that the City’s probability for flood is **high** and that their vulnerability to flood is **moderate**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure CA-4 illustrates the flood hazard area for Canby. Portions of Canby have areas of floodplain (located in the Hazard Overlay Zone). The Federal Emergency Management Agency (FEMA) regulatory floodplains for the Molalla and Willamette Rivers are depicted as relatively narrow areas on each side of the channels. On the Willamette River, the floodway is generally confined within high stream banks. On the Molalla River, the floodways cover a somewhat larger area that is usually located on the outside bank from Canby. Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

Figure CA-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Canby outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage. City staff has identified sites where local drainage facilities are taxed during high flows, especially where open ditches enter culverts or go underground into storm sewers and works to mitigate the stormwater flood risks in these areas (see the City’s Stormwater Master Plan for more information).

The largest flooding event to affect Canby was the February 1996 flood. The high-water level meant tributaries could not drain into the Molalla and Willamette River, which led to localized flooding on several backed-up creeks. Recently in December 2015, the Molalla River flooded low lying areas around Canby’s South Pine Street.

The extent of flooding hazards in Canby primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow.

Vulnerability Assessment

The City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

Approximately 4% percent of the total land area in Canby is exposed to the flooding hazard, and in some areas this hazard presents potential life safety hazards. Multi-family housing structures, including Redwood Terrace Apartment Complex and Canby Grove, may be affected by flooding. Critical facilities exposed to the flood hazard include the water treatment facility main river intake structure, the wastewater treatment facility, backwash ponds, and the city’s public works facility. In flooding events these facilities may be exposed to high waters and services can be interrupted.

Bridges and culverts are also vulnerable to flooding because debris and sediment can choke culverts and undermine bridges, causing surface water drainage problems. Canby relies on bridges for transportation and connection to other main highways. Canby could potentially be isolated if the bridges were to fail. Knights Bridge and Goods Bridge are particularly exposed. Roadways exposed include S. Ivy (Hwy 170) and SW/SE 1st Ave (Hwy 99E). Disruption to this infrastructure could result in transportation issues, power outages, sewage back-up, and affect overall community and environmental health.

Many older buildings will have difficulty sustaining pressure from flooding events and should be targeted for floodplain retrofitting. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section and Table CA-4.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹⁰ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled flood hazard.

¹⁰ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-14.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹¹ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

National Flood Insurance Program (NFIP)

FEMA’s [Flood Insurance Study](#) (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. The last Community Assistance Visit (CAV) for the city was November 19, 1993. Canby does not participate in the Community Rating System (CRS). Canby has no Repetitive Loss or Severe Repetitive Loss Properties.

Landslide

The HMAC determined that the City’s probability for landslide is **high** and that their vulnerability to landslide is **moderate**. *The probability and vulnerability ratings increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Although catastrophic landslides have not occurred in Canby, steep slopes do exist along the banks of the Molalla River and extends south from 6th Street up to the northern city limits. Highway 99E, north of Canby, is especially vulnerable to landslides with multiple incidents of rockslides shutting down lanes in 2007, 2010, and 2015. As an example, on January 7, 2009, two slides occurred in private yards after an intense winter storm. About three feet of earth fell 30 to 50 feet from the back yard of a home on North Baker Drive. Another home on Alder Creek Lane in Knights Bridge Estates lost approximately 10 feet of its back yard.

Landslide susceptibility exposure for Canby is shown in Figure CA-5. Most of Canby demonstrates a low to moderate landslide susceptibility exposure. Approximately 2% of Canby has very high or high, and approximately 9% moderate, landslide susceptibility exposure.¹² However, most of the areas that are identified to exhibit dangerous potential rapidly moving landslides are vacant and often preserved in wooded and dedicated open space.

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 (O-16-02), general findings from that report are provided above and within Figure CA-5. Additionally, the City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018. This analysis looked at identified hazard

¹¹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

¹² DOGAMI. [Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon](#) (2016)

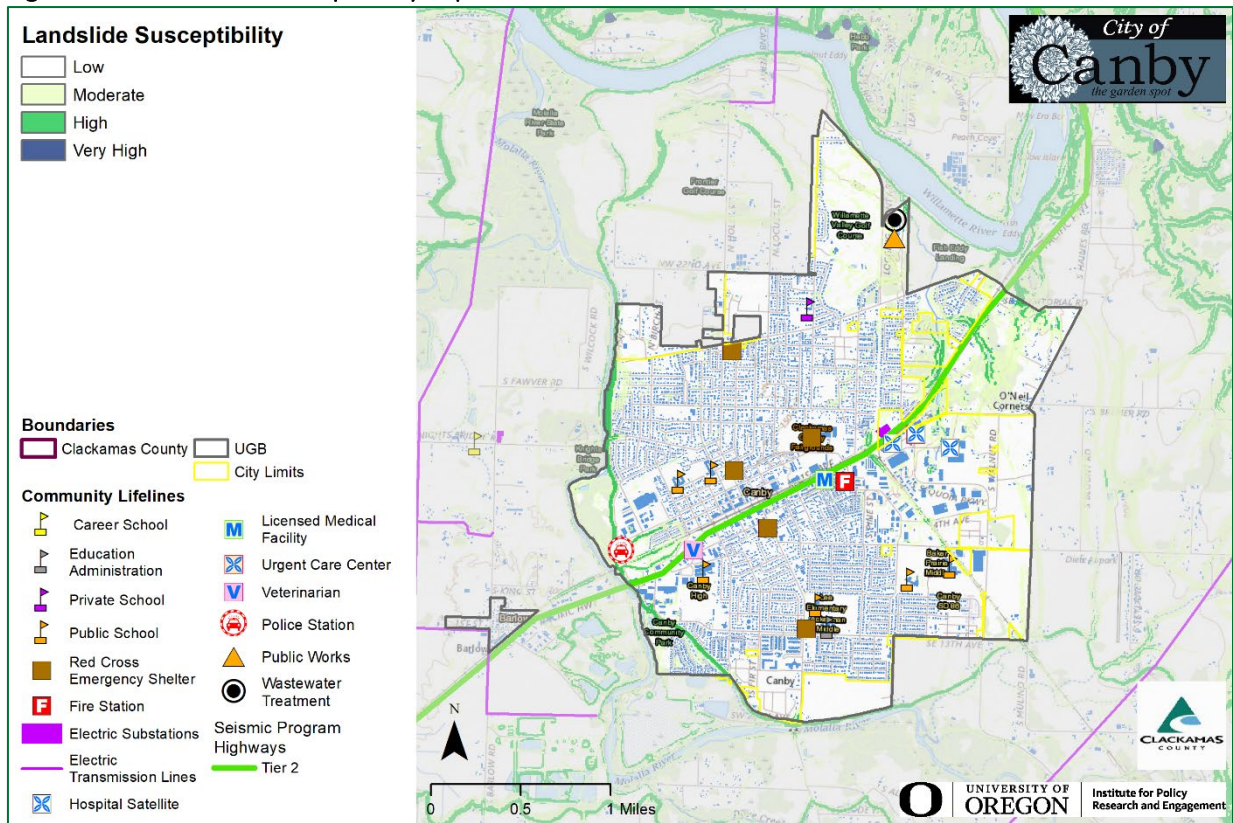
areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

Natural Hazard Risk Reports for Clackamas County

The **Risk Report** (DOGAMI, 2024)¹³ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 11 buildings are exposed to the *high and very high landslide susceptibility* hazard (1 critical facility) for a total exposure of \$19.5 million (an exposure ratio of less than 1%). About 20 residents may be displaced by landslides (about 18% of the population).

Figure CA-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Two critical facilities are exposed to the landslide hazard — Canby Utility’s main river intake, Springs Gallery, and pump houses as well as the Police Department (EOC #2). The critical infrastructure is especially exposed to the landslide hazard. In addition, economic centers, cultural or historic assets, environmental assets, and hazardous material sites are exposed to the landslide hazard. Hazardous materials sites would also suffer damage, resulting in threats to environmental and human health, while disrupting the availability of gasoline for vehicle transport and furthering economic loss because

¹³ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-14.

such sites are also sources of employment. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section and Table CA-4.

This exposure means that large scale and simultaneous landslides triggered by an earthquake could substantially disrupt City operations buildings, police, fire stations and key pieces of infrastructure (bridges, sewage pump stations, water reservoirs) that would hinder the ability of the City to respond to emergency situations created by such an event.

As a result, it will be important for the City to pursue opportunities for retrofitting and mitigating important structures and infrastructure, such that said facilities can withstand and survive landslides, particularly simultaneous landslides generated by an earthquake. Business continuity planning shall also be an important factor, given the number of economic centers and employment facilities that are threatened by the landslide hazard.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **high** and that their vulnerability is **low**. *The probability rating increased and the vulnerability rating decreased since the previous NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of Canby has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"¹⁴ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City's probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**. *The probability and vulnerability ratings decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Canby. In July 2016, two funnel clouds were spotted due to a low-pressure system and no damage was reported. While five miles east of Canby, a tornado touched down at Aurora State Airport in October of 2017.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris. Additionally, transportation and economic disruptions result as well.

Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

¹⁴ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the City’s probability for winter storm is **moderate** and that their vulnerability to winter storm is **moderate**. *The probability rating decreased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Most winter storms typically do not cause significant damage, they are frequent, and have the potential to impact economic activity. Road closures due to winter weather are an uncommon occurrence but can interrupt commuter and commercial traffic.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁵ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Vulnerability Assessment

Due to insufficient data and resources, Canby is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards.

The areas of the City that are often most at risk to severe winter storms are residential areas on steeper slopes, where roads may be icy and, thus, difficult to climb and descend. Road corridors leading to residential areas with fuller tree canopies are susceptible to downed tree limbs, and those areas that are above 500 feet in elevation are particularly vulnerable. However, some weather systems are

¹⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

characterized by a temperature inversion, where the valley floor is colder than the nearby hills. Consequently, severe winter storms affect the entire city.

The major risk to property results from exposed utilities, especially power lines and water pipes that are damaged by wind, broken tree limbs and cold temperatures. Businesses also suffer economic losses when they must close as the result of the inclement weather and/or the loss of power, which, in turn, disrupts the local supply chain of goods and services. Periods of extended ice coverage hinder emergency response services and limit the mobility of residents, which could result in serious life safety issues.

Telcom Central Station and City Hall Complex are critical facilities located adjacent to vulnerable power lines. Canby Utility, Public Works, and Canby Telephone would be strained during a severe storm event as they work to clear roads and repair or replace power distribution and/or transmission lines and maintain telephone lines for communication. Additionally, the area along 99E from South Elm to South Ivy St. is particularly vulnerable to damaged power lines from fallen tree limbs.

All schools and one adult community center that are considered essential facilities are also exposed to the severe weather hazards. In addition, critical infrastructure, economic centers, cultural or historic assets, environmental assets, and hazardous material sites are exposed to severe weather hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets section and Table CA-4.

The exposure of these facilities and infrastructure means that severe weather events could substantially disrupt the operations of City government buildings and fire stations, impairing key City functions, while hindering the ability of emergency response personnel to respond to emergency situations that are created by a severe storm event.

Volcanic Event

The HMAC determined that the City's probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of volcanic hazards, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the western portion of the County is likely to affect Canby as well. Several volcanoes are located near Canby, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Canby's relative distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash.

Natural Hazard Risk Reports for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹⁶ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did

¹⁶ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-14.

not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

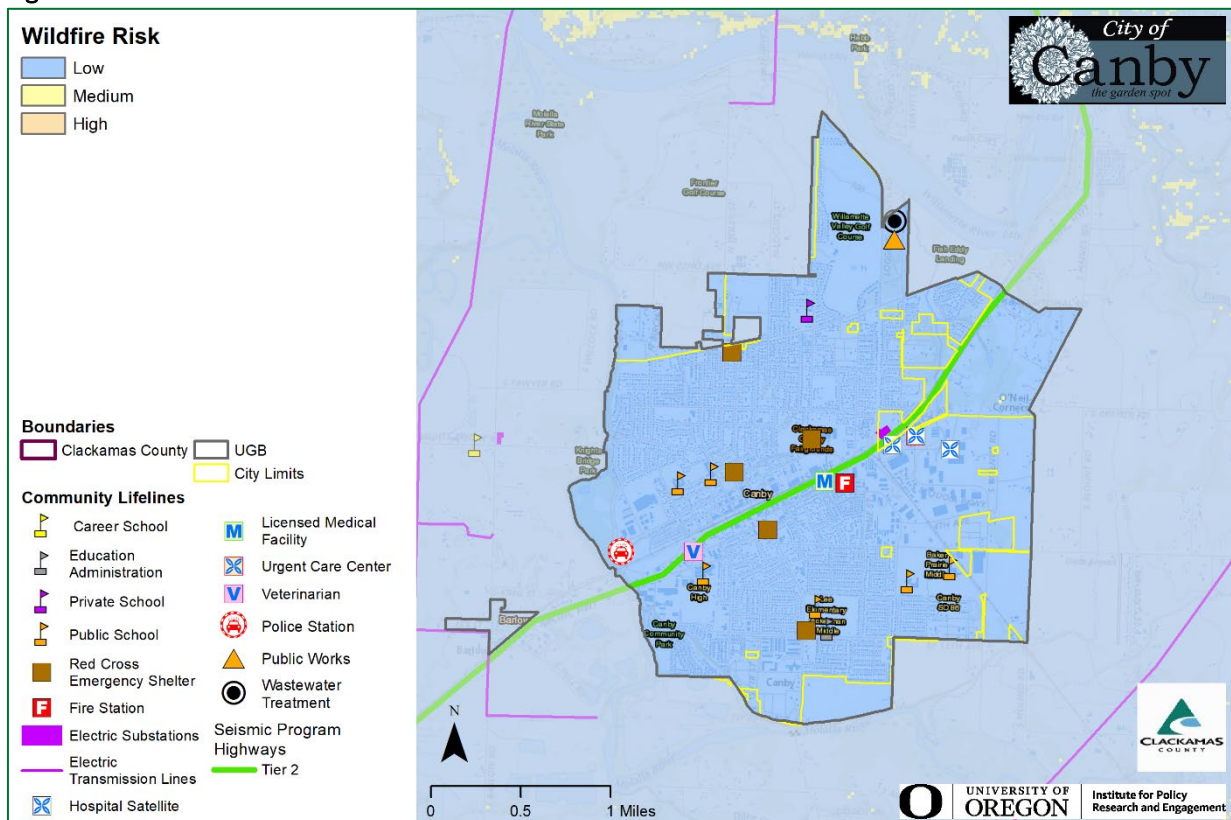
The HMAC determined that the City’s probability for wildfire is **low**, and that their vulnerability to wildfire is **moderate**. *These ratings did not change since the previous version of this NHMP.*

The Clackamas County Community Wildfire Protection Plan (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Canby is found in the following chapter: Chapter 9.2: Canby Rural Fire Protection District #62.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Figure CA-6 shows overall wildfire risk in Canby. Weather, and urbanization conditions are primarily at cause for the hazard level. Canby has not experienced a catastrophic wildfire within City limits.

Figure CA-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer's CWPP Planning Tool

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Canby, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

The forested hills within, and surrounding Canby are interface areas including the following High Priority Communities at Risk (CARs): Adkins Circle, Dutch Vista/Madrona, Public Works Infrastructure, Sundowner, and the following Medium Priority CARs: N Side Molalla River Bluff, Molalla River State Park, and South End.¹⁷

The City is characterized by lush parks, neighborhoods surrounded by mature trees and under story vegetation and development intermingled with the natural landscape. One area of wildland-urban interface is the northeast portion of Canby. A heavily wooded area borders the north and south boundaries of the sewage treatment facility and Public Works Building (EOC #3). Most of the woodlands are surrounded by urban development that are a concern in the case of a wildfire event.

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four feet under normal weather conditions, except in a small, wooded area near the Willamette River on North Holly Street that has the probability of four to eight feet expected flame lengths. However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Vulnerability Assessment

Due to insufficient data and resources, Canby is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. However, the City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

Residences and businesses that border wooded woodlands with slopes greater than 25% are at the greatest risk of loss or damage from wildfires. A great deal of infrastructure is exposed to the wildfire hazard, including Canby's primary water source, water treatment facilities, and Public Works Building (EOC#3). This could affect the efficiency of fire protection professionals during a large-scale wildfire. Vegetation along roadways is also highly dangerous, as negligent motorists provide ignition sources by tossing cigarette butts out car windows. A variety of historic landmarks are also included in the high wildfire zone.

¹⁷ Clackamas County Community Wildfire Protection Plan, *Canby Rural Fire Protection District #62* (2018), Table 10.13-1.

Natural Hazard Risk Reports for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹⁸ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 9 buildings are exposed to the *high and (or) moderate (medium) risk wildfire* hazard (no critical facilities) for a total exposure of \$2.9 million replacement value (an exposure ratio of less than 1%). About 8 residents may be displaced by wildfires (less than 1% of the population).

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁹ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

¹⁸ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-14.

¹⁹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table CA-7 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table CA-1).

Previous NHMP Actions that are Complete:

Severe Weather #1, *“Obtain funding to bury power lines subject to frequent failures to reduce power outages from the windstorm and severe winter storm hazard, where possible.”* Complete. This is part of normal operations.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table CA-7 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Multi-Hazard #2	#2	Not Complete	Yes
Multi-Hazard #3	#3	Not Complete	Yes
Multi-Hazard #4	#4	Not Complete	Yes
Multi-Hazard #5	#5	Not Complete	Yes
Earthquake #1	#6	Not Complete, revised	Yes
Flood #1	#7	Not Complete, revised	Yes
Flood #2	#8	Not Complete	Yes
Landslide #1	#9	Not Complete	Yes
Severe Weather #1	-	Complete	No
Wildfire #1	#10	Not Complete	Yes

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from March 6 through March 31 on the City's website. The plan was also posted and announced on the County's website. There were several comments provided that have been reviewed and integrated into the NHMP as applicable. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B. Organizations and agencies that were provided an opportunity to provide input, include, but are not limited to:

City of Canby's Business and Tourism e-newsletter, which is sent out to over 600 people including businesses and property owners, residents, visitors:

- Canby Business edition 3.06.2024
- Canby Business edition 3.14.2024

The draft was sent to the following City of Canby departments and outside agencies:

- City of Canby
 - Planning Department (Don Hardy, Ryan Potter)
 - Public Works Department including streets, pre-treatment, collections, waste water treatment, parks (Jerry Nelzen, Neil Olsen, Spencer Polack, Christopher Goetz, Dave Conner, Jeff Snyder)
 - Police Department (Jorge Tro)
- Canby Fire District (Chief Jim Davis, M. Crawford)
- Canby School District (Aaron Downs)
- Canby Utility (Carol Sullivan, Jason Peterson, Josh Muravez, Jason Berning, J. Brennan)
- Clackamas County Fairgrounds & Event Center (Brian Crow)
- Canby Center (Ray Keen)
- Canby Area Chamber of Commerce (Belinda Goody)
- NW Natural (Gary Callahan, Andrew Schurter)
- DirectLink (engineering@directlink.coop)
- Astound Broadband (oregonconstruction@astound.com)

The draft was sent to the following media:

- Canby Herald (https://www.canbyherald.com/lifestyle/canby-seeks-input-on-natural-hazards-mitigation-plan/article_0f89a0f4-dc2d-11ee-aae6-7f2162b5d1e7.html)
- Canby Current

Website Posting

Canby Seeks Input on Update to Natural Hazards Mitigation Plan

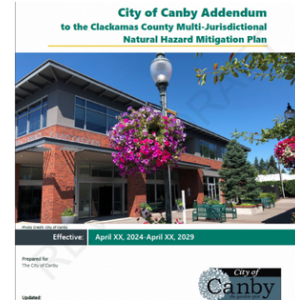
En Español

The City of Canby is in the process of updating their existing Natural Hazards Mitigation Plan (NHMP). This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management (OEM) utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program. With re-adoption of the plan, the City of Canby will maintain its eligibility to apply for federal funding towards natural hazard mitigation projects. This local planning process includes a wide range of representatives from city, special districts, and county government, emergency management personnel, and outreach to members of the public.


A natural hazards mitigation plan provides communities with a set of goals, action items, and resources designed to reduce risk from future natural disaster events. Engaging in mitigation activities provides jurisdictions with a number of 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.

An electronic version of the updated draft Canby NHMP addendum will be available for formal public comment beginning **March 6, 2024**. To view the draft please see **Supporting Documents** below: **2024 Canby Natural Hazards Mitigation Plan Addendum**

If you have any questions regarding the Canby NHMP addendum or the update process in general, please contact: Jamie Stickel, City of Canby Economic Development Director & Communications Specialist at (503) 545-5808 or StickelJ@CanbyOregon.gov; or Michael Howard, Director for the Oregon Partnership for Disaster Resilience at (541) 346-8413 or mrhoward@uoregon.edu.



Supporting Documents

 [2024 Canby Natural Hazards Mitigation Plan Addendum \(3 MB\)](#)

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following dates:

Meetings #1 and #2: March 20 and May 24, 2023 (via remote conference)

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #3: December 14, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

City of Estacada Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: City of Estacada

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The City of Estacada

Updated:
June 24, 2024, (Resolution # 2024-09)
May 13, 2019, (Resolution # 2019-013)
April 22, 2013
November 23, 2009

CITY OF
ESTACADA
unexpected / untamed / unforgettable

This Natural Hazard Mitigation Plan was prepared by:



Planning grant funding provided by:



Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

RESOLUTION #2024-009

A RESOLUTION ADOPTING THE CITY OF ESTACADA REPRESENTATION IN THE UPDATES TO THE CLACKAMAS COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

Whereas, the City of Estacada recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the City of Estacada has fully participated in the FEMA prescribed mitigation planning process to prepare the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

Whereas, the City of Estacada has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of Estacada to the impacts of future disasters within the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*; and

Whereas, these proposed projects and programs have been incorporated into the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

Whereas, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, June 11, 2024) contingent upon this official adoption of the participating governments and entities;

Whereas, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

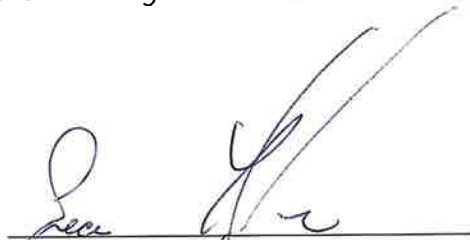
Whereas, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

Whereas, City of Estacada adopts the NHMP and directs the City Manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

Now, therefore, be it resolved, that the City of Estacada adopts *the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan; and

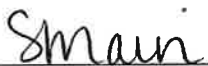
Be it further resolved, that the City of Estacada will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

Adopted this 24th day of June, 2024.



Sean Drinkwine, Mayor

ATTEST:



Sadie Main, City Recorder

Purpose

This is an update of the Estacada addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Estacada’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Estacada adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on June 24, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Estacada to update their NHMP.

The Clackamas County NHMP, and Estacada addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Estacada HMAC guided the process of developing the NHMP.

Convener

The Estacada City Manager serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Estacada HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Estacada HMAC was composed of the following representatives:

- Convener, Elaina Turpin, Assistant City Manager
- Donald DeRosia, Public Works Director
- Allan Wilson, Senior Planner
- Chris Lewis, Water & Wastewater Treatment Plant Operations Director
- Mike Waer, Executive Director of Operations for Estacada School District
- Casey Owens, Traffic & Public Safety Committee Member
- Jon Dolezal, Traffic & Public Safety Committee Member
- Sarah Poet, Fire Marshal, Estacada Rural Fire District #69

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Estacada addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the Estacada NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, Building Codes, the Clackamas County Community Wildfire Protection Plan (CWPP), as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Estacada will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Estacada to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

Estacada addresses Statewide Planning Goal 7 Natural Hazards as part of their Comprehensive Plan within Element 6: Environmental Quality and Land Use Hazards. This element was adopted in 1980 and has not been comprehensively updated to include the findings of later Natural Hazard Mitigation Plans. However, it does contain a recommendation for flood plain and slide hazard zone districts and airport area development regulations to be added to the zoning ordinances to regulate development in areas of natural hazard. Planned updates to the jurisdiction's Goal 7 element or its broader comprehensive plan

will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community's long-range plans.

Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

- Title 12 – Streets, Sidewalks, and Public Places
- Title 13 – Public Services
- Title 15 – Buildings and Construction, include adoption of the State of Oregon Fire Code, Abatement of Dangerous Buildings, and the following Oregon Specialty Codes (last updated Ord 2017-003):
 - Dwelling code is the "Oregon One and Two Family Dwelling Specialty Code";
 - Manufactured home installation code is the "Oregon Manufactured Home Installation Specialty Code";
 - Manufactured home park code is the "Oregon Manufactured Home Park Construction Specialty Code";
 - Mechanical code is the "Oregon Mechanical Specialty Code";
 - Plumbing code is the "Oregon Plumbing Specialty Code";
 - Recreational vehicle park code is the "Oregon Recreational Vehicle Park Construction Specialty Code."

It also includes regulations on Erosion Control (Chapter 15.25) that are designed to eliminate environmental and property damage resulting from soil erosion due to construction, excavation, and other land disturbances.

- Title 16 – Development, which promotes the public health, safety, and general welfare and to assist in the implementation of the comprehensive plan for the city. Chapter 16.68 Natural Hazard Areas provides procedures necessary to protect against hazardous or otherwise undesirable development activities. The primary areas of concern are active and potential landslides, high groundwater, weak foundation soils, and steep slopes.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

The Estacada Building Department administers and enforces the 2022 Oregon Structural Specialty Code and the 2022 Oregon Fire Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

Staffing Resources

Community Development Department

The Estacada Community Development Department is the oversight entity for all matters related to current and long range land use planning in the city. It is responsible for the administration of state, county, and local land use policies and regulations as they relate to the preservation and quality development of property lying within the city limits and urban growth boundary (UGB). The Community Development Department periodically updates development codes and long range plans to ensure adequate public facilities are available to serve new development, preserve community livability, and enhance the resilience of Estacada. They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Public Works

The City of Estacada Public Works Department is responsible for streets, water, sewer, stormwater, parks, and public facilities. Much of their work is designed to minimize or reduce the potential of neighborhood flooding during periods of high water. Maintenance activities include repair and cleaning of the public storm water piping system, culverts, manholes, catch basins, and open channel ditches. Funding for storm water maintenance is provided by a storm drain user fee.

City Administration

The City Council of Estacada has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Local funds for resilience and mitigation projects are captured through system development fees and water, sewer and storm drain user fees. Development fees are assessed when a newly developed property connects to the existing water, sewer or storm drain system. Current utility users contribute a monthly user fee with an added consumption fee. The City collects a storm water management fee for the purpose of ongoing maintenance of the storm water collection system, re-vegetation projects, erosion and sediment control, and temperature improvements.

Policies and Programs

This Plan directs Estacada and Clackamas County to explore integration into other planning documents and processes. Estacada has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

GIS Update

The City is currently implementing a GIS project with dedicated funding from the general fund budget. Incorporating hazard mitigation is one of the key priorities for this GIS project. The goal is to develop an internal platform within a year (and hopefully an external platform soon after).

TMDL Plan

The City is committed to implementing the Willamette Basin Total Maximum Daily Load (TMDL) Implementation Plan (updated in 2023), which includes actions that are designed to improve water quality and water quantity. The NHMP actions are incorporated into this document as appropriate. Example projects include public education and outreach on water quality and quantity issues. As part of

their 5-year review process, the City is committed to researching post-construction strategies to identify which strategies are a good fit for the community and the terrain.

Transportation System Plan

The Estacada Transportation System Plan is in final draft stages for adoption in 2024. It incorporates resilience strategies into maintenance and expansion of the transportation system.

Housing Strategies Report

In 2022, Estacada adopted a Housing Strategies Report and new code that amended Chapter 16.08 Development definitions, incorporating restrictions on environmentally constrained lands, including floodplains, and slopes within landslide hazard areas.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex and into the City's Capital Improvement Plan. The CWPP is expected to be adopted in early 2024.

Urban Renewal District

Estacada has an urban renewal district that encourages economic vitality and livability while ensuring that future development preserves and enhances the eclectic character of the community. Projects include water and sewer system improvements, street improvements, and riverfront facilities, which will include hazard related considerations.

Capital Improvement Plans

Estacada maintains and updates Capital Improvement Plans for each of its primary services every five years. The Parks Capital Improvement Plan and new System Development Charge was adopted in February 2019. A new Transportation Capital Improvement Plan was adopted in 2023. Wastewater Master Plan was updated in 2021. Stormwater Master Plan is scheduled to be updated in the new two years.

NFIP

Estacada participates in the National Flood Insurance Program (NFIP), although there are no special flood hazard areas within the urban growth boundary. Consequently, there is no flood hazard code or regulation related to floodplains. They do maintain a wetlands overlay district.

Personnel

The following Estacada personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: City Manager, Melanie Wagner; or Assistant City Manager, Elaina Turpin; or designee

Public Information Officer: City Manager, Melanie Wagner; or Assistant City Manager, Elaina Turpin; or designee

Grant writing (for Public Works or emergency management): City Manager, Melanie Wagner; or Assistant City Manager, Elaina Turpin; or designee

Capital improvement planning: Public Works Director, Finance Director, City Administrator, City Engineer

Capital improvement execution: City Manager, Melanie Wagner; or Assistant City Manager, Elaina Turpin; or designee

Estacada does not have any employees solely designated to Emergency Management or Mitigation. Their limited personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is little remaining capacity to expand upon their capabilities or workloads.

Capital Projects

Estacada has implemented recommendations from the last NHMP into its capital improvement projects over the last 5 years, including:

- Storm drainage improvements including upsizing culverts along Wade Creek.
- Stream restoration and stormwater improvements at Wade Creek Park phase 3
- Tree trimming, removal, and pest control treatment around public facilities
- Purchased new truck for plowing, de-icing, sanding during winter weather events
- Installed generator at Water Treatment Plant
- Procured portable generator for the Industrial Park Sewer Pump Station

Ongoing projects

- Seismic rehabilitation of the Estacada High School gym

Wastewater Treatment Plant Upgrade

City of Estacada owns and operates our Wastewater Treatment Plant (WWTP), which is nearing capacity, with equipment that is at the end of its useful life. The current plant was built in 1963 and has undergone multiple improvements. The current plant would need to be updated due to age, regardless of growth. To best serve our community, the City plans to replace the WWTP with the latest technology to protect the Clackamas River watershed, comply with permitted waste discharge limits, and ensure the City's commitment to environmental stewardship. The plan for the project, which should start construction in 2024, is to build a facility which will process wastewater into the cleanest possible discharge, while accommodating growth for the next thirty years. The City was awarded an Oregon Lottery Direct Legislative Award in the amount of \$2.4 million to assist with the cost of the new wastewater facility.

Upcoming projects include:

- Necessary improvements to the Water Treatment Plant
- Estacada Fire Station (new building on same site)

Capital Resources

Estacada maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan, including critical facilities with power generators for use during emergency blackouts (Water treatment facility, Estacada Fire Station, Wastewater Treatment Facility, all school buildings); warming or cooling shelters (Estacada AntFarm, 350 Zobrist St., Estacada Public Library, Estacada High School Gym for cooling shelter only); and food pantries (Estacada Food Bank, St. Aloysius Catholic Church, School Pantry at Estacada Middle School (for students only).

Findings

Several important findings from this capability assessment informed the design of the Plan's mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Estacada staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can

undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Estacada operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City's ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions, and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The City's mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAC assessed the City's risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the

actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)¹.

FEMA Funded Mitigation Successes

- 2023: HMGP-FM-5446-03 – Water Plant Backup Power (\$19,987) - FEMA Sub-application Review

Seismic Rehabilitation Grant Program Mitigation Successes

- 2023: Estacada High School Gymnasium (\$2,498,072) (to be complete in 2024)
- 2021: River Mill Elementary School (\$1,928,855)
- 2017: Estacada Middle School (\$1,065,500)
- 2017: Estacada Rural Fire District 69: Main Fire Station (\$702,794)

(Note: A new facility is expected to be constructed in the next few years.)

Other Successes:

- Wade Creek stormwater project

Action Items

Table EA-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAc decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAc in terms of implementation, the HMAc has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

¹ The Seismic Rehabilitation Grant Program (SRGP) 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.

Table EA-1 Actions

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
1	Create an emergency evacuation plan; amend Development Code to ensure that future developments can be easily evacuated.	X	X	X	X	X	X	X	X	X	HMAC	Medium	Local Resources, DLCDD TA, FEMA HMA TA/C&CB	Medium
2	Review, promote, and implement action items identified in the Clackamas County CWPP.							X			Estacada RFPD/ HMAC	Ongoing	Local Resources, FEMA HMA, CWDG	Low to High
3	Compile a book for emergency management staff with resources needed in the case of an emergency/disaster.	X	X	X	X	X	X	X	X	X	HMAC CCSO/ Estacada RFPD / CERT	Short	Local Resources	Low
4	Create a self-registry in which residents with additional needs or assistance can be added to a list in case of emergencies.		X	X	X	X	X	X	X	X	HMAC/ CCSO	Short	Local Resources	Low
5	Create and maintain a registry of people and agencies willing to assist with evacuating livestock.		X		X	X	X	X		X	HMAC/ CCSO/ Estacada RFPD	Short	Local Resources	Low
6	Conduct Seismic Evaluations and Upgrades on Critical Facilities. Implement appropriate structural and non-structural mitigation strategies		X								City/ Estacada RFPD /ESD	Long	Local, State, Federal Grants; FEMA HMA	High
7	Complete seismic rehabilitation of the Estacada High School Gym (in process, grant received in 2023).		X								Estacada School District	Short	IFA-SRGP	High
8	Support funding and construction of new seismically resilient and code compliant fire station on same site for Estacada RFPD.		X								Estacada RFPD	Short	Local Resources, FEMA HMA	High

Table EA-1 Actions

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
9	Support funding and construction of seismic retrofits at the Water Treatment Plant.	X	X		X						HMAC	Medium	Local Resources/ FEMA HMA	High
10	Create an online &/or phone system where residents can report downed limbs, power lines, etc.								X	X	City/ Estacada RFPD /CCSO	Short	Local Resources	Medium
11	Share information on responsible driving practices during ice.									X	HMAC	Short	Local Resources	Low
12	Purchase equipment for salting roads during ice events.									X	HMAC	Long	Local Resources, FEMA HMA	Medium
13	Establish a fuel storage facility (tanks) which does not require electricity and can be used for essential emergency services during a hazard event.		X		X	X	X	X	X	X	HMAC/ Estacada RFPD	Medium	Local, State, Federal Grants; FEMA HMA	Medium
14	Manage vegetation around critical infrastructure to reduce negative effects from storm events.								X	X	Public Works	Ongoing	Local Resources, FEMA HMA	Low
15	Install commercial air conditioning and scrubbers at HS gym for a clean air/cooling center during extreme weather events and wildfires.			X				X		X	Estacada School District	Short	Local Resources, FEMA HMA, DHS	High
16	Encourage facilities to become certified warming/cooling shelters,			X				X		X	HMAC/ Estacada RFPD, CERT	Ongoing	Local Resources	Medium
17	Encourage facilities to become Red Cross shelter sites. Maintain a list of sites throughout the Estacada area. Renew Shelter MOU with Oregon Red Cross (at HS).		X	X	X	X	X	X	X	X	HMAC/ Red Cross, CERT/ Estacada School District	Ongoing	Local Resources	Low

Table EA-1 Actions

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
18	Create a plan to manage drought addressing importing potable water, reducing water usage, and establishing drought policies for domestic usage.	X									HMAC/ EOM	Medium	Local Resources, DLCDC TA, FEMA HMA C&CB	Medium
19	Share information on responsible watering practices.	X		X							HMAC/ CRWP	Ongoing	Local Resources	Low
20	Update list of projects in Stormwater Management Plan based on completed projects, growth, and need. Implement projects when able.				X					X	HMAC	Medium	Local Resources	High
21	Conduct annual flood mitigation and response education classes				X						HMAC	Ongoing	Local Resources	Low
22	Update Emergency Preparedness Plan to reflect new protocols and systems for emergency incidents.	X	X	X	X	X	X	X	X	X	Estacada School District	Short	Local Resources	Low
23	Integrate the goals and action items from this plan into regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	HMAC	Ongoing	Local Resources, DLCDC TA, FEMA HMA TA/C&CB	Medium
24	Support funding and development of a new, more resilient, Wastewater Treatment Plant.	X	X		X						HMAC	Medium	Local Resources/ FEMA HMA-BRIC	High
25	Update building/development codes to address hazards including wildfire/fire safety	X	X		X	X		X	X	X	HMAC	Long	Local Resources/ FEMA HMA-C&CB, DLCDC TA	Low to Medium

Table EA-1 Actions

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
26	Ensure that hazard mitigation plans, educational materials, emergency alerts are accessible in the most common languages spoken/written in the city.	X	X	X	X	X	X	X	X	X	HMAC/ DEI Committee	Short	Local Resources, OEM, FEMA C&CB	Low

Source: Estacada NHMP HMAC, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

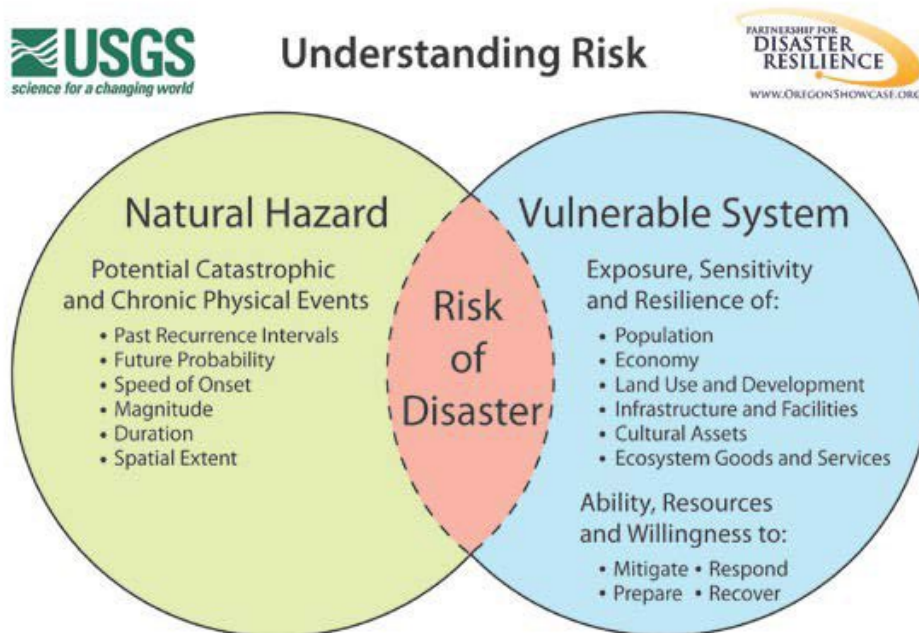
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure EA-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure EA-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Estacada HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Estacada, which are discussed throughout this addendum. Table EA-2 shows the HVA matrix for Estacada listing

each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Two chronic hazards (wildfire and winter storm) and one catastrophic hazard (Cascadia Subduction Zone earthquake) rank as the top hazard threats to the City (Top Tier). Crustal earthquake, extreme heat, and drought comprise the next highest ranked hazards (Middle Tier), while landslide, windstorm, flood, and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table EA-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Wildfire	20	50	100	70	240	1	Top Tier
Earthquake - Cascadia	2	50	100	35	187	2	
Winter Storm	14	40	80	49	183	3	
Earthquake - Crustal	6	50	100	21	177	4	Middle Tier
Extreme Heat Event	12	40	70	49	171	5	
Drought	10	25	50	56	141	6	
Landslide	14	20	20	63	117	7	Bottom Tier
Windstorm	10	15	30	42	97	8	
Flood	10	20	20	28	78	9	
Volcanic Event	2	15	50	7	74	10	

Source: Estacada HMAC, 2023.

Community Characteristics

Table EA-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

The city is on the Clackamas Highway (OR 224 and OR 211) at 468 feet above sea level. Because of its location Estacada’s climate is consistent with the marine west coast climate zone, with warm summers and cool, wet winters. Estacada receives most of its rainfall between October and May, and averages 58 inches of rain, and around two (2) inches of snow, per year.²

Population, Housing, and Income

Estacada has grown substantially since its incorporation in 1905 and has an area today of 2.27 square miles. It is in the south-central region of Clackamas County, located approximately 30 miles southeast of the City of Portland. The City is within the Clackamas River watershed.

Between 2016 and 2021 the City grew by 2,218 people (70%; as of 2022 the population is 5,373).

Between 2022 and 2040 the population is forecast to grow by 29% to 6,922.

Most of the population is White/Caucasian (92%) and about 18% of the population is Hispanic or Latino. The poverty rate is 17% (0% of children under 18, 27% for people 65 and older), 6% do not have health insurance, and 41% of renters pay more than 30% of their household income on rent (72% for owners). About 16% of the population has a bachelor’s degree or higher (7% do not have a high school degree).

² [“Monthly Average for Estacada, OR”](#) The Weather Channel Interactive, Inc. Retrieved November 25, 2018.

Approximately 14% of the population lives with a disability (52% of population 65 and older), and 39% are either below 15 (18%) or over 65 (21%) years of age. About 11% of the population are 65 or older and living alone and 40% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 81% of housing units are single-family, 9% are multifamily, and 10% are mobile homes. More than one-fifth of homes (21%) were built before 1970 and 64% were built after 1990. Newer homes are more likely to be built to current seismic, flood, and other hazard standards. Almost two-thirds (78%) of housing units are owner occupied, 13% are renter occupied, 3% are seasonal homes, and 7% are vacant.

Transportation and Infrastructure

Estacada is located at the intersection of Highway 224 (Clackamas Highway) and Highway 211, east of the Clackamas River. The downtown central business district is a relatively dense grid of mostly compact and walkable streets located north of the Highway 211/224 intersection. The major collectors in central Estacada such as SW 2nd Avenue, Broadway Street, and Main Street have full sidewalks on both sides of the street along most segments. There are collectors outside of the central district that have missing links of sidewalks, but connectivity and pedestrian linkages are relatively good especially near schools. There is also a multi-use path that travels along the Clackamas River near SW Lake Shore Drive and terminates at Timber Park.

Estacada is most accessed from the Portland Metro area by car via Interstate 205 to Highway 224. The City has public transit to Portland Metro region by TriMet transit system via Main Street, North 6th Street, Eagle Creek Road, and the Clackamas Highway stops. The SAM Estacada service provides direct service to Sandy. Estacada has a small airport called the Valley View Airport within its urban growth boundary. There are no active rail facilities within the City of Estacada.

Motor vehicles represent the dominant mode of travel through and within Estacada. Thirty-two percent (32%) of renters and 2% of owners do not have a vehicle. Most workers drive alone to work (76%); 13% carpool, 0% use public transit, 4% either walk or use a bicycle, and 6% work at home.

Economy

Estacada's proximity to major transportation routes and access to rail has made it a desirable place for commercial and industrial development. Historically Estacada's economy focused on forestry and farming, which is still has a major presence in the workforce. About 43% of the resident population 16 and over is in the labor force (1,884 people) and are employed in a variety of occupations including professional (16%), production (15%), office and administrative (13%), management, business, and financial (13%), and transportation and material moving (12%) occupations.

Estacada has an economic advantage due to its location at the edge of Mt Hood National Forest and its proximity to Portland. Businesses benefit from low property costs, moderate local government fees, ample utilities, and increased residential and tourist traffic. Estacada has over 200 acres of industrial land, commercial land located on Highway 224, and retail and office space located downtown. Estacada's available commercial and industrial properties have fiber on site or are fiber ready. The City is home to a robust cluster of metal fabrication companies and growing businesses such as Northwest Technologies and Locke Buildings.

Most workers residing in the city (90%, 1,742 people) travel outside of the city for work primarily to Portland, Gresham, and surrounding areas.³ A significant population of people travel to the city for work, (87% of the workforce, 1,249 people) primarily from Portland, Gresham, and surrounding areas.⁴

³ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 20, 2023 at <https://onthemap.ces.census.gov>.

⁴ Ibid.

Table EA-3 Community Characteristics

Population Characteristics			Population	
			Growth	
2016 Population Estimate	3,155			
2022 Population Estimate	5,373		70%	
2040 Population Forecast*	6,922		29%	
Race				
American Indian and Alaska Native			2%	
Asian			2%	
Black/ African American			< 1%	
Native Hawaiian and Other Pacific Islander			0%	
White			92%	
Some Other Race			0%	
Two or More Races			4%	
Hispanic or Latino/a (of any race)			18%	
Limited or No English Spoken	0		0%	
Vulnerable Age Groups				
Less than 5 Years	263		6%	
Less than 15 Years	797		18%	
65 Years and Older	654		15%	
85 Years and Older	245		6%	
Age Dependency Ratio			0.50	
Disability Status (Percent age cohort)				
Total Disabled Population	621		14%	
Children (Under 18)	42		4%	
Working Age (18 to 64)	238		9%	
Seniors (65 and older)	341		52%	
Income Characteristics				
Households by Income Category				
Less than \$15,000	79		6%	
\$15,000-\$29,999	269		19%	
\$30,000-\$44,999	137		10%	
\$45,000-\$59,999	62		4%	
\$60,000-\$74,999	157		11%	
\$75,000-\$99,999	165		12%	
\$100,000-\$199,999	501		36%	
\$200,000 or more	38		3%	
Median Household Income			\$75,000	
Gini Index of Income Inequality			0.36	
Poverty Rates (Percent age cohort)				
Total Population	729		17%	
Children (Under 18)	0		0%	
Working Age (18 to 64)	551		21%	
Seniors (65 and older)	178		27%	
Housing Cost Burden (Cost > 30% of household income)				
Owners with a Mortgage	762		72%	
Owners without a Mortgage	0		0%	
Renters	83		41%	
Household Characteristics				
Housing Units				
Single-Family (includes duplexes)	1,256		81%	
Multi-Family	144		9%	
Mobile Homes (includes RV, Van, etc.)	153		10%	
Household Type				
Family Household	1,004		71%	
Married couple (w/ children)	382		27%	
Single (w/ children)	570		40%	
Living Alone 65+	158		11%	
Year Structure Built				
Pre-1970	328		21%	
1970-1989	239		15%	
1990-2009	557		36%	
2010 or later	429		28%	
Housing Tenure and Vacancy				
Owner-occupied	1,204		78%	
Renter-occupied	204		13%	
Seasonal	42		3%	
Vacant	103		7%	
Vehicles Available (Occupied Units)				
No Vehicle (owner occupied)	21		2%	
Two+ vehicles (owner occupied)	937		78%	
No Vehicle (renter occupied)	66		32%	
Two+ vehicles (renter occupied)	56		27%	
Employment Characteristics				
Labor Force (Population 16+)				
In labor Force (% Total Population)	1,884		43%	
Unemployed (% Labor Force)	150		7%	
Occupation (Top 5) (Employed 16+)				
Professional & Related	309		16%	
Production	287		15%	
Office & Administrative	253		13%	
Management, Business, & Financial	251		13%	
Transportation and Material Moving	222		12%	
Health Insurance				
No Health Insurance	262		6%	
Public Health Insurance	1,484		34%	
Private Health Insurance	3,064		71%	
Transportation to Work (Workers 16+)				
Drove Alone	1,395		76%	
Carpooled	244		13%	
Public Transit	0		0%	
Motorcycle	0		0%	
Bicycle/Walk	71		4%	
Work at Home	103		6%	

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", 2016 & 2022; Portland State University, Population Research Center, "Population Forecast Tables", (2023, [Preliminary](#)).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Estacada. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table EA-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table EA-4 Critical Facilities

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Adventist Health Urgent Care	-	X	-	-	-
Clackamas River Elementary School	-	-	-	-	-
Estacada City Hall	-	X	-	-	-
Estacada Community Center	-	X	-	-	-
Estacada High School	-	X	-	-	-
Estacada Junior High School	-	X	-	-	-
Estacada Public Works	-	-	-	-	-
Estacada RFPD No. 69	-	X	-	-	-
Estacada RFPD No. 69 - Administration	-	X	-	-	-
Estacada STP	-	X	-	-	-
Mount Hood National Forest - Clackamas River Ranger District - Estacada	-	X	-	-	-
Orchid Health Wade Creek Clinic	-	X	X	-	-
River Mill Elementary School	-	X	-	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-17

Additional Critical Facilities not included in the DOGAMI Risk Report:

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include: OR 211, OR 224, 211 Bridge over Eagle Creek, 211/224 Bridge, Airport, 6th Avenue Bridge, Clackamas River dams, water supply lines, phone and internet grid, power grid, hydrants, and arterial roads (Main Street, SW 2nd Avenue, River Mill Road, Broadway Street).

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public's ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields. Examples include: area churches, city hall, schools, grocery stores, ODOT facilities, library, post office, School District bus barn, Wade Creek Clinic, Estacada Community Center, etc.

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include: Campanella Park, Cascadia Ridge Park, Cazadero Park, Milo McIver Park, North Complex Ball Fields, Portal Park, Ranger Woods, Timber Park, and Wade Creek Park.

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include: 300 Main Retirement, Adult and Teen Challenge, Altramar II, AntFarm, Clackamas River Elementary and Day Care, Estacada Community Center, Estacada Food Bank, Estacada Timber School, Golden Years, Head Start, Red Barn Co-Op Preschool, Rivermill Elementary, Tiny Timbers Daycare, Whispering Pines, Wade Creek Commons, Elm Street Apartments, etc.

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered "critical." Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: Gas Stations, All American Rentals, industrial park, propane sellers, School District Bus Barn, Wastewater and Water Treatment Plants, Reliance Connects, ODOT buildings, True Value Hardware, NAPA, Les Schwab, Dick's Logging, Fire Department, PGE, and other industrial businesses.

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Estacada. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers, and are a concern during evacuation/notification during a hazard event include: School District, banks, Eagle Foundry, Faraday-Westside Hydro, markets, industrial parks, Reliance Connects, Milo McIver Park, and Metzler Park.

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

An example of the types of properties that should be considered before, during, and after an event include:

- Arthur Smadbeck House
- August Stubbe House
- Baby Guard Station
- Elimore Williams House
- Ella C Stephens House
- Estacada Bridge
- Estacada City Hall
- Estacada Lodge
- Estacada Middle School Auditorium
- Estacada St. Bank
- Frank Ewing Store
- Lichthoen Gustave H. House
- Mae B. and CF Howe House
- OR Jacobs House
- RG Marchbank Store
- St. Aloysius Church
- WA Cunningham House
- William HH Wade House
- WT & Cora Kaake House

Hazard Characteristics

Drought

The HMAC determined that the City’s probability for drought is **high** and that their vulnerability to drought is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

The City of Estacada has their water intake on the Clackamas River, located in the Lower Clackamas and Middle Clackamas River Watershed in the Clackamas Sub-Basin of the Willamette Basin. The drinking water protection area for Estacada totals 673 square miles both upstream and downstream from the two intakes. The water treatment facilities are located both inside and outside city limits with a capacity of two million gallons per day.

Estacada will have five water reservoirs (the fifth is set to go online in 2024) to improve the city’s capacity for water demands and drought conditions. However, due to the high increase in population this capacity is more than offset by the increased usage. The city is planning to increase its water plant capacity in 2024 to take full advantage of the current water rights (currently only processing about 50% of available water). Preventive and corrective maintenance is routinely performed at these facilities for safe and cost-effective operations.

Vulnerability Assessment

Due to insufficient data and resources, Estacada is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table EA-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁵ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

The city’s proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the “Valley Zone” (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

Figure EA-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas near rivers and streams will experience severe (light red) to violent (dark red) shaking in a CSZ event.

Community assets located in the center of the city include Estacada High School, which is located near a high impact area. The Wade Creek Bridge is located in the high impact zone and might make access to that area difficult. Another high impact area is on the Clackamas River which has a mostly residential area next to it and the Clackamas Highway. Highway 211 bridge is in a high impact area, which might result in difficulties in accessing that side of the river, which is outside city limits.

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in 1700 A.D.⁶

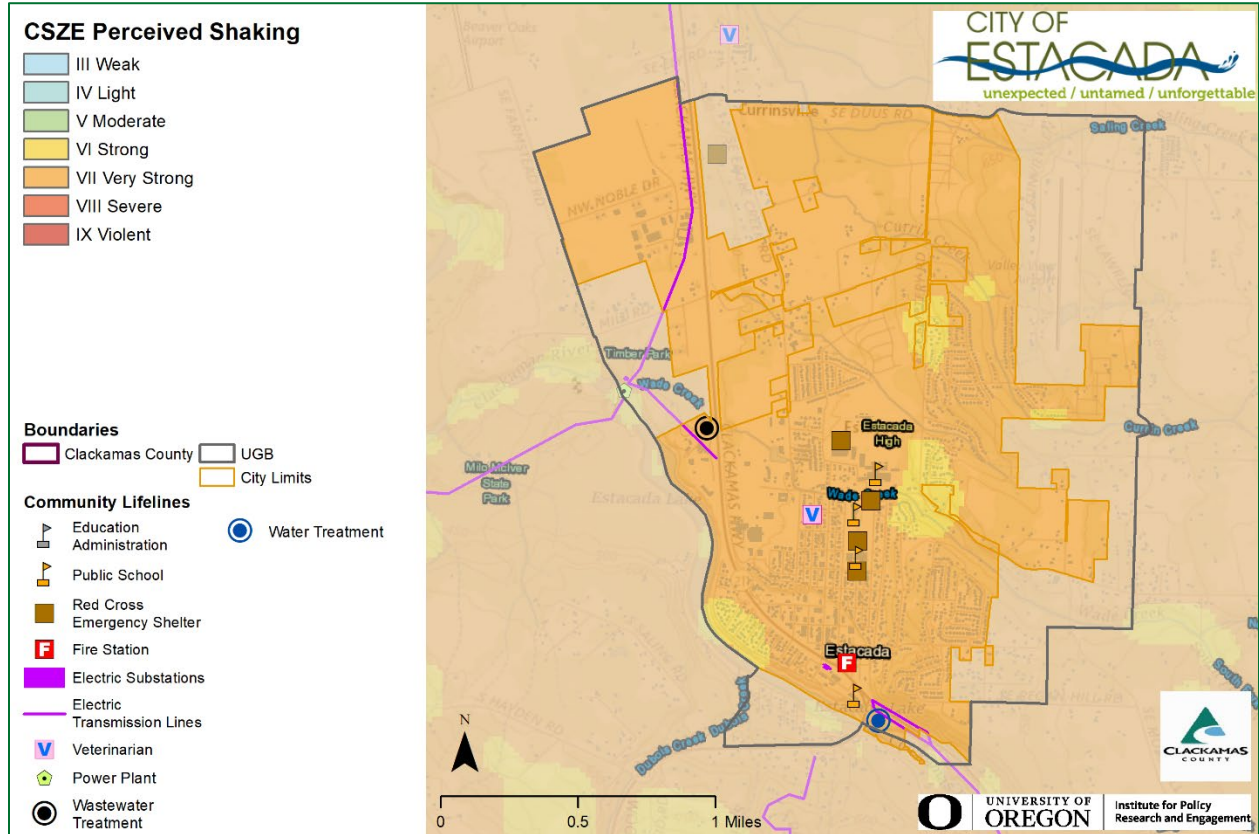
The city’s proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the “Valley Zone” (Valley Zone, from the

⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

⁶ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

Figure EA-2 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Earthquake (Crustal)

The HMAC determined that the City’s probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Estacada as well. Figure EA-3 shows a generalized geologic map of the Estacada area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

The Canby-Molalla Fault runs through the center of the City and can generate high- magnitude earthquakes. The City is also 15 miles away from the Portland Hills Fault Zone (discussed in greater detail below). Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993, Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8. In December 2017 a 4.0 tremor was felt in Estacada along the same epicenter as the 5.6 quake, this time no damage occurred.

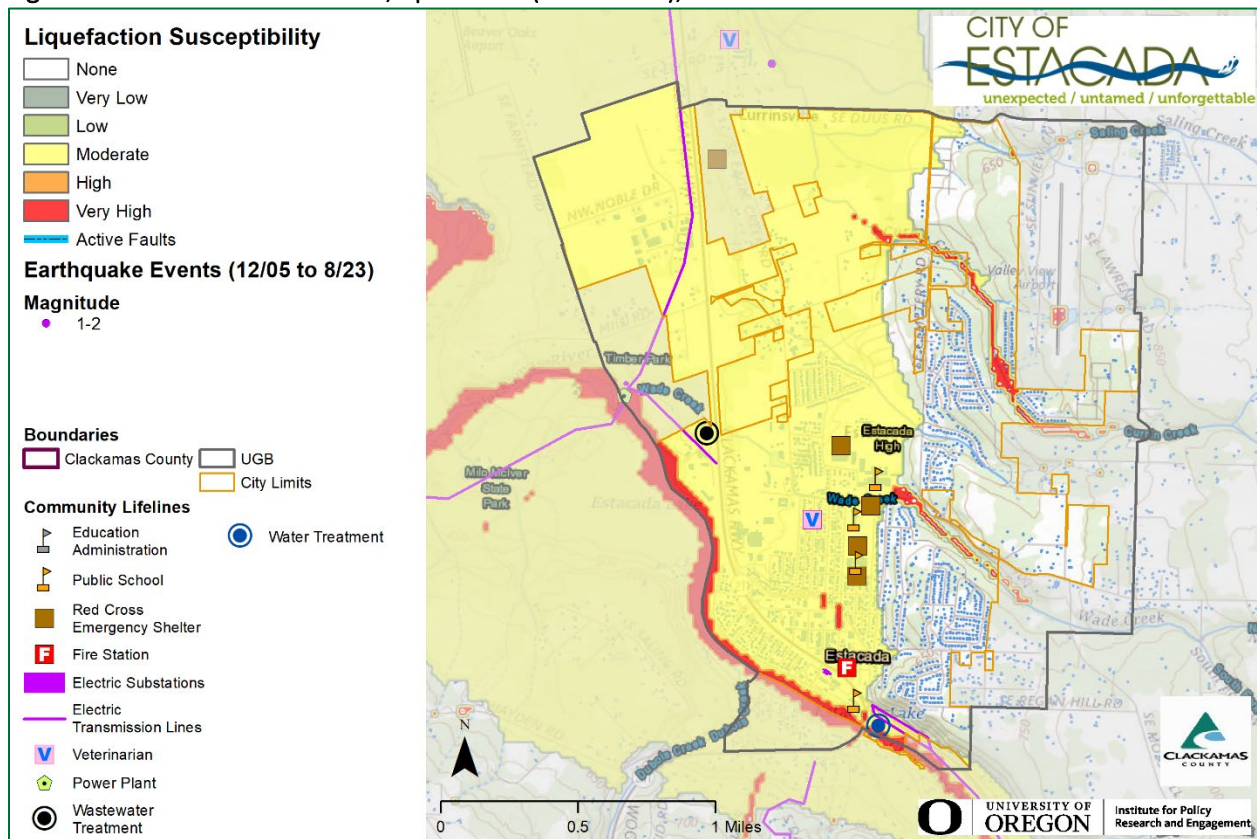
Canby-Estacada Fault Zone

The Canby-Estacada Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Estacada in northern Oregon.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 10 miles northeast of Estacada.

Figure EA-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 36% of residential buildings were built prior to 1990, which increases the City’s vulnerability to the earthquake hazard. Information on specific public buildings’ (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table EA-5; each “X” represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), zero (0) have a very high (100% chance) collapse potential and zero (0) have a high (greater than 10% chance) collapse potential.

For a list of facilities and infrastructure vulnerable to this hazard, see the Community Assets Section and Table EA-4.

Table EA-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Clackamas River Elementary Estacada SD 108 (301 NE 2nd Ave)	Clac_sch59	X			
River Mill Elementary Estacada SD 108 (850 N Broadway St) see Mitigation Successes	Clac_sch60	X			
Estacada Middle Estacada SD 108 (500 NE Main St) see Mitigation Successes	Clac_sch61	X			
Estacada High Estacada SD 108 (355 NE 6th Ave) see Mitigation Successes	Clac_sch62	X			
Fire Facilities					
Estacada RFD 69: Station 10 (261 SE 5th Ave) see Mitigation Successes	Clac_fir19	X			
Estacada RFD 69: Admin Office/EOC (445 SE Currin St) see Mitigation Successes	Clac_fir50	X			

Source: [DOGAMI 2007. Open File Report O-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)

“*” – Site ID is referenced on the [RVS Clackamas County Map](#)

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially

230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table EA-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Cascadia Subduction Zone Scenario

The City of Estacada is expected to have a 5% building loss ratio with a repair cost of \$23 million under the CSZ “dry” scenario, and a 6% building loss ratio with a repair cost of \$27 million under the CSZ “wet” scenario.⁷ The city is expected to have around 29 daytime or 3 nighttime casualties during the CSZ “dry” scenario and 33 daytime or 5 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 12 for the CSZ “dry” scenario and 27 for the CSZ “wet” scenario.⁸ (See Risk Report for more information.)

⁷ DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8 and 12-9.

⁸ Ibid, Tables 12-8 and 12-9.

Portland Hills Fault Scenario

The City of Estacada is expected to have a 9% building loss ratio with a repair cost of \$42 million under the CSZ “dry” scenario, and a 17% building loss ratio with a repair cost of \$74 million under the CSZ “wet” scenario.⁹ The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 55 daytime or 6 nighttime casualties during the Portland Hills Fault “dry” scenario and 105 daytime or 21 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 25 for the Portland Hills Fault “dry” scenario and 197 for the Portland Hills Fault “wet” scenario.¹⁰

Recommendations from the report included topics within Planning, Recovery, and Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table EA-1) and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Table EA-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	1,309	1,309	1,309	1,309
Building Value (\$ Million)	448	448	448	448
Building Repair Cost (\$ Million)	23	27	42	74
Building Loss Ratio	5%	6%	9%	17%
Debris (Thousands of Tons)	17	18	27	39
Long-Term Displaced Population	12	27	25	197
Total Casualties (Daytime)	29	33	55	105
Level 4 (Killed)	2	2	3	7
Total Casualties (Nighttime)	3	5	6	21
Level 4 (Killed)	0	0	0	1

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

⁹ Ibid, Tables 12-10 and 12-11

¹⁰ Ibid, Tables 12-10 and 12-11.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, 2024)¹¹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone Scenario

The City of Estacada is expected to experience damage to 104 buildings (11 critical facilities) for a total potential loss of \$47.6 million (a loss ratio of about 7%). About 39 residents may be displaced (less than 1% of the population).

Canby-Molalla Fault Scenario

With this crustal fault, 18 buildings are expected to be damaged (1 critical facility), for a total potential loss of \$10.9 million (a loss ratio of about 2%). Less than 10 residents may be displaced (less than 1% of the population).

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

The HMAC determined that the City's probability of flooding is **moderate** and that their vulnerability to flooding is **moderate**. *The probability rating decreased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure EA-4 illustrates the flood hazard area for Estacada.

Portions of Estacada are prone to flooding, however, there are no mapped flood hazard areas within the City. Wade Creek is the only riverine flooding potential. The geographic location of the flooding hazard was determined using the designated FEMA 100-year floodplain data.

Vulnerability Assessment

FEMA updated the Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) in 2019 (effective January 18, 2019). According to the FIS there are no Special Flood Hazard Areas (SFHAs) identified in Estacada. The Department of Geology and Mineral Industries (DOGAMI) conducted a multi-hazard risk assessment (Risk Report) for Clackamas County. However, flood risk was not provided for Estacada since there are no identified SFHAs in the city.

While Estacada is not as vulnerable to riverine flooding, it is still vulnerable to flooding caused by excess water from storms. Floods from either rivers or storms can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events.

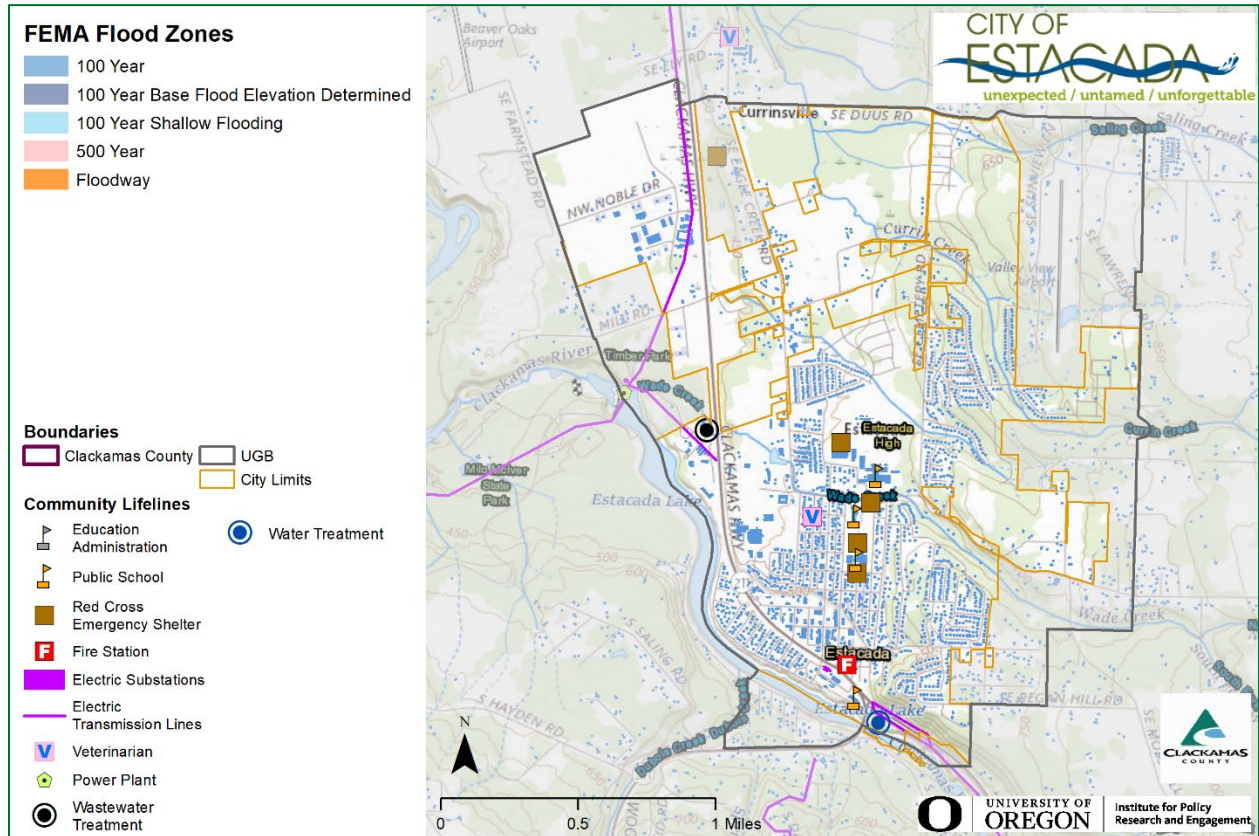
¹¹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-16.

Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Estacada outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage. Currin Creek watershed (Basin 20) located in the north-northeast portion of the city and the Wade Creek watershed (Basin 40) the main stream flowing through the city have both had flooding issues due to insufficient culvert sizes.

The extent of flooding hazards in Estacada primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow. In the past flooding has occurred along the Currin Creek and Wade Creek. These have typically been caused by insufficient sized culverts. Some culverts have been replaced or retrofitted with expanded capacity, such as piping installed from SE 4th and Shafford Streets to Highway 211/224 to eliminate creek bank flooding.

Figure EA-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹² provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

The Risk Report did not identify population or property within the study area that may be impacted by the profiled flood hazard.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹³ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

National Flood Insurance Program (NFIP)

FEMA’s [Flood Insurance Study](#) (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. There are no special flood hazard areas within the City. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program, although the City does not have a delineated Special Flood Hazard Area (SFHA). There have been no Community Assistance Visits (CAV) and the City does not participate in the Community Rating System (CRS). The Community Repetitive Loss record does not identify any Repetitive Loss Properties¹⁴ or Severe Repetitive Loss Properties¹⁵.

Landslide

The HMAC determined that the City’s probability for landslide is **high** and that their vulnerability to landslide is **moderate**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Estacada has had a few landslides over the years due to the steepest slopes located near and along the Clackamas River. In 1996 a landslide lead to a house slide and debris onto Highway 224 and in 2005 about 20 yards worth of material slid but no damage was sustained. Due to the 2020 Riverside Fire damage and to a lesser extent, the 2022 Milo McIver Fire, we expect to see increased probability and vulnerability to debris flows.

¹² DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-16.

¹³ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

¹⁴ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

¹⁵ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Landslide susceptibility exposure for Estacada is shown in Natural Hazard Risk Report for Clackamas County. The Risk Report (DOGAMI, 2024) provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report, 371 buildings are exposed to the high and very high landslide susceptibility hazard for a total exposure of \$102 million (a building exposure ratio of 15.2%). About 1,386 residents may be displaced by landslides (a population exposure ratio of 26.2%).

Landslide susceptibility exposure for Estacada is shown in Figure EA-5. Most of Estacada demonstrates a low to moderate landslide susceptibility exposure. Approximately 26% of Estacada has very high or high, and 15% moderate, landslide susceptibility exposure.¹⁶

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table EA-4.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹⁷ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report, 371 buildings are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of \$102 million (a building exposure ratio of about 15%). About 1,386 residents may be displaced by landslides (about 26% of the population).

Future Projections

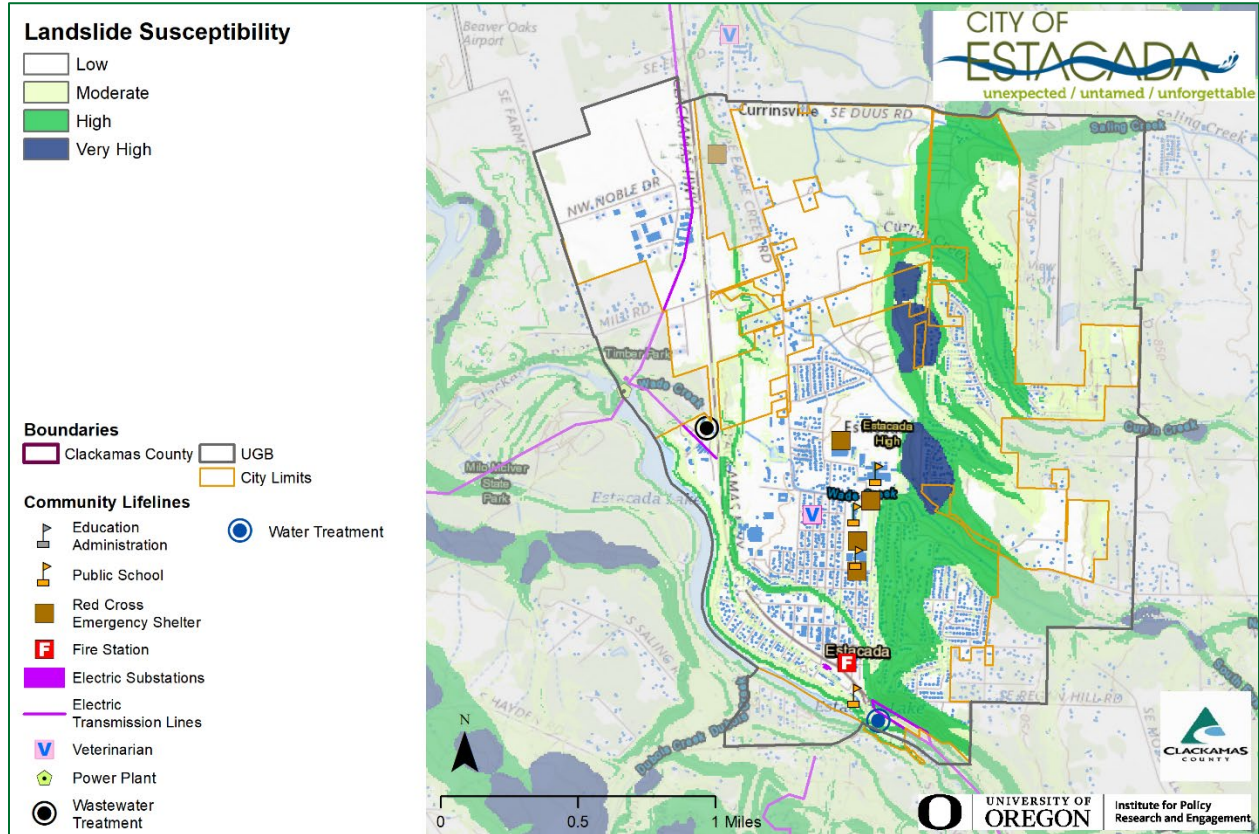
Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects

¹⁶ DOGAMI. [Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon](#) (2016)

¹⁷ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-16.

of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Figure EA-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **moderate** and that their vulnerability is **high**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. Prior to 2010 they occurred every two to three years on average. In the past few years they have been occurring yearly, with higher temperatures. The 2021 Heat Dome necessitated an emergency declaration from the state and have several days of temperatures over 100, with a high temperature of 117 degrees.¹⁸

The City of Estacada has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"¹⁹ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City's probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**. *The probability and vulnerability ratings decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and

¹⁸ NOAA Climate Data Online Daily Summaries access 4/25/2023 <https://www.ncdc.noaa.gov/cdo-web/>

¹⁹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Estacada.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris.

Additionally, transportation, and economic disruptions result as well. Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the City's probability for winter storm is **moderate** and that their vulnerability to winter storm is **high**. *The probability rating decreased and the vulnerability rating increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

There have been two Governor Disaster declarations for winter storms in February of 2019 and 2021, but there was no significant damage to infrastructure within the city. The ice from these storms impacted travel on some of the steeper roads within the city. The 2021 storm caused citywide power outages but they did not last more than a few days. Most winter storms typically do not cause significant damage, they are frequent, and have the potential to impact economic activity. Road closures due to winter weather are an are becoming more common and can interrupt commuter, and commercial traffic as noted above. As more housing developments are built in the higher elevations, we expect to see more traffic impacts during ice and snow.

Vulnerability Assessment

Due to insufficient data and resources, Estacada is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets Section and Table EA-4.

Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding. The area most affected is Lake Shore Drive which runs parallel to the Clackamas River and is lined with large fir trees.

The street has overhead power lines so power outages are frequent. Generally, the power does not stay out very long, but it has been out for up to three days at a time on Lake Shore Drive. Estacada’s power grid is divided, so usually the power will go out in half the town at a time. Another potential problem is the heavily treed area behind the cemetery. Trees and branches blown over in this area during severe storms could affect the high school grounds.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²⁰ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Volcanic Event

The HMAC determined that the City’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **low**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volcanoes are located near Estacada, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Estacada’s relative distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash. Within Estacada, public health would be a primary concern, and keeping transportation routes open/accessible would be important as well.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²¹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

²⁰ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

²¹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-16.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the City's probability for wildfire is **high**, and that their vulnerability to wildfire is **high**. *The probability and vulnerability ratings increased since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan](#) (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Estacada is found in the following chapter: Chapter 9.9: Estacada Rural Fire Protection District #69.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather, and urbanization conditions are primarily at cause for the hazard level. Estacada has not experienced a wildfire within City limits; however, both the 2020 Riverside Fire, and the 2022 Milo McIver Fire, were not far from the city limits. Figure EA-6 shows overall wildfire risk in Estacada.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Estacada, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

Vulnerability Assessment

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. Estacada's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City will update the City's wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²² provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

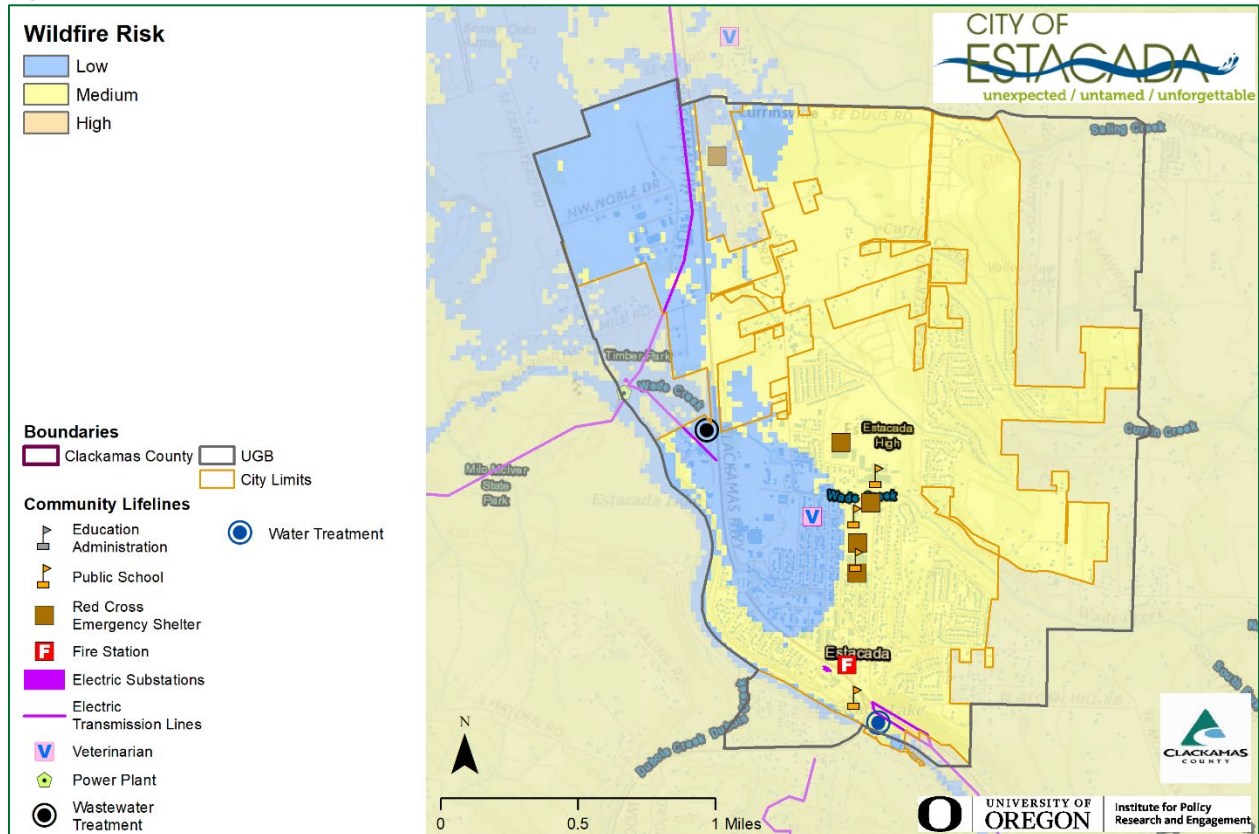
²² DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-16.

According to the Risk Report 212 buildings are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of \$60.8 million (a building exposure ratio of about 9%). About 826 residents may be displaced by wildfires (about 16% of the population).

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²³ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

Figure EA-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

²³ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table EA-7 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table EA-1).

Previous NHMP Actions that are Complete:

Flood #1, “Increase capacity of culverts by identifying and proposing mitigation actions for culverts that are prone to flooding within the City. Complete.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table EA-7 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
-	#1	New	-
Wildfire #1	#2	Not Complete, revised	Yes
-	#3	New	-
-	#4	New	-
-	#5	New	-
Earthquake #1	#6	Not Complete, revised	Yes
Earthquake #1	#7	Not Complete, revised	Yes
-	#8	New	-
-	#9	New	-
Severe Weather #1	#10	Not Complete, revised	Yes
Severe Weather #1	#11	Not Complete, revised	Yes
Severe Weather #1	#12	Not Complete, revised	Yes
-	#13	New	-
Severe Weather #1	#14	Not Complete, revised	Yes
-	#15	New	-
Severe Weather #1	#16	Not Complete, revised	Yes
Severe Weather #2	#17	Not Complete, revised	Yes

Table EA-7 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
-	#18	New	-
Multi-Hazard #1	#19	Not Complete, revised	Yes
Flood #1	-	Complete	No
Flood #2	#20	Not Complete, revised	Yes
Multi-Hazard #1	#21	Not Complete, revised	Yes
-	#22	New	-
Multi-Hazard #2	#23	Not Complete, revised	Yes
-	#24	New	-
-	#25	New	-

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from January 22 through March 31 on the City's website. The plan was also posted and announced on the County's website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Outreach Events

The City organized a team comprised of city staff, fire district staff, school district staff, and community members to serve as the Hazard Mitigation Advisory Committee. This committee met on three occasions to review, update, and compile the data listed in this report.

The City of Estacada's Diversity, Equity, and Inclusion Committee met 2/5/2024 to review the community assets and determine if any were missing or categorized incorrectly. They suggested possible action items which could assist the members of the community most impacted by disasters or least able to recover from disasters.

The City's Infrastructure Committee reviewed the NHMP to see if there were any community assets missing and to see if the action items were appropriate for the infrastructure within the community.

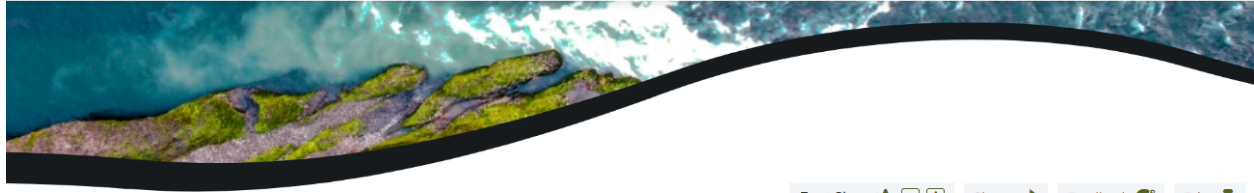
The draft plan was shared at the May 2023 "What's Up, Estacada" (a networking group featuring government partners, service agencies, non-profit organizations, religious institutions, businesses, and community support organizations) and community members were invited to submit comments on the plan (1/25/2024).

The draft plan was shared at the Estacada Fire District's Wildfire Community Preparedness event and community members and agency representatives were invited to submit comments.

Both the City of Estacada and Clackamas County Emergency Management posted surveys related to the NHMP and natural hazards. This information was incorporated into the plans from those respective agencies.

After these meetings, the information presented was incorporated into the plan and the updated draft shared on the city's website with a form for additional comments.

Website Posting



- Administration ▲
- Emergency Operation
- Natural Hazard Mitigation
- Community Development ▼
- Estacada Public Library
- Public Safety & Municipal Court ▼
- Public Works ▼

Home → Departments → Administration → Natural Hazard Mitigation

Natural Hazard Mitigation

Clackamas County and the City of Estacada updated this Multi-Jurisdictional Natural Hazards Mitigation Plan (NHMP) to prepare for the long-term effects resulting from hazards.

The plan gives an overview of potential hazards, impacts, and ways that the community can help mitigate the impacts.

It is currently in a draft stage.

Supporting Documents

[2024 Draft City of Estacada Addendum \(PDF\)](#)

Page on the website where the plan and feedback form was posted on 1.22.24:
<https://www.cityofestacada.org/departments/administration/natural-hazard-mitigation/>

Press release sent to the Estacada News on 1.25.24
https://www.estacadanews.com/business/estacada-updating-plan-to-reduce-risks-from-disasters/article_c04d59ea-bf08-11ee-9dcd-03d9c78e7c65.html



City of Estacada - Government

Published by Melanie Wagner · January 29 at 10:39 AM

The city works with the community and partner agencies to plan for ways to mitigate future natural disasters. Our 5 year plan update is available on the website. Please take a look and submit your comments via the webform. <https://www.cityofestacada.org/.../natural-hazard-2/>

NATURAL HAZARD MITIGATION PLAN UPDATE

As part of the Clackamas County Multi-Jurisdictional Hazard Mitigation Plan, the City of Estacada has updated their addendum.

Take a look and let us know what you think.

<https://www.cityofestacada.org/departments/administration/natural-hazard-mitigation-2/>

Comments on the draft Natural Hazard Mitigation Plan

Submit

Instagram



cityofestacada

NATURAL HAZARD MITIGATION PLAN UPDATE

As part of the Clackamas County Multi-Jurisdictional Hazard Mitigation Plan, the City of Estacada has updated their addendum.

Take a look and let us know what you think.

<https://www.cityofestacada.org/departments/administration/natural-hazard-mitigation-2/>



cityofestacada The city works with the community and partner agencies to develop a plan to help mitig... more

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1 and #2: April 6 and May 3, 2023

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Create list for updates to community assets, essential facilities, vulnerable populations
- Review Clackamas County’s Hazard Analysis Matrix
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Created new actions items.
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #3: November 8, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city’s capabilities assessment.
- Reviewed, confirmed, and prioritized the city’s mitigation strategies.

City of Gladstone Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: City of Gladstone

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The City of Gladstone

Updated:
July 9, 2024, (Resolution # 1238)
November 12, 2019, (Resolution #1167)
January 14, 2014 (Resolution #988)
February 9, 2010, (Resolution #911)



This Natural Hazard Mitigation Plan was prepared by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

RESOLUTION # 1238

**A RESOLUTION ADOPTING THE CITY OF GLADSTONE
REPRESENTATION IN THE UPDATES TO THE CLACKAMAS COUNTY
MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN**

WHEREAS, the City of Gladstone recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, the City of Gladstone has fully participated in the FEMA prescribed mitigation planning process to prepare the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

WHEREAS, the City of Gladstone has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of Gladstone to the impacts of future disasters within the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*; and

WHEREAS, these proposed projects and programs have been incorporated into the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, May 29, 2024) contingent upon this official adoption of the participating governments and entities;

WHEREAS, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

WHEREAS, the NHMP is in an on-going cycle of development and revision to improve it's effectiveness; and

WHEREAS, City of Gladstone adopts the NHMP and directs the City Administrator to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

NOW, THEREFORE, BE IT RESOLVED, that the City of Gladstone adopts *the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan; and

BE IT FURTHER RESOLVED, that the City of Gladstone will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

This Resolution is adopted by the Gladstone City Council and approved by the Mayor this 9th day of July, 2024

ATTEST:



Michael Milch, Mayor



Tami Bannick, City Recorder

Purpose

This is an update of the Gladstone addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Gladstone’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Gladstone adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 9, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Gladstone to update their NHMP.

The Clackamas County NHMP, and Gladstone addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Gladstone HMAC guided the process of developing the NHMP.

Convener

The Gladstone City Administrator serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Gladstone HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Gladstone HMAC was comprised of the following representatives:

- Convener, Jacque Betz, City Administrator
- Justin Poyser, City of Gladstone Utility Manager
- Darren Caniparoli, Public Works Director
- John Schmerber, Police Chief
- Haley Kratz, Executive Assistant
- Tami Bannick, City Recorder

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Gladstone addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the Gladstone NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Gladstone will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Gladstone to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

Gladstone addresses Statewide Planning Goal 7 Natural Hazards as part of their Comprehensive Plan Element, Natural Resources. This element was written in 1979 and contains policies *to protect life and property from natural disasters and hazards such as floods, landslides, weak foundation soils and earthquakes.*

Planned updates to the jurisdiction's Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community's long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

The Gladstone Municipal Code, last updated in 2022 with housing code amendments to comply with HB 2001, includes Chapter 17 Zoning Code. The Zoning Code identifies uses and restrictions for all properties within the city limits of Gladstone, and includes overlay district standards for Flood Management Areas (17.29), habitat conservation, open space, water quality resource areas, etc., as well as development standards related to siting, design, drainage, grading and fill, and land divisions. Chapter 17.29 Flood Management Area District includes all flood management areas and is an overlay district that also includes areas of inundation from February 1996 flood, FIS June 16, 2008 (last amended in 2008). Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

Gladstone’s planning services are provided by 3J Consulting, which is responsible for the administration of state, county, and local land use policies and regulations as they relate to the preservation and quality development of property lying within the city limits and urban growth boundary (UGB). The consultants work closely with Building, Public Works, and Fire in the review of development applications and building permits.

Recent planning activity that integrates natural hazards and resilience findings and actions include:

- Gladstone Nature Park Site Plan (2020) – retains and restores the tree canopy that covers 90% of site
- Meldrum Bar Park Site Plan (2022) – includes plan for flood management area, wetlands, greenway and habitat conservation areas
- 2021 Gladstone Housing Needs Analysis -- included analysis of lands within floodplains and floodways, and land with slopes over 25% (as unsuitable for residential development)

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

The Clackamas County Building Department administers and enforces the 2022 Oregon Fire Code and the 2022 Oregon Structural Specialty Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

Public Works

The City of Gladstone Public Works Department is responsible for drinking water, sanitary sewer, stormwater, roads and streets, parks, and public facilities. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

Gladstone maintains a local system of three water tanks, two pump stations, and almost 40 miles of pipelines. Gladstone is an owner in a regional water treatment provider, the North Clackamas County Water Commission. This Commission provides safe, treated water from the Clackamas River. Gladstone is also part of the [Clackamas River Water Providers, Our Regional Water Source](#), a coalition of all the municipal water providers that receive their drinking water from the Clackamas River.

Gladstone Public Works partners with Oregon City to provide residents with a comprehensive GIS mapping system.

City Administration

The City Council of Gladstone has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Policies and Programs

This Plan directs Gladstone and Clackamas County to explore integration into other planning documents and processes. Gladstone has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

Infiltration & Inflow (I/I) Project

The City of Gladstone has a longstanding history of Oregon Department Environmental Quality (DEQ) violations pertaining to raw sewage overflowing into the Clackamas River. Violations that have been a result of stormwater Infiltration and Inflow (I&I) into the city's sewer collection system.

As part of a Mutual Agreement Order (No. WQ/M-NWR-2019-038) between DEQ and the City of Gladstone, DEQ granted the city time to correct the system's deficiencies. In May 2019 the City contracted with Leeway Engineering to complete field work, which included smoke testing and CCTV investigations. The findings from the fieldwork were used to prepare the final I&I report for DEQ.

In April 2022 the City Council approved a contract with Leeway Engineering to design the I&I Reduction Project. Leeway Engineering is in the final design stages of the work that needs to be completed in 2024. The City issue a second Request for Proposal in November 2023 and will bring a contract before City Council in early 2024 for approval.

MS4 Permit

Gladstone's Phase II Municipal Separate Storm Sewer System (MS4) permit was reissued by the Oregon Department of Environmental Quality (DEQ) in 2021. The permit program has six areas of focus that are consistent with EPA's Federal Clean Water Act: public education, public involvement, illicit discharge detection and elimination, construction, post-construction, and municipal operations.

The City revised its Stormwater Management Program document in 2022 to meet the requirements of the new MS4 Permit.

TMDL Plan

The City also maintains a Total Maximum Daily Load (TMDL) Plan (updated in 2020). The Total Maximum Daily Load (TMDL) program includes many of the same requirements as the MS4 program, focusing on measures that impact the parameters of concern – temperature, bacteria, and mercury – with the Willamette River and the Clackamas and Lower Willamette Subbasins. The NHMP actions are incorporated into this document as appropriate. Example projects include participation in regional stormwater outreach projects, staff training on pollution control, and street cleaning after major storm events.

Gladstone Emergency Management Support

The City of Gladstone administers a Volunteer Emergency Management Program, Gladstone Emergency Management Support (GEMS). The program realizes that Gladstone has limited personnel and equipment resources for a sustained medium to large scale natural or human caused emergency. During

an emergency, the Gladstone Community Center becomes an Emergency Resource Center for volunteer assembly and management.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The NHMP will also be integrated into the City's Capital Improvement Plan, to be adopted by early 2024.

National Flood Insurance Program

Gladstone participates in the National Flood Insurance Program. The Planning consultants are responsible for administering the day-to-day activities of the city's floodplain program. They are assisted by the Building Department, the Public Works Department, and by the City Administrator.

Specifically, the floodplain manager:

- maintains and administers Gladstone's floodplain regulations;
- reviews and issues floodplain development permits;
- maintains elevation certificates for all new and substantially improved structures (and maintains an extensive database of historic elevation certificates);
- ensures that encroachments do not occur within the regulated floodway;
- implements measures to ensure that new and substantially improved structures are protected from flood losses;
- maintains floodplain studies and maps and makes this information available to the public;
- maintains a flood information website with digital flood insurance rate map (DFIRM) data;
- conducts site visits to assess conditions and provide technical assistance to the public;
- maintains a library of historical flood related information;
- informs the public of flood insurance requirements; and
- conducts outreach and training about flood hazards and development within the floodplain.

Personnel

The following Gladstone personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Police Department

Public Information Officer: Police Department

Floodplain Manager: Planning

Grant writing (for Public Works or emergency management): Administration

Capital improvement planning: Public Works Department

Capital improvement execution: Public Works Department

Gladstone does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Gladstone has implemented recommendations from the last NHMP into its capital improvement projects over the last 5 years, including:

The following mitigation-related or resilience projects have been completed since 2018:

- New Public Works facility (underway, 2024 completion)
- Barclay Stormwater Project
- Gladstone Civic Center Project
- Duniway and Watts Stormwater upgrades in conjunction with Gladstone Civic Center Project
- West Clackamas Sewer Project
- New library (underway 2024 completion)
- Gladstone Fire Station 22 remodeled

The following projects are in development and proposed for completion by 2025:

- Trolley Trail Bridge Replacement Engineering/Environmental Phase
- 82nd Drive Pump Station replacement
- Evergreen Storm Line Replacement
- Capital improvements in Oak Lodge Service Area

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)¹.

FEMA Funded Mitigation Successes

- 2007: City of Gladstone Fire/EMS Seismic Upgrade (PDM 2007), completed 2010

Seismic Rehabilitation Grant Program Mitigation Successes

- 2013/14: Gladstone Police Department seismic retrofit (\$360,729)
NOTE: police department is no longer located at this location.

Other Mitigation Successes

- Gladstone High School new building (2009)
- Gladstone Library (owned and operated by Clackamas County)
- Civic Center developed at 18505 Portland Ave to house City Hall and Police Station (2020)
- Public Works Facility (under construction, completion Spring 2024)
- Gladstone Library (owned and operated by Clackamas County)
- Barkley Stormwater Project
- Duniway and Watts
- Evergreen Lane Stormwater Project scheduled for 2024
- 82nd Drive Pump station 2024
- Inflow and infiltration Project Phase 1 & 2 (Fall 2024)
- Oaklodge Infrastructure Improvements (complete 2027)

¹ The Seismic Rehabilitation Grant Program (SRGP) 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.

Capital Resources

Gladstone maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Critical facilities with power generators for use during emergency blackouts include:

- Gladstone Community Center
- Gladstone Public Works
- Gladstone Civic Center

Warming or cooling shelters include:

- Gladstone Community Center
- Gladstone Library
- New Life Church

Findings

Several important findings from this capability assessment informed the design of the Plan's mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Gladstone staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Gladstone operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City's ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3(iv), *Mitigation Strategy*.

The City’s mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAC assessed the City’s risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table GA-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAC decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five years. Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table GA-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
1	Integrate the goals and mitigation actions from the Gladstone Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	Planning	Ongoing	Local Resources. DLCDC TA, FEMA HMA-C&CB	Low
2	Develop, enhance, and implement education programs designed to reduce the losses from natural hazards.	X	X	X	X	X	X	X	X	X	Gladstone EMS	Ongoing	Local Resources. DLCDC TA, FEMA HMA-C&CB	Low
3	Improve vegetation management throughout the city.				X	X		X	X	X	Public Works	Ongoing	Local Resources	Low
4	Enhance strategies for debris management for all hazards.		X		X	X	X	X	X	X	Public Works	Ongoing	Local Resources. DLCDC TA, FEMA HMA	Low
5	Maintain the Gladstone Emergency Operations Plan.	X	X	X	X	X	X	X	X	X	Police	Ongoing	Local, State, Federal Grants and BRIC	Low
6	Evaluate and upgrade stormwater management infrastructure and identify appropriate mitigation strategies.				X						Public Works	Long	Local, State and Federal Grants; FEMA HMA	High

Table GA-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
7	Update water distribution system.		X			X					Public Works	Ongoing	Local and State	Medium to High
8	Conduct seismic evaluations on identified critical/essential facilities and infrastructure for implementing appropriate structural and non-structural mitigation strategies.		X								City Administration	Long	Local Resources, SRGP, FEMA HMA	Medium to High
9	Ensure continued compliance in the National Flood Insurance Program through enforcement of local floodplain management ordinances.				X						City Administration	Ongoing	Local Resources, FEMA HMA (FMA)	Low
10	Coordinate with Clackamas County to address the flooding issues on Glen Echo that stem from the two-way diversion on Hull Avenue put in by Clackamas County.				X						Public Works	Medium	Local, State, Federal Grants and BRIC	Medium to High
11	Maintain and implement the Gladstone Stormwater Master Plan.				X						Public Works	Ongoing	Local Resources, FEMA HMA (FMA)	Medium to High
12	Update Water System Telemetry System.				X					X	Public Works	Short (2024-2025)	Local Resources, FEMA HMA (FMA)	High

Table GA-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
13	Replace failed storm line and outfall on Evergreen Lane.		X		X					X	Public Works	Short (2024)	Local Resources, FEMA HMA (FMA)	High
14	Construct repairs to sanitary sewer and storm system extensions to reduce I/I and SSOs				X					X	Public Works	Short (2024)	Local Resources, FEMA HMA (FMA)	High
15	Construct repairs identified in the 2021 TV survey of the sanitary sewer system draining to Oak Lodge.				X					X	Public Works	Short (2024-2027)	Local Resources, FEMA HMA (FMA)	Medium to High
16	Replace aging Sherwood Forest water distribution system piping.		X		X					X	Public Works	Medium (2025-2030)	Local Resources, FEMA HMA (FMA)	High
17	Reduce the vulnerability of property owners in landslide-prone areas.					X					City Administration	Long	Local Resources, FEMA TA, FEMA HMA	Medium to High
18	Reduce negative effects from severe windstorm and severe winter storm events.								X	X	Public Works	Ongoing	Local Resources, FEMA HMA	Low to High

Table GA-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
19	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.							X			Clackamas Fire District	Ongoing	Local Resources, FEMA HMA	Low to High

Source: Gladstone NHMP HMAC, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

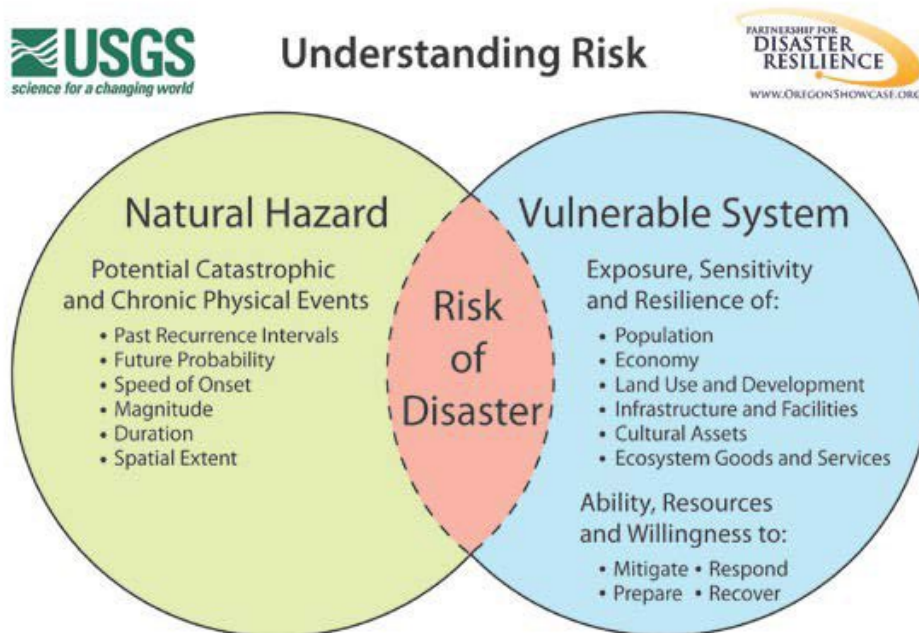
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure GA-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure GA-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Gladstone HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Gladstone, which are discussed throughout this addendum. Table GA-2 shows the HVA matrix for Gladstone listing each hazard in order of rank from high to low. For local governments, conducting the

hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) and one chronic hazard (winter storm) rank as the top hazard threats to the City (Top Tier). Extreme heat event, flood, windstorm, and wildfire comprise the next highest ranked hazards (Middle Tier), while drought, landslide, and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table GA-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Earthquake - Cascadia	2	45	100	35	182	1	Top Tier
Earthquake - Crustal	6	50	100	21	177	2	
Winter Storm	14	35	70	49	168	3	
Extreme Heat Event	10	40	70	35	155	4	Middle Tier
Flood	6	25	70	49	150	5	
Windstorm	10	35	50	42	137	6	
Wildfire	6	25	50	42	123	7	
Drought	10	15	30	56	111	8	Bottom Tier
Landslide	2	25	40	35	102	9	
Volcanic Event	2	20	40	7	69	10	

Source: Gladstone HMAc, 2023.

Community Characteristics

Table GA-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Population, Housing, and Income

Gladstone has grown substantially since its incorporation in 1911 and has an area today of 2.4 square miles. It is in the south-central region of Clackamas County, located approximately 12 miles south of the City of Portland. Gladstone is part of the Clackamas River Water Providers, which is a coalition that gets its water from the Clackamas River.

Located at 57 feet above sea level, Gladstone’s climate is consistent with a Mediterranean climate zone, with warm summers and cool, wet winters. Gladstone receives most of its rainfall between October and May, and averages 46 inches of rain, and less than a couple inches of snow, per year.

Between 2016 and 2021 the City grew by 510 people (4%; as of 2022 the population is 12,170). Between 2022 and 2040 the population is forecast by Metro to decrease slightly to 12,021 (due to two years of negative growth following the COVID pandemic). As the region rebounds from pandemic-related economic challenges, this population projection is expected to change.

Most of the population is White/Caucasian (76%) and about 18% of the population is Hispanic or Latino. The poverty rate is 16% (25% of children under 18, 11% for people 65 and older), 5% do not have health insurance, and 52% of renters pay more than 30% of their household income on rent (39% for owners). About 26% of the population has a bachelor’s degree or higher (8% do not have a high school degree). Approximately 16% of the population lives with a disability (39% of population 65 and older), and 39% are

either below 15 (19%) or over 65 (20%) years of age. About 11% of the population are 65 or older and living alone and 15% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 71% of housing units are single-family, 23% are multifamily, and 6% are mobile homes. One third of homes (32%) were built before 1970 and 27% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (62%) of housing units are owner occupied, 36% are renter occupied, 0% are seasonal homes, and 2% are vacant.

Transportation and Infrastructure

Gladstone is roughly 12 miles south from Portland and adjacent to Milwaukie, Oregon City, and West Linn. It is located within the Portland Metro with Highway 99E, otherwise known as McLoughlin Blvd, running north to south through the southwestern corner of Gladstone. The majority of Gladstone lies west of Interstate 205 and Highway 212/224 is located just north of the city boundary. The Union Pacific Railroad main line, which carries both passengers and freight, crosses through Gladstone east of Interstate 205 and west of the Clackamas River.

Motor vehicles represent the dominant mode of travel through and within Gladstone. Fifteen percent (15%) of renters and 3% of owners do not have a vehicle. Most workers drive alone to work (75%); 6% carpool, 4% use public transit, 2% either walk or use a bicycle, and 13% work at home. Portland Tri-Met has a light-rail line in Milwaukie and is the bus service that provides public transit to the City. There are no port services available on the Willamette and Clackamas Rivers near Gladstone, but there are recreational areas along the river.

Economy

Gladstone's proximity to major transportation routes and access to rail has made it a desirable place for commercial and industrial development. Historically Gladstone's economy focused on forestry and farming, which still has a major presence in the workforce. About 50% of the resident population 16 and over is in the labor force (6,015 people) and are employed in a variety of occupations including professional (16%), office and administrative (15%), management, business, and financial (14%), production (11%), and construction, extraction, and maintenance (11%) occupations.

Gladstone has an economic advantage due to its location at the north end of the Willamette Valley and its proximity to Portland. A significant portion of the land available for industrial development in Clackamas County is in the Gladstone area. There are currently new expansions in existing industries currently underway with available industrial land in the Industrial Parks.²

Most workers residing in the city (96%, 5,464 people) travel outside of the city for work primarily to Portland and surrounding areas.³ A significant population of people travel to the city for work, (93% of the workforce, 2,971 people) primarily from Portland and surrounding areas.⁴

² Economic Development (2019). City of Gladstone. <https://www.cityofGladstone.com/ed>

³ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 21, 2023 at <https://onthemap.ces.census.gov>.

⁴ Ibid.

Table GA-3 Community Characteristics

Population Characteristics		Population	Household Characteristics	
		Growth		
2016 Population Estimate	11,660		Housing Units	
2022 Population Estimate	12,170	4%	Single-Family (includes duplexes)	3,410 71%
2045 Population Forecast*	12,021	-1%	Multi-Family	1,127 23%
Race			Mobile Homes (includes RV, Van, etc.)	293 6%
American Indian and Alaska Native		1%	Household Type	
Asian		2%	Family Household	3,123 66%
Black/ African American		2%	Married couple (w/ children)	624 13%
Native Hawaiian and Other Pacific Islander		< 1%	Single (w/ children)	699 15%
White		76%	Living Alone 65+	523 11%
Some Other Race		< 1%	Year Structure Built	
Two or More Races		6%	Pre-1970	1,546 32%
Hispanic or Latino/a (of any race)		18%	1970-1989	1,961 41%
Limited or No English Spoken	379	3%	1990-2009	984 20%
Vulnerable Age Groups			2010 or later	339 7%
Less than 5 Years	369	3%	Housing Tenure and Vacancy	
Less than 15 Years	1,946	16%	Owner-occupied	2,978 62%
65 Years and Older	1,994	17%	Renter-occupied	1,742 36%
85 Years and Older	302	3%	Seasonal	0 0%
Age Dependency Ratio		0.49	Vacant	110 2%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)	
Total Disabled Population	1,901	16%	No Vehicle (owner occupied)	75 3%
Children (Under 18)	163	7%	Two+ vehicles (owner occupied)	2,280 77%
Working Age (18 to 64)	988	13%	No Vehicle (renter occupied)	258 15%
Seniors (65 and older)	750	39%	Two+ vehicles (renter occupied)	581 33%
Income Characteristics			Employment Characteristics	
Households by Income Category			Labor Force (Population 16+)	
Less than \$15,000	439	9%	In labor Force (% Total Population)	6,015 50%
\$15,000-\$29,999	427	9%	Unemployed (% Labor Force)	378 6%
\$30,000-\$44,999	475	10%	Occupation (Top 5) (Employed 16+)	
\$45,000-\$59,999	309	7%	Professional & Related	961 16%
\$60,000-\$74,999	498	11%	Office & Administrative	885 15%
\$75,000-\$99,999	671	14%	Management, Business, & Financial	856 14%
\$100,000-\$199,999	1,467	31%	Production	678 11%
\$200,000 or more	434	9%	Construction, Extraction, & Maint.	660 11%
Median Household Income		\$83,214	Health Insurance	
Gini Index of Income Inequality		0.43	No Health Insurance	641 5%
Poverty Rates (Percent age cohort)			Public Health Insurance	5,057 42%
Total Population	1,932	16%	Private Health Insurance	7,833 66%
Children (Under 18)	591	25%	Transportation to Work (Workers 16+)	
Working Age (18 to 64)	1,136	15%	Drove Alone	4,465 75%
Seniors (65 and older)	205	11%	Carpooled	336 6%
Housing Cost Burden (Cost > 30% of household income)			Public Transit	225 4%
Owners with a Mortgage	877	39%	Motorcycle	0 0%
Owners without a Mortgage	289	40%	Bicycle/Walk	91 2%
Renters	911	52%	Work at Home	791 13%

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", 2016 & 2022; Portland State University. METRO 2040 Population Distributed Forecast (2021, Exhibit A to Ordinance 21-1457).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Gladstone. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table GA-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table GA-4 Critical Facilities

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Gladstone Emergency Operations Center	-	X	-	-	-
Gladstone Fire Department	-	-	-	-	-
Gladstone High School	-	X	X	-	-
Gladstone Police Department	-	X	X	-	-
Gladstone Public Works	-	X	X	-	-
Grace Christian School	-	-	-	-	-
John Wetten Elementary School	-	X	X	-	-
Rivergate SDA School	-	X	X	-	-
Walter L Kraxberger Middle School	-	X	-	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-19

Additional Critical Facilities not included in the DOGAMI Risk Report:

- Gladstone Civic Center (City Hall and Police Station)
- Gladstone Community Center
- Public Works
- Gladstone Fire Station #22
- Gladstone area churches

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include: Oregon City Bridge, communication towers, Highway 205, McLoughlin Blvd Corridor (Highway 99E), NW Natural pipelines off McLoughlin Blvd, power substation on Jennings, railroad, Clackamas River Water, Oak Lodge Water,

pump stations, sanitary sewer collection system and pump station, stormwater infrastructure, and water lines.

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public's ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields.

- Gladstone High School
- John Wetten Elementary
- Kraxburger Middle School
- Gladstone Center for Children and Families
- Hillside Christian Fellowship Gladstone
- Church of Christ
- Church of Jesus Christ of Latter-Day Saints
- Gladstone Christian Church
- First Baptist Church
- Seventh Day Adventist
- St. Stephen Lutheran Church
- The Source Church
- Safeway
- Avamere Rehabilitation of Clackamas
- Somerset Assisted Living
- Tukwila Springs (Affordable Housing)

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include: Billy Goat Island, McLoughlin/Risley Wetland, Olsen Wetland, Willamette and Clackamas Rivers and riparian corridors, and City Parks (including Abernathy Lane Trail, Cross Park, Dahl Beach, Diericks Field, Gladstone Nature Park, Glen Echo Wetland, High Rock Park, Max Patterson Memorial City Park, Meldrum Bar Park, Nick Shannon Park, Ridgeway Tracts, Robin Hood Park, Salty Acres Wetlands, and Stocker Park).

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include:

Assisted Living Facilities

- Avamere Rehabilitation of Clackamas
- Gladstone Senior Center
- Somerset Assisted Living
- Somerset Lodge

Child Care Centers

- Gladstone Center for Children and Families

Mobile Home Parks

- Tri-City Mobile Home Park
- Two Rivers Coop Home Park
- Hollyview Court

Other Vulnerable Populations

- 7th Day Adventist Annual Conference (Gladstone Park)
- Schools
- Tukwilla Springs (Affordable Housing)

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered "critical." Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility.

Those sites that store, manufacture, or use potentially hazardous materials include: Cal Spas Chemical Storage, Classic Pool and Spa, First Student Bus Barn, Gas Stations, and Gladstone Public Works.

Facilities that are critical to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more.

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Happy Valley. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers, and are a concern during evacuation/notification during a hazard event include:

Economic Centers

- 82nd/Arlington Corridor
- Budget Inn
- Holiday Inn
- McLoughlin Blvd Corridor
- Walgreens
- Safeway

Apartment Centers

- Alder Creek Apartments
- Arlington West Apartments
- Autumn Oak Apartments
- Bridgland's Properties LLC
- Fairway Village
- Gladstone Forest Apartments
- Los Verdes Townhomes
- Lynisa Apartments
- Monte Verde Apartments
- Oak Hill Apartments
- PDX Pads LLC
- Rask Properties LLC
- Rivergreens Associates LLC
- Riverplace Apartments
- Rocky Bluff Townhomes
- T & K Properties
- Webster A to Z LLC
- Webster Ridge Apartments

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

Hazard Characteristics

Drought

The HMAC determined that the City's probability for drought is **moderate** and that their vulnerability to drought is **low**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

The City of Gladstone Public Works Department manages Gladstone’s water supply. Gladstone maintains a local system of three water tanks, two pump stations, and almost 40 miles of pipelines. These pipelines and other water infrastructure has not been updated or repaired properly, so the City Council approved water and sewer rate increases since 2018 to help with maintenance costs. The City is also part of a regional water treatment provider, the North Clackamas County Water Commission. The City draws its water supply from the Clackamas River. There is potential contamination sources within the Clackamas Watershed area from agriculture, managed forest land, wastewater treatment plans, and other sources.⁵

Vulnerability Assessment

Due to insufficient data and resources, Gladstone is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table GA-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁶ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Gladstone as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Gladstone as well.

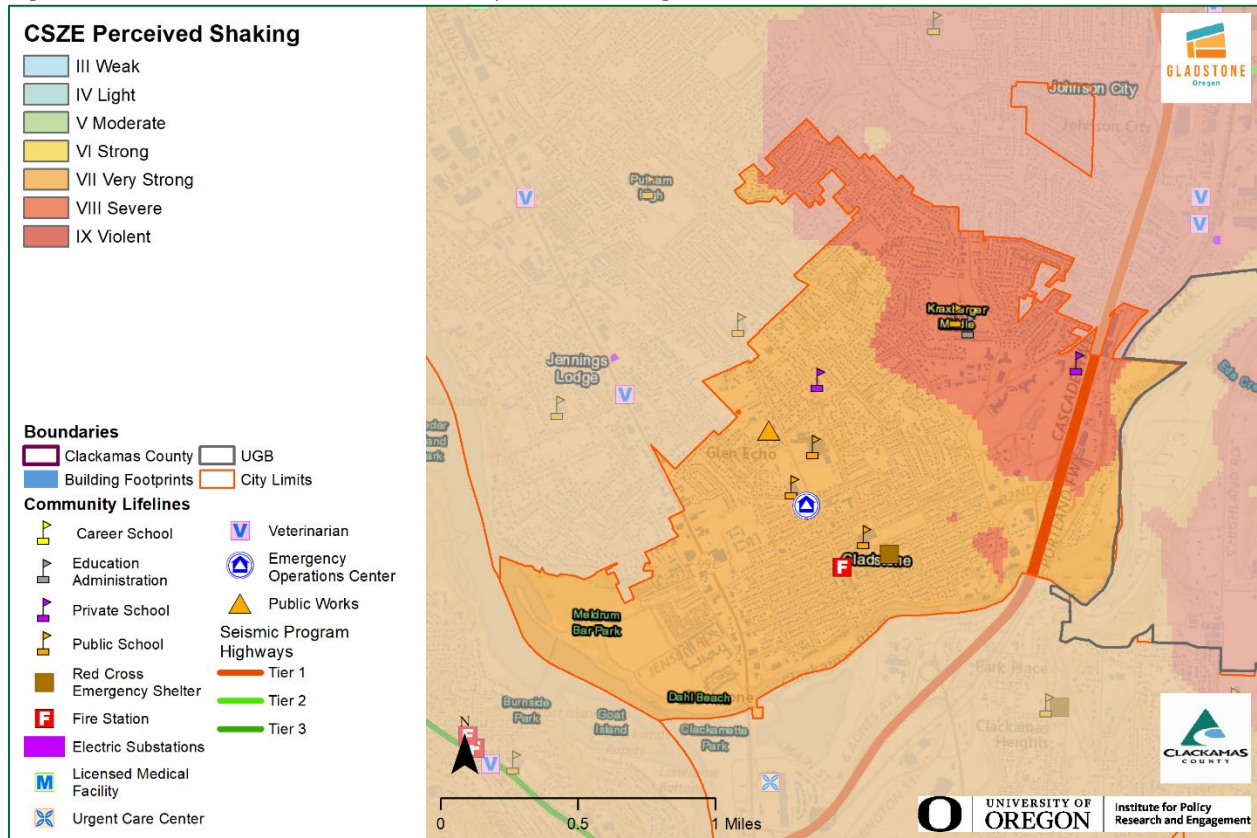
Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Gladstone Fault Zone (discussed in the crustal earthquake section).

Figure GA-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange).

⁵ Profita, C. *Clackamas Watershed Collects Pollutants and Drinking Water* (2013). OPB.org.

⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Figure GA-2 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.⁷

The city’s proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the “Valley Zone” (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

The City is not within the severe shaking area, though there is significant area around the City that have severe and very severe shaking if a large earthquake were to occur. These areas include Highway 205 and

⁷ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

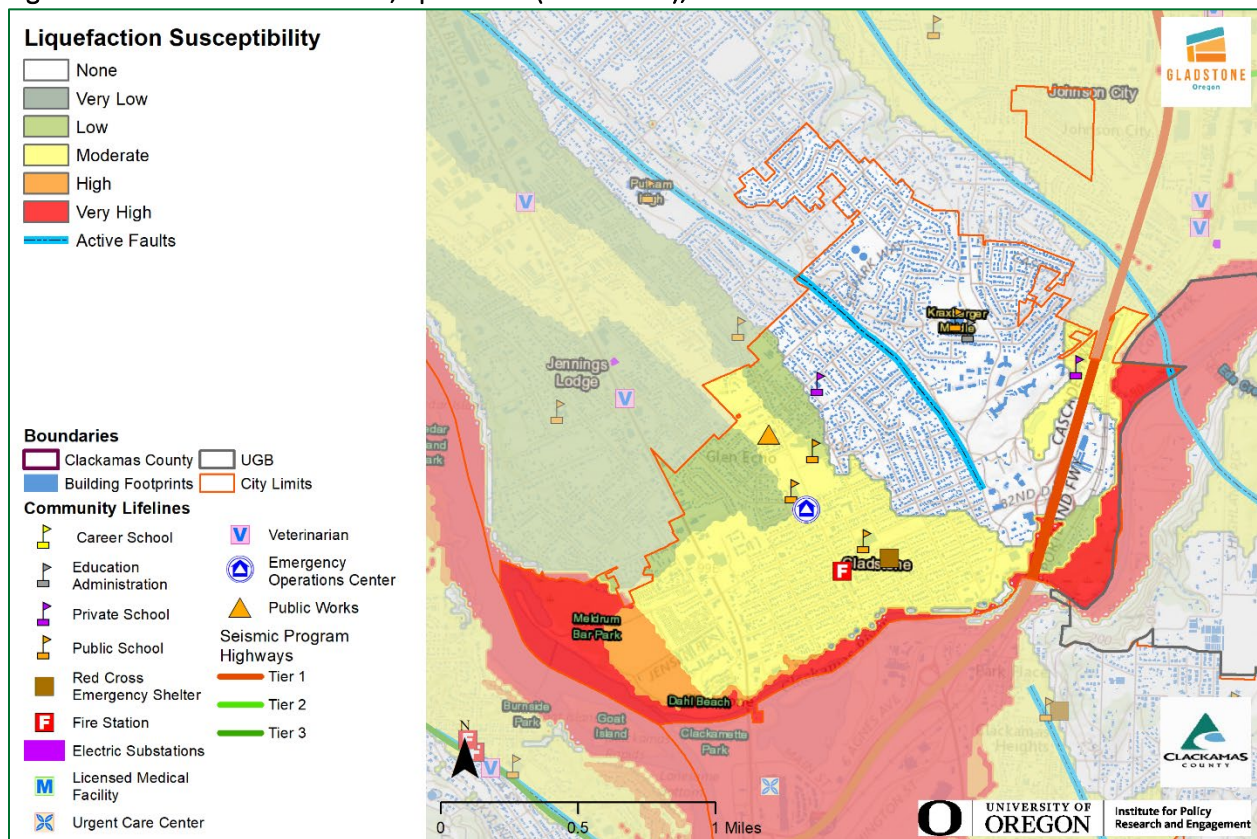
Highway 99E, which could result in Gladstone having access issues from emergency vehicles and other response efforts.

Earthquake (Crustal)

The HMAC determined that the City’s probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Gladstone as well. Figure GA-3 shows a generalized geologic map of the Gladstone area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

Figure GA-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

Gladstone has the Canby-Molalla and Portland Hills Faults running through the city, which can generate high-magnitude earthquakes. Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Canby-Molalla Fault Zone

The Canby-Gladstone Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Gladstone in northern Oregon.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 15 miles northeast of Gladstone.

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 36% of residential buildings were built prior to 1990, which increases the City’s vulnerability to the earthquake hazard. Information on specific public buildings’ (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table GA-5; each “X” represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), zero (0) have a very high (100% chance) collapse potential and zero (0) have a high (greater than 10% chance) collapse potential.

Table GA-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Gladstone High (18800 Portland Ave)	Clac_sch64	X	X,X		
John Wetten Elementary (250 E Exeter St)	Clac_sch63	X	X	X	
Walter L Kraxberger Middle (17777 Webster Rd)	Clac_sch90	X	X,X	X	
Fire Facilities					
Gladstone Fire Main Station (operated by CFD #1) (555 Portland Ave) see mitigation successes	Clac_fir19	X			

Police Facilities

Police Station (EOC) (18505 Portland Ave)	n/a	This building was built after 2007 and not included in the RVS.
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Source: [DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)
“*” – Site ID is referenced on the [RVS Clackamas County Map](#)

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table GA-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Table GA-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	4,022	4,022	4,022	4,022
Building Value (\$ Million)	1,129	1,129	1,129	1,129
Building Repair Cost (\$ Million)	51	69	437	504
Building Loss Ratio	5%	6%	39%	45%
Debris (Thousands of Tons)	27	32	139	157
Long-Term Displaced Population	63	235	1,816	2,656
Total Casualties (Daytime)	48	61	351	394
Level 4 (Killed)	3	3	11	24
Total Casualties (Nighttime)	13	26	197	258
Level 4 (Killed)	0	1	5	7

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

The City of Gladstone is expected to have a 2% building loss ratio with a repair cost of \$21 million under the CSZ “dry” scenario, and under the CSZ “wet” scenario.⁸ The city is expected to have around 12 daytime or 3 nighttime casualties during the CSZ “dry” scenario and 12 daytime or 3 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 8 for the CSZ “dry” scenario and 8 for the CSZ “wet” scenario.⁹ (See Risk Report content for additional information.)

Portland Hills Fault Scenario

The City of Gladstone is expected to have a 4% building loss ratio with a repair cost of \$37 million under the CSZ “dry” scenario, and under the CSZ “wet” scenario.¹⁰ The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 17 daytime or 7 nighttime casualties during the Portland Hills Fault “dry” scenario and 17 daytime or 7 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 17 for the Portland Hills Fault “dry” scenario and 17 for the Portland Hills Fault “wet” scenario.¹¹

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table GA-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

⁸ DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8 and 12-9.

⁹ Ibid, Tables 12-8 and 12-9.

¹⁰ Ibid, Tables 12-10 and 12-11.

¹¹ Ibid, Tables 12-10 and 12-11.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹² provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report, the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone Scenario

In Gladstone, 369 buildings and 7 critical facilities are expected to be damaged for a total potential loss of \$121 million (a loss ratio of about 8%). About 263 residents may be displaced (about 2% of the population).

Canby-Molalla Fault Scenario

In the city, 348 buildings are expected to be damaged, 5 critical facilities, for a total potential loss of \$91 million (a loss ratio of 6%). About 240 residents may be displaced (about 2% of the population).

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

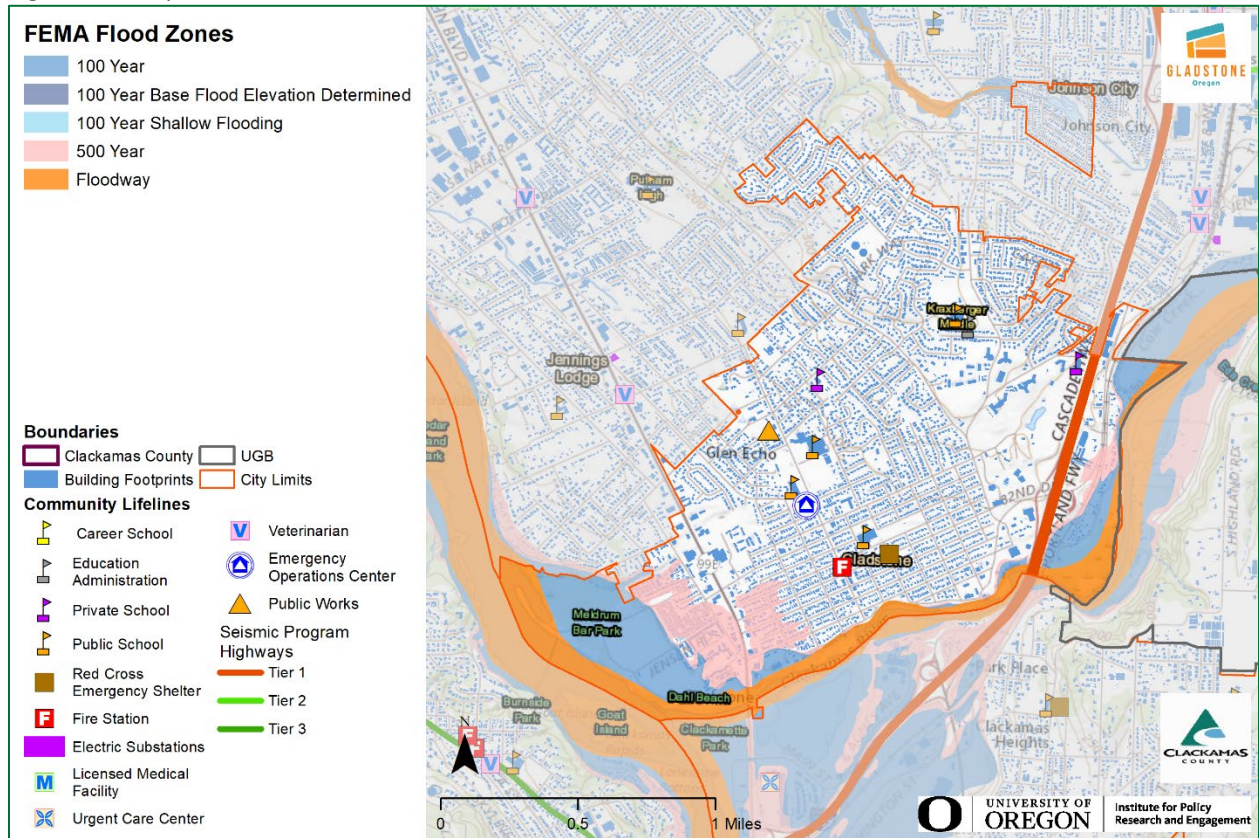
The HMAC determined that the City's probability of flooding is **moderate** and that their vulnerability to flooding is **moderate**. *These ratings decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure GA-4 illustrates the flood hazard area for Gladstone.

While Gladstone does not show many areas within the FEMA mapped special flood hazard areas (100-year flood vulnerability), with roughly 274 acres (21% of the total land within the city) is located within the 100-year floodplain. A larger flooding event, such as the 500-year flood, could cause serious damage. The city can experience urban flooding which is primarily due to inadequate storm drain pipes, and culverts that are too small. Additionally, the extent of flooding will vary depending on climatic conditions and precipitation levels. Typically, roads are covered with water in urban flooding events, and water will occasionally overflow manholes in some parts of the city. Newer homes are built on higher ground to avoid flooding issues, and many older homes have pumps within their crawlspaces to avoid flood events.

¹² DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-18.

Figure GA-4 Special Flood Hazard Area



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

There are no critical facilities in the 100-year floodplain. The only essential facility exposed to flooding is the river View Care Center as well as sewer, water lines, and roads. These roads include Clackamas Blvd, Edgewater Rd, Glen Echo Ave, Risley Ave, River Ln, Evergreen Ln, south end of Rinearson Rd, and the south end of Rivergreens Rd.

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Gladstone outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The extent of flooding hazards in Gladstone primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or

vegetation removal can influence water flow. In the past flooding has occurred along Edgewater Rd, Risley Ave, Glen Echo Ave, Ipswich St, Evergreen Ln, and Portland Ave. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table GA-4.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹³ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report 29 buildings could be damaged for a total potential loss of \$2.8 million (a building loss ratio of less than 1%). About 110 residents may be displaced by flood (less than 1% of the population).

National Flood Insurance Program (NFIP)

FEMA’s Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. The Community Repetitive Loss record does not identify any Repetitive Loss Properties¹⁴ or Severe Repetitive Loss Properties¹⁵.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁶ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the City’s probability for landslide is **moderate** and that their vulnerability to landslide is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Gladstone does not have a history of landslides. This is due to the relatively flat topography within the UGB as well as the City’s requirements of geological analysis on slopes of 20% or greater, usually located along stream embankments, before extensive tree removal, excavation, or construction occurs.

The biggest landslide threat is in the residential Oatfield/Oakridge corridor. This area has several steep slopes and slow ground movement. A home on Oakridge Drive slowly slid over the years and was

¹³ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-18.

¹⁴ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

¹⁵ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

¹⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

eventually removed from the property. Ground movement is also common on Parkway and Caldwell, as several homeowners on these streets have put pilings under their homes.

Landslide susceptibility exposure for Gladstone is shown in Figure GA-5. Most of Gladstone demonstrates a low landslide susceptibility exposure. Steep slopes are primarily located along the Willamette and Clackamas Rivers, some of these locations are in High Rocks Park, Cross Park, Dahl Park, and Meldrum Park. The McLoughlin/Risley Wetland, a tributary to the Willamette River, has small areas of steep slopes as well. There is approximately 7% within Gladstone that have very high or high landslide susceptibility exposure, while approximately 22% show moderate landslide susceptibility exposure.¹⁷

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above and within Figure GA-5.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table GA-4.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹⁸ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report, 244 buildings are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of \$103 million (a building exposure ratio of about 7%). About 974 residents may be displaced by landslides (about 8% of the population).

Future Projections

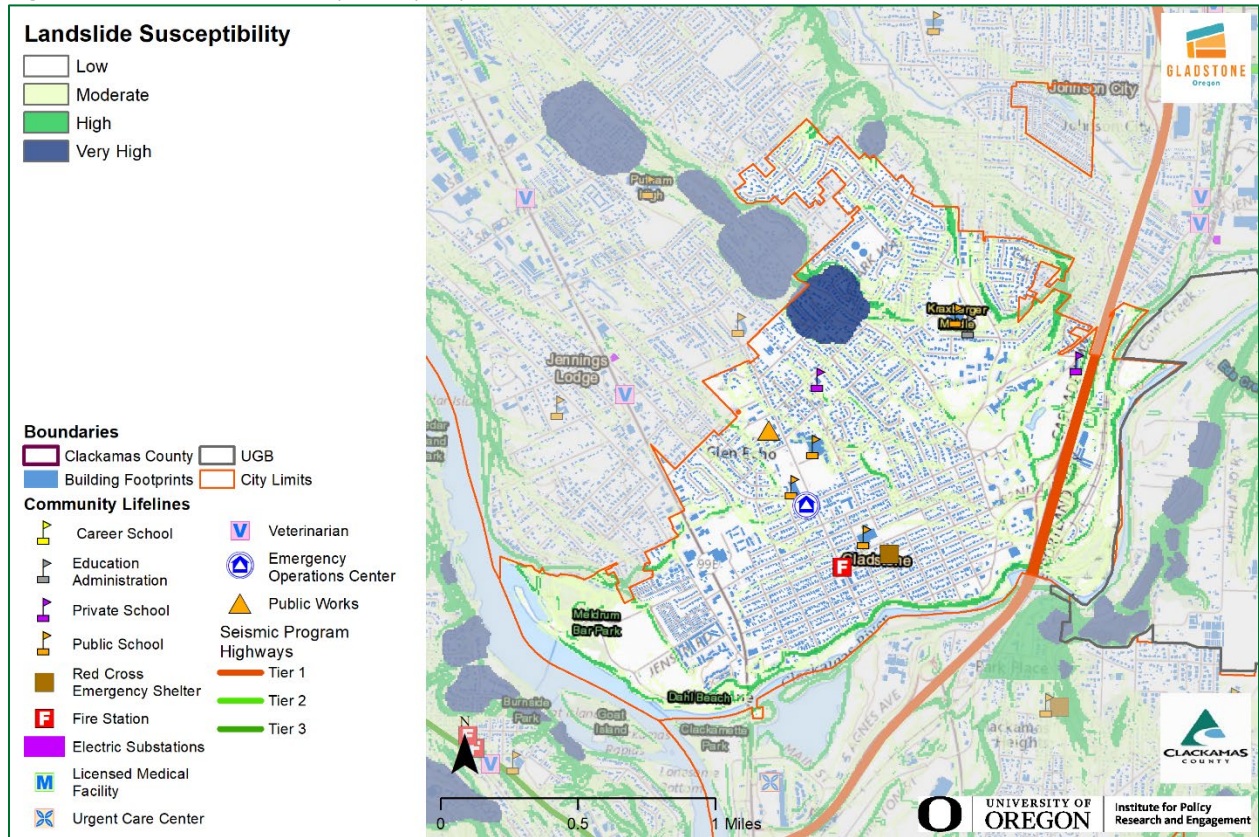
Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of

¹⁷ DOGAMI. [Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon](#) (2016)

¹⁸ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-18.

landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Figure GA-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **moderate** and that their vulnerability is **high**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees

Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of Gladstone has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events. resulting from hazards.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁹ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City’s probability for windstorm is **moderate** and that their vulnerability to windstorm is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Gladstone.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris.

Transportation and economic disruptions result as well. Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Power outages can affect sewer and water pump stations. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

¹⁹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Winter Storm (Snow/Ice)

The HMAC determined that the City's probability for winter storm is **moderate** and that their vulnerability to winter storm is **moderate**. *The probability rating decreased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Winter storms cause problems on roadways as well as power outages that affect sewer and water pump stations. In 2016 and 2017 the Governor declared a state of emergency for the county, though no major damage was reported in city limits.

Most winter storms typically do not cause significant damage, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter, and commercial traffic as noted above.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"²⁰ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Vulnerability Assessment

Due to insufficient data and resources, Gladstone is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets Section and Table GA-4.

²⁰ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Volcanic Event

The HMAC determined that the City’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **moderate**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volcanoes are located near Gladstone, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Gladstone’s relative distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²¹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the City’s probability for wildfire is **moderate**, and that their vulnerability to wildfire is **moderate**. *These ratings did not change since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan](#) (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Gladstone is found in the following chapter: Chapter 9.6: Gladstone Fire Department (note Clackamas Fire District #1 provides services for the fire district).

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

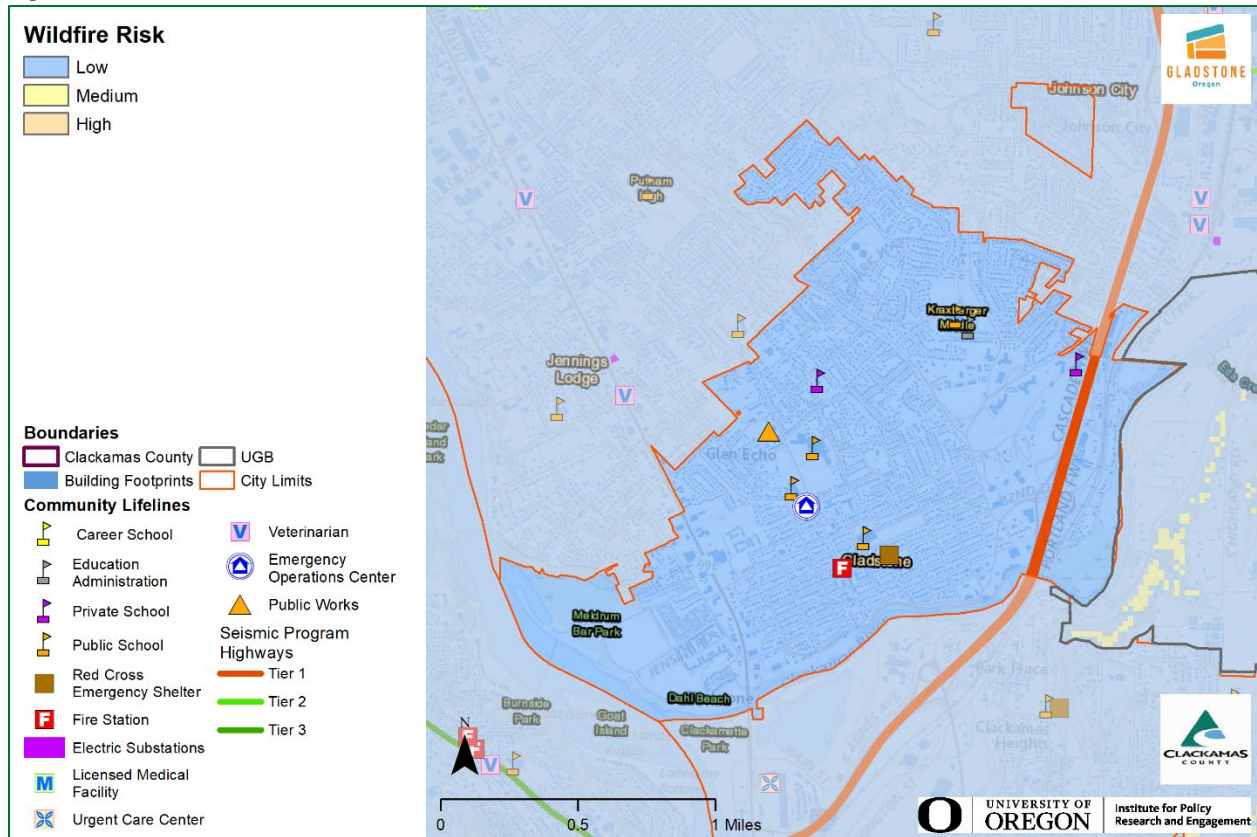
Weather and urbanization conditions are primarily at cause for the hazard level. Gladstone has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. Figure GA-6 shows overall wildfire risk in Gladstone.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Gladstone, is the most heavily populated portion of the county and is

²¹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-18.

characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County. In Gladstone, most fires have been small enough to contain quickly and easily.

Figure GA-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Gladstone is surrounded mostly by urban areas which creates a buffer from the forested areas. There are some areas of heavy tree coverage and other fuel supplies include the open field along Webster Rd, Billy Goat Island, Meldrum Bar, and Nick Shannon Park. Additionally, these areas are located adjacent to potential wildfire hazard zones: the business corridor along Highway 99E, area between Ridgeway Dr and Parkway Dr, area near Bird Song Way, Rinearson Creek wetlands, and the Oatfield/Oakridge corridor. Identified High and Medium Priority Communities at Risk (CARs) located within the City are: (High) Billy Goat Island, Dahl Beach, Parkway Woods, and (Medium) Risley Wetlands.²² Wildfires are not a frequent occurrence within the city, but regional wildfires occasionally introduce pollutants within the city. Gladstone sits in the bottom of a valley, and pollution from regional fires settles in the area, causing health concerns for residents.

Most of the city has low wildfire burn probability that includes expected flame lengths less than four-feet under normal weather conditions.²³ However, conditions vary widely and with local topography, fuels,

²² Clackamas County Community Wildfire Protection Plan, *Molalla Fire Department* (2018), Table 10.13-1.

²³ [Oregon Wildfire Risk Explorer](#), date accessed November 9, 2018.

and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Vulnerability Assessment

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. Gladstone’s fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City will update the City’s wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²⁴ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard. There are no moderate (medium) or high wildfire hazard zones in the City. As such, the Risk Report does not identify any exposed buildings or displaced residents.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²⁵ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

²⁴ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-18.

²⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table GA-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table GA-1).

Previous NHMP Actions that are Complete:

None identified.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table GA-7 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete, Ongoing	Yes
Multi-Hazard #2	#2	Not Complete, Ongoing	Yes
Multi-Hazard #3	#3	Not Complete, Ongoing	Yes
Multi-Hazard #4	#4	Not Complete, Ongoing	Yes
Multi-Hazard #5	#5	Not Complete, Ongoing	Yes
Multi-Hazard #6	#6	Not Complete, Ongoing	Yes
Multi-Hazard #7	#7	Not Complete, Ongoing	Yes
Earthquake #1	#8	Not Complete, Ongoing	Yes
Flood #1	#9	Not Complete, Ongoing	Yes
Flood #2	#10	Not Complete, Ongoing	Yes
Flood #3	#11	Not Complete, Ongoing	Yes
-	#12	New	-
-	#13	New	-
-	#14	New	-
-	#15	New	-
-	#16	New	-
Landslide #1	#17	Not Complete, Ongoing	Yes
Severe Weather #1	#18	Not Complete, Ongoing	Yes
Wildfire #1	#19	Not Complete, Ongoing	Yes

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from January 26 through February 9 on the City's website, Instagram, and Facebook. The plan was also posted and announced on the County's website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting




How May We Help You?


Government Community Business & Services I Want

The screenshot shows a website page with a navigation menu on the left and a main content area. The navigation menu includes 'Administration', 'ADMINISTRATION OVERVIEW', 'ELECTIONS', and 'HUMAN RESOURCES'. Below the navigation is a 'Contact Information' section with the address: 18505 Portland Avenue, Gladstone, OR 97027, Office Hours: Monday – Friday, 8:00 a.m. to 5:00 p.m., and a 'VIEW FULL CONTACT DETAILS' button. The main content area features a header 'Seeking Input on Updates to Gladstone's Natural Hazards Mitigation Plan' and a sub-header '(Gladstone, OR) – The City of Gladstone is in the process of updating their existing Natural Hazards Mitigation Plan (NHMP). This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management (OEM) utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program. With re-adoption of the plan, the City of Gladstone will maintain its eligibility to apply for federal funding towards natural hazard mitigation projects. This local planning process includes a wide range of representatives from city, special districts, and county government, emergency management personnel, and outreach to members of the public.' Below this is a paragraph: 'A natural hazards mitigation plan provides communities with a set of goals, action items, and resources designed to reduce risk from future natural disaster events. Engaging in mitigation activities provides jurisdictions with a number of 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.' This is followed by a paragraph: 'An electronic version of the Gladstone NHMP updated draft addendum is available for formal public comment from January 26, 2024 to February 9, 2024.' Below this is a paragraph: 'If you have any questions regarding the Gladstone NHMP addendum or the update process in general, please contact: Justin Poyser, City of Gladstone Utility Manager at 503-774-4281 or poyser@ci.gladstone.or.us; or Michael Howard, Director for the Oregon Partnership for Disaster Resilience at (541) 346-8413 or mhoward@uoregon.edu.' At the bottom of the main content area is a 'Supporting Documents' section with a link: 'Gladstone draft update to the Clackamas County Natural Hazards Mitigation Plan (3 MB)'.

Facebook and Instagram Posts

 **The City of Gladstone**
Published by Gladstone SocialMedia · January 26 at 2:34 PM · 🌐

The City of Gladstone is seeking public input on their addendum to the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan Update. The full draft can be found on the City's website at <https://www.ci.gladstone.or.us/.../seeking-input-updates...>

 **Clackamas County
Pre-Disaster Mitigation Planning
PRESS RELEASE**

DATE: January 26, 2024
FROM: City of Gladstone, Oregon
SUBJECT: Press Release for the City of Gladstone addendum to the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan Update – Notice and Opportunity for Public Comment

For Immediate Release


The City of Gladstone seeks additional public input on their update to the Clackamas County Natural Hazards Mitigation Plan

(Gladstone, OR) – The City of Gladstone is in the process of updating their existing Natural Hazards Mitigation Plan (NHMP). This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management (OEM) utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program. With re-adoption of the plan, the City of Gladstone will maintain its eligibility to apply for federal funding towards natural hazard mitigation projects. This local planning process includes a wide range of representatives from city, special districts, and county government, emergency management personnel, and outreach to members of the public.

A natural hazards mitigation plan provides communities with a set of goals, action items, and resources designed to reduce risk from future natural disaster events. Engaging in mitigation activities provides jurisdictions with a number of 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.

An electronic version of the Gladstone NHMP updated draft addendum is available for formal public comment from **January 26, 2024 to February 9, 2024**. To view the draft please visit the City of Gladstone's website at: <https://www.ci.gladstone.or.us/administration/page/seeking-input-updates-gladstones-natural-hazards-mitigation-plan>

If you have any questions regarding the Gladstone NHMP addendum or the update process in general, please contact: Justin Poyser, City of Gladstone Utility Manager at 503-774-4281 or

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 city_of_gladstone

 city_of_gladstone The City of Gladstone is seeking public input on their addendum to the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan Update. A link to the plan can be found in our bio.
2w

[View insights](#) [Boost post](#)

👍 📌

 Liked by sumwyf and 3 others
January 26

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1 and #2: March 8 and May 30, 2023

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated community lifelines.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: November 14, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

City of Happy Valley Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: Jake Egbert

Effective:

September 12, 2024 - September 11, 2029

Prepared for
The City of Happy Valley

Updated:
July 16, 2024, (Resolution # 24-22)
September 17, 2019, (Resolution # 19-21)
September 17, 2013
March 10, 2010



This Natural Hazard Mitigation Plan was prepared by:



Planning grant funding provided by:



Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

**CITY OF HAPPY VALLEY
RESOLUTION 24-22**

**A RESOLUTION ADOPTING THE CITY OF HAPPY VALLEY REPRESENTATION IN
THE UPDATES TO THE CLACKAMAS COUNTY MULTI-JURISDICTIONAL
NATURAL HAZARDS MITIGATION PLAN**

WHEREAS, the City of Happy Valley recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and,

WHEREAS, the City of Happy Valley has fully participated in the FEMA prescribed mitigation planning process to prepare the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and,

WHEREAS, the City of Happy Valley has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of Happy Valley to the impacts of future disasters within the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*; and

WHEREAS, these proposed projects and programs have been incorporated into the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, May 29, 2024) contingent upon this official adoption of the participating governments and entities;

WHEREAS, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

WHEREAS, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

WHEREAS, City of Happy Valley adopts the NHMP and directs the City Manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

NOW THEREFORE, THE CITY OF HAPPY VALLEY RESOLVES AS FOLLOWS:

- Section 1. The City of Happy Valley adopts the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan.
- Section 2. That the City of Happy Valley will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Clackamas County Multi Jurisdictional Natural Hazards Mitigation Plan*.

Resolution 24-22 is enacted by the City Council of the City of Happy Valley, this 16th day of July, 2024.

Tom Ellis

Tom Ellis
Mayor

ATTEST:

Kara Kerpan

Kara Kerpan
City Recorder

Purpose

This is an update of the Happy Valley addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Happy Valley’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Happy Valley adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 16, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Happy Valley to update their NHMP.

The Clackamas County NHMP, and Happy Valley addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Happy Valley HMAC guided the process of developing the NHMP.

Convener

The Happy Valley Director of Public Safety serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Happy Valley HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Happy Valley HMAC was comprised of the following representatives:

- Convener, Steve Campbell, Director of Public Safety
- Co-convener, Chris Randall, Public Works Director
- Chris Alfino, Senior Planner
- Sally Curran, City Engineer
- Mark Ennis, Building Official
- Jaimie Lorenzini, Administrator
- Chris Sliwka, Public Works Supervisor
- Laura Terway, Planning Manager

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Happy Valley addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the Happy Valley NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Happy Valley will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Happy Valley to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

The Happy Valley Comprehensive Plan contains specific goals and policies for the developed and undeveloped areas of the City that are intended to improve the quality of existing areas and assure that new areas are built out in a manner compatible with the established character of the City.

The current Happy Valley Comprehensive Plan is a 1984 Plan that was reorganized and redesigned in 2017 to enable the Plan text and graphics to be more easily viewed electronically. This 2017 update includes the goals and policies of the Rock Creek Comprehensive Plan (2001) and East Happy Valley Comprehensive Plan (2009), and the Transportation System Plan (TSP) Update (2016). The 2023 Pleasant Valley North Carver Comprehensive Plan, an addition to the City's Comprehensive Plan covering the 2,700

acre urban reserve on the east side of Happy Valley, adopted overall policy framework and vision for Pleasant Valley /North Carver, including a resilient, connected transportation system.

The Natural Environment Chapter of the Comprehensive Plan includes Natural Environment Goals and Policies addressing Statewide Planning Goals 5, 6, and 7 (Natural Hazards). This chapter states its goal is to accommodate population growth while protecting new development against such hazards as erosion, flooding, and the mass movement of earth or landslides, and preserving important natural features.¹

The Natural Environment Chapter includes a Buildable Lands Inventory that was revised based on four factors: steep slopes, geologic hazards, drainage channels, and flood hazards. It limits development to slopes of 20% or less and includes special regulations protecting steep slopes (steep slope development overlay) to specifically minimize seismic and landscape hazards and soil erosion associated with development of steep or unstable slopes.

Planned updates to the jurisdiction's Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community's long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

Community Development and Planning play an integral role in and facilitates land use development patterns through implementation of the City's Comprehensive Plan(s) and [Land Development Code](#) while supporting environmental regulations and economic needs. They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Example applicable codes include:

Title 15 Buildings and Construction

Chapter 15.24 Flood Damage Prevention

It is the purpose of this ordinance to promote public health, safety, and general welfare, and to minimize public and private losses due to flood conditions. This flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

Title 16, Land Development Code

Chapter 16.32 Steep Slopes Development Overlay Zone

Of the 1,440 acres in the City, 690 acres, or nearly half of the total area of the City, exceeds a 15 percent slope. Land areas over 20 percent slopes are normally considered not developable because of a combination of hazards. Through this code, allowed intensity of development is correlated with the degree of natural hazard. The City made minor amendments to the Land Development Code to reduce the allowable density allowed near streams and on sloped areas (LDC Chapter 16.32 and 16.34).

Chapter 16.35 Flood Management Overlay Zone

This code, adopted in 2009, establishes a flood management area overlay zone, which is delineated on the flood management area map incorporated by reference. The flood management areas mapped include land contained within the one hundred (100) year floodplain, flood area and floodway as shown on the Federal Emergency Management Agency flood insurance maps (dated June 17, 2008).

¹ [City of Happy Valley Comprehensive Plan](#), City of Happy Valley, 2017 Graphic Revision.

The standards that apply to the flood management areas apply in addition to local, state, or Federal restrictions governing floodplains or flood hazard areas, including the standards in Chapter [15.24](#), Flood Damage Prevention.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

The Happy Valley Community Development Department administers and enforces the 2022 Oregon Fire Code and the 2022 Oregon Structural Specialty Code, Mechanical Specialty Code, Plumbing Specialty Code, Electrical Specialty Code, and Residential Specialty Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

Public Works

The City of Happy Valley Public Works Department is the operations side of the city. Their role is to provide, operate and maintain the City's transportation infrastructure, city facilities, and parks/trail system. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

City Administration

The City Council of Happy Valley has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Policies and Programs

This Plan directs Happy Valley and Clackamas County to explore integration into other planning documents and processes. Happy Valley has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

City of Happy Valley Wildfire Assessment Program, May 2022

This [report](#) assesses fuel load and fire risk, determines appropriate mitigation measures, and develops a long-term vegetation management program. The report highlighted the areas that were most at risk for wildfire, and provided recommendations for mitigation measures that could be taken to reduce the risk. The City Council recognized the importance of this work and sought out grants to help fund the mitigation efforts, begin to implement the vegetation mitigation plan for each described site location. Over one hundred sites were mitigated in the first year following the completion of the assessment, and completing the remaining risk reduction projects remains a priority for the community.

Happy Valley Transportation System Plan, March 2023

The Transportation System Plan (TSP) prepares Happy Valley for accommodating traffic within the city in the best manner possible through 2040. The TSP's big picture view allows it to guide the city in developing and maintaining acceptable transportation network performance more efficiently than a piecemeal or unorganized approach.

Parks, Recreation, and Open Space Plan, January 2021

This Master Parks Plan creates a vision for an innovative, inclusive, and interconnected system of parks, trails and open spaces that promotes outdoor recreation, health and environmental conservation.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The NHMP will also be integrated into the City’s Capital Improvement Plan, to be adopted by early 2024.

National Flood Insurance Program

Happy Valley participates in the National Flood Insurance Program. The Planning Department is responsible for administering the day-to-day activities of the city’s floodplain program.

Specifically, the floodplain manager:

- maintains and administers Happy Valley’s floodplain regulations;
- reviews and issues floodplain development permits;
- maintains elevation certificates for all new and substantially improved structures (and maintains an extensive database of historic elevation certificates);
- ensures that encroachments do not occur within the regulated floodway;
- implements measures to ensure that new and substantially improved structures are protected from flood losses;
- maintains floodplain studies and maps and makes this information available to the public;
- maintains a flood information website with digital flood insurance rate map (DFIRM) data;
- conducts site visits to assess conditions and provide technical assistance to the public;
- maintains a library of historical flood related information;
- informs the public of flood insurance requirements; and
- conducts outreach and training about flood hazards and development within the floodplain.

Community Emergency Response Teams (CERT)

The Happy Valley CERT, which is managed by the Clackamas Fire District, meets at Happy Valley City Hall. Their mission is to help communities become resilient in the face of local disasters and promote community connections.

NFPA Firewise

The National Fire Protection Association’s (NFPA) Firewise program has been a great success in the community. There are two recognized Firewise communities in good standing within the city – Spring Mountain Homeowners Association and Happy Valley Heights Homeowners Association.

Personnel

The following Happy Valley personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Steve Campbell, Director of Public Safety, Chris Randall, Public Works Director

Public Information Officer: Steve Campbell, PIO

Floodplain Manager: Chris Alfino, Senior Planner

Grant writing (for Public Works or emergency management): Jaimie Lorenzini, Admin

Capital improvement planning: Sally Curran, City Engineer

Capital improvement execution: Chris Randall, Public Works Director

Happy Valley does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Happy Valley has implemented recommendations from the last NHMP into its capital improvement projects over the last 5 years, including:

- 122nd/129th “S” Curve Street Improvement Project (curb, sidewalks, storm drain improvements)
- Superblock Phase 1 (curb/sidewalk/storm drain improvements SE Ridgecrest Rd)
- Superblock Phase 2 (curb/sidewalk/storm drain improvements SE Ridgecrest Rd, SE 132nd and SE King Rd)
- Coyote Way Storm Drain Improvements
- Natalya and Christilla Ln Storm Drain Improvements

Ongoing projects that enhance the City’s resilience include:

- Happy Valley Library expansion (2023-2024)

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority’s [Seismic Rehabilitation Grant Program](#)².

FEMA Funded Mitigation Successes

- DR4562-55: Library Hazardous Fuels Reduction (\$6,399.75) - pending
- DR4562-56: Parks Hazardous Fuels Reduction Project (\$62,951.70) - pending

Seismic Rehabilitation Grant Program Mitigation Successes

- Sunnyside Elementary (Phase Two of 2015-2017 grant award, \$1,500,000).

Other Mitigation Successes

A \$433 million seismic retrofit/ school upgrade bond was (3-487) passed in 2016 for the North Clackamas School District, which addressed the different needs of schools throughout the school district. The bond turned Rock Creek Middle School into a comprehensive high school [Adrian C Nelson] to deal with overcrowding, as well as added six classrooms to Happy Valley Middle School.

Capital Resources

Happy Valley maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

² The Seismic Rehabilitation Grant Program (SRGP) 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.

Communication Towers: one on City property

Critical facilities with power generators for use during emergency blackouts: City Hall, Emergency Operations Center, Happy Valley Library, Happy Valley Police Station, and Happy Valley Public Works.

Warming or cooling shelters: the Happy Valley Library

Fueling storage: 4000 gallons stored at Happy Valley Public Works

Findings

Several important findings from this capability assessment informed the design of the Plan’s mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Happy Valley staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Happy Valley operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City’s ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community’s environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions, and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3(iv), *Mitigation Strategy*.

The City's mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAc assessed the City's risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table HV-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAc decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAc in terms of implementation, the HMAc has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table HV-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
1	Develop, enhance, and implement public education programs to inform the public about methods for mitigating the impacts of natural hazards.	X	X	X	X	X	X	X	X	X	Planning/ Public Works, Public Safety, Building, Planning Commission, Finance	Ongoing	Local Resources. DLCD TA, FEMA HMA	Low
2	Integrate the goals and action items from the Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	Planning/ Public Works, Building, Engineering, Planning Commission	Ongoing	Local Resources. DLCD TA, FEMA HMA-C&CB	Low to Medium
3	Implement the vegetation management activities identified in the Wildfire Mitigation Assessment.				X	X		X	X	X	Economic and Community Development/ Planning, Public Works	Ongoing	Local Resources. DLCD TA, FEMA HMA	
4	Conduct seismic evaluations of the Community Policing Center, Public Works Complex, and identified shelters and implement appropriate structural and non-structural mitigation strategies.		X								Economic and Community Development, Public Works/ Building, Engineering	Long	Local Resources, State, Federal Grants, FEMA HMA, SRGP	Low to High
5	Design and construct Public Works facility to include seismic resiliency to accommodate for a backup EOC.		X								Public Works/ Economic and Community Development, Building, Engineering	Short	Local Resources, State, Federal Grants, FEMA HMA	High

Table HV-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
6	Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.				X						Economic and Community Development/ GIS, Public Works	Ongoing	Local Resources, DLCD TA, FEMA HMA-C&CB	Low
7	Increase capacity of culverts throughout the city by implementing projects identified in the Clackamas Water Environment Services Storm System Master Plan.				X						Economic and Community Development/ Engineering, Public Works	Ongoing	Local Resources, FEMA HMA (FMA)	Medium to High
8	Reduce negative effects from severe windstorm, severe winter storm, and extreme heat events.			X					X	X	Economic and Community Development/ Public Works, Engineering, Building	Ongoing	Local Resources, FEMA HMA-C&CB	Low to High
9	Reduce negative effects from severe windstorm, severe winter storm through undergrounding existing utility lines.								X	X	Public Works/ Economic and Community Development, Engineering, Building	Ongoing	Local Resources, FEMA HMA, Utilities	High

Table HV-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
10	Promote fire-resistant strategies for new and existing developments (e.g., drought and fire-resistant landscaping and defensible space).	X						X			Planning/ Engineering, Building, Planning Commission, Clackamas Fire District #1	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low
11	Work with Firewise Communities to conduct community-based fuel reduction demonstration projects in the wildland-urban interface.							X			Community Services/ Parks and Recreation, Clackamas Fire District #1	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM, Firewise	Low to High
12	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan	X						X			Clackamas Fire District #1/ Economic and Community Development, Public Works	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low to High

Source: Happy Valley NHMP HMA, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

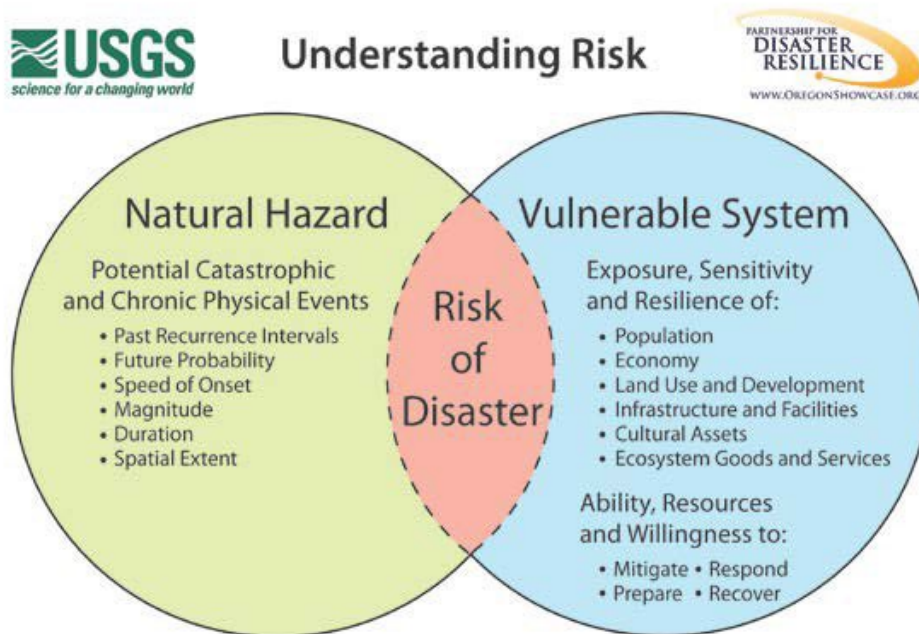
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure HV-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure HV-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Happy Valley HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Happy Valley, which are discussed throughout this addendum. Table HV-2 shows the HVA matrix for Happy Valley listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. One

catastrophic hazard (Cascadia Subduction Zone earthquake) and two chronic hazards (winter storm and wildfire) rank as the top hazard threats to the City (Top Tier). Crustal earthquake, landslide, and extreme heat event comprise the next highest ranked hazards (Middle Tier), while drought, flood, windstorm, and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table HV-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Winter Storm	18	35	80	56	189	1	Top Tier
Earthquake - Cascadia	2	45	100	35	182	2	
Wildfire	12	30	70	49	161	3	
Earthquake - Crustal	6	25	100	21	152	4	Middle Tier
Landslide	10	25	60	56	151	5	
Extreme Heat	10	35	70	35	150	6	
Drought	16	20	30	56	122	7	Bottom Tier
Flood	16	20	30	56	122	8	
Windstorm	14	15	50	42	121	9	
Volcanic Event	2	15	50	7	74	10	

Source: Happy Valley HMAC, 2023.

Community Characteristics

Table HV-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Geographically, the City is located in the northwestern region of Clackamas County, about 18 miles south of the Washington border and 10 miles southeast of downtown Portland. The City is 497 feet above sea level and located at the northern end of the Willamette River watershed (Willamette Valley).

Because of its location Happy Valley’s climate is consistent with the Marine west coast climate zone, with warm summers and cool, wet winters. Happy Valley receives most of its rainfall between October and May, and averages 49 inches of rain, and two (2) inches of snow, per year.⁷

Population, Housing, and Income

Happy Valley was incorporated in 1965 and remained a small community until the late 1990s, when it became one of the fastest-growing cities in Oregon. Today, the city has an area of 11.58 square miles. Between 2016 and 2022 the City grew by 8,009 people (43%; as of 2022 the population is 26,689). Between 2022 and 2045 the population is forecast to grow by 115% to 57,362.

A majority of the population is White/Caucasian (64%) and about 18% of the population is Hispanic or Latino. Twenty percent (20%) identify as Asian. Over 18% of the population speaks a language other than English at home, and 7% of the total population speaks English less than “very well”.

The poverty rate is 4% (3% of children under 18, 5% for people 65 and older), 4% do not have health insurance, and 47% of renters pay more than 30% of their household income on rent (31% for owners). About 49% of the population has a bachelor’s degree or higher (5% do not have a high school degree). Approximately 14% of the population lives with a disability (41% of population 65 and older), and 35% are

either below 15 (24%) or over 65 (11%) years of age. About 9% of the population are 65 or older and living alone and 17% are single parents.

Over the last several years, the City of Happy Valley has annexed more than 1,000 acres of land that had been primarily in the western portion of the former Damascus area. New development has complied with the standards of the Oregon Building Code and the city's development code.

The City includes a diversity of land uses but is zoned primarily residential. About 87% of housing units are single-family, 13% are multifamily, and 1% are mobile homes. Less than one-tenth of homes (9%) were built before 1970 and 81% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (83%) of housing units are owner occupied, 14% are renter occupied, less than 1% are seasonal homes, and 3% are vacant.

Transportation and Infrastructure

Happy Valley is roughly 6 miles from Portland. Its proximity has made it a desirable place for commercial and industrial development. Happy Valley's Commercial areas are located near the primary routes of SE Sunnyside Road (provides access to Highway 205), SE 172nd Avenue, and Highway 212. Residential development is located nearby commercial areas, with most residential areas located in the northern part of the City.

Motor vehicles represent the dominant mode of travel through and within Happy Valley. Twenty-three percent (8%) of renters and 2% of owners do not have a vehicle. Most workers drive alone to work (74%); 5% carpool, 3% use public transit, 1% either walk or use a bicycle, and 14% work at home. The City's public transit is provided by TriMet, which, subject to a [2022 Revised Service Concept "Forward Together"](#), operates four bus routes and one light rail transit line to serve the greater Happy Valley area.

Happy Valley does not have any industrial rail access. The Metro Regional Freight Plan identifies Highway 212 as a main roadway route and 172nd Avenue as a road connector for freight and commercial truck movement throughout the region. A multi-lane highway is proposed along the Highway 212/224 corridor to accommodate expected population growth.

Economy

Happy Valley's proximity to major transportation routes and access to rail has made it a desirable place for commercial and industrial development. Happy Valley's commercial sites are made accessible through Highways 205 and 224. Happy Valley is predominately residentially zoned, but also has commercial and campus industrial areas. The Urban and Rural Strategic Investment Zone provides 15-year property tax abatements on facilities and equipment to industries such as production, high tech, and manufacturing.

About 50% of the resident population 16 and over is in the labor force (11,741 people) and are employed in a variety of occupations including professional (29%), management, business, and financial (24%), sales (12%), office and administration (9%), and construction, extraction, and maintenance (5%) occupations.

Happy Valley has an economic advantage due to its location at the north end of the Willamette Valley and its proximity to Portland. A significant portion of the land available for industrial development in Clackamas County is in the Happy Valley area. There are currently new expansions in existing industries currently underway with available industrial land in the Industrial Parks.³

³ Economic Development (2019). City of Happy Valley. <https://www.cityofHappyValley.com/ed>

Most workers residing in the city (97%, 10,452 people) travel outside of the city for work primarily to Portland and surrounding areas.⁴ A significant population of people travel to the city for work, (92% of the workforce, 4,402 people) primarily from Portland and surrounding areas.⁵

⁴ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2020). Longitudinal-Employer Household Dynamics Program, accessed on August 17, 2023 at <https://onthemap.ces.census.gov>.

⁵ Ibid.

Table HV-3 Community Characteristics

Population Characteristics		Population	Household Characteristics	
		Growth		
2016 Population Estimate	18,680		Housing Units	
2022 Population Estimate	26,689	43%	Single-Family (includes duplexes)	6,632 87%
2045 Population Forecast*	57,362	115%	Multi-Family	965 13%
Race			Mobile Homes (includes RV, Van, etc.)	65 1%
American Indian and Alaska Native		< 1%	Household Type	
Asian		20%	Family Household	5,978 80%
Black/ African American		1%	Married couple (w/ children)	2,435 33%
Native Hawaiian and Other Pacific Islander		< 1%	Single (w/ children)	768 10%
White		64%	Living Alone 65+	412 6%
Some Other Race		2%	Year Structure Built	
Two or More Races		7%	Pre-1970	699 9%
Hispanic or Latino/a (of any race)			1970-1989	765 10%
Limited or No English Spoken	1,559	7%	1990-2009	3,804 50%
Vulnerable Age Groups			2010 or later	2,394 31%
Less than 5 Years	975	4%	Housing Tenure and Vacancy	
Less than 15 Years	5,286	23%	Owner-occupied	6,334 83%
65 Years and Older	3,166	14%	Renter-occupied	1,098 14%
85 Years and Older	549	2%	Seasonal	17 < 1%
Age Dependency Ratio		0.56	Vacant	213 3%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)	
Total Disabled Population	1,515	6%	No Vehicle (owner occupied)	139 2%
Children (Under 18)	98	1%	Two+ vehicles (owner occupied)	5,270 83%
Working Age (18 to 64)	565	4%	No Vehicle (renter occupied)	91 8%
Seniors (65 and older)	852	27%	Two+ vehicles (renter occupied)	444 40%
Income Characteristics			Employment Characteristics	
Households by Income Category			Labor Force (Population 16+)	
Less than \$15,000	256	3%	In labor Force (% Total Population)	11,741 50%
\$15,000-\$29,999	290	4%	Unemployed (% Labor Force)	316 3%
\$30,000-\$44,999	540	7%	Occupation (Top 5) (Employed 16+)	
\$45,000-\$59,999	312	4%	Professional & Related	3,420 29%
\$60,000-\$74,999	608	8%	Management, Business, & Financial	2,795 24%
\$75,000-\$99,999	766	10%	Sales & Related	1,354 12%
\$100,000-\$199,999	2,809	38%	Office & Administrative	1,089 9%
\$200,000 or more	1,851	25%	Construction, Extraction, & Maint.	631 5%
Median Household Income			Health Insurance	
		\$131,980	No Health Insurance	1,008 4%
Gini Index of Income Inequality			Public Health Insurance	5,081 22%
		0.42	Private Health Insurance	19,232 82%
Poverty Rates (Percent age cohort)			Transportation to Work (Workers 16+)	
Total Population	925	4%	Drove Alone	8,552 74%
Children (Under 18)	185	3%	Carpooled	610 5%
Working Age (18 to 64)	585	4%	Public Transit	341 3%
Seniors (65 and older)	155	5%	Motorcycle	0 0%
Housing Cost Burden (Cost > 30% of household income)			Bicycle/Walk	158 1%
Owners with a Mortgage	1,407	31%	Work at Home	1,632 14%
Owners without a Mortgage	351	19%		
Renters	518	47%		

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", 2016 & 2022; Portland State University. METRO 2040 Population Distributed Forecast (2021, Exhibit A to Ordinance 21-1457).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Happy Valley. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table HV-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table HV-4 Critical Facilities in Happy Valley

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Academy for Kids	-	-	-	-	-
Beatrice Morrow Cannady Elementary	-	-	-	-	-
Clackamas Fire District #1 - Station 5	-	X	-	-	-
Clackamas Fire District #1 - Station 6	-	X	-	-	-
Clackamas Fire District #1 - Station 7	-	X	-	-	-
Clackamas Fire District #1 - Station 8	-	X	-	-	-
Clackamas Fire District #1 - Training Center	-	-	-	-	-
Happy Valley Emergency Operations Center	-	-	-	-	-
Happy Valley Public Works	-	-	-	-	-
Happy Valley Middle School	-	X	-	-	-
Happy Valley Police Department	-	-	-	-	-
Providence Medical Group - Happy Valley	-	X	-	-	-
Rock Creek Middle School	-	X	-	-	-
Scouters Mountain Elementary	-	X	-	-	-
Spring Mountain Elementary School	-	-	-	-	-
Sunnyside Montessori House	-	-	-	-	-
The Goddard School - Clackamas	-	-	-	-	-
Valley View Dayschool	-	X	-	-	-
Verne A. Duncan Elementary	-	X	-	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-21.

Additional Critical Facilities not included in the DOGAMI Risk Report:

Possible Shelters:

- Abundant Life Church
- Ashley Meadows Park
- Church of Jesus Christ of Latter-Day Saints
- Ella V. Osterman
- Fire Training Center (Pleasant Valley Golf Course)
- Happy Valley Park
- Hidden Falls Nature Park
- Hood View Park
- Happy Valley Library
- Mount Talbert Nature Park
- Southern Lights Park

Hospitals:

- Happy Valley Urgent Care
- Columbia Clinic
- Kiser Hospital
- Oregon Pediatrics
- Providence Immediate Care
- Willamette Hospital

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

Arterials

*designates road maintained by others

- 132nd Avenue
- 152nd/147th/145th Avenues
- 162nd Avenue
- 172nd Avenue
- Carver Road/Hwy 212*
- Clatsop Street
- Foster Road
- Hwy 224*
- Idleman Road
- King Road
- Ridge Crest Road
- 122nd/129th Avenues
- Mount Scott Blvd
- Sunnyside Road

Bridges

- 152nd and Sunnyside Road
- Hwy 212

Other Critical Infrastructure

- Gas lines
- Radio/cell phone towers
- Sunrise Water Authority
- Telephone lines
- Water and sanitary sewer pump stations
- Water reservoirs

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public’s ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields.

Schools

- Cannady Elementary School
- Happy Valley Elementary/Middle School
- Rock Creek Middle School
- Scouters Mountain Elementary
- Spring Mountain Elementary
- Verne A. Duncan Elementary
- Happy Valley Grange
- South Happy Valley

Churches

- Emmanuel Community Church
- Happy Valley Baptist Church
- Happy Valley Evangelical Church
- New Hope Community Church
- Sunnyside Foursquare Church

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include: Clackamas River waterfront property, Eagle Landing Golf Course, Happy Valley Park, Happy Valley Wetland Park, Hidden Falls Park, Mitchell Creek, Mount Scott Park, Mt. Talbert, Pleasant Valley Neighborhood Park, Rebstock Park, Rock Creek, Scouters Mountain and adjacent green space.

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include:

Memory Care & Assisted Living Facilities

- Happy Valley Adult Care Home
- Sunnyside Meadows Memory Care
- Monterey Court Memory
- Miracle Heights
- Morning Star Assisted Living
- Peaceful Care House
- Glenmore Gracious Retirement Living
- The Springs at Happy Valley
- Graceful Living Adult Care Home

Child Care Centers in Happy Valley/Clackamas

- Happy Valley Preschool and Childcare
- Happy Valley Childs Kingdom
- Therese’s Childcare
- Clackamas Day School
- Sunnyside KinderCare
- Cadence Academy Preschool
- Valley View Day school

Other Vulnerable Populations

- Carver Mobile Home Park
- Day Spring Mobile Home Park
- Happy Valley Mobile Manor

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this

type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: Camp Withycombe, Davis Trucking, and Fred Meyer Fuel.

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Happy Valley. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers, and are a concern during evacuation/notification during a hazard event include:

Economic Centers

- Community of Carver
- Davis Trucking
- Downtown Damascus
- East and West Happy Valley Crossroads
- Happy Valley Town Center
- Industrial properties on Hwy 212
- Sunnyside Village
- Sunnyside Village Plaza

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

An example of the types of properties that should be considered before, during, and after an event include the following properties identified on the National Register of Historic Places within Happy Valley:

- Pete French Round Barn

Hazard Characteristics

Drought

The HMAC determined that the City's probability for drought is **high** and that their vulnerability to drought is **moderate**. *These ratings increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

The Sunrise Water Authority distributes water to the City of Happy Valley through 200 miles of pipe from the Clackamas River Water and North Clackamas County Water Commission treatment plants on the Clackamas River. The water is pumped to thirteen different reservoirs scattered throughout the service territory at varying elevations. The system is a gravity fed system. Water is also extracted from wells located in the unincorporated community of Damascus during periods of peak water use and in case of drought conditions.

Vulnerability Assessment

Due to insufficient data and resources, Happy Valley is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table HV-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁶ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Happy Valley as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Happy Valley as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Molalla Fault Zone (discussed in the crustal earthquake section).

Figure HV-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.⁷

The city’s proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the “Valley Zone” (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage

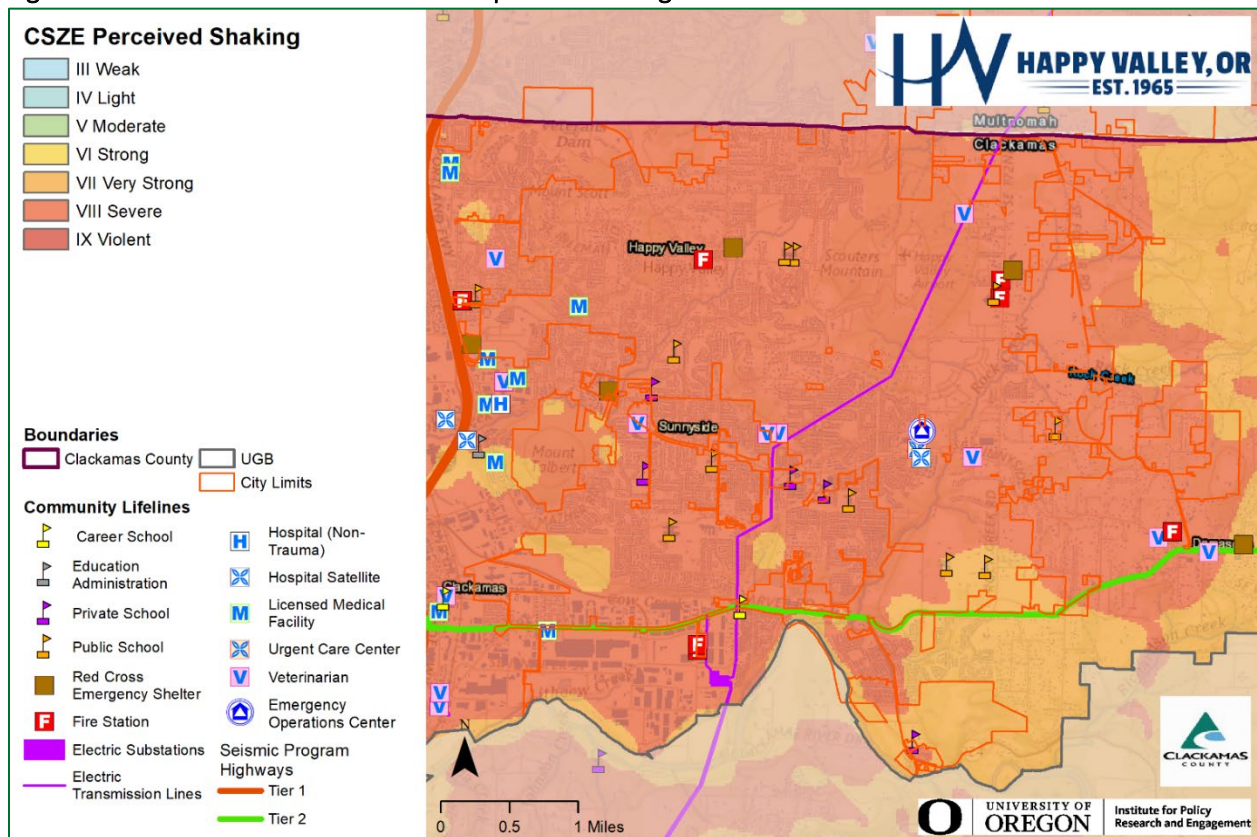
⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

⁷ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

The majority of Happy Valley is located within the strong to very strong zone for expected earthquake shaking. An area of concern is located outside the City limits along Highway 205, which has an area of violent expected shaking. The destruction of Highway 205 could impede post disaster assistance to the City.

Figure HV-2 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

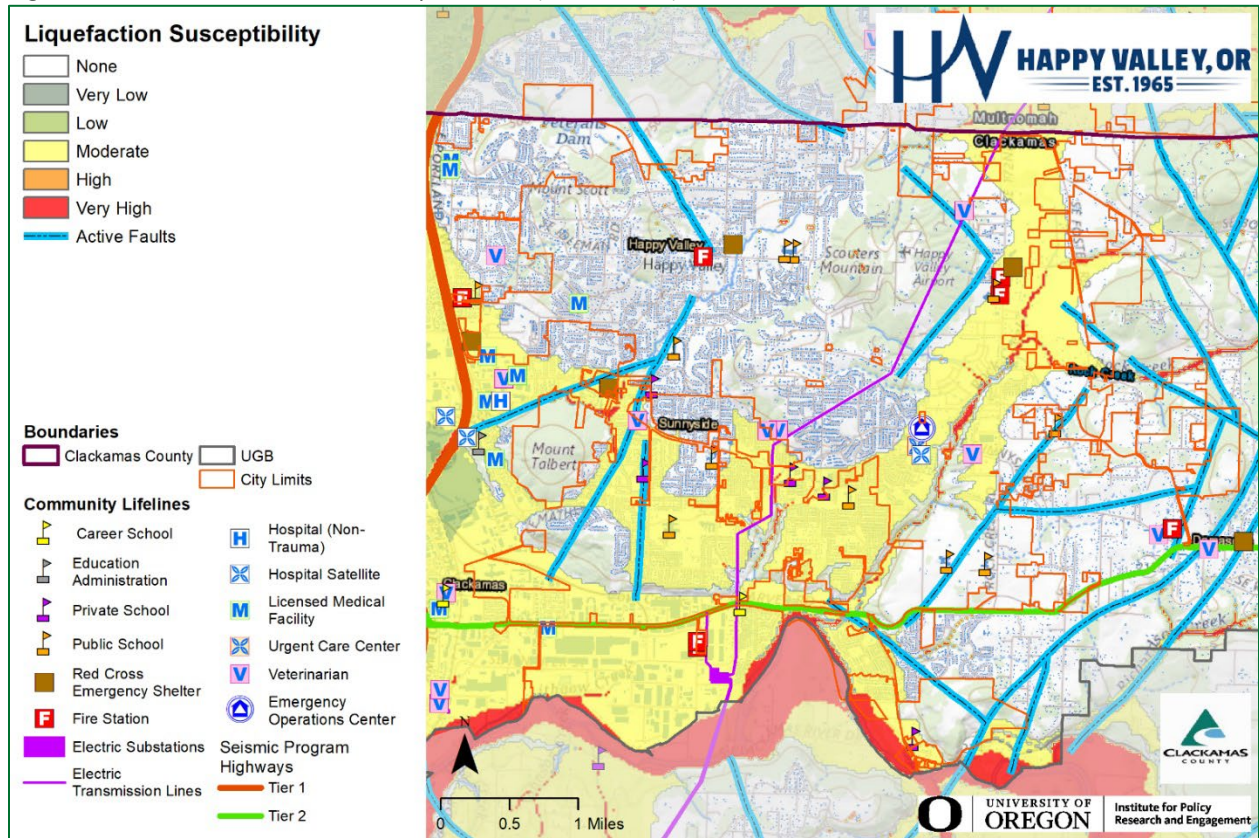
Note: To view hazard detail click this [link](#) to access Oregon HazVu

Earthquake (Crustal)

The HMAC determined that the City’s probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **moderate**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Happy Valley as well. Figure HV-3 shows a generalized geologic map of the Happy Valley area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

Figure HV-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

There are several potential crustal faults and/or zones to the west of the City that can generate high-magnitude earthquakes. Among them are the Damascus-Tickle Creek Fault Zone (shown in Figure HA-3) and the Portland Hills Fault Zone about five (5) miles west of Happy Valley. Other nearby faults include the Oatfield faults which run to the west of the Portland Hills Fault Zone. While there are no reported recent earthquakes within Happy Valley limits, historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Damascus-Tickle Creek Fault Zone

The Damascus-Tickle Creek Fault zone consists of numerous short northeast- and northwest-trending faults that form a broad, northeast-trending fault zone. The area is on the southern margin of the Portland basin and the faults fold and offset rocks of the Pliocene formation. The length of these faults is 16 km and some fault strands may have controlled the locations of eruptive vents. The fault zone is located approximately seven (7) miles from Portland and runs underneath the City of Happy Valley.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 5 miles west of Happy Valley.

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 36% of residential buildings were built prior to 1990, which increases the City’s vulnerability to the earthquake hazard. Information on specific public buildings’ (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table HV-10; each “X” represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), zero (0) have a very high (100% chance) collapse potential and zero (0) have a high (greater than 10% chance) collapse potential.

Table HV-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Cannady Elementary** (18031 SE Vogel Road)	-	2007 RVS report did not include structural appendix for this facility; built 2019.			
Duncan Elementary (14898 SE Parklane Drive)	-	2007 RVS report did not include structural appendix for this facility; built 2009.			
Mount Scott Elementary* (11201 SE Stevens Road)	Clac_sch70	X,X			
Oregon Trail Elementary* (13895 SE 152 Drive)	Clac_sch75		X		
Scouters Mountain Elementary (10811 SE 172nd Ave)	-	2007 RVS report did not include structural appendix for this facility.			
Sunnyside Elementary* (13401 SE 132nd Avenue)	Clac_sch22	X	X, X, X		
See Mitigation Successes					
Spring Mountain Elementary (11645 SE Masa Lane)	Clac_sch80	X			
Happy Valley Elementary (13865 SE King Road)	Clac_sch18		X, X, X		
Rock Creek Middle (14897 SE Parklane Drive)	-	2007 RVS report did not include structural appendix for this facility.			

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Clackamas High* (14489 SE 122nd Avenue)	Clac_sch27	X			
Clackamas High – East Campus* (14331 SE 132nd Avenue)	Clac_sch25	X			
Fire Facilities					
Station 5 – Mt Scott (9339 SE Causey Ave)	Clac_fir21	X			
Station 6 – Happy Valley (12901 SE King Road)	Clac_fir23	X			
Station 7 – Pleasant Valley (10921 SE 172nd)	Clac_fir07	X			
Station 8 – Clackamas (15990, 16100 SE 130th Avenue)	Clac_fir06	X			

Source: [DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)

“*” – Site ID is referenced on the [RVS Clackamas County Map](#)

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances

15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table HV-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Table HV-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	5,856	5,856	5,856	5,856
Building Value (\$ Million)	2,692	2,692	2,692	2,692
Building Repair Cost (\$ Million)	59	75	243	318
Building Loss Ratio	2%	3%	9%	12%
Debris (Thousands of Tons)	28	32	79	100
Long-Term Displaced Population	8	89	118	552
Total Casualties (Daytime)	41	50	179	217
Level 4 (Killed)	2	2	10	13
Total Casualties (Nighttime)	5	11	30	65
Level 4 (Killed)	0	0	1	2

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

The City of Happy Valley is expected to have a 2% building loss ratio with a repair cost of \$59 million under the CSZ “dry” scenario, and a 3% building loss ratio with a repair cost of \$75 million under the CSZ “wet” scenario.¹⁰ The city is expected to have around 41 daytime or 5 nighttime casualties during the CSZ “dry” scenario and 50 daytime or 11 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 8 for the CSZ “dry” scenario and 89 for the CSZ “wet” scenario.¹¹ (See Risk Report content for additional information.)

Portland Hills Fault Scenario

The City of Happy Valley is expected to have a 9% building loss ratio with a repair cost of \$243 million under the CSZ “dry” scenario, and a 12% building loss ratio with a repair cost of \$318 million under the CSZ “wet” scenario.¹² The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 179 daytime or 30 nighttime casualties during the Portland Hills Fault “dry” scenario and 217 daytime or 65 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 118 for the Portland Hills Fault “dry” scenario and 552 for the Portland Hills Fault “wet” scenario.¹³

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table HV-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))⁸ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone event (M9.0 Deterministic)

327 buildings are expected to be damaged (10 critical facilities) for a total potential loss of \$254 million (a loss ratio of about 7%). About 396 residents may be displaced (about 2% of the population).

Crustal event (Canby-Molalla fault M6.8 Deterministic)

77 buildings are expected to be damaged (0 critical facilities), for a total potential loss of \$53.4 million (a loss ratio of about 1%). About 66 residents may be displaced (less than 1% of the population).

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

The HMAC determined that the City's probability of flooding is **high** and that their vulnerability to flooding is **moderate**. *These ratings did not change since the previous version of this NHMP.*

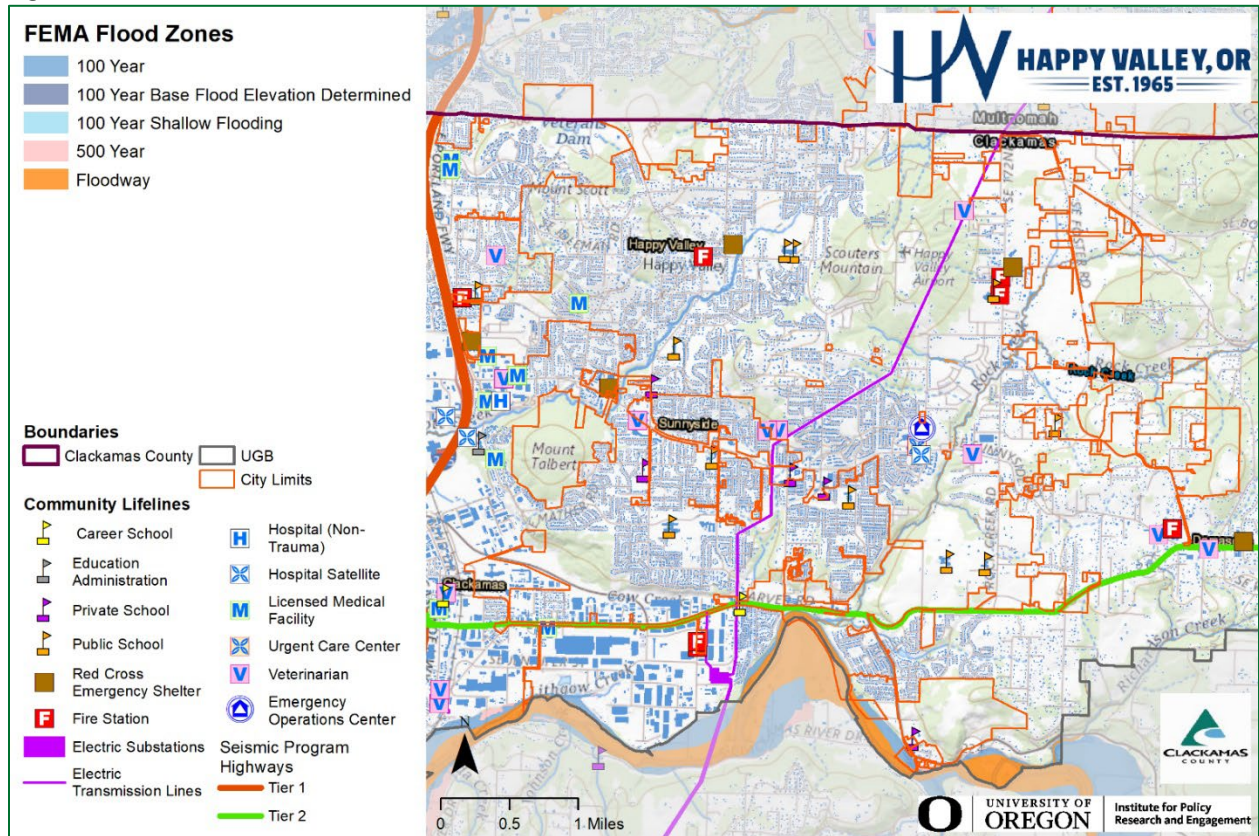
Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure HV-4 illustrates the flood hazard area for Happy Valley.

Portions of Happy Valley have areas of floodplain (special flood hazard areas, SFHA). These include the Mount Scott Creek, Rock Creek, and part of the Clackamas River. Though flooding occurs on the southern side of Clackamas River and Happy Valley is not affected. The geographic location of the flooding hazard was determined using the designated FEMA 100-year floodplain data, as well as the inundation line for the 1996 flood. There is potential flood impact along SE 192nd and SE 172nd Avenues, as well as near the newly annexed land along Carver Road (otherwise known as Highway 212/224).

Typically, roads are covered with water in urban flooding events, and water will occasionally overflow manholes in some parts of the city. Newer homes are built on higher ground to avoid flooding issues, and many older homes have pumps within their crawlspaces to avoid flood events.

⁸ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-20.

Figure HV-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

Happy Valley has a Flood Management Overlay Zone that creates standards for building within the flood zone and does not allow net fill.

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Happy Valley outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage. Other portions of Happy Valley outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The extent of flooding hazards in Happy Valley primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or

vegetation removal can influence water flow. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table HV-4.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, 2024)⁹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report 40 building are expected to be damaged (0 critical facilities), for a total potential loss of \$1.5 million (a loss ratio of less than 1%). About 68 residents may be displaced (less than 1% of the population).

National Flood Insurance Program (NFIP)

FEMA’s Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage. The Community Repetitive Loss record does not identify and Repetitive Loss Properties¹⁰ or Severe Repetitive Loss Properties¹¹.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹² winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the City’s probability for landslide is **high** and that their vulnerability to landslide is **moderate**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. While Happy Valley has a hilly terrain, there has only been a few landslides over the years. In 1996 a hillside in the Mt. Scott area slide into a homeowner’s yard and continued past the home towards Foster Road with no injuries or severe damage sustained. In the Development Code, Chapter 16.32 deals with the Steep Slopes Development Overlay Zone. The Overlay Zone limits the potential residential density

⁹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-20.

¹⁰ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

¹¹ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

¹² Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

and facilitates transferring the development away from slope constrained lands. This provides special protection on lands within “transition slope areas” and “conservation slope areas”.

Although there have been few landslides to occur in Happy Valley, steep slopes that do exist include Scouters Mountain, The Reserve, Rock Creek, Mt. Scott, Mt. Talbert, and the area east of SW 145th Avenue.

Landslide susceptibility exposure for Happy Valley is shown in Figure HV-5. Most of Happy Valley demonstrates a moderate to high landslide susceptibility exposure. Approximately 16% of Happy Valley has very high or high, and approximately 49% moderate, landslide susceptibility exposure.¹⁷

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above and within Figure HV-5.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table HV-5.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹³ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 428 buildings are exposed to the *high and very high landslide susceptibility* hazard (0 critical facilities) for a total exposure of \$255.5 million (a building exposure ratio of about 7%). About 1,901 residents may be displaced by landslides (about 7% of the population).

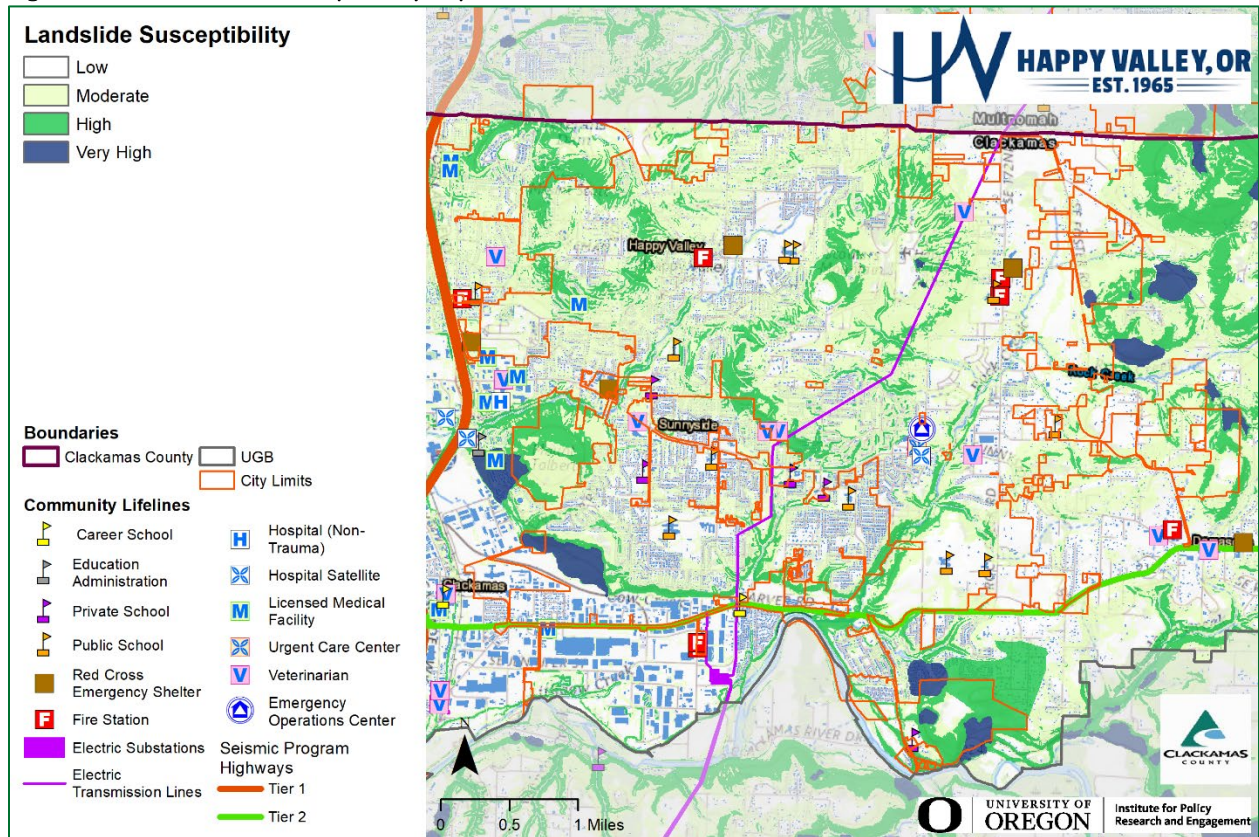
Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of

¹³ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-20.

landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Figure HV-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **moderate** and that their vulnerability is **moderate**. *These ratings increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees

Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of Happy Valley has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events. resulting from hazards.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁴ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City’s probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**. *These ratings decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Happy Valley.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris. Additionally, transportation and economic disruptions result as well.

In general, Happy Valley is more susceptible to windstorms than other communities in Clackamas County because the city is situated at a higher elevation and closer to the Columbia Gorge. Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

¹⁴ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Winter Storm (Snow/Ice)

The HMAC determined that the City’s probability for winter storm is **high** and that their vulnerability to winter storm is **moderate**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

The biggest impact of winter storms is congestion on roadways. Due to the steeper slopes of some communities, freezing weather can cause steep roadways to become difficult to traverse. Most winter storms typically do not cause significant damage, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter, and commercial traffic as noted above.

Vulnerability Assessment

Due to insufficient data and resources, Happy Valley is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets Section and Table HV-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁵ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Volcanic Event

The HMAC determined that the City’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **low**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

¹⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Volume I, Section 2 describes the characteristics of volcanic event hazards, history, as well as the location, extent, and probability of a potential event within the region. Volcanoes are located near Lake Oswego, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Happy Valley's relative distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹⁶ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the City's probability for wildfire is **moderate**, and that their vulnerability to wildfire is **moderate**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan](#) (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Happy Valley is found in the following chapters: Chapter 9.3: Clackamas Fire District #1.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather, and urbanization conditions are primarily at cause for the hazard level. Happy Valley has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. Figure HV-6 shows overall wildfire risk in Happy Valley.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Happy Valley, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than

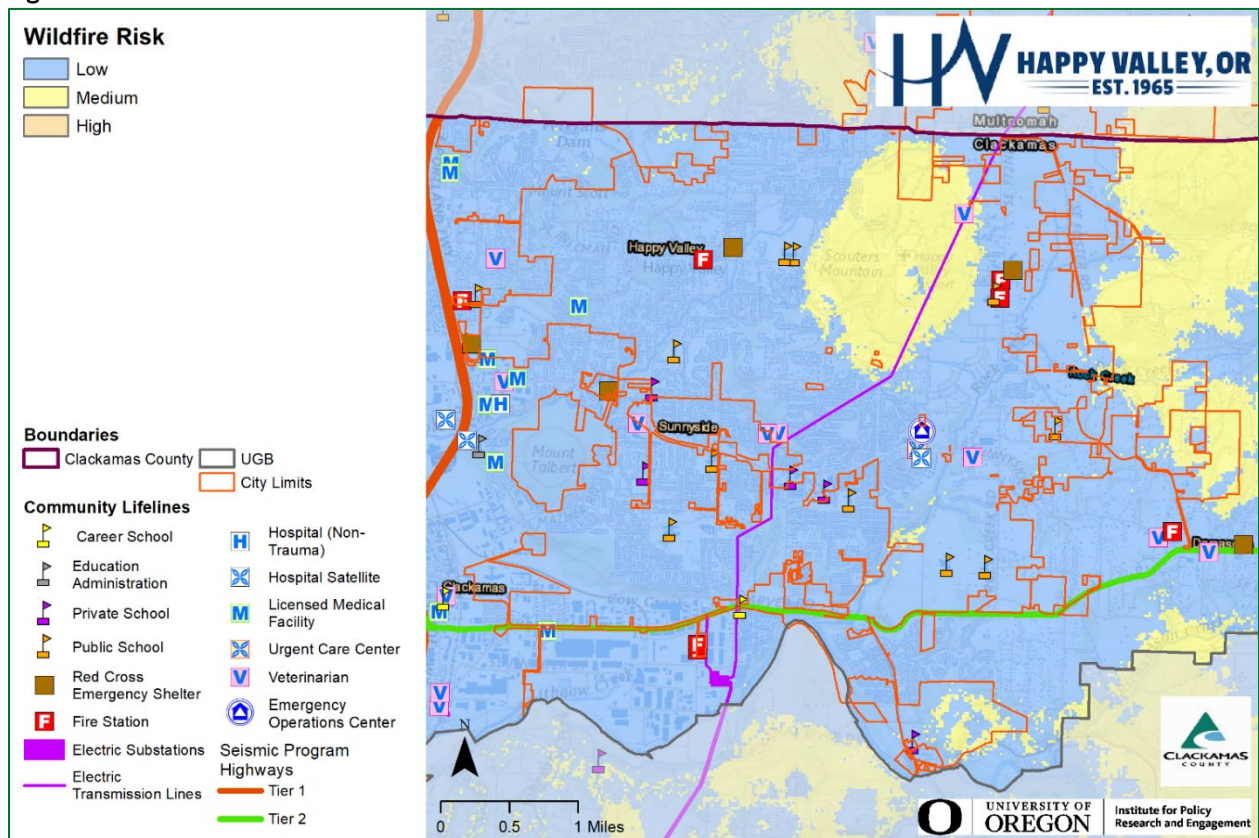
¹⁶ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-20.

western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County. In Happy Valley most instances of fire have been started by human activity, but the fires have been small enough to contain quickly and easily.

The forested hills within and surrounding Happy Valley that are interface areas include Mount Talbert, Scouter Mountain, Happy Valley Nature Trail, and the Highway 224 corridor. Scouters Mountain has a series of natural areas adjacent to homes and infrastructure, while Mount Talbert Nature Park has medium to high density residential development. Mount Talbert Nature Park has steep slopes and transient camps, which makes the area highly vulnerable to fire. High Priority Communities at Risk (CARs) within and around the city include: Mt. Talbert (high) and Scouters Mountain (high), which have been identified by the CFD #1 as important areas for fuel reduction projects.¹⁸

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four-feet under normal weather conditions.¹⁹ However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Figure HV-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Happy Valley is surrounded mostly by farmlands which creates a buffer from the forested areas. There are some areas of heavy tree coverage in the northeast and southern portions of the City. Identified High

and Medium Priority Communities at Risk (CARs) are all located outside of the City limits.¹⁷ Wildfires are not a frequent occurrence within the city, but regional wildfires occasionally introduce pollutants within the city. Happy Valley sits in the bottom of a valley, and pollution from regional fires settles in the area, causing health concerns for residents.

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four feet under normal weather conditions.¹⁸ However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts. The city has completed 126 wildfire impact assessments on 100 properties over the last five years.

Vulnerability Assessment

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. Happy Valley's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City will update the City's wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹⁹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 188 buildings are exposed to the *high and (or) moderate (medium) risk wildfire* hazard (no critical facilities) for a total exposure of \$76.5 million replacement value (a building replacement value exposure ratio of about 2%). About 603 residents may be displaced by wildfires (about 2% of the population).

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"²⁰ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

¹⁷ Clackamas County Community Wildfire Protection Plan, *Happy Valley Fire Department* (2018), Table 10.13-1.

¹⁸ [Oregon Wildfire Risk Explorer](#), date accessed November 9, 2018.

¹⁹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-20.

²⁰ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table HV-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table HV-1).

Previous NHMP Actions that are Complete:

Flood #3, “Maintain and implement surface water management plan.”

Previous NHMP Actions that are Not Complete and No Longer Relevant:

Multi-Hazard #3, “Identify and pursue funding opportunities to develop and implement hazard mitigation activities.” This is part of the existing NHMP implementation process.

Table HV-7 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Multi-Hazard #2	#2	Not Complete	Yes
Multi-Hazard #3	-	Not Complete	No
Multi-Hazard #4	#3	Not Complete, revised	Yes
Earthquake #1	#4	Not Complete, revised	Yes
-	#5	New	-
Flood #1	#6	Not Complete	Yes
Flood #2	#7	Not Complete, revised	Yes
Flood #3	-	Complete	No
Severe Weather #1	#8	Not Complete	Yes
-	#9	New	-
Volcanic Event #1	-	Not Complete	No
Wildfire #1	#10	Not Complete, revised	Yes
Wildfire #2	#11	Not Complete, revised	Yes
Wildfire #3	#12	Not Complete	Yes

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from February 4 through February 28 on the City's website. The plan was also posted and announced on the County's website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Posting Information

The draft plan was posted via the links below on the website and a notification sent out.

- <https://www.happyvalleyor.gov/the-city-of-happy-valley-seeks-additional-public-input-on-their-update-to-the-clackamas-county-natural-hazards-mitigation-plan/>

The above was also sent out as a notification to those who signed up for city news items.

- <https://www.happyvalleyor.gov/services/code-enforcement/>
- <https://www.happyvalleyor.gov/services/police-department/>
- <https://www.happyvalleyor.gov/community/community-services/emergency-management/>

The press release was posted to FlashAlert with directions to the website for review of the draft plan.

A post was also placed on the City's Facebook page with comments closed. Directions send people to the website for plan review.

- <https://www.facebook.com/CityofHappyValley>

Emails sent to the following reps with direction to head to the website for review of the draft plan.

- cwolff@sunrisewater.com – Sunrise Water
- TLoggan@clackamas.us - WES
- rene@rootmortgage.com -HVBA
- longc@nclack.k12.or.us -NCS
- Nina.Carlson@nwnatural.com -NW Natural Gas
- Julie.hernandez@pgn.com - PGE

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1 and #2: March 9 and May 24, 2023

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: December 14, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

City of Lake Oswego Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: Photo Credit: Martin Stabler

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The City of Lake Oswego



Updated:
July 16, 2024, (Resolution # 24-32)
May 21, 2019, (Resolution # 19-34)
May 21, 2013 (Resolution # 13-19)
March 23, 2010 (Resolution # 10-21)

This Natural Hazard Mitigation Plan was prepared by:



Planning grant funding provided by:



Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

RESOLUTION 24-32

A RESOLUTION OF THE CITY COUNCIL ADOPTING THE CITY OF LAKE OSWEGO ADDENDUM TO THE CLACKAMAS COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN.

WHEREAS, the City of Lake Oswego recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, the City of Lake Oswego has fully participated in the FEMA prescribed mitigation planning process to prepare the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

WHEREAS, the City of Lake Oswego has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of Lake Oswego to the impacts of future disasters within the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan; and

WHEREAS, these proposed projects and programs have been incorporated into the Clackamas County, Multi-Jurisdictional Natural Hazard Mitigation Plan that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the City of Lake Oswego addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan and pre-approved it (dated June 11, 2024) contingent upon this official adoption of the participating governments and entities;

WHEREAS, the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan is in an on-going cycle of development and revision to improve its effectiveness; and

WHEREAS, City of Lake Oswego adopts its addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan and directs the City Manager or their designee to develop, approve, and implement the mitigation strategies and any administrative changes as outlined in the Plan.

NOW THEREFORE, BE IT RESOLVED that:

1. The City of Lake Oswego adopts the Lake Oswego addendum to the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan as an official plan; and
2. The City Council directs that this Adoption Resolution be submitted to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan.

This resolution shall take effect upon passage.

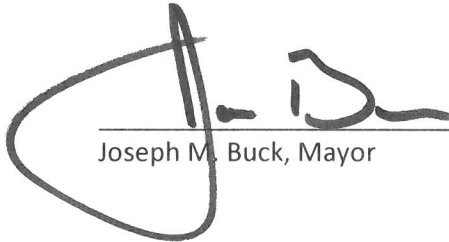
Approved and adopted by the City Council of the City of Lake Oswego at a regular meeting held on the 16th day of July, 2024.

AYES: Mayor Buck, Afghan, Wendland, Verdick, Rapf, Corrigan

NOES: None

ABSTAIN: None

EXCUSED: Mboup



Joseph M. Buck, Mayor

ATTEST:



Kari Linder, City Recorder

APPROVED AS TO FORM:



Ellen Osoinach, City Attorney

Purpose

This is an update of the Lake Oswego addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Lake Oswego’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Lake Oswego adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 16, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Lake Oswego to update their NHMP.

The Clackamas County NHMP, and Lake Oswego addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Lake Oswego HMAC guided the process of developing the NHMP.

Convener

The Lake Oswego City Manager, or their designee, serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Lake Oswego HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Lake Oswego HMAC was comprised of the following representatives:

- Rob D. Amsberry - Program Lead/Flood Plain Manager, Engineering Department
- Megan Big John - Parks Manager, Parks & Recreation Department
- Bonnie Hirshberger - Citizen Information & Emergency Management Specialist, City Manager's Office
- Jessica Morey-Collins - Sr Development Specialist, Planning Department
- Jeff Munro - Deputy Director, Parks & Recreation Department
- Megan Phelan - Assistant City Manager, City Manager's Office
- Edward VanBuren - Deputy Director, Public Works Department
- Amanda Watson - Sustainability Program Manager, City Manager's Office
- Darryl Wrisley - Police Department Lieutenant, Police Department
- Gert Zoutendijk - Fire Marshal, Fire Department

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Lake Oswego addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the Lake Oswego NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Lake Oswego will implement the NHMP’s recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP’s action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Lake Oswego to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, water system master plan, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community’s capabilities.

Comprehensive Plan

Oregon’s Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

Lake Oswego addresses Statewide Planning Goal 7 Natural Hazards as part of their Comprehensive Plan Element, Community Health, and Public Safety. This element was updated in 2014, and contains policies related to air, water, and natural resources, areas subject to natural disasters and hazards, public facilities, and energy. It incorporated the findings and recommendations of the 2010 City of Lake Oswego

Natural Hazards Mitigation Plan for six major hazards: floods, landslides, severe storm (wind and winter), wildfires, earthquakes, and volcanoes.

Planned updates to the jurisdiction's Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community's long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

- Chapter 50, Community Development Code (revised July 2023)

This Chapter includes Article 50.05.011 Flood Management Area, which applies to the lands within the "flood management area" and is applied when development occurs within the "flood management area," which are the areas of special flood hazard, as identified by the Federal Insurance Administrator in a scientific and engineering report entitled "The Flood Insurance Study for Clackamas County, OR and Incorporated Cities" dated January 18, 2019. It also regulates based on the 1996 flood areas, which were those areas inundated during the February 1996 flood along the Willamette River. This code was amended by Ord. 2847, January 2022. Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

Article 50.04.010 Sensitive Lands Overlay Districts manages the impacts of development on lands with environmental and natural resource significance in order to protect the functions and values of wetlands, stream corridors, and tree groves within the Lake Oswego City limits. Many of these significant resources are associated with hillsides, ravines, and ridge lines.

This Chapter also includes Article 50.06.006 Geologic Hazards and Drainage, addressing development in known potential severe landslide hazard areas.

- Chapter 52, Erosion Control

This chapter aims to control erosion at its source as a means of maintaining and improving water quality and minimizing water pollution, downstream flooding, and wildlife habitat damage.

- Lake Oswego City Code and Charter, Chapter 38.25

This chapter was established to protect the health, safety, and welfare of the public residing in watersheds in the jurisdiction of the City by controlling the rate, quality and volume of stormwater originating from development and redevelopment sites to the maximum extent practicable, so that surface water and groundwater are protected from pollution and flooding, and so that erosion potential does not increase.

- Lake Oswego Bridge Inspections and Records Manual

This manual outlines the City's bridge inspection program that was implemented to better respond in the event of a natural disaster. The intent of the program is to utilize trained City personnel to closely document bridge conditions through visual inspections, establishing baseline condition information to use for comparison to bridge conditions after a disaster. Overall, bridges throughout the City are old and in need of upgrading. Additionally, the manual outlines a disaster response plan, including identification of disaster response team members and a bridge closure and detour plan.

The Lake Oswego Planning Department is the oversight entity for all matters related to long range planning, development review, and code enforcement. It is responsible for the administration of state, county, and local land use policies and regulations as they relate to the preservation and quality development of property lying within the city limits and urban growth boundary (UGB). Planning works closely with Building, Engineering, and Fire in the review of development applications and building permits. Planning is also responsible for administering and maintaining the Lake Oswego Comprehensive Plan and Community Development Code, Tree Code, and Sign Code. Planning staff also administer the City's Annexation, Neighborhood Planning, Historic Preservation, and Urban and Community Forestry programs. They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Recent efforts to update land use regulations to integrate hazard mitigation and resilience include:

- Section 50-05-011 (The Flood Management Area) of the Community Development Code was completely updated. Adopted in January of 2022.
- Chapter 15, Section 15.06.616 of the Fire Protection Code was updated in 2021 in order for the Fire Chief or Fire Marshal to implement a burn ban within the limits of the City of Lake Oswego.
- Staff is currently working with a consultant team and internal staff to update the Surface Water Management Manual and the Stormwater Management Code (Article 38.25).

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code and the 2021 International Residential Code.

The Lake Oswego Building Department administers and enforces the 2022 Oregon Structural Specialty Code, which includes fire provisions from the 2022 Oregon Fire Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards. The Fire Department administers the Fire Code, however, current legislation prevents adoption of the WUI Code, which would administer standards for using fire resistant building materials in proximity to or within the wildland-urban interface (WUI).

Public Works

The City of Lake Oswego Public Works Department is responsible for surface water management, water treatment and delivery, wastewater collection and treatment (with Portland Bureau of Environmental Services), street construction and maintenance, and public facilities maintenance. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

The Lake Oswego Public Works Department Engineering Section administers and enforces the Flood Management Area code. Minimum submission requirements stipulate an Elevation Certificate is required at submittal if property is in a flood hazard area, and require a two (2) foot free board and other flood construction requirements.

City Administration

The City Council of Lake Oswego has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

The City's solid waste management program is managed by the Sustainability Program Manager in the City Manager's Office.

Policies and Programs

This Plan directs Lake Oswego and Clackamas County to explore integration into other planning documents and processes. Lake Oswego has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

Emergency Operations Plan

The City's Emergency Operations Plan is in the process of being updated and we anticipate that it will be adopted by the City Council in early 2024.

Sustainability and Climate Action Plan

The City's Sustainability and Climate Action Plan was adopted in May 2020. This plan built on the City's 2014 Sustainability Action Plan for City Operations and includes climate adaptation goals, including updating disaster management policies and procedures in preparation for more extreme weather events.

Intergovernmental cooperation

The City Council passed resolution 23-09 which authorized an IGA for the lending of personnel within Clackamas County when personnel are unable to get to their normal reporting location due to an emergency and/or natural hazard.

Water management and Conservation Plan

The City of Lake Oswego and the City of Tigard joined together to develop a Water Management and Conservation Plan in 2019. This plan coordinates the management and conservation of their shared water resource in the Clackamas River.

MS4 Permit

Lake Oswego's Phase II Municipal Separate Storm Sewer System (MS4) permit was reissued by Oregon Department of Environmental Quality (DEQ) in 2021. The permit program has six areas of focus that are consistent with EPA's Federal Clean Water Act: public education, public involvement, illicit discharge detection and elimination, construction, post-construction, and municipal operations.

The City revised its Stormwater Management Plan and Monitoring Plans in 2022 to meet the requirements of the new MS4 Permit. These plans are awaiting approval from DEQ.

TMDL Plan

The City also maintains a Total Maximum Daily Load (TMDL) Plan (updated in 2019). The Total Maximum Daily Load (TMDL) program includes many of the same requirements as the MS4 program, but also incorporates measures that stabilize stream temperatures. The affected watersheds within the City's jurisdiction include the Willamette and Tualatin Rivers. The NHMP actions are incorporated into this document as appropriate. Example projects include participation in regional stormwater outreach projects, staff training on pollution control, and street cleaning after major storm events. Several new stormwater facilities were constructed as a result of capital improvement projects. An infiltration raingarden and two filtration swales were constructed in the Tryon Creek watershed. Two detention tanks and 41 infiltration planters were constructed in the Oswego Lake watershed.

Capital Improvement Plans

The City adopts a new updated capital improvement plan (CIP) every two years, in conjunction with our biennial budget process. The most recent CIP was approved for July 1, 2023.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The NHMP will also be integrated into the City's Capital Improvement Plan, to be adopted by early 2024.

National Flood Insurance Program

Lake Oswego participates in the National Flood Insurance Program. The Engineering Section within Public Works Department is responsible for administering the day-to-day activities of the city's floodplain program. They are assisted by the Building Department, the Planning Department, and by the City Administrator.

Specifically, the Engineering Section:

- maintains and administers Lake Oswego's floodplain regulations;
- reviews and issues floodplain development permits;
- maintains elevation certificates for all new and substantially improved structures (and maintains an extensive database of historic elevation certificates);
- ensures that encroachments do not occur within the regulated floodway;
- implements measures to ensure that new and substantially improved structures are protected from flood losses;
- maintains floodplain studies and maps and makes this information available to the public;
- maintains a flood information website with digital flood insurance rate map (DFIRM) data;
- conducts site visits to assess conditions and provide technical assistance to the public;
- maintains a library of historical flood related information;
- informs the public of flood insurance requirements; and
- conducts outreach and training about flood hazards and development within the floodplain.

In 2022, the Lake Oswego City Council adopted Ordinance 2847, which introduced a new version of Chapter 50.05.011 Flood Management Area and adopted an updated Flood Insurance Study for Clackamas County, OR and Incorporated Areas (effective January 18, 2019).

Community Emergency Response Teams (CERT)

The City has a unique Community Emergency Response Team (CERT) program that trains residents in emergency management. The [program](#) has trained around 2,000 people since 1995.

Personnel

The following Lake Oswego personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: City Manager's Office, Police Department, Fire Department, and Public Works Department

Public Information Officer: City Manager's Office staff oversees a Communications Team comprised of members from all City departments

Floodplain Manager: Engineering Division of Public Works Department

Grant writing (for Public Works or emergency management): Public Works Department, Fire Department, Police Department, and City Manager's Office

Capital improvement planning: Engineering Division of Public Works Department

Capital improvement execution: Engineering Division of Public Works Department

Lake Oswego does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Lake Oswego has implemented recommendations from the last NHMP into its capital improvement projects.

The following mitigation-related or resilience projects have been completed prior to 2018:

- Lake Oswego Interceptor Sewer (LOIS) (replacement, seismic upgrades to elevated wastewater mains)
- Tualatin River flood model
- First Addition drainage improvement plan
- Evaluation of Flood Management Alternatives for Oswego Lake and Canal (Pacific Water Resources, Inc. June 2003)
- Clean Streams Plan (2009)
- Lakewood Bay Flood Protection at North Shore Road Bridge Plan (2000)
- Dam spillway improvements (2011-2012) (FEMA Flood Mitigation Assistance grant funded)
- Rockinghorse Lane landslide area stabilization

The following mitigation-related or resilience projects have been completed since 2018: ¹

- New City Hall (2021)
- Lake Front Drainage Improvements
- Deer Oak Circle Water Main Replacement
- Wastewater Lift Station Generator Additions
- Wembley Park Road and Stormwater Project
- Wastewater Collection System Rehabilitation
- Boones Ferry Road Project, including stormwater facilities
- 10th Street Water Reservoir removal and Pump Station upgrade
- Fosberg Road drainage improvements
- Telemetry upgrades
- Lakewood Trunk Sewer Rehabilitation
- Blue Heron Trunk Sewer Rehabilitation
- South Shore wastewater System Rehabilitation
- North Shore Bridge Retaining Wall Improvements
- Blue Heron Stormwater Outfall Replacement
- Water Quality Monitoring
- Telemetry Upgrades in all water distribution pump stations and reservoirs
- Completed seismic upgrades at Adult Community Center
- Lakeridge Junior High School (rebuilt 2022)
- Lake Oswego Middle School to be rebuilt starting in 2024, (expected completion 2026)
- Seismic rehabilitation of elementary schools (Hallinan Elementary, Oak Creek Elementary, Westridge Elementary, Palisades, Lake Grove, Forest Hills). All elementary schools gyms have been

upgraded to Category IV seismic level and all elementary schools have received incremental seismic upgrades throughout.

- River Grove Elementary School (new building is currently being constructed)

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)².

FEMA Funded Mitigation Successes

- None identified

Seismic Rehabilitation Grant Program Mitigation Successes

- None identified

Other Mitigation Successes

Lake Oswego School District

- 2017: Lakeridge Junior High School, rebuilt per local bond (2019)
- 2017: Lake Oswego Junior High School, seismic retrofit local bond (The entire school is to be replaced by Lake Oswego Middle School. Demolition of Lake Oswego Junior High School expected to begin after 2024 school year ends. Projected completion date, 2026.)
- 2018: River Grove Elementary School, seismic retrofit of gym/play area per local bond (Replacement in process 2024 - school to be rebuilt to level 4)
- 2018: Uplands Elementary School, seismic retrofit of entire building, gym/play area per local bond
- 2018: Westridge Elementary School, seismic retrofit of entire building per local bond
- 2019: Oak Creek Elementary School, seismic retrofit per local bond
- 2020: Hallinan Elementary School, seismic retrofit of entire building per local bond
- 2021: Lake Grove, Seismic retrofit, gym
- 2021: Forest Hills, Seismic retrofit, gym and covered play
- 2022: Lake Oswego High School, seismic retrofit gym local bond
- 2022: Lakeridge High School, seismic retrofit of gym per local bond

City Facilities

- 2021: City Hall (which includes Police Department and LOCOM (9-1-1 Center)), rebuilt to meet Category IV risk standards pursuant to Section 202 of the 2014 Oregon Structural Specialty Code
- 2017: Maintenance Center, rebuilt to meet Category IV risk standards (main building) and Category III risk standards (vehicle barn/motor pool)
- 2017: Water Treatment Plant, updated to current seismic codes - finished water building at the WTP and river intake pump station built to Category IV
- 2011: Overhead mains to wastewater treatment plant replaced as part of [Lake Oswego Interceptor Sewer](#) (LOIS) Project

² The Seismic Rehabilitation Grant Program (SRGP) 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.

Capital Resources

Lake Oswego maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Critical facilities with power generators for use during emergency blackouts include:

- Lake Oswego City Hall, 380 A Avenue
- Station 210 Westlake Fire Station, 4900 Melrose Street
- Station 211 Jean Road Fire Station, 4555 Jean Road
- Station 212 South Shore Fire Station, 1880 South Shore Blvd
- Station 214 Main Fire Station and Admin Office, 300 B Avenue
- Lake Oswego Maintenance Center, 17601 Pilkington Road
- Adult Community Center, 505 G Avenue
- Lake Oswego Public Library, 706 Fourth Street
- Lake Oswego Water Treatment Plant, 4260 Kenthorpe Way, West Linn (administration building only)
- Several water pump stations and wastewater lift stations
- Lakeridge High School, 1235 Overlook Drive
- Lake Oswego High School, 2501 Country Club Road
- Lakeridge Middle School, 4700 Jean Road
- Oak Creek Elementary School, 55 Kingsate Road
- Forest Hills Elementary School, 1133 Andrews Road
- Many (if not all) buildings located on Meadows in the Kruse Woods Corporate Park have generators

Warming or cooling shelters include:

- Adult Community Center, 505 G Avenue
- Lake Oswego Public Library, 706 Fourth Street

Facilities listed in the American Red Cross National Shelter System include:

- Lake Oswego United Methodist Church, 1855 South Shore Boulevard
- The Church of Jesus Christ of Latter-Day Saints
- Lake Oswego High School, 2501 Country Club Road
- Lakeridge High School, 1235 Overlook Drive
- Lakeridge Middle School (to be added), 4700 Jean Road

Food pantries include:

- Hunger Fighters of Oregon, 4 Monroe Parkway, Suite A

Fueling storage:

- Lake Oswego Maintenance Center, 17601 Pilkington Road

The main fuel island holds 8,193 gallons of unleaded and 5,447 gallons of diesel. We have currently 4 fuel “cubes” that hold anywhere from 50 -150 gallons depending on the cube (the cubes are filled and driven to various locations for generator or other critical equipment refueling).

Findings

Several important findings from this capability assessment informed the design of the Plan's mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Lake Oswego staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Lake Oswego operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City's ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The City's mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAC assessed the City's risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table LO-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAC decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table LO-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
1	With a focus on reaching vulnerable populations, conduct public education and outreach on strategies to stay safe during extreme heat and hazardous air quality events, including information about available cooling shelters and clean air spaces.			X			X	X	X	X	City Manager's Office	Ongoing	Local Resources, DLCD TA, FEMA HMA	Low
2	Integrate the goals and action items from the Lake Oswego Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	City Manager's Office, Planning, and Engineering	Ongoing	Local Resources, DLCD TA, FEMA HMA	High
3	Improve vegetation management throughout the city. Prioritize the removal of hazard trees. Maintain status as Tree City USA.							X	X	X	Parks & Recreation, Public Works	Ongoing	Local Resources, FEMA HMA	High
4	Develop a community resilience hub designed to support residents and coordinate resource distribution before, during, or after a natural hazard event. Hub could also provide refuge site from cold, heat, and poor air quality.	X	X	X	X	X	X	X	X	X	Development Services	Medium	Local Resources, FEMA HMA-C&CB,	Medium (scoping) to High (implementation)
5	Conduct seismic evaluations on identified critical/essential facilities and infrastructure. Implement appropriate structural and non-structural mitigation strategies first on high priority buildings and infrastructure (including the library, reservoirs, and lift/pump stations.).		X								City Manager's Office and Public Works	Ongoing	Local Resources, FEMA HMA (BRIC, C&CB), SRGP	Medium
6	Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.				X						Planning, and Engineering	Ongoing	Local, State, Federal Grants	Low

Table LO-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
7	Improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.					X					Community Development	Ongoing	Local Resources, FEMA HMA-C&CB, FEMA Risk MAP	Low to High
8	Reduce frequency and duration of power outages from the severe wind and winter storm hazards, where possible. Potential projects include undergrounding utilities, establishing, and maintaining backup generators at critical facilities, developing energy redundancy through microgrids.								X	X	Public Works, Planning	Ongoing	Local Resources, FEMA HMA, Energy Trust of Oregon	High
9	Promote fire resistant strategies and home hardening by evaluating and making recommendations to current code to encourage noncombustible building materials for newly constructed residences in Lake Oswego.							X			Fire, Planning, Building	Medium	Local Resources, DLCD TA, FEMA HMA (FMA)	Low
10	Promote wildland home assessments and NFPA Firewise Communities.							X			Fire, Planning	Medium	Local Resources, FEMA HMA (FMA)	Low
11	Implement Clackamas County Community Wildfire Protection Plan in areas listed at risk of wildfire.							X			Fire, Planning, Building	Ongoing	Local Resources, FEMA HMA, CWDG	Low to High

Source: Lake Oswego NHMP HMA, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

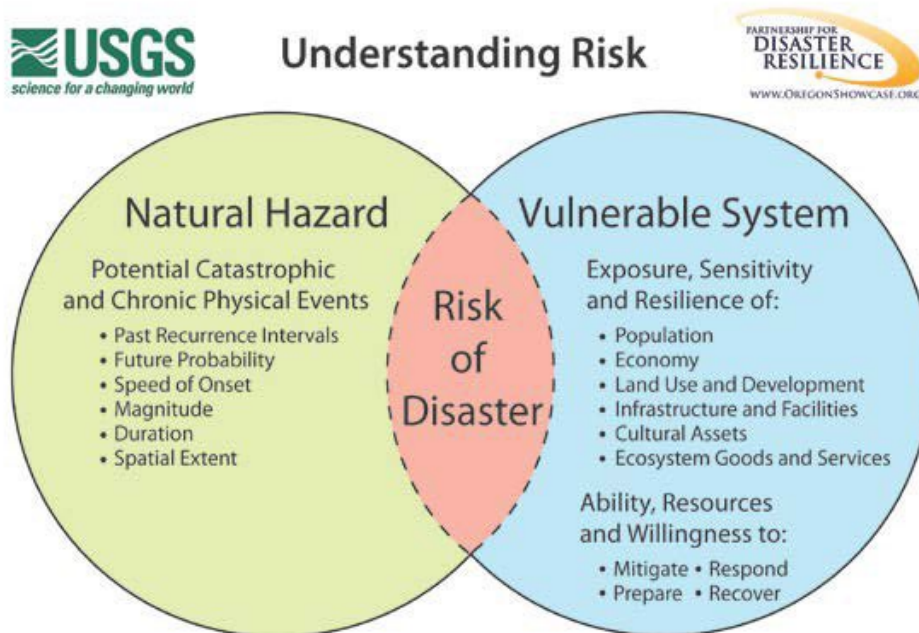
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure LO-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure LO-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Lake Oswego HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Lake Oswego, which are discussed throughout this addendum. Table LO-2 shows the HVA matrix for Lake

Oswego listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) and two chronic hazards (wildfire and winter storm) rank as the top hazard threats to the City (Top Tier). Extreme heat event, drought, flood, and windstorm comprise the next highest ranked hazards (Middle Tier), while landslide and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table LO-2 Hazard Analysis Matrix – Lake Oswego

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Wildfire	18	35	80	56	189	1	Top Tier
Earthquake - Cascadia	2	45	100	35	182	2	
Earthquake - Crustal	6	50	100	21	177	3	
Winter Storm	12	30	70	49	161	4	
Extreme Heat Event	10	35	70	35	150	5	Middle Tier
Drought	10	15	50	56	131	6	
Flood	16	20	30	56	122	7	
Windstorm	14	15	50	42	121	8	
Landslide	14	15	20	63	112	9	Bottom Tier
Volcanic Event	2	25	50	7	84	10	

Source: Lake Oswego HMAC, 2023.

Community Characteristics

Table LO-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Lake Oswego is in the northwestern corner of Clackamas County, located in the Tualatin Valley, and within the Metro Portland UGB. There are three major drainage basins: Oswego Lake, the Tualatin River, and the Willamette River. Lake Oswego has a complex geography with many steep, wooded hillsides, and streams that flow from the higher areas to the drainage basins. Oswego Lake is the largest physical feature, and its geographic center.

Lake Oswego’s temperatures range from a monthly average low of 35°F in the winter months to a high of 82°F in the summer months. The coldest month is January, and the hottest month is August. The average annual precipitation is about 37 inches.

Population, Housing, and Income

Lake Oswego has grown substantially since its incorporation in 1910 and has an area today of 10.78 square miles. It is in the south-central region of Clackamas County, located approximately 25 miles southeast of the City of Portland.

Between 2016 and 2021 the City grew by 3,723 people (10%; as of 2022 the population is 41,148). Between 2022 and 2045 the population is forecast to grow by 2% to 42,133.

Most of the population is White/Caucasian (78%) and about 18% of the population is Hispanic or Latino. The poverty rate is 4% (3% of children under 18, 5% for people 65 and older), 3% do not have health

insurance, and 49% of renters pay more than 30% of their household income on rent (38% for owners). About 73% of the population has a bachelor's degree or higher (1% do not have a high school degree). Approximately 8% of the population lives with a disability (19% of population 65 and older), and 46% are either below 15 (23%) or over 65 (23%) years of age. About 15% of the population are 65 or older and living alone and 5% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 73% of housing units are single-family, 27% are multifamily, and less than 1% are mobile homes. One quarter of homes (25%) were built before 1970 and 31% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (66%) of housing units are owner occupied, 27% are renter occupied, 2% are seasonal homes, and 5% are vacant.

Transportation and Infrastructure

In the City of Lake Oswego, the town is surrounded by hills on the north, and the south, the Willamette River to the east, and I-5 to the west. Highway 43, a State highway, runs through the eastside of town with Oswego Lake in the center of the City. The current freight railroad system is the Portland, and Western Railroad, which serves local, and regional industry. Lake Oswego's commercial areas developed along primary routes, and residential development followed nearby.

Motor vehicles represent the dominant mode of travel through and within Lake Oswego. Twenty-three percent (8% of renters and 1% of owners do not have a vehicle. Most workers drive alone to work 69%; 5% carpool, 2% use public transit, 2% either walk or use a bicycle, and 20% work at home. Tri-Met provides local, and regional bus service, to serve the high number of commuters within the Tri-Met region. There are also free or donation-based shuttle services for residents going to the Adult Community Center, medical escorts for doctor appointments, wheelchair, and/or special transportation needs, and services provided by the Tri-Met Lift program.⁴

Economy

Lake Oswego is an inner-urban suburb of the Portland metropolitan region, and has easy access to downtown Portland, and surrounding communities. There is significant economic activity happening within the City of Lake Oswego, making it a desirable place to live, work, and visit. The Kruse Way Corridor, from I-5 to Boones Ferry Road, is a significant economic engine within the City of Lake Oswego.

About 48% of the resident population 16 and over is in the labor force (19,214 people) and are employed in a variety of occupations including professional (35%), management, business, and financial (31%), sales (10%), office and administrative (10%), and transportation and material moving (4%) occupations.

Most workers residing in the city (88%, 14,887 people) travel outside of the city for work primarily to Portland and surrounding areas.³ A significant population of people travel to the city for work, (91% of the workforce, 20,464 people) primarily from Portland and surrounding areas.⁴

³ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 21, 2023 at <https://onthemap.ces.census.gov>.

⁴ Ibid.

Table LO-3 Community Characteristics

Population Characteristics		Population	Household Characteristics	
		Growth		
2016 Population Estimate	37,425		Housing Units	
2022 Population Estimate	41,148	10%	Single-Family (includes duplexes)	12,891 73%
2045 Population Forecast*	42,133	2%	Multi-Family	4,783 27%
Race			Mobile Homes (includes RV, Van, etc.)	29 < 1%
American Indian and Alaska Native		< 1%	Household Type	
Asian		8%	Family Household	11,150 68%
Black/ African American		1%	Married couple (w/ children)	4,183 25%
Native Hawaiian and Other Pacific Islander		< 1%	Single (w/ children)	836 5%
White		78%	Living Alone 65+	2,479 15%
Some Other Race		< 1%	Year Structure Built	
Two or More Races		7%	Pre-1970	4,452 25%
Hispanic or Latino/a (of any race)			1970-1989	7,765 44%
Limited or No English Spoken	1,292	3%	1990-2009	4,356 25%
Vulnerable Age Groups			2010 or later	1,130 6%
Less than 5 Years	1,883	5%	Housing Tenure and Vacancy	
Less than 15 Years	7,104	18%	Owner-occupied	11,636 66%
65 Years and Older	8,483	21%	Renter-occupied	4,822 27%
85 Years and Older	820	2%	Seasonal	293 2%
Age Dependency Ratio		0.63	Vacant	952 5%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)	
Total Disabled Population	3,138	8%	No Vehicle (owner occupied)	171 1%
Children (Under 18)	184	2%	Two+ vehicles (owner occupied)	8,989 77%
Working Age (18 to 64)	1,316	6%	No Vehicle (renter occupied)	385 8%
Seniors (65 and older)	1,638	19%	Two+ vehicles (renter occupied)	2,007 42%
Income Characteristics			Employment Characteristics	
Households by Income Category			Labor Force (Population 16+)	
Less than \$15,000	684	4%	In labor Force (% Total Population)	19,214 48%
\$15,000-\$29,999	909	6%	Unemployed (% Labor Force)	1,014 5%
\$30,000-\$44,999	1,104	7%	Occupation (Top 5) (Employed 16+)	
\$45,000-\$59,999	1,388	8%	Professional & Related	6,645 35%
\$60,000-\$74,999	851	5%	Management, Business, & Financial	5,991 31%
\$75,000-\$99,999	1,867	11%	Sales & Related	2,001 10%
\$100,000-\$199,999	5,164	31%	Office & Administrative	1,815 10%
\$200,000 or more	4,491	27%	Transportation and Material Moving	726 4%
Median Household Income	\$120,585		Health Insurance	
Gini Index of Income Inequality	0.49		No Health Insurance	1,401 3%
Poverty Rates (Percent age cohort)			Public Health Insurance	11,247 28%
Total Population	1,693	4%	Private Health Insurance	33,606 83%
Children (Under 18)	302	3%	Transportation to Work (Workers 16+)	
Working Age (18 to 64)	941	4%	Drove Alone	13,068 69%
Seniors (65 and older)	450	5%	Carpooled	1,031 5%
Housing Cost Burden (Cost > 30% of household income)			Public Transit	458 2%
Owners with a Mortgage	3,014	38%	Motorcycle	23 < 1%
Owners without a Mortgage	878	24%	Bicycle/Walk	394 2%
Renters	2,343	49%	Work at Home	3,724 20%

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", 2016 & 2022; Portland State University. METRO 2040 Population Distributed Forecast (2021, Exhibit A to Ordinance 21-1457).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Lake Oswego. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table LO-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table LO-4 Critical Facilities

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
Critical Facilities by Community	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Bethlehem Christian Preschool	-	-	X	-	-
Forest Hills Elementary School	-	X	X	-	-
Hallinan Elementary School	-	-	X	-	-
Harmony Academy	-	X	X	-	-
International Leadership Academy	-	X	X	-	-
Lake Grove Elementary School	-	-	X	-	-
Lake Oswego Fire Department - Station 210 Westlake	-	-	-	-	-
Lake Oswego Fire Department - Station 211 Jean Road	-	X	X	-	-
Lake Oswego Fire Department - Station 212 South Shore	-	-	-	-	-
Lake Oswego Fire Department - Station 214 Main Station and Admin.	-	-	-	-	-
Lake Oswego Middle School	-	-	-	-	-
Lake Oswego Police Department	-	X	X	-	-
Lake Oswego Public Works	-	X	X	-	-
Lake Oswego High School	-	X	X	-	-
Lakeridge High School	-	X	X	-	-
Lakeridge Middle School	-	X	X	-	-
Legacy Medical Group - Lake Oswego	-	-	-	-	-
Mountain Park Kindercare	-	-	-	-	-
Oak Creek Elementary School	-	-	-	-	-

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Our Lady of the Lake School	-	X	X	-	-
Palisades Elementary School	-	-	X	-	-
Park Academy	-	X	X	-	-
Portland - Tryon Creek WWTP	-	X	X	-	-
Providence Medical Group - Mercantile	-	X	X	-	-
River Grove Elementary School	-	X	X	-	-
Sonshine Express Preschool	-	-	-	-	-
Touchstone Elementary School	-	-	-	-	-
Uplands Elementary School	-	-	X	-	-
Village Montessori of Lake Oswego	-	-	-	-	-
West Hills Montessori School - Lake Oswego Campus	-	X	X	-	-
Westridge Elementary School	-	-	X	-	-
Westside Christian High School	-	-	-	-	-
Oswego Place Assisted Living		Y	Y		
The Pearl at Kruse Way		Y	Y		
The Springs at Carman Oaks		Y	Y		
The Springs Living at Lake Oswego		Y	Y		
Greenridge Estates		Y	Y		
The Stafford and Mary's Woods		Y	Y		

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-24.

Note: Oswego Place Assisted Living, The Pearl at Kruse Way, The Springs at Carman Oaks, The Springs Living at Lake Oswego, Greenridge Estates, and The Stafford and Mary's Woods not included in the DOGAMI analysis. Hazard ranking providing by City (y).

Additional Critical Facilities not included in the DOGAMI Risk Report:

- City Hall (includes Police Department, 9-1-1 Center, and primary EOC)
- Adult Community Shelter
- Water Treatment Plant
- Tennis Center

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

- Communications towers
- Fiber optic lines
- Highway 43 (State St.), McVey Avenue, Stafford Road
- Highway 43 (State St.) and Sucker Creek Bridge
- NW Natural gas pipelines and gas substations
- Oswego Lake dam and headgate
- Oswego Lake sanitary sewer interceptor
- Portland & Western Railroad
- Portland General Electric substations
- Transportation networks, including all major roads and all bridges including Country Club Rd, Boones Ferry Rd, and Kruse Way
- Tryon Creek Wastewater Treatment Plant, lift stations, and main lines

- Water treatment plant, water pumping stations, major water lines, reservoirs, water intake on Clackamas River

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public’s ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields.

- Area Churches
- Forest Hills Elementary School
- Hallinan Elementary School
- Lake Grove Elementary School
- Lake Oswego High School
- Lakeridge High School
- Lakeridge Middle School
- Oak Creek Elementary School
- Our Lady of the Lake School
- Palisades Elementary School
- Park Academy
- River Grove Elementary School
- St Stephen’s Academy South Campus
- Uplands Elementary School
- Westridge Elementary School
- Lake Oswego Public Library
- Lake Oswego Tennis Center
- Lake Oswego Municipal Golf Course

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include: Bryant Woods Park, Canal Acres Natural Area, Cook’s Butte Park, Foothills Park, Freepons Park, George Roger Park, Hallinan Natural Area, Iron Mountain Park, Lake Grove Swim Park, Lake Oswego Hunt Club, Luscher Farm, Millennium Plaza Park, Oswego Lake, Oswego Lake Country Club Golf Course, River Run Park, Roehr Park, Rossman Park, Southwood Park, Springbrook Park, Sundeleaf Park, Tryon Cove Park, Tryon Creek State Natural Area, Tualatin River, East Waluga Park, West Waluga Park, Westlake Park, and the Willamette River.

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include:

Adult Care Facilities

- Abby’s Adult Foster Care
- Always Caring
- Autumn Health Care II
- Best Family Care
- Cherry Crest Adult Care Home
- Daniel’s Adult Care Home
- Eva & Gabriel Adult Care Home
- Felisia’s Adult Care Home
- Greenridge Estates
- Greentree Adult Care
- Home Health for Life
- Hillside Home Adult Care
- Hope’s Sweet Home
- Indian Springs Adult Care Home
- Lake Oswego Care
- Home Lake Oswego
- Comfort Living Loving
- Care Adult Care Home
- Lucky’s Home
- Mary’s Woods
- Oswego Care Home LTD
- Oswego Place Assisted Living
- Oswego Pointe Adult Care Home
- Rosewood Inn Adult Foster Care

- Sunshine Adult Foster Care
- The Pearl at Kruse Way
- The Stafford
- The Springs at Carman Oaks
- The Springs Living at Lake Oswego

- King’s Children Preschool
- Lake PreK
- Maayan Ha Torah Day School
- Maple Street Kids
- Noah’s Arc Pre-School
- Oswego Play School
- Our Lady of the Lake Extended Care
- Palisades School
- Play Boutique/Peake Academy
- Pipster Prep Lake Oswego
- Riverdale After School Program
- Sonshine Express Pre-School and Kindergarten
- Sprout & Spark School
- Storybook Daycare
- The Children’s Hour Academy
- The Play School at Mt. Park
- Village Montessori
- West Hills Montessori
- Westridge Elementary School

Child Care Centers

- Bethlehem Church Pre-School
- Child’s View Montessori
- Christ Church Episcopal Preschool
- Community Arts Pre-School
- DropNPlay
- Early Years Children’s Center
- International Leadership Academy
- KCE Champions LLC (Palisades)
- KCE Champions LLC (Westridge)
- Kiddie Care Child Care
- KinderCare (Lake Grove)
- KinderCare (Monroe Pkwy)

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: Gas Stations, Biotronics, Bus Barn School District, Interstate 5, Lakeshore Concrete Co., Portland Willamette Railroad, Quest Corporation, State Highway 43, Taylor Made Labels Inc., Verizon Northwest Inc., Water Treatment Plant (in West Linn).

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Lake Oswego. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers, and are a concern during evacuation/notification during a hazard event include: City Hall, Meadows Road and Center Pointe Complex, School District, SW Employment Area (Industrial Zone).

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

Examples of the types of properties that should be considered before, during, and after an event include the following properties:

- Allen House I and II
- Angler’s Club
- Aquinas Hall
- Bickner Building
- Black House
- Brown-Vose House
- Bryant Home
- Marker
- Carl House
- Carmen House
- Carter House
- Christie School
- Clara Weinstein House
- Cleary House
- Collard House
- Conway House
- Davidson House
- Didzun House
- Eastman House
- Education Hall
- Erickson House
- F. Davidson House
- Flavia Hall
- Harris House
- Headrick-Carothers House
- Hofer House
- Iron Furnace Chimney
- Jantzen Estate
- Johnson Barn
- Klose House
- Laidlaw House
- Lake Grove Fire Station
- Lake Oswego Country Club
- Lake Oswego Hunt Club
- Lakewood School
- Larson School
- Log Hoist
- Lueg House
- Marylhurst Administration Building
- Marylhurst Cemetery/Alter
- McCall House
- McWaters House
- Methodist Episcopal Church
- Mulder House
- Murphy Company Building
- Noel Dew House
- Odd Fellows Hall
- Old Mine Trail
- Parelus House
- Parron House
- Peg Tree
- Pioneer Cemetery
- Rogers Building I and II
- Rogers House
- Rosentreter House
- Sacred Heart School
- Shepard House
- Smith House
- St. Catherine’s Dormitory
- Sundeleaf House
- Trueblood House
- Tualatin-Oswego Canal
- Tug Masters House
- Twinings House
- Van Houten House
- Vose House
- Waldfork House
- Warren House
- White House
- Worker’s Cottage
- Worthington House

Hazard Characteristics

Drought

The HMAC determined that the City’s probability for drought is **high** and that their vulnerability to drought is **low**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

Lake Oswego draws its main water supply from the Clackamas River intake facility in Gladstone, which is then treated at the [Water Treatment Plant](#) in West Linn.⁵ The West Linn Water Treatment Plant was originally built in unincorporated Clackamas County for the City of Lake Oswego in the 1960s, it now

⁵ Water Source, and System. Lake Oswego Tigard Water Partnership. Last visited 10/9/18. <http://lotigardwater.org/?p=water-source-and-system>

serves multiple jurisdictions-- including Tigard, and Lake Oswego. There was recently a project completed in October 2017 to increase the treated water capacity (to 38 million gallons per day) for residents of Lake Oswego, and Tigard.⁶ The treatment plant has two different utility substations on the property for back up electricity, and has agreements with other treatment plants around the region for water use that creates redundancies within the water supply system for residents, and businesses. During the 2020 windstorm, both power sources at the water treatment plant were comprised. The Engineering Department is currently preparing the designs to develop onsite emergency backup power to the treatment plant and the water intake facility in Gladstone.

Vulnerability Assessment

Due to insufficient data and resources, Lake Oswego is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table LO-44.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁷ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *The probability and vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Lake Oswego as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Lake Oswego as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Lake Oswego Fault Zone (discussed in the crustal earthquake section).

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per

⁶ Lake Oswego-Tigard Water Treatment Plant. Public Works, City of West Linn. Last visited 10/9/18: <https://westlinnoregon.gov/publicworks/lake-oswego-tigard-water-treatment-plant>

⁷ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

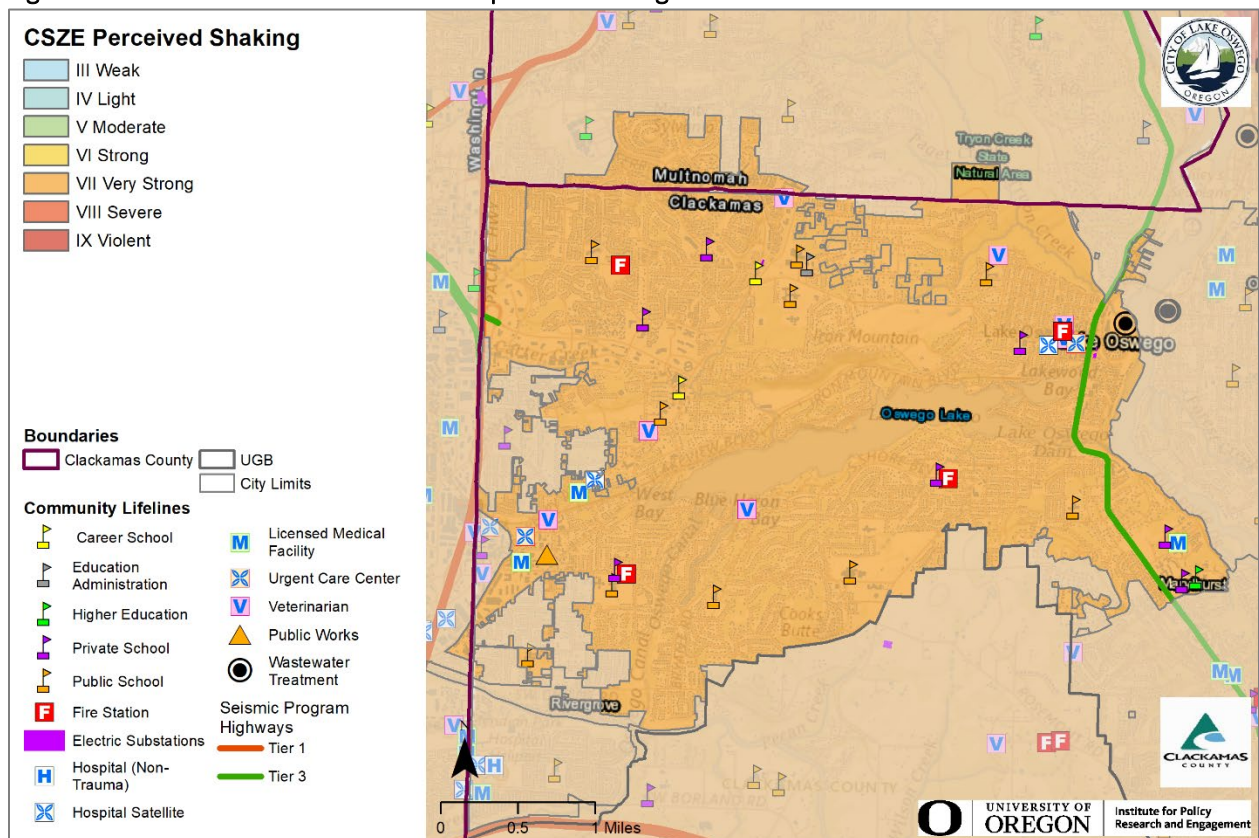
year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.⁸

The city’s proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the “Valley Zone” (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

The City is not within the severe shaking area, though there is significant area around the City that have severe and very severe shaking if a large earthquake were to occur.

Figure LO-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Figure LO-2 Cascadia Subduction Zone Expected Shaking



⁸ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

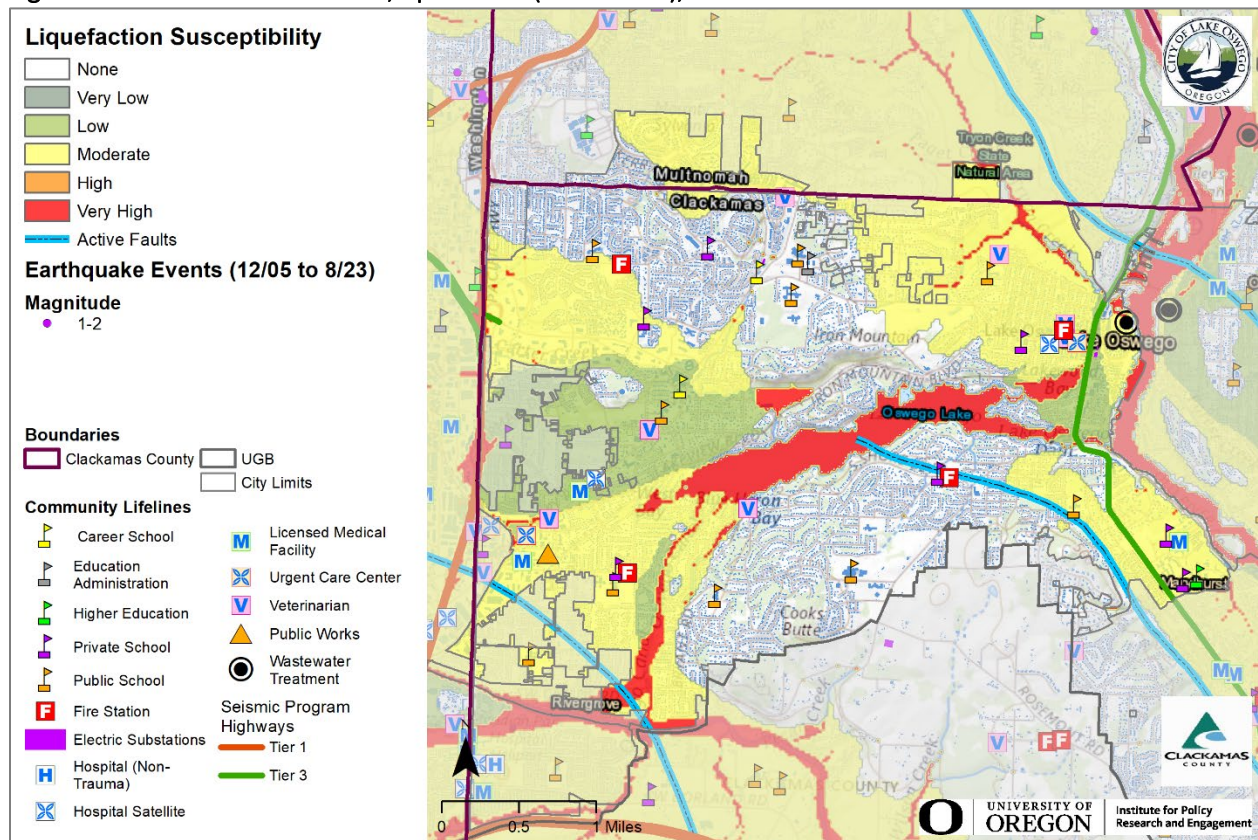
Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
 Note: To view hazard detail click this [link](#) to access Oregon HazVu

Earthquake (Crustal)

The HMAC determined that the City’s probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Lake Oswego as well. Figure LO-3 shows a generalized geologic map of the Lake Oswego area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

Figure LO-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.
 Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
 Note: To view hazard detail click this [link](#) to access Oregon HazVu

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

There are two potential crustal faults and/or zones near the City that can generate high- magnitude earthquakes. These include the Gales Creek-Mt. Angel Structural Zone (about 15 miles southwest of the city, not pictured) and the Portland Hills Fault Zone (about 3 miles northwest of the city, not pictured). The fault pictured in the southwest is the Canby-Molalla Fault, the Bolton Fault runs through Oswego Lake, and the Oatfield Fault is pictured in the northeast. More distant is the Mt. Hood Fault in eastern Clackamas County which has potential to impact Lake Oswego. Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Canby-Lake Oswego Fault Zone

The Canby-Lake Oswego Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Lake Oswego in northern Oregon.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 3 miles northwest of Lake Oswego.

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

City Hall, the Main Fire Station, and the Adult Community Center are critical facilities exposed to relative earthquake hazard Zone A, the highest hazard zone. Seismic design standards range by category from Seismic Zone 1 to Seismic Zone 4. Occupancy Category IV is the highest design standard achievable. Construction of the new City Hall was completed in September 2021. City Hall contains the City's law enforcement and emergency dispatch facilities as well as the City's primary Emergency Operations Center (EOC) and is considered an essential facility. City Hall was built to meet Category IV risk standards pursuant to Section 202 of the 2014 Oregon Structural Specialty Code. As such, it is intended to remain operational in the event of extreme environmental event, including flood, wind, snow, or earthquake. The Main Fire Station, and the main building of the new Maintenance Center, which houses the alternate EOC, were built to Occupancy Category IV standards, a step above the required standard for Seismic Zone 3. The Maintenance Center's vehicle barn/motor pool was built to Occupancy Category III standards. The Adult Community Center, which would serve as an emergency short-term shelter, has not had any seismic upgrades, and does not meet modern seismic standards.

Several Essential Facilities are in the high earthquake hazard zone. These facilities include the former Marylhurst University building, Lake Grove Elementary (proposed to be replaced, voter approval required). Our Lady of the Lake School, and several churches, which could potentially serve as Red Cross shelter sites.

Operation of and access to exposed infrastructure including the Oswego Lake headgate, City water pumping stations, a PGE substation and the communications towers located at City Hall, could potentially be impacted during an earthquake. Other exposed infrastructure including wastewater main lines, major water lines, natural gas pipeline and fiber optic lines are buried, however they are also vulnerable to damage from earthquake hazards, potentially limiting or delaying access for the purposes of operation or

repair. The fiber optic lines located along Highway 43/State Street, McVey Avenue and Stafford Road is a significant communication link for the entire region.

The City's fresh drinking water supply comes from the water treatment plant in West Linn and is in earthquake hazard Zone A (highest hazard), while the water intake located on the Clackamas River in Gladstone is in Zone C. The water line from the West Linn water treatment plant enters Lake Oswego along Highway 43, which crosses through earthquake Zone A. The water treatment plant and the intake have been upgraded to earthquake Zone 4 standards. There are 16 reservoirs serving Lake Oswego.

The three newest reservoirs, Touchstone II, McNary II, and Palisades II were constructed to earthquake Zone 4 standards.

The regional Emergency Transportation Route follows State Highway 43 from the northern City limits, and continues south on State Street to McVey Avenue, and then southwest to and along Stafford Road. The Emergency Transportation Route passes through earthquake hazard Zone A at the northern City limits along State Street, possibly impacting access to and from the City. The City, working with Clackamas County, is currently working on evacuation plans and zones based on key roadways, neighborhood and community areas, geographic features, and population.

Additionally, several the City's environmental assets are exposed to the high earthquake hazard. These include Iron Mountain Park, Canal Acres Natural Area, River Run Park, Glenmorrie Park, Foothills Park, Roehr Park, Rossman Park, and Tryon Creek State Natural Area.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 69% of residential buildings were built prior to 1990, which increases the City's vulnerability to the earthquake hazard. Information on specific public buildings' (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table LO-6; each "X" represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), zero (0) have a very high (100% chance) collapse potential, however, seven (7) schools have a high (greater than 10% chance) collapse potential.

For a list of facilities and infrastructure vulnerable to this hazard, see the Community Assets Section and Table LO-4. In addition to building damages, utility (electric power, water, wastewater, natural gas), and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings, and damage to utility infrastructure, including water treatment plants, and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Table LO-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Bryant Elementary (4750 Jean Rd)	Clac_sch03	Closed in 2013			
Forest Hills Elementary^^ (1133 Andrews Rd)	Clac_sch04	(X)		X	
Hallinan Elementary (16800 Hawthorne Dr) see mitigation successes	Clac_sch05	X			
Lake Grove Elementary^^ (15777 Boones Ferry Rd)	Clac_sch06	(X)		X	
Lake Oswego Middle^ (2500 Country Club Rd) see mitigation successes	Clac_sch10	(X)		X	
Lake Oswego High (2501 Country Club Rd) see mitigation successes	Clac_sch12	X			
Lakeridge Junior High (4700 Jean Rd) see mitigation successes	Clac_sch11	Structure rebuilt ca. 2022			
Lakeridge High (1235 Overlook Dr) see mitigation successes	Clac_sch13	X			
Oak Creek Elementary (55 Kingsgate Rd) see mitigation successes	Clac_sch74	(X)		X	
Palisades Elementary (1500 Greentree Ave)	Clac_sch69		X		
Rivergrove Elementary^ (5850 McEwan Rd) see mitigation successes	Clac_sch07	(X)		X	
Uplands Elementary (2055 Wembley Park Rd) see mitigation successes	Clac_sch08		X		
Westridge Elementary (3400 Royce Way) see mitigation successes	Clac_sch09	X			
Fire Facilities					
Fire Department Station 210 Westlake (4900 Melrose St)	Clac_fir21	X			

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Fire Department Station 211 Jean Road (4555 Jean Rd)	Clac_fir23	X			
Fire Department Station 212 South Shore (1880 S Shore Blvd)	Clac_fir07	X			
Fire Department Station 214 Main Station and Admin. (300 B Ave)	Clac_fir06	X			
Police Facilities					
Police Dept/ EOC/ City Hall (380 A Ave)	Clac_pol02	Structure rebuilt ca. 2021			

Source: [DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)

“*” – Site ID is referenced on the [RVS Clackamas County Map](#)

Note 1: Collapse potential ratings indicated in parentheses (x) provided in 2008 by Froelich Consulting Engineers.

Note 2: ^ Phase 2 (2021) proposes to demolish and rebuild this school (voter approval required). Lake Oswego MS is scheduled to be rebuilt in 2025/2025. Will be built to a Category IV seismic level. Rivergrove Elementary school is currently being rebuilt (ca. 2024). Will be built to a Category IV seismic level.

Note 3: ^^ Phase 3 (2025) proposes to demolish and rebuild this school (voter approval required)

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table LO-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property

are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Table LO-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	13,770	13,770	13,770	13,770
Building Value (\$ Million)	6,805	6,805	6,805	6,805
Building Repair Cost (\$ Million)	337	523	1,877	2,377
Building Loss Ratio	5%	8%	28%	35%
Debris (Thousands of Tons)	134	184	552	685
Long-Term Displaced Population	220	1,207	3,243	6,391
Total Casualties (Daytime)	174	258	965	1,194
Level 4 (Killed)	8	12	53	65
Total Casualties (Nighttime)	50	130	418	659
Level 4 (Killed)	2	4	14	21

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

The City of Lake Oswego is expected to have a 5% building loss ratio with a repair cost of \$337 million under the CSZ “dry” scenario, and an 8% building loss ratio with a repair cost of \$523 million under the “wet” scenario.⁹ The city is expected to have around 174 daytime or 50 nighttime casualties during the CSZ “dry” scenario and 258 daytime or 130 nighttime casualties during the “wet” scenario. It is expected that there will be a long-term displaced population of around 220 for the CSZ “dry” scenario and 1,207 for the “wet” scenario.¹⁰ (See Risk Report content for additional information.)

Portland Hills Fault Scenario

The City of Lake Oswego is expected to have a 28% building loss ratio with a repair cost of \$1.877 billion under the Portland Hills Fault “dry” scenario, and a 35% building loss ratio with a repair cost of \$2.377 billion under the “wet” scenario.¹¹ The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 965 daytime or 418 nighttime casualties during the “dry” scenario and 1,194 daytime or 659 nighttime casualties during the “wet” scenario. It is expected that there will be a long-term displaced population of around 3,243 for the “dry” scenario and 6,391 for the “wet” scenario.¹²

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMP’s mitigation strategies (Table LO-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and

⁹ DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8 and 12-9.

¹⁰ Ibid, Tables 12-8 and 12-9.

¹¹ Ibid, Tables 12-10 and 12-11

¹² Ibid, Tables 12-10 and 12-11.

the recommendations see: Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02).

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**¹³ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone event (M9.0 Deterministic): 752 buildings (15 critical facilities) are expected to be damaged for a total potential loss of \$665 million (a loss ratio of about 8%). Over 1,000 residents may be displaced (about 3% of the population).

Crustal event (Canby-Molalla fault M6.8 Deterministic): 2,353 buildings are expected to be damaged (21 critical facilities), for a total potential loss of \$1.5 billion (a loss ratio of about 17%). More than 2,600 residents may be displaced (about 7% of the population).

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Mitigation Activities

Earthquake mitigation activities listed here include current mitigation programs and activities that are being implemented by Lake Oswego agencies or organizations.

A primary mitigation objective is to construct or upgrade critical and essential facilities and infrastructure to withstand future earthquake events. The Main Fire Station, a critical facility which serves as an alternate to the City's Emergency Operations Center (EOC), was constructed to Seismic Zone 4 standards. The South Shore Fire Station recently underwent seismic upgrades, and upgrades have been completed at the West Lake and Jean Road Fire Stations to harden the apparatus bays. Seismic upgrades have also been made to the City's water treatment plant to ensure it remains operational after a magnitude seven earthquake. Additionally, school remodels must now include seismic upgrades and the installation of sprinkler systems.

City Hall which contains the police department and 9-1-1 dispatch center (LOCOM) and the City's primary EOC, was rebuilt to meet Category IV risk standards pursuant to Section 202 of the 2014 Oregon Structural Specialty Code in 2021. The City's Maintenance Center, which houses Public Works and Parks Maintenance, was rebuilt in 2017. The main building was built to category 4 seismic code (highest available) and the motor pool shop/vehicle barn was built to a category 3. Completed in 2017, the City's Water Treatment Plant, which serves the City of Lake Oswego and Tigard, was designed to seismic standards above current codes. In addition, the City's wastewater (sewer) interceptor system was completely rebuilt and seismically upgraded with the LOIS Project, including the overhead mains into the treatment plant.

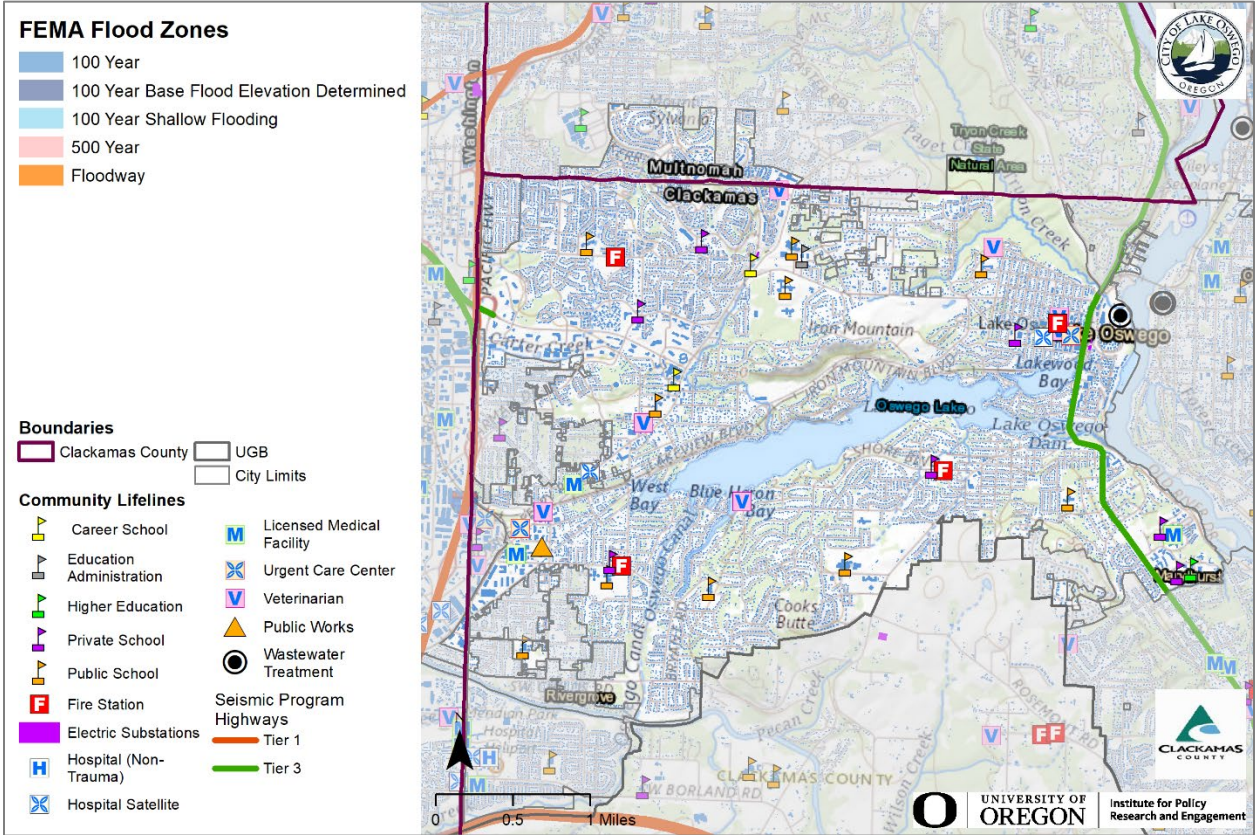
¹³ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-24.

Flood

The HMAC determined that the City’s probability of flooding is **high** and that their vulnerability to flooding is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure LO-4 illustrates the flood hazard area for Lake Oswego. Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Portions of Lake Oswego have areas of floodplains (special flood hazard areas, SFHA). These include areas include along Willamette River, Tualatin River, Oswego Canal, and Oswego Lake (Figure LO-4). Furthermore, other portions of Lake Oswego, outside of the mapped floodplains, are also subject to flooding from local storm water drainage.

Figure LO-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.
 Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
 Note: To view hazard detail click this [link](#) to access Oregon HazVu

Oswego Lake and Canal

Oswego Lake is three and a half miles long, with the main portion covering 385 acres, and an additional seven acres in West Bay and 28 acres in Lakewood Bay. The Lake is a reservoir and is privately owned and managed by the Lake Oswego Corporation, commonly known as The Lake Corporation. The Lake Corporation has owned and maintained the Lake since 1942. In addition to its natural resource values, Oswego Lake is a multiple-use facility that serves the community in a variety of roles. It is a hydroelectric reservoir at the center of a 7,400-acre drainage basin. The lake receives most of its water from streams,

storm drain outfalls, and surface runoff. Also, there is a City sanitary sewer interceptor below the lake's normal surface water elevation that has been constructed at an engineered grade to convey sewage to the Tryon Creek Sewage Treatment Plant. A spillover dam was completed in 1921 that raised the lake and greatly increased its size, creating Blue Heron Bay and West Bay on the west end of the lake, and Lakewood Bay on the east end.¹⁴

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk. The City has been proactive in mitigating flood hazards by purchasing floodplain property.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Lake Oswego outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The City of Lake Oswego has been impacted by floods several times since incorporating in 1910. There have been at least six events in the past fifty years which have caused widespread damage. Flooding within the City has been caused by the Willamette River, Tualatin River, Oswego Canal, and Oswego Lake. The [FEMA Flood Insurance Study \(June 17, 2008\)](#) has a brief history of flooding in Clackamas County, and Lake Oswego (Volume I, Section 2).

The highest recorded flood levels on the Tualatin River were recorded on February 10, 1996. The period of record on this river only extends back to 1928. As measured from the Oswego Canal Inlet gage, this record flood reached an elevation of 120.12 feet (National Geodetic Vertical Datum of 1929, NGVD). Waters that normally flow from the Tualatin River into the Oswego Canal are regulated by the canal headgate structure which has a top of headgate height of 113.6 feet. Once Tualatin River levels exceeded the top of headgate, the water flows unimpeded into the canal, and northward to Oswego Lake. When the river reaches a level of 117.5 feet, water begins to leave the north banks of the Tualatin near the 5400 block of Dogwood Drive, and then migrates across Sycamore Avenue eventually rejoining the main Oswego Canal near Childs Road, and Bryant Woods Park.

In 2011-2012 the Oswego Lake Corporation completed a dam spillway modification project funded by a FEMA Flood Mitigation Assistance grant via the City of Lake Oswego. The project involved the installation of new, larger, spillway gates, sized to allow the passage to the 100-year flood flows. The project resulted in the lowering of the base flood elevation (BFE) by 3.5 feet (to 99.7 feet NGVD of 1929), which is below the top of the seawall on the main lake, Lakewood Bay, Westlake, and Blue Heron Canal. The Letter of Map Revision (LOMR) covering the entirety of Oswego Lake is effective as of [August 31, 2012](#). Before the flood project the Lake Corporation's ability to release water at the east end of Oswego Lake was outstripped by the flows entering the lake from the Oswego Canal, and the lake level would rise uncontrollably. Dozens of homes, businesses, and boathouses were damaged by these floodwaters. Properties along Dogwood Drive, Melissa Drive, Canal Road, Pioneer Court, Bryant Road, Cardinal Drive, Kelok Road, Sarah Hill Lane, Lake Haven Drive, Canal Circle, many homes surrounding Oswego Lake

¹⁴ Comprehensive Plan of the City of Lake Oswego. Adopted December, 1994

(including all bays, and canals), businesses along State Street from the railroad crossing south to North Shore Road, plus many apartments, businesses, and carports in the Oswego Pointe area all experienced severe water, and structural damage. With the completion of the dam spillway modification project flooding is no longer expected to happen to the homes surrounding Oswego Lake (including all bays, Blue Heron canal), businesses along State Street from the railroad crossing south to North Shore Road, plus many apartments, businesses, and carports in the Oswego Pointe area, with the exception that there might be some minor roadway flooding (less than a foot deep) on North Shore at North Shore Circle, Eena Road, and perhaps at South Shore Boulevard near the Gerber Pond.

Heavy rains following a severe winter storm from January 1 to 2, 2009 contributed to a sewer interceptor overflow on Cardinal Drive near Oswego Canal. Approximately 226,000 gallons of wastewater were sent out of the sewer system. Maintenance crews were able to capture about 75% of the discharge using vacuum trucks.

Record flooding is usually accompanied by low elevation snows in the Coast, and Cascade Mountain foothills. Often snow is on the ground at the 1,000' elevation, and sometimes it is even present all the way down to sea level. Larger than normal snow depths in the middle, easily melted, elevations such as 2000' to 3,500' are another major source of water runoff. These depths are frequently observed at the Saddle Mountain Snowtel station located at 3,250' in the Coast range of western Washington County. Both the 1964, and 1996 floods were preceded by a period of sub-freezing temperatures that caused the soils of the drainage basins to solidify and become relatively impervious.

Finally, there is a rainfall pattern known as the "Pineapple Express" which brings very heavy, and warm rains from the southwest. These warm rains begin their journey from parts of the Pacific near Hawaii, holding their heat, and moisture until making landfall along the Oregon coast. As an example, at 1 A.M. on the morning of February 8, 1996, the temperature had risen to 61°F with a driving rain following a period of freezing conditions. This warm rainstorm preceded the flood crest on the Willamette River by 2.5 days.

Vulnerability Assessment

The City of Lake Oswego GIS Department completed an analysis, using the best available data, as a component of the vulnerability assessment in 2013 and reviewed and updated it, as appropriate, in 2018. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing critical and essential facilities and infrastructure with each hazard and identifying where assets and hazards intersected.

While no essential or critical facilities are in the floodplain, several critical infrastructure and environmental assets are exposed to the flood hazard. Exposed critical infrastructure includes Tryon Creek Wastewater Treatment Plant, Oswego Lake sanitary sewer interceptor, Oswego Lake dam and headgate, Highway 43, McVey Avenue, wastewater main lines, water lines, NW Natural gas pipelines, the fiber optic line along Highway 43, several wastewater lift stations, and the Foothills power substation. Exposed environmental assets include Bryant Woods Park, Canal Acres Natural Area, Foothills Park, George Rogers Park, Iron Mountain Park, Lake Grove Swim Park, Lake Oswego Hunt Club, Lake Oswego Swim Park, Millennium Park, River Run Park, Roehr Park, and Tryon Creek State Park.

The Tryon Creek Wastewater Treatment Plant, located in the Foothills area, is located on a parcel that is affected by the Flood Management Area. In off-peak hours, the facility is remotely operated, reducing potential life safety issues from a flood hazard. However, flood conditions that result in a change in hydraulics could affect the operation of the facility.

The water transmission main from the intake on the Clackamas River in Gladstone is susceptible to flooding hazards. The transmission main is buried in the peninsula but can be exposed in a large flood, making it susceptible to damage. Additionally, prolonged periods of rain can cause the sewer interceptor system to back up and flow out of manholes and into Oswego Lake or onto streets near the lake.

The three wastewater main lines located in the Foothills area are elevated above ground level, potentially increasing susceptibility to flood damage. Other exposed infrastructure including wastewater main lines, natural gas pipeline and fiber optic lines are buried, decreasing their vulnerability to damage from flood hazards. However, these service lines and pipes could be exposed in large flooding events and become susceptible to damage. Hazardous flood conditions could potentially limit or delay access for the purposes of operation or repair. The fiber optic line located in Highway 43/State Street, McVey Avenue and Stafford Road is a significant communication link for the entire region.

The regional Emergency Transportation Route follows State Highway 43 from the northern City limits, and continues south on State Street to McVey Avenue, and then southwest along Stafford Road. This route crosses a bridge on McVey Road (Oswego Lake Outlet/McVey Ave. Bridge) that could be potentially affected during flood conditions. Culverts located along the Emergency Transportation Route could also be affected during hazardous conditions as flood waters could exceed the hydraulic capacity of the facility. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table LO-4.

2024 Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**¹⁵ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report, 82 buildings could be damaged for a total potential loss of \$6.6 million (a building loss ratio of less than 1%). About 224 residents may be displaced by flood (less than 1% of the population).

National Flood Insurance Program (NFIP)

FEMA's Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. The last Community Assistance Visit (CAV) for Lake Oswego was on August 28th, 2003. Lake Oswego does not participate in the Community Rating System (CRS). The Community Repetitive Loss record (Table LO-7) identifies one (1) Repetitive Loss Property¹⁶ and zero (0) Severe Repetitive Loss Properties¹⁷. For information on the location of the property see Volume I, Section 2, Figure 14.

¹⁵ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-24.

¹⁶ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

¹⁷ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Table LO-7 Community Repetitive Loss Properties

RL #	RL or SRL Property	Occupancy	Mitigated?	Currently NFIP Insured	Rated Flood Zone	Post FIRM	Paid Claims	Total Paid Amount
86066	RL	Single Family	No	Yes	C	No	2	\$52,587
Total							2	\$52,587

Source: FEMA Region X, Regional Flood Insurance Liaison, email February 23, 2023.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁸ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Flood Mitigation Projects

Between 2009-2011, the City replaced the Lake Oswego Interceptor Sewer (LOIS), which is located in Oswego Lake. The project also involved seismic upgrades to the elevated wastewater mains that lead into the Tryon Creek Wastewater Treatment Plant.

The previous interceptor was undersized, resulting in overflows during heavy rains and was vulnerable during an earthquake. Replacement of LOIS was critical to ensuring the environmental protection of Oswego Lake and maintaining sewer service for residents. The project was identified in Lake Oswego’s 2004 mitigation plan addendum.

Lake Oswego has completed a study to incrementally model the flood levels of the Tualatin River. The final product of this effort is the production of a series of flood inundation area maps that are based upon the level of the river as measured at the USGS “West Linn” gage station. The city will use these maps to provide critical information to the Emergency Operation Center and crews in the field in an effort to better manage flood response. The maps will allow for strategic allocation of resources necessary to evacuate specific areas, close threatened roads, set up detours and deploy sand bagging materials.

The Engineering Division is developing a drainage improvement plan for the First Addition Neighborhood. Currently, due to a lack of designed neighborhood-wide drainage system, rainwater does not drain properly and streets can flood in this neighborhood. The improvements include the design and construction of new storm drainage systems throughout the neighborhood. The new drainage systems will help to reduce the amount of roadway sediments and pollutants entering into the drainage system, by utilizing various methods such as pollution control manholes and catch basins, infiltration swales, and compost filters. The FAN drainage plan was completed and identifies several projects. The projects have been included in the city CIP Plan, and to date, several have been constructed.

In 2003, Lake Oswego commissioned a study, “Evaluation of Flood Management Alternatives for Oswego Lake and Canal” (Pacific Water Resources, Inc., June, 2003) which detailed strategies to help alleviate

¹⁸ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

flooding of Oswego Lake. In the fall of 2009, the City completed a surface water master plan called the “Clean Streams Plan,” a completed action item from the 2004 mitigation plan.

After the 1996 flood event the City of Lake Oswego commissioned a study, “Lakewood Bay Flood Protection at North Shore Road Bridge” (Pacific Water Resources, June 30, 2000), to evaluate the event of the 1996 flood and what impacts would be experienced by the main part of Oswego Lake if Lakewood Bay were isolated during a similar flood event. During a flood event, blocking the inlet of Lakewood Bay would stop flood waters from filling the bay and overtopping State Street (Highway 43), as occurred in 1996. During the 1996 flood, State Street was flooded and blocked for over a day, affecting emergency access to the eastern part of Lake Oswego. With improvements to the dam spillway in 2011-2012, the city will no longer need to consider blocking the flow path into Lakewood Bay. All flood flows (up to the 100-yr event) will spill over the dam.

During the flood event in 1996, the primary cause of the flooding in the Foothills Road area was due to two sources. Both sources have since been mitigated, as described below:

- A low point in the levy behind (north of) the Tryon Creek Treatment Plant allowed flood waters from the Tryon Creek/Willamette River to overtop the levy and enter the Foothills Road area. The City of Portland has since made repairs and improvements to address the problem.
- A large diameter storm drain pipe that receives runoff from an area of downtown (200+ acres) drains through the Toklat Industries parking lot and discharges into Tryon Creek. Flood waters from the Tryon Creek/Willamette River system backed up through this storm system, surcharging the manholes and catch basins, contributing to the flooding in the Foothills Road area. Subsequently, this problem has been rectified. Redundant check valves have been installed on the storm pipes to prevent back up, and two pump stations have been designed and built that will accept the runoff generated in the upstream drainage basin and “force” it into the drain pipe and through the submerged outlet.

The smaller pump station is an electric submersible pump, designed to handle runoff that accumulates at the Lakeshore Concrete site. Should power fail during a flood event, the pump is positioned so a trailer-mounted portable generator can be plugged into the control panel to provide backup power.

The other pump station is located at the north end of Toklat Industries parking lot. These are two variable speed pumps with a combined capacity of 5,000 GPM. Each pump is powered by a Ford six-cylinder engine, fueled with natural gas. In the event of a loss of supply of natural gas, the backup power source is a power take-off (PTO) drive that is mounted on the vertical drive shaft of the pumps. City Maintenance staff would then mobilize a piece of equipment that employs hydraulics (such as a back-hoe, tractor, or dump truck,) and plug in the quick-connect hoses (stored on site) into the PTO and the piece of mobile equipment.

These pumps were installed in the late 1990’s and City Maintenance staff is familiar with their operation. These systems are inspected and exercised on a regular basis.

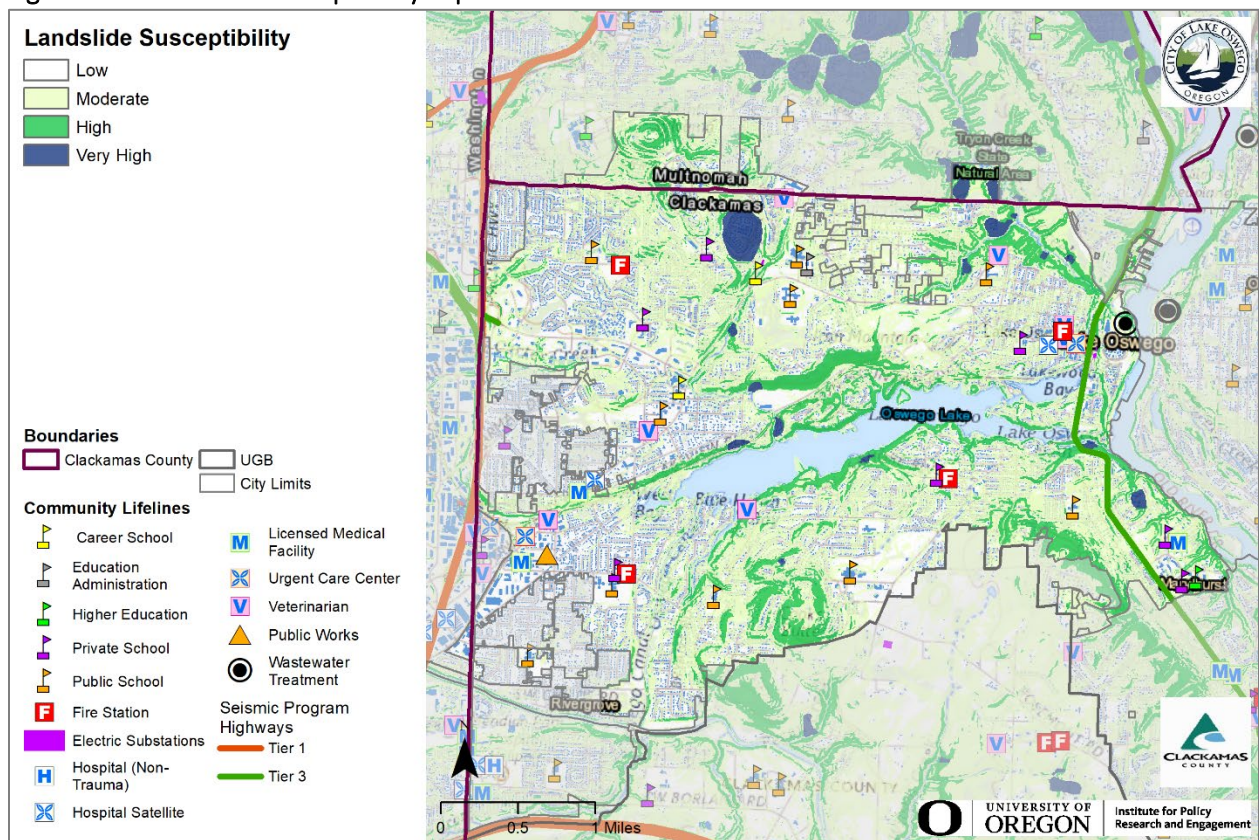
In 2011-2012 the Oswego Lake Corporation completed a dam spillway modification projected funded by a FEMA Flood Mitigation Assistance grant via the City of Lake Oswego (see above for more information).

Landslide

The HMAC determined that the City’s probability for landslide is **high** and that their vulnerability to landslide is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Most of Lake Oswego demonstrates a low to moderate landslide susceptibility exposure, with an area of high exposure around Mountain Park. Approximately 14% of Lake Oswego has very high or high, and approximately 44% moderate, landslide susceptibility exposure. The City’s wastewater main lines, major water lines, and fiber optic lines are identified as being especially vulnerable. Landslide susceptibility exposure for Lake Oswego is shown in Figure LO-5.

Figure LO-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

The City’s drinking water supply comes from the 38 million gallon per day Lake Oswego - Tigard Water Treatment Plant. Located in West Linn, the plant uses water sourced from the Clackamas River in Gladstone to serve Tigard and Lake Oswego. Electricity for the water treatment plant is provided through separate connections located on its property with two utility substations. There are also agreements with other regional water suppliers for back up sources of drinking water.

The water line from the City’s water treatment plant located in West Linn enters the City along Highway 43, and runs north through George Rogers Park, an area vulnerable to landslide hazards. The fiber optic

line located in Highway 43/State Street, McVey Avenue, and Stafford Road is a significant communication link for the entire region.

The last major landslide event occurred in 2009 when a large landslide originated from the slopes above Green Bluff Drive in the Marylhurst area and slid into a home on Woodhurst Place just after 1:00am. Twenty-one homes, and twenty-eight people were evacuated, while five people were transported to the hospital. The Adult Community Center was opened to accommodate families in need of shelter. A second slide down the hill from Green Bluff damaged another home, and the right of way. A third slide on Oak Street deposited earth onto the road and diverted runoff to the properties downhill. Additional landslide events occurred on February 2, 2008 in George Rogers Park, leading to the closure of the pathway between George Rogers Park and Old River Road for five months; in 2008 on Green Street; in December 2007, a rain event led to three slides on Iron Mountain Boulevard and Green Bluff; in 2007 on Eagle Crest Drive and Glenmorrie Drive; in 2006 on Royce Way, Oak Street, and Laurel Street; and in 2004 on Kerr Parkway, Del Prado Street, and Oak Terrace.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)).

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table LO-4.

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

The Adult Community Center, a critical facility, is within a potential landslide area and is exposed to landslide hazards. However, the portion of the parcel that contains the Adult Community Center is relatively flat, while the undeveloped rear portion of the parcel is at the top of a steep slope leading down to Tryon Creek, thereby minimizing risks of the facility to the landslide hazard. The Hallinan School and Westridge Elementary are essential facilities exposed to the landslide hazard.

Exposed infrastructure including wastewater main lines, major water lines and fiber optic lines are buried, decreasing their vulnerability to damage from landslide hazards. However, hazardous landslide conditions could potentially damage the infrastructure and limit or delay access for the purposes of operation or repair. The City's fresh drinking water supply comes from the water treatment plant in West Linn, with the water intake located on the Clackamas River in Gladstone. The water line from the City's water treatment plant located in West Linn enters the City along Highway 43 and runs north through George Rogers Park, an area vulnerable to landslide hazards.

The fiber optic line located in Highway 43/State Street, McVey Avenue and Stafford Road is a significant communication link for the entire region. Exposed environmental assets include George Rogers Park, Iron Mountain Park, Lake Oswego Hunt Club, Lake Oswego Swim Park, and Tryon Creek State Natural Area.

The regional Emergency Transportation Route follows State Highway 43 from the north City limits, and continues south on State Street to McVey Avenue, and then southwest along Stafford Road. At the northern City limits, the Emergency Transportation Route along State Street passes through a potential landslide area, possibly impacting access to and from the City.

The portion of Lake Oswego in Multnomah County, primarily the northern part of the Mountain Park neighborhood, contains steep slopes that are potentially susceptible to landslide hazards. Additionally, a communications tower that is used for emergency communications is in this area on Mt. Sylvania.

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**¹⁹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 1,305 buildings (no critical facilities) are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of \$791.5 million (a building exposure ratio of about 9%). About 4,500 residents may be displaced by landslides (about 11% of the population).

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **moderate** and that their vulnerability is **moderate**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the

¹⁹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-24.

average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of Lake Oswego has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events. resulting from hazards.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²⁰ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City’s probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Lake Oswego.

During a 2021 windstorm, wind caused one minor injury, property damage, power outages, and road closures due to falling tree limbs. Community members also reported flooding, including in the Lake Oswego Public Library. Additionally, both electric power sources at the West Linn Water Treatment Plant were compromised. The Engineering Dept is currently preparing a design to develop onsite emergency backup power to the treatment plant and the water intake facility in Gladstone.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris. Additionally, transportation and economic disruptions result as well.

Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

²⁰ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the City’s probability for winter storm is **moderate** and that their vulnerability to winter storm is **moderate**. *The probability rating decreased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Major winter storms can, and have occurred in the Lake Oswego area, including in December 2008 with the largest winter storm in forty years. The storm led to significant power outages, eight water main breaks, and hazardous road conditions. The City contracted forces to assist in snow removal efforts. Additional recent winter storm (including wind) events occurred in 2021, December 2016/January 2017, January 2016, December 2015 (DR-4258), February 2014 (snow/ice), January 2009, December 2008, and December 2007.

During a winter snow/ice storm in 2021 power was lost throughout the City due to down trees impacting power lines. Water became a significant issue as power was lost at the River Intake Pump Station (RIPS). No permanent generator exists at this location cause extreme difficulty “wiring in” a generator during the weather event.

Most winter storms typically do not cause significant damage; however, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter and commercial traffic as noted above.

Vulnerability Assessment

Due to insufficient data and resources, Lake Oswego is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets Section and Table LO-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²¹ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) by the 2050s, relative to the 1971–2000 historical baselines, under the

²¹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

higher emissions scenario. The temperature on the coldest night of the year is projected to increase by an average of 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Volcanic Event

The HMAC determined that the City’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of volcanic event hazards, history, as well as the location, extent, and probability of a potential event within the region. Volcanoes are located near Lake Oswego, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Lake Oswego’s relative distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**²² provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

²² DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-24.

Wildfire

The HMAC determined that the City’s probability for wildfire is **high**, and that their vulnerability to wildfire is **moderate**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan](#) (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Lake Oswego is found in the following chapter: Chapter 9.8: Lake Oswego Fire Department.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location and extent of a wildland fire vary depending on fuel, topography, and weather conditions. The forested hills within, and surrounding Lake Oswego are interface areas. High Priority Communities at Risk (CARs) include: Iron Mountain Bluff, Palisades, Cooks Butte Park, and Mountain Park. Medium priority CARs include: Tryon Creek State Park, Springbrook Park, and Waluga Park.²³ These areas are characterized by varying housing structures (often large houses on small lots, some with shake roofs), natural, and ornamental vegetation, and topography that may increase the risk for wildfire spreading.²⁴

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four-feet under normal weather conditions.²⁵ However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Weather and urbanization conditions are primarily at cause for the hazard level. Lake Oswego has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. Figure LO-6 shows overall wildfire risk in Lake Oswego.

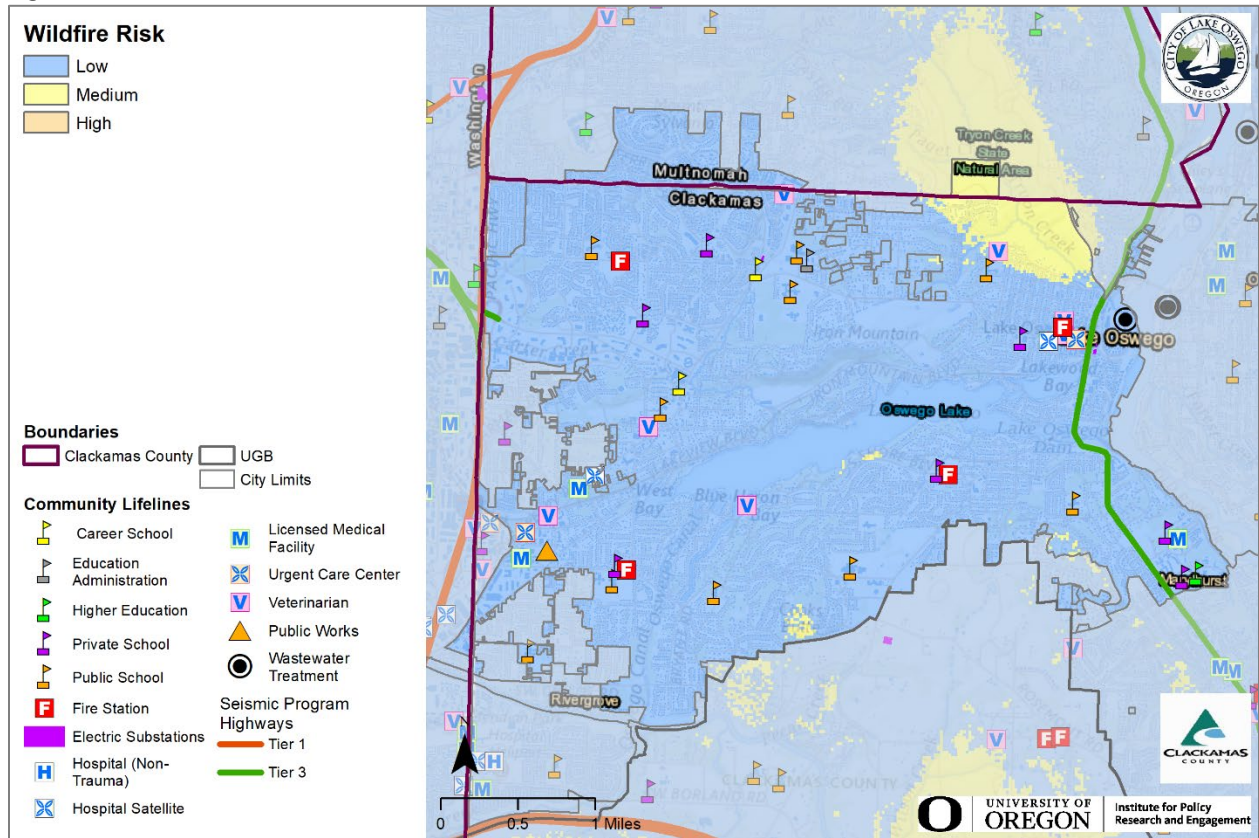
Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Lake Oswego, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

²³ Clackamas County Community Wildfire Protection Plan, *Lake Oswego Fire Department* (2018), Table 10.8-1.

²⁴ Ibid.

²⁵ [Oregon Wildfire Risk Explorer](#), date accessed November 9, 2018.

Figure LO-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Vulnerability Assessment

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. Lake Oswego’s fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City will update the City’s wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

The Adult Community Center, a critical facility, is exposed to a high hazard wildfire area. The rear (northern) portion of the parcel is covered with trees, and slopes steeply down to Tyron Creek, potentially exposing the facility and limiting its availability as an emergency short- term site in the event of a wildfire. The South Shore Fire Station is another critical facility in the high wildfire hazard zone. Essential facilities exposed to high wildfire hazard include Oak Creek Elementary, Westridge Elementary, Hallinan Elementary, Uplands Elementary, Forest Hills Elementary, the area west of Lake Oswego Jr. High, portions of the former Marylhurst University campus, and several churches, which could potentially serve as Red Cross shelter sites.

Exposed infrastructure including wastewater main lines, major water lines, natural gas pipeline and fiber optic lines are buried, decreasing their vulnerability to damage from wildfire hazards. However, wildfire conditions could potentially limit or delay access for the purposes of operation or repair. The City's fresh drinking water supply comes from a water treatment plant in West Linn, with the water intake located on the Clackamas River in Gladstone. The water line from the City's water treatment plant in West Linn enters the City along Highway 43/State Street and runs north through George Rogers Park. This alignment includes areas that could be vulnerable to wildfire hazards. The fiber optic line located along Highway 43/State Street, McVey Avenue and Stafford Road is a significant communication link for the entire region. Operation of and access to other exposed infrastructure including the Oswego Lake headgate, several water pumping stations and reservoirs, a PGE substation in the Mountain Park area and communications towers used for emergency communications located on Cook's Butte and Mt. Sylvania, could be potentially impacted during a wildfire hazard.

The regional Emergency Transportation Route follows State Highway 43 from the northern City limits, and continues south on State Street to McVey Avenue, and then southwest to and along Stafford Road. The Emergency Transportation Route passes through several high wildfire hazard areas, at the northern City limits along State Street and McVey Avenue to the south, possibly impacting access to and from the City.

Several Lake Oswego's parks and open spaces are considered wildfire hazards. These include Bryant Woods Park, Canal Acres Natural Area, **Cooks Butte Park**, Freepons Park, George Rogers Park, Hallinan Natural Area, **Iron Mountain Park**, River Run Park, Roehr Park, Lake Grove Swim Park, Southwood Park, **Springbrook Park**, and **Waluga Park** (parks and open spaces denoted in **bold** are considered high or medium priority CARs within the CWPP, see above for more information). Fuels reduction priority areas identified in the CWPP include: Cooks Butte Park, Iron Mountain Bluff, Springbrook Park, Tryon Park, and Waluga Park.

For the portion of Lake Oswego in Multnomah County, primarily the northern part of the Mountain Park neighborhood, Lake Oswego Fire Department staff has determined that due to the steep slopes and wooded character of this neighborhood, the wildfire hazard ranges from moderate to high.

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**²⁶ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 233 buildings (no critical facilities) are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of \$124.8 million (a building exposure ratio of about 2%). About 765 residents may be displaced by wildfires (about 2% of the population).

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"²⁷ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river

²⁶ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-24.

²⁷ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

Attachment A: Action Item Changes

Table LO-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table LO-1).

Previous NHMP Actions that are Complete:

Multi-Hazard #3, “Address wireless communication deficiencies locally and regionally.” Complete.

- In 2022, the Clackamas County Public Safety Radio Communications System replaced its outdated analog system with a new digital emergency radio system. This system is used by the multi-agency Clackamas 800 Radio Group (C800). The new digital radio system was funded in part from bond funds (Ballot Measure 3-476).
- In January 2024, City Council approved a contract with Motorola Solutions, Inc. to replace 9-1-1 telephone and mapping equipment. The State Office of emergency Management will reimburse the cost through 9-1-1 state telephone fees.
- Lake Oswego's Emergency Operations Center (EOC) has been set up for Family Radio Service (FRS) and General Mobile Radio Service (GMRS) systems.

Multi-Hazard #5, “Upgrade Lake Oswego wastewater system.” Complete.

- The Lake Oswego Interceptor Sewer (LOIS) was completed in June 2011. This project replaced the 20,000-foot interceptor pipe that forms the backbone of the City's sewer collection system and is in Oswego Lake. Sewer from roughly 75% of Lake Oswego households and businesses flows through the interceptor pipe to Portland's Tryon Creek Wastewater Treatment Facility in the Foothills area. (Note - An interceptor sewer line or pipe is a large sewer line that controls the flow of sewage to the treatment plant. It collects the sewage from main and trunk sewer pipes and carries it to the treatment plant.) The LOIS project included seismic upgrades to the new sewer main as well as seismic retrofits to the elevated sewer mains in the Foothills area.

Wildfire #2, “Develop and implement an Urban Forest Fire Management Plan. Complete.

In December 2022, the City Council adopted a Natural Area Habitat Management Plan. In the plan, Objective 4 - Reduce Wildfire Hazards states:

The natural areas that make Lake Oswego a beautiful and desirable place to live and work inherently come with the risk of wildfire by supplying a potential fuel source. Fire hazards are present when there is fuel (e.g., wood) combined with conditions related to local topography and seasonal weather, particularly relative humidity, heat, and wind. Lake Oswego's Fire Department website provides instructions for maintaining defensible space and fire-resistant plants along the interface between human developments and forested areas. The City's Addendum to the Multi-Jurisdictional Hazard Mitigation Plan lists wildfire hazards for neighborhoods bordering specific natural areas, including Iron Mountain Bluff, Palisades neighborhood, Tryon Creek State Park, Springbrook Park, and Waluga Park. In general, this objective is met by reducing fuels along the periphery of natural areas where they are adjacent to human developments. Because of the risk posed by fallen trees or debris generated during windstorms, the City should monitor the edges of these natural areas and identify hazards. Then, within one year or less, those

hazards should then be removed to the park interior or modified (e.g., chipped) to create a less hazardous condition.

Success Criteria: City will monitor applicable park boundaries at least once every two years and remove fire hazards observed within those boundaries within one year. Actions taken to thin dense vegetation and reduce woody debris piles within these edge areas will be documented in a Natural Areas Management Plan Effectiveness Monitoring Report once every five years.

For this action item, the City also:

- Ongoing - Target areas of brush and implement management strategies that are consistent with habitat protection requirements;
- Ongoing - Replace flammable non-native vegetation with native plants that are less flammable; and
- Completed - Enhance water storage facilities and water distribution systems (including hydrants) to serve the wild land/urban interface.

In addition, an early draft of the update to the City's Urban and Community Forestry Plan (UCFP) has been completed. The UCFP brings together policies, practices, and plans related to Lake Oswego's urban forest and serves as a planning and policy tool for managing our urban forest. The UCFP includes some high-level policy guidance related to fire. The final UCFP is expected to be adopted by City Council in Spring 2024.

The City's 2020 Sustainability and Climate Action Plan also contains information relating to wildfires, specifically, noting how proper management of forests will reduce the risk of wildfire events and protect natural resources.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table LO-8 Status of All Hazard Mitigation Actions in the Previous Plan

2019 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete, revised	Yes
Multi-Hazard #2	#2	Not Complete	Yes
Multi-Hazard #3	-	Complete	No
Multi-Hazard #4	#3	Not Complete	Yes
Multi-Hazard #5	-	Complete	No
-	#4	New	-
Earthquake #1	#5	Not Complete, revised	Yes
Flood #1	#6	Not Complete	Yes
Landslide #1	#7	Not Complete	Yes
Severe Weather #1	#8	Not Complete, revised	Yes
Wildfire #1	#9, #10	Not Complete	Yes
Wildfire #2	-	Complete	No
Wildfire #3	#11	Not Complete	Yes

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from February 15 through March 8 on the City's website. The plan was also posted and announced on the County's website. There were several comments provided that have been reviewed and integrated into the NHMP as applicable. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting

The screenshot displays the City of Lake Oswego website's 'Natural Hazard Mitigation Plan' page. The page features a navigation menu on the left with categories like 'City Manager Home', 'About', 'Programs', 'City Recorder', 'Emergency Info', 'Emergency Management', 'Emergency Operations Plan', 'Natural Hazard Mitigation Plan', 'Public Alerts - Emergency Notification', 'Are You Ready?', 'Business Preparedness', 'Power Outage', 'Neighborhood Preparedness & PlanC', and '3 Steps to Preparedness'. The main content area includes a header image of a lake and mountains, followed by the title 'Natural Hazard Mitigation Plan' and a detailed introductory paragraph. A 'Related Links' section contains a link to 'Provide Comments on the Draft 2024 Lake Oswego NHMP'. An 'Attachments' section lists 'DRAFT 2024 Natural Hazards Mitigation Plan', '2019 Natural Hazard Mitigation Plan', and '2013 Natural Hazards Mitigation Plan'. The page also includes a 'Public Alerts - Emergency Notification' section and a 'Business Preparedness' section with a 'Weekend hot swap hot line' link. A 'Tips for Winter Travel' section is also visible. The page footer contains contact information for Michael Howard and Bonnie Hirschberger, and a deadline for comments on the draft 2024 Lake Oswego NHMP by 5 p.m. on March 8, 2024.

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1: March 20 and May 30, 2023

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: November 13, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

City of Milwaukie Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: City of Milwaukie

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The City of Milwaukie

Updated:
July 9, 2024, (Resolution # 38-2024)
January 21, 2020, (Resolution # 8-2020)
2013
2009

This Natural Hazard Mitigation Plan was prepared by:



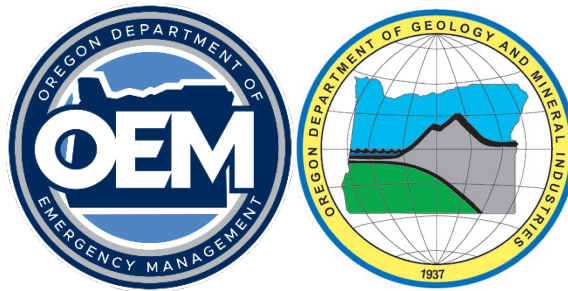
Planning grant funding provided by:



Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS



COUNCIL RESOLUTION No. 38-2024

**A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF MILWAUKIE, OREGON,
ADOPTING AN UPDATED NATURAL HAZARDS MITIGATION PLAN (NHMP).**

WHEREAS the City of Milwaukie recognizes the threat that natural hazards pose to people, property, and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple Federal Emergency Management Administration (FEMA) pre- and post-disaster mitigation grant programs; and

WHEREAS the city has identified natural hazard risks and prioritized a number of proposed actions and programs to mitigate the vulnerabilities of the city to the impacts of future disasters within the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan; and

WHEREAS these proposed projects and programs have been incorporated into the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan that has been prepared for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS the Oregon Department of Emergency Management and FEMA Region X officials have reviewed the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan and pre-approved it on May 29, 2024, contingent upon official adoption by participating governments and entities.

Now therefore, be it Resolved by the City Council of the City of Milwaukie, Oregon, that the City of Milwaukie adopts the NHMP and directs the city manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

And be it further Resolved that the City of Milwaukie adopts the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan as an official plan.

And be it further Resolved that the City of Milwaukie will submit this adoption resolution to the Oregon Department of Emergency Management and FEMA Region X officials to enable final approval of the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan.


Introduced and adopted by the City Council on July 9, 2024.

This resolution is effective immediately.

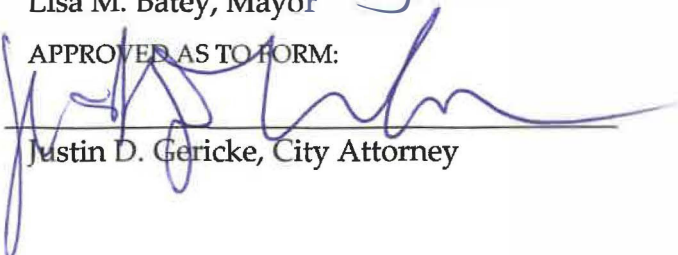
ATTEST:



Scott S. Stauffer, City Recorder



Lisa M. Batey, Mayor

APPROVED AS TO FORM:


Justin D. Gericke, City Attorney

Purpose

This is an update of the Milwaukie addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Milwaukie’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Milwaukie adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 9, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

Milwaukie first developed an addendum to Clackamas County’s Natural Hazard Mitigation Plan in 2003. This plan was updated in 2009, 2012/2013, and in 2018/2019.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Milwaukie to update their NHMP.

The Clackamas County NHMP, and Milwaukie addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Milwaukie HMAC guided the process of developing the NHMP.

Convener

The Milwaukie Events & Emergency Management Coordinator serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Milwaukie HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City's addendum, with focus on the NHMP's risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City's risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Milwaukie HMAC was composed of the following representatives:

- Convener, Dan Harris, Events and Emergency Management Coordinator
- Luke Strait, Police Chief
- Robbie Graves, Police Captain
- Damien Farwell, Fleet and Facilities Supervisor
- Mike Harman, Acting Fleet and Facilities Supervisor
- Nick Lindekugel, GIS Coordinator
- Natalie Rogers, Climate and Natural Resources Manager
- Peter Passarelli, Public Works Director
- Steve Adams, City Engineer
- Jennifer Garbely, City Engineer
- Patrick McLeod, Building Official
- Joseph Briglio, Community Development Director
- Brett Kelper, Senior Planner

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Milwaukie addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County's multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City's HMAC will convene after re-adoption of the Milwaukie NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The city's Events & Emergency Management Coordinator will serve as the convener and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4.

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction's website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Milwaukie will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Milwaukie to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

Milwaukie adopted a new Comprehensive Plan document in August 2020. The Community Vision in the Comprehensive Plan includes the statement: “Milwaukie is a resilient community, adaptive to the realities of a changing climate, and prepared for emergencies, such as the Cascadia Event.” The [Environmental Stewardship and Community Resiliency](#) chapter addresses Statewide Planning Goal 7 Natural Hazards. It includes “important issues that have gained prominence more recently, such as climate change adoption and mitigation” in Subsection 5, Natural Hazards. This chapter reflects the findings and recommendations of the Milwaukie Climate Action Plan (2018), Milwaukie Hazard Mitigation Plan (2020), and Clackamas County Multi-Jurisdictional Hazard Mitigation Plan (2019).

Hazards specifically called out include flooding, landslides, weak foundation soils, earthquakes, high winds, and wildfires. Key issues include climate change, Cascadia Subduction Zone Earthquake, and vulnerable populations. Goals identify areas with high natural hazard potential and develop policies and programs to avoid or reduce potential negative impact, expand partnerships and education, ensure that the City’s build environment and infrastructure are adequately prepared, and develop programs for adaptation and mitigation. This includes a prohibition against building essential facilities that serve vulnerable populations in areas at risk from flooding, landslides, liquefaction, and fire.

Planned updates to the jurisdiction’s Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community’s long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

Title 3 of the Metro Urban Growth Management Functional Plan

This policy requires the city to balance any fill in the floodplain with a corresponding cut that excavates an equal amount of material. In addition, Title 3 requires the city to regulate the area of inundation from the 1996 flood in addition to the area with a 1% chance of flooding as identified on National Flood Insurance Program (NFIP) maps.

Municipal Development Codes

The Planning Department maintains and implements the Comprehensive Plan and other planning documents, and implements the community’s development standards through the Zoning, Land Division, and Sign Ordinances. They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Examples of Municipal Code sections that directly relate to resilience and mitigation efforts include:

- Title 16 Environment
 - Includes Chapter 16.12 Seismic Conditions, Chapter 16.16 Weak Foundation Soils, and Chapter 16.28 Erosion Control.
- Title 18 Flood Hazard Regulations
 - Adopted 2021 by Ordinance 2199, this section enforces the National Flood Insurance Program requirements within the city limits. Special flood hazard areas are those identified in the Flood Insurance Study for Clackamas County, Oregon and Incorporated Areas,” dated January 18, 2019, with accompanying FIRMs 4100C0009D, 4100C0017D, 4100C0028D, and 4100C0036D. The February 1996 flood inundation area identified by the Metro Water Quality and Flood Management Area is also incorporated by reference. Their flood prevention code section is based on the Oregon Model Flood Hazard

Prevention code, which includes provisions addressing substantial improvement/substantial damage.

- Title 19 Zoning
 - Title 19 includes land use standards for all zones and uses within the city.
- Title 12 Public Services
 - Includes development standards to meet provisions of the City’s NPDES permit, including design standards for water quality facilities.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

The Milwaukie **Community Development Department** oversees the following departments and services:

The **Planning Division** regulates growth and development in the city of Milwaukie by administering the city’s Comprehensive Plan and Municipal Code related to zoning and land division. Tasks range from implementing existing zoning regulations to assisting city Council with land use and growth planning policy development. Planning is also responsible for regulating development impacts in natural resource areas.

The **Building Division** is responsible for plan review and inspections on commercial, industrial, and residential developments, as well as fire life and safety plan review. The Division administers and enforces the 2022 Oregon Fire Code, the 2022 Oregon Structural Specialty Code, Mechanical Specialty Code, Plumbing Specialty Code, Electrical Specialty Code, and Residential Specialty Code.

The **Engineering Department** provides quality engineering services to ensure that all city utilities, including wastewater collection, water, streets, and storm water infrastructure, meet all municipal code requirements, are efficiently managed at the lowest cost to ratepayers, and serve the long-term needs of the community. In addition, the Engineering Department provides floodplain management and regulation for the city.

Public Works

The City of Milwaukie Public Works Department is composed of the divisions responsible for stormwater, wastewater, water, streets, facilities, natural resources, and the city’s fleet. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

The **Public Works Department** provides many of the basic urban services to the citizens of Milwaukie including the following:

The **Stormwater Division** conducts regular sewer line cleaning and inspection. The Stormwater Division maintains all the components that comprise the city's stormwater infrastructure, valued at over \$6,094,886. The various components of the system include: 1190 catch basins, 548 manholes, 62 sedimentation-manholes, 197 drywells, 37 miles of pipe and open ditches, and 5 detention ponds. It uses information from inspections for ongoing analysis of the sewer system components and capital needs assessment, and on the spot pipe rehabilitation to minimize sewer back-ups.

The **Wastewater Division** is responsible for the maintenance of the city’s wastewater (sanitary sewer) system. The Wastewater Division maintains all the components that comprise the city's wastewater

infrastructure, valued at over \$7,029,552. The various components of the system include: 75 miles of sanitary sewer, 5 lift stations, and 1,607 manholes.

The **Water Division** is responsible for the supply and distribution of drinking water. The Water division maintains all the components that comprise the city's infrastructure, valued at over \$16,516,356. The various components of the system include: 100 miles of water main, 964 fire hydrants, 6,911 water services, 7 well houses, 3 storage reservoirs and 4 pump stations. The division ensures that the city's water storage and distribution systems comply with all state and federal regulations.

The **Streets Division** maintains all the components that comprise the city's infrastructure, valued at over \$38,785,042. The various components of the system include: 75 miles of road surface, signage, and street pavement markings.

The **Fleet Division** maintains all the city's vehicles and equipment including police cars, sweepers, excavators, dump trucks and 150 pieces of small equipment and generators. And, the **Facilities Division** is responsible for maintaining all city facilities.

The **Natural Resources Division** is responsible for the maintenance of green infrastructure in the city, including management of the urban forest. It also ensures that the city complies with the National Discharge Elimination System (NPDES) to protect surface water quality. The Natural Resources division also leads the city's climate work and environmental outreach and education.

City Administration

The City Council of Milwaukie has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

The **Office of the City Manager** is responsible for taking charge of the daily supervision of city affairs. The Events & Emergency Management Coordinator is assigned to this department.

Policies and Programs

This Plan directs Milwaukie and Clackamas County to explore integration into other planning documents and processes. Milwaukie has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

Transportation System Plan 2025

The City has begun a comprehensive Transportation System Plan update (updating the original 2008 document, which was partially updated in 2013). One of the broad goals for the update is to “improve Milwaukie’s ability to recover from severe storms or an earthquake.”

Water System Master Plan 2021

This 2021 Water Master Plan (2021 WMP) updates the City of Milwaukie’s 2010 Water Master Plan. The 2021 WMP describes current conditions of the City’s water system and addresses projected future needs. Information in the 2021 WMP enables City staff to respond effectively to new water system demand for future development. It includes a capital improvement program (CIP) designed to meet current and future demand and to replace aging and seismically non-resilient assets. The 2021 WMP includes an assessment of seismic resiliency of public water system assets in compliance with Oregon Health

Authority requirements and identifies water system risks associated with natural hazards and malevolent act based on the U.S. Environmental Protection Agency’s comprehensive list of water system threats.

Stormwater Management

Under the Clean Water Act, the City of Milwaukie is permitted to manage storm water in a manner that reduces pollution from entering local streams and groundwater to the maximum extent practicable. The division develops and oversees the Capital Improvement Program (CIP) for replacing or upgrading Stormwater infrastructure found in the 2014 Stormwater Management Plan.

The Stormwater division must ensure that the work is done in compliance with the National Pollutant Discharge Elimination System (NPDES) Permit. This Division has an aggressive sweeping cycle of every eight days to meet NPDES MS4 Permit requirements and it is committed to an ongoing education program for its employees to keep up with the evolving changing technology, rules, and regulations.

TMDL Plan

The City maintains a Total Maximum Daily Load (TMDL) Plan (updated in 2022). The Total Maximum Daily Load (TMDL) program is intended to comply with the Willamette Basin TMDL order and to address the Revised Willamette Basin Mercury TMDL (effective February 2021). The goal of this Implementation Plan is to minimize and reduce temperature, bacteria, mercury, and DDT/dieldrin (Johnson Creek only) contributions to surface waters within Milwaukie. The NHMP actions are incorporated into this document as appropriate. Example projects include erosion control education and enforcement, stormwater conveyance system cleaning and maintenance, and consistent street cleaning.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The NHMP will also be integrated into the City’s Capital Improvement Plan, to be adopted by early 2024.

National Flood Insurance Program

Milwaukie participates in the National Flood Insurance Program. The Engineering and Planning Divisions and Public Works share responsibility for administering the day-to-day activities of the city’s floodplain program.

Specifically, the floodplain manager is responsible for:

- maintains and administers Milwaukie’s floodplain regulations;
- reviews and issues floodplain development permits;
- maintains elevation certificates for all new and substantially improved structures (and maintains an extensive database of historic elevation certificates);
- ensures that encroachments do not occur within the regulated floodway;
- implements measures to ensure that new and substantially improved structures are protected from flood losses;
- maintains floodplain studies and maps and makes this information available to the public;
- maintains a flood information website with digital flood insurance rate map (DFIRM) data;
- conducts site visits to assess conditions and provide technical assistance to the public;
- maintains a library of historical flood related information;
- informs the public of flood insurance requirements; and
- conducts outreach and training about flood hazards and development within the floodplain.

Community Emergency Response Teams (CERT)

The Milwaukie CERT program was founded in 2010 and includes active and reserve members who meet periodically for training and to conduct drills that prepare them to help in responding to natural hazards – such as flooding, earthquakes, and snow/ice – that impact Milwaukie.

Personnel

The following Milwaukie personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Dan Harris, Events & Emergency Management Coordinator

Public Information Officer: Jordan Imlah, Communication Program Manager

Floodplain Manager: Brett Kelter, Senior Planner

Grant writing (for Public Works or emergency management): Dan Harris, Events & Emergency Management Coordinator

Capital improvement planning: Jennifer Garbely, City Engineer

Capital improvement execution: Jennifer Garbely, City Engineer

Milwaukie does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Milwaukie has implemented recommendations from the last NHMP into its capital improvement projects over the last 5 years, including:

The following mitigation-related or resilience projects are a sample of those completed prior to 2018:

- Ardenwald Elementary reconstruction (2010)

The following mitigation-related or resilience projects have been completed since 2019:

- Milwaukie High School reconstruction

Ongoing projects that enhance the City's resilience include:

- Public Safety Building seismic upgrade

Proposed projects that relate to hazard mitigation and resilience within the next five years include:

- Seismic evaluation of Stanley Reservoir and performance of required retrofit
- Seismic evaluation of wells, pumphouses, and 3rd Pressure Zone building.
- Removal of Kellogg Dam in 2027-2028. The project will include habitat restoration on lower Kellogg Creek.

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)¹.

FEMA Funded Mitigation Successes

- 2016: FMA-PJ-10-OR-2016-002, *Rusk Road Acquisition/demolition* (\$395,485) In City
- 2016: FMA-PJ-10-OR-2016-003, *Acquisition/demolition* (\$474,078) In City

Seismic Rehabilitation Grant Program Mitigation Successes

- 2022: Public Safety Building (\$1,233,817) *-in process*

Capital Resources

Milwaukie maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Critical facilities with power generators for use during emergency blackouts include: City Hall, the Public Safety Building, and several Public Works facilities around the city.

Warming or cooling shelters include: The City's Ledding Library acts as a de facto warming/cooling center during operating hours. Discussions are underway with Clackamas County to expand its capacity as a cooling center and to identify private providers for a warming shelter within the city.

Food pantries include: The city does not maintain any food pantries. Pantries are maintained by Providence Milwaukie Hospital, the North Clackamas School District, the LoveOne community organization, and other non-city organizations.

Fueling storage: The city does not maintain fueling services following the decommissioning of its fueling center at its Johnson Creek Boulevard facility. The city relies on commercial fueling centers for gasoline and diesel fuel.

Findings

Several important findings from this capability assessment informed the design of the Plan's mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Milwaukie staff are assigned hazard mitigation responsibilities as a part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

¹ The Seismic Rehabilitation Grant Program (SRGP) 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.

Reliance upon outside funding streams and local match requirements

Milwaukie operates on a limited budget with many conflicting priorities. The city incorporates hazard mitigation as part of infrastructure and other projects, even where hazard mitigation is not the primary purpose of those projects. The city relies upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City's ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

“Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.”

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The City's mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAAC assessed the City's risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the

actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table MI-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAC decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table MI-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
1	Coordinate with Clackamas County, OEM, the American Red Cross, and other relevant agencies to identify shelter facilities within Milwaukie to ensure there are adequate shelter facilities in hazard-free zones to serve Milwaukie residents.		X	X	X	X	X	X	X	X	Emergency Management/ CERT Volunteer, CFD#1	Ongoing	General Fund, BRIC	Low
2	Increase outreach and education for hazard awareness and natural disaster preparedness, especially for low-income, elderly, non-English speaking, and other vulnerable populations.	X	X	X	X	X	X	X	X	X	Emergency Management/ Public Works, Community Services, CFD#1, CERT	Ongoing	General Fund, HMGP, BRIC	Medium
3	Maintain and enhance strategies for debris management for all hazards.		X		X	X	X	X	X	X	Public Works/ METRO	Ongoing	General Fund	Medium
4	Improve and obtain resources and equipment essential for responding to and recovering from disasters.	X	X	X	X	X	X	X	X	X	Public Works/ Emergency Management	Ongoing	General Fund, HMGP, BRIC, Seismic Rehabilitation Grant Program	High
5	Coordinate natural hazard related climate change action items through the Milwaukie Community Climate Action Plan (CAP).	X		X	X			X	X	X	Public Works/ Planning, CFD#1, EM, Community Services	Ongoing	General Fund	High
6	Evaluate alternatives for reducing the flooding hazard for properties along Kellogg Creek, Johnson Creek, Mount Scott Creek area, and the Willamette River.				X						Engineering/ Planning, Public Works	Long	General Fund, HMGP, FMA, PDM	High

Table MI-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
7	Bury vulnerable critical infrastructure, such as power lines, to lessen potential failures during severe weather.								X	X	Public Works / Engineering	Long	General Fund, HMGP, BRIC	High
8	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.									X	Emergency Management/ Clackamas FD1, Public Works, Building, Planning	Ongoing	General Fund, HMGP, BRIC	Low

Source: Milwaukie NHMP HMAP, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

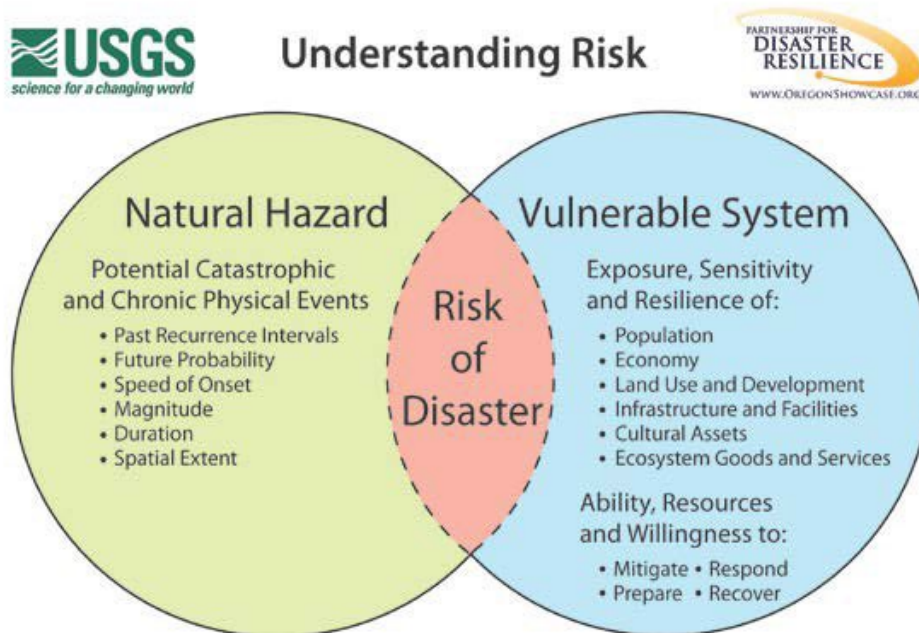
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure MI-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure MI-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Milwaukie HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Milwaukie, which are discussed throughout this addendum. Table MI-2 shows the HVA matrix for

Milwaukie listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Three chronic hazards (extreme heat, wildfire, and flood) rank as the top hazard threats to the City (Top Tier). Cascadia earthquake, crustal earthquake, winter storm, drought, and windstorm comprise the next highest ranked hazards (Middle Tier), while landslide and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table MI-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Extreme Heat Event	16	50	90	70	226	1	Top Tier
Wildfire	16	45	90	70	221	2	
Flood	10	30	80	70	190	3	
Earthquake - Cascadia	2	50	100	35	187	4	Middle Tier
Earthquake - Crustal	2	40	100	42	184	5	
Winter Storm	16	20	90	56	182	6	
Drought	16	20	70	70	176	7	
Windstorm	8	25	70	56	159	8	
Landslide	12	15	60	56	143	9	Bottom Tier
Volcanic Event	2	15	50	7	74	10	

Source: Milwaukie HMA, 2023.

Future Climate Variability

Human-caused climate change is impacting the natural systems and environmental health of regional and local communities. The city of Milwaukie recognizes the effects that climate change will have on the city and its residents, including changes to the frequency, severity, and impacts of natural hazards from historical norms. According to the [Intergovernmental Panel on Climate Change Fourth National Climate Assessment](#), the Pacific Northwest region will see impacts to drought risk, water quality, wildfires and air quality, human health and more due to climate change. Even with these challenges, the Pacific Northwest and the city of Milwaukie will shelter a growing population seeking livability and refuge from more extreme climates in the nation.

Climate models for Oregon suggest, future regional climate changes include increases in temperature around 0.2-1°F per decade in the 21st Century, along with warmer and drier summers, and some evidence that extreme precipitation will increase in the future.² Increased droughts may occur in the Willamette Valley under various climate change scenarios because of factors, including reduced snowpack, rising temperatures, and reductions in summer precipitation. Climate models suggest that as the region warms, winter snow precipitation will likely shift to higher elevations and snowpack will be diminished as more precipitation falls as rain altering surface flows.

Acknowledging the city’s responsibility to be a leader in the climate crisis, Milwaukie adopted a [Climate Action Plan](#) detailing 53 city-led actions to mitigate and adapt to climate change. Along with reducing the city’s greenhouse gas emissions and contribution to climate change, the Climate Action Plan calls for

² Oregon Climate Change Research Institute (OCCRI), [Fourth Oregon Climate Assessment Report](#) (2019) and [Fourth National Climate Assessment, Chapter 23: Northwest](#) (2019). <http://www.occri.net/publications-and-reports/publications/>

increasing the community’s resiliency and preparedness for natural hazards through policy, advocacy, outreach, and education.

Milwaukie is committed to planning and preparing for the immediate and future threats that climate change will have on the community. By addressing the climate crisis through the actionable goals of the Climate Action Plan, Milwaukie hopes to reduce the risk and impact of climate change related natural hazards on residents of Milwaukie and the region while encouraging others to take climate action.

Community Characteristics

Table MI-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

The city is located within the southern bounds of the Portland metropolitan area approximately six miles from downtown Portland. The city is within the Willamette River basin and has two major creeks flowing through it, Johnson Creek in the northern part of the city and Kellogg Creek in the south.

Milwaukie’s climate is consistent with the Marine West Coast Climate Zone, with warm summers and cool, wet winters. Milwaukie receives most of its rainfall between October and May, and averages 43 inches of rain, and less than one (1) inch of snow, per year. Elevations in the city range from 205 feet near 59th Avenue and Monroe Street to a low of 43 feet on the shores of the Willamette River. Milwaukie is characterized by flat or gently hilly topography.

Population, Housing, and Income

Milwaukie has grown substantially since its incorporation in 1903 and has an area today of about 5 square miles. Between 2016 and 2021 the City grew by 795 people (4%; as of 2022 the population is 21,305). Between 2022 and 2040 the population is forecast to grow by 9% to 23,268.

Most of the population is White/Caucasian (81%) and about 18% of the population is Hispanic or Latino. The poverty rate is 8% (7% of children under 18, 11% for people 65 and older), 6% do not have health insurance, and 53% of renters pay more than 30% of their household income on rent (34% for owners). About 38% of the population has a bachelor’s degree or higher (5% do not have a high school degree). Approximately 12% of the population lives with a disability (30% of population 65 and older), and 38% are either below 15 (21%) or over 65 (17%) years of age. About 12% of the population are 65 or older and living alone and 10% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 73% of housing units are single-family, 26% are multifamily, and 1% are mobile homes. Over half of homes (55%) were built before 1970 and only 22% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (57%) of housing units are owner occupied, 40% are renter occupied, less than 1% are seasonal homes, and 3% are vacant.

Transportation and Infrastructure

Milwaukie is accessible by two state highways, 99E (or McLoughlin Blvd.), running north to south in the western part of the city, and Highway 224, running west to east through the central part of the city. Milwaukie is also bisected by the Union Pacific Railroad main line, which travels northwest to southeast carrying both passengers and freight.

As shown in Table MI-3 Motor vehicles represent the dominant mode of travel through and within Milwaukie. Nine percent (9%) of renters and 39% of owners do not have a vehicle. Most workers drive alone to work (69%); 7% carpool, 6% use public transit, 4% either walk or use a bicycle, and 14% work at home.

The responsibility and authority, as well as the financial capability, to maintain an adequate level of service for the highways rests with Metro and Oregon Department of Transportation (ODOT) authorities. Congestion can result in the diversion of traffic onto City streets.

The City's public transit is provided by the TriMet transit system. Nine bus routes go through the downtown Milwaukie transit center daily. The [MAX Orange Line](#) provides service to Milwaukie. The availability and quality of pedestrian and bicycling facilities (sidewalks, bike lanes, and pathways) is inconsistent but has improved substantially since the 2019 NHMP update due to an increased investment in the Safe Routes to School and Safe Access for Everyone Programs. [Base Maps](#) are found on the city's website.

Economy

Milwaukie is a major industrial center in the Portland metropolitan area containing one of the largest concentrations of warehousing and distribution facilities in the region. The Milwaukie Industrial Park, Omark Industrial Park, and the Johnson Creek industrial area comprise over 300 acres of industrial land within the city. These areas are nearing capacity and very little land within the city is currently available for new industrial development.

Milwaukie's commercial lands are largely built up. New commercial development along Highway 224, McLoughlin Boulevard, and 82nd Avenue has lured many people away from downtown Milwaukie for purchasing comparison goods such as clothes, furniture, and appliances. Downtown Milwaukie, however, has continued to attract commercial investment in the form of commercial service uses including banks, insurance, professional offices, and several residential mixed-use developments. The city has identified areas for commercial, office, or mixed use development: [map](#).

The City, school district, and smaller employers (retail, offices and other professional services) provide for most of Milwaukie's employment.

About 56% of the resident population 16 and over is in the labor force (11,892 people) and are employed in a variety of occupations including professional (25%), management, business, and financial (19%), office and administrative (13%), sales (10%), and construction, extraction, and maintenance (9%) occupations.

Most workers residing in the city (93%, 9,523 people) travel outside of the city for work primarily to Portland and surrounding areas.³ A significant population of people travel to the city for work, (95% of the workforce, 12,992 people) primarily from Portland and surrounding areas.⁴

³ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 18, 2023 at <https://onthemap.ces.census.gov>.

⁴ Ibid.

Table MI-3 Community Characteristics

Population Characteristics		Population	Household Characteristics		
		Growth			
2016 Population Estimate	20,510		Housing Units		
2022 Population Estimate	21,305	4%	Single-Family (includes duplexes)	6,935 73%	
2045 Population Forecast*	23,268	9%	Multi-Family	2,507 26%	
Race			Mobile Homes (includes RV, Van, etc.)	116 1%	
American Indian and Alaska Native		< 1%	Household Type		
Asian		3%	Family Household	5,176 56%	
Black/ African American		1%	Married couple (w/ children)	1,482 16%	
Native Hawaiian and Other Pacific Islander		< 1%	Single (w/ children)	892 10%	
White		81%	Living Alone 65+	1,090 12%	
Some Other Race		< 1%	Year Structure Built		
Two or More Races		6%	Pre-1970	5,212 55%	
Hispanic or Latino/a (of any race)			1970-1989	3,129 33%	
Limited or No English Spoken	309	2%	1990-2009	1,151 12%	
Vulnerable Age Groups			2010 or later	66 1%	
Less than 5 Years	1,108	5%	Housing Tenure and Vacancy		
Less than 15 Years	3,264	16%	Owner-occupied	5,441 57%	
65 Years and Older	3,217	15%	Renter-occupied	3,779 40%	
85 Years and Older	369	2%	Seasonal	32 < 1%	
Age Dependency Ratio		0.44	Vacant	306 3%	
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)		
Total Disabled Population	2,618	12%	No Vehicle (owner occupied)	171 3%	
Children (Under 18)	124	3%	Two+ vehicles (owner occupied)	3,824 70%	
Working Age (18 to 64)	1,546	11%	No Vehicle (renter occupied)	352 9%	
Seniors (65 and older)	948	30%	Two+ vehicles (renter occupied)	1,268 34%	
Income Characteristics			Employment Characteristics		
Households by Income Category			Labor Force (Population 16+)		
Less than \$15,000	504	5%	In labor Force (% Total Population)	11,892 56%	
\$15,000-\$29,999	754	8%	Unemployed (% Labor Force)	632 5%	
\$30,000-\$44,999	1,363	15%	Occupation (Top 5) (Employed 16+)		
\$45,000-\$59,999	994	11%	Professional & Related	2,978 25%	
\$60,000-\$74,999	1,090	12%	Management, Business, & Financial	2,223 19%	
\$75,000-\$99,999	1,167	13%	Office & Administrative	1,585 13%	
\$100,000-\$199,999	2,891	31%	Sales & Related	1,152 10%	
\$200,000 or more	457	5%	Construction, Extraction, & Maint.	1,027 9%	
Median Household Income			\$73,351	Health Insurance	
Gini Index of Income Inequality			0.40	No Health Insurance	1,329 6%
Poverty Rates (Percent age cohort)				Public Health Insurance	7,194 34%
Total Population	1,902	9%		Private Health Insurance	15,210 72%
Children (Under 18)	403	10%	Transportation to Work (Workers 16+)		
Working Age (18 to 64)	1,159	8%	Drove Alone	8,126 69%	
Seniors (65 and older)	340	11%	Carpooled	841 7%	
Housing Cost Burden (Cost > 30% of household income)			Public Transit	678 6%	
Owners with a Mortgage	1,406	34%	Motorcycle	0 0%	
Owners without a Mortgage	226	17%	Bicycle/Walk	416 4%	
Renters	1,986	53%	Work at Home	1,662 14%	

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", METRO 2040 Population Distributed Forecast (2021, [Exhibit A to Ordinance 21-1457](#)).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Milwaukie. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table MI-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table MI-4 Critical Facilities

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
Critical Facilities by Community	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Ardenwald Elementary School	-	X	X	-	-
Campbell Elementary School	-	X	X	-	-
Public Safety Building (CFD #1 - Station 2)	-	X	-	-	-
Kellogg Creek WWTP	-	X	X	-	-
Lewelling Elementary School	-	X	-	-	-
Milwaukie Elementary School	-	X	X	-	-
Milwaukie High School	-	X	X	-	-
Milwaukie Public Works Campus	-	X	X	-	-
Portland Waldorf School	-	X	X	-	-
Providence Milwaukie Hospital	-	X	X	-	-
Rowe Middle School	-	X	X	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-27.

Additional Critical Facilities not included in the DOGAMI Risk Report:

Facilities not in the City:

- [Town Center Station](#) (11300 SE Fuller Rd)
- [Oak Grove Station](#) (2930 SE Oak Grove Blvd)
- [Lake Road Station](#) (6600 SE Lake Rd)
- Clackamas County Sheriff’s Office (9101 SE Sunnybrook Blvd)
- Oregon State Police (8805 SE Deer Creek Ln)

Hospitals:

- Kaiser Permanente Sunnyside Hospital (10180 SE Sunnyside Rd; not in city)
- Providence Willamette Falls Medical Center (1500 Division St; not in city)

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public’s ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields.

City Buildings:

- City Hall
- Ledding Library
- Milwaukie Community Center
- Johnson Creek Blvd Campus
- Public Safety Building

County Buildings:

- Kellogg Treatment Plant

Schools:

- Ardenwald Elementary
- Clackamas Community College (Harmony Road Campus)
- Linwood Elementary
- Milwaukie Elementary/ El Puente
- Milwaukie High School
- Portland Waldorf School (private)
- Rowe Middle School
- Seth Lewelling Elementary
- St. John the Baptist School (private)
- School Transportation Center (not in city)
- Wichita Center (not in city)

Potential Red Cross Shelter Sites:

- Milwaukie Community Center (5440 SE Kellogg Creek Dr)
- Milwaukie Presbyterian Church (2416 SE Lake Rd)
- Clackamas Park Friends Church (8120 SE Thiessen Rd, Oak Grove)
- King of Kings Lutheran Church (5501 SE Thiessen Rd, Oak Grove)
- New Hope Church (5197 SE King Rd, Milwaukie)
- Grace Pointe Church (10750 SE 42nd Ave)
- Oddfellows Hall (10282 SE Main St)
- Schools throughout Milwaukie

Essential Infrastructure

Infrastructure that provides necessary services for emergency response include:

Bridges:Clackamas County:

- 55th Ave across Johnson Creek
- 60th Ave across Johnson Creek
- Linwood Ave across Johnson Creek
- Milport Rd across Johnson Creek
- Oatfield Rd across Kellogg Creek
- Rusk Rd across Mount Scott Creek

Portland:

- Johnson Creek Blvd. across Johnson Creek
- Ochoco St across Johnson Creek

TriMet (rail):

- Rail across Highway 99E
- Rail across Kellogg Creek
- Rail crossing north of Mailwell Dr

State of Oregon:

- 17th Ave across Johnson Creek
- McLoughlin Blvd. across Johnson Creek N. of city
- McLoughlin Blvd. across Kellogg Creek
- McLoughlin off-ramp to Hwy 224 across Johnson Creek
- Hwy 224 across Johnson Creek, McLoughlin Blvd. & Main
- Hwy 224 across railroad tracks and 26th Ave
- Hwy 224 across Mount Scott Creek
- Hwy 224 across MAX Light Rail Orange Line tracks

City of Milwaukie:

- Kellogg Creek near Milwaukie Bay Park
- Wichita Ave across Johnson Creek
- Stanley Ave across Johnson Creek
- 55th Ave across Johnson Creek

Transportation Corridors:

- 17th Ave
- 32nd Ave
- 55th Ave
- Harrison St/42nd Ave/King Rd.
- Highway 224
- Johnson Creek Blvd
- King Rd
- Lake Rd
- Linwood Ave
- Max Orange Line
- McLoughlin Blvd/Highway 99E
- Oatfield Rd
- River Rd

Water Treatment Facilities:

- 8 City Wells
- Aeration Packed Towers – 5 total at two locations
- Concrete Storage Tank – 40th Ave & Harvey St
- Elevated Water Storage Tank – 40th Ave & Harvey St
- Ground Level Metal Tank – Stanley Ave & Harlow St
- Sewerage Pump Stations – 5

Other Utilities:

- NW Natural pipelines
- PGE Substations (One is at edge of Lake Rd / Harmony Rd; a second is on the East end of Johnson Creek; a third is on the border between Milwaukie and Oak Grove)

Environmental Assets

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include:

City-owned Parks:

- Ball-Michel Park
- Dogwood Park
- Homewood Park
- North Clackamas Park
- Milwaukie Bay Park
- Stanley Park
- Water Tower Park
- Spring Park
- Wichita Park
- Scott Park
- Balfour Park
- Bowman Brae Park

City-managed greenspaces and green infrastructure:

- Stormwater detention facilities
- Public bioswales and raingardens
- Elk Rock Island
- Minthorn Wetlands (partial ownership)
- Willow Place Natural Area
- Public street trees

Waterways and Willamette Tributaries

- Johnson Creek
- Kellogg creek
- Spring Creek

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include:

- Behavioral Health Facility (9200 SE McBrod Ave)
- Hillside Manor (2889 SE Hillside Ct)
- Johnson Creek Treatment Facility (2808 SE Balfour St)
- Prestige Post-Acute and Rehab Center (12045 SE Stanley Ave)
- Royal Marc Retirement Residence (5555 SE King Rd)
- Annie Ross House (transitional family housing; 2316 SE Willard St)
- Milwaukie Community Center (daytime programs; 5440 SE Kellogg Creek Dr)
- ElderPlace Providence (daytime programs, Providence Milwaukie; 10330 SE 32nd Ave)
- Retirement Community near North Clackamas Park (5801 SE Kellogg Creek Dr)
- Deerfield Village (5770 SE Kellogg Creek Dr, not in city)

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include:

- Johnson Creek Blvd (numerous businesses along the road)
- North Milwaukie Industrial Area

- Milwaukie Business Industrial Area
- Kellogg Treatment Plant
- Precision Cast Parks

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the City of Milwaukie. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers, and are a concern during evacuation/notification during a hazard event. These assets include: Downtown, McLoughlin Commercial Areas, and North Milwaukie Industrial Area.

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

Historic Inventory: (see [State Historic Preservation Office](#) for more information)

- | | | |
|--------------------------|--------------|----------------|
| • Over 500 houses | • 3 schools | • 1 city hall |
| • 5 commercial buildings | • 1 cemetery | • 1 waterworks |
| | • 1 church | |

Community Attractions:

- | | |
|--|-----------------------------------|
| • 17 th Avenue Bike/Pedestrian Path | • Milwaukie Farmers Market |
| • Bob’s Red Mill | • Milwaukie Museum |
| • Carefree Sunday | • Sara Hite Memorial Rose Garden |
| • Dark Horse Comics Corporate Headquarters | • Spring Park and Elk Rock Island |
| • First Friday (June-October) | • Springwater Trail |
| • Milwaukie Art and Artisan Market | • Trolley Trail |
| • Milwaukie Bay Park | • Umbrella Parade |
| | • Winter Solstice Event |

Hazard Characteristics

Drought

The HMAC determined that the City’s probability for drought is **high** and that their vulnerability to drought is **moderate**. *These ratings both increased from the previous NHMP addendum due to a combination of a different understanding of the most severe possible effects of drought and an increasingly unstable climate.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

The City of Milwaukie currently obtains its potable water from the Troutdale Aquifer through eight operating wells located throughout the city. Interties to the City of Portland and Clackamas River Water systems are maintained for emergency water supplies. The network of three water reservoirs provides a storage volume of six million gallons. The [Water System Master Plan](#) was last updated in 2021 to provide long-term guidance for the development of the city’s water system. It is a supporting document for the Comprehensive Plan. The document also includes recommended capital improvement projects and a map documenting the water infrastructure placement within the city.

Vulnerability Assessment

Due to insufficient data and resources, Milwaukie is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁵ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Mitigation Activities

Milwaukie has a public awareness action item that can be used to address drought education. The existing drought hazard mitigation activities are conducted at the county, regional, state, and federal levels and are described in the Clackamas County NHMP.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect

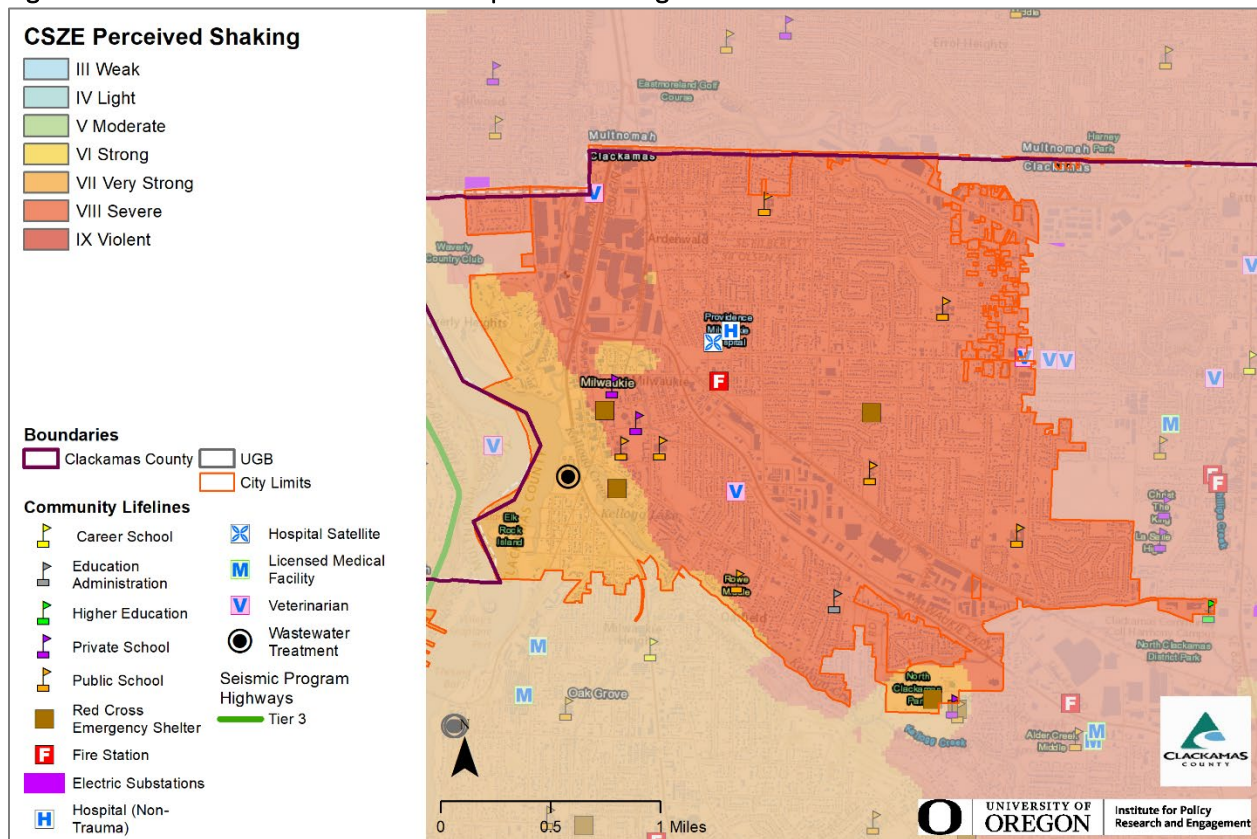
⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Milwaukie as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Milwaukie as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Milwaukie Fault Zone (discussed in the crustal earthquake section).

Figure MI-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Figure MI-2 Cascadia Subduction Zone Expected Shaking



Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and

5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.⁶

The city's proximity to the Cascadia Subduction Zone, potential slope instability, and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the "Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

Earthquake (Crustal)

The HMAC determined that the City's probability for a crustal earthquake is **moderate** and that their vulnerability to crustal earthquake is **high**. *The probability rating increased while the vulnerability rating did not change since the previous version of this NHMP addendum due to an improved understanding of the likelihood of a crustal earthquake.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Milwaukie as well. Figure MI-3 shows a generalized geologic map of the Milwaukie area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

There are two potential crustal faults and/or zones near the city that can generate high-magnitude earthquakes. These are the Gales Creek-Mt. Angel Structural Zone and Portland Hills Fault Zone (discussed in greater detail below). Other faults include the Oatfield fault (just to the east of the city on the eastern side of the Willamette River), the Damascus-Tickle Creek fault, also to the east of the city, and the Mt. Hood Fault in eastern Clackamas County. Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993, Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Canby-Molalla Fault Zone

The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Milwaukie in northern Oregon.

Portland Hills Fault Zone

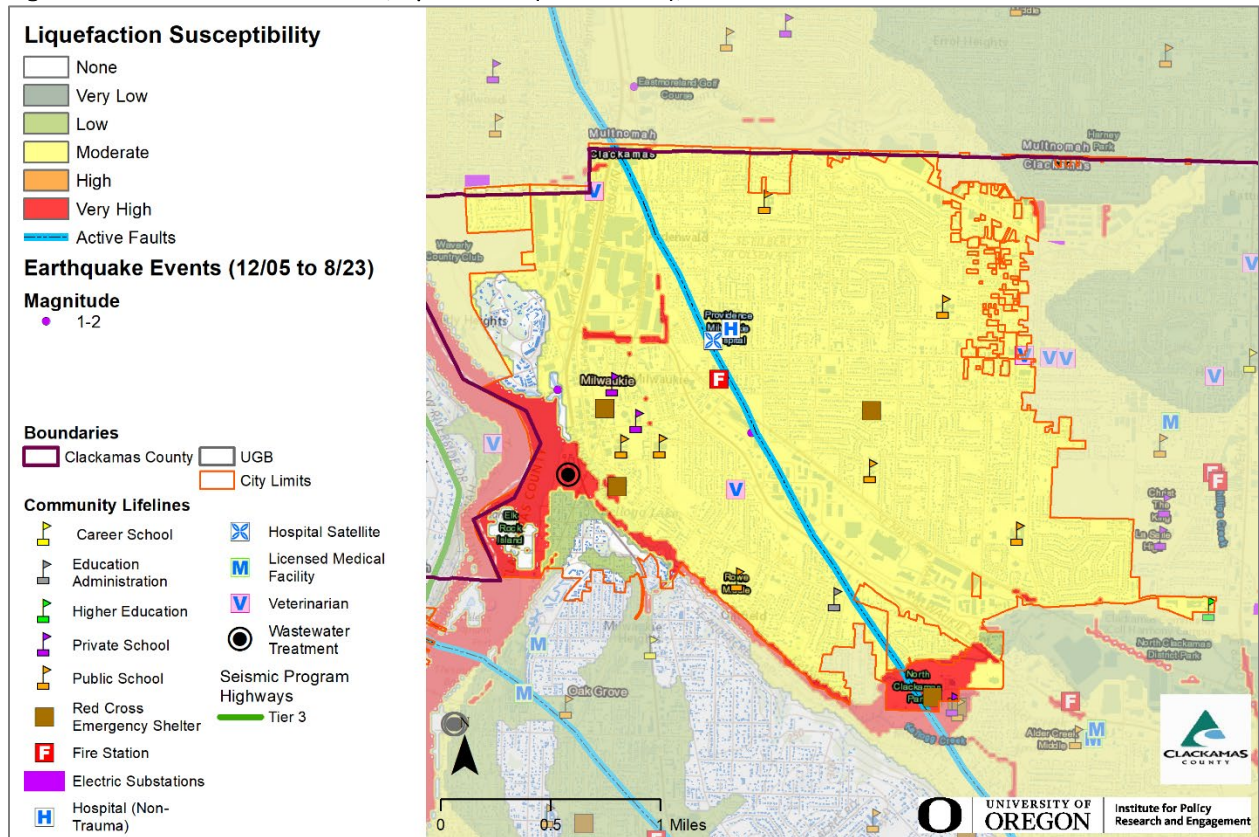
The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and runs through the western side of Milwaukie.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to

⁶ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

Figure MI-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Vulnerability Assessment

The city completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018 and 2023. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected. Additionally, in 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

Community assets located in the highest hazard zone for earthquakes include the Public Safety Building (Milwaukie Police Department and Clackamas Fire District Station 2), Providence Milwaukie Hospital, and the Milwaukie Business Industrial Area. Milwaukie’s infrastructure is particularly vulnerable to earthquake damage, especially Highway 224, Highway 99E, and the crossings of Johnson Creek. Of the city’s eight wells, two of them are along the fault line, with others in the moderate to high hazard zones for earthquakes. During a major earthquake, emergency responders may have difficulty performing their duties because their buildings could be impacted by the event. The Public Safety Building is in the moderate to high hazard zones. Areas near the Willamette River and various creeks around Milwaukie are

likely composed of softer soils prone to liquefaction. This can be very destructive to underground utilities such as water and sewer lines. Buildings and water lines can sink into the liquefied ground while sewer pipes, manholes and pump stations (assets partially filled with air) may float to the surface. After the earthquake, the liquefied soil will re-solidify, locking tilted buildings and broken pipe connections into place.

Vulnerable populations, including children, could be significantly impacted, as many schools lie in the highest two hazard zones. The data gathered from the statewide DOGAMI inventory should be used to prioritize school buildings in Milwaukie for seismic hazard retrofitting.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 36% of residential buildings were built prior to 1990, which increases the City's vulnerability to the earthquake hazard. Information on specific public buildings' (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table MI-5; each "X" represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), zero (0) have a very high (100% chance) collapse potential and zero (0) have a high (greater than 10% chance) collapse potential. *Note: two schools, Ardenwald Elementary and Milwaukie High School, have been rebuilt since the 2007 DOGAMI study.*

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Mitigation Activities

Milwaukie has taken mitigation steps to reduce the city's vulnerability in earthquake events. Additional mitigation activities completed by the City of Milwaukie include:

- Compliance with SB 13, enacted in 2001, requiring local governments to develop seismic preparation procedures, inform their employees about the procedures, and conduct earthquake drills.
- Conformance with seismic-related construction requirements in the Oregon Structural Specialty Code and Oregon One- and Two-Family Dwelling Specialty Code.
- Adoption of a policy to require undergrounding of power lines in new subdivisions.
- Development Code restrictions regarding construction on steep slopes.
- The following buildings have been constructed to be earthquake safe:
 - Water tower at 40th Ave and Harvey St, Milwaukie High School Fine Arts Center, and Linwood Elementary Media Center and Gym.
 - Ardenwald Elementary rebuilt per 2008 bond passed by voters (former building demolished in 2009).
 - Milwaukie High School Main building rebuilt in 2021.

Table MI-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Alder Creek Middle (13801 SE Webster Rd)	Clac_sch83	X			
Ardenwald Elementary (8950 SE 36th Ave)	Clac_sch14	Retrofitted ca. 2010 per a 2008 bond.			
Hector Campbell Elementary (11326 SE 47th Ave) - CLOSED	Clac_sch87		X	X	
Linwood Elementary (11909 SE Linwood Ave)	Clac_sch19	X			X
Milwaukie Elementary School (11250 SE 27th Ave)	Clac_sch20			X	X
Milwaukie High School (2301 SE Willard St)	-	Rebuilt ca. 2021 per a 2016 bond.			
Portland Waldorf School (2300 SE Harrison St)	-	2007 RVS report did not include structural appendix for this facility.			
Seth Lewelling Elementary (5325 SE Logus Rd)	Clac_sch88	X			
St. John Catholic School (10956 SE 25th Ave)	-	2007 RVS report did not include structural appendix for this facility.			
Fire Facilities					
<u>CFD Fire Station 1</u> (ca. 1983) (11300 SE Fuller Rd)	Clac_fir09	X			
<u>CFD Fire Station 2</u> (ca. 1993) (Public Safety Building) (3200 SE Harrison)	Clac_fir26	X			
<u>CFD Fire Station 3</u> (ca. 1997) (2930 SE Oak Grove Blvd)	Clac_fir27	X			
<u>CFD Fire Station 4</u> (ca. 1999) (6600 SE Lake Rd)	Clac_fir08	X			
Hospital					
Providence Milwaukie (10150 SE 32nd Ave)	Clac_hos02	X			

Source: [DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)

“*” – Site ID is referenced on the [RVS Clackamas County Map](#)

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and

emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table MI-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Table MI-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	7,891	7,891	7,891	7,891
Building Value (\$ Million)	2,890	2,890	2,890	2,890
Building Repair Cost (\$ Million)	295	394	1,341	1,598
Building Loss Ratio	10%	14%	46%	55%
Debris (Thousands of Tons)	162	193	542	615
Long-Term Displaced Population	93	83	2,459	5,456
Total Casualties (Daytime)	294	380	1,427	1,595
Level 4 (Killed)	14	19	82	89
Total Casualties (Nighttime)	34	92	326	546
Level 4 (Killed)	1	3	10	16

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

The City of Milwaukie is expected to have a 10% building loss ratio with a repair cost of \$295 million under the CSZ “dry” scenario, and a 14% building loss ratio with a repair cost of \$394 million under the

CSZ “wet” scenario.⁷ The city is expected to have around 294 daytime or 34 nighttime casualties during the CSZ “dry” scenario and 380 daytime or 92 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 93 for the CSZ “dry” scenario and 83 for the CSZ “wet” scenario.⁸

Portland Hills Fault Scenario

The City of Milwaukie is expected to have a 46% building loss ratio with a repair cost of \$1.341 billion under the CSZ “dry” scenario, and a 55% building loss ratio with a repair cost of \$1.598 billion under the CSZ “wet” scenario.⁹ The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 1,427 daytime or 326 nighttime casualties during the Portland Hills Fault “dry” scenario and 1,595 daytime or 546 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 2,459 for the Portland Hills Fault “dry” scenario and 5,456 for the Portland Hills Fault “wet” scenario.¹⁰

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table MA-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**¹¹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone event (M9.0 Deterministic): 1,045 buildings, and (11 critical facilities), are expected to be damaged for a total potential loss of \$1.09 billion (a loss ratio of about 30%). About 1,115 residents may be displaced (about 5% of the population).

Crustal event (Canby-Molalla fault M6.8 Deterministic): 745 building are expected to be damaged (9 critical facilities), for a total potential loss of \$471 million (a loss ratio of about 13%). About 558 residents may be displaced (about 3% of the population).

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

⁷ DOGAMI, *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, O-18-02), Tables 12-8 and 12-9.

⁸ Ibid, Tables 12-8 and 12-9.

⁹ Ibid, Tables 12-10 and 12-11

¹⁰ Ibid, Tables 12-10 and 12-11.

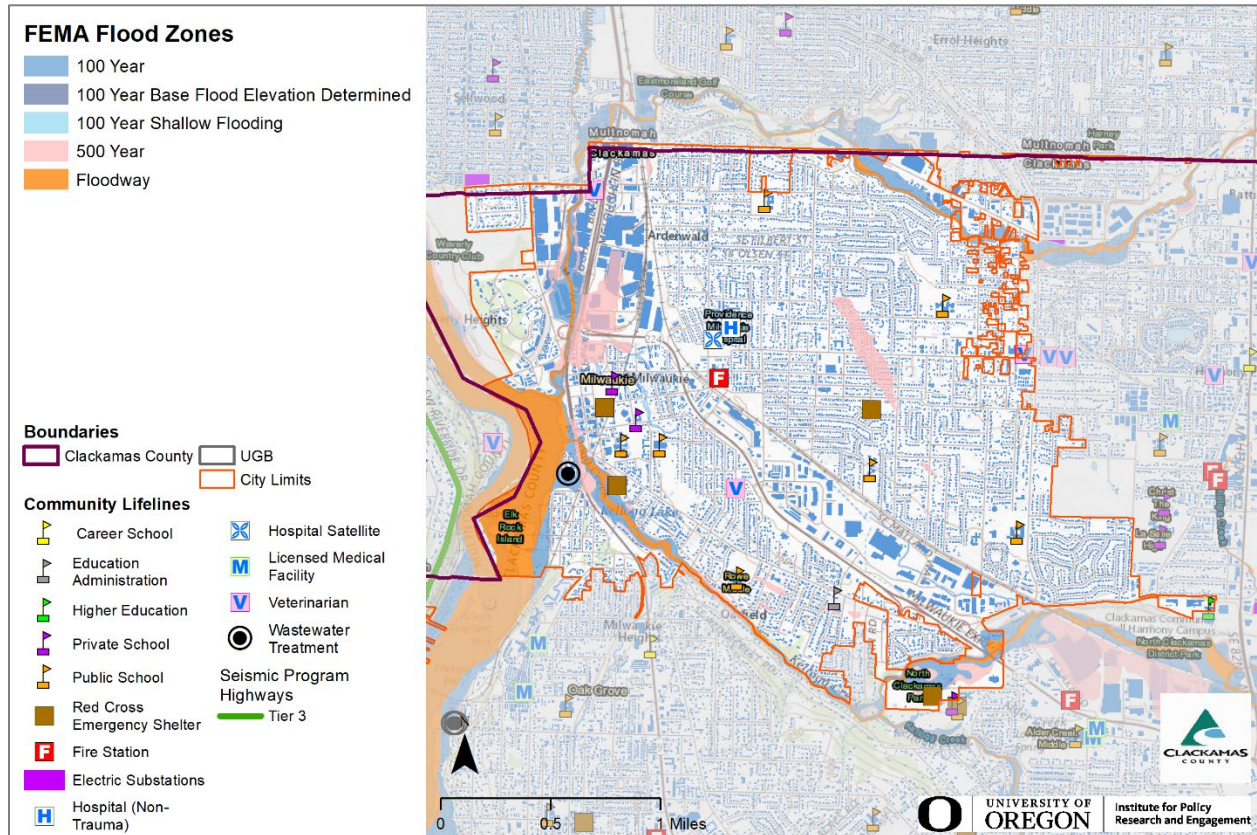
¹¹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-26.

Flood

The HMAC determined that the City’s probability of flooding is **high** and that their vulnerability to flooding is **moderate**. *The probability rating did not change, while the vulnerability rating decreased since the previous version of this NHMP addendum due to progress made in infrastructure retrofitting and other mitigation actions.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure MI-4 illustrates the flood hazard area for Milwaukie.

Figure MI-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Portions of Milwaukie have areas of floodplain (special flood hazard areas, SFHA). These include Johnson Creek, Kellogg Creek, Mount Scott Creek, Minthorn Creek, Spring Creek, and the Willamette River. The Federal Emergency Management Agency (FEMA) regulatory floodplains for each of these rivers are depicted as relatively narrow areas on each side of the channels. On the Willamette River, the floodway is generally confined within high stream banks. The FEMA 100-year map shows that approximately 1.3 miles of the transportation network could be affected in a flood.

More information on stormwater infrastructure and floodplain and runoff capacity planning can be found in the Milwaukie Stormwater System Plan.

The largest flooding event to affect Milwaukie was the February 1996 flood. The high-water level meant tributaries could not drain into the Tualatin and Willamette River, which led to localized flooding on several backed-up creeks.

The extent of flooding hazards in Milwaukie primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow.

Vulnerability Assessment

The City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018 and 2023. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

The areas around Johnson Creek (impacts industrial area), Kellogg Creek, Mount Scott Creek (impacts North Clackamas Park, Senior Center, and multiple residences north of Highway 224 and south of Lake Road), and Willamette River are particularly vulnerable to flooding. Additionally, proposed lots on 19th Avenue may be vulnerable to Willamette River flooding. Johnson Creek runs through the Downtown Mixed Use and North Milwaukie Employment zones. Kellogg Creek mostly affects residential areas in the chance of flooding. The downtown area is located near the Willamette River due to the historic use of the river for economic reasons.

Additionally, a great deal of infrastructure (bridges, water lines, sewage pump stations, etc.) is in the floodplain. Infrastructure exposed to flooding includes, but is not limited to, Highway 224, SE Lake Rd, SE McLoughlin Blvd, and the north industrial park. Highway 99 is adjacent to the river, but approximately 50-70 feet above flood stage. Disruption to this infrastructure could result in transportation issues, power outages, sewage back-up, and affect overall community and environmental health.

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. As an urban city, Milwaukie is predominantly covered in impermeable surfaces like roads and buildings, impacting historical watershed hydrology and altering the amount and speed of stormwater runoff as sheet flow. With more frequent and intense storms caused by climate change, flash flooding events can produce volumes of surface water which can quickly exceed the capacity of the city's stormwater infrastructure. These events lead to an overflowing of piped stormwater facilities during high flow, as well as scouring, erosion, overflow flooding, and vegetation decline and/or death at facilities like detention ponds and rain gardens, along with the numerous small creeks, streams, ponds, and other waterbodies crossing Milwaukie's landscape. Resulting damage from these events can be extremely costly in both labor and materials, and can compromise both gray and green infrastructure. This in turn reduces the functionality of these systems for protecting water quality, jeopardizing the city's ability to meet state and federal water quality mitigation requirements.

The speed of onset, lack of warning, and depth of flooding make dam failures a potentially deadly, albeit unlikely, occurrence. There are four major dams upstream of Milwaukie on the Clackamas River: North Fork, Faraday, River Mill and Timothy. These are operated by Portland General Electric and are subject to the dam safety and warning requirements of the Federal Energy Regulatory Commission. According to the

Clackamas County Emergency Operations Plan, areas of Milwaukie bordering on the Willamette in the vicinity of its confluence with the Clackamas would be inundated by a wall of water 60 - 80 feet high in approximately an hour and a half should the North Fork dam fail under a “probable maximum flood” (a worst-case scenario where all four dams fail). In December 2015 Milwaukie had to evacuate approximately 50 people from their homes as Mount Scott and Johnson Creek overflowed.

The largest flooding event to affect Milwaukie was the February 1996 flood. The high-water level meant tributaries could not drain into the Tualatin and Willamette River, which led to localized flooding on several backed-up creeks.

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**¹² provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report 20 buildings (0 critical facilities) could be damaged for a total potential loss of \$6.1 million (a building loss ratio of less than 1%). About 130 residents may be displaced by flood (less than 1% of the population).

National Flood Insurance Program (NFIP)

FEMA’s Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. The city development code includes policies and regulations for flood prone areas including, Natural Resources Overlay Zone (Chapter 19.402, [Natural Resources Administrative Map](#)), Flood Hazard Regulations (Title 18 – Flood Hazard Areas (includes the SFHA and the 1996 flood inundation area; [Flood Hazard Map Viewer](#)), and Willamette Greenway Zone (Chapter 19.401). The City’s flood hazard regulations include substantial damage/substantial improvement provisions which are enforced by the Floodplain Administrator. The last Community Assistance Visit (CAV) for the City was in July 2019. The City does not participate in the Community Rating System (CRS).

Risk Analysis - Repetitive Loss Properties

Milwaukie works to mitigate problems regarding flood issues when they arise. Some areas in the city are more susceptible to flooding issues and have incurred repetitive losses. The Community Repetitive Loss record for Milwaukie identifies ten (10) Repetitive Loss (RL) properties¹³, and one (1) Severe Repetitive Loss (SRL) property¹⁴. RL and SRL properties are troublesome because they continue to expose lives and valuable property to the flooding hazard. Local governments as well as federal agencies such as FEMA attempt to address losses through floodplain insurance and attempts to remove the risk from repetitive loss of properties through 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.

¹² DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-26.

¹³ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

¹⁴ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP, and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000, and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Table MA-8 provides information on the identified RL and SRL properties. There have been 31 paid RL claims totaling \$1,550,590. Seven (7) of the RL and SRL properties are not insured as of May 2023. For additional detail and a map of their general location see Volume I, Section 2, and Figure 14.

Table MA-7 Repetitive Loss and Severe Repetitive Loss Properties Detail

RL #	RL or SRL Property	Occupancy	Mitigated?	Currently NFIP Insured	Rated Flood Zone	Post FIRM	Paid Claims	Total Paid Amount
38925	SRL	Single Family	NO	NO	B	N	6	\$100,814
75554	RL	2-4 Family	NO	NO	C	N	3	\$28,463
82010	RL	Single Family	NO	NO	X	N	2	\$5,058
83292	RL	2-4 Family	NO	NO	C	N	2	\$17,351
84896	RL	Non-Residential	NO	NO	A19	N	2	\$396,804
245015	RL	Single Family	NO	YES	X	Y	2	\$65,060
245137	RL	Single Family	NO	NO	AE	N	2	\$141,105
246398	RL	2-4 Family	NO	YES	AE	N	3	\$138,450
246399	RL	2-4 Family	NO	YES	AE	N	3	\$226,756
246400	RL	2-4 Family	NO	YES	AE	N	3	\$240,033
288900	RL	Single Family	NO	NO	AE	N	3	\$190,696
Total							31	\$1,550,590

Source: FEMA Region X, Regional Flood Insurance Liaison, email February 23, 2023.

Mitigation Activities

The City maintains a Stormwater Master Plan and has been planning various projects to restore Kellogg Creek. These projects would include building a bridge over the creek and downtown revitalization.

In 2022 and 2023, the city and project partners secured grant funding through the National Oceanic and Atmospheric Administration to pay for the planning, design, and permitting of the Kellogg Creek Restoration and Community Enhancement Project. Although Kellogg Creek has historically been less prone to flooding than Johnson Creek, the removal of the dam and restoration of the lower creek, as well as 14 acres of buried floodplain, is expected to further mitigate the existing flood hazard by draining Kellogg Lake and removing substantial amounts of contaminated sediment impounded by the dam. City engineers are working with project partners to undertake project planning, including risk assessment, design, and permitting for project implementation.

To improve stormwater management the city of Milwaukie continues to line the interiors of pipes in conjunction with Clackamas County Water Environment Services. This mitigation project minimizes the amount of groundwater that infiltrates into sewer lines and helps reduce the overall amount of water going into the wastewater treatment plant, thus reducing the chance of overflow of the sewer system. Additionally, a severe repetitive loss property on Rusk Road was purchased and demolished using FEMA Flood Mitigation Assistance funding in 2018 (grant covered approximately \$315,000 for the purchase of the property, additional funds were allocated for staff hours, title report, due diligence reports, and demolition contract).

In 2006 Clackamas County Water Environment Services partnered with eight community groups to restore the Three Creeks area – including Mount Scott Creek, a tributary to Kellogg Creek and the Willamette River. The group reshaped the stream channel to make it more natural; removed invasive species; planted thousands of native plants to stabilize banks; and put in wood and boulders to stabilize the channel and provide habitat for fish. The groups also removed trash and transient camps that polluted the streams during floods.

Projects completed by the Johnson Creek Watershed Council:

- Tree Plantings along Johnson Creek in various places.
- Storm water detention near Milport.

The North Clackamas Watersheds Council has published a 10-year plan for further restoration and enhancement actions. Although many of these actions are currently unfunded, the city will continue to seek new opportunities to partner with the council.

In 2018 the city completed its Urban Forest Management Plan which includes information on tree planting and maintenance strategies. Increasing the extent of the urban canopy can help to divert, capture, and infiltrate precipitation and surface water that would otherwise contribute directly to flooding.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁵ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the City’s probability for landslide is **high** and that their vulnerability to landslide is **low**. *The probability rating increased, and the vulnerability rating did not change since the previous version of this NHMP addendum due to the inclusion of smaller scale landslides and landslides occurring upstream of Milwaukie in the current update.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Although catastrophic landslides have not occurred in Milwaukie, steep slopes do exist along the banks of the Willamette River and Kellogg Creek. Additionally, upstream landslides affecting waters that flow into or through Milwaukie pose secondary hazards to the city due to debris and flood risks.

Landslide susceptibility exposure for Milwaukie is shown in Figure MI-5. Most of Milwaukie demonstrates a low to moderate landslide susceptibility exposure. Approximately 4% of Milwaukie has very high or high, and approximately 31% moderate, landslide susceptibility exposure.¹⁶ However, most of the areas that are identified to exhibit dangerous potential rapidly moving landslides are vacant and often preserved in wooded and dedicated open space.

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

¹⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

¹⁶ DOGAMI. [Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon](#) (2016)

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)); general findings from that report are provided above and within Figure MI-5.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well.

Across the Willamette River in Riverdale area, there is a large area of land that is at a very high risk of landslide. This could result in flooding along Milwaukie's banks in the event of a landslide that disrupts the flow of the Willamette River. Within the City, parts of Highway 224, SE Lake Rd, and SE Johnson Creek Blvd are located within the areas of high landslide susceptibility. These important arterials help connect Milwaukie. The Milwaukie Heights area, which includes mostly low density residential and open space areas, is also vulnerable. This exposure means that large scale and simultaneous landslides triggered by an earthquake could substantially disrupt City operations buildings, fire stations and key pieces of infrastructure (bridges, sewage pump stations, water reservoirs) that would hinder the ability of the City to respond to emergency situations created by such an event.

As a result, it will be important for the City to pursue opportunities for retrofitting and mitigating important structures and infrastructure, such that said facilities can withstand and survive landslides, particularly simultaneous landslides generated by an earthquake. Business continuity planning shall also be an important factor, given the number of economic centers and employment facilities that are threatened by the landslide hazard.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**¹⁷ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 102 buildings (no critical facilities) are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of \$73.8 million (a building exposure ratio of about 2%). About 568 residents may be displaced by landslides (about 3% of the population).

Mitigation Activities

Milwaukie works to mitigate future landslide hazards. The city development code includes several policies and regulations to protect slopes including Erosion Control (Chapter 16.28), Willamette Greenway Zone Overlay (Chapter 19.401), and limitations of permitted development within slopes greater than 25%.

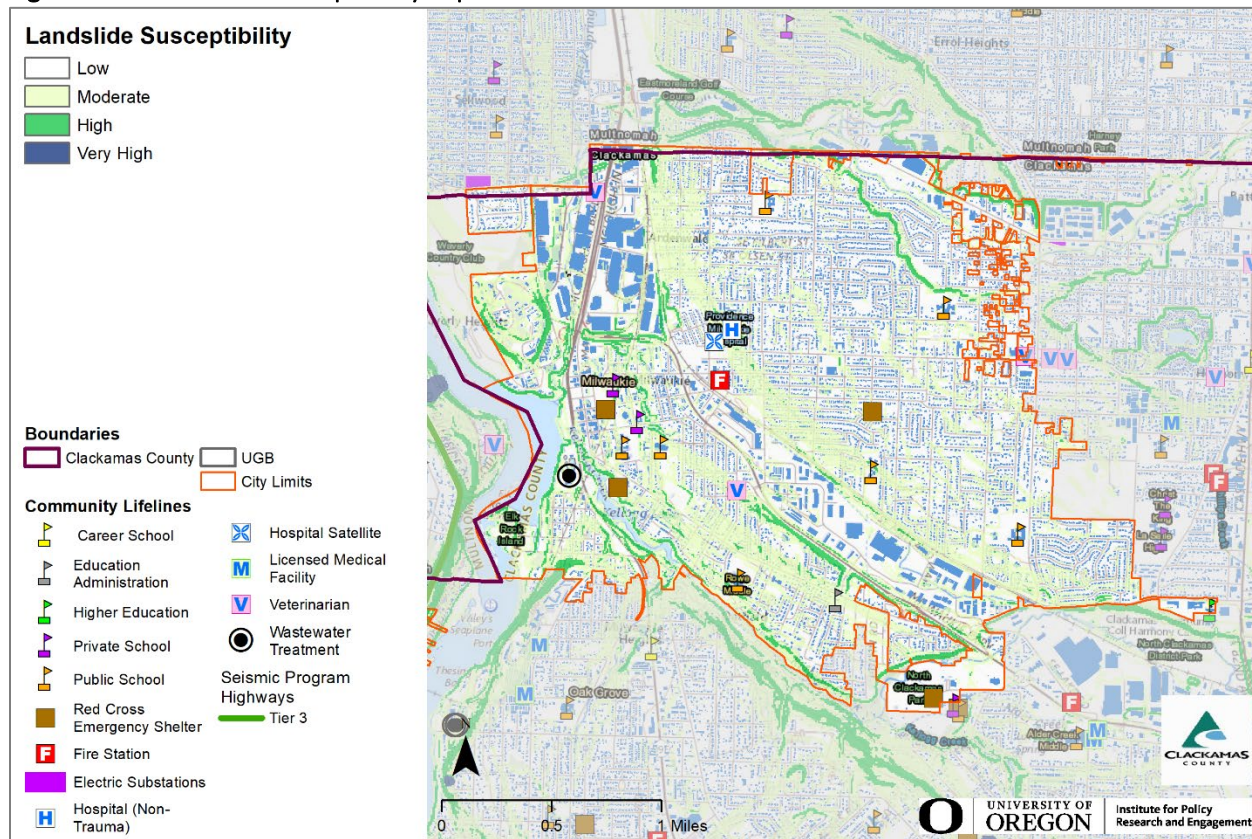
Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the

¹⁷ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-26.

landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Figure MI-5 Landslide Susceptibility Exposure



Severe Weather

Severe weather can account for a variety of intense, and potentially damaging, hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City’s probability for extreme heat events is **high** and that their vulnerability is **high**. *The probability rating increased and vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well, but Milwaukie is more vulnerable to the so “heat island effect” than more rural portions of the county. Heat islands occur where extremely localized ambient air temperatures in urban areas are an average of 1-7 degrees higher than those found in surrounding areas. They occur as

structures and pavement absorb, radiate, and reflect heat energy rather than engaging in evapotranspiration as trees and other plants do. Milwaukie’s efforts to preserve and expand its urban forest canopy will continue to play a role in mitigating the formation of heat islands, but the threat remains a significant one.

A severe heat episode or "heat wave" occurs about every two to three years. These heat episodes typically last two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of temperatures upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 14.6 days with temperatures above 90-degrees Fahrenheit, and 1.2 days above 100-degrees Fahrenheit annually, based on new 30-year climate averages (1991-2020) from the National Weather Service – Portland Weather Forecast Office. The 30-year average is used to account for short-term variation in temperatures. The frequency of high temperature days is expected to increase with the growing climactic instability of anthropogenic climate change. For example, the six hottest summers on record for Portland occurred between 2015 and the present.

Future Projections

Increasing frequency and duration of extreme heat events pose threats to human and animal life, as well as a danger to agricultural production in the Willamette Valley.

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁸ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City’s probability for windstorm is **high** and that their vulnerability to windstorm is **moderate**. *These ratings increased since the previous version of this NHMP addendum due to the increased frequency and intensity of windstorms in recent years.*

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris. Additionally, transportation and economic disruptions result as well.

Damage from high winds generally has resulted in downed utility lines and trees, usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves and debris may clog drainage-ways, which in turn may cause localized pluvial flooding.

¹⁸ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the City's probability for winter storm is **high** and that their vulnerability to winter storm is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the city typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Most winter storms do not cause significant damage, but they are semi-frequent, and have the potential to impact economic activity. Road closures due to winter weather can interrupt commuter and commercial traffic, and roads that are not closed may present vehicle operators and pedestrians with dangerous conditions.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"¹⁹ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Vulnerability Assessment

Due to insufficient data and resources, Milwaukie is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. However, the city completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018 and 2023. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the

¹⁹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

The areas of the city that are often most at risk of severe storms are residential areas on steeper slopes, where roads may be icy and, thus, difficult to climb and descend. Road corridors leading to residential areas with fuller tree canopies are susceptible to downed tree limbs, and those areas that are above 500 feet in elevation are particularly vulnerable. However, some weather systems are characterized by a temperature inversion, where the valley floor is colder than the nearby hills. Consequently, severe storms affect the entire city. In 2016, 2017, 2019, and 2021 the State of Oregon declared a state of emergency for severe storms. The city's Plowing, Sanding, and De-Icing Removal Plan is maintained by the Public Works Department and includes provisions to place equipment on designated principal routes throughout the city (Plowing and Sanding Routes Map). Private property owners are also required to clear the sidewalks abutting their property of snow or ice within 24 hours after the snow has stopped falling. For more information see the city's Winter Weather Response Plan information webpage.

The major risk to property results from exposed utilities, especially power lines and water pipes that are damaged by wind, broken tree limbs and cold temperatures. Businesses also suffer economic losses when they must close as the result of the inclement weather and/or the loss of power, which, in turn, disrupts the local supply chain of goods and services. Periods of extended ice coverage hinder emergency response services and limit the mobility of residents, which could result in serious life safety issues.

Residents and businesses that are in areas that exhibit the severe storm hazard face some risk of damage from severe storms. Severe weather events are expected to impact nearly all city residents. In addition, critical infrastructure, economic centers, cultural or historic assets, environmental assets, and hazardous material sites are exposed to the severe weather hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets section.

The exposure of these facilities and infrastructure means that severe weather events could substantially disrupt the operations of city government buildings and fire stations, impairing key city functions, while hindering the ability of emergency response personnel to respond to emergency situations that are created by a severe storm event.

All these facilities depend upon utility lines, roads and bridges to operate and perform their respective important functions within the city. Exposed utility and power lines are particularly vulnerable to damage from severe winter storms by wind, ice and snow.

Hardened infrastructure, like bridges and roads, can sustain a severe winter storm, but during the event, they are often hazardous to traverse because of icy, windy and snowy conditions.

Consequently, severe weather (wind or winter storm) could substantially disrupt numerous key resources and facilities within the city through impediments to the transportation system and damage to the power grid. Among other things, these transportation problems and power failures disrupt business operations and educational facilities, resulting in economic losses and halting educational opportunities.

Power to hazardous material sites, including gas stations, rail yards, and some industrial facilities in the city, could also be disrupted. The sites themselves could be damaged or rendered inaccessible in an especially severe storm. These conditions could pose threats to the natural environment of the city and the health of its population, while disrupting the availability of gasoline for vehicle transport.

As a result, it will be important for the city to pursue opportunities for undergrounding utilities and retrofitting utility lines so that they may withstand cold weather conditions without freezing and bursting. Adhering to current building codes for weatherization of structures, as well as current engineering and fire codes that pertain to the steepness of new roads, are also key factors for the city to consider.

Business continuity planning shall also be an important factor, given the number of economic centers and employment facilities that are threatened by the severe storm hazard

Mitigation Activities

Mitigating severe weather can be difficult because storms affect all areas of the city, but Milwaukie has made progress to reduce the effects of storms. Milwaukie has a tree board to maintain a plan for the care of the trees as well as codes governing where trees can be planted (Chapter 16.32). Most utilities are underground, and all new utilities are required to be underground. In case of power outages the city's critical facilities have back up power generation. Milwaukie also has a designated snow plow and sanding routes to help expedite snow removal ([Plowing and Sanding Routes Map](#)). The city is also partnering with Clackamas County to develop the Ledding Library as a cooling center and is exploring options for the potential establishment of an overnight warming shelter in the downtown area.

Volcanic Event

The HMAC determined that the City's probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **low**. *These ratings did not change since the previous version of this NHMP addendum.*

Volume I, Section 2 describes the characteristics of volcanic hazards, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the western portion of the County is likely to affect Milwaukie as well. Volcanoes are located near Milwaukie, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Given Milwaukie's relatively long distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions may have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. In the event of an eruption on Mount Hood, the city could experience a heavier coating of ash due to its closer proximity to that volcano.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²⁰ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

Mitigation Activities

The existing volcano hazard mitigation activities are conducted at the county, regional, state, and federal levels and are described in the Clackamas County NHMP.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

²⁰ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-26.

Wildfire

The HMAC determined that the City's probability for wildfire is **high**, and that their vulnerability to wildfire is **high**. *The probability and vulnerability ratings increased since the previous version of this NHMP due in part to the increased hazard posed by wildfire smoke.*

The [Clackamas County Community Wildfire Protection Plan \(CWPP\)](#) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Milwaukie is found in the following chapter: Chapter 9.3: Clackamas Fire District #1.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather and urbanization conditions are primarily at cause for the hazard level. Milwaukie has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. Clackamas Fire District #1 provides services to other cities besides Milwaukie, including: Oregon City, Happy Valley, Johnson City, and many unincorporated areas within Clackamas County. Figure MI-6 shows overall wildfire risk in Milwaukie.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Milwaukie, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

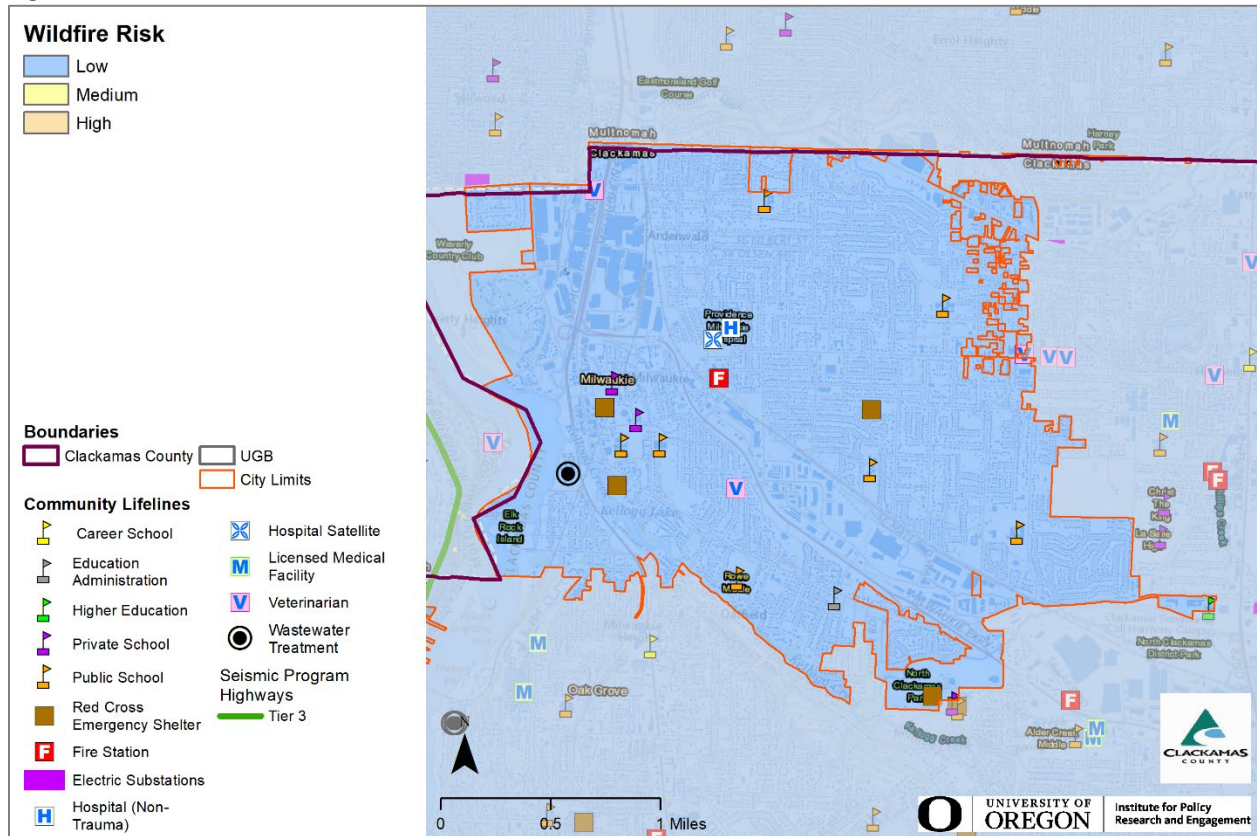
Milwaukie is highly urbanized and as such does not have as much danger of wildfire within its boundaries as more rural locations in Clackamas County. The City does have parks and neighborhoods surrounded by mature trees, as well as several natural areas. Located on the edge of its southeastern boundary is the Three Creeks Natural Area, which has heavy fuels adjacent to homes and infrastructure. Three Creeks Natural Area is a designated Medium Priority Community at Risk (CARs).²¹ Elk Rock Island, though listed as low risk for wildfire by the Oregon Wildfire Risk Explorer, is a publicly owned greenspace near a built-up residential area. The island contains dense vegetation which dries out in the summer, and has no roads, which makes firefighting operations on the island more difficult, as demonstrated by the large fire there in 2020.

Most of the city has less severe (moderate or less) wildfire burn probability. This indicates expected flame lengths less than four feet under normal weather conditions.²² However, conditions vary widely and with local topography, fuels, and local weather conditions, especially wind. Under warm, dry, windy, and drought conditions, the City expects higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

²¹ Clackamas County Community Wildfire Protection Plan, *Clackamas Fire District #1* (2018), Table 10.13-1.

²² [Oregon Wildfire Risk Explorer](#), date accessed February 14, 2023.

Figure MI-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Vulnerability Assessment

The City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2018 and 2023. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

Milwaukie does not have much vulnerability to wildfire flames, though there is always the risk of fire destroying residential and commercial areas. Vegetation along roadways can be highly dangerous, as negligent motorists provide ignition sources by tossing cigarette butts out car windows. Because schools are generally located near parks and scenic areas, they can be threatened by wildfires.

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the city as well. Milwaukie’s fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City will update its wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively

respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Although the direct threat of wildfire burning Milwaukie is low, the city is vulnerable to smoke and aerial particulate matter generated by fires in the region. The 2020 wildfire season was especially bad, with the air quality index in the Portland metropolitan area being recorded as over 500, the upper limit of that scale. The region's air quality was rated as the worst in the world during that period. Air quality is not listed as standalone hazard by FEMA or the State of Oregon for the purposes of natural hazard mitigation planning. It was, nonetheless, discussed by the Milwaukie HMAC and factored into the vulnerability rating calculation for wildfires.

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**²³ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 10 buildings (no critical facilities) are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of \$5.6 million (a building exposure ratio of less than 1%). About 59 residents may be displaced by wildfires (less than 1% of the population).

Mitigation Activities

Milwaukie and Clackamas Fire District #1 (CFD#1) use several mitigation tools to reduce the city's risk to wildfires. CFD #1 provides emergency fire suppression, medical response, and rescue services to the City of Milwaukie. Mutual aid agreements with neighboring jurisdictions are also in place. Water supply and storage capacity in Milwaukie conforms with recommended fire flow requirements.

The city does not allow backyard burning due to requirements of DEQ. The CFD #1 provides outreach and education to the community on wildfire mitigation via news releases, posters, signage, website messages, safety exhibits at community events, and visits to schools, civic organizations, and neighborhood associations.

Partially in response to the fire hazard they create, the city banned the sale and use of fireworks in 2023. Additionally, the city partners with the North Clackamas Parks and Recreation District to manage and reduce the amount of potential fuel for wildfires in natural areas.

Clackamas Fire District #1 (CFD #1) serves the city of Milwaukie. For more information on the fire district see their addendum.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"²⁴ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

²³ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-26.

²⁴ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table MI-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table MI-1).

Previous NHMP Actions that are Complete:

Multi-Hazard #2, “Improve network of communications during a disaster.” Complete. Although there are always opportunities for improvement, the combination of satellite, radio, and cellular communication technology provides layers of redundancy in the event of a major disaster.

Multi-Hazard #4, “Maintain and promote CERT program activity in the area and recruit new members for training.” Complete. The City regularly coordinates with CERT and Clackamas FD1.

Multi-Hazard #7, “Integrate the goals and mitigation actions from the Milwaukie Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.” Comprehensive plan last updated in 2021.

Earthquake #1, “Conduct seismic evaluations on identified critical and essential facilities and infrastructure and implement appropriate structural and non-structural mitigation strategies.” Complete. The city has evaluated its existing infrastructure and will continue to evaluate newly acquired infrastructure for seismic resiliency.

Flood #2, “Ensure continued compliance with the National Flood Insurance Program through enforcement of local floodplain management ordinances.” Complete. The city is continuing to comply with participation requirements for the National Flood Insurance Program

Previous NHMP Actions that are Not Complete and No Longer Relevant:

Drought #1, “Develop public brochures to raise awareness about drought hazards and mitigation actions residents can take to reduce the impact of drought.” No longer relevant. Pamphlets are an inefficient and largely outmoded form of communication. This has been rolled into Action Item 2.

Table MI-8 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Multi-Hazard #2	-	Complete	No
Multi-Hazard #3	#2	Not Complete, revised	Yes
Multi-Hazard #4	-	Complete	No
Multi-Hazard #5	#3	Not Complete	Yes
Multi-Hazard #6	#4	Not Complete	Yes
Multi-Hazard #7	-	Complete	No
Multi-Hazard #8	#5	Not Complete, revised	Yes
Drought #1	-	Complete	No
Earthquake #1	-	Complete	No
Flood #1	#8	Not Complete	Yes
Flood #2	-	Complete	No
Severe Weather #1	#10	Not Complete	Yes
Wildfire #1	#11	Not Complete	Yes

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

This document was completed with the assistance of a substantial community engagement effort. During August 2023, members of the public had the opportunity to ask questions and offer suggestions about the composition of the NHMP through the Engage Milwaukie platform. More than 450 community members visited the page during these months. The suggestions made through the platform resulted in several additions to the list of essential facilities and environmental assets. This opportunity was advertised through the city website, the Pilot newsletter, Facebook, and various other media.

Drafts of the plan were submitted to the Milwaukie City Council for discussion at the council's August 1 and August 15, 2023 regular meetings. Suggestions and comments from members of the council were incorporated throughout the document.

Also in August, a draft of this document was sent to 23 community groups with focus areas ranging from housing and medical care to education and environmental protection. Substantive changes, particularly concerning the flood hazard, were made based on feedback from these partners.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from February 1 through March 31 on the County's website and shared via a link on the City's website. There were no comments provided. The city also provided a link in summer 2023 that included an opportunity to provide feedback, a poll, a mapping exercise, and an opportunity to discuss action items). Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting

Home / Natural Hazard Mitigation Plan

Natural Hazard Mitigation Plan

This is a chance to provide feedback about the [Natural Hazard Mitigation Plan \(NHMP\)](#). The NHMP is an opportunity for the City of Milwaukee to review and consider natural hazards that may affect its residents and businesses. The plan includes a ranking of potential hazards, description of how they may affect Milwaukee, and a list of action items to be taken to improve the city's ability to prepare for those hazards.



While not every proposed change will be included in the final plan, the city is collecting community feedback, and will consider and respond to comments and questions. After reviewing the [NHMP](#), please consider completing the first three engagement tools below ([Quick Poll](#), [Mapping Exercise](#) and [Action Items Discussion](#)). Additional questions can also be added to the [Questions](#) tool.

The NHMP is only one aspect of the city's emergency management strategy, and updating it every five years allows the city to remain eligible for certain federal emergency management grants. Please note, the NHMP does not contain any information about how the city will respond to hazards that are not naturally occurring.

Feedback and questions can also be shared by contacting the staff person listed under "[Who's Listening](#)" below or to the right (depending on the device being used).

The city is excited to hear from you!

Register to get involved!



STAY INFORMED

Subscribe for project updates

Your email address..

SUBSCRIBE

7 members of your community are following this project

Documents

Milwaukee NHMP August 17 Draft (2.33 MB) (pdf)

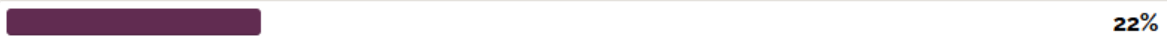
More..

Based on the food, water, and medications you have at home right now, how long could your household go without outside assistance following a major disaster? Select the option that best fits your household.

Less than three days



Three to five days



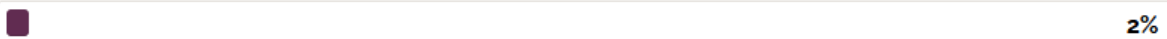
At least one week



Two weeks or more



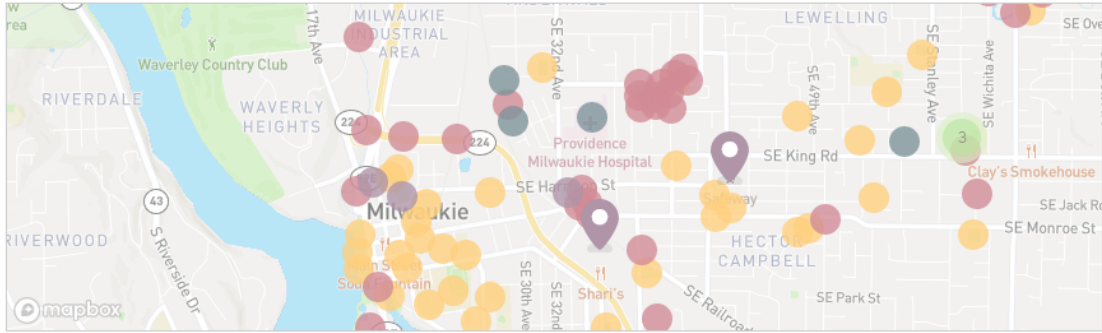
I'm not sure



Total Votes : 104

Mapping Exercise

7 months



This map includes the following types of sites that have been recognized as being critical to the city's Natural Hazards Mitigation Plan. You can click on each circle on the map for the site's name, type, address, and asset type.

- Community spaces (gold)
- Critical infrastructure (red)
- Essential facilities (purple)
- Vulnerable populations (blue)

If you know of any critical sites that are missing or are out of date, please drag and drop a pin using the plus sign (+) to let us know where they are and provide a brief description.

The chart below includes a list of action items that the city proposes to work on over the next five years. The full text of these items can be found on page MA-48 of the [NHMP](#). It is important to remember that not all action items are fully funded so grants and other outside revenue sources will be important in completing these action items.

Please join the discussion if there are items not on this list that you would like to see included. You can also join the discussion if there are any items that you think should be removed from the list or altered.

Thanks for participating!

Proposed Milwaukie NHMP Action Items	
Item Number	Description
MH 1	Coordinate with Clackamas County, OEM, the American Red Cross, and other relevant agencies to identify shelter facilities within Milwaukie.
MH 2	Increase outreach and education for hazard awareness and natural disaster preparedness, especially for low-income, elderly, non-English-speaking, and other vulnerable populations.
MH 3	Maintain and enhance strategies for debris management for all hazards.
MH 4	Improve and obtain resources and equipment essential for responding to and recovering from disasters.
MH 5	Coordinate natural hazard related climate change action items through the Milwaukie Community Climate Action Plan.
F 1	Evaluate alternatives for reducing the flooding hazard for properties along Kellogg Creek, Johnson Creek, Mount Scott Creek area, and the Willamette River.
SW 1	Bury and protect vulnerable critical infrastructure, such as power lines, to lessen potential failures during severe weather.
WF 1	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.

14 comments

Recently active | Posted first

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible.

Members of Milwaukie HMAC met on the following dates:

Meeting #1 and #2: March 9 and May 22, 2023

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: December 6, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

City of Molalla Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: City of Molalla

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The City of Molalla

Updated:
July 24, 2024, (Resolution # 2024-11)
January 22, 2020, (Resolution # 2020-02)
August 25, 2012 (amended October 28, 2015, Res. # 2015-11).
Year of first FEMA Approval 2009



This Natural Hazard Mitigation Plan was prepared by:



With support from:



UNIVERSITY OF
OREGON

School of Planning, Public
Policy and Management

Institute for Policy
Research and Engagement

Planning grant funding provided by:

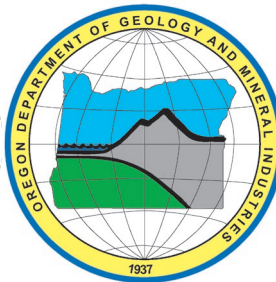


FEMA

Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS



RESOLUTION NO. 2024-11

A RESOLUTION OF THE CITY OF MOLALLA, OREGON ADOPTING THE CITY OF MOLALLA REPRESENTATION IN THE UPDATES TO THE CLACKAMAS COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

WHEREAS, the City of Molalla recognizes the threat that natural hazards pose to people, property and infrastructure 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 FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, the City of Molalla has fully participated in the FEMA prescribed mitigation planning process to prepare the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

WHEREAS, the City of Molalla has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of Molalla to the impacts of future disasters within the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*; and

WHEREAS, these proposed projects and programs have been incorporated into the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, May 29, 2024) contingent upon this official adoption of the participating governments and entities;

WHEREAS, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

WHEREAS, the NHMP is in an on-going cycle of development and revision to improve it’s effectiveness; and

WHEREAS, City of Molalla adopts the NHMP and directs the City Manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

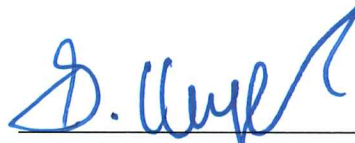
Now, Therefore, the City of Molalla Resolves:

Section 1. The City of Molalla adopts *the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan.

Section 2. The City of Molalla will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

Section 3. Effective Date. This Resolution shall be effective upon adoption.

Signed this 24th day of July 2024.



Scott Keyser, Mayor

ATTEST:



Christie Teets, CMC
City Recorder

Purpose

This is an update of the Molalla addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Molalla’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Molalla adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 24, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Molalla to update their NHMP.

The Clackamas County NHMP, and Molalla addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Molalla HMAC guided the process of developing the NHMP.

Convener

The Molalla City Manager or designee serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Molalla HMAC met formally and informally, to discuss updates to their addendum (Updated Appendix). The HMAC reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Molalla HMAC was comprised of the following representatives:

City of Molalla:

- Convener, City Manager, Dan Huff
- PW Operations Manager, Andy Peters
- PW Maintenance Section Manager, Adam Shultz
- Police Lieutenant, Bobby Call
- Police Chief, Chris Long
- Waste Water Treatment Manager, Seth Kelly
- Water Treatment Manager, Katie Niece
- Assistant City Manager, Mac Corthell
- Healthy Sustainable Communities, Jon Legarza (Consultant)

Molalla Fire District:

- Chief, Vince Stafford
- Fire Lieutenant, Mike Everhart
- Fire Lieutenant, Mike Penunuri

Molalla River School District:

- Superintendent, Tony Mann
- Finance Director, Keith McClung

Clackamas County Emergency Management:

- Daniel Nibouar
- Molly Caggiano

Molalla Buckeroo Association:

- Board Chair, Tim Anderson

South Clackamas Transit District:

Executive Director, Mike Strauch

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Molalla addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the Molalla NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Molalla will implement the NHMP’s recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP’s action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Molalla to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, water system master plan, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

Molalla addresses Statewide Planning Goal 7 Natural Hazards as part of their Comprehensive Plan Element, Natural Hazards. This plan was adopted in 2014. It identifies three potential natural hazards – flooding associated with the Molalla River, slope hazards, and earthquakes, associated with weak foundation soils. The Natural Hazard Policies recognize the adoption of the joint Molalla/Clackamas County Hazard Mitigation Plan. Hazard assessments and mapping from the NHMP are used to help determine the suitability of a location for development. Policy #5 states that “the City shall continue to work cooperatively with Clackamas County to implement that plan.”

Planned updates to the jurisdiction's Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community's long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

Title 13 – Public Services

The City of Molalla Municipal Code, Title 13-Public Services provides requirements for the protection of the City's storm drainage system by reducing illegal discharge and cross connections.

Title 17 – Development Code

The City of Molalla completed and adopted revisions to the City of Molalla Development Code on October 11, 2017. Code sections uphold water quality efforts, protect, and enhance significant wetlands and floodplains in the Molalla Natural Features Inventory (Water Resources Overlay, 17-2.4.030), and establish requirements for development on steep slopes and expansive soils. Subdivision regulations are also part of this code, which requires adequate drainage to reduce exposure to flood damage and improve water quality (17-4.3) and avoidance of natural hazards in master plan layout (17.4.8-040). Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

Title 21 – Additional Regulations

The City of Molalla Municipal Code, Title 21-Additional Regulations includes provisions for excavation, fills, grading, and erosion control.

The Community Development Department is composed of the Planning, Parks & Recreation, Public Works, Economic Development and Code Compliance. The Molalla Community Development Department is the oversight entity for all matters related to long range planning, development review, and code enforcement. It is responsible for the administration of state, county, and local land use policies and

regulations as they relate to the preservation and quality development of property lying within the city limits and urban growth boundary (UGB). The Planning Division is also responsible for administering and maintaining the Molalla Comprehensive Plan and Community Development Code. They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

The Molalla Community Development Department contracts with the Clackamas County Building Department to administer and enforce the 2022 Oregon Structural Specialty Code. The Molalla Fire District administers the 2022 Oregon Fire Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

Public Works

The City of Molalla Public Works Division is part of the Community Development Department, and is composed of the Engineering Section, the Maintenance Section, the Water Section, and the Wastewater Section. They are responsible for surface water management, water treatment and delivery, wastewater collection and treatment, street maintenance, and public facilities maintenance. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

2017 Molalla Standard Specifications for Public Works Construction

Public Works standards are part of the regulatory policies used to implement many resilience measures, including Erosion Prevention and Sediment Control (1.18.4), General Design Requirements (Stormwater (3.1.2), Water Quality Facility Design Standards (3.5.1), etc.

City Administration

The City Council of Molalla has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Policies and Programs

This Plan directs Molalla and Clackamas County to explore integration into other planning documents and processes. Molalla has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

Transportation System Plan (2018)

Goals include: minimize and/or mitigate the effects of transportation projects and systems on natural resources and systems; preserve and maintain the existing transportation system assets to extend their useful life; and address existing and potential future safety issues.

Wastewater Facility and Collection System Master Plan (2018)

This document updated the City's most recent Wastewater Facility Plan, adopted in 2000. It was necessary to satisfy conditions stipulated in a Mutual Agreement Order with the Oregon Department of Environmental Quality (DEQ) over violations of the City's NPDES permit. It quantifies existing loads, evaluates existing infrastructure, identifies deficiencies, and contains a comprehensive Capital Improvement Plan for the next twenty years.

Water Management, Conservation and Water System Master Plan (2021)

This Water Management, Conservation and Water System Master Plan (WMCWSMP) was compiled to provide guidance to address the City of Molalla's future water needs. This Plan summarizes the components of the existing water distribution system, analyzes local water demand patterns, evaluates the performance of the water system with respect to critical service standards, and identifies the improvements necessary to remedy system deficiencies and accommodate future growth. This Plan recommends specific projects to the water distribution system for inclusion in the City of Molalla's Capital Improvement Plan (CIP).

Capital Improvement Plan (2022-2027)

The Capital Improvement Plan (CIP) is the primary tool used by the City in determining the Capital Improvement Fund Budget Proposal. The 5-year CIP is created using the master planning documents from each system, staff knowledge of needs that have arisen since master plan adoption, and community input as provided by the City Council. The CIP is essentially a tool that the Council uses to provide staff with marching orders for Capital Improvements; it aids staff in planning, budgeting, and managing growth and development of the City's infrastructure systems in accordance with best practices and community need.¹

TMDL Plan (2022)

The City maintains a Total Maximum Daily Load (TMDL) Plan (updated in 2022). The Total Maximum Daily Load (TMDL) program is intended to comply with the Willamette Basin TMDL order and to meet pollutant load allocations for the Molalla-Pudding Subbasin. The goal of this Implementation Plan is to minimize and reduce temperature, bacteria, and mercury contributions to surface waters within Molalla. The NHMP actions are incorporated into this document as appropriate. Example projects include participation in regional stormwater outreach projects, staff training on pollution control, and street cleaning after major storm events.

Community Wildfire Protection Plan (2024)

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex and into the City's Capital Improvement Plan. The CWPP is expected to be adopted in early 2024.

Personnel

The following Molalla personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: City Manager

Public Information Officer: City Manager

Floodplain Manager: Community Development Director

¹ City of Molalla Staff Report, Resolution 2022-03 Adopting a 5-year Capital Improvement Plan (CIP), dated April 27, 2022.

Grant writing (for Public Works or emergency management): Community Development Director

Capital improvement planning: Community Development Director

Capital improvement execution: Engineering Section Manager

Molalla does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Molalla has implemented recommendations from the last NHMP into its capital improvement projects over the last 5 years, including:

The following mitigation-related or resilience projects have been completed since 2018²

- Transportation System Master Plan Update (2018)
- Recycled Water Reuse Plan Update (2018)
- Wastewater Facility and Collection System Master Plan Update (2018)
- WWTP O&M Manual Update (2019)
- Fenton Avenue Sewer Replacement (2019)
- Fenton Avenue Sewer Replacement (2020)
- Patrol Street Sewer Replacement (2020)
- WWTP New Headworks Screen (2020)
- Molalla Ave PS Sewer Replacement (2021)
- Sewer Line installation on S Leroy Ave (2022)
- City Hall Public Sewer Line Replacement (2022)
- Molalla Avenue Waterline Improvements (2018)
- WTP Security Fencing and Gate Improvements (2018)
- Faurie Avenue Waterline Replacement (2018)
- Fenton Avenue Waterline Replacement Ph 1 (2019)
- Fenton Avenue Waterline Replacement Ph 2 (2020)
- Patrol Street Waterline Replacement Ph 2 (2020)
- Trout Creek Monitoring Station (2020)
- WTP New 2MGD Filtration Unit (2021)
- WTP Sodium Hypochlorite and SCADA Upgrades (2021)
- Water Management, Conservation, and Water System Master Plan (2021)
- Comprehensive Leak Analysis (2021)
- Water Main Upsize at Cascade Center (2022)
- City Shops/Elementary School to WWTP Waterline Replacement (2022) Stormwater
- Molalla Avenue Stormwater Improvements (2018)
- Ross Street Stormwater Improvements (2018)
- 5 YR TMDL Implementation Plan (2018)
- City Shops Bioswale (2020)
- Creamery Creek Storm Culvert Improvement (2021)
- Mercury TMDL Implementation Plan (2022)
- Clark Park Improvements Phase 4 (2022)
- Public Works Shops (2020)
- City Hall Remodel – Phase 3 (2021)
- New Police Facility Land Acquisition (2021)

² City of Molalla 2022-2026 Capital Improvement Plan, adopted by Resolution 2022-03.

- City Hall Remodel – Phase 4 (2022)
- Civic Center Remodel – Phase 1 (2022)

Ongoing projects that enhance the City’s resilience include:

- Wastewater Treatment Plant Upgrade
- New Police Facility
- Undergrounding of all new utilities

Proposed projects that relate to hazard mitigation and resilience within the next five years include:

- Pump station improvements
- New raw water intake
- Tank replacement (2 million gallon reservoir)
- Stormwater Master Plan Update
- Parks Master Plan Update
- Seismic retrofit of 1.5 million gallon reservoir structure

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority’s [Seismic Rehabilitation Grant Program](#)³.

FEMA Funded Mitigation Successes

- None identified

Seismic Rehabilitation Grant Program Mitigation Successes

- 2019: Clarkes Elementary School (\$2,498,235)
- 2017: Molalla Fire District Station 82 (\$1,189,967)

Capital Resources

Molalla maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

- Critical facilities with power generators for use during emergency blackouts: 3 lift stations, water treatment plant, wastewater treatment plant, City Hall
- Food pantries: Foothill Church, Molla River School District
- Fueling storage: 2,000 gallon diesel fueling storage bladder at Public Works Shop

Findings

Several important findings from this capability assessment informed the design of the Plan’s mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Molalla staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can

³ The Seismic Rehabilitation Grant Program (SRGP) 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.

undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Molalla operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City's ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The City’s mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAAC assessed the City’s risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the

actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table MO-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAC decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table MO-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
1	Develop and conduct public education and outreach, with a focus on wildfire, water system improvements, and critical redundant systems to support the community.	X	X	X	X	X	X	X	X	X	City Manager and Community Development Department	Short	Local Resources. DLCDC TA, FEMA HMA	Medium
2	Integrate the goals and action items from the City of Molalla NHMP into existing Capital Improvement Plan and programs.	X	X	X	X	X	X	X	X	X	City Manager and Community Development Department	Ongoing	Local Resources. DLCDC TA, FEMA HMA	Low
3	Improve vegetation management throughout the city. Work with code enforcement to reduce the risk of wildfire and to improve the resiliency with the community around parks, trails, transportation corridors to ensure necessary protection from natural hazard events.	X		X	X			X	X	X	Code Enforcement	Short	Local Resources. DLCDC TA, FEMA HMA	High
4	Identify and map evacuation routes for all hazards. Create update mapping system to be accessible for residents through mobile applications for hazard incidents.		X		X	X		X		X	GIS	Ongoing	Local Resources. DLCDC TA, FEMA HMA	Low
5	Reduce hazardous fuels from vegetation in the city parks and trails to mitigate risk from drought and wildfires.	X						X			Community Development	Ongoing	Local, State, Federal Grants and BRIC	High

Table MO-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
6	Identify planning and capital funding for 2 MG Treated Water Tank (including Land Acquisition and installation of Water Storage Seismic valves on existing tank and new tank) per Water Master Plan. Estimated \$7 million project cost.	X	X					X			City Manager/ Community Development	Ongoing	Local, State and Federal Grants and BRIC	High
7	Conduct building assessments on all city facilities to identify seismic and landslide hazards and recommend capital improvements for facilities based on the ASTM. Ensure recommendations for structural and non-structural seismic retrofits are included in the capital improvement plan.		X			X					Community Development	Long	Local and State	Medium
8	Conduct infrastructure improvements to reduce flood risk from Bear Creek.				X						Community Development/ Public Works	Medium	Local Resources, FEMA HMA (FMA)	Medium
9	Install emergency generators to provide redundant power in five pump station locations Estimate at \$250,000 each for a total project cost of \$1,250,000.		X			X	X	X	X		Community Development/ Public Works	Ongoing	Local, State, Federal Grants and BRIC	High

Table MO-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
10	Acquire emergency equipment to help with tree removal and snow removal following severe storms (snow, ice, wind, etc.). Estimate equipment cost of \$150,000.								X	X	Community Development/ Public Works	Ongoing	Local Resources, FEMA HMA (FMA)	High
11	Identify Capital Funding for permanent water intake. The existing city intake structure is “temporary” in nature and has become susceptible to low river flows due to changes in river hydrology over time. Water resiliency is critical to development of the city and mitigation of drought and extreme heat effects. Additionally, Molalla’s water supply has been the primary resource for fighting wildfires on BLM, National Forest, and Private Timber lands in and around the Molalla River Corridor.	X	X	X	X	X		X			City Manager/ Community Development	Short	Local Resources, FEMA TA, FEMA HMA	High
12	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.							X			Community Development/ Public Works	Ongoing	Local Resources, FEMA HMA, CWDG	Low to High
13	Install pressure reducing valves to increase system redundancy. The city has one main line that is stressed during periods of drought. Additional capacity is also needed for fire protection. Conservation of water is critical. Estimated \$1.5 million project cost.	X	X	X				X		X	Community Development/ Public Works	Medium	Local Resources, FEMA HMA	High

Source: Molalla NHMP HMA, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

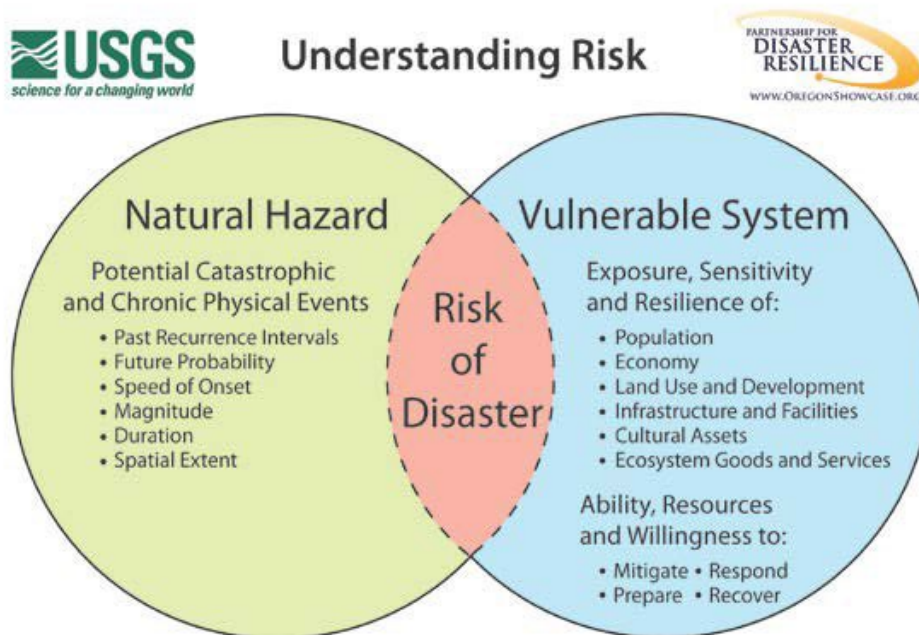
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure MO-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure MO-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Molalla HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Molalla, which are discussed throughout this addendum.

Table MO-2 shows the HVA matrix for Molalla listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) and two chronic hazards (wildfire, winter storm, and drought) rank as the top hazard threats to the City (Top Tier). Windstorm, extreme heat event, and flood comprise the next highest ranked hazards (Middle Tier), while volcanic event and landslide comprise the lowest ranked hazards (Bottom Tier).

Table MO-2 Hazard Analysis Matrix – Molalla

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Earthquake - Cascadia	2	45	100	35	182	1	<i>Top Tier</i>
Wildfire	6	40	80	56	182	2	
Earthquake - Crustal	6	50	100	21	177	3	
Winter Storm	10	35	70	49	164	4	
Drought	10	35	60	56	161	5	
Windstorm	10	35	50	35	130	6	<i>Middle Tier</i>
Extreme Heat Event	10	15	50	35	110	7	
Flood	6	25	40	35	106	8	
Volcanic Event	2	25	50	7	84	9	<i>Bottom Tier</i>
Landslide	16	20	30	14	80	10	

Source: Molalla HMAP, 2023.

Community Characteristics

Table MO-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

The city has three drainage basins: Molalla River basin, Creamery Creek basin, and Bear Creek basin. Located at 371 feet above sea level, Molalla’s climate is consistent with a Mediterranean climate zone, with warm summers and cool, wet winters. Molalla receives most of its rainfall between October and May, and averages 42 inches of rain, and around 6 inches of snow, per year.⁴

Population, Housing, and Income

Molalla has grown substantially since its incorporation in 1913 and has an area today of 2.26 square miles. It is in the south-central region of Clackamas County, located approximately 29 miles southeast of the City of Portland. The City is within the Molalla River watershed, with the Molalla River about a mile east of the UGB.⁵

Between 2016 and 2022 the City grew by 1,213 people (13%; as of 2022 the population is 10,298) and median household income increased by about 20%. Between 2022 and 2045 the population is forecast to grow by 13% to 11,618.

Most of the population is White/Caucasian (89%) and about 18% of the population is Hispanic or Latino. The poverty rate is 8% (7% of children under 18, 11% for people 65 and older), 5% do not have health insurance, and 50% of renters pay more than 30% of their household income on rent (28% for owners). About 16% of the population has a bachelor’s degree or higher (6% do not have a high school degree). Approximately 14% of the population lives with a disability (41% of population 65 and older), and 35% are either below 15 (24%) or over 65 (11%) years of age. About 9% of the population are 65 or older and living alone and 17% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 72% of housing units are single-family, 24% are multifamily, and 5% are mobile homes. Less than one-fifth of homes (17%) were built before 1970 and 61% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (64%) of housing units are owner occupied, 34% are renter occupied, 1% are seasonal homes, and 1% are vacant.

The City is pursuing an urban growth boundary expansion within the next five years that may expand development into areas that are at greater risk to landslide and other hazards.

Transportation and Infrastructure

Molalla is roughly 29 miles from Portland and is connected to surrounding communities by two state highways that run through the downtown area. Highway 211 runs east-west and connects Molalla to Interstate 5 and 99E. Highway 213 runs north-south through the City and connects it to both Silverton and Oregon City. Molalla’s proximity to Portland and Salem has enabled residents to live in town and work elsewhere.

⁴ “[Monthly Average for Molalla, OR](#)” The Weather Channel Interactive, Inc. Retrieved March 10, 2018.

⁵ [Annual Water Quality Report](#) (2017). City of Molalla. Retrieved March 10, 2019.

Motor vehicles represent the dominant mode of travel through and within Molalla. Twenty-three percent (23%) of renters and 3% of owners do not have a vehicle. Most workers drive alone to work (78%); 9% carpool, 1% use public transit, 3% either walk or use a bicycle, and 9% work at home. The South Clackamas Transportation District (SCTD) is the bus service that provides public transit to the City. There are no port services available on Molalla River, a tributary of the Willamette River, but there are recreational areas along the river.

Economy

Molalla's proximity to major transportation routes and access to rail has made it a desirable place for commercial and industrial development. Historically Molalla's economy focused on forestry and farming, which is still has a major presence in the workforce. About 51% of the resident population 16 and over is in the labor force (5,083 people) and are employed in a variety of occupations including construction, extraction, and maintenance (18%), office and administrative (17%), professional (16%), management, business, and financial (12%), and production (9%) occupations.

Molalla has an economic advantage due to its location at the north end of the Willamette Valley and its proximity to Portland. A significant portion of the land available for industrial development in Clackamas County is in the Molalla area. There are new expansions in existing industries currently underway with available industrial land in the Industrial Parks.⁶

Most workers residing in the city (91%, 4,277 people) travel outside of the city for work primarily to Portland and surrounding areas.⁷ A significant population of people travel to the city for work, (80% of the workforce, 2,063 people) primarily from Portland and surrounding areas.⁸

⁶ Economic Development (2019). City of Molalla. <https://www.cityofmolalla.com/ed>

⁷ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 18, 2023 at <https://onthemap.ces.census.gov>.

⁸ Ibid.

Table MO-3 Community Characteristics

Population Characteristics		Population	Household Characteristics	
		Growth		
2016 Population Estimate	9,085		Housing Units	
2022 Population Estimate	10,298	13%	Single-Family (includes duplexes)	2,740 72%
2045 Population Forecast*	11,618	13%	Multi-Family	909 24%
Race			Mobile Homes (includes RV, Van, etc.)	178 5%
American Indian and Alaska Native		< 1%	Household Type	
Asian		1%	Family Household	2,456 66%
Black/ African American		< 1%	Married couple (w/ children)	1,167 31%
Native Hawaiian and Other Pacific Islander		0%	Single (w/ children)	628 17%
White		89%	Living Alone 65+	320 9%
Some Other Race		0%	Year Structure Built	
Two or More Races		1%	Pre-1970	640 17%
Hispanic or Latino/a (of any race)			1970-1989	853 22%
Limited or No English Spoken	122	1%	1990-2009	2,101 55%
Vulnerable Age Groups			2010 or later	233 6%
Less than 5 Years	626	6%	Housing Tenure and Vacancy	
Less than 15 Years	2,400	24%	Owner-occupied	2,441 64%
65 Years and Older	1,144	11%	Renter-occupied	1,296 34%
85 Years and Older	92	1%	Seasonal	45 1%
Age Dependency Ratio		0.54	Vacant	45 1%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)	
Total Disabled Population	1,363	14%	No Vehicle (owner occupied)	69 3%
Children (Under 18)	111	4%	Two+ vehicles (owner occupied)	1,992 82%
Working Age (18 to 64)	800	13%	No Vehicle (renter occupied)	297 23%
Seniors (65 and older)	452	41%	Two+ vehicles (renter occupied)	613 47%
Income Characteristics			Employment Characteristics	
Households by Income Category			Labor Force (Population 16+)	
Less than \$15,000	199	5%	In labor Force (% Total Population)	5,083 51%
\$15,000-\$29,999	483	13%	Unemployed (% Labor Force)	325 6%
\$30,000-\$44,999	291	8%	Occupation (Top 5) (Employed 16+)	
\$45,000-\$59,999	439	12%	Construction, Extraction, & Maint.	912 18%
\$60,000-\$74,999	460	12%	Office & Administrative	853 17%
\$75,000-\$99,999	628	17%	Professional	820 16%
\$100,000-\$199,999	1,123	30%	Management, Business, & Financial	610 12%
\$200,000 or more	114	3%	Production	471 9%
Median Household Income		\$74,718	Health Insurance	
Gini Index of Income Inequality		0.37	No Health Insurance	485 5%
Poverty Rates (Percent age cohort)			Public Health Insurance	3,075 31%
Total Population	815	8%	Private Health Insurance	7,485 75%
Children (Under 18)	186	7%	Transportation to Work (Workers 16+)	
Working Age (18 to 64)	509	8%	Drove Alone	3,927 78%
Seniors (65 and older)	120	11%	Carpooled	457 9%
Housing Cost Burden (Cost > 30% of household income)			Public Transit	68 1%
Owners with a Mortgage	557	28%	Motorcycle	0 0%
Owners without a Mortgage	51	11%	Bicycle/Walk	150 3%
Renters	654	50%	Work at Home	440 9%

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", 2016 & 2022; Portland State University, Population Research Center, "Population Forecast Tables", (2023, [Preliminary](#)).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Molalla. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and/or essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table MO-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table MO-4 Critical Facilities in Molalla

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Far Horizons Academy	-	-	-	-	-
Molalla Elementary School	-	-	X	-	-
Molalla High School	-	-	X	-	-
Molalla Police Department & City Hall	-	-	X	-	-
Molalla Public Works	-	-	X	-	-
Molalla RFPD 73 - Station 382	-	-	X	-	-
Molalla River Middle School	-	X	X	-	-
Molalla Sewage Treatment Plant	-	X	X	-	-
Molalla Urgent Care	-	X	X	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-29.

Note: Police Facility to be constructed per local bond, estimated completion 2025. Molalla Civic Center (EOC Temporary) and Molalla Water Treatment Plan not included in DOGAMI analysis.

Additional Critical Facilities not included in the DOGAMI Risk Report:

- Fleet Services
- Water Treatment Plant

Hospitals

- Providence Medical

Potential Shelter Sites

- Molalla Adult Community Center
- All Churches (see p. 21 for list)

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

Arterials

*designates road maintained by others

- Highway 213*
- Highway 211*

Bridges

- Bridge over the Molalla River
- Feyer Park Bridge
- Milk Creek Bridge
- Mulino Bridge*
- Pudding River Bridge
- Wagon Wheel Park Bridge

Other Critical Infrastructure

- Communication Towers
- NW Natural Pipelines
- Power Substations
- Sewage Infrastructure
- Water Distribution/Drainage Infrastructure

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public's ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields.

Granges

- Molalla Grange

Churches

- Church of Christ of Latter-Day Saints
- Church of the Nazarene
- Country Church
- Foothills Community Church
- Grace Lutheran Church
- Molalla Assembly of God
- Molalla Christian Church
- Molalla Church of Christ
- Saint James Catholic Church
- Seventh-Day Adventist
- United Methodist Church

Food Providers

- Safeway
- Grocery Outlet

Other Essential Facilities

- High School Football Field
- Masonic Lodge
- Molalla Aquatic Center
- Molalla Buckeroo Grounds
- Molalla Communications Company
- Molalla Public Library
- Moose Lodge
- Safeway
- Skydive Oregon Airport

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include: Bear Creek Byway, Billy Sheets Field, Bohlander Field, Clark Park, High School Sports Complex, Ivor Davies Trail Park, Leonard Long Park, Rosse Posse Acres (Elk Farm), Sally Fox Park, and the Molalla BMX Track.

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include:

Assisted Living Facilities

- Evergreen Court
- Molalla Manor
- Pheasant Pointe
- Twin Firs Mobile Home Park

Child Care Centers

- 24 Hours Child Care/Preschool
- Early Horizons Preschool Childcare, Inc.

Schools

- Country Christian School
- Molalla Elementary School
- Molalla High School
- Molalla River Middle School
- Molalla River Academy
- Rural Dell Elementary

Other Vulnerable Populations

- Cole Apartments (Spanish speaking)
- Molalla Adult Community Center
- Molalla Mobile Manor
- Plaza Los Robles (Spanish speaking)

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: Gas Stations, IXL Propane, IDMS, Molalla Aquatic Center, Molalla Wastewater Treatment Plant, Molalla Water Treatment Plant, and Pacer Propane.

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Happy Valley. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers, and are a concern during evacuation/notification during a hazard event include:

Economic Centers

- Bus Company – First Student
- Cascade Center(Grocery Outlet/Goodwill)
- Cash Ice
- Dentist of Main
- Fountain Valley Dental
- International Forest Products Limited
- IXL Propane
- Lincotech
- Molalla Buckaroo
- Molalla Family Dental
- Molalla Market Center
- Molalla Redi-Mix
- Molalla Square (Bi-Mart)
- Northwest Polymers
- Pacer Propane
- Quanex
- Safeway Shopping Center
- Titanic Ice

Population Centers

- Bear Creek Apartments
- Bear Creek Subdivision
- Big Meadows Subdivision
- Colima Apartments
- Fir Crest Apartments
- Lexington Estates
- Molalla School District
- Rondel Court
- Schools
- Shel Mar Estates
- Stone Place Apartments
- Sunrise Acres
- Toliver Terrace
- Twin Meadows Subdivision

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

An example of the types of properties that should be considered before, during, and after an event include the following properties identified on the National Register of Historic Places within Molalla:

- Horace and Julia Ann Von der Ahe House and Summer Kitchen
- Dibble House, 616 Molalla Avenue

Hazard Characteristics

The following subsections briefly describe relevant information for each hazard. For additional background on the hazards, vulnerabilities and general risk assessment information for hazards in the City refer to Volume I, Section 2 and the [Risk Assessment for Region 2, Northern Willamette Valley/Portland Metro, of the Oregon NHMP \(2020\)](#).

Drought

The HMAC determined that the City's probability for drought is **high** and that their vulnerability to drought is **moderate**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

The City of Molalla Public Works Department manages Molalla's water supply. Molalla houses one large water intake facility and water treatment plant, which provides water to the City of Molalla. The City draws its water supply from the Molalla River and serves approximately 10,335 residents.⁹ There are potential contamination sources within Molalla's drinking water protection area from agriculture, managed forest land, and other sources.

There is an action item to construct a second accessible water source for the City in case of contamination or drought.

⁹ Population Research Center, "Annual Population Estimates", 2023

Vulnerability Assessment

Due to insufficient data and resources, Molalla is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section and Table MO-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁰ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Molalla as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Molalla as well.

Figure MO-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Molalla Fault Zone (discussed in the crustal earthquake section).

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.¹¹

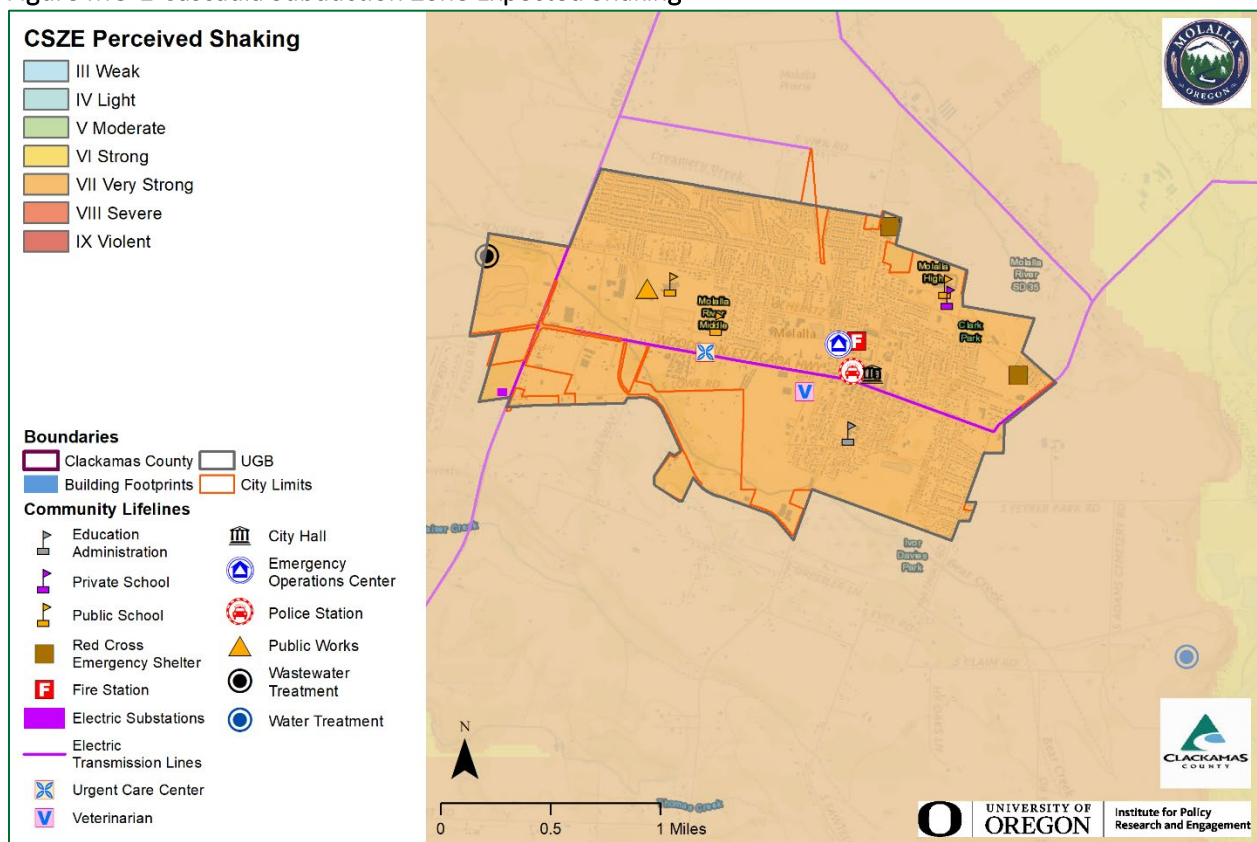
¹⁰ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

¹¹ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

The city's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the "Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

The City is not within the severe shaking area, though there is significant area around the City that have severe and very severe shaking if a large earthquake were to occur. These areas include Highway 211 and Highway 213, which could result in Molalla having access issues from emergency vehicles and other response efforts.

Figure MO-2 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Earthquake (Crustal)

The HMAC determined that the City's probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

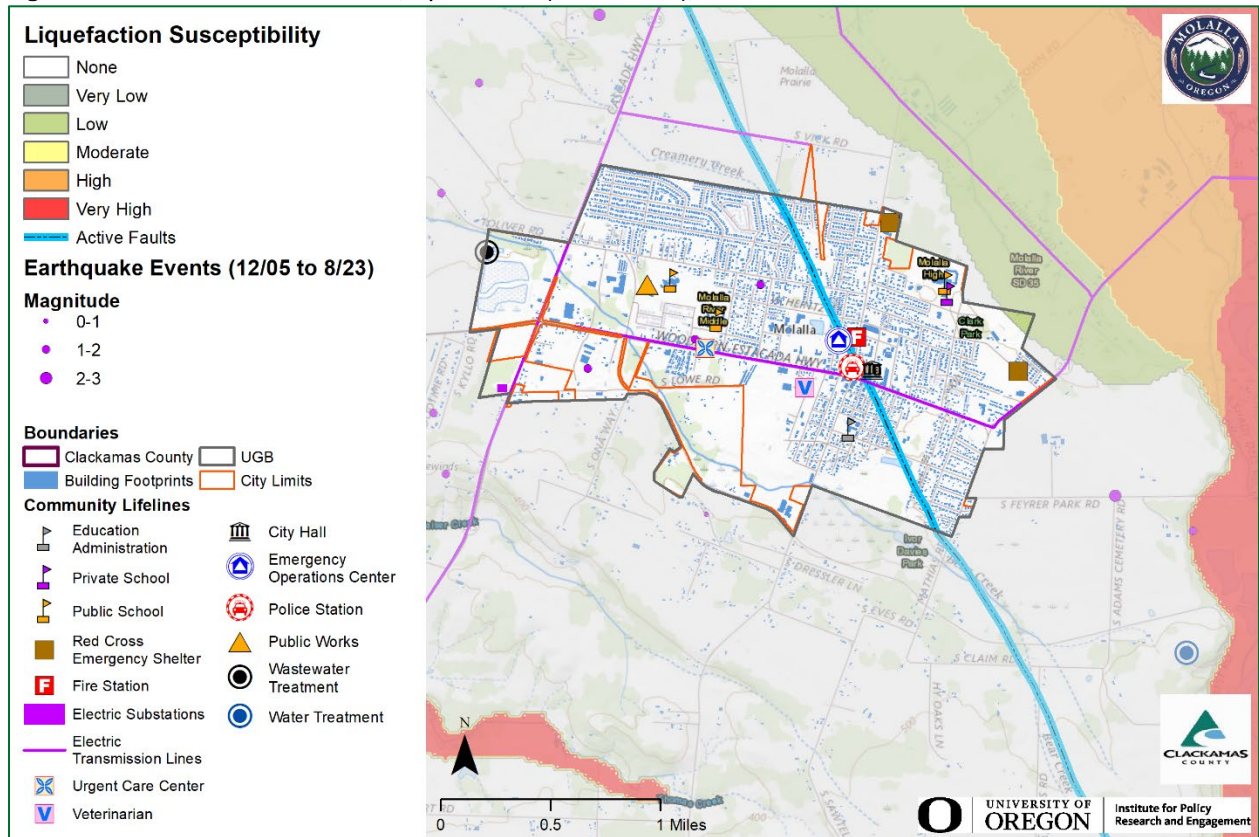
Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Molalla as well. Figure MO-3 shows a generalized geologic map of the Molalla area that includes

the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

The Canby-Molalla Fault runs through the center of the City and can generate high- magnitude earthquakes. The City is also 15 miles away from the Portland Hills Fault Zone (discussed in greater detail below). Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993, Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8. In December 2017 a 4.0 tremor was felt in Molalla along the same epicenter as the 5.6 quake; this time, no damage occurred.

Figure MO-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Canby-Molalla Fault Zone

The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Molalla in northern Oregon.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 15 miles northeast of Molalla.

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 36% of residential buildings were built prior to 1990, which increases the City’s vulnerability to the earthquake hazard. Information on specific public buildings’ (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table MO-5; each “X” represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), zero (0) have a very high (100% chance) collapse potential and zero (0) have a high (greater than 10% chance) collapse potential.

For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table MO-4.

Table MO-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Molalla Elementary (910 Toliver Rd)	Clac_sch32	X			
Molalla River Middle (318 Leroy Ave)	Clac_sch33	X			
Molalla High (357 Francis St)	Clac_sch68	X			
Fire Facilities					
Molalla RFPD #73 – Station 82 EOC (320 N Molalla Ave)	Clac_fir18	X			
See Mitigation Successes					
Law Enforcement Facilities					
City Hall/Police Department (117 N Molalla Ave)	Clac_pol10	X			

Source: [DOGAMI 2007. Open File Report O-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)

“*” – Site ID is referenced on the [RVS Clackamas County Map](#)

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table MO-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

The critical facilities at most risk within Molalla are the middle school, sewer treatment plan, water treatment plan, and Molalla Urgent Care.

Table MO-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	3,176	3,176	3,176	3,176
Building Value (\$ Million)	854	854	854	854
Building Repair Cost (\$ Million)	21	21	37	37
Building Loss Ratio	2%	2%	4%	4%
Debris (Thousands of Tons)	11	11	14	16
Long-Term Displaced Population	8	8	17	17
Total Casualties (Daytime)	12	12	17	17
Level 4 (Killed)	0	0	1	1
Total Casualties (Nighttime)	3	3	7	7
Level 4 (Killed)	0	0	0	0

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

The City of Molalla is expected to have a 2% building loss ratio with a repair cost of \$21 million under the CSZ “dry” scenario, and under the CSZ “wet” scenario.¹² The city is expected to have around 12 daytime or 3 nighttime casualties during the CSZ “dry” scenario and 12 daytime or 3 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 8 for the CSZ “dry” scenario and 8 for the CSZ “wet” scenario.¹³ (See Risk Report content for additional information.)

Portland Hills Fault Scenario

The City of Molalla is expected to have a 4% building loss ratio with a repair cost of \$37 million under the CSZ “dry” scenario, and under the CSZ “wet” scenario.¹⁴ The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 17 daytime or 7 nighttime casualties during the Portland Hills Fault “dry” scenario and 17 daytime or 7 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 17 for the Portland Hills Fault “dry” scenario and 17 for the Portland Hills Fault “wet” scenario.¹⁵

Recommendations from the DOGAMI report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table MO-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

¹² DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8 and 12-9.

¹³ Ibid, Tables 12-8 and 12-9.

¹⁴ Ibid, Tables 12-10 and 12-11.

¹⁵ Ibid, Tables 12-10 and 12-11.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹⁶ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard.

According to the Risk Reports the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone event (M9.0 Deterministic): 47 buildings (3 critical facilities) are expected to be damaged for a total potential loss of \$27.6 million (a loss ratio of about 3%). About 10 residents may potentially be displaced (less than 1% of the population).

Crustal event (Canby-Molalla fault M6.8 Deterministic): 528 buildings (8 critical facilities) are expected to be damaged, for a total potential loss of \$150.8 million (a loss ratio of about 15%). About 409 residents may be displaced (about 4% of the population).

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

The HMAC determined that the City's probability of flooding is **moderate** and that their vulnerability to flooding is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure MO-4 illustrates the flood hazard area for Molalla.

The latest flooding incident was in February 2014 when Main Street was flooded. While Molalla does not show any areas within the FEMA mapped special flood hazard areas (100- year flood vulnerability), the city regularly experiences urban flooding. This is primarily due to inadequate storm drainpipes, and culverts that are too small. Molalla also has clay soils, which means that the percolation rate is very slow, and the water table is very high.

Additionally, the extent of flooding will vary depending on climatic conditions and precipitation levels. Areas within Molalla that are frequently impacted by urban flooding events include: the intersection of South Cole and Main Street; East 3rd Street; Mathias Road south of 8th Street; areas south of 7th Street; and Highway 213 south of Toliver Road.

Typically, roads are covered with water in urban flooding events, and water will occasionally overflow manholes in some parts of the city. Newer homes are built on higher ground to avoid flooding issues, and many older homes have pumps within their crawlspaces to avoid flood events.

Future Projections

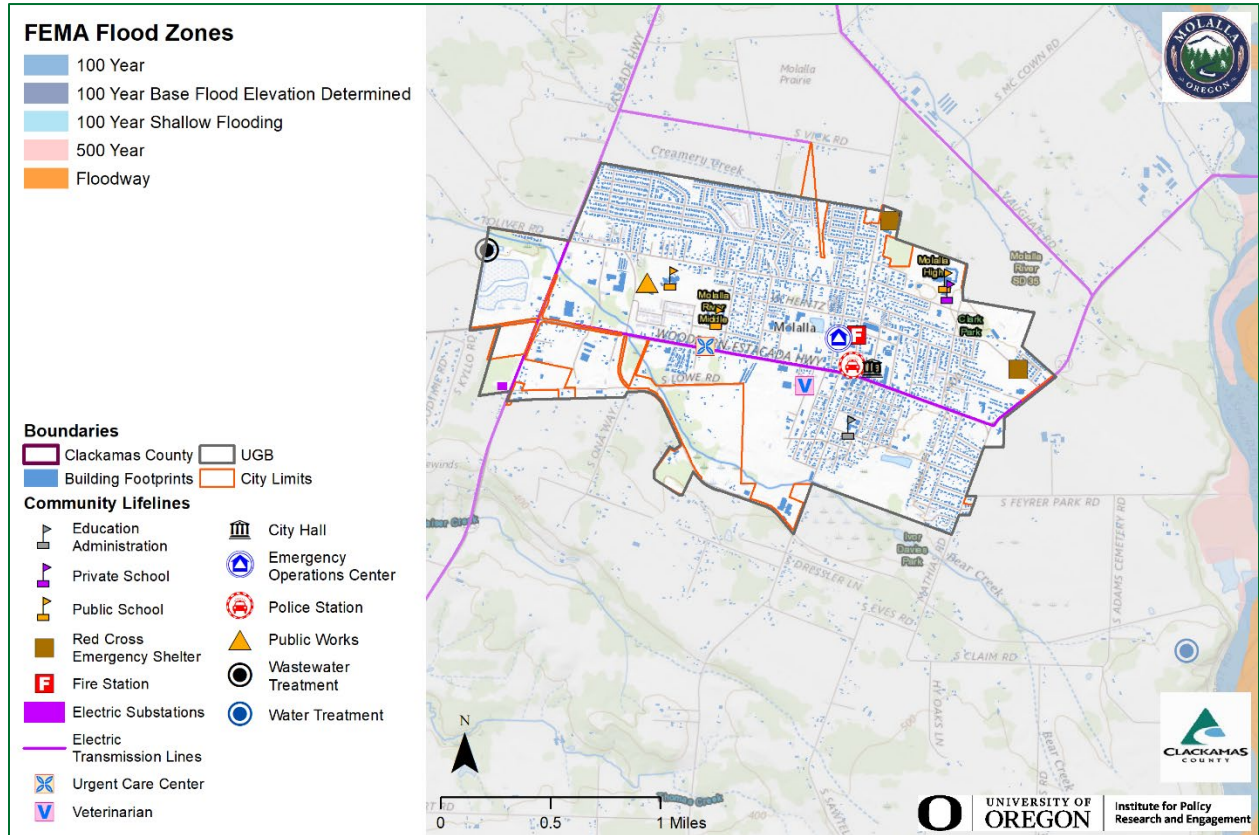
According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"¹⁷ winter flood risk at mid- to low elevations in Clackamas County, where temperatures are near freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of

¹⁶ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-28.

¹⁷ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

precipitation falling as rain rather than snow. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Figure MO-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.
Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

Molalla is in a “Non-special Flood Hazard Area” (NSFHA), which means the entire city is in a low-to-moderate risk flood zone. A NSFHA is not in any immediate danger from flooding caused by overflowing rivers or hard rains.

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Molalla outside of the mapped floodplains

may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The extent of flooding hazards in Molalla primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow. The only public infrastructure at risk to direct flooding are the City's surface water intake areas. In the past flooding has occurred along Main Street and other roadways due to urban flooding. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table MO-5.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹⁸ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

The Risk Report did not identify population or property within the study area that may be impacted by the profiled flood hazard.

National Flood Insurance Program (NFIP)

FEMA's Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program, although the City does not have a delineated Special Flood Hazard Area (SFHA). Molalla has not had a Community Assistance Visit (CAV) and does not participate in the Community Rating System (CRS). The Community Repetitive Loss record does not identify any Repetitive Loss Properties¹⁹ or Severe Repetitive Loss Properties²⁰.

Landslide

The HMAC determined that the City's probability for landslide is **low** and that their vulnerability to landslide is **moderate**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Molalla does not have a history of landslides. This is due to the relatively flat topography within the UGB as well as the City's requirements of geological analysis on slopes of 25% or greater, usually located along stream embankments, before extensive tree removal, excavation, or construction occurs.

Although landslides have not occurred in Molalla, in 1996 a landslide upstream of Molalla dammed the Molalla River for about 6 or 7 hours and destroyed the City's intake valves. A dammed river is the City's biggest vulnerability to landslide hazards, which could also damage Highway 211 and 213 bridges.

¹⁸ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-28.

¹⁹ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

²⁰ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Landslide susceptibility exposure for Molalla is shown in Figure MO-5. Most of Molalla demonstrates a low landslide susceptibility exposure. There are no areas within Molalla that have very high or high landslide susceptibility exposure, while approximately 4% show moderate landslide susceptibility exposure.²¹

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table MO-5.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

The City currently has little risk to landslides; however, if the urban growth boundary is expanded to the south east, new development could be within or close to areas vulnerable to landslides.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²² provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

The Risk Report did not identify population or property within the study area that may be impacted by the profiled landslide hazard.

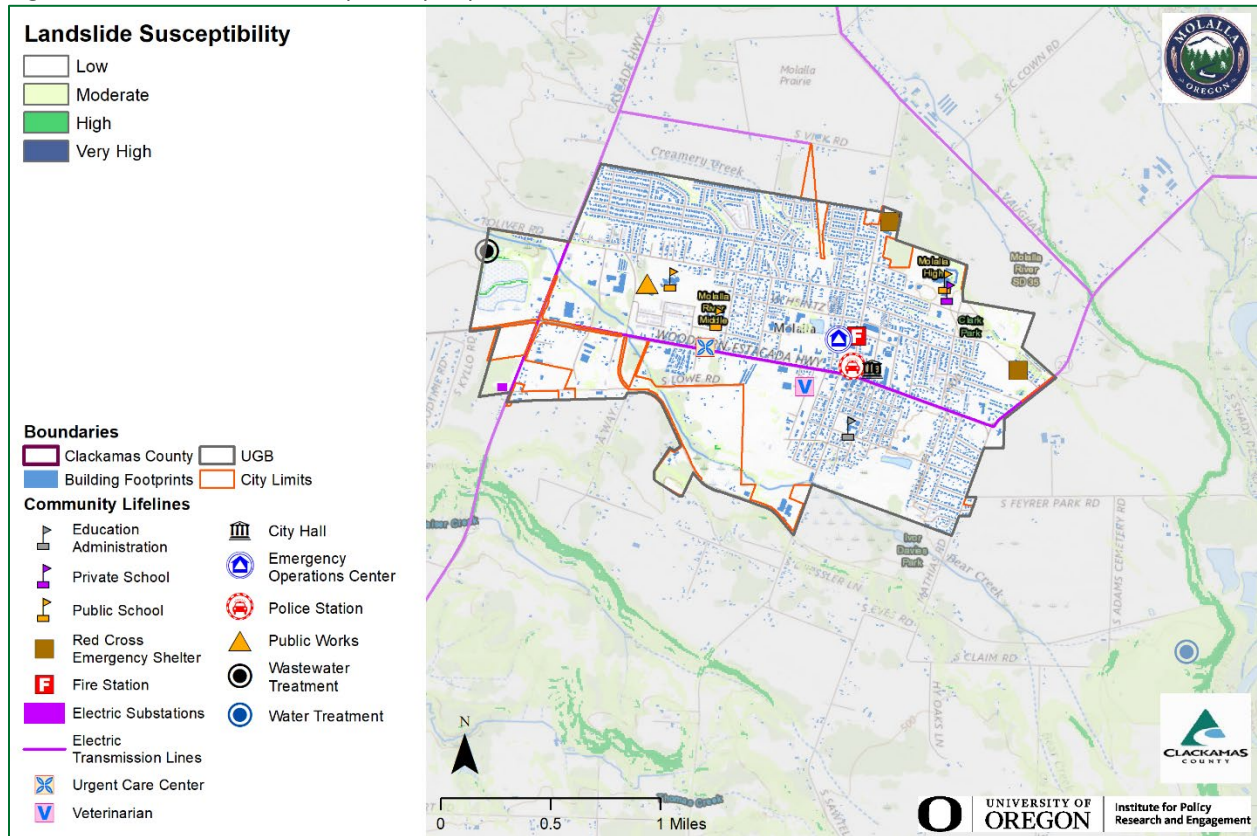
Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

²¹ DOGAMI. [Open-File Report, O-16-02](#), *Landslide Susceptibility Overview Map of Oregon* (2016)

²² DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-28.

Figure MO-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **moderate** and that their vulnerability is **low**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of Molalla has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events. resulting from hazards.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²³ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City’s probability for windstorm is **moderate** and that their vulnerability to windstorm is **moderate**. *The probability rating decreased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Molalla.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris.

Additionally, transportation, and economic disruptions result as well. Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

²³ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Winter Storm (Snow/Ice)

The HMAC determined that the City's probability for winter storm is **moderate** and that their vulnerability to winter storm is **moderate**. *The probability rating decreased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

The biggest impact of winter storms is congestion on roadways. In January 2007 the City experienced freezing temperatures and high winds caused a tree to fall on the main fire station and blocked some of the roads.

Most winter storms typically do not cause significant damage, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter, and commercial traffic as noted above.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"²⁴ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Vulnerability Assessment

Due to insufficient data and resources, Molalla is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets Section and Table MO-5.

²⁴ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Volcanic Event

The HMAC determined that the City’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **moderate**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volcanoes are located near Molalla, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Molalla’s relative distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²⁵ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard.

The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the City’s probability for wildfire is **high**, and that their vulnerability to wildfire is **high**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan](#) (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Molalla is found in the following chapter: Chapter 9.9: Molalla Rural Fire Protection District #73.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather and urbanization conditions are primarily at cause for the hazard level. Molalla has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. Figure MO-6 shows overall wildfire risk in Molalla per the state’s evaluation. However, as the community had to be evacuated during the wildfire season of 2020 due to the proximity

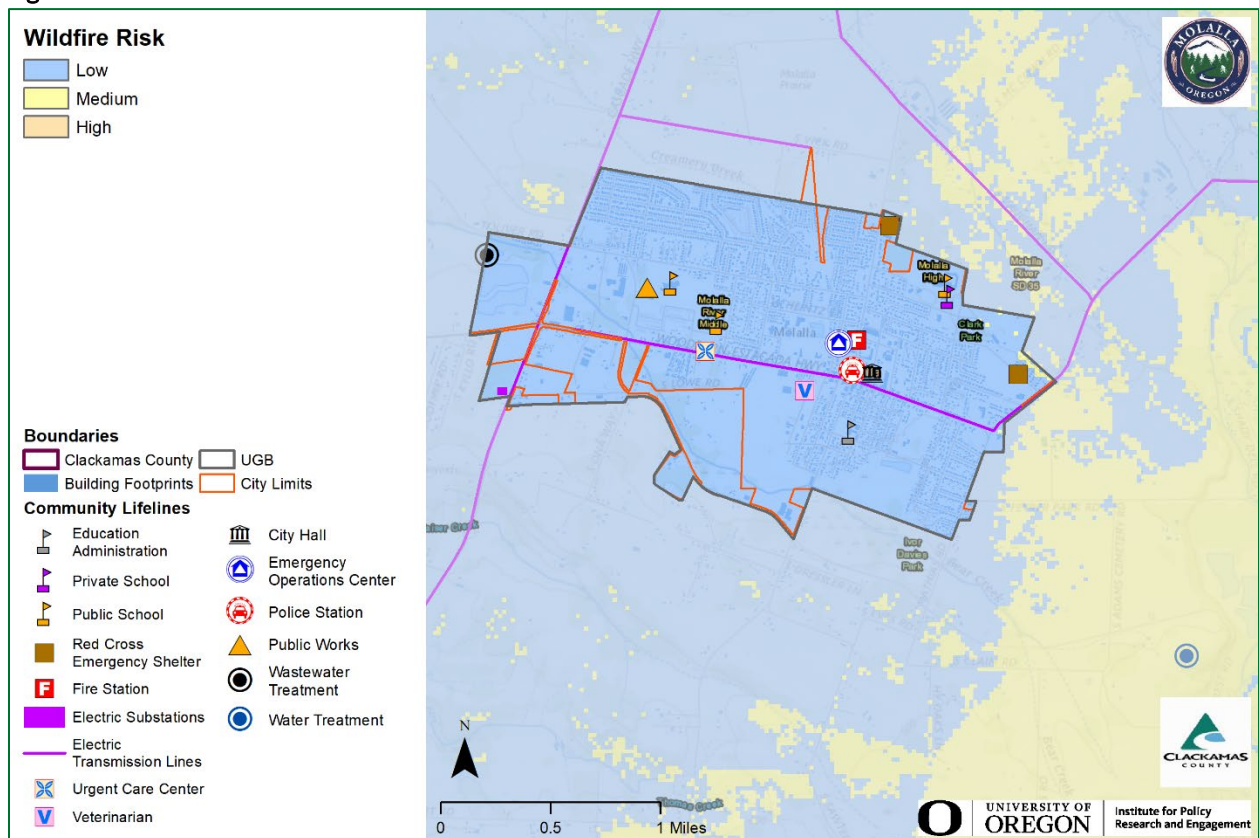
²⁵ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-28.

of adjacent wildfires and their unpredictable nature, wildfire has been elevated in the priority ranking for this NHMP.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Molalla, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

The City of Molalla, Oregon, is working to update its Emergency Operations Plan (EOP) the current plan was completed in 2011. However, after experiencing devastating wildfires in both 2020 and 2022, as well as severe ice storms, the city's proactive management recognized the need for a comprehensive and up-to-date plan. The city is committed to ensuring its residents' safety and well-being in an emergency, and Phase 1 of the EOP update is a crucial step toward achieving that goal.

Figure MO-6 Wildfire Risk



Molalla is surrounded mostly by farmlands which creates a buffer from the forested areas. There are some areas of heavy tree coverage in the northeast and southern portions of the City. Identified High and

Medium Priority Communities at Risk (CARs) are all located outside of the City limits.²⁶ Wildfires are not a frequent occurrence within the city, but regional wildfires occasionally introduce pollutants within the city. Molalla sits in the bottom of a valley, and pollution from regional fires settles in the area, causing health concerns for residents.

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four feet under normal weather conditions.²⁷ However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Vulnerability Assessment

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. Molalla's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City will update the City's wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Natural Hazard Risk Reports for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²⁸ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 147 buildings (no critical facilities) are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of \$34.6 million (a building exposure ratio of about 3%). About 505 residents may be displaced by wildfires (about 5% of the population).

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"²⁹ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

²⁶ Clackamas County Community Wildfire Protection Plan, *Molalla Fire Department* (2018), Table 10.13-1.

²⁷ [Oregon Wildfire Risk Explorer](#), date accessed November 9, 2018.

²⁸ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-28.

²⁹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table MO-7 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table MO-1).

Previous NHMP Actions that are Complete:

Flood #2, “Minimize overall impervious cover and disconnect impervious areas.” Complete. Stormwater management plan adopted.

Wildfire #1, “Promote fire-resistant strategies for new and existing developments.” Complete. Part of existing code.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table MO-7 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Multi-Hazard #2	#2	Not Complete	Yes
Multi-Hazard #3	#3	Not Complete	Yes
Multi-Hazard #4	#4	Not Complete	Yes
Severe Weather #1	#5	Not Complete, revised	Yes
-	#6	New	-
Earthquake #1	#7	Not Complete, revised	Yes
Flood #1	#2, #8	Not Complete, revised	Yes
Flood #2	-	Complete	No
-	#8	New	-
-	#9	New	-
Severe Weather #1	#9, #10	Not Complete, revised	Yes
Landslide #1	#11	Not Complete, revised	Yes
Wildfire #1	-	Complete	No
Wildfire #2	#12	Not Complete	Yes

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from January 17 through February 2 on the City's website. The plan was also posted and announced on the County's website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Summary of Public Participation and Outreach

The Technical Advisory Committee (TAC) is comprised of members from Molalla Public Works, Molalla Police Department, Molalla Fire District, Molalla River School District, South Clackamas Transit District, Molalla Buckeroo Association, and Clackamas County Emergency Management. The TAC met on the following dates:

- 3/6/23
- 4/10/23
- 5/1/23
- 6/12/23
- 7/31/23

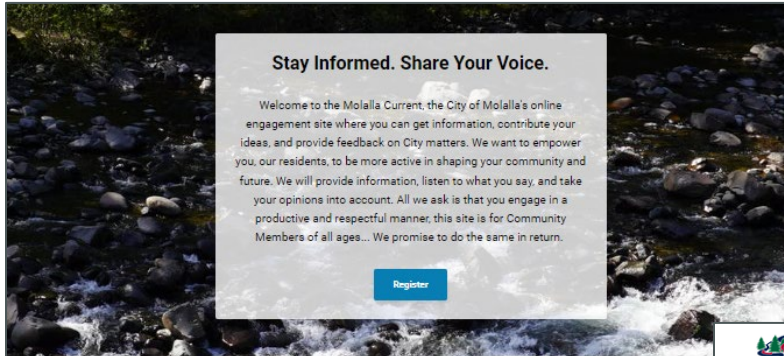
The Molalla Planning Commission reviewed the NHMP Draft on 1/4/2024 and Molalla City Council reviewed the NHMP Draft on 1/10/2024. On 1/17/2024 the City sent a press release was sent to Pamplin Media, posted the NHMP to their [website](#) (to be removed on 2/2/2024), posted on City of Molalla Facebook Page, and sent an email blast to 1,363 recipients via Molalla's E-Newsletter Mailing List.

Additionally, on 1/17/2027 the following individuals and agencies that work directly with and/or provide support to **underserved communities and socially vulnerable populations** were provided an opportunity to be involved:

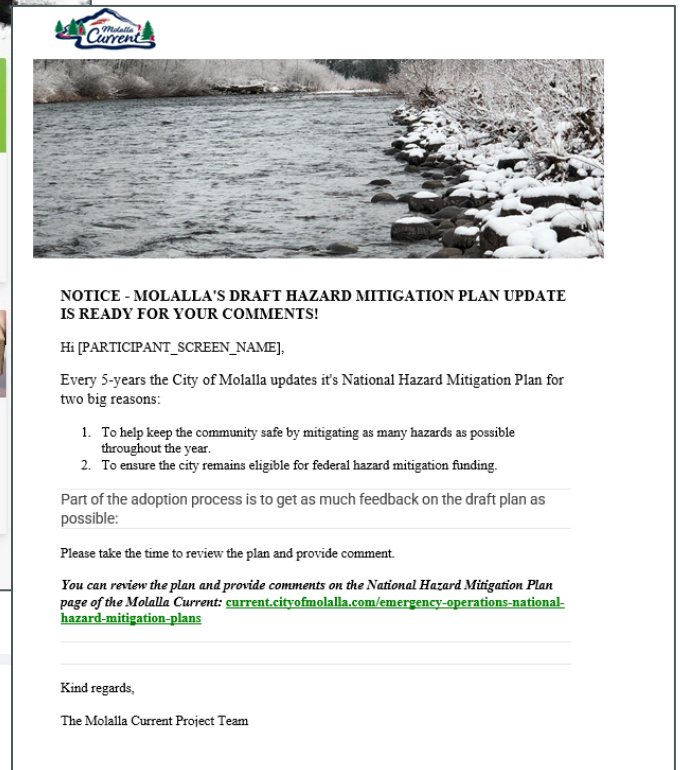
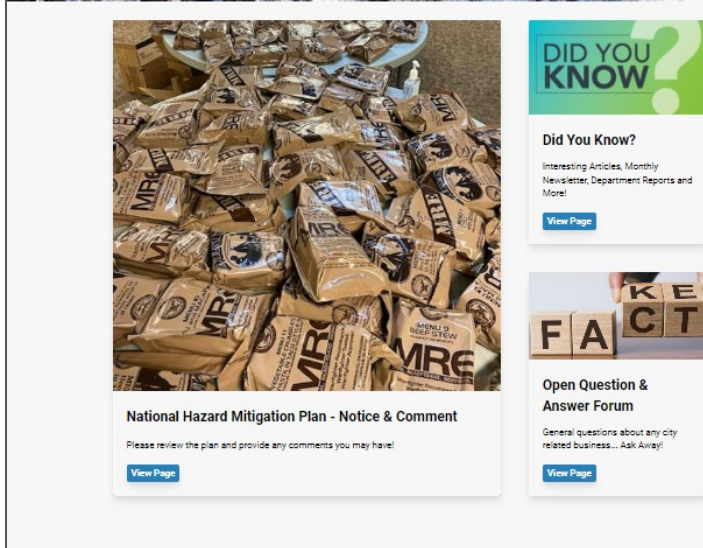
- MRSD Superintendent, Tony Mann;
- Ant Farm Youth services Director, Neal Hatley;
- Molalla Communications Company, Lance Eves and Daphne Lisac;
- Portland General Electric Local Government Affairs Manager, Julie Hernandez;
- Molalla Area Chamber of Commerce Office Coordinator, Jill Gates;

- Plaza Los Robles Property Manager (plazalosrobles@cascade-management.com);
- Todos Juntos Molalla Site Contact, Albert Garcia
- Molalla Police
- Molalla Public Works
- Molalla Fire District

Website & Social Media Posting, and Email Blast



*Left: Posting on the Molalla Current
Below: Email Blast
Both Posted 1/17/24*



*Left: Facebook Post
(1/17/24)*

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1: May 30, 2023

During this meeting, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: November 20, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

City of Oregon City Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: City of Oregon City

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The City of Oregon City

Updated:
July 17, 2024, (Resolution # 24-22)
September 4, 2019, (Resolution # 19-30)
April 8, 2013
September 2, 2009



This Natural Hazard Mitigation Plan was prepared by:



Planning grant funding provided by:



Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

RESOLUTION NO. 24-22

A RESOLUTION adopting the City of Oregon City Representation in the Updates to the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan

WHEREAS, the City of Oregon City recognizes the threat that natural hazards pose to people, property and Infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, the City of Oregon City has fully participated in the FEMA prescribed mitigation planning process to prepare the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

WHEREAS, the City of Oregon City has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of Oregon City to the impacts of future disasters within the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan; and

WHEREAS, these proposed projects and programs have been incorporated into the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan and pre-approved it (dated, May 29, 2024) contingent upon this official adoption of the participating governments and entities; and

WHEREAS, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

WHEREAS, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

NOW, THEREFORE, OREGON CITY RESOLVES AS FOLLOWS:

1. The City of Oregon City adopts the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* (NHMP) as its official plan along with the *Oregon City Addendum to the NHMP* and directs the City Manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.
2. The City of Oregon City will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan.
3. This resolution shall take effect immediately upon its adoption by the City Commission.

Approved and adopted at a regular meeting of the City Commission held on the 17th day of July 2024.


DENYSE C. MCGRIFF
Mayor

Attested this 17th day of July 2024:


Jakob Wiley, City Recorder

Approved as to legal sufficiency:


City Attorney

Purpose

This is an update of the Oregon City addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Oregon City’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Oregon City adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 17, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Oregon City to update their NHMP.

The Clackamas County NHMP, and Oregon City addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Oregon City HMAc guided the process of developing the NHMP.

Convener

The Oregon City’s Public Works Director serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Oregon City HMAc met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAc reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Oregon City HMAC was comprised of the following representatives:

- Convener, John Lewis, Public Works Director
- Vance Walker, Assistant Public Works Director
- Audrey Meeker, Senior Administrative Assistant

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Commission will be responsible for adopting the Oregon City addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the Oregon City NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among

agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Oregon City will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Oregon City to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, water system master plan, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

Oregon City addresses Statewide Planning Goal 7 Natural Hazards as part of their Comprehensive Plan. Adoption of the revised Oregon City 2040 (OC2040) Comprehensive Plan is underway. Goal 4, Protected Environment, covers Statewide Planning Goal 7, Natural Hazards. It integrates the hazard analysis and findings of the 2019 Natural Hazards Mitigation Plan. Goal 3 for Protected Environments states that the City will "ensure the safety of residents and property by supporting plans, programs, and investments that minimize the impacts of future natural hazard events and aid in rapid response and recovery." Strategy 2A further states that the City will "protect existing development from natural hazards through mitigation measures identified in the Clackamas County Hazard Mitigation Plan."

Planned updates to the jurisdiction's Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community's long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

Oregon City has undertaken the updating of a number of sections of their Municipal Code to directly address recommendations found within the 2019 Natural Hazards Mitigation Plan, including:

- Oregon City Municipal Code Section 17.42 – Floodplain was amended August 17, 2022.
- Oregon City Municipal Code Section 17.44 – Geologic Hazards was amended July 21, 2021.
- Oregon City Municipal Code Section 17.44 – Natural Resource Overlay District was amended July 3, 2019.
- https://library.municode.com/or/oregon_city/codes/municipal_code
- Stormwater and Grading Design Standards were amended March 2020.
- <https://www.orcity.org/DocumentCenter/View/3530/Stormwater-and-Grading-Design-Standards-PDF>

The Oregon City Community Development Department is the oversight entity for all matters related to long range planning, development review, and code enforcement.

The Planning Department, which is part of Community Development, is responsible for the administration of state, county, and local land use policies and regulations as they relate to the preservation and quality development of property lying within the city limits and urban growth boundary (UGB). The Planning Department assists the City Commission and community by developing the policies and regulations that guide development and ensures that developments are planned according to zoning codes and statewide land use laws. The Planning Department is responsible for comprehensive and neighborhood planning, environmental planning (including geologic hazard review, floodplain review, and natural resources overlay verification and reviews), and growth and development analysis and procedures. Planning works closely with Building, Engineering, and Fire in the review of development applications and building permits. They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

The Oregon City Building Department, which is part of the Community Development Department, administers and enforces the following codes:

- Oregon Structural Specialty Code – October 1, 2022
- Oregon Residential Specialty Code – October 1, 2023
- Oregon Mechanical Specialty Code – October 1, 2022
- Oregon Electrical Specialty Code – October 1, 2023
- Oregon Plumbing Specialty Code – October 1, 2023
- Oregon Energy Efficiency Specialty Code – April 1, 2021
- Oregon Manufactured Dwelling Installation Specialty Code – April 1, 2010
- Oregon Manufactured Dwelling and Parks Specialty Code – April 1, 2005

The Oregon Fire Code is not adopted through the Building Codes Division; it is adopted through the Oregon State Fire Marshal and was adopted October 1, 2022.

Through the continued updating and administration of these codes, new residential and commercial structures and repaired or new infrastructure will be required to build according to the latest seismic and wind hardening standards in addition to using fire resistant building materials for those structures constructed in proximity or within the WUI.

Public Works

The City of Oregon City Public Works Department is responsible for the delivery of safe and reliable sewer, storm water, transportation (streets), and potable water systems to city residents. They are also responsible for maintaining sustainable public infrastructure and protecting public health and safety, water quality, and natural resources within the jurisdiction. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

City Administration

The City Commission of Oregon City has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Commission tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Policies and Programs

This Plan directs Oregon City and Clackamas County to explore integration into other planning documents and processes. Oregon City has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

Emergency Operations Plan

The City's Emergency Operations Plan was updated within the last five years. It leans upon the hazard assessment found in the 2019 NHMP for identification of likely areas of concern and for the development of evacuation planning scenarios.

Water Master Plan 2021

This plan establishes the capital improvement plan for the city's water system through 2040, including many projects that will enhance the community's resilience to drought, extreme heat, earthquakes, flooding, etc.

Stormwater Master Plan 2020

The City adopted a new Stormwater Master Plan, with new Stormwater and Grading Design Standards, in 2020. This plan provides the background for capital improvement planning for the next five years, and implements the requirements of the City's Municipal Separate Storm Sewer System (MS4) permit (reissued in 2021). The permit program has six areas of focus that are consistent with EPA's Federal Clean Water Act: public education, public involvement, illicit discharge detection and elimination, construction, post-construction and municipal operations.

TMDL Plan

The City also maintains a Total Maximum Daily Load (TMDL) Plan (updated in December 2023). The Total Maximum Daily Load (TMDL) program includes many of the same requirements as the MS4 program, but also incorporates measures that stabilize stream temperatures. The affected watersheds within the City's

jurisdiction include the Clackamas River and Middle Willamette subbasins of the Willamette River Basin. The NHMP actions are incorporated into this document as appropriate. Example projects include implementation of illicit discharge elimination programs, implementation of erosion control ordinance, review and updating of stormwater standards, public outreach and master planning and implementation of capital projects for stormwater quality enhancement.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The NHMP will also be integrated into the City's Capital Improvement Plan, to be adopted by early 2024.

National Flood Insurance Program & Community Rating System

The City of Oregon City participates in the National Flood Insurance Program (NFIP), which makes flood insurance available to everyone. The community information is as follows:

- Name of Community: City of Oregon City
- Community ID No: 410021
- Current Flood Insurance Rate Map (FIRM) Date: June 17, 2008
- FIRM Effective Date: February 15, 1980

Oregon City has floodplain regulations that apply to development within the Flood Management Overlay District (Chapter 17.42 of the [Oregon City Municipal Code](#)). Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

Compliance with floodplain development regulations is reviewed through the land use review and building permitting process, with review responsibility by the Planning, Public Works Engineering and Building Divisions. The city's Floodplain Administrator is the [City Building Official](#).

Specifically, the Building Official:

- maintains and administers Oregon City's floodplain regulations;
- reviews and issues floodplain development permits;
- maintains elevation certificates for all new and substantially improved structures (and maintains an extensive database of historic elevation certificates);
- ensures that encroachments do not occur within the regulated floodway;
- implements measures to ensure that new and substantially improved structures are protected from flood losses;
- maintains floodplain studies and maps and makes this information available to the public;
- maintains a flood information website with digital flood insurance rate map (DFIRM) data;
- conducts site visits to assess conditions and provide technical assistance to the public;
- maintains a library of historical flood related information;
- informs the public of flood insurance requirements; and
- conducts outreach and training about flood hazards and development within the floodplain.

In 2023, Oregon City had 24 active flood insurance policies in place in Oregon City. Of those policies, 14 were in the 100 year floodplain, and 10 were not in other zones. There are 117 buildings which exist within the floodplain. The Special Flood Hazard Area contains 530.88 acres.

The City has adopted [FEMA and 100-year floodplain maps](#). Property owners can view the floodplain layers on [OCWebMap](#). OCWebMap shows the extent of the 1996 flood inundation, the FEMA 2008 100-Year floodplain, the FEMA 2008 500-year floodplain, the FEMA 2008 floodway, and the FEMA 2008 Base Flood Elevation.

The City makes continual efforts to reduce flood damage potential, which reduces insurance rates through participation in the Community Rating System (CRS). The CRS program was created by the [Federal Emergency Management Agency \(FEMA\)](#) in an effort to improve public safety, prevent property damage, and protect the natural floodplain environment. Communities that participate in this program agree to manage flood hazard areas by adopting minimum regulatory standards. The City's ability to maintain a Class 6 CRS certification saves policy holders in the 100-year floodplain an average of \$745 per year.

Personnel

The following Oregon City personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Police Chief, Shaun Davis

Public Information Officer: Community Communications Manager, Jarrod Lyman

Floodplain Manager: Jim Sayers, Building Official

Grant writing (for Public Works or emergency management): Public Works, Dayna Webb, City Engineer.

Capital improvement planning: Public Works Director, John Lewis.

Capital improvement execution: Public Works Director, John Lewis

Oregon City does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Oregon City has implemented recommendations from the last NHMP into its capital improvement projects over the last 5 years, including:

The following mitigation-related or resilience projects have been completed since 2018:

- Newell Canyon Stormwater Outfall Assessment – Determining conditions of existing outfalls
- Beemer Way Outfall – Rehabilitation of a stormwater outfall (2023)
- Permitting of Private Development – Forest Edge Apartments – Implemented monitoring well and water reduction system
- Inflow/Infiltration Program (several projects) – These prevent stormwater from getting into sanitary system overwhelming the sewage treatment plant. Some included storm disconnections.
- Trillium Drive Restoration – Removed failing road and house from landslide area and restabilized ground to prevent future failure. Now pedestrian path connects ends of Trillium Park Drive
- Henrici Reservoir Rehabilitation Project (2023) -- structural improvements to withstand earthquakes
- I-205 Abernethy Bridge seismic upgrades and widening (2022-2026) (ODOT)

- Clackamette Park Master Plan (2023) including relocating RV park out of the floodplain
- 10.5 million-gallon Mountainview drinking water reservoir (seismic upgrades)
- Numerous buildings at Clackamas Community College
- New building - Oregon City High School
- New water lines with flexible couplings at the joints were installed near the Newell Creek Apartments
- New fire station: Clackamas Fire Station 16, Category 4 seismic
- New Public Works Building, Category 4 seismic, 13895 Fir St
- New Police Facility, Category 4 seismic, 1234 Linn Ave

In addition, a \$158 million bond was passed in 2018 to improve security, address overcrowding, and finance and construction including the replacement of Gardiner Middle School and renovation of Tumwata Middle School. The school district also received a \$25,000 Seismic Assessment Grant from the Oregon Department of Education’s Office of School Facilities Technical Assistance Program for seismic assessments at Barclay School, Eastham Community Center, and Park Place School.¹

Ongoing projects that enhance the City’s resilience include:

- Wastewater Treatment Plant Upgrade
- Undergrounding of all new utilities

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority’s [Seismic Rehabilitation Grant Program](#)².

- 2004: PDMC-PJ-10-OR-2003-002 - Mountainview Reservoir Seismic Retrofit
- 2001: HMGP-DR-1099-033 – Acquisition of Structures (\$) – 5 structures near Abernathy and Washington

Seismic Rehabilitation Grant Program Mitigation Successes

- 2021: Clackamas Community College’s Jackson Prep Building B (\$2,457,412)
- 2017: Clackamas Community College’s Randall Hall (\$1,500,000).
- 2013-2014: Clackamas Fire District’s Hilltop Fire Station #16 (\$483,062)

Other Mitigation Successes (projects listed identified in previous plan)

- Carnegie Center, Clackamas Fire Station #15 (John Adams, ca. 1998),
- 10.5 million-gallon Mountainview drinking water reservoir,
- numerous buildings at Clackamas Community College
- New building - Oregon City High School
- new water lines with flexible couplings at the joints were installed near the Newell Creek Apartments.

² The Seismic Rehabilitation Grant Program (SRGP) 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.

- A \$158 million bond was passed in 2018 to improve security, address overcrowding, and finance and construction including the replacement of Gardiner Middle School and renovation of Ogden Middle School.
- The school district received a \$25,000 Seismic Assessment Grant from the Oregon Department of Education’s Office of School Facilities Technical Assistance Program for seismic assessments at Barclay School, Eastham Community Center and Park Place School.
- New fire station, Clackamas Fire District #1, Station 16 (Hilltop)
- Seismic upgrades to Henrici Reservoir
- Police Station, 1234 Linn Ave – new building
- New Public Works Building, 13895 Fir St

Capital Resources

Oregon City maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Communication Towers:

- 415 Mt. View Ln.

Critical facilities with power generators for use during emergency blackouts include:

- OC Engineering and Operations Center, 13895 Fir St.
- OC Police Dept. 1234 Linn Av.
- City Hall, 625 Center St.
- “Old” Public Works, 122 S. Center St.

Wastewater Sites:

- | | |
|---|--|
| <ul style="list-style-type: none"> • Amanda, 275 Amanda Ct. • Cook, 18763 Cook St. • Parrish, 11520 Parrish Rd. • Pease, 19638 Pease Rd. • Settlers, 19468 Wild bill Ct. | <ul style="list-style-type: none"> • Nobel Ridge, 13181 Gaffney Ln. • Hidden Ck., 19833 Hwy. 213 • Barclay Hills, 17881 Peter Skene Way • Newell Crest, 18161 Newell Crest Dr. |
|---|--|

Water Sites

- Fairway downs pump station, Beaver creek Rd.
- Hunter pump station, Hunter Dr.
- Mt. View Reservoir

Warming or cooling shelters include:

- Father’s Heart, 603 12th St.
- OC Library, 606 John Adams St.

Facilities listed in the American Red Cross National Shelter System include:

- Father’s Heart, 606 12th St.

Food pantries include:

- Oregon City View Manor Free Food Market. Every 2nd Wed morning of every month. 200 Longview Way
- Oregon City DHS Free Food Market. 1st Tues morning of every month. 315 Beaver creek Rd
- Father’s Heart, 606 12th St.

- Clackamas County Gleaners, 13833 Fir St.

Fueling storage:

- Oregon City Engineering and Operations Center, 13895 Fir St.

Findings

Several important findings from this capability assessment informed the design of the Plan’s mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Oregon City staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Oregon City operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City’s ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community’s environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The City's mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAc assessed the City's risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table OC-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. Current conditions (risk assessment), needs, and capacity have not altered community priorities as such the HMAc decided not to modify the prioritization of action items in this update (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAc in terms of implementation, the HMAc has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table OC-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
MH#1	Maintain Certification and coordinate with Clackamas County and regional partners to identify and coordinate building officials that are qualified to conduct damage assessments.		X		X	X		X	X	X	Emergency Management/ Building	Ongoing	Local Resources	Low
MH#2	Integrate the goals and action items from the Oregon City Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	Community Development/ Public Works, City Commission	Ongoing	Local Resources, DLCD-TA, FEMA HMA-C&CB	Low
MH#3	Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing risk.	X	X	X	X	X	X	X	X	X	Community Development/ Public Works, CFD #1	Ongoing	Local Resources, DLCD-TA, FEMA, OEM	Low
MH#4	Improve vegetation management throughout Oregon City.							X	X	X	Community Services/ Community Development, Code Enforcement, Parks and Recreation, Public Works	Ongoing	Local Resources	Low to Moderate
EQ#1	Conduct seismic evaluations on identified community assets and 'high risk' school and emergency service buildings and implement appropriate structural and non-structural mitigation strategies.		X								Emergency Management/ Community Development, Public Works	Long Term	Local Resources, DLCD-TA, FEMA HMA-C&CB	Low to High

Table OC-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
FL#1	Promote and protect the use of naturally flood prone open space or wetlands as flood storage areas.				X						Community Development/ Public Works	Ongoing	Local Resources	Low
FL#2	Continue participating in the National Flood Insurance Program and develop strategies to reduce property damage and related financial impacts due to flooding.				X						Community Development/ Public Works	Ongoing	Local Resources	Low
FL#3	Complete periodic updates of the Surface Water Management Master Plan.				X						Public Works / Community Development	Ongoing	Local Resources	Low
LS#1	Continue to implement municipal codes and policies mitigating future landslide damage.					X					Public Works / Community Development	Ongoing	Local Resources	Low
LS#2	Maintain an inventory of streets and properties threatened by landslides.					X					Mapping, GIS / Community Development, Public Works	Ongoing	Local Resources	Low

Table OC-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
SW#1	Reduce frequency and duration of power outages from the severe wind and winter storm hazards where possible.								X	X	Public Works/ Community Development	Ongoing	Local Resources, DLCD-TA, FEMA HMA-C&CB	Low to High
WF#1	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan							X			Clackamas Fire District #1 / Community Development, Public Works	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low to High
WF#2	Complete periodic updates of the Water Master Plan.	X			X			X			Public Works/ Community Development	Ongoing	Local Resources	Low
WF#3	Promote fire-resistant strategies and the use of non-combustible roofing materials by evaluating and making recommendations to current code to encourage noncombustible roofing standards in high fire-hazard areas.							X			Community Development / Public Works; Clackamas Fire District #1	Ongoing	Local Resources	Low

Source: Oregon City NHMP HMA, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

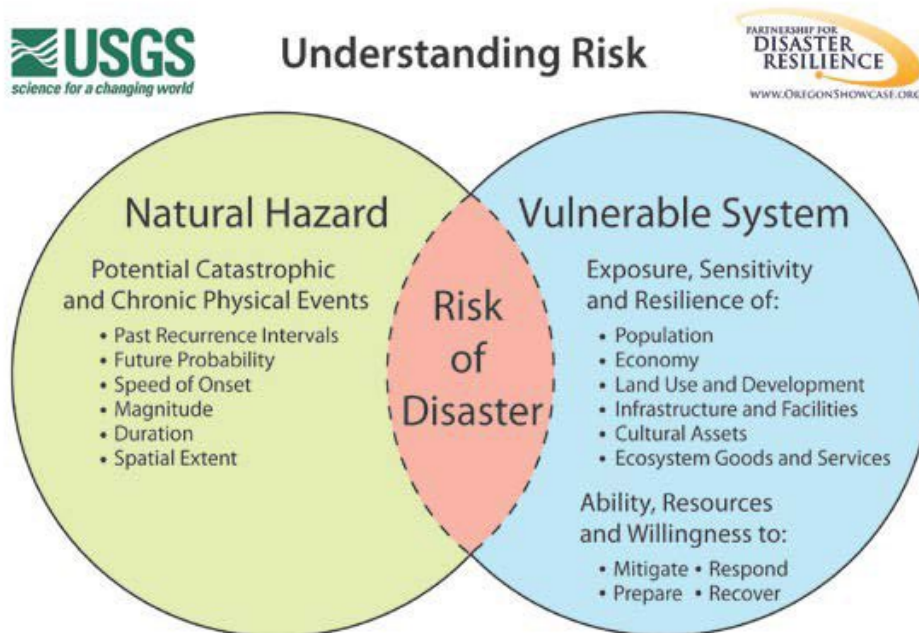
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure OC-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure OC-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Oregon City HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Oregon City, which are discussed throughout this addendum. Table OC-2 shows the HVA matrix for Oregon City

listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) and two chronic hazards (extreme heat and winter storm) rank as the top hazard threats to the City (Top Tier). Flood, landslide, and wildfire comprise the next highest ranked hazards (Middle Tier), while drought, windstorm, and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table OC-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Earthquake - Cascadia	2	45	100	49	196	1	Top Tier
Extreme Heat Event	18	35	70	56	179	2	
Earthquake - Crustal	6	50	100	21	177	3	
Winter Storm	20	30	70	49	169	4	
Flood	16	20	70	56	162	5	Middle Tier
Landslide	14	35	30	63	142	6	
Wildfire	12	25	70	21	128	7	
Drought	10	15	50	42	117	8	Bottom Tier
Windstorm	14	15	30	42	101	9	
Volcanic Event	2	15	50	7	74	10	

Source: Oregon City HMAC, 2023.

Community Characteristics

Table OC-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Oregon City is near the southern limits of the Portland metro-area and is the County Seat of Clackamas County. The City has benefited from its natural setting. Its location on the Willamette and Clackamas Rivers supplied an abundant power source and bolstered an economy based on manufacturing, timber, and commerce. This prime location drew settlers from around the nation and helped Oregon City become the first incorporated city in Oregon. In the shadow of Mount Hood and surrounded by forests, Oregon City is a scenic settlement built on the “solid ground” of the valleys and hillsides.

The City has grown in land area over the years. As of 2023, Oregon City occupies 6,576 acres. Urbanization at the edge of Oregon City is constrained by the Willamette River and the City of West Linn to the west, the Clackamas River and the City of Gladstone to the north, and steep topography to the south and east.

Oregon City’s temperatures range from monthly average lows of 36°F in the winter months (December/January coldest) to average highs of 82°F in the summer months (July/August hottest). The average annual precipitation is 46 inches.³

³ [Western Regional Climate Center, Oregon City, Oregon](#). Retrieved November 16, 2018

Population, Housing, and Income

Oregon City has grown substantially since its incorporation in 1913 and has an area today of 2.26 square miles. It is in the south-central region of Clackamas County, located approximately 29 miles southeast of the City of Portland. The City is within the Oregon City River watershed, with the Oregon City River about a mile east of the UGB.

Between 2016 and 2021 the City grew by 3,546 people (10%; as of 2022 the population is 37,786). Between 2022 and 2045 the population is forecast to grow by 30% to 49,009.

Most of the population is White/Caucasian (88%) and about 18% of the population is Hispanic or Latino. The poverty rate is 6% (6% of children under 18, 7% for people 65 and older), 7% do not have health insurance, and 49% of renters pay more than 30% of their household income on rent (37% for owners). About 30% of the population has a bachelor's degree or higher (5% do not have a high school degree). Approximately 12% of the population lives with a disability (37% of population 65 and older), and 41% are either below 15 (25%) or over 65 (16%) years of age. About 9% of the population are 65 or older and living alone and 5% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 80% of housing units are single-family, 17% are multifamily, and 2% are mobile homes. One quarter of homes (25%) were built before 1970; almost half (49%) were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (64%) of housing units are owner occupied, 33% are renter occupied, less than 1% are seasonal homes, and 4% are vacant.

Transportation and Infrastructure

In Oregon City, transportation has played a major role in shaping the community. Oregon City has three state highways and one interstate. State Highway 99E (or McLoughlin Blvd.), runs along the western border of the city; Highway 213 runs north to south through the eastern part of the city; Highway 43 enters at the northwest border of the city, and Interstate 205 runs along the northern border.

Motor vehicles represent the dominant mode of travel through and within Oregon City. Thirteen percent (13%) of renters and 1% of owners do not have a vehicle. Most workers drive alone to work (77%); 9% carpool, 1% use public transit, 3% either walk or use a bicycle, and 9% work at home. Oregon City public transportation is serviced by Tri-Met which provides daily local bus services to numerous community transit centers, including downtown Oregon City and the Clackamas County College Campus. The Canby Area Transit (CAT) additionally serves Oregon City with service to Canby, Aurora, Hubbard, and Woodburn, while the South Clackamas Transportation District (SCTD) provides transportation between Clackamas Community College south to Molalla. Oregon City is also accessed by the Union Pacific Railroad main line and Amtrak, which travels northeast to southwest carrying both passengers and freight. In 2021 Clackamas County started the ClackCo connects shuttle. The shuttle service fills gaps from TriMet stops to underserved portions of Oregon City and the Clackamas Industrial Area.

Economy

Oregon City is located near the greater Portland region, resulting in easy access to downtown Portland and surrounding communities. Historically, Oregon City had a strong mill and timber economic presence. Now, Oregon City residents are mostly employed in professional and related occupations.⁹ In 2022, the average per capita income for residents was \$37,997. About 51% of the resident population 16 and over is in the labor force (18,960 people) and are employed in a variety of occupations including professional (22%), management, business, and financial (17%), office and administrative (13%), construction, extraction, and maintenance (11%), and sales (10%) occupations.

Most workers residing in the city (87%, 15,440 people) travel outside of the city for work primarily to Portland and surrounding areas.⁴ A significant population of people travel to the city for work, (86% of the workforce, 13,471 people) primarily from Portland and surrounding areas.⁵

⁴ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 18, 2023 at <https://onthemap.ces.census.gov>.

⁵ Ibid.

Table OC-3 Community Characteristics

Population Characteristics		Population	Household Characteristics	
		Growth		
2016 Population Estimate	34,240		Housing Units	
2022 Population Estimate	37,786	10%	Single-Family (includes duplexes)	11,278 80%
2045 Population Forecast*	49,009	30%	Multi-Family	2,427 17%
Race			Mobile Homes (includes RV, Van, etc.)	342 2%
American Indian and Alaska Native		1%	Household Type	
Asian		1%	Family Household	9,150 68%
Black/ African American		< 1%	Married couple (w/ children)	3,323 25%
Native Hawaiian and Other Pacific Islander		0%	Single (w/ children)	738 5%
White		88%	Living Alone 65+	1,216 9%
Some Other Race		1%	Year Structure Built	
Two or More Races		4%	Pre-1970	3,518 25%
Hispanic or Latino/a (of any race)			1970-1989	3,586 26%
Limited or No English Spoken	766	2%	1990-2009	5,479 39%
Vulnerable Age Groups			2010 or later	1,464 10%
Less than 5 Years	2,335	6%	Housing Tenure and Vacancy	
Less than 15 Years	7,204	19%	Owner-occupied	8,924 64%
65 Years and Older	5,294	14%	Renter-occupied	4,585 33%
85 Years and Older	562	2%	Seasonal	13 < 1%
Age Dependency Ratio		0.51	Vacant	525 4%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)	
Total Disabled Population	4,551	12%	No Vehicle (owner occupied)	59 1%
Children (Under 18)	275	3%	Two+ vehicles (owner occupied)	7,091 79%
Working Age (18 to 64)	2,375	10%	No Vehicle (renter occupied)	594 13%
Seniors (65 and older)	1,901	37%	Two+ vehicles (renter occupied)	2,254 49%
Income Characteristics			Employment Characteristics	
Households by Income Category			Labor Force (Population 16+)	
Less than \$15,000	590	4%	In labor Force (% Total Population)	18,960 51%
\$15,000-\$29,999	932	7%	Unemployed (% Labor Force)	985 5%
\$30,000-\$44,999	1,276	10%	Occupation (Top 5) (Employed 16+)	
\$45,000-\$59,999	1,550	11%	Professional & Related	4,089 22%
\$60,000-\$74,999	1,398	10%	Management, Business, & Financial	3,257 17%
\$75,000-\$99,999	2,042	15%	Office & Administrative	2,537 13%
\$100,000-\$199,999	4,612	34%	Construction, Extraction, & Maint.	2,014 11%
\$200,000 or more	1,109	8%	Sales & Related	1,906 10%
Median Household Income			Health Insurance	
		\$85,193	No Health Insurance	2,483 7%
Gini Index of Income Inequality			Public Health Insurance	11,599 32%
		0.37	Private Health Insurance	26,921 74%
Poverty Rates (Percent age cohort)			Transportation to Work (Workers 16+)	
Total Population	2,180	6%	Drove Alone	14,439 77%
Children (Under 18)	469	6%	Carpooled	1,618 9%
Working Age (18 to 64)	1,361	6%	Public Transit	233 1%
Seniors (65 and older)	350	7%	Motorcycle	16 < 1%
Housing Cost Burden (Cost > 30% of household income)			Bicycle/Walk	547 3%
Owners with a Mortgage	2,585	37%	Work at Home	1,756 9%
Owners without a Mortgage	203	10%		
Renters	2,235	49%		

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", METRO 2040 Population Distributed Forecast (2021, [Exhibit A to Ordinance 21-1457](#)).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Oregon City. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table OC-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table OC-4 Critical Facilities in Oregon City

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Alliance Charter Academy	-	X	-	-	-
Clackamas Academy of Industrial Sciences	-	X	X	-	-
Clackamas Community College	-	X	-	-	-
Clackamas Community College - Public Safety	-	-	-	-	-
Clackamas County Jail	-	X	X	-	-
Clackamas County Public Works	X	X	X	-	-
Clackamas County Sheriff's Lot	X	X	X	-	-
Clackamas County Sheriff's Office - South Station	-	-	-	-	-
Clackamas Fire District #1 - Station 9 Holcomb (built 1974)	-	-	-	-	-
Clackamas Fire District #1 - Station 15 John Adams (remodeled 1998)	-	X	X	-	-
Clackamas Fire District #1 - Station 16 Hilltop (rebuilt 2018)	-	X	-	-	-
Clackamas Fire District #1 - Station 17 (built 2004)	-	-	-	-	-
Clackamas Middle School	-	-	-	-	-
Eye Health Northwest	-	X	-	-	-
Gaffney Lane Elementary School	-	X	-	-	-
Gardiner Middle School	-	X	-	-	-
Holcomb Elementary School	-	X	-	-	-

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Jackson Building	-	X	X	-	-
John McLoughlin Elementary School	-	X	X	-	-
Kings Academy	-	X	X	-	-
North Clackamas Christian School	-	X	-	-	-
Oregon City Police Department (built 2020)	-	X	-	-	-
Oregon City Senior High School	-	X	-	-	-
Oregon City Service Learning Academy	-	X	X	-	-
Providence Willamette Falls Hospital	-	X	X	-	-
St John the Apostle School	-	-	-	-	-
The Marylhurst School	-	X	-	-	-
Tri-City Service District	-	-	X	-	-
Willamette Falls Hospital	-	X	X	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-31.

Additional Critical Facilities not included in the DOGAMI Risk Report:

- Public Works Operation Center
- Clackamas County EOC
- PGE Substation, Canemah
- PGE Substation, 18th Street

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

- Natural Gas System
- Electrical Power System
- Tri-City Wastewater Treatment Plant
- Wastewater Collection System
- Hunter Pump Station
- Mountain View Pump Station
- Barlow Crest Reservoir
- Boynton Standpipe Reservoir and Pump Station
- Henrici Reservoir (seismically upgraded)
- Mountainview Reservoir #1 (2 MG)
- Mountainview Reservoir #2 (10.5 MG)
- North Fork Water Transmission Pipe
- South Fork Water Filter Plant
- South Fork Water Intake
- South Fork/Division Street Pump Station
- Clackamas River Water/South Fork Water Intake
- South Fork Water Transmission Line
- Metro South Transfer Station

- PGE Dam
- Water Distribution System

Additionally, the following transportation infrastructure is considered vulnerable (hazards noted where applicable):

- 5th Street
- 7th Street
- Abernethy Road (flood)
- Abernethy Creek Culvert at McLoughlin Blvd.
- Anchor Way
- Anchor Way Bridge at Abernethy Creek
- Beaver Creek Road (flood)
- Central Point Road
- Division Street
- George Abernethy Bridge (I-205 at Willamette)
- Glen Oak Road
- High Street
- Highway 43 Arch Bridge
- Highway 213 at Holcomb Boulevard
- Redland Road overcrossing on Hwy 213
- I-205 over Clackamas River
- Interstate 205
- Leland Road
- Linn Avenue (flood)
- Main Street (7th to McLoughlin Blvd)
- Main Street overcrossing at I-205
- Maple Lane Road
- McLoughlin Blvd Viaduct
- South End Road
- Warner Milne Road
- Warner Parrott Road
- Washington Street overcrossing on Hwy 213
- Washington Street Bridge (at Abernethy Creek)

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public’s ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields.

Schools

- Gaffney Lane Elementary School
- Holcomb Elementary School
- John McLoughlin Elementary School
- King Elementary School
- Park Place Elementary School
- Gardiner Middle School
- Tumwata Middle School
- Oregon City High School
- Jackson Campus (CAIS)
- Clackamas Community College

- Eastham Community School

Other Facilities

- City Hall
- Pioneer Community Center
- Community Development Building
- Clackamas County Jail
- Area churches
- Clackamas County Road Services
- Veterans of Foreign Wars Post 1324

Churches include: First Presbyterian, First United Methodist Church, Light on the Hill Fellowship, Logan Community Church, Maranatha Baptist Church, Mountain View Community Church, North Clackamas Christian, Oregon City Christian, Oregon City Church of the Nazarene, Oregon City Evangelical, St. John the Apostle Catholic Church, St. Paul’s Episcopal Church, St. Philip Benizi Church, Trinity Lutheran Church, and Victorious Faith Family Church.

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include Clackamette Park and Mill Creek Canyon.

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include child care facilities and adult care facilities.

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: Clackamas Community College, Benchmade, Metro South Transfer Station, Railroad, Rossman Landfill.

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Happy Valley. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers and are a concern during evacuation/notification during a hazard event.

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

The following historic resources can be found in Oregon City:

- 7th Street Historic Fire Station
- 90 Historic Homes in Canemah, a National Registered Historic District
- 376 Individually Designated Historic Homes in McLoughlin Historic Conservation District
- 98 Individually Designated Historic Homes Outside of a Historic District
- Barclay House
- Carnegie Center
- Carnegie Library
- Clackamas County Courthouse
- End of the Oregon Trail Interpretive Center
- Ermatinger House
- McLoughlin House
- McLoughlin Promenade
- Museum of the Oregon Territory
- Oregon City Municipal Elevator
- Rose Farm
- Stevens-Crawford House

- Willamette Falls Locks
- Oregon City/West Linn (Hwy. 43) Bridge

The city’s Historic Review Board reviews new development in the McLoughlin and Canemah historic districts and the city has adopted a Historic Overlay District to ensure that new development is compatible with existing historically designated structures.

Hazard Characteristics

Drought

The HMAC determined that the City’s probability for drought is **moderate** and that their vulnerability to drought is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

Oregon City provides [water](#) to most of its residents within a service area of approximately 6,297 (source: OC GIS) acres; residents not within the services area are served by the Clackamas River Water District. Oregon City draws its main water supply comes from the Clackamas River which is supplied by the South Fork Water Board (a wholesale water supplier that is equally owned by Oregon City and West Linn). Water is provided via an intake and pumping station just to the north of the Oregon City boundary limits which is delivered to the SFWB water treatment plant located in the Park Place area. The City has a current surplus of 4.99 million gallons (MG), however, the city’s Water Master Plan has identified the need for an additional storage to meet anticipated growth.

To meet these needs the city plans to build two new ground level storage reservoirs (one 2 MG storage reservoir just beyond the Henrici Reservoir, and the other 3 MG storage reservoir near Holly Lane (additional storage will be needed if/when CRW facilities are incorporated into the City). The City has identified areas that will need to replace existing pipelines to meet the demand and flow requirements.

Vulnerability Assessment

Due to insufficient data and resources, Oregon City is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table OC-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁶ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Earthquake (Cascadia Subduction Zone)

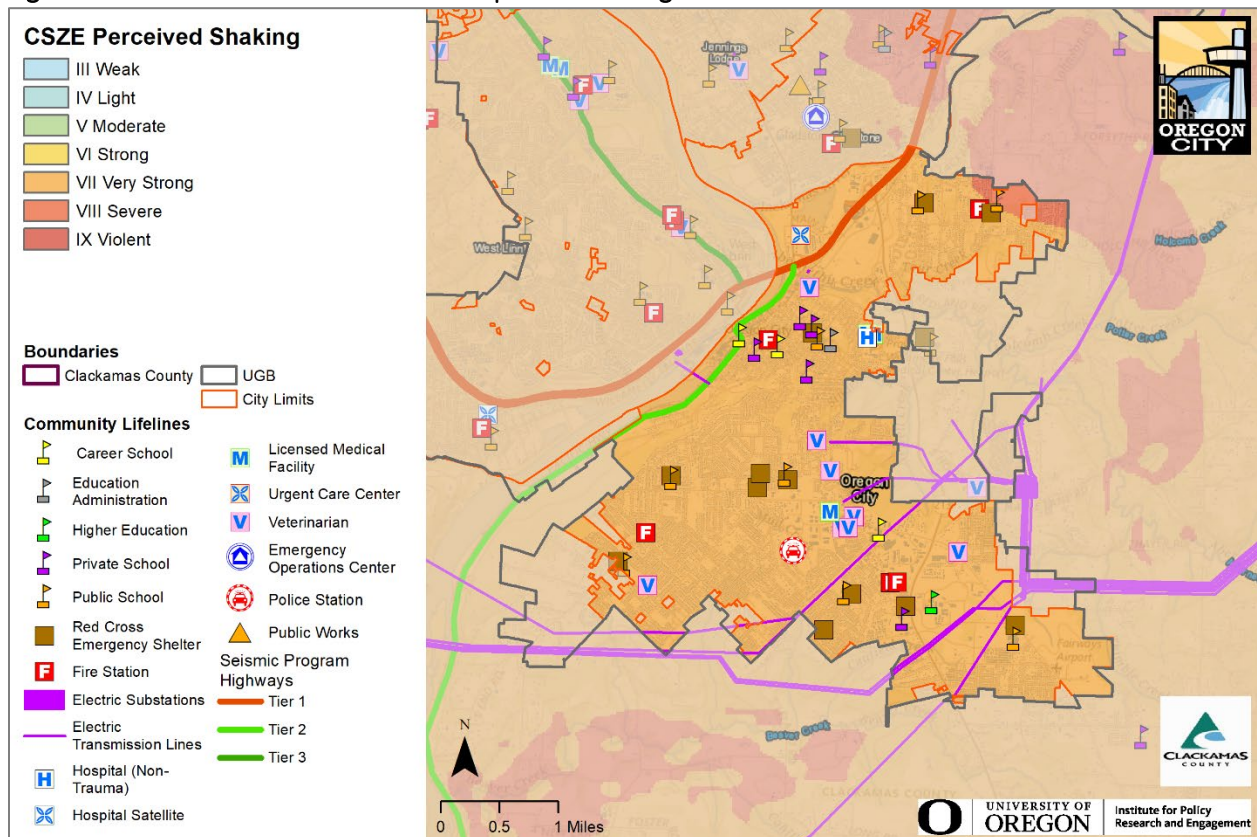
The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Oregon City as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Oregon City as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Oregon City Fault Zone (discussed in the crustal earthquake section).

Figure OC-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Figure OC-2 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.⁷

The city's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the "Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

Older buildings and the sewer system in the city are most vulnerable to damage. Earthquakes shift soil that could cause landslides. Transportation routes and economic centers within the City can also be affected. Demand for resources such as Police, Fire and Public Works would also increase.

Earthquake (Crustal)

The HMAC determined that the City's probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Oregon City as well. Figure OC-3 shows a generalized geologic map of the Oregon City area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

There are two potential crustal faults and/or zones near the City that can generate high- magnitude earthquakes. These include the Gales Creek-Mt. Angel Structural Zone and Portland Hills Fault Zone (discussed in greater detail below). Other nearby faults include the Bolton fault and Oatfield faults which run through the city west and east side respectively, Canby-Molalla structural zones located west of the city, and the Mt. Hood Fault in eastern Clackamas County. Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

⁷ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

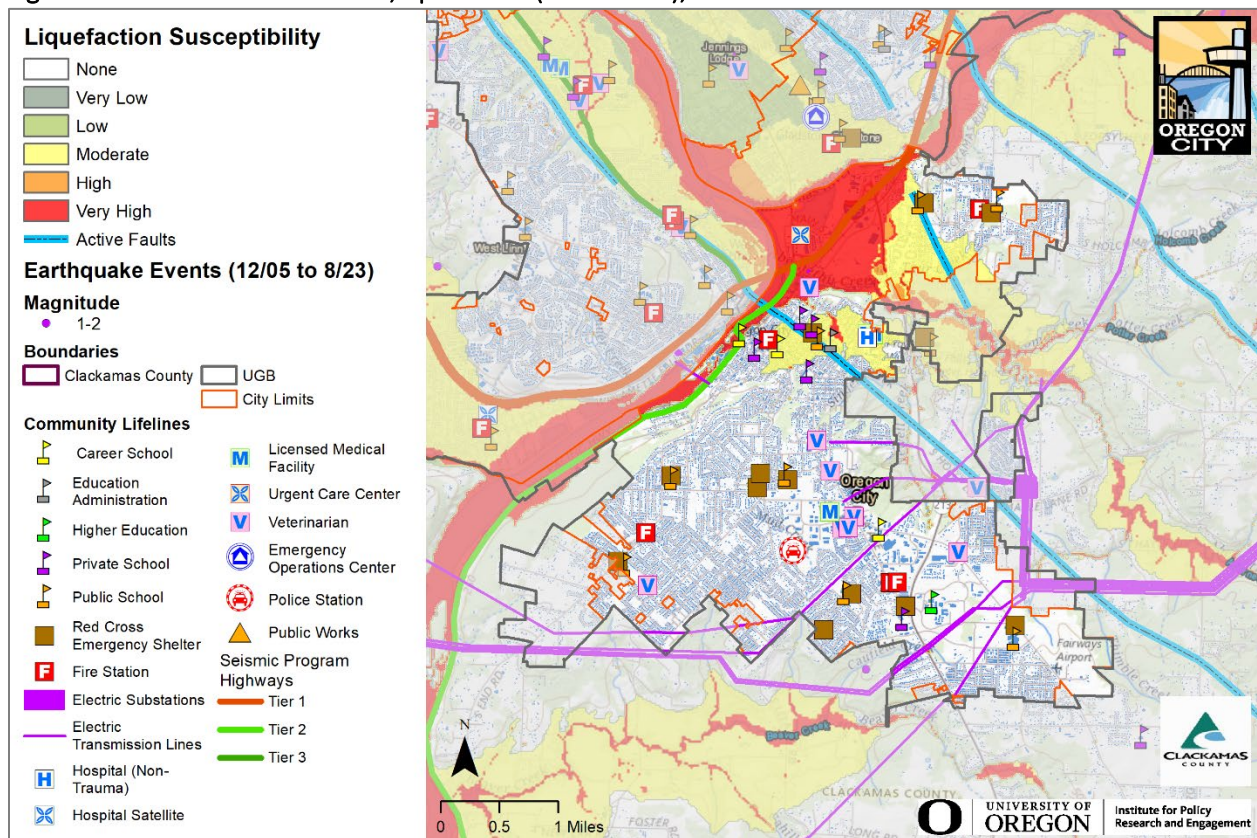
Canby-Molalla Fault Zone

The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Oregon City in northern Oregon.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 11 miles northeast of Oregon City.

Figure OC-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Findings from that report are provided at the end of the crustal earthquakes hazard section.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 36% of residential buildings were built prior to 1990, which increases the City’s vulnerability to the earthquake hazard. Information on specific public buildings’ (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table OC-5; each “X” represents one building within that

ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), one (1) have a very high (100% chance) collapse potential and eight (8) has a high (greater than 10% chance) collapse potential.

For a list of facilities and infrastructure vulnerable to this hazard, see the Community Assets Section and Table OC-5.

Table OC-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Jackson Campus: CAIS (ca. 1939) (19761 Beaver Creek Rd)	None	2007 RVS report did not include structural appendix for this facility. Facility built 1939.			
Gaffney Ln Elementary (ca. 1965) (13521 S Gaffney Ln)	Clac_sch44	X		X	
Gardiner Middle (ca. 1954) (180 Ethel St) see Mitigation Successes	-	School rebuilt per 2019 school bond.			
Holcomb Elementary (ca. 1966) (14625 S Holcomb)	Clac_sch43	X	X		
John McLoughlin Elem. (ca. 1975) (19230 S End Rd)	Clac_sch91			X	
King Campus: OCSLA (ca. 1959) (995 S End Rd)	Clac_sch46			X,X	
<i>Mt Pleasant Elementary</i> (1232 Linn Ave) – Building demolished	<i>Clac_sch47</i>	School demolished and replaced with Police Department (2020)			
Tumwata Middle (ca. 1965) (14133 S Donovan Rd) see Mitigation Successes	Clac_sch50				
Oregon City High (ca. 2003) (19761 S Beaver Creek Rd) see Mitigation Successes	Clac_sch51			X,X	
Alliance Charter Academy (16075 S Front Ave)	Clac_sch48				
Clackamas Community College (19600 S Molalla Ave)	Varies	See note below.			
Fire Facilities					
<u>Station 9 – Holcomb</u> (300 Longview Wy)	Clac_fir29	X			
<u>Station 15 – John Adams</u> (624 W 7 th St)	Clac_fir35	X			
<u>Station 16 – Hilltop</u> (19340 S Molalla Ave) see Mitigation Successes	Clac_fir36	Station rebuilt to Category 4 seismic standards (ca. 2018)			
<u>Station 17 – South End</u> (19001 South End)	Clac_fir51	X			

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Police Facilities					
Police Department (no longer in use) (Building sold to Clackamas County) (320 Warner Milne Rd)	Clac_pol11	X			
Police Department (1234 LinnAve)	None	2007 RVS report did not include structural appendix for this facility. Facility built 2020.			
Hospital					
Providence Milwaukie (10150 SE 32nd Ave)	Clac_hos02	X		X	

Source: [DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)
 “*” – Site ID is referenced on the [RVS Clackamas County Map](#)

Note: Clackamas Community College buildings with ‘very high’ collapse potential include: Dye Learning Center, Family Residential Center, Gregory Forum ; and with ‘high’ collapse potential include: McLoughlin Hall, Pauling Center (east and south), Randall Hall (mitigated per 2015-2017 SRGP grant), and Streeter Hall.

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario

generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table OC-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Table OC-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	12,641	12,641	12,641	12,641
Building Value (\$ Million)	4,190	4,190	4,190	4,190
Building Repair Cost (\$ Million)	277	342	1,319	1,422
Building Loss Ratio	7%	8%	31%	34%
Debris (Thousands of Tons)	148	170	496	525
Long-Term Displaced Population	102	307	2,983	3,827
Total Casualties (Daytime)	258	318	1,286	1,364
Level 4 (Killed)	14	18	80	85
Total Casualties (Nighttime)	38	57	383	448
Level 4 (Killed)	1	2	11	13

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

Oregon City is expected to have a 7% building loss ratio with a repair cost of \$277 million under the CSZ “dry” scenario, and an 8% building loss ratio with a repair cost of \$170 million under the CSZ “wet” scenario.⁸ The city is expected to have around 258 daytime or 33 nighttime casualties during the CSZ “dry” scenario and 318 daytime or 57 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 102 for the CSZ “dry” scenario and 307 for the CSZ “wet” scenario.⁹

Portland Hills Fault Scenario

Oregon City is expected to have a 31% building loss ratio with a repair cost of \$1.32 billion under the CSZ “dry” scenario, and a 34% building loss ratio with a repair cost of \$1.42 billion under the CSZ “wet” scenario.¹⁰ The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 1,286 daytime or 383 nighttime casualties during

⁸ DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8 and 12-9.

⁹ Ibid, Tables 12-8 and 12-9.

¹⁰ Ibid, Tables 12-10 and 12-11

the Portland Hills Fault “dry” scenario and 1,364 daytime or 448 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 2,983 for the Portland Hills Fault “dry” scenario and 3,827 for the Portland Hills Fault “wet” scenario.¹¹

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table OC-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**¹² provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone event (M9.0 Deterministic): 477 buildings (including 22 critical facilities) are expected to be damaged for a total potential loss of \$340.2 million (a loss ratio of about 6%). About 213 residents may be displaced (less than 1% of the population).

Crustal event (Canby-Molalla fault M6.8 Deterministic): 696 buildings are expected to be damaged, (including 12 critical facilities), for a total potential loss of \$431.9 million (a loss ratio of about 8%). About 415 residents may be displaced (about 1% of the population).

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

The HMAC determined that the City’s probability of flooding is **high** and that their vulnerability to flooding is **moderate**. *These ratings did not change since the previous version of this NHMP.*

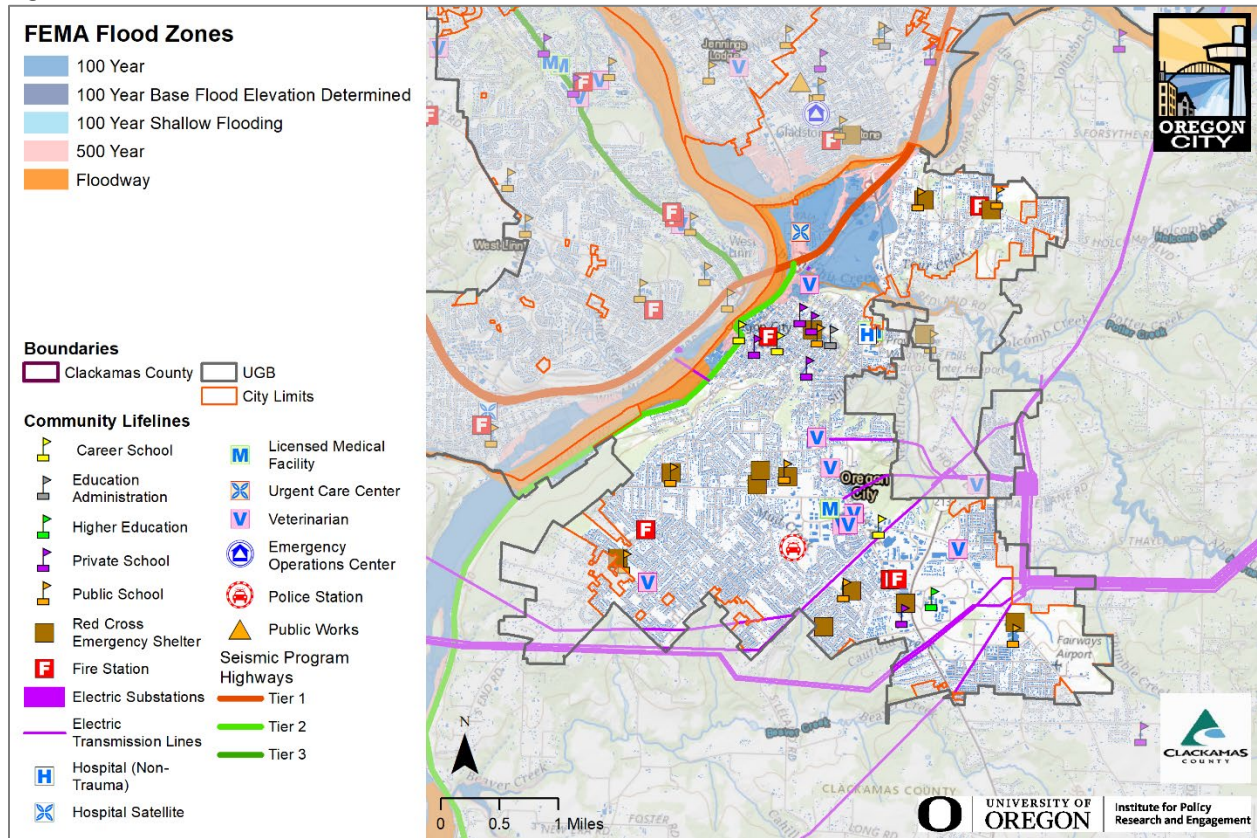
Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure OC-4 illustrates the flood hazard area for Oregon City.

Portions of Oregon City have areas of floodplains (special flood hazard areas, SFHA). These include areas include along Willamette River, Clackamas River, and Abernethy Creek (Figure OC-4). Other portions of Oregon City, outside of the mapped floodplains, are also subject to flooding from local storm water drainage. Not all flood prone areas are subject to damage. Several valleys, such as the upper reaches of Abernethy Creek, are still in or near their natural state. Flooding of such areas causes no damage to human development and may help the riparian habitat.

¹¹ Ibid, Tables 12-10 and 12-11.

¹² DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-30.

Figure OC-4 FEMA Flood Zones



Vulnerability Assessment

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Oregon City outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The Willamette and Clackamas Rivers both flooded in January 1997 and from December 28, 2005 to January 1, 2006 following severe winter storms. The high water caused bank erosion and cleanup was required at Clackamette Park, for which FEMA provided some funding.

From January 1 to 2, 2009 a severe winter storm dropped over 3.5 inches of rain over a 24-hour period. The event led to localized flooding, land movement, traffic delays, and sewer line back-ups. Sections of

Meyers Road, Beaver Creek Road, Linn Avenue, Abernethy Road, and Van Buren Street were closed because of the storm. Additional significant floods occurred in December 2015 and March 2017.

Finally, there is a rainfall pattern known as the “Pineapple Express” which brings very heavy and warm rains from the southwest. These warm rains begin their journey from parts of the Pacific near Hawaii, holding their heat and moisture until making landfall along the Oregon coast.

Most of the buildings affected by flooding are in the lowest part of the city, where the three waterways converge. The Floodplain Map shows 12.7 miles of the transportation network could be affected in a flood. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section and Table OC-4.

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, 2024)¹³ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report 103 buildings (2 critical facilities) could be damaged for a total potential loss of \$57.1 million (a building loss ratio of about 1%). About 44 residents may be displaced by flood (about 1% of the population).

National Flood Insurance Program (NFIP)

FEMA’s Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of January 19, 2018. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. The last Community Assistance Visit (CAV) for Oregon City was on March 21st, 2023. Oregon City’s Class Rating within the Community Rating System (CRS) is 6.

The Community Repetitive Loss record for Oregon City identifies two (2) Repetitive Loss Properties (RL)¹⁴ and no Severe Repetitive Loss Properties (SRL)¹⁵. The SRL property is non-residential, located in zone A21, and has had two claims for a total of \$111,661. For additional detail and a map of its general location see Volume I, Section 2 and Figure 2-14.

Table OC-7: Community Repetitive Loss Properties

RL #	RL or SRL Property	Occupancy	Mitigated?	Currently NFIP Insured	Rated Flood Zone	Post FIRM	Paid Claims	Total Paid Amount
38925	RL	Single Family	YES	NO	C	N	3	\$60,499
75554	RL	Non-Residential	NO	NO	A21	N	2	\$51,163
Total							5	\$111,661

Source: FEMA Region X, Regional Flood Insurance Liaison, email February 23, 2023.

¹³ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-30.

¹⁴ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

¹⁵ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁶ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the City’s probability for landslide is **high** and that their vulnerability to landslide is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. The potential for landslide in Oregon City is high and the City’s wastewater main lines, major water lines and fiber optic lines. The flooding of 1996 caused numerous landslide events in Oregon City. One of these events caused a sanitary sewer pump to begin sliding downhill. A report by Portland State University found that half of the 48 landslides that occurred in the region in 1996 were considered “natural,” while the others were triggered by human activity. Oregon City experienced another series of landslides because of the December 28th, 2005 to January 1st, 2006 storm and flood on Trillium Drive, Morton Road, near the football field at Oregon City High School Jackson Campus, Newell Crest Drive and Newell Creek Village Apartments. In December 2015 landslides impacted the Forest Edge Apartment Complex, forcing the evacuation of all 41 apartments. Landslides in 2017 impacted Trillium Park, South End Road, Center Street, and OR-224.

Landslides destroy or damage anything on the sliding hillside or in the path of the slide. This includes buildings, houses, and streets. Sometimes, a small amount of settlement occurs, giving the owner time to shore up or retrofit the building to prevent further damage. Many property owners in Oregon City have built retaining walls and replaced slide prone soils with rock to help prevent landslides. However, if an entire hillside fails, the buildings may be destroyed and the streets washed out or covered in debris.

Landslide susceptibility exposure for Oregon City is shown in Figure OC-5. Most of Oregon City demonstrates a moderate to high susceptibility to landslide exposure. Approximately 12% of Oregon City has very high or high and approximately 16% moderate, landslide susceptibility exposure.¹⁷

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property

¹⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

¹⁷ DOGAMI Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon (2016)

damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table OC-4.

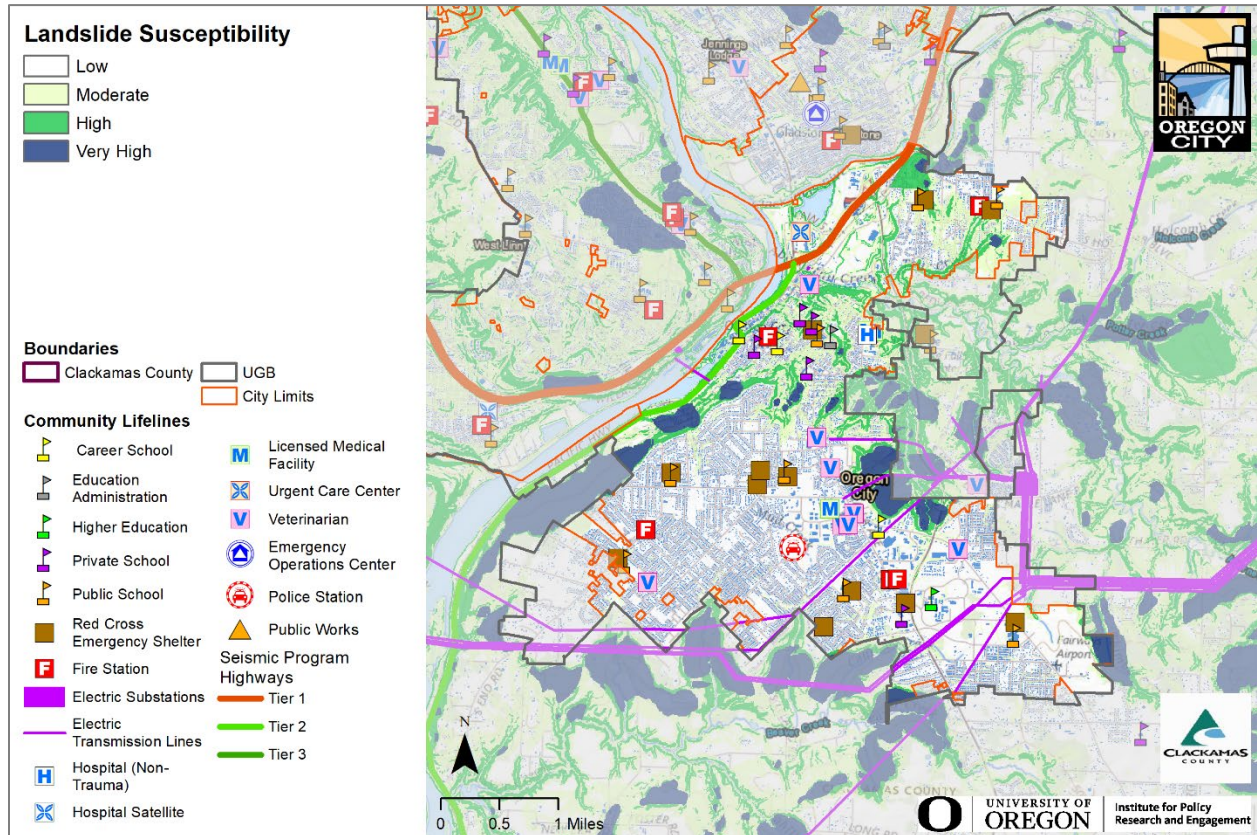
The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, 2024)¹⁸ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 533 buildings (no critical facilities) are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of \$205.4 million (a building exposure ratio of about 4%). About 1,778 residents may be displaced by landslides (about 5% of the population).

Figure OC-5 Landslide Susceptibility Exposure



¹⁸ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-30.

Mitigation Activities

Oregon City works to mitigate future landslide hazards. Oregon City uses percent slope as an indicator of hill slope stability. The city uses a 25% or greater threshold to identify potentially unstable hill slopes. Approximately, 518 acres in the city exceeds this 25% slope threshold (about 8.25% of the land in Oregon City). The city development code includes policies and regulations for landslide prone areas including Chapter 15.48 (Grading, Filling, and Excavating), Chapter 17.44 (US Geologic Hazards), and Chapter 17.47 (Erosion and Sediment Control).

After the 1996 landslide events, 20 of the 48 landslides were repaired by the city, meaning reconstruction or mitigation took place. These fixes varied and included constructing retaining walls, installing rockfill, and moving structures. The sanitary sewer pump station that began sliding downhill had seismic isolation piles installed under the foundation of the building to mitigate future slides.

Repairs and mitigation after the December 28th, 2005 to January 1st, 2006 landslides included:

- The storm sewer manhole that failed on Trillium Drive was repaired. The city installed monitoring wells with inclinometers to allow the city to continue to monitor the slope.
- The owner of the Morton Road apartment building installed a crib wall.
- A homeowner on Newell Crest Drive constructed a retaining wall, costing approximately \$100,000.
- Newell Creek Apartments had the most mitigation work done. The city temporarily repaired one of the water lines and permanently abandoned the waterline on the slope and reconfigured the second water line. The repaired line that remained at risk was later replaced with a new water line with flexible couplings at the joints. The city required relocation and reconstruction of the apartment complex's private sanitary sewer pump station.

The city additionally has many ongoing mitigation actions including a water pipe line leak detection system and annual assessments of slide hazard areas.

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **high** and that their vulnerability is **moderate**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of Oregon City has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events. In June of 2021 there was a "Heat Dome" that produced temperatures of approximately 115* for 3 days. There were 15 deaths attributed to this extreme weather event in Clackamas County.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"¹⁹ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City's probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. On December 11th, 1995, a windstorm hit Oregon. Oregon City was one of the most severely damaged cities in Clackamas County. Winds tore off roofs from buildings, uprooted or damaged trees, and knocked out electrical and telephone service. Because windstorms typically occur during winter months, they are sometimes accompanied by ice, freezing rain, flooding and very rarely, snow. Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes, are generally negligible for Oregon City. Windstorms also impacted Oregon City in December 2015 and during December 2016 and January 2017 including cold weather and damaging winds.

¹⁹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris. Additionally, transportation and economic disruptions result as well.

Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the City's probability for winter storm is **moderate** and that their vulnerability to winter storm is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Major winter storms can and have occurred in the Oregon City area. From January 9th to 12th, 1998, a severe winter storm included freezing rain and snow and was accompanied by high winds for two days. Most of the city lost power due to downed electrical lines and malfunctioning transformers. One emergency shelter was opened for those who could not stay in their homes. Off-duty firefighters were called in to help respond to the increased number of calls. Another winter storm happened in January 2009, which resulted in over 3.5 inches of rain in a 24-hour period. The snow and rain led to localized flooding, land movement, traffic delays, and sewer line back-ups. Sections of Meyers Road, Beaver Creek Road, Linn Avenue, Abernethy Road, and Van Buren Street were closed due to the effects of the storm. The storm led to significant power outages, eight water main breaks, and hazardous road conditions. The City contracted forces to assist in snow removal efforts.

Another winter storm impacted the City during December 2016 and January 2017 including cold weather and damaging winds. In February of 2021 a severe ice storm hit Oregon city causing widespread power outages, hundreds of downed trees and branches, road closures, and communication failures. City Public Works staff worked tirelessly for several days clearing streets and ROW areas. The ice event produced hundreds of cubic yards of tree debris which took weeks to clear.

Most winter storms typically do not cause significant damage, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter, and commercial traffic as noted above.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²⁰ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Vulnerability Assessment

Due to insufficient data and resources, Oregon City is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets Section and Table OC-4.

Volcanic Event

The HMAC determined that the City’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of volcanic hazards, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect Oregon City as well. Volcanoes are located near Oregon City, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Oregon City’s relative distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash.

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**²¹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard.

The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

²⁰ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

²¹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-30.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the City's probability for wildfire is **low**, and that their vulnerability to wildfire is **moderate**. *These ratings did not change since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan \(CWPP\)](#) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Oregon City is found in the following chapter: Chapter 9.3: Clackamas Fire District #1.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location and extent of a wildland fire vary depending on fuel, topography, and weather conditions. Figure OC-6 shows wildfire risk in Oregon City.

Weather and urbanization conditions are primarily at cause for the hazard level. Oregon City has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. However, a major fire broke out near Rosemont Ridge in September 1967. The fire burned 300 acres and cut telephone and electrical service, but fire fighters were able to save all threatened homes. Less than two weeks later another fire destroyed 500 acres. This fire took the efforts of over 150 firefighters to save the homes.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Oregon City, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County. In Oregon City most instances of fire have been started by the railroads and I-5 but the fires have been small enough to contain quickly and easily.

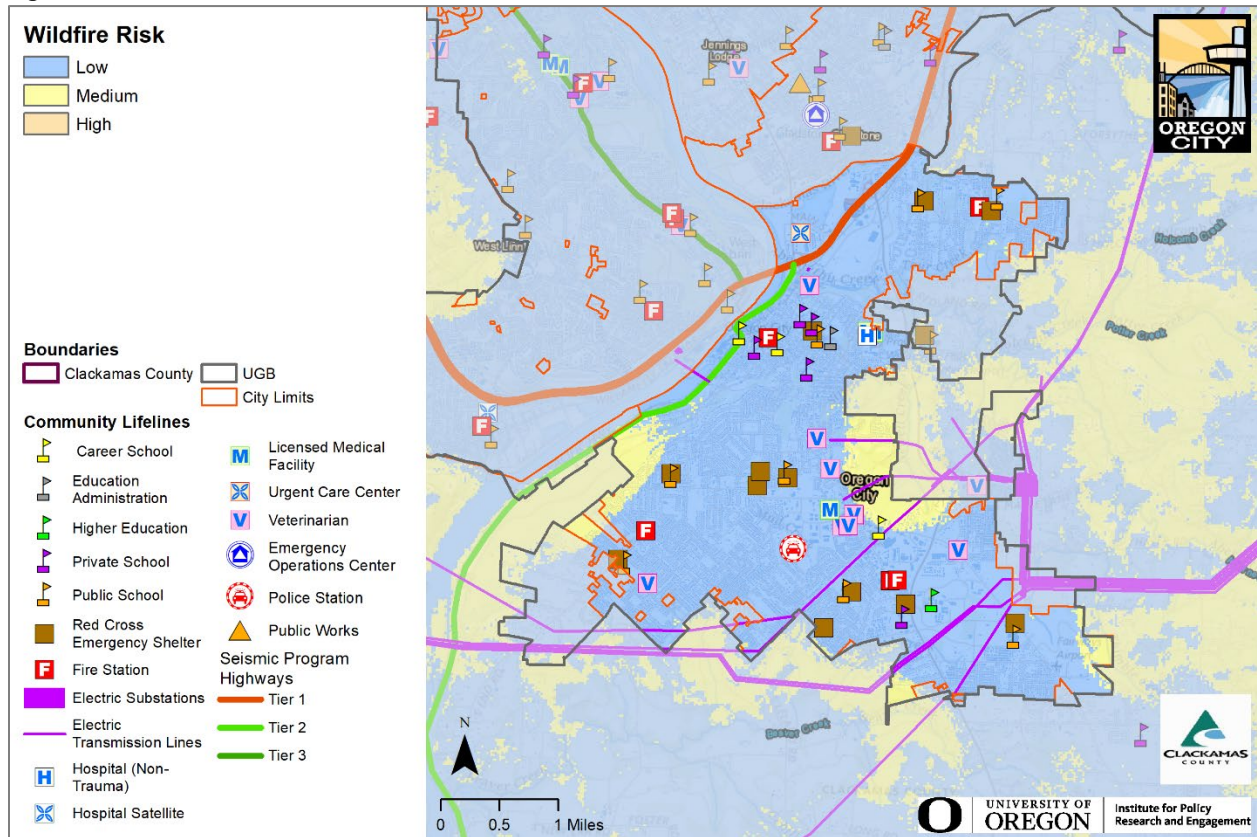
The forested hills within, and surrounding Oregon City are interface areas. One area that's particularly susceptible to fires is the Canemah Bluffs area. This area has heavy tree coverage and a dense neighborhood sits atop a steep wooded area, increasing the threat of wildfire. In August 2005, a wildfire on the Canemah Bluffs burned down a non-occupied historic structure. Another fire began in this same area in 2007. The 2007 fire began at Highway 99E and spread up the rock cliff face. Two additional areas that are particularly susceptible to wildfires: Newell Creek Canyon and the Waterboard Park. Newell Creek Canyon is open space located outside the Metro UGB and is not part of a master plan. This area is a major wildland urban interface and has the potential for a catastrophic fire.

Transients often have campfires in this area, creating a potential for fire to start. Highway 213 runs through this area and a cigarette thrown from a car is another potential source of ignition. If a fire were to break out along the highway, firefighters would have to fight it from the highway as there is limited access to the canyon. The Barclay Hills residential development on the west side of the canyon has very poor access, with only one way in and one way out. Waterboard Park is located along the bluff below

Promontory Avenue. This area is considered a charter park, meaning trees and brush cannot be cut to reduce fuel load. Like Newell Creek Canyon, Waterboard Park is home to many transients and campfires pose a threat to igniting a fire. High and medium Priority Communities at Risk (CARs) within the City include: Canemah Bluffs (high) and Holcomb (medium).²²

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four-feet under normal weather conditions.²³ However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Figure OC-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Vulnerability Assessment

The potential community impacts and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. Oregon City’s fire response is addressed within the CWPP, which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City

²² Clackamas County Community Wildfire Protection Plan, *Clackamas Fire District #1* (2018), Table 10.3-1.

²³ [Oregon Wildfire Risk Explorer](#), date accessed November 19, 2018.

will update the City’s wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**²⁴ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 173 buildings (no critical facilities) are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of \$60.1 million (a building exposure ratio of about 1%). About 599 residents may be displaced by wildfires (about 2% of the population).

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²⁵ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

²⁴ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-30.

²⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table OC-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table OC-1).

Previous NHMP Actions that are Complete:

None identified.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table OC-8 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Multi-Hazard #2	#2	Not Complete	Yes
Multi-Hazard #3	#3	Not Complete	Yes
Multi-Hazard #4	#4	Not Complete	Yes
Earthquake #1	#5	Not Complete	Yes
Flood #1	#6	Not Complete	Yes
Flood #2	#7	Not Complete	Yes
Flood #3	#8	Not Complete	Yes
Landslide #1	#9	Not Complete	Yes
Landslide #2	#10	Not Complete	Yes
Severe Weather #1	#11	Not Complete	Yes
Wildfire #1	#12	Not Complete	Yes
Wildfire #2	#13	Not Complete	Yes
Wildfire #3	#14	Not Complete	Yes

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from March 6 through March 31 on the City’s website. The plan was also posted and announced on the County’s website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan’s content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting

The screenshot shows the Oregon City website header with navigation links: I WANT TO..., YOUR GOVERNMENT, DEPARTMENTS, DOING BUSINESS, and OUR COMMUNITY. A sidebar menu on the left lists: Stormwater Plans, Natural Hazards Mitigation Plan, Water Plans, Sanitary Sewer Master Plan, and Transportation Plans. The main content area features a breadcrumb trail: Home | Departments | Public Works | Documents, Drawings, Forms & Permits | Public Works Master Plans | Natural Hazards Mitigation Plan. The article title is "NATURAL HAZARDS MITIGATION PLAN" with a sub-headline "Latest Draft Of Natural Hazard Mitigation Plan released for comment". The text states: "Oregon City is in the process of updating our existing Natural Hazards Mitigation Plan (NHMP). This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management (OEM) utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program. The plan is available for public review and comment for two weeks. You can read the plan here. Email comments here." To the right is a thumbnail for the "City of Oregon City Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan" with a photo of a building and a date of "April 02, 2024 - April 02, 2024". A language selection dropdown is visible in the bottom left.

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1: March 20 and May 24, 2023

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #3: November 17, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

City of Sandy Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: City of Sandy

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The City of Sandy

Updated:

July 15, 2024, (Resolution # 2024-16)
December 2, 2019, (Resolution # 2019-23)
2013
2009



This Natural Hazard Mitigation Plan was prepared by:



Planning grant funding provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS



RESOLUTION NO. 2024-16

A RESOLUTION ADOPTING THE CITY OF SANDY REPRESENTATION IN THE UPDATES TO THE CLACKAMAS COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

WHEREAS, the City of Sandy recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, the City of Sandy has fully participated in the FEMA prescribed mitigation planning process to prepare the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

WHEREAS, the City of Sandy has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of Sandy to the impacts of future disasters within the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan; and

WHEREAS, these proposed projects and programs have been incorporated into the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan and pre-approved it (dated, June 11, 2024) contingent upon this official adoption of the participating governments and entities; and

WHEREAS, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

WHEREAS, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

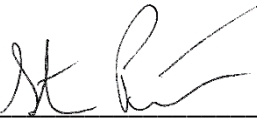
WHEREAS, City of Sandy adopts the NHMP and directs the City Manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SANDY:

Section 1: The City of Sandy adopts the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan as an official plan. The plan is attached to this resolution as Exhibit A.

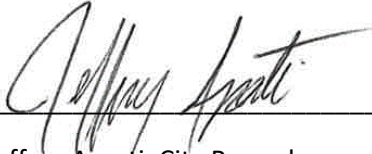
Section 2: The City of Sandy will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan.

This resolution is adopted by the City Council of the City of Sandy this 15th day of July, 2024.



Stan Pulliam, Mayor

ATTEST:



Jeffrey Aprati, City Recorder

Purpose

This is an update of the Sandy addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Sandy’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Sandy adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 15, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Sandy to update their NHMP.

The Clackamas County NHMP, and Sandy addendum, are the result of a collaborative effort between residents, public agencies, non-profit organizations, the private sector, and regional organizations. The Sandy HMAC guided the process of developing the NHMP.

Convener

The Sandy City Manager serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Sandy HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Sandy HMAC was comprised of the following representatives:

- Jeff Aprati – Deputy City Manager
- Jenny Coker -- Public Works Director
- Andi Howell – Transit Director
- Sean Lundry – Interim Police Chief
- Kelly O’Neill Jr. – Development Services Director
- Ernie Roberts – Police Chief
- A.J. Thorne – Assistant Public Works Director

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Sandy addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the Sandy NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Sandy will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Sandy to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, water system master plan, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

Sandy addresses Statewide Planning Goal 7 Natural Hazards as part of their Comprehensive Plan Element, Natural Hazards. This element was written in 1997 and focuses on steep slopes "and other natural hazards." The City is working on the first comprehensive revision to the comprehensive plan since 1997. "Envision Sandy 2050" is drafting the Goals and Policies for the four key topic areas: Community and Culture, Transportation and Infrastructure, Parks, Trails, and Natural Resources, and Natural Hazards and Resiliency.

Planned updates to the jurisdiction's Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community's long-range plans.

Transportation System Plan

The City adopted a new transportation system plan in 2023. Goal 1.4 of the transportation system plan states to ensure sufficient capacity to accommodate future travel demand (transit, bicycle, pedestrian, etc.) to, within, and through the City of Sandy. Goal 5 is to minimize environmental impacts on natural resources and encourage carbon-neutral or efficient transportation alternatives. Goal 8.1 states to ensure the transportation system provides equitable access to underserved, disadvantaged, and vulnerable populations and is easy to use and accommodating to travelers of all ages. These three goals, along with many others, will prepare Sandy for natural hazards.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

- Title 13 Water and Sewer, includes stormwater, water, and sanitary sewer system rules and regulations.
- Chapter 17 Development Code, includes allowed uses and development standards for all zones, including hillside development and the flood and slope hazard overlay zone.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

Development Services

The Sandy Planning Division is the oversight entity for all matters related to the City's land use development process, long range planning, and some components of [urban renewal](#). It is responsible for the administration of state, county, and local land use policies and regulations as they relate to the preservation and quality development of property lying within the city limits and urban growth boundary (UGB). Planning works closely with Building, Engineering, and Fire in the review of development applications and building permits. They also work closely with the County and neighboring jurisdictions to ensure plans are aligned.

The Sandy Building Division administers and enforces the 2022 Oregon Structural Specialty Code. Clackamas Fire District uses the 2022 Oregon Fire Code. As a result, both new residential and commercial structures are required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

The Sandy Development Services Director oversees and enforces the Flood and Slope Hazard Area code. Minimum submission requirements stipulate an Elevation Certificate is required at submittal if property is in a flood hazard area and requires a two (2) foot free board and other flood construction requirements.

Public Works

The Public Works staff is responsible for the day-to-day operation and maintenance of all public facilities in the City of Sandy. Services include water, sewer, streets, parks and building maintenance, stormwater, engineering, and erosion control. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

City Administration

The City Council of Sandy has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Policies and Programs

This Plan directs Sandy and Clackamas County to explore integration into other planning documents and processes. Sandy has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

Urban Renewal Plan

The City has undertaken several urban renewal projects within the downtown, based on the adopted Sandy Urban Renewal Plan (originally adopted in 1998, and updated in 2008, 2015, and 2018). These include undergrounding of utilities on Pioneer and Proctor Boulevards, fire protection improvements (including fire station improvements), and City Hall improvements (added in 2018).

Drinking Water System Reinvestment Project

Sandy's Drinking Water System Reinvestment Project is a long-term effort that will help to meet Sandy's future drinking water needs using several complementary strategies: repairing facilities and reinvesting in water source treatment and storage infrastructure, building new infrastructure to have access to Bull Run water, exploring groundwater sources, and keeping rates affordable.

2022 Water Master Plan

As part of the Drinking Water System Reinvestment Project, the City adopted a revised Water System Master Plan (WSMP) in 2022. It estimates future water requirements including potential water system expansion areas, identifies deficiencies and recommend water facility improvements that may correct system deficiencies and provide for growth, and updated the 5-year water system Capital Improvement Plan.

Wastewater System Improvements

The City of Sandy adopted a new Wastewater System Facilities Plan in 2019. However, despite improved operations, the City's wastewater treatment plant has been unable to reliably meet federal/state permit requirements. In 2022, Oregon DEQ mandated that Sandy discontinue wastewater effluent to Tickle Creek. A temporary moratorium on land use permits with new sanitary sewer connections was established in October 2022 (through October 2023) to give sewer system improvements time to catch up with the community's growth and aging infrastructure.

The City is currently working with engineers and consultants to explore alternative treatment options and water recycling opportunities and prepare the preliminary design plans for wastewater treatment plant upgrades and repairs to the collection system. This project, called "Sandy Clean Waters," is on track for completion by 2026.

Stormwater Management Incentive Program

The City of Sandy has initiated a stormwater management incentive program to encourage multi-family, commercial, and industrial property owners to reduce runoff by treating and disposing of stormwater on-site. The resulting decrease in runoff entering the stormwater system will reduce capital and maintenance costs to the City and the decrease in runoff and pollution loading will improve the water quality of streams in and around Sandy and reduce potential urban flooding.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex.

National Flood Insurance Program

Sandy participates in the National Flood Insurance Program. The Planning Division is responsible for administering the day-to-day activities of the city's floodplain program. They are assisted by the Building Division, the Public Works Department, and by the City Administrator.

Specifically, the Planning Division:

- maintains and administers Sandy's floodplain regulations;
- reviews and issues floodplain development permits;
- maintains elevation certificates for all new and substantially improved structures (and maintains an extensive database of historic elevation certificates);
- ensures that encroachments do not occur within the regulated floodway;
- implements measures to ensure that new and substantially improved structures are protected from flood losses;
- maintains floodplain studies and maps and makes this information available to the public;
- maintains a flood information website with digital flood insurance rate map (DFIRM) data;
- conducts site visits to assess conditions and provide technical assistance to the public;
- maintains a library of historical flood related information;
- informs the public of flood insurance requirements; and
- conducts outreach and training about flood hazards and development within the floodplain.

The City completed an amendment to the Flood and Slope Hazard (FSH) Overlay District in Chapter 17.60 of Title 17 of the Sandy Municipal Code. This was completed in 2019 in consultation with the Oregon Department of Land Conservation and Development (DLCD), on behalf of FEMA. Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

There are only nine (9) floodplain insurance policies active in Sandy as of May 2, 2023, none of which are owned by the City.

Personnel

The following Sandy personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Police Chief

Public Information Officer: Deputy City Manager

Floodplain Manager: Development Services Director

Grant writing (for Public Works or emergency management): Assistant Public Works Director

Capital improvement planning: Public Works Director

Capital improvement execution: Public Works Director

Sandy does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Sandy has implemented recommendations from the last NHMP into its capital improvement projects over the last 5 years, including:

- **(Stormwater) Stormwater drainage improvements/replacement at Strawbridge Parkway and Tupper Road (2022 and 2023.)** Completed an emergency repair of a sinkhole from a failed stormwater line.
- **(Water) Sandercock Reservoir Repairs (2023).** Completed an urgent structural repair to a critical drinking water reservoir for our resilient groundwater drinking source.
- **(Street) 362nd Avenue and Bell Street Improvements Project** - Highway 26 is an essential transportation corridor. Connecting 362nd and Bell allows first responders to avoid the highway and allows secondary emergency access to the high school as well as an alternate evacuation route for residents.
- **(Sewer) Sandy Clean Waters Program - Phase 1A.** Rehabilitation and Repairs of Collection System basins 2 and 8 and 6 and 7, as well as the Wastewater Treatment Plant Immediate Repairs Project including a fiber optic upgrade. Phase 1A was a collective investment of \$30 million in conveyance and wastewater treatment system improvements to comply with the City's NPDES permit and protect Tickle Creek and the downstream Clackamas River.¹

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)².

FEMA Funded Mitigation Successes

- None identified.

Seismic Rehabilitation Grant Program Mitigation Successes

- 2017: Sandy Fire District Station 82 (\$1,189,967)

² The Seismic Rehabilitation Grant Program (SRGP) 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.

Capital Resources

Sandy maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Communication towers include:

- AT&T Wireless Services, Inc. 40494 Highway 26 Sandy, OR (1) cell tower
- U S West Newvector Group, Inc. Dba 17100 Bluff Rd Sandy, OR (1) cell tower
- Clackamas 800 Radio Group 16950 Bluff Road Sandy, OR (1) radio tower

Critical facilities with power generators for use during emergency blackouts include:

- Sandy Police Department - propane generator - 39850 Pleasant Street
- Sandy City Hall - Automatic Transfer Switch - Natural Gas - 39250 Pioneer BLVD.
- Sandy Operations Center - Automatic Transfer Switch - Natural Gas - 16610 Champion Way
- Sandy Wastewater Treatment Plant - Automatic Transfer Switch - Diesel - 33400 Jarl Rd., Boring, OR 97009
- Alder Creek Water Treatment Plant - Manual Transfer Switch - Diesel - 52500 Hwy 26
- Terra Fern Pump Station and Reservoir - Automatic Transfer Switch - Diesel - 51515 E Terra Fern Dr.
- Revenue Reservoir - Automatic Transfer Switch - Natural Gas - 17160 Revenue Ave.
- Hudson Pump Station - Automatic Transfer Switch - Diesel - 39175 SE Hudson Rd.
- Southwest Wastewater Pump Station - Automatic Transfer Switch - Natural Gas - 18770 SE Jacoby Rd.
- Meinig Ave Wastewater Pump Station - Automatic Transfer Switch - Natural Gas - 17174 SE Meinig Ave.
- Sleepy Hollow Wastewater Pump Station - Automatic Transfer Switch - Natural Gas - 17591 Constable Dr.
- Snowberry Wastewater Pump Station - Automatic Transfer Switch - Natural Gas - 37810 Cascadia Village Dr.
- Northside Wastewater Pump Station - Automatic Transfer Switch - Diesel - 36145 Hwy 26

Warming or cooling shelters include:

- Ant Farm Cafe 39140 Proctor Blvd
- Sandy Library 38980 Proctor Blvd
- Sandy Community Center 38348 Pioneer Blvd

Food pantries include:

- Sandy Community Action Center, 38982 Pioneer Blvd

Fueling storage:

- Sandy Public Works has initiated a temporary pilot onsite fueling project that will provide critical emergency fuel reserve. The project is in the final stages of implementation. In conducting this pilot study they plan to evaluate the potential cost savings with onsite fueling while providing an emergency fuel reserve to mitigate risks associated with natural hazards. In recent years, Sandy

has seen extended power outages due to wildfire Public Safety Power Shutoffs (PSPS), winter weather events limiting local fuel deliveries, along with other climate related events. The fuel reserve will help provide a buffer to continue operating our water and sewer utility systems via generator power in the event of larger power outages or fuel shortages.

Findings

Several important findings from this capability assessment informed the design of the Plan's mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Sandy staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Sandy operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City's ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions, and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The City's mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAC assessed the City's risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table SA-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAC decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table SA-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/Partners	Timeline	Potential Funding Source	Estimated Cost
1	Maintain public education programs to inform the public about methods for mitigating the impacts of natural hazards.	X	X	X	X	X	X	X	X	X	City Administration	Ongoing	Local Resources. DLCD TA	Low
2	Integrate the goals and action items from the Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	Development Services	Medium	Local Resources. DLCD TA, FEMA HMA-C&CB	High
3	Improve vegetation management throughout the city. Use zoning codes to regulate development and apply code enforcement to mitigate impacts.							X	X	X	Development Services	Ongoing	Local Resources, FEMA HMA	High
4	Encourage structural mitigation practices in developments at risk to natural hazards.		X		X	X		X	X	X	Development Services	Ongoing	Local Resources. DLCD TA, FEMA HMA-C&CB	Low to High
5	Develop a community resilience hub designed to support residents and coordinate resource distribution before, during, or after a natural hazard event. Hub could also provide refuge site from cold, heat, and poor air quality.	X	X	X	X	X	X	X	X	X	Development Services	Medium	Local Resources, FEMA HMA-C&CB,	Medium (scoping) to High (implementation)

Table SA-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/Partners	Timeline	Potential Funding Source	Estimated Cost
6	Maintain and update mapping for the Flood Slope Hazard Overlay District as identified in Chapter 17.60 of the Sandy Development Code.		X		X	X					Development Services	Medium	Local Resources, FEMA HMA-C&CB	High
7	Install temporary diesel and gasoline fuel reserves tanks for public works, police, and transit.		X		X	X		X		X	Public Works	Short	Local Resources, State and Federal Grants, FEMA HMA	High
8	Explore opportunities to partner with local agencies to hire a dedicated emergency manager.	X	X	X	X	X	X	X	X	X	City Administration	Medium	Local Resources, State and Federal Grants	High
9	Reduce negative impacts of earthquakes by performing seismic evaluations and retrofits (structural and non-structural).		X								Development Services, Public Works	Ongoing	Local Resources. DLCDC TA, FEMA HMA (FMA)	High
10	Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.				X						Development Services	Ongoing	Local Resources, FEMA HMA	Low
11	Implement actions identified in the Drinking Water Master Plan.	X	X		X						Public Works	Ongoing	Local Resources, FEMA HMA	Low to High

Table SA-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/Partners	Timeline	Potential Funding Source	Estimated Cost
12	Implement actions identified in the Wastewater Facility Plan.	X			X						Public Works	Ongoing	Local Resources, FEMA HMA	Low to High
13	Promote and protect the use of naturally flood prone open space or wetlands as flood storage areas.				X						Development Services	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low
14	Maintain and update an inventory of streets and properties threatened by landslides.					X					Development Services	Ongoing	Local Resources, FEMA HMA-C&CB	High
15	Reduce negative effects from severe windstorm and severe winter storm events.								X	X	Public Works	Ongoing	Local Resources, FEMA HMA	Medium
16	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.							X			Sandy Fire District	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low to High

Source: Sandy NHMP HMA, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

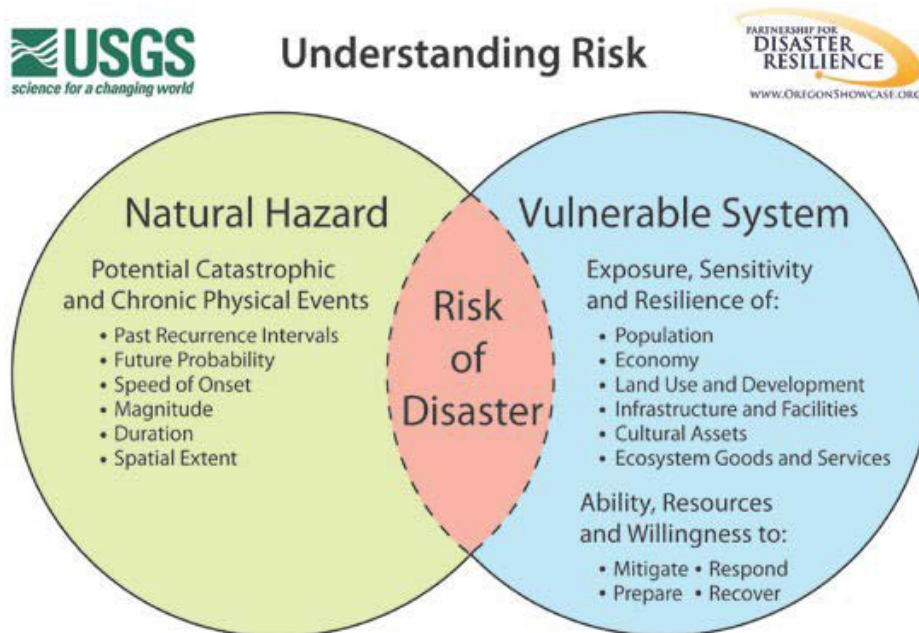
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure SA-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure SA-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Sandy HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Sandy, which are discussed throughout this addendum. Table SA-2 shows the HVA matrix for Sandy listing each

hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Three chronic hazards (wildfire, drought, and winter storm) and one catastrophic hazard (Cascadia earthquake) rank as the top hazard threats to the City (Top Tier). Windstorm, crustal earthquake, and extreme heat comprise the next highest ranked hazards (Middle Tier), while landslide, volcanic event, and flood comprise the lowest ranked hazards (Bottom Tier).

Table SA-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Wildfire	18	45	100	63	226	1	Top Tier
Drought	10	35	100	56	201	2	
Winter Storm	14	30	70	49	163	3	
Earthquake - Cascadia	2	45	80	35	162	4	
Windstorm	16	30	70	42	158	5	Middle Tier
Earthquake - Crustal	6	50	80	21	157	6	
Extreme Heat Event	10	35	70	35	150	7	
Landslide	14	20	40	63	137	8	Bottom Tier
Volcanic Event	2	40	80	7	129	9	
Flood	10	20	30	56	116	10	

Source: Sandy HMAC, 2023.

Community Characteristics

Table SA-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Population, Housing, and Income

Located on Highway 26, Sandy is a scenic community with beautiful views and vast outdoor recreational opportunities and serves as a gateway for tourists visiting Mount Hood and the Mount Hood National Forest. Sandy’s residents enjoy a rural lifestyle while still having the urban amenities of Portland, located just 25 miles to the northwest. Sandy was originally settled in 1853 and incorporated in 1911. Today it has an area today of 3.57 square miles. The City has doubled its population since 2000 and is expected to double its population again by 2040.

Sandy’s largest body of water is the Sandy River. Smaller tributaries include Tickle Creek, Cedar Creek, and Badger Creek. The topography in Sandy is quite diverse, ranging from the steep Sandy River canyon to relatively flat farmland. The areas to the east and south of the city are mostly forested land, and areas to the north and west of the city are primarily farmland.

The City is within the Sandy River watershed at 967 feet above sea level. Because of its location Sandy’s climate is consistent with the Marine west coast climate zone, with warm summers and cool, wet winters. Sandy receives most of its precipitation between October and May, averaging 79 inches of rain, and about one (1) inch of snow, per year.

Between 2016 and 2021 the City grew by 2,336 people (22%; as of 2022 the population is 12,991). Between 2022 and 2040 the population is forecast to grow by 24% to 16,144.

Most of the population is White/Caucasian (84%) and about 18% of the population is Hispanic or Latino. The poverty rate is 8% (6% of children under 18, 16% for people 65 and older), 6% do not have health insurance, and 58% of renters pay more than 30% of their household income on rent (32% for owners). About 22% of the population has a bachelor's degree or higher (6% do not have a high school degree). Approximately 13% of the population lives with a disability (40% of population 65 and older), and 41% are either below 15 (27%) or over 65 (14%) years of age. About 7% of the population are 65 or older and living alone and 16% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 84% of housing units are single-family, 11% are multifamily, and 4% are mobile homes. Eleven (11%) of homes were built before 1970 and 65% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost three-quarter (74%) of housing units are owner occupied, 22% are renter occupied, and 4% are vacant.

Transportation and Infrastructure

Downtown Sandy is an asset to the community and the city has undertaken several urban renewal projects to increase the community's prosperity by enabling an economically viable and vibrant city. The 3/4 mile stretch between Bluff Road and Ten Eyck Road is the heart of the city and offers shopping, dining and entertainment. Sandy's downtown is also home to a variety of city services including City Hall, Sandy Fire and Police, the City Library and Community Center.

Sandy's commercial sector is centered along Highway 26. Industry is primarily located in the western portion of the city. Most residential properties are in the southern part of town, although the northern part of town is also zoned for residential use.

Transportation is an important consideration when planning for emergency service provisions. Growth within the city will put pressure on both major and minor roads, especially if the main mode of travel is by single occupancy vehicles.

Motor vehicles represent the dominant mode of travel through and within Sandy. Twelve percent (12%) of renters and less than 1% of owners do not have a vehicle. Most workers drive alone to work (80%); 7% carpool, less than 1% use public transit, 1% either walk or use a bicycle, and 12% work at home. The City owns and operates a regional transit system, Sandy Area Metro (SAM), and collaboratively administers Clackamas County's Mt Hood Express (MHX) service. All transit services pause at the City's Transit Center in the downtown Centennial Plaza.

Economy

Sandy is dominated by small businesses, with more than 77% of businesses employing fewer than five employees.

About 51% of the resident population 16 and over is in the labor force (5,083 people) and are employed in a variety of occupations including professional (16%), office and administrative (16%), transportation and material moving (12%), management, business, and financial (11%), and sales related (9%) occupations.

Most workers residing in the city (89%, 5,485 people) travel outside of the city for work primarily to Portland, Gresham, and surrounding areas.³ A significant population of people travel to the city for work, (81% of the workforce, 2,828 people) primarily from Gresham, Portland, and surrounding areas.⁴

³ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on December 21, 2023 at <https://onthemap.ces.census.gov>.

⁴ Ibid.

Table SA-3 Community Characteristics

Population Characteristics			Household Characteristics		
2016 Population Estimate	10,655	Population Growth	Housing Units		
2022 Population Estimate	12,991	22%	Single-Family (includes duplexes)	3,784	84%
2040 Population Forecast*	16,144	24%	Multi-Family	514	11%
Race			Mobile Homes (includes RV, Van, etc.)	202	4%
American Indian and Alaska Native		< 1%	Household Type		
Asian		2%	Family Household	3,273	76%
Black/ African American		< 1%	Married couple (w/ children)	1,475	34%
Native Hawaiian and Other Pacific Islander		0%	Single (w/ children)	683	16%
White		84%	Living Alone 65+	292	7%
Some Other Race		0%	Year Structure Built		
Two or More Races		5%	Pre-1970	508	11%
Hispanic or Latino/a (of any race)			1970-1989	1,080	24%
Limited or No English Spoken	276	2%	1990-2009	1,893	42%
Vulnerable Age Groups			2010 or later	1,019	23%
Less than 5 Years	858	7%	Housing Tenure and Vacancy		
Less than 15 Years	2,503	20%	Owner-occupied	3,316	74%
65 Years and Older	1,428	12%	Renter-occupied	1,001	22%
85 Years and Older	185	2%	Seasonal	0	0%
Age Dependency Ratio		0.47	Vacant	183	4%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)		
Total Disabled Population	1,639	13%	No Vehicle (owner occupied)	12	< 1%
Children (Under 18)	170	5%	Two+ vehicles (owner occupied)	2,761	83%
Working Age (18 to 64)	902	12%	No Vehicle (renter occupied)	120	12%
Seniors (65 and older)	567	40%	Two+ vehicles (renter occupied)	473	47%
Income Characteristics			Employment Characteristics		
Households by Income Category			Labor Force (Population 16+)		
Less than \$15,000	198	5%	In labor Force (% Total Population)	6,259	51%
\$15,000-\$29,999	323	8%	Unemployed (% Labor Force)	267	4%
\$30,000-\$44,999	456	11%	Occupation (Top 5) (Employed 16+)		
\$45,000-\$59,999	342	8%	Professional & Related	982	16%
\$60,000-\$74,999	391	9%	Office & Administrative	967	16%
\$75,000-\$99,999	815	19%	Transportation and Material Moving	738	12%
\$100,000-\$199,999	1,464	34%	Management, Business, & Financial	711	11%
\$200,000 or more	328	8%	Sales & Related	590	9%
Median Household Income			Health Insurance		
		\$88,775	No Health Insurance	709	6%
Gini Index of Income Inequality			Public Health Insurance	3,733	30%
		0.36	Private Health Insurance	9,673	78%
Poverty Rates (Percent age cohort)			Transportation to Work (Workers 16+)		
Total Population	944	8%	Drove Alone	4,746	80%
Children (Under 18)	172	6%	Carpooled	420	7%
Working Age (18 to 64)	540	7%	Public Transit	7	< 1%
Seniors (65 and older)	232	16%	Motorcycle	7	< 1%
Housing Cost Burden (Cost > 30% of household income)			Bicycle/Walk	46	1%
Owners with a Mortgage	843	32%	Work at Home	699	12%
Owners without a Mortgage	251	36%			
Renters	579	58%			

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", 2016 & 2022; Portland State University, Population Research Center, "Population Forecast Tables", (2023, [Preliminary](#)).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Sandy. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table SA-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table SA-4 Critical Facilities in Sandy

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk	Volcanic Lahar
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed	Exposed	Exposed
Cedar Ridge Middle School	-	X	-	-	-	-	-
Legacy Medical Group – Firwood	-	-	-	-	-	-	-
Mount Hood National Forest - Headquarters	-	-	-	-	-	-	-
Sandy Grade School	-	-	-	-	-	-	-
Sandy High School	-	-	-	-	-	-	-
Sandy Police Department	-	-	-	-	-	-	-
Sandy RFPD 72 - Main Station	-	-	-	-	-	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-34. Note: The Sandy Operations Center is not included in the DOGAMI analysis.

Additional Critical Facilities not included in the DOGAMI Risk Report:

- Sandy Operations Center (Public Works and Transit and Fuel reserves)

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

Drinking Water

- Alder Creek Water Treatment Plant (including Raw Water Booster Pump Station)
- Terra Fern Pump Station
- Hudson Pump Station
- Transfer Pump Station

Wastewater

- Jarl Road Wastewater Treatment Plant (including Effluent Pump Station)
- Marcy Street Pump Station
- Sandy Bluff Pump station
- Meinig Avenue Pump Station
- Jacoby Pump station
- Sleepy Hollow Pump Station
- Snowberry Pump Station

Other

- AT&T and T-Mobile Cellular Towers
- PGE Substation – Hwy 26 and Bluff Road
- Highway 211
- Highway 26
- Alder Creek Watershed
- SandyNet Infrastructure and Facilities

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public's ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields.

Essential facilities within Sandy include: Sandy High School, Cedar Ridge Middle School, Sandy Grade School, Firwood Grad School, Oregon Trail Primary Academy, Adventist Health Clinic and Urgent Care, Sandy Health Center, Fred Meyer (& pharmacy), Safeway (& pharmacy), Mt. Hood National Forest Headquarters, Walgreens (pharmacy), and community churches.

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include: Barlow Ridge Park, Hamilton Ridge Park, Salmon Creek Park, Timberline Ridge Park, Bornstedt Park, Cascadia Park, Champion Way Park, Deer Point Park, Ponder Lane, Sandy Bluff Park, Tupper Park, Sandy Community Campus and Skate Park, Meinig Memorial Park, Knollwood Park, Sandy River Park, and Trickle Creek Park.

Vulnerable Populations

Vulnerable populations, including seniors, disabled residents, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include: Avamere Assistant Living, Cedar Park Garden Apartments, Country Garden Apartments, Evans Street Senior Apartments, Firwood Village Apartments, Harlon Garden Apartments, Hummingbird Apartments, Mt. Hood Senior Living, and Hood Chalet Mobile Estates.

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: Gas Stations, , Advanced Plastics Inc, Amerigas Propane Champion Collision, US Metal Works Inc., Performance Auto Body, Sandy Auto Body, and Sandy Funeral Home.

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Happy Valley. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers and are a concern during evacuation/notification during a hazard event. The five largest employers in Sandy are Oregon Trail School District, Safeway, US Metal Works (truck bins, air pneumatic systems, conveyors), Quality Tank and Construction, and Web Steel Buildings NW.

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

An example of the types of properties that should be considered before, during, and after an event include the following properties within Sandy:

- RS Smith Motor Company Building (39150 Pioneer Blvd) (National Register Listed)
- Jonsrud Viewpoint
- Junker Business Building
- Centennial Plaza
- Sandy Historical Society Museum
- Veterans Memorial Square
- Sandy Public Library
- Sandy Community/Senior Center

Hazard Characteristics

Drought

The HMAC determined that the City’s probability for drought is **high** and that their vulnerability to drought is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

The City of Sandy has three water sources: Alder Creek (small tributary of the Sandy River), Brownell Springs (city-owned natural spring on Lenhart Butte), and Portland Water Bureau. During the spring, fall, and winter, approximately one third of supply comes from each source, while during the summer Brownell Springs is reduced to our Senior Water rights and produces only 6%, while Alder Creek and Portland provide about 42% of supply each. The Alder Creek site, located within the Alder Creek watershed (3,915 acres), provides about 1.3MGD (million gallons per day, approximately equal to half the water rights the city has on Alder Creek). This reduced production is due to the deteriorated conditional of the water treatment plant whose facilities are past their useful life. The site includes a treatment plant, reservoirs, piping, and pump stations built in 1977 and last updated in 2001. Brownell Springs can reliably support about 90,000 gallons per day and is located on 22 acres of City-owned land on the north face of Lenhart Butte.

The Portland Water Bureau source has been providing about 500,000 gallons per day (up to a maximum of 3 MGD) since 2013. In addition, the city holds water rights to withdraw up to 25 CFS (cubic feet per second – roughly 16 MGD) from the Salmon River near the Mount Hood National Forest Boundary (current agreements limit future withdrawal to 16.3 CFS – roughly 1-.5 MGD). However, it should be noted that it will take approximately 15-20 years before the City would be able to access the Salmon Creek Water right. The existing water rights and system is considered adequate to supply the City’s expected growth with the planned connection to Portland Water Bureau’s new treatment facility in 2027. Until the new pipeline is constructed, which will also connect the City of Sandy to the Columbia wellfield via the Portland Water Bureau, the City remains vulnerable to droughts due to limitations at the existing Portland Connection, and vulnerabilities with Alder Creek.

Vulnerability Assessment

Due to insufficient data and resources, Sandy is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table SA-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁵ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and

⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

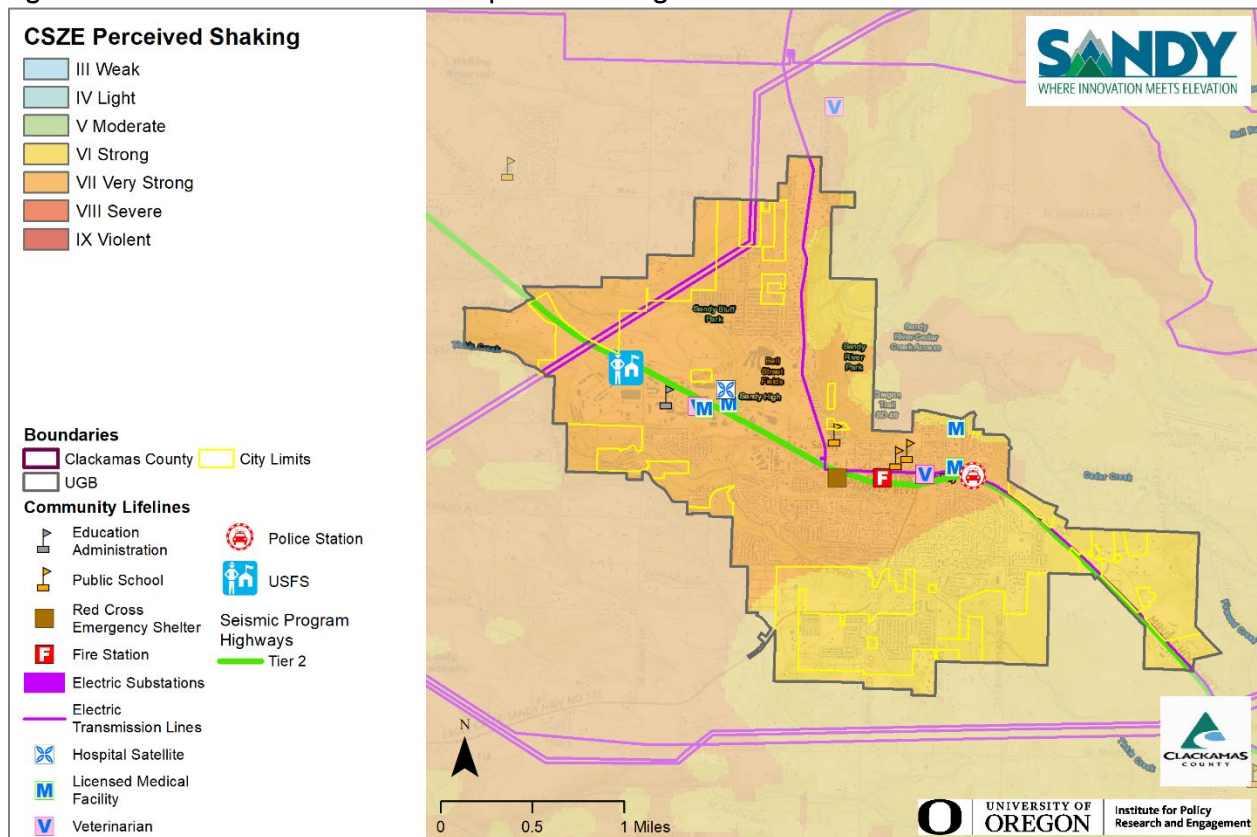
Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Sandy as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Sandy as well.

Figure SA-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Figure SA-2 Cascadia Subduction Zone Expected Shaking



Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Molalla Fault Zone (discussed in the crustal earthquake section).

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.⁶

The city's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a moderate-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the "Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

Earthquake (Crustal)

The HMAC determined that the City's probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Sandy as well. Figure SA-3 shows a generalized geologic map of the Sandy area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

The Canby-Molalla Fault runs through the center of the City and can generate high- magnitude earthquakes. The City is also about 15 miles away from the Portland Hills Fault Zone (discussed in greater detail below). Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993, Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Canby-Molalla Fault Zone

The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement

⁶ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Sandy in northern Oregon.

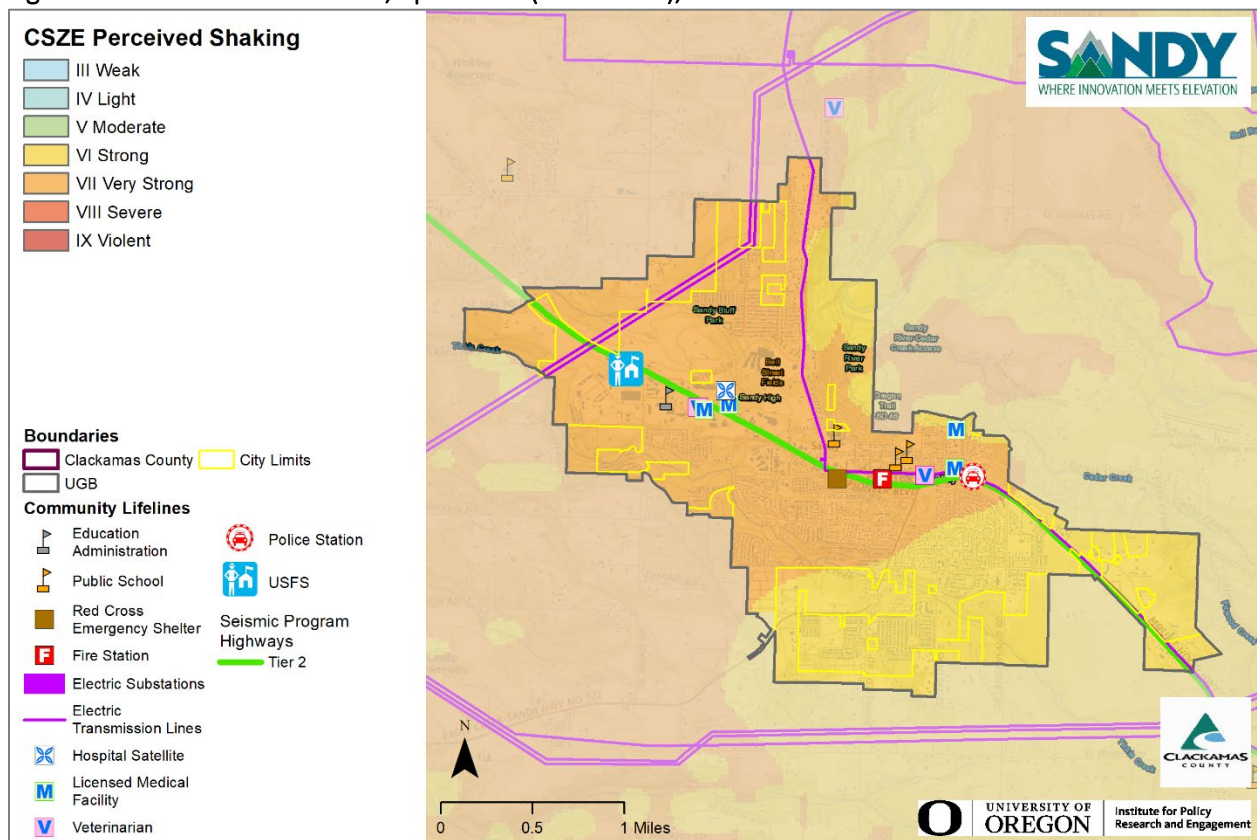
Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 11 miles northwest of Sandy.

Mount Hood Fault Zone

The Mount Hood Fault Zone is a series of four north-trending faults that extend approximately 34 miles north from Clear Lake to the Columbia River, its major segments include the Blue Ridge and the Twin Lakes faults.⁷

Figure SA-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

⁷ Madin, I. P., Streig, A. R., Burns, W. J., and Ma, L., 2017, The Mount Hood Fault Zone – Late Quaternary and Holocene fault features newly mapped with high-resolution lidar Imagery, in Scott, W. E., and Gardner, C. A. (eds.), Field-trip guide to Mount Hood, Oregon, highlighting eruptive history and hazards: U.S. Geological Survey Scientific Investigations Report 2017-5022-G, p. 100-109. <https://pubs.usgs.gov/sir/2017/5022/g/sir20175022g.pdf>

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 36% of residential buildings were built prior to 1990, which increases the City’s vulnerability to the earthquake hazard. Information on specific public buildings’ (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table SA-5; each “X” represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), zero (0) have a very high (100% chance) collapse potential and zero (0) have a high (greater than 10% chance) collapse potential.

For a list of facilities and infrastructure vulnerable to this hazard, see the Community Assets Section and Table SA-4.

Table SA-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Aquatic and Community Center (former Cedar Ridge Middle) (17225 Smith Ave)	Clac_sch38	X			
Sandy Grade (38955 Pleasant St)	Clac_sch36	X			
Fire Facilities					
Sandy Fire 72 – Main Station (17460 Bruns Ave) see Mitigation Successes	Clac_fir37	X			
Other Facilities					
Sandy Public Library (former Police Department) (38970 Proctor Blvd)	Clac_pol07	X			

Source: [DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)

“*” – Site ID is referenced on the [RVS Clackamas County Map](#)

Note 1: The Former Sandy High (Frazier) (RVS ID Clac_sch6) was demolished in and rebuilt via a 2008 bond. It now houses Cedar Ridge Middle School. New High School is located at 37400 Bell St.

Note 2: The Sandy Public Library was formerly the Police Department. There has been an extensive renovation of the building.

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will

suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table SA-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Cascadia Subduction Zone Scenario

The City of Sandy is expected to have a 1% building loss ratio with a repair cost of \$11 million under the CSZ “dry” scenario, and a 1% building loss ratio with a repair cost of \$12 million under the CSZ “wet” scenario.⁸ The city is expected to have around 5 daytime or 2 nighttime casualties during the CSZ “dry” scenario and 5 daytime or 2 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 4 for the CSZ “dry” scenario and 6 for the CSZ “wet” scenario.⁹

Portland Hills Fault Scenario

The City of Sandy is expected to have a 2% building loss ratio with a repair cost of \$20 million under the CSZ “dry” scenario, and a 2% building loss ratio with a repair cost of \$21 million under the CSZ “wet”

⁸ DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8 and 12-9.

⁹ Ibid, Tables 12-8 and 12-9.

scenario.¹⁰ The long-term displaced population and casualties are slightly increased for all the Portland Hills Fault scenarios. The city is expected to have around 8 daytime or 3 nighttime casualties during the Portland Hills Fault “dry” scenario and 9 daytime or 4 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 4 for the Portland Hills Fault “dry” scenario and 16 for the Portland Hills Fault “wet” scenario.¹¹

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table SA-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Table SA-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	3,734	3,734	3,734	3,734
Building Value (\$ Million)	1,077	1,077	1,077	1,077
Building Repair Cost (\$ Million)	11	12	20	21
Building Loss Ratio	1%	1%	2%	2%
Debris (Thousands of Tons)	5	5	8	8
Long-Term Displaced Population	4	6	4	16
Total Casualties (Daytime)	5	5	8	9
Level 4 (Killed)	0	0	0	0
Total Casualties (Nighttime)	2	2	3	4
Level 4 (Killed)	0	0	0	0

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Natural Hazard Risk Report for Clackamas County

The **Risk Reports** (DOGAMI, [2024](#) and [2020](#)) provide hazard analysis summary tables that identify populations and property within the Lower Columbia-Sandy River Watershed Study Area and countywide that are vulnerable to the Cascadia subduction zone earthquake and a local crustal earthquake event associated with the Mount Hood fault or the Canby-Molalla Fault.

Note: The differences between the two Risk Reports are due to the watershed based study area of O-20-06. This study was only for the Lower Columbia-Sandy watershed, which meant that communities along the edge of the watershed like Sandy, Troutdale, and Gresham were only partially included in the study. As such, the O-20-06 report under-represented the potential impacts to the City of Sandy from this hazard.

¹⁰ Ibid, Tables 12-10 and 12-11

¹¹ Ibid, Tables 12-10 and 12-11.

2024 DOGAMI Risk Report (2024)¹²

Cascadia Subduction Zone Scenario: In the City of Sandy, 16 buildings and 1 critical facility are expected to be damaged for a total potential loss of \$17.3 million (a loss ratio of about 1%). Only a few residents may potentially be displaced (less than 1% of the population).

Canby-Molalla Fault Scenario: Six (6) buildings are expected to be damaged, 0 critical facilities, for a total potential loss of \$5.6 million (a loss ratio of less than 1%). Very few residents, if any, may be displaced (less than 1% of the population).

2020 DOGAMI Risk Report (O-20-06)¹³

Mount Hood Fault Scenario: One (1) building is expected to be damaged for a total potential loss of \$1,402,000 (a loss ratio of less than 1%). No residents are expected to be displaced.

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

The HMAC determined that the City’s probability of flooding is **high** and that their vulnerability to flooding is **moderate**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

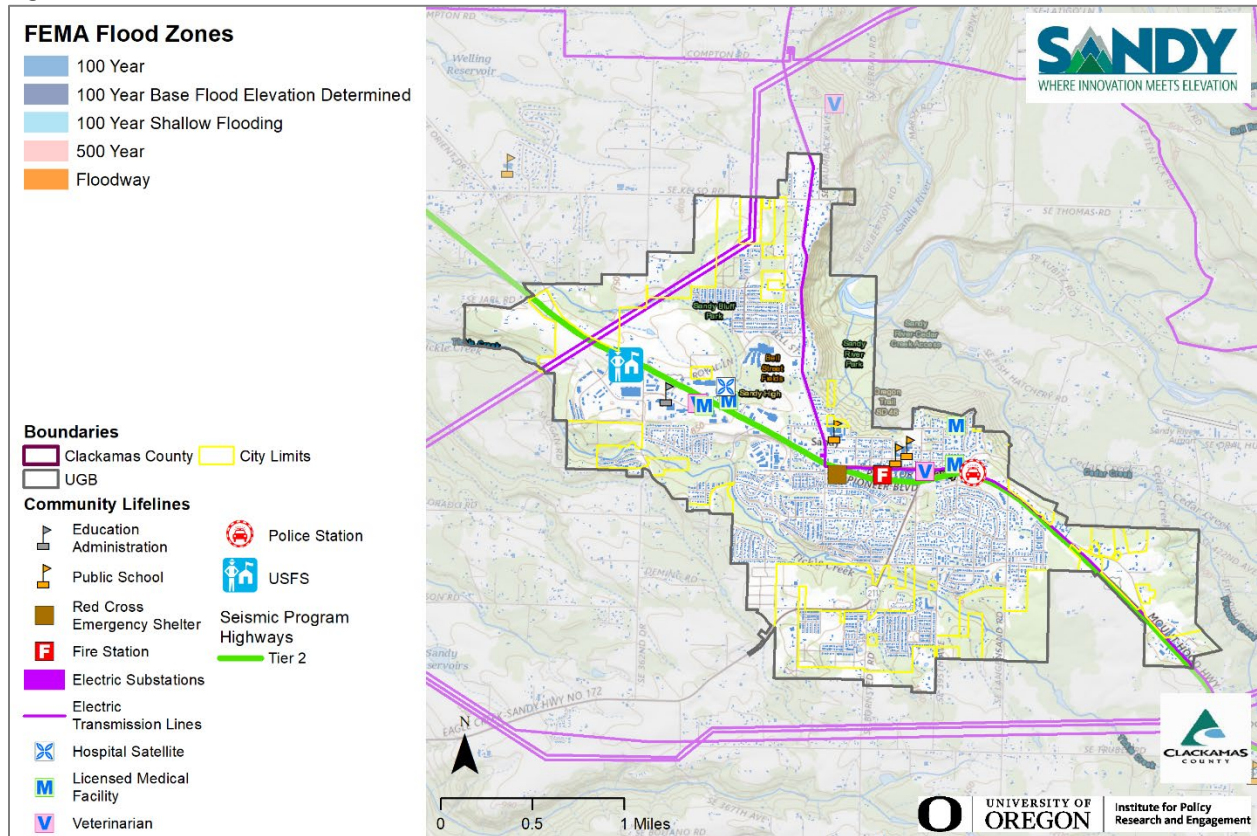
Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure SA-4 illustrates the flood hazard area for Sandy.

The main sources of flooding in Sandy are Tickle Creek, No Name Creek, and numerous drainage ways. Regionally, the Sandy River is a flooding source as well, but not for Sandy as the river is located at a much lower elevation than the city. The largest flooding event affecting Sandy was in January 2009. From January 1-2, 2009, a winter storm event led to flooding throughout many of the smaller tributaries and drainage ways. Some rural homeowners rerouted the culverts and drainage ways near their homes to protect their property, but this resulted in more damage and flooding to neighbors downstream.. Some rural residents outside Sandy depend on small bridges to access their homes. A few of these structures were washed out, damaging the bridges, and essentially cutting residents off from their homes. Two trailers were lost, and many homes had crawl space flooding.

¹² DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-33.

¹³ DOGAMI, *Lower Columbia-Sandy Watershed Natural Hazard Risk Report (2018)*, Table A-11.

Figure SA-4 FEMA Flood Zones



Vulnerability Assessment

The Oregon Department of Geology and Mineral Industries (DOGAMI) conducted a multi-hazard risk assessment (Risk Report) for the Lower Columbia-Sandy Watershed including the City of Sandy. The Risk Report provides a quantitative risk assessment for the flood (including channel migration) hazard along the Sandy River.

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

The only mapped floodplain hazard within city limits is in the area surrounding Tickle Creek, which bisects the southern side of the city. A few homes are located within this mapped floodplain (Figure SA-4). A steep bluff protects the northern areas of the city from the Sandy River. For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Sandy outside of the mapped floodplains, such as the majority of No Name Creek, may also be at relatively high risk from over bank flooding. Small creek tributaries and

drainageways area often not mapped by FEMA. It is also important to verify that culverts are not blocked and are approximately sized to accommodate rainfall increases during storm events.

The HMAC identified Sandy's wastewater treatment plant as a potential vulnerability in severe flooding situations. Portions of the road that lead to the plant are in the floodplain; as such, access to the sewage treatment plant could be isolated in a flooding event. Additionally, any transportation closures within the region will be difficult for Sandy's residents. The city is largely a bedroom community, and residents rely upon regional transportation routes for work.

Natural Hazard Risk Report for Clackamas County

The **Risk Reports** (DOGAMI, [2024](#) and [2020](#)) provide hazard analysis summary tables that identify populations and property within the Lower Columbia-Sandy River Watershed Study Area and countywide that are vulnerable to the flood and channel migration hazards.

Note: The differences between the two Risk Reports are due to the watershed based study area of O-20-06. This study was only for the Lower Columbia-Sandy watershed, which meant that communities along the edge of the watershed like Sandy, Troutdale, and Gresham were only partially included in the study. As such, the O-20-06 report under-represented the potential impacts to the City of Sandy from this hazard.

2024 DOGAMI Risk Report (2024)¹⁴

According to the 2024 Risk Report there is minimal risk to buildings and population within the city from the channel migration or flooding of the Sandy River. One (1) building could be damaged for a total potential loss of \$2,000 (a building loss ratio of less than 1%). About 6 residents may be displaced by flood (less than 1% of the population).

2020 DOGAMI Risk Report (O-20-06)¹⁵

According to the 2020 Risk Report there is minimal risk to buildings and population within the city from the channel migration or flooding of the Sandy River (note: The Risk Report did not assess flood risk from the Tickle Creek).

National Flood Insurance Program (NFIP)

FEMA's Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance, which was updated in 2019, and their floodplain management program. The last Community Assistance Visit (CAV) for Sandy was on April 28, 1994. Sandy does not participate in the Community Rating System (CRS). The Community Repetitive Loss record does not identify any Repetitive Loss Properties¹⁶ or Severe Repetitive Loss Properties¹⁷.

¹⁴ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-33.

¹⁵ DOGAMI, *Lower Columbia-Sandy Watershed Natural Hazard Risk Report (2018)*, Table A-11.

¹⁶ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

¹⁷ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁸ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the City’s probability for landslide is **high** and that their vulnerability to landslide is **moderate**. *The probability and vulnerability ratings increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Rural areas outside Sandy that have experienced landslides in the past include Ten Eyck Road, Barlow Trail, Laughing Water Road, Coalman Road, and Salmon River Road. In 1982, a landslide on Ten Eyck Road closed the road for 3-4 months. This was one of the biggest impacts that rural Sandy has experienced because of sliding activity. More recently landslides occurred on January 1 and 2, 2009. On the night of January 1st, a large mudslide to the east of city limits closed Highway 26 at milepost 35. At about 1:00am on January 2nd, an embankment above the Mount Hood Industrial Park east of Ruben Lane on the south side of Highway 26 gave way and destroyed a building. The slide also damaged a water line, a fiber optic cable and took out 9-1-1 service for part of the early morning.

Most of Sandy demonstrates a low to moderate landslide susceptibility exposure. Outside the city approximately 18% of the area has very high or high, and inside the city approximately 30% has a moderate, landslide susceptibility exposure.¹⁹

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table SA-4.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be

¹⁸ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

¹⁹ DOGAMI. [Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon](#) (2016)

smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

The property at 39641 Scenic St, Cedar Ridge Middle School, and the adjacent Verizon Wireless Tower, Advance Auto, and Pacific Pride Fuel are located above or below steep slopes. The local slump and earthflow hazards are located at the hill on Tupper Road between Sandy Heights Road and Strawbridge Parkway, and another hazard is on the slope between Nettie Connett Drive and the entrance to Hood Chalet Mobile Estates. The Hood Chalet Mobile Villa is located at the base of the hill and a slide in this area could devastate a large portion of the mobile home park. The mudflow and debris flow hazard is located on the slope near Dubarko Road, at Melissa Ave, and Solso Court.

Past landslide-incurred damages are proof that landslides can cause adverse effects upon residents, transportation systems, and local businesses. In the future, the HMAC expects that a slide could pollute the city water supply if sediment enters streams and rivers.

Sandy's residents are very dependent on Highway 26 for travelling to and from work, and Sandy's stores are similarly dependent on Highway 26 for inventory. If a large slide impacted this arterial Sandy could be cut off from neighboring communities.

There is evidence of earth movement affecting several multi-family dwellings on the west end of Park St. near Beers Ave. Some of the foundations show evidence of cracking and concrete buttresses have been built to support the foundation walls on the downhill side of these structures. In addition, the piping connecting a private sewage lift station serving these dwellings has been affected by movement of the surrounding soils and structures. It is unknown whether the soil instability is a result of earth movement or poor construction practices when these dwellings were built (ca. 1977). While this area has not been impacted in the past, it could be the location of a future landslide, especially because unstable soils could be subject to liquefaction in an earthquake event.

The raw water intake for the Alder Creek Water Treatment Plant is accessible only by foot or helicopter. A slide in the watershed above could bring trees and debris down the stream channel and plug the diversion intake. It would be difficult to bring equipment to the area within a reasonable amount of time because the intake is so remote.

Approximately 40 homes are located on the 'cliff' side of Bluff. A landslide could impact some or all of these dwellings. The water transmission line connecting Sandy to the Portland Water Bureau's system is also located in the northbound lane of Bluff Road. A mass earth movement affecting the roadway prism could damage the transmission main. Lastly, tourism surrounding Mount Hood has a great impact on Sandy's economy. If roads leading to Mt. Hood are altered by a landslide, tourism would be severely impaired. In addition to skiing, Sandy is home to a large mountain biking and hiking community. A landslide could block access to these activities or create an unsightly environment and reduce tourism in the area.

Natural Hazard Risk Report for Clackamas County

The **Risk Reports (DOGAMI, [2024](#) and [2020](#))** provide hazard analysis summary tables that identify populations and property within the Lower Columbia-Sandy River Watershed Study Area and countywide that are vulnerable to the landslide hazard.

Note: The differences between the two Risk Reports are due to the watershed based study area of O-20-06. This study was only for the Lower Columbia-Sandy watershed, which meant that communities along the edge of the watershed like Sandy, Troutdale, and Gresham were only partially included in the study. As such, the O-20-06 report under-represented the potential impacts to the City of Sandy from this hazard.

2024 DOGAMI Risk Report (2024)²⁰

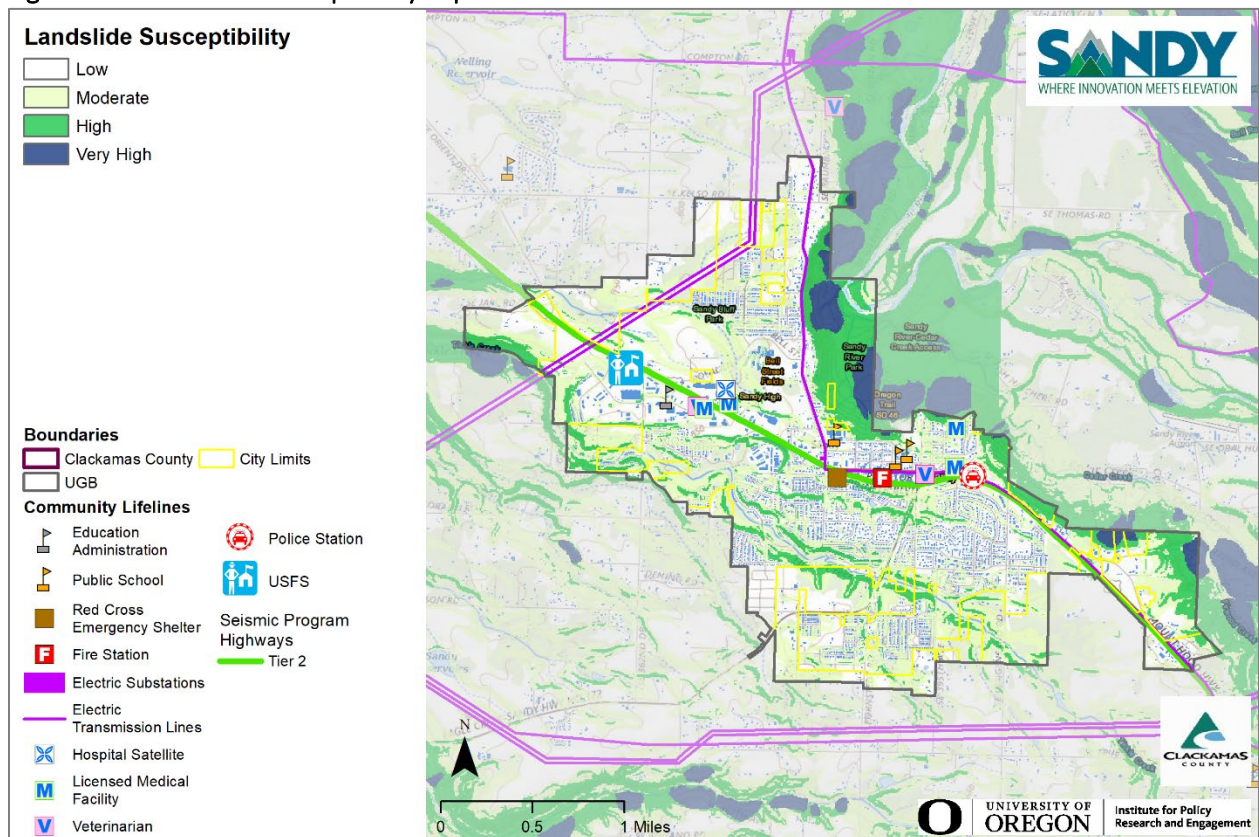
According to the most recent Risk Report, 127 buildings (no critical facilities) are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of \$41.4 million (a building exposure ratio of less than 3%). About 492 residents may be displaced by landslides (about 4% of the population).

2020 DOGAMI Risk Report (O-20-06)²¹

Landslide event (High and Very High Susceptibility): 18 buildings are exposed (0 critical facilities) for a total potential loss of \$4,488,000 (an exposure ratio of 2%). In addition, 53 residents may be displaced (about 5% of the population).

Note: the exposure number is for all buildings and population exposed to the high and very high landslide susceptibility areas.

Figure SA-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

²⁰ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-33.

²¹ DOGAMI, *Lower Columbia-Sandy Watershed Natural Hazard Risk Report (2018)*, Table A-11.

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **moderate** and that their vulnerability is **moderate**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of Sandy has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events. resulting from hazards.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"²² the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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

²² Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

of about 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City’s probability for windstorm is **moderate** and that their vulnerability to windstorm is **moderate**. *The probability rating decreased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Sandy.

In September of 2022, a combination of dry conditions, windstorm and heat were the perfect blend to trigger a significant wildfire event from downed powerlines. PGE activated a Public Safety Power Alert (PSPS) in designated high fire risk zones, of which Sandy and the Mt Hood corridor were the first pre-emptive de-energization. The PSPS lasted from 2:20 am September 9, 2022, until Sunday evening September 11, 2022 once the windstorm had passed, and PGE line crews had confirmed or repaired no downed powerlines. Our prediction is that late summer and fall wind events will continue to cause PSPS on a routine basis. Power shutoff not only affects heat and cooling for dwellings, but electrical power that supplies the water and wastewater utility as well as traffic lights for safe passage.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris.

Additionally, transportation, and economic disruptions result as well. Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog storm drainage grates, which in turn may cause localized urban flooding. Most electrical telephone and CATV utilities serving Sandy are still above ground and vulnerable to falling tree branches and debris. For example, the Alder Creek Water Treatment Plant suffers from power interruptions during wind events. The water plant is equipped with a standby generator to reduce the impact of power outages; however, procuring diesel or gasoline fuel for water and wastewater treatment as well as pump station generators could be difficult in an extended power outage/wind event.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the City’s probability for winter storm is **moderate** and that their vulnerability to winter storm is **moderate**. *The probability rating decreased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

The biggest impact of winter storms is congestion on roadways. Highway 26 bisects Sandy and is used as the main route to the Mount Hood region for residents of the Portland Metro area.

Although most winter storms typically do not cause significant damage, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter, and commercial traffic as noted above.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²³ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Vulnerability Assessment

Due to insufficient data and resources, Sandy is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets Section and Table SA-4.

Volcanic Event

The HMAC determined that the City’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of volcanic hazards, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the western portion of the County is likely to affect Sandy as well. Volcanoes are located near Sandy, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

²³ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Vulnerability Assessment

Due to Sandy's location near the Sandy River and proximity to Mount Hood, the city is likely to experience some of the immediate effects that eruptions have on surrounding areas. It is estimated that Sandy will have two hours before a lahar following the course of the Sandy River reaches the city (Figure SA-6 and Figure SA-7), allowing time for individuals to evacuate if needed. A lahar following the Sandy River is likely to severely damage the conduit connecting the Bull Run water source to Sandy, which provides approximately one fourth of the City's total water supply. An eruption also has the potential to severely impact Sandy's Alder Creek water source, which provides the majority of the City's total water supply.

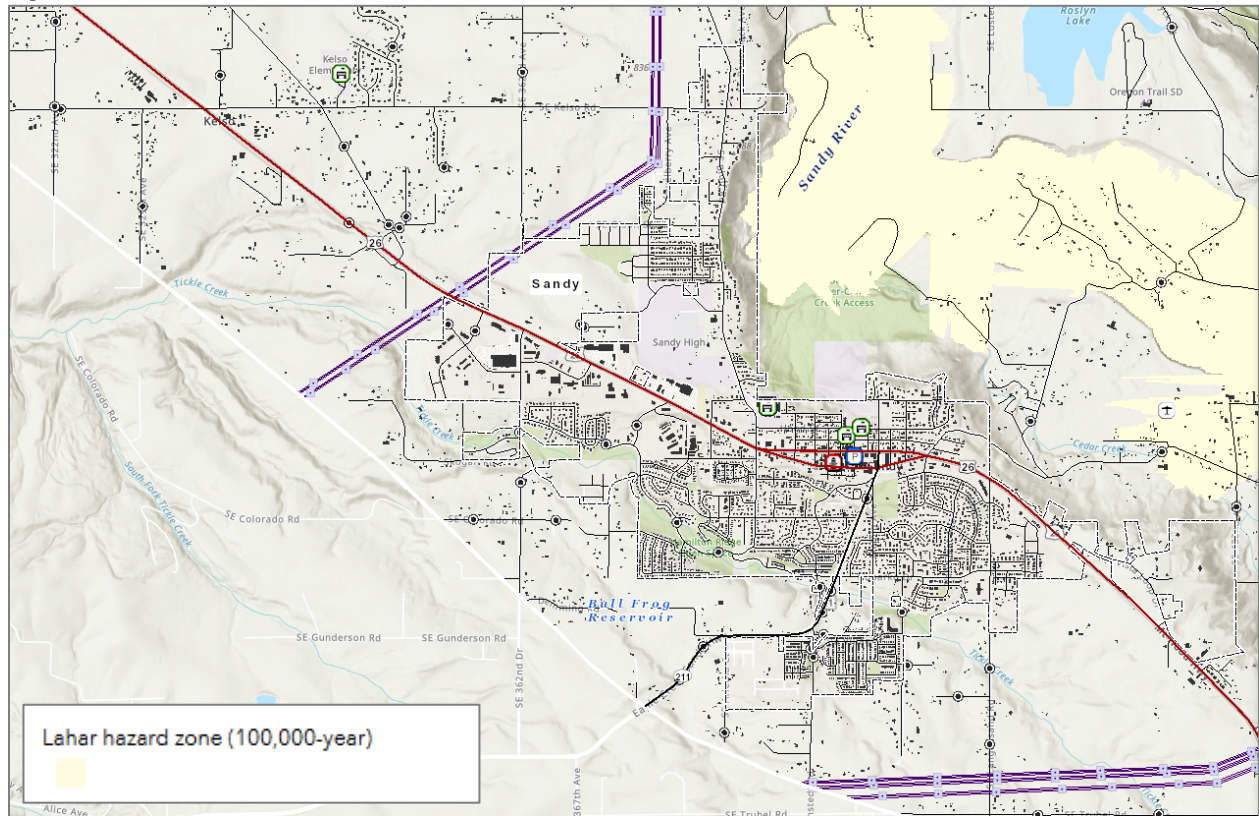
Figure SA-6 Mount Hood Hazards Map



Source: USGS Mount Hood – History and Hazards of Oregon's Most Recently Active Volcano.

A steep bluff shields the city from the Sandy River so a lahar should not affect assets within city limits. Additionally, depending on wind patterns and which volcano erupts, the city may experience ashfall (tephra). The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash.

Figure SA-7 Lahar Hazard Zone and Critical Facilities



Source: [Mount Hood Hazards and Assets Viewer \(DOGAMI\)](#)

Natural Hazard Risk Report for Clackamas County

The Risk Reports (DOGAMI, [2024](#) and [2020](#)) provide hazard analysis summary tables that identify populations and property within the Lower Columbia-Sandy River Watershed Study Area and countywide that are vulnerable to the landslide hazard.

Note: The differences between the two Risk Reports are due to the watershed based study area of O-20-06. This study was only for the Lower Columbia-Sandy watershed, which meant that communities along the edge of the watershed like Sandy, Troutdale, and Gresham were only partially included in the study. As such, the O-20-06 report under-represented the potential impacts to the City of Sandy from this hazard.

2024 DOGAMI Risk Report (2024)²⁴

According to the Risk Reports there is no to minimal risk to buildings and population within the city from the medium (1% annual chance) lahar volcanic event.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

²⁴ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-33.

Wildfire

The HMAC determined that the City's probability for wildfire is **high**, and that their vulnerability to wildfire is **high**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan \(CWPP\)](#) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Sandy is found in the following chapter: Chapter 9.11: Sandy Fire District (note Clackamas Fire District #1 provides services for the fire district).

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather and urbanization conditions are primarily at cause for the hazard level. Sandy has not experienced a wildfire within City limits, but the city has abundant forested areas within and adjacent to the city limits that are a concern in the case of a wildfire event. Figure SA-8 shows overall wildfire risk in Sandy.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Sandy, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County. In eastern Clackamas County, the most common human induced wildfire source is debris burn escape.

The wildfire events experienced in the area in 2020 demonstrate the level of risk of wildfire. The City of Sandy proper experienced a level II evacuation notice during this event and a portion of the city's residents were part of the Public Safety Power Shutoff (PSPS) that is administered by Portland General Electric (PGE). The city's Police Department and other personnel were tasked with providing 24-hour public updates during the event via social media etc. Air quality in and around the area was of great concern during the event.

According to the Clackamas County Community Wildfire Protection Plan (CWPP), local forest lands have accumulated an unnatural buildup of fuel (undergrowth, brush, etc.) because of decades of timber harvest and aggressive fire suppression. Additionally, residential development near the wildland urban interface has increased the community's overall exposure to wildfire hazards. Some developments within the city have only one road in and one road out, and some areas of Sandy do not have evacuation plans. The potential for loss of life is great because of this accessibility issue. Communities at Risk (CARs) within the City include: Bluff Road (northeast). Rural areas outside the City at risk include Cedar Creek (southeast).²⁵

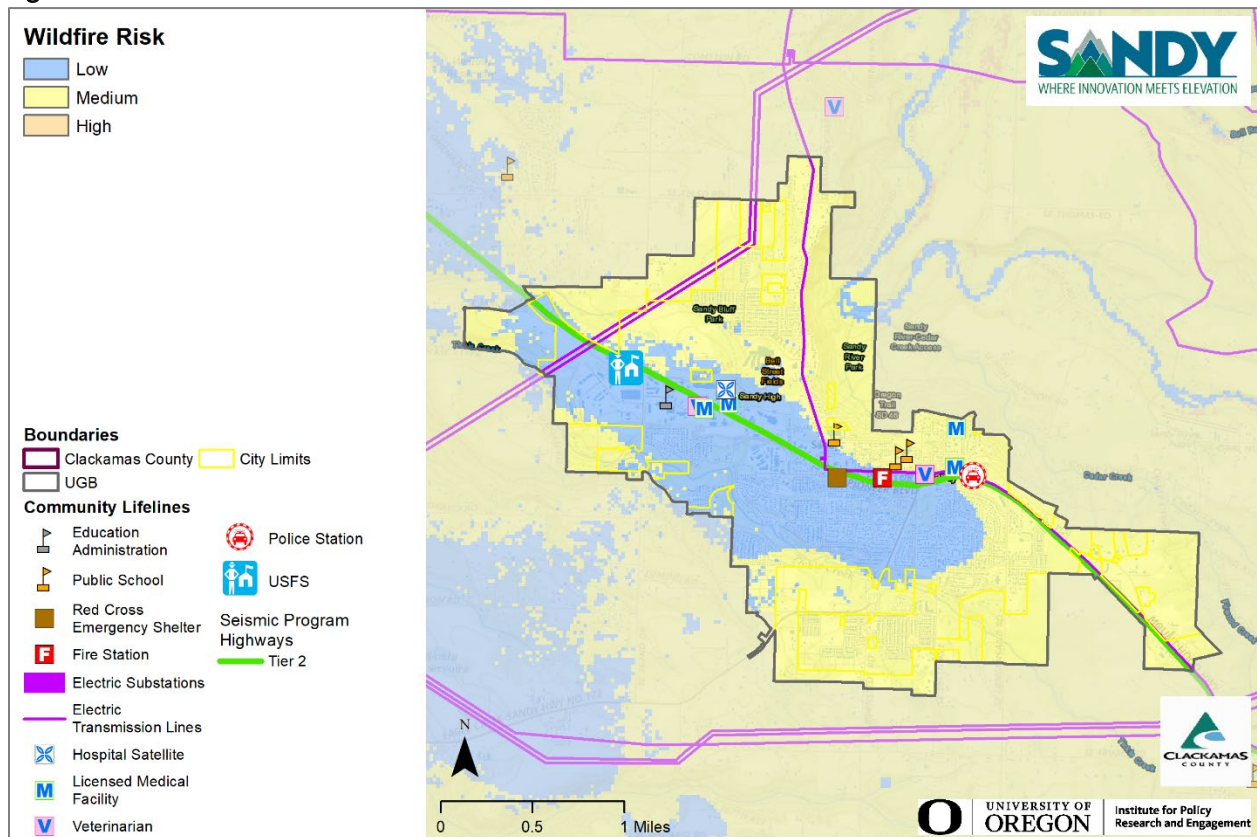
The Bluff Road area is also threatened by the potential of wildfire along the steep bluff above the Sandy River, and the difficulty of accessing this area with firefighting apparatus due to the extremely steep

²⁵ Clackamas County Community Wildfire Protection Plan, *Sandy Rural Fire Protection District* (2018), Table 10.11-1.

terrain. Additional future analysis may support the efficacy of road improvements in the area to facilitate emergency vehicle access down to the river.

Fortunately, areas within the City are served by the water supply system and a network of fire hydrants that can more efficiently provide access to firefighting water sources than the rural areas surrounding Sandy. Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four feet under normal weather conditions.²⁶ However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Figure SA-8 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Vulnerability Assessment

Due to insufficient data and resources, Sandy is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table SA-4.

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. Sandy’s fire response is addressed within the CWPP which assesses wildfire

²⁶ Oregon Wildfire Risk Explorer

risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City and the Sandy Fire District will update the City's wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Natural Hazard Risk Report for Clackamas County

The Risk Reports (DOGAMI, [2024](#) and [2020](#)) provide hazard analysis summary tables that identify populations and property within the Lower Columbia-Sandy River Watershed Study Area and countywide that are vulnerable to the wildfire hazard.

Note: The differences between the two Risk Reports are due to the watershed based study area of O-20-06. This study was only for the Lower Columbia-Sandy watershed, which meant that communities along the edge of the watershed like Sandy, Troutdale, and Gresham were only partially included in the study. As such, the O-20-06 report under-represented the potential impacts to the City of Sandy from this hazard.

2024 DOGAMI Risk Report (2024)²⁷

According to the most recent Risk Report, 404 buildings (no critical facilities) are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of \$118.1 million (a building exposure ratio of about 8%). About 1,386 residents may be displaced by wildfires (about 11% of the population).

2020 DOGAMI Risk Report (O-20-06)²⁸

Wildfire event (High Risk): 2 buildings are exposed (0 critical facilities) for a total potential loss of \$535,000 (an exposure ratio of < 1%). In addition, 4 residents may be displaced (< 1% of the population).

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²⁹ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

²⁷ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-33.

²⁸ DOGAMI, *Lower Columbia-Sandy Watershed Natural Hazard Risk Report* (2018), Table A-11.

²⁹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table SA-7 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table SA-1).

Previous NHMP Actions that are Complete:

Flood #2, “Explore participation in the NFIP’s Community Rating System (CRS).” Complete. The city explored CRS and determined it to not be feasible at this time. The City will consider it as an option in the future.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

Earthquake #2, “Seismically retrofit (structural and non-structural) the Sandy Community Center to exceed life safety standards in order to operate as a possible shelter.” No longer relevant, considered redundant with Action #9 which is included with this update.

Earthquake #3, “Seismically retrofit (structural and non-structural) City Hall in order to continue operations post-earthquake and to protect city and county IT infrastructure (servers).” No longer relevant, considered redundant with Action #9 which is included with this update.

Landslide #2, “Reduce the vulnerability of property owners in landslide-prone areas” No longer relevant. Existing policies are considered adequate for the risk to population.

Table SA-7 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Multi-Hazard #2	#2	Not Complete	Yes
Multi-Hazard #3	#3	Not Complete	Yes
Multi-Hazard #4	#4	Not Complete	Yes
-	#5	New	-
-	#6	New	-
-	#7	New	-
-	#8	New	-
Earthquake #1	#9	Not Complete	Yes
Earthquake #2	-	Not Complete	No
Earthquake #3	-	Not Complete	No

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Flood #1	#10	Not Complete	Yes
Flood #2	-	Complete	No
-	#11	New	-
-	#12	New	-
Flood #3	#13	Not Complete	Yes
Landslide #1	#14	Not Complete	Yes
Landslide #2	-	Not Complete	No
Severe Weather #1	#15	Not Complete	Yes
Wildfire #1	#16	Not Complete, revised	Yes

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from February 2 through March 31 on the City's website. The plan was also posted and announced on the County's website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting

ADMINISTRATION

City Manager's Office
City Recorder's Office +
Legal Department
Administrative Policies +
Economic Development Division
Homelessness
Social Services Task Force +
Customer Feedback Form
Public Meeting Information / Archive
Heat Index / Air Quality
The Sandy Source Newsletter
Community Campus Site Preparation

Natural Hazard Mitigation Plan - 2024


The City of Sandy is in the process of updating our existing Natural Hazards Mitigation Plan (NHMP). This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management (OEM) utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program. With re-adoption of the plan, the City will maintain its eligibility to apply for federal funding towards natural hazard mitigation projects. This local planning process includes a wide range of representatives from city, special districts, and county government, emergency management personnel, and outreach to members of the public.

A natural hazards mitigation plan provides communities with a set of goals, action items, and resources designed to reduce risk from future natural disaster events. Engaging in mitigation activities provides jurisdictions with a number of 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.

An electronic version of the updated draft City of Sandy NHMP Addendum is available for formal public comment. To view the draft, please click the file at the bottom of this page.

If you have any questions regarding the City of Sandy NHMP Addendum or the update process in general, please contact: Jeff Aprati, Deputy City Manager, at 503-489-0938 or japrati@ci.sandy.or.us; or Michael Howard, Director for the Oregon Partnership for Disaster Resilience at (541) 346-8413 or mrhoward@uoregon.edu.

SUPPORTING DOCUMENTS

 City of Sandy NHMP Addendum - 2024 (4 MB)

CONTACT INFORMATION

Sandy City Hall
39250 Pioneer Blvd.
Sandy, OR 97055
(503) 668-5533

[View Full Contact Details](#)

LATEST NEWS

[Natural Hazard Mitigation Plan - 2024](#)
Posted On Fri, 02/02/2024

[Hoodview Disposal Service Delays](#)
Posted On Tue, 01/16/2024

[PGE Outage Information](#)
Posted On Sun, 01/14/2024

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City of Sandy, Oregon – City Government

2d · 🌐

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City of Sandy Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



CI.SANDY.OR.US

Natural Hazard Mitigation Plan - 2024

An electronic version of the updated draft City of Sandy NHMP Addendum is available for for...

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following dates:

Meeting #1 and #2: March 8 and May 22, 2023

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #3: November 15, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

City of West Linn Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: Gary Halvorson, Oregon State Archives

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The City of West Linn

Updated:
August 5, 2024, (Resolution # 2024-07)
July 8, 2019
July 15, 2013
2009

This Natural Hazard Mitigation Plan was prepared by:



Planning grant funding provided by:



Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

RESOLUTION 2024-07

A RESOLUTION ADOPTING THE CITY OF WEST LINN ADDENDUM IN THE UPDATES TO THE CLACKAMAS COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

WHEREAS, the City of West Linn recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, the City of West Linn has fully participated in the FEMA prescribed mitigation planning process to prepare the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

WHEREAS, the City of West Linn has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the City of West Linn to the impacts of future disasters within the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*; and

WHEREAS, these proposed projects and programs have been incorporated into the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, May 29, 2024) contingent upon this official adoption of the participating governments and entities;

WHEREAS, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

WHEREAS, the NHMP is in an on-going cycle of development and revision to improve it's effectiveness; and

WHEREAS, City of West Linn adopts the NHMP and directs the City Manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

NOW, THEREFORE, THE CITY OF WEST LINN RESOLVES AS FOLLOWS:

SECTION 1. The City of West Linn adopts *the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan; and


SECTION 2. The City of West Linn will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

This resolution was PASSED and ADOPTED this 5th day of August, 2024, and takes effect upon passage.



RORY BIALOSTOSKY, MAYOR

ATTEST:



KATHY MOLLUSKY, CITY RECORDER

APPROVED AS TO FORM:



CITY ATTORNEY

Purpose

This is an update of the West Linn addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to West Linn’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

West Linn adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on August 5, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and West Linn to update their NHMP.

The Clackamas County NHMP, and West Linn addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The West Linn HMAC guided the process of developing the NHMP.

Convener

The West Linn Emergency Manager serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of West Linn HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The West Linn HMAC was comprised of the following representatives:

- Dylan Digby, Assistant to the City Manager/Emergency Manager
- Erich Lais, Assistant City Engineer/Interim Director of Public Works
- Darren Wyss, Planning Manager
- Megan Big John, Parks and Recreation Director

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the West Linn addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the West Linn NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, West Linn will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of West Linn to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, water system master plan, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

West Linn last updated their [Comprehensive Plan](#) in 2016. This plan includes background and analytic sections that support recommendations for, among other things, sustainable economic activity, housing, recreation and open space, transportation, land use livability, and preventing degradation of quality of life in and for West Linn. The Comprehensive Plan provides the basis for other plans, ordinances, and other implementing documents that set forth more detailed direction regarding specific activities and requirements.

Chapter 7 of the Comprehensive Plan addresses with Statewide Planning Goal 7, Natural Hazards. This Chapter incorporates known hazard information from before 2002, focusing on landslides, soil erosion, earthquake damage, and flooding. The goal of its Natural Hazard policies and recommended actions is to

protect life and property from flood, earthquake, other geological hazards, and terrorist threats or attacks.¹

Planned updates to the jurisdiction’s Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community’s long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

Title 3 of the Metro Urban Growth Management Functional Plan

This policy requires the city to balance any fill in the floodplain with a corresponding cut that excavates an equal amount of material. In addition, Title 3 requires the city to regulate the area of inundation from the 1996 flood in addition to the area with a 1% chance of flooding as identified on National Flood Insurance Program (NFIP) maps.

Community Development Code

This Code is designed to set forth the standards and procedures governing the development and use of land in West Linn and to implement the West Linn Comprehensive Plan. It was last amended in September 2023.

Chapter 27 Flood Management Areas

This chapter applies to all flood management areas (equal to Special Flood Hazard Areas) within the jurisdiction of West Linn. This code is based upon the 2021 Oregon Model Flood Hazard Ordinance, and was adopted in February 2022.

The regulatory special flood hazard areas (SFHA) for West Linn are identified in the “Flood Insurance Study: Clackamas County, Oregon and Incorporated Areas,” dated 06/2008 and revised 01/2019, FIRM Panels 41005C0018D, 41005C0019D, 41005C0038D, 41005C0257D, 41005C0259D, 41005C0260D, and 41005C0276D.

Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage and higher regulatory standards than required by state or federal regulations, including requirements for critical facilities to be located outside of the SFHA. If no alternative site is available, critical facilities must be elevated three feet or to the height of the 500-year flood, whichever is higher.

Chapter 28 Willamette and Tualatin River Protection

This chapter protects water quality and the scenic integrity of the river corridors on either side of West Linn. Standards within this chapter help protect against bank erosion and flooding.

Chapter 32 Water Resource Area Protection

This chapter complies with Title 13 and Title 3 of Metro’s Urban Growth Management Functional Plan, protecting water quality by moderating storm water impacts and preventing erosion and excessive sedimentation into water bodies. It includes standards that minimize construction of structures and improvements where they are at risk of flooding. This chapter was adopted in 2014.

¹ City of West Linn Comprehensive Plan, 2016.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

The West Linn Community Development Department administers and enforces the 2022 Oregon Fire Code, the 2022 Oregon Structural Specialty Code, Mechanical Specialty Code, Plumbing Specialty Code, Electrical Specialty Code, and Residential Specialty Code. Tualatin Valley Fire & Rescue also participates in plan review for development projects. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

Public Works

The City of West Linn Public Works Department is composed of the divisions responsible for environmental services (storm and sanitary sewer), water, streets, and engineering. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

City Administration

The City Council of West Linn has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Policies and Programs

This Plan directs West Linn and Clackamas County to explore integration into other planning documents and processes. West Linn has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

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Sanitary Sewer Master Plan 2019

The Sanitary Sewer Master Plan was adopted in 2019 to address the sanitary sewer system needs over the next 20 years. It includes capital improvement and capital maintenance plans for the sanitary sewer system.

Storm Drainage Master Plan 2019

The Storm Drainage Master Plan guides the City's efforts to manage storm water runoff, reduce storm water pollution, and protect/enhance natural habitat areas affected by the drainage system. It acts as the master plan for the city's National Pollutant Discharge Elimination System (NPDES) program and for Total Maximum Daily Load (TMDL) compliance. Recommendations in this plan led to the update of the City's floodplain management regulations, updated erosion control standards, etc. Capital projects identified include culvert replacements at key locations (5th Avenue, Sunset Creek, Maddox Creek), and road improvements to address roadway flooding (Blankenship Road, Mark Lane, Buck Street, Sunset Avenue).

TMDL Implementation Plan

The City maintains a Total Maximum Daily Load (TMDL) Plan (updated in September 2022). The Total Maximum Daily Load (TMDL) program is intended to comply with the Tualatin River Subbasin and Willamette River Basins TMDL order and to address the Revised Willamette Basin Mercury TMDL (effective February 2021). Tributaries within the City limits do not currently meet state water quality standards for several parameters, including bacteria, mercury, chlorophyll a and pH (total phosphorus as a surrogate measure), dissolved oxygen (ammonia and total suspended solids [TSS] as surrogate measures), and temperature. The NHMP actions are incorporated into this document as appropriate. Example projects include riparian planting and revegetation, erosion control education and enforcement, design standards for new and redevelopment, and public outreach.

Water Master Plan 2024

The current Water Master Plan dates to 2008. The update of the Water Master Plan is underway and is expected to be complete in 2024.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The CWPP will also be integrated into the City's Capital Improvement Plan (2024-2029 CIP approved June 2023).

Tree City USA

This distinction means West Linn has an active tree care ordinance and public education pieces, among others, which help to maintain a healthy urban forest. Most utilities are underground, and all new utilities are required to be undergrounded, but in case of power outages the city's critical facilities have back up power generation.

National Flood Insurance Program

West Linn participates in the National Flood Insurance Program. The Planning Division is responsible for administering the day-to-day activities of the city's floodplain program.

Specifically, the floodplain manager:

- maintains and administers West Linn's floodplain regulations;
- reviews and issues floodplain development permits;
- maintains elevation certificates for all new and substantially improved structures (and maintains an extensive database of historic elevation certificates);
- ensures that encroachments do not occur within the regulated floodway;
- implements measures to ensure that new and substantially improved structures are protected from flood losses;
- maintains floodplain studies and maps and makes this information available to the public;
- maintains a flood information website with digital flood insurance rate map (DFIRM) data;
- conducts site visits to assess conditions and provide technical assistance to the public;
- maintains a library of historical flood related information;
- informs the public of flood insurance requirements; and
- conducts outreach and training about flood hazards and development within the floodplain.

Other program successes include:

- Compliance with SB 13, enacted in 2001, requiring local governments to develop seismic preparation procedures, inform their employees about the procedures, and conduct earthquake drills.

- Adoption of a policy to require undergrounding of power lines in new subdivisions.
- Development Code restrictions regarding construction on steep slopes.
- Adoption of Emergency Operations Plan (2017 update)

Personnel

The following West Linn personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Dylan Digby, Assistant to City Manager

Public Information Officer: Danielle Choi, Community Relations Coordinator

Floodplain Manager: Darren Wyss, Planning Manager

Capital improvement planning: Erich Lais, Public Works Director

Capital improvement execution: Erich Lais, Public Works Director

West Linn does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

West Linn has implemented recommendations from the last NHMP into its capital improvement projects.

Mitigation activities completed by the City of West Linn include:

- The Police Station was built on a new site (1800 8th Avenue) in 2014 via a 2011 voter approved bond.²
- Seismic strengthening of supports for the West Linn primary water transmission line (24-inch) attached to the underside of the I-205 (Abernethy) Bridge over the Willamette River between West Linn and Oregon City, as part of a general seismic upgrade of the bridge by the Oregon Department of Transportation, 2001-02
- In 2006 a \$77.5 million bond measure (34-133) was passed by southeast Portland metro-area voters to correct seismic safety deficiencies at Tualatin Valley Fire and Rescue Fire by rebuilding [Station 58](#) (Bolton) and [Station 59](#) (Willamette).³
- In 2018, TVF&R completed construction on [Station 55](#) (Rosemont). In 2011, a local school district capital bond was approved to structurally reinforce Bolton Primary, Cedaroak Park Primary, and Stafford Primary schools. The historic Sunset Primary school was demolished⁴ and replaced in September 2017 with a new school per a 2014 school district capital bond.⁵

² Malee, Patrick. Portland Tribune (August 7, 2014). "After three years, police station set for grand opening." <https://pamplinmedia.com/wlt/95-news/229497-92676-after-three-years-police-station-set-for-grand-opening-> (Accessed December 7, 2018)

³ Tualatin Valley Fire & Rescue, "General Obligation Bond". <https://www.tvfr.com/100/General-Obligation-Bond> (Accessed December 5, 2018)

⁴ Kilstrom, Andrew. WestLinnTidings (June 29, 2017) "Sunset: 127 years and counting". <https://pamplinmedia.com/wlt/95-news/364495-244263-sunset-127-years-and-counting> (Accessed December 6, 2018)

⁵ West Linn-Wilsonville School District. "2014 Capital Bond Program". <https://www.wlww.k12.or.us/Bond> (Accessed December 6, 2018)

- Bolton Reservoir (Primary) was seismically upgraded and enlarged to 4 million gallons (2017).
- Robinwood Station Community Center has been seismically renovated (2023).

West Linn has taken mitigation steps to reduce the city's vulnerability in earthquake events.

- Abernethy Bridge is currently under construction with significant seismic resilience.

Ongoing projects that enhance the City's resilience include:

- Construction of new centrally located Public Works and Parks Operations and Maintenance Facility (with emergency generator)
- Replacement and seismic upgrades to the City's water transmission main on the I-205 Abernethy Bridge.
- Upgrades to the City's water telemetry system
- Water Master Plan Update (underway)
- Upgrading of Calaroga sanitary sewer pump station
- Athey Creek Middle School (new)

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)⁶.

FEMA Funded Mitigation Successes

- None identified.

Seismic Rehabilitation Grant Program Mitigation Successes

- None identified.

Other Mitigation Successes

- Police Station (new, 1800 8th Avenue)
- Bolton Reservoir seismic improvements
- Seismic strengthening of water transmission line under I-205
- Replacement of Sunset Primary School
- Athey Creek Middle School

Capital Resources

West Linn maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Critical facilities with power generators for use during emergency blackouts: Police Station, City Hall, Operations Facility, and Library

Food pantries: West Linn Food Pantry (1683 Willamette Falls Drive)

⁶ The Seismic Rehabilitation Grant Program (SRGP) 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.

Fueling storage: Generator locations have some fuel storage. Operations facility has a fuel storage tanks for vehicles and equipment.

Findings

Several important findings from this capability assessment informed the design of the Plan’s mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

West Linn staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

West Linn operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City’s ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community’s environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions, and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The City's mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAC assessed the City's risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table WL-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAC decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table WL-1 Action Items

		Impacted Hazard										Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost	
1	Reduce threat to critical and essential public facilities.	X	X	X	X	X	X	X	X	X	Parks and Recreation/ Public Works, Engineering	Ongoing	Local Resources, DLCDD TA, FEMA HMA	Low to High	
2	Enhance recognition of hazards, and appropriate mitigation and response activities through public education. Identify, improve, and sustain public and private partnerships and collaborations focused on natural hazard mitigation and risk reduction.	X	X	X	X	X	X	X	X	X	Administration/ Public Works, Parks and Recreation, Building, Planning	Ongoing	Local Resources, FEMA HMA	Low	
3	Maintain a public awareness campaign regarding severe weather mitigation measures and the importance of personal safety.			X					X	X	Administration/ Public Works, Parks and Recreation, Building, Planning	Ongoing	Local Resources, FEMA HMA	Low	
4	Integrate the goals and action items from the Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	Planning/ Public Works, Building, City Council	Ongoing	Local, State, Federal Grants and BRIC	Low	
5	Conduct seismic evaluations on identified critical and essential facilities and infrastructure and implement appropriate structural and non-structural mitigation strategies. (e.g., reservoirs) – Bolton complete since previous NHMP.		X								Public Working – Engineering/ Planning	Long	Local, State and Federal Grants and BRIC	High	

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		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost	
6	Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.				X						Planning/ GIS, Public Works	Ongoing	Local Resources. DLCDC TA, FEMA HMA (FMA)	Low	
7	Implement Surface Water Master Plan (storm water) capital improvement projects that can reduce flood threats.				X						Public Works/ Planning	Ongoing	Local Resources. DLCDC TA, FEMA HMA (FMA)	Low to High	
8	Address vulnerabilities of sewer pump stations to potential flood events.				X						Public Works/ Planning	Ongoing	Local Resources. DLCDC TA, FEMA HMA (FMA)	Medium	
9	Acquire flood-prone and repetitive loss properties and preserve as open space (e.g., property at Cedar Oak around stream and natural resource area).				X						Planning/ Public Works, GIS	Long	Local Resources. DLCDC TA, FEMA HMA (FMA)	High	
10	Reduce risk of erosion and soil destabilization by implementing the strategies outlined in the Surface Water Management Plan.				X	X				X	Public Works/ Planning	Ongoing	Local, State, Federal Grants and BRIC	Medium	
11	Maintain a tree hazard program for preventing future hazards, while improving long-term health and care of urban forest.								X	X	X	Parks and Recreation/ Planning, Building, Public Works	Ongoing	Local Resources, FEMA HMA (FMA)	Low

Table WL-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
12	Promote and support wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.							X			TVF&R/ Public Works, Parks and Recreation, Building, Planning	Ongoing	Local Resources, FEMA HMA, CWDG	Low to High
13	Encourage private landowners to create and maintain defensible space around homes and other buildings and make home hardening improvements							X			TVF&R/ Public Works, Parks and Recreation, Building, Planning	Ongoing	Local Resources, FEMA HMA, CWDG	Low to High
14	Underground utilities near critical/essential facilities and other vulnerable areas.							X	X	X	Public Works, Parks and Recreation, Building, Planning	Ongoing	Local Resources, FEMA HMA	High

Source: West Linn NHMP HMA, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

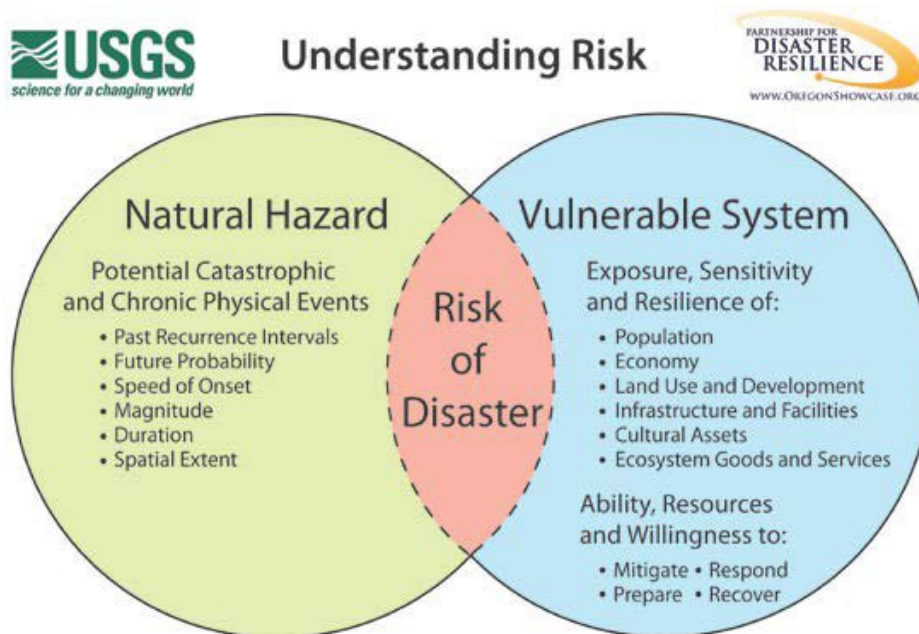
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure WL-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure WL-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The West Linn HMAAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to West Linn, which are discussed throughout this addendum. Table WL-2 shows the HVA matrix for West Linn listing each hazard in order of rank from high to low. For local governments, conducting the hazard

analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. One chronic hazard (winter storm) and two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) rank as the top hazard threats to the City (Top Tier). Landslide, extreme heat event, flood, and wildfire comprise the next highest ranked hazards (Middle Tier), while drought, windstorm, and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table WL-2 Hazard Analysis Matrix – West Linn

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Winter Storm	12	40	70	63	185	1	<i>Top Tier</i>
Earthquake - Cascadia	2	45	100	35	182	2	
Earthquake - Crustal	6	50	100	21	177	3	
Landslide	14	30	60	63	167	4	<i>Middle Tier</i>
Extreme Heat Event	10	35	70	35	150	5	
Flood	16	25	50	56	147	6	
Wildfire	16	20	50	49	135	8	
Drought	10	15	50	56	131	7	<i>Bottom Tier</i>
Windstorm	14	15	50	42	121	9	
Volcanic Event	2	25	50	7	84	10	

Source: West Linn HMAc, 2023.

Community Characteristics

Table WI-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

West Linn has grown substantially since its incorporation in 1913 and has an area today of 7.43 square miles. The city is on Interstate 205 and within the southern bounds of the Portland metropolitan area (about 12 miles south of the City of Portland) and is bordered on the east by the Willamette River, and to the southwest by the Tualatin River, on the north by the City of Lake Oswego, and to the west by unincorporated Clackamas County. The City is within the Willamette River watershed.

Because of its location West Linn's climate is consistent with the Marine west coast climate zone, with warm summers and cool, wet winters. West Linn receives most of its rainfall between October and May, and averages 44 inches of rain, and less than one (1) inch of snow, per year.⁷

The easterly and southerly areas of the City that border the Willamette and Tualatin rivers are low-lying - 55 to 60 feet above sea level at Willamette Falls - while the central and northwesterly sections of the City contain a ridge that rises to as high as 650 feet above sea level.

Population, Housing, and Income

West Linn has grown substantially since its incorporation in 1913 and has an area today of 2.26 square miles. It is in the south-central region of Clackamas County, located approximately 29 miles southeast of the City of Portland. The City is within the West Linn River watershed, with the West Linn River about a mile east of the UGB.⁸

Between 2016 and 2021 the City grew by 1,805 people (7%; as of 2022 the population is 27,420). Between 2022 and 2045 the population is forecast to decline by 2% to 26,990. (This decline is based upon two years of negative growth following the COVID-19 pandemic and is likely to reverse over the upcoming years.)

Most of the population is White/Caucasian (82%) and about 18% of the population is Hispanic or Latino. The poverty rate is 5% (3% of children under 18, 6% for people 65 and older), 3% do not have health insurance, and 63% of renters pay more than 30% of their household income on rent (35% for owners). About 63% of the population has a bachelor's degree or higher (less than 3% do not have a high school degree). Approximately 9% of the population lives with a disability (22% of population 65 and older), and 45% are either below 15 (25%) or over 65 (20%) years of age. About 8% of the population are 65 or older and living alone and 6% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 87% of housing units are single-family, 13% are multifamily, and less than 1% are mobile homes. Less than one-fifth of homes (16%) were built before 1970 and 44% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (80%) of housing units are owner occupied, 16% are renter occupied, 2% are seasonal homes, and 2% are vacant.

⁷ ["Monthly Average for West Linn, OR"](#) The Weather Channel Interactive, Inc. Retrieved November 1, 2018.

⁸ [Annual Water Quality Report](#) (2017). City of West Linn. Retrieved March 10, 2019.

Transportation and Infrastructure

The City of West Linn is divided by two major regional transportation facilities - Interstate 205, a freeway running east-west through the southerly section of the City and State Highway 43 (Willamette Drive) that connects to I-205 near its southerly terminus and runs north-south through the northerly section of the City all the way to Portland.

Motor vehicles represent the dominant mode of travel through and within West Linn. Four percent (4%) of renters and 1% of owners do not have a vehicle. Most workers drive alone to work (69%); 7% carpool, 2% use public transit, 2% either walk or use a bicycle, and 21% work at home. West Linn contains two interchanges with I-205, the 10th Street interchange in the Willamette neighborhood and the Highway 43 (Willamette Drive) interchange in the Bolton neighborhood. The responsibility and authority, as well as the financial capability, to maintain an adequate level of service for the freeway I-205 rests with Metro and Oregon Department of Transportation (ODOT) authorities. Congestion on I-205, nonetheless, can result in the diversion of traffic onto City streets.

The City's public transit is provided by Portland's TriMet transit system which serves all of the commercially zoned areas. The availability and quality of pedestrian and bicycling facilities (sidewalks, bike lanes, and pathways) is inconsistent, generally newer neighborhoods have facilities. [Road and Base Maps](#) are found on the West Linn website.

Economy

The economy of West Linn is based primarily on service and retail-oriented commercial businesses and the City has more residents than employees. The City's single major industrial employer is the West Linn Paper Company. West Linn's Waterfront Plan will revitalize the area by the Paper Mill. The City, School District, and smaller employers (retail, offices and other professional services) provide for most of the City's employment.

The City of West Linn does not contain a major commercial district or downtown, but rather it possesses four distinct commercial districts. The Historic Willamette District was one of the first commercial and residential areas in West Linn. The commercial area still retains some of the turn-of-the-century architecture along Willamette Falls Drive and features on-street parking and residential units above retail establishments. Newer commercial and office buildings have been built to the north and east of the Historic District, including north of I-205.

About 46% of the resident population 16 and over is in the labor force (12,463 people) and are employed in a variety of occupations including professional (29%), management, business, and financial (28%), sales (12%), office and administrative (11%), and construction, extraction, and maintenance (5%) occupations.

Most workers residing in the city (93%, 10,920 people) travel outside of the city for work primarily to Portland and surrounding areas.⁹ A significant population of people travel to the city for work, (84% of the workforce, 4,665 people) primarily from Portland and surrounding areas.¹⁰

⁹ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on January 8, 2024 at <https://onthemap.ces.census.gov>.

¹⁰ Ibid.

Table WI-3 Community Characteristics

Population Characteristics		Population	Household Characteristics	
		Growth		
2016 Population Estimate	25,615		Housing Units	
2022 Population Estimate	27,420	7%	Single-Family (includes duplexes)	9,011 87%
2045 Population Forecast*	26,990	-2%	Multi-Family	1,333 13%
Race			Mobile Homes (includes RV, Van, etc.)	48 < 1%
American Indian and Alaska Native		< 1%	Household Type	
Asian		5%	Family Household	7,536 75%
Black/ African American		1%	Married couple (w/ children)	3,123 31%
Native Hawaiian and Other Pacific Islander		< 1%	Single (w/ children)	552 6%
White		82%	Living Alone 65+	812 8%
Some Other Race		< 1%	Year Structure Built	
Two or More Races		4%	Pre-1970	1,621 16%
Hispanic or Latino/a (of any race)			1970-1989	4,215 41%
Limited or No English Spoken	824	3%	1990-2009	4,073 39%
Vulnerable Age Groups			2010 or later	483 5%
Less than 5 Years	1,375	5%	Housing Tenure and Vacancy	
Less than 15 Years	5,452	20%	Owner-occupied	8,360 80%
65 Years and Older	4,778	18%	Renter-occupied	1,638 16%
85 Years and Older	462	2%	Seasonal	184 2%
Age Dependency Ratio		0.60	Vacant	210 2%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)	
Total Disabled Population	2,415	9%	No Vehicle (owner occupied)	124 1%
Children (Under 18)	214	3%	Two+ vehicles (owner occupied)	6,745 81%
Working Age (18 to 64)	1,150	7%	No Vehicle (renter occupied)	61 4%
Seniors (65 and older)	1,051	22%	Two+ vehicles (renter occupied)	814 50%
Income Characteristics			Employment Characteristics	
Households by Income Category			Labor Force (Population 16+)	
Less than \$15,000	589	6%	In labor Force (% Total Population)	12,463 46%
\$15,000-\$29,999	367	4%	Unemployed (% Labor Force)	604 5%
\$30,000-\$44,999	649	7%	Occupation (Top 5) (Employed 16+)	
\$45,000-\$59,999	712	7%	Professional & Related	3,578 29%
\$60,000-\$74,999	693	7%	Management, Business, & Financial	3,472 28%
\$75,000-\$99,999	1,154	12%	Sales & Related	1,535 12%
\$100,000-\$199,999	3,277	33%	Office & Administrative	1,333 11%
\$200,000 or more	2,557	26%	Construction, Extraction, & Maint.	590 5%
Median Household Income		\$124,098	Health Insurance	
Gini Index of Income Inequality		0.45	No Health Insurance	813 3%
Poverty Rates (Percent age cohort)			Public Health Insurance	7,007 26%
Total Population	1,263	5%	Private Health Insurance	23,325 86%
Children (Under 18)	215	3%	Transportation to Work (Workers 16+)	
Working Age (18 to 64)	761	5%	Drove Alone	8,501 69%
Seniors (65 and older)	287	6%	Carpooled	805 7%
Housing Cost Burden (Cost > 30% of household income)			Public Transit	255 2%
Owners with a Mortgage	2,007	35%	Motorcycle	0 0%
Owners without a Mortgage	793	30%	Bicycle/Walk	186 2%
Renters	1,029	63%	Work at Home	2,532 21%

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", METRO 2040 Population Distributed Forecast (2021, [Exhibit A to Ordinance 21-1457](#)).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of West Linn. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table WL-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table WL-4 Critical Facilities in West Linn

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Athey Creek Middle School					
Bolton Primary School	-	X	X	-	-
Cedar oak Park Primary School	-	X	X	-	-
Rosemont Ridge Middle School	-	-	-	-	-
Sullivan substation	-	X	X	-	-
Sunset Primary School	-	X	X	-	-
Trillium Creek Primary School	-	-	-	-	-
Tualatin Valley Fire and Rescue - Station 55 (Rosemont, ca. 2018)					
Tualatin Valley Fire and Rescue - Station 58 (Bolton, ca. 2010)	-	X	X	-	-
Tualatin Valley Fire and Rescue - Station 59 (Willamette, ca. 2010)	-	X	X	-	-
West Linn City Hall (ca. 2012)					
West Linn Library					
West Linn Adult Community Center					
West Linn High School	-	X	X	-	-
West Linn Police Department/EOC	-	X	X	-	-
West Linn Public Works/Operations	-	X	X	-	-
Willamette Primary School	-	X	X	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-36.

Note: Athey Creek Middle School, TVF&R Stn 55, West Linn City Hall, Library, and Adult Community Center are not included in the DOGAMI analysis.

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

Transportation

- Abernathy Bridge (I-205) (rebuilding 2024/2025)
- Arch Bridge (ODOT) (2012 upgrades)
- Fields Bridge (County, Tualatin River, Borland Rd, 2010)
- Weiss Bridge (County, Tualatin River, Petes Mtn Rd)
- Highway 43
- I-205 (ODOT)
- I-205 bridge over Tualatin River
- ODOT overpasses, including Sunset Avenue, West A Street, Broadway Street, 10th Street, OR 43, and Blankenship Road. The Broadway Street overpass may be removed as part of ODOT's I-205 widening project.

Sewer Pump Stations

- Arbor
- Bolton (Tri-City)
- Calaroga
- Cedaroak
- Johnson
- Mapleton
- Marylhurst
- River Heights
- River Street (Tri-City)
- Willamette (Tri-City)

Drinking Water

- Primary and Alternative Water Sources
- South Fork Water
- I-205 Water Line (risk reduced in 2024 with new bridge)
- Lake Oswego Intertie Pump Station

Reservoirs/Pressure Zones

- Bland
- Bolton(+pump station)
- Horton(+pump station)
- Rosemont
- View Drive (Robinwood) (+pump station)
- Willamette (+pump station)

Other critical facilities

- Adult Community Center
- West Linn Public Library

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public's ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields.

Schools

- Athey Creek Middle School
- Bolton Primary School
- Cedaroak Park Primary School
- Rosemont Ridge Middle School
- Sunset Primary School
- Trillium Creek Primary School

- West Linn High School

- Willamette Primary School

Commercial Centers

- Cascade Summit
- West Linn Central Village
- Robinwood Commercial Center
- Willamette Main Street

Other essential facilities

- City Parks (potential for debris storage)

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community. See [West Linn Maps](#) for a map of park and open space areas. West Linn has more than 600 acres of park land, ranging from active-oriented parks with areas for sports, picnicking and playing on playgrounds, to passive-oriented parks for walking, biking, and wildlife viewing.

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include:

Assisted Living Facilities

- Rose Linn Care Center
- Tanner Springs Assisted Living
- Small Residential Adult Care Homes

Child Care Centers and Preschools

- Atlas Immersion Academy
- Cascade Montessori
- Kindercare Learning Center
- La Petite Academy, Inc.
- SunGarden Montessori
- Lutheran Church Preschool

Schools

- Athey Creek Middle School
- Bolton Primary School
- Cedaroak Park Primary School
- Rosemont Ridge Middle School
- Sunset Primary School
- Trillium Creek Primary School
- West Linn High School
- Willamette Primary School
- Youth Music Project

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: Gas Stations (5), Paper Mill, Public Works/Operations, and the Water Treatment Plant (Lake Oswego-Tigard).

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of West Linn. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers, and are a concern during evacuation/notification during a hazard event. Our four key economic/business centers

are Willamette (Main Street/Blankenship), Robinwood commercial district, Bolton/West Linn Central Village, and Salamo Rd/City Hall. See [West Linn maps](#) for a listing of commercial areas and multi-family housing.

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

Examples of the types of properties that should be considered before, during, and after an event include Historic Landmarks (28+), Historic City Hall, McLean House and Park, Willamette Falls Historic District, and Willamette Locks.

Hazard Characteristics

Drought

The HMAC determined that the City’s probability for drought is **high** and that their vulnerability to drought is **low**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

The City of West Linn currently obtains its potable water from the South Fork Water Board (SFWB, a wholesale water supplier that is equally owned by Oregon City and West Linn). The SFWB source of water is the Clackamas River that originates, like the Willamette, in the Cascade Range and flows west to its confluence with the Willamette River just east of the City. The SFWB operates a conventional water treatment plant located on the south side of the Clackamas River near its confluence with the Willamette. Its system includes intake facilities, a water treatment plant (located in Oregon City), and a transmission pipeline to a pump station located on Division Street in Oregon City. The water distribution system includes six service zones that are supplied by six storage facilities (reservoirs) and five pumping stations. The Water System Master Plan was last updated in 2008 and is currently in the update process to provide long-term guidance for the development of the City's water system, which is a supporting document for the Comprehensive Plan. The City has a map of their Water System on their website.

Vulnerability Assessment

Due to insufficient data and resources, West Linn is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifelines Section and Table WL-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹¹ drought, as represented by low summer soil moisture, low spring snowpack, low summer

¹¹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

runoff, and low summer precipitation, is projected to become more frequent in Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction's ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City's probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect West Linn as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for West Linn as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-West Linn Fault Zone (discussed in the crustal earthquake section).

Figure WL-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

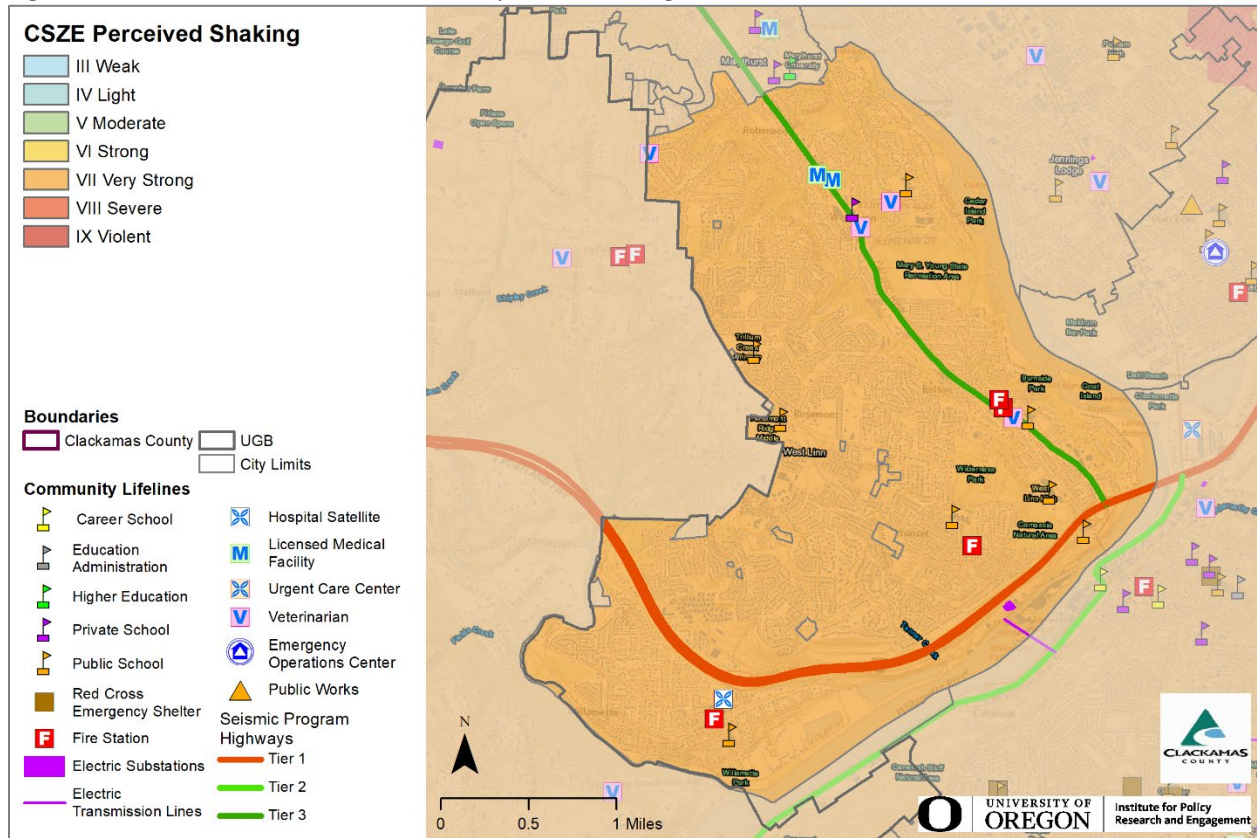
Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.¹²

The city's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the "Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

¹² The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

Figure WL-2 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Earthquake (Crustal)

The HMAC determined that the City’s probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect West Linn as well. Figure WL-3 shows a generalized geologic map of the West Linn area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

There are two potential crustal faults and/or zones near the City that can generate high- magnitude earthquakes. These include the Gales Creek-Mt. Angel Structural Zone and Portland Hills Fault Zone (discussed in greater detail below). Other faults include the Bolton fault (running through the city's east edge roughly parallel to Willamette Drive/Highway 43) and Oatfield fault (to the east of the city on the

eastern side of the Willamette River}, Canby-Molalla structural zones located west of the city, and the Mt. Hood Fault in eastern Clackamas County. Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

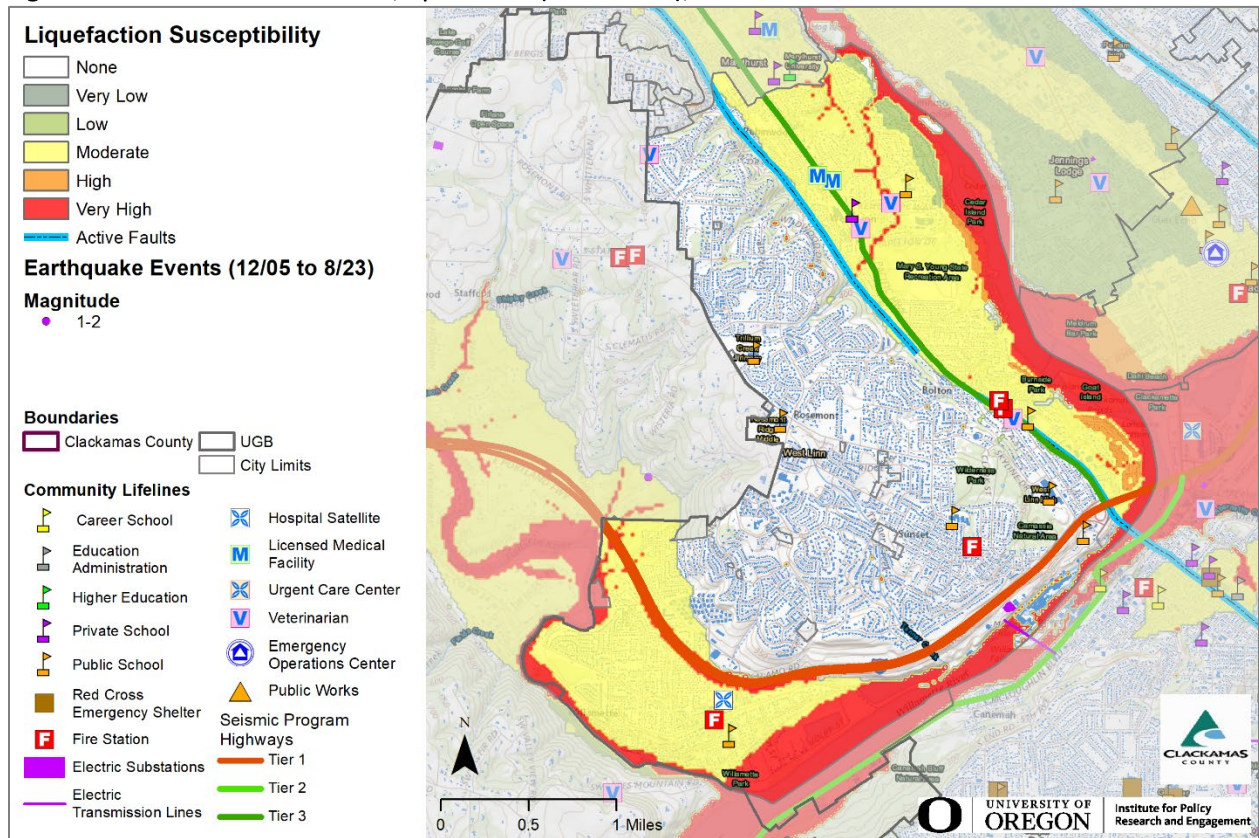
Canby-Molalla Fault Zone

The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and West Linn in northern Oregon.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 11 miles northeast of West Linn.

Figure WL-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

Community assets located in the highest hazard zone for earthquakes include both major hazardous materials fixed sites in West Linn (West Linn Paper Company and Lake Oswego-Tigard Water Treatment Plant) as well as two gas stations. West Linn's infrastructure is particularly vulnerable to earthquake damage. Of the city's nine pump stations, eight are in the moderate to high hazard zones for earthquakes. While the I-205/Abernathy bridge has been seismically retrofitted and is currently being replaced as the first earthquake-ready interstate structure across the Willamette River in the area, its footings lie in the highest hazard zone, as do those for the Oregon City-West Linn Bridge. During a major earthquake, emergency responders may have difficulty performing their duties because their buildings could be impacted by the event.

The Bolton Fire Station, and the Police Department's headquarters are in the moderate to high hazard zones. Areas near the Willamette and Tualatin Rivers are likely comprised of softer soils prone to liquefaction. This can be very destructive to underground utilities such as water and sewer lines. Buildings and water lines can sink into the liquefied ground while sewer pipes, manholes and pump stations (assets partially filled with air) may float to the surface. After the earthquake, the liquefied soil will re-solidify, locking tilted buildings and broken pipe connections into place. In 2018, TVF&R rebuilt Station #55 (Rosemont), and in 2010 they rebuilt Station #58 (Bolton) and Station #59 (Willamette). For a list of facilities and infrastructure vulnerable to this hazard, see the Community Lifelines section and Table WL-4.

Vulnerable populations such as children could be significantly impacted, as many schools lie in the highest two hazard zones. The data gathered from the statewide DOGAMI inventory should be used to prioritize school buildings in West Linn for seismic hazard retrofitting.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 36% of residential buildings were built prior to 1990, which increases the City's vulnerability to the earthquake hazard. Information on specific public buildings' (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table WL-5; each "X" represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), zero (0) have a very high (100% chance) collapse potential, while four (4) have a high (greater than 10% chance) collapse potential. Note: three fire stations and one school have been rebuilt.

For a list of facilities and infrastructure vulnerable to this hazard, see the Community Lifelines section and Table WL-4.

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Table WL-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Athey Creek Middle (2900 SW Borland Rd)	Clac_sch73	X			
Bolton Primary (5933 Holmes St)	Clac_sch82		X,X		
Cedaroak Park Primary (4515 S Cedaroak Dr)	Clac_sch85			X	
Rosemont Ridge (20001 Salamo Rd)	Clac_sch79	X			
Stafford Primary (19875 SW Stafford Rd)	Clac_sch93			X	
Sunset Primary (2351 Oxford St) see Mitigation Successes	Clac_sch01	School rebuilt in 2017 per a 2014 bond			
West Linn High (5464 W A St)	Clac_sch02	X			
Willamette Primary (1403 SE 12th St)	Clac_sch72			X,X	
Fire Facilities					
TVF&R Fire Station #58 (Bolton) (6050 Failing St) see mitigation successes	Clac_fir32	Facility rebuilt in 2010 per a 2006 bond			
TVF&R Fire Station #59 (Willamette) (1860 Willamette Falls Drive) see mitigation successes	Clac_fir33	Facility rebuilt in 2010 per a 2006 bond			
Police Facilities					
Police Department (22825 Willamette Drive) see mitigation successes	Clac_pol06	Facility rebuilt in 2014 in a different location per a 2011 bond			

Source: [DOGAMI 2007. Open File Report O-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)
 “*” – Site ID is referenced on the [RVS Clackamas County Map](#)

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were

tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table WL-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Table WL-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	9,170	9,170	9,170	9,170
Building Value (\$ Million)	3,817	3,817	3,817	3,817
Building Repair Cost (\$ Million)	117	209	899	1,093
Building Loss Ratio	3%	5%	24%	29%
Debris (Thousands of Tons)	39	64	251	304
Long-Term Displaced Population	96	797	1,679	3,457
Total Casualties (Daytime)	68	99	493	566
Level 4 (Killed)	4	5	32	35
Total Casualties (Nighttime)	19	72	216	347
Level 4 (Killed)	0	2	6	9

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

The City of West Linn is expected to have a 3% building loss ratio with a repair cost of \$117 million under the CSZ "dry" scenario, and an 5% building loss ratio with a repair cost of \$209 million under the CSZ

"wet" scenario.¹³ The city is expected to have around 68 daytime or 19 nighttime casualties during the CSZ "dry" scenario and 99 daytime or 72 nighttime casualties during the CSZ "wet" scenario. It is expected that there will be a long-term displaced population of around 96 for the CSZ "dry" scenario and 797 for the CSZ "wet" scenario.¹⁴

Portland Hills Fault Scenario

The City of West Linn is expected to have a 24% building loss ratio with a repair cost of \$899 million under the CSZ "dry" scenario, and a 29% building loss ratio with a repair cost of \$1.093 billion under the CSZ "wet" scenario.¹⁵ The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 493 daytime or 216 nighttime casualties during the Portland Hills Fault "dry" scenario and 566 daytime or 347 nighttime casualties during the Portland Hills Fault "wet" scenario. It is expected that there will be a long-term displaced population of around 1,679 for the Portland Hills Fault "dry" scenario and 3,457 for the Portland Hills Fault "wet" scenario.¹⁶

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table WL-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**¹⁷ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard.

Cascadia Subduction Zone event (M9.0 Deterministic): 422 buildings (10 critical facilities), are expected to be damaged for a total potential loss of \$235 million (a loss ratio of about 5%). About 332 residents may potentially be displaced (about 1% of the population).

Crustal event (Canby-Molalla fault M6.8 Deterministic): 926 buildings are expected to be damaged (10 critical facilities), for a total potential loss of \$382 million (a loss ratio of about 9%). About 771 residents may be displaced (about 3% of the population).

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

¹³ DOGAMI, *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, O-18-02), Tables 12-8 and 12-9.

¹⁴ Ibid, Tables 12-8 and 12-9.

¹⁵ Ibid, Tables 12-10 and 12-11

¹⁶ Ibid, Tables 12-10 and 12-11.

¹⁷ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-35.

Flood

The HMAC determined that the City's probability of flooding is **high** and that their vulnerability to flooding is **moderate**. *The probability rating increased, and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure WL-4 illustrates the flood hazard area for West Linn.

Portions of West Linn have areas of floodplain (special flood hazard areas, SFHA). These include the Tualatin, and Willamette Rivers. The Federal Emergency Management Agency (FEMA) regulatory floodplains for each of these rivers are depicted as relatively narrow areas on each side of the channels. On the Willamette River, the floodway is generally confined within high stream banks. On the Tualatin, the floodways cover a somewhat larger area.

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

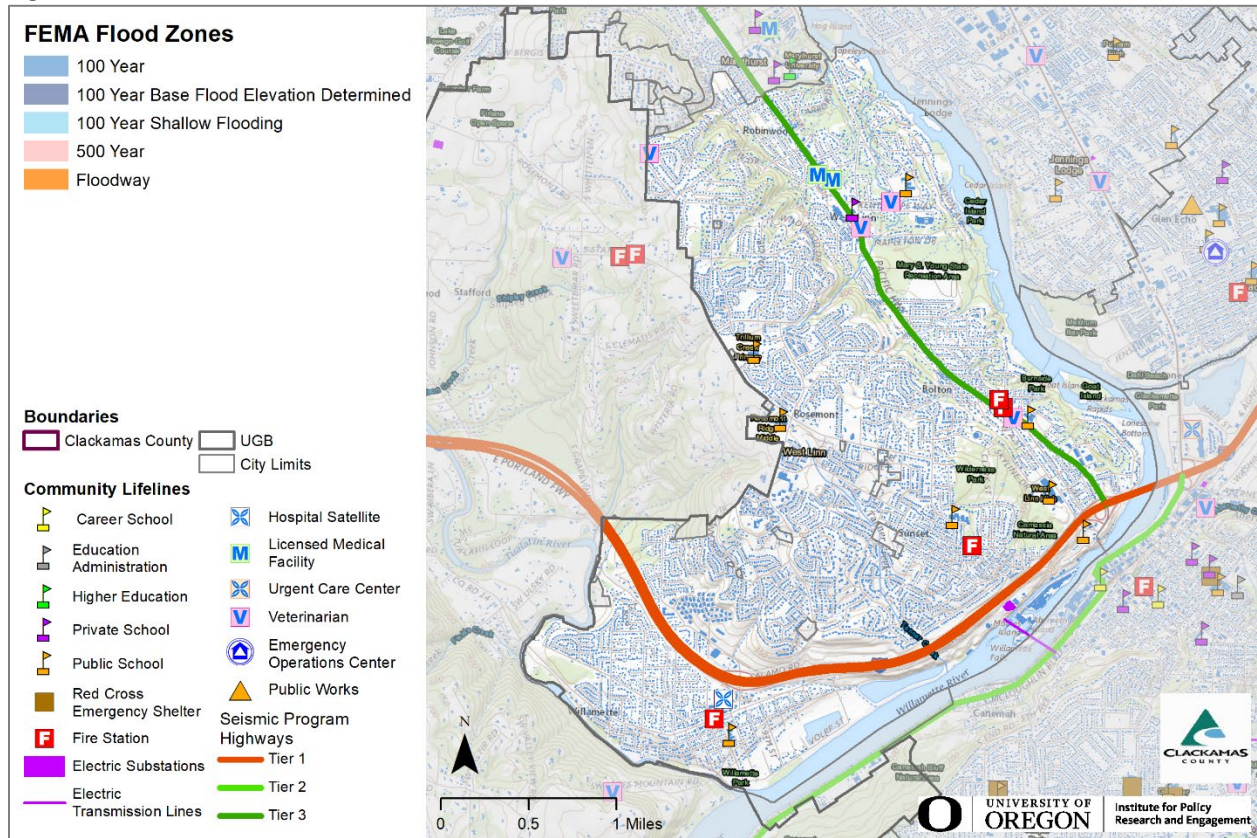
For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of West Linn outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage. City staff has identified sites where local drainage facilities are taxed during high flows, especially where open ditches enter culverts or go underground into storm sewers and works to mitigate the stormwater flood risks in these areas (see the City's 2019 [Surface Water Management Plan](#) for more information).

The speed of onset, lack of warning, and depth of flooding make dam failures a potentially deadly, albeit unlikely, occurrence. There are four major dams upstream of West Linn on the Clackamas River: North Fork, Faraday, River Mill and Timothy. These are operated by Portland General Electric and are subject to the dam safety and warning requirements of the Federal Energy Regulatory Commission. According to the Clackamas County Emergency Operations Plan, areas of West Linn bordering on the Willamette in the vicinity of its confluence with the Clackamas would be inundated by a wall of water 60 - 80 feet high in approximately an hour and a half should the North Fork dam fail under a "probable maximum flood" (a worst-case scenario where all four dams fail). There are no major dams on the Tualatin, and the Willamette River dams are far enough upstream and dispersed so that failures on these two rivers would not be much worse than a regular flood.

The largest flooding event to affect West Linn was the February 1996 flood. The high-water level meant tributaries could not drain into the Tualatin and Willamette River, which led to localized flooding on several backed-up creeks.

The extent of flooding hazards in West Linn primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow.

Figure WL-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

The City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012, and reviewed and updated, as appropriate, in 2023. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

Relatively few people (about 3% of the total population) live in the floodplain and thus are directly at risk from flooding. Dwelling units within or adjacent to the 100-year floodplain of the Tualatin those located on Swiftshore Avenue, Fields Bridge Park, and the Willamette Park. Residences along the Willamette that could be exposed to 100-year flooding events include those along River Street, Nixon Ave, Calaroga Ct., and Cedar Oak Park. Other properties are vulnerable to urban flooding when the Willamette or Tualatin rivers overflow their banks.

Several economic centers, zoned commercial and industrial, are in the 100-year floodplain (including the site of the former West Linn Paper Company). Studies show that most businesses do not survive extended closure due to disasters, which can thus economically devastate local communities. It will be essential that the economic centers mapped in hazard areas be targeted for business continuity planning.

Additionally, a great deal of infrastructure (bridges, water lines, sewage pump stations, etc.) is in the floodplain. Infrastructure exposed to flooding includes, but is not limited to, Portland General Electric's Sullivan Hydroelectric Plant, Weiss Bridge, Fields Bridge, 1-205 water line, Tri Cities sewage pump

stations, and many more pieces of critical infrastructure that assist in supporting the essential needs of the community. Disruption to this infrastructure could result in transportation issues, power outages, sewage back-up, and affect overall community and environmental health.

A few historic sites, including the Mclean House, are also located in the floodplain. Many older buildings will have difficulty sustaining pressure from flooding events and should be targeted for floodplain retrofitting. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifelines section and Table WL-4.

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, 2024)¹⁸ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report 48 buildings (0 critical facilities) could be damaged for a total potential loss of \$72 million (a building loss ratio of about 2%). About 165 residents may be displaced by flood (less than 1% of the population).

National Flood Insurance Program (NFIP)

FEMA’s Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. The last Community Assistance Visit (CAV) for West Linn was on August 28, 2003. West Linn does not participate in the Community Rating System (CRS). The Community Repetitive Loss record (Table WL-7) identifies two (2) Repetitive Loss Properties¹⁹ and no Severe Repetitive Loss Properties²⁰. For information on the location of the properties, see Volume I, Section 2, Figure 14.

Table WL-7: Community Repetitive Loss Properties

RL #	RL or SRL Property	Occupancy	Mitigated?	Currently NFIP Insured	Rated Flood Zone	Post FIRM	Paid Claims	Total Paid Amount
85733	RL	Single Family	No	Yes	A21	Yes	2	\$23,271
304139	RL	Single Family	No	No	AE	Yes	2	\$10,902
Total							2	\$23,271

Source: FEMA Region X, Regional Flood Insurance Liaison, email February 23, 2023.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²¹ winter flood risk at mid- to low elevations in Clackamas 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

¹⁸ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-35.

¹⁹ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

²⁰ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

²¹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

precipitation falling as rain rather than snow. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the City's probability for landslide is **high** and that their vulnerability to landslide is **moderate**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Although catastrophic landslides have not occurred in West Linn, steep slopes do exist along the banks of the Willamette River, and east of Willamette Drive coincident with the Bolton fault.

Landslide susceptibility exposure for West Linn is shown in Figure WL-5. Most of West Linn demonstrates a low to moderate landslide susceptibility exposure. Approximately 21% of West Linn has very high or high, and approximately 44% moderate, landslide susceptibility exposure.²² However, most of the areas that are identified to exhibit dangerous potential rapidly moving landslides are vacant and often preserved in wooded and dedicated open space. Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

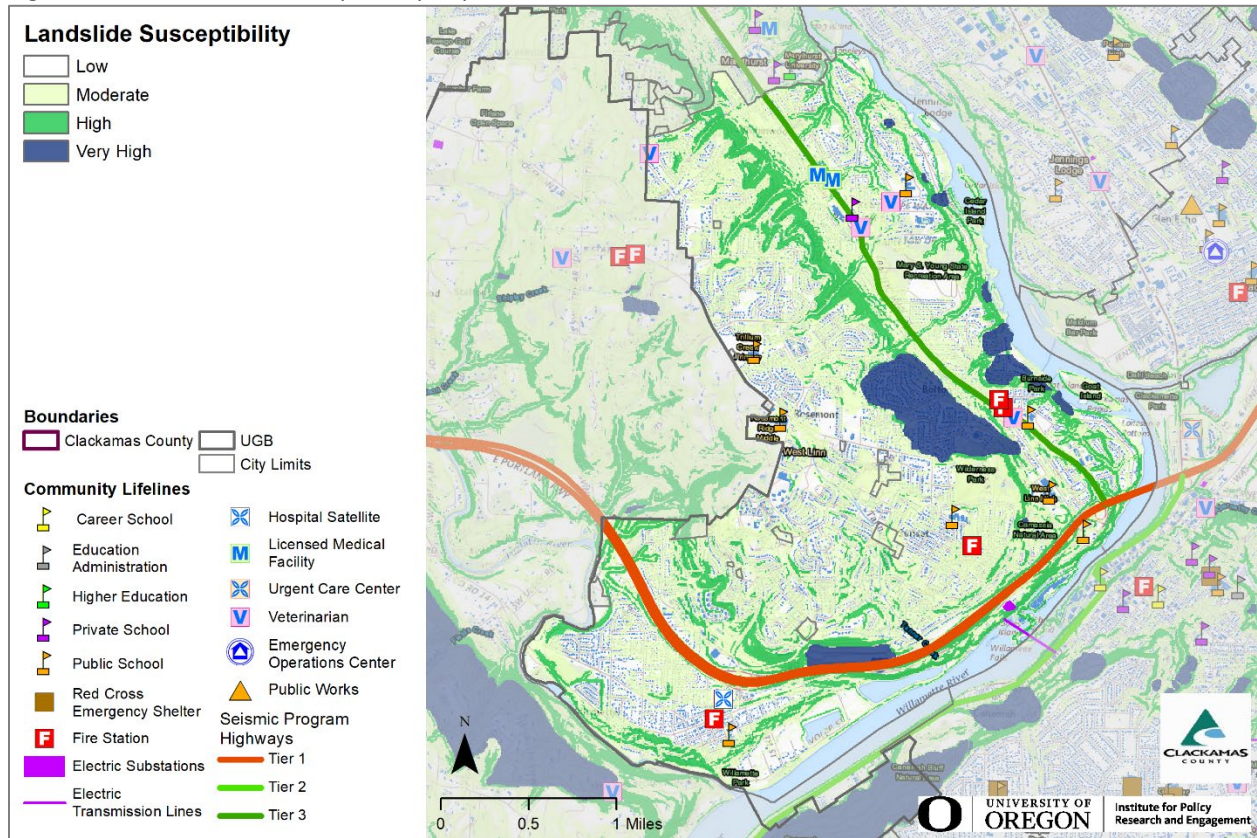
Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above.

Additionally, the City completed an analysis, using the best available data, as a component of the vulnerability assessment in 2009, updated in 2012 and 2018, and reviewed and updated, as appropriate, in 2023. This analysis looked at identified hazard areas in conjunction with available data on property exposed to the hazard. Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

²² DOGAMI. [Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon](#) (2016)

Figure WL-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.
 Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
 Note: To view hazard detail click this [link](#) to access Oregon HazVu

About 50 percent of the City's population live in potential landside areas. Two critical facilities are exposed to the landslide hazard -Public Works Operations Building and Library. Three schools that are considered essential facilities are also exposed to the landslide hazard. In addition, critical infrastructure, economic centers, cultural or historic assets, environmental assets, and hazardous material sites are exposed to the landslide hazard. Hazardous materials sites would also suffer damage, resulting in threats to environmental and human health, while disrupting the availability of gasoline for vehicle transport and furthering economic loss because such sites are also sources of employment. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifelines section and Table WL-4.

This exposure means that large scale and simultaneous landslides triggered by an earthquake could substantially disrupt City operations buildings, fire stations and key pieces of infrastructure (bridges, sewage pump stations, water reservoirs) that would hinder the ability of the City to respond to emergency situations created by such an event.

As a result, it will be important for the City to pursue opportunities for retrofitting and mitigating important structures and infrastructure, such that said facilities can withstand and survive landslides, particularly simultaneous landslides generated by an earthquake. Business continuity planning shall also be an important factor, given the number of economic centers and employment facilities that are threatened by the landslide hazard.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property

damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifelines section and Table WL-4.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**²³ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 1,376 buildings are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of \$722 million (a building exposure ratio of about 16%). About 4,882 residents may be displaced by landslides (about 18% of the population). *Note: the exposure number is for all buildings and population exposed to the high and very high landslide susceptibility areas.*

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **moderate** and that their vulnerability is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees,

²³ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-35.

Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of West Linn has experienced life-threatening consequences for vulnerable populations from the few historical extreme heat events. Changes in climate indicate that the area should expect to see more extreme heat events.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²⁴ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City’s probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for West Linn.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris. Additionally, transportation and economic disruptions result as well.

Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

²⁴ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Winter Storm (Snow/Ice)

The HMAC determined that the City's probability for winter storm is **high** and that their vulnerability to winter storm is **high**. *The probability and vulnerability ratings increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Most winter storms typically do not cause significant damage, but they are frequent and have the potential to impact economic activity. Road and rail closures due to winter weather are a common occurrence but can interrupt commuter and commercial traffic as noted above.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"²⁵ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Vulnerability Assessment

Due to insufficient data and resources, West Linn is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Lifelines section and Table WL-4.

Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected.

The areas of the City that are often most at risk from severe storms are residential areas on steeper slopes, where roads may be icy and, thus, difficult to climb and descend. Road corridors leading to residential areas with fuller tree canopies are susceptible to downed tree limbs, and those areas that are above 500 feet in elevation are particularly vulnerable. However, some weather systems are characterized by a temperature inversion, where the valley floor is colder than the nearby hills.

²⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Consequently, severe storms affect the entire city. Several streets in areas of the City with steep grades are particularly hazardous during snow and ice events and are subject to closure during winter weather events including: Marylhurst Drive (from Hillcrest Drive to Lower Midhill Drive), Hidden Springs Road (from Bluegrass Way to Cottonwood Court), Pimlico Drive (from Palamino Way to Willamette Drive), Summit Street (from Rosemont Road to Skyline Drive), 12th Street (from Tualatin Avenue to Volpp Street), and Skye Parkway (from Troon Drive to Hillside Drive). The City's Snow and Ice Removal Plan is maintained by the Public Works Department and includes provisions to place equipment on designated principal routes throughout the City. For more information see the City's inclement weather information webpage and their Winter Weather Route Map.

The major risk to property results from exposed utilities, especially power lines and water pipes that are damaged by wind, broken tree limbs and cold temperatures. Businesses also suffer economic losses when they must close as the result of the inclement weather and/or the loss of power, which, in turn, disrupts the local supply chain of goods and services. Periods of extended ice coverage hinder emergency response services and limit the mobility of residents, which could result in serious life safety issues. Residents and businesses that are in areas that exhibit the severe storm hazard face some risk of damage from severe storms. Severe weather events are expected to impact nearly all City residents.

All critical facilities are exposed to severe weather hazards. The exposure of these facilities and infrastructure means that severe weather events could substantially disrupt the operations of City government buildings and fire stations, impairing key City functions, while hindering the ability of emergency response personnel to respond to emergency situations that are created by a severe storm event.

All these facilities depend upon utility lines, roads, and bridges to operate and perform their respective important functions within the City. Exposed utility and power lines are particularly vulnerable to damage from severe winter storms by wind, ice, and snow. More hardened infrastructure, like bridges and roads, can sustain a severe winter storm, but during the event, they are often hazardous to traverse because of icy, windy, and snowy conditions.

Consequently, severe weather (wind or winter storm) could substantially disrupt numerous key resources and facilities within the City through impediments to the transportation system and damage to the power grid. Among other things, these transportation problems and power failures disrupt business operations and educational facilities, resulting in economic losses and halting educational opportunities.

Power to Hazardous material sites could also be disrupted. The sites themselves could be damaged or rendered inaccessible. In turn, these conditions could pose threats to the natural environment of the City and the health of its population, while disrupting the availability of gasoline for vehicle transport and furthering economic losses.

As a result, it will be important for the City to pursue opportunities for undergrounding utilities and retrofitting utility lines so that they may withstand cold weather conditions without freezing and bursting. Adhering to current building codes for weatherization of structures, as well as current engineering and fire codes that pertain to the steepness of new roads, are also key factors for the City to consider. Business continuity planning shall also be an important factor, given the number of economic centers and employment facilities that are threatened by the severe storm hazard.

Volcanic Event

The HMAC determined that the City's probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of volcanic hazards, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the western portion of the County is likely to affect West Linn as well. Volcanoes are located near West Linn, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to West Linn's relative distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²⁶ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard.

The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the City's probability for wildfire is **medium**, and that their vulnerability to wildfire is **moderate**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

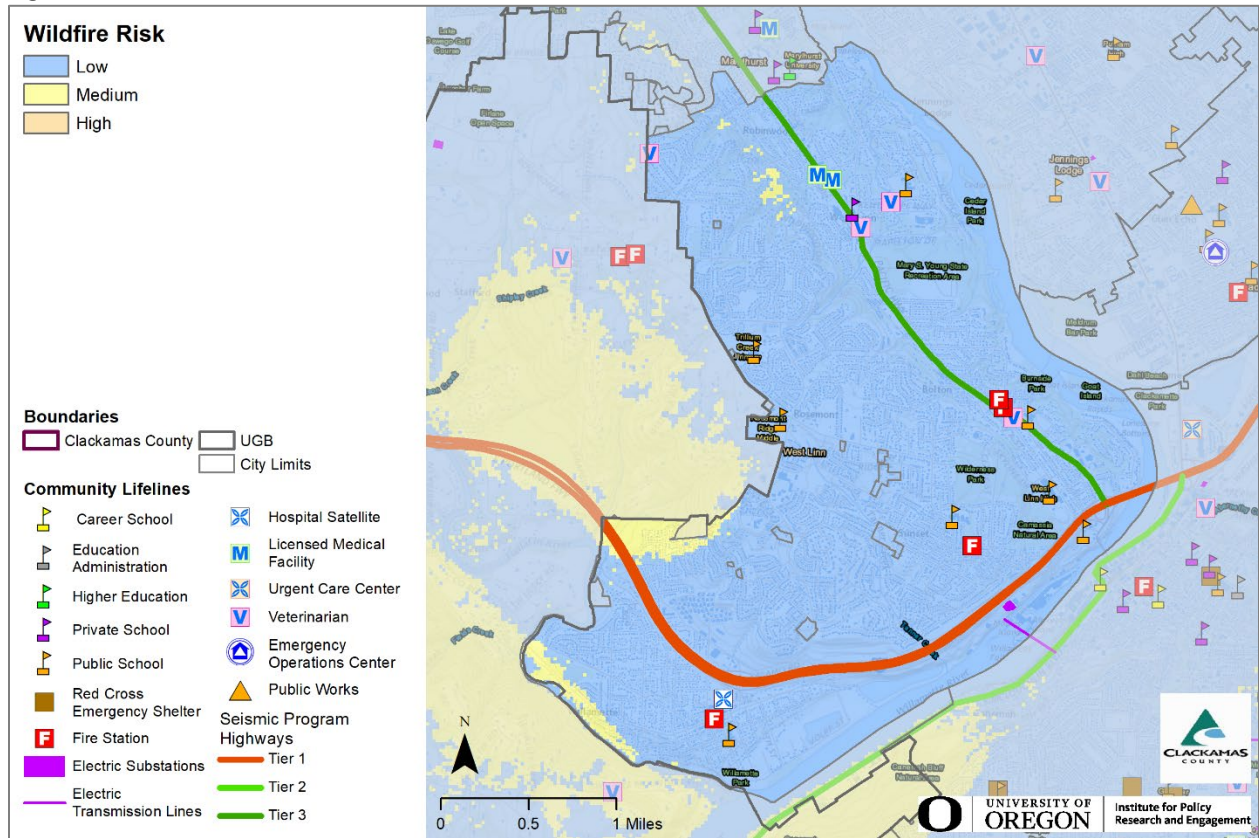
The [Clackamas County Community Wildfire Protection Plan](#) (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to West Linn is found in the following chapter: Chapter 9.13: Tualatin Valley Fire and Rescue.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather, and urbanization conditions are primarily at cause for the hazard level. West Linn has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. Figure WL-6 shows overall wildfire risk in West Linn.

²⁶ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-35.

Figure WL-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer's CWPP Planning Tool

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes West Linn, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

The City is characterized by lush parks, neighborhoods surrounded by mature trees and under story vegetation and development intermingled with the natural landscape. Much of West Linn's undeveloped topography consists of wooded slopes 25 percent or steeper.

These occluded woodlands range in size from 2 to 20 acres and make up a significant portion of the 373 acres of parks and open space managed by the City. Most of the woodlands are surrounded by urban development that are a concern in the case of a wildfire event. Figure WL-6 shows overall wildfire risk in West Linn. The forested hills within, and surrounding West Linn are interface areas including the following High Priority Communities at Risk (CARs): 1-205 Corridor, Skyline Ridge, and Wilderness Park/Camassia Park; and the following Medium Priority CARs: Burnside Park and Maddax Woods, Hidden Springs, Mary S

Young Park, White Oak Savannah, Wildwood Open Space, Wilson Creek Natural/Rosemont Area, and Wisteria. and Wisteria.²⁷

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four-feet under normal weather conditions.²⁸ However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts. Increasing periods of high heat, dry conditions, and low precipitation increase the potential for wildfire.

Vulnerability Assessment

Exposure of community assets to natural hazards was determined by manually comparing community assets with each hazard and identifying where assets and hazards intersected. Residences and businesses that border occluded woodlands with slopes greater than 25% are at the greatest risk of loss or damage from wildfires. A great deal of infrastructure is exposed to the wildfire hazard, including West Linn's primary water source. This could affect the efficiency of fire protection professionals during a large-scale wildfire. Vegetation along roadways is also highly dangerous, as negligent motorists provide ignition sources by tossing cigarette butts out car windows. Because schools are generally located near parks and scenic areas, they can be threatened by wildfires. Bolton Middle School, CedarOak Park School, and West Linn High School and the Library are particularly at risk. A variety of historic landmarks are also included in the high wildfire zones.

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. West Linn's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City will update the City's wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**²⁹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 74 buildings (no critical facilities) are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of \$32.4 million replacement value (a building replacement value exposure ratio of less than 1%). About 228 residents may be displaced by wildfires (less than 1% of the population).

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"³⁰ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very

²⁷ Clackamas County Community Wildfire Protection Plan, *Tualatin Valley Fire and Rescue* (2018), Table 10.13-1.

²⁸ [Oregon Wildfire Risk Explorer](#), date accessed November 9, 2018.

²⁹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-35.

³⁰ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

Attachment A: Action Item Changes

Table WL-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table WL-1)

Previous NHMP Actions that are Complete:

Multi-Hazard #3, “Identify, protect, and enhance natural resources in accordance with Goal 5.” Complete.

Multi-Hazard #4, “Maintain and incorporate available natural hazard data into City GIS databases and applications.” Complete.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table WL-8 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Multi-Hazard #2	#2	Not Complete, revised	Yes
-	#3	New	-
Multi-Hazard #3	-	Complete	No
Multi-Hazard #4	-	Complete	No
Multi-Hazard #5	#4	Not Complete	Yes
Earthquake #1	#5	Not Complete, revised	Yes
Flood #1	#6	Not Complete	Yes
Flood #2	#7	Not Complete	Yes
Flood #3	#8	Not Complete	Yes
Flood #4	#9	Not Complete	Yes
Severe Weather #1	#10	Not Complete	Yes
Severe Weather #2	#11	Not Complete	Yes
Wildfire #1	#12	Not Complete	Yes
-	#13	New	-
-	#14	New	-

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from March 5 through March 20, 2024 on the City's website. The plan was also posted and announced on the County's website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting

The screenshot shows the City of West Linn website with a navigation bar (Community, Business, Departments, How Do I..., Contact Us) and a search bar. The main content area is titled "West Linn Ready" and features a sidebar with links to various preparedness resources. The central focus is a "Natural Hazard Mitigation Plan Update" announcement. The announcement includes a description of the NHMP, a call for community feedback on a draft addendum, and a list of key points regarding the update process. A graphic titled "NATURAL HAZARD PLAN UPDATE Survey" is also visible.

West Linn Ready

- Emergency Contacts
- Emergency Alerts and Warnings
- Earthquake Preparedness
- Fire Preparedness +
- Flood Preparedness
- Protecting Your Documents
- Winter Weather Preparedness and Resources
- Natural Hazard Mitigation Plan Update**
- Natural Hazards Mitigation Plan

Natural Hazard Mitigation Plan Update

The City of West Linn's Natural Hazard Mitigation Plan (NHMP) identifies natural hazards that may impact our community and provides the City with a set of goals, action items, and resources designed to reduce risk from future natural disaster events. Engaging in mitigation activities provides jurisdictions with a number of 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.

We welcome the community's feedback on our [draft NHMP](#) (attached below).

Please submit comments on the draft 2024 [West Linn NHMP](#) by 5 p.m., March 20, 2024 using the [webform here!](#)

The City of West Linn's NHMP will be included as addendum to the larger [Clackamas County NHMP](#) as we face many of the same natural hazards and coordinate on emergency preparation and response. The local planning process for this update included a wide range of representatives from city, special districts, county emergency management personnel, and the University of Oregon's Institute for Policy Research and Engagement.

- The City of West Linn is in the process of updating their existing 2019 Natural Hazards Mitigation Plan (2019). The process should be complete in 2024, pending Oregon Department of Emergency Management, FEMA, and City Council approval.
- Every five years, Federal guidelines require the City's addendum to the Clackamas County NHMP be updated and submitted to the Federal Emergency Management Agency (FEMA) for approval.
- With re-adoption of a FEMA-approved NHMP, the City maintains its eligibility to apply for federal funding towards natural hazard mitigation projects.
- This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management (OEM) utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program. With re-adoption of the plan, West Linn will maintain its eligibility to apply for federal funding towards natural hazard mitigation projects.

If you have any questions regarding the City's NHMP addendum or the update process in general, please contact: Michael Howard (mrhoward@uoregon.edu), Director for the Oregon Partnership for Disaster Resilience at 541-346-8413; or Dylan Digby (ddigby@westlinnoregon.gov), Assistant to the City Manager.

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1 and #2: March 8 and May 24, 2023

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #3: December 11, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

City of Wilsonville Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: City of Wilsonville

Effective:

September 12, 2024 - September 11, 2029

Prepared for
The City of Wilsonville

Updated:
September 5, 2024 (Resolution # 3129)
June 17, 2019 (Resolution # 2755)
May 20, 2013 (Resolution # 2418)
November 16, 2009 (Resolution # 2213)



This Natural Hazard Mitigation Plan was prepared by:



UNIVERSITY OF
OREGON

School of Planning, Public
Policy and Management

Institute for Policy
Research and Engagement

Planning grant funding provided by:

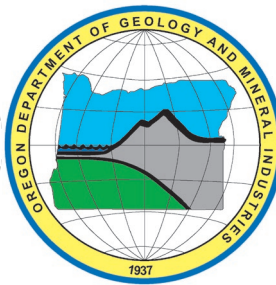


FEMA

Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

RESOLUTION NO. 3129

A RESOLUTION OF THE CITY OF WILSONVILLE ADOPTING THE CITY OF WILSONVILLE REPRESENTATION IN THE UPDATES TO THE CLACKAMAS COUNTY MULTI-JURISDICTIONAL NATURAL HAZARD MITIGATION PLAN.

WHEREAS, the City of Wilsonville recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, the City of Wilsonville has fully participated in the FEMA prescribed mitigation planning process to prepare the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan (NHMP), which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

WHEREAS, the City of Wilsonville has identified natural hazard risks and prioritized several proposed actions and programs needed to mitigate the vulnerabilities of the City of Wilsonville to the impacts of future disasters within the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan; and

WHEREAS, these proposed projects and programs have been incorporated into the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan and pre-approved it (dated, May 29, 2024) contingent upon this official adoption of the participating governments and entities; and

WHEREAS, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

WHEREAS, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

WHEREAS, City of Wilsonville adopts the NHMP and directs City staff to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

NOW, THEREFORE, THE CITY OF WILSONVILLE RESOLVES AS FOLLOWS:

Section 1. To adopt the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation plan as an official plan.

Section 2. The City of Wilsonville will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan.

Section 3. Effective Date. This Resolution is effective upon adoption.

ADOPTED by the Wilsonville City Council at a regular meeting thereof this 5th day of September 2024 and filed with the Wilsonville City Recorder this date.

Signed by:

8A974AF3ADE042E...

JULIE FITZGERALD, MAYOR

ATTEST:

DocuSigned by:

E781DE10276B498...

Kimberly Veliz, City Recorder

SUMMARY OF VOTES:

Mayor Fitzgerald	Yes
Council President Akervall	Yes
Councilor Linville	Excused
Councilor Berry	Yes
Councilor Dunwell	Yes

EXHIBIT:

- A. City of Wilsonville Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan: September XX, 2024 - September XX, 2029

Purpose

This is an update of the Wilsonville addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Updates to Wilsonville’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Wilsonville adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on September 5, 2024. FEMA Region X approved the Clackamas County NHMP and the City’s addendum on September 12, 2024. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the city will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Office of Emergency Management (OEM), Clackamas County, and Wilsonville to update their NHMP.

The Clackamas County NHMP, and Wilsonville addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Wilsonville HMAC guided the process of developing the NHMP.

Convener

The Wilsonville Public Works Director, Delora Kerber serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the City of Wilsonville HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). The HMAC reviewed and revised the City’s addendum, with focus on the NHMP’s risk assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and communication with the Clackamas County Resilience Coordinator, and the OPDR. The changes are highlighted with more detail throughout this document and within Volume III, Appendix B. Other documented changes include a revision of the City’s risk assessment and hazard identification sections, NHMP mission and goals, action items, and community profile.

The Wilsonville HMAC was comprised of the following representatives:

- Convener, Delora Kerber, Public Works Director
- Martin Montolvo, Public Works Operations Manager
- Kerry Rappold, Natural Resources Manager
- Planning Division Staff

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The City Council will be responsible for adopting the Wilsonville addendum to the Clackamas County NHMP. This addendum designates a HMAC and a convener to oversee the development and implementation of action items. Because the City addendum is part of the County’s multi-jurisdictional NHMP, the City will look for opportunities to partner with the County. The City’s HMAC will convene after re-adoption of the Wilsonville NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The convener will serve as the conveners and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAC members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the city; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Capital Improvements Plan, and Building Codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the city. Plans and policies already in existence have support from residents, businesses, and policy makers. Where possible, Wilsonville will implement the NHMP's recommended actions through existing plans and policies. Many land-use, comprehensive and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Wilsonville to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, water system master plan, capital improvement plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting building codes that account for best practices in structural hardening, and codifying land use regulations and zoning designations that prescribe mitigation into development requirements. The extent to which a municipality or multi-jurisdictional effort leverages these approaches is an indicator of that community's capabilities.

Comprehensive Plan

Oregon's Statewide Planning Goal 7 requires comprehensive planning within every jurisdiction that is designed to reduce risks to people and property from natural hazards.

The [Wilsonville Comprehensive Plan](#) is an official statement of the goals, policies, implementation measures, and physical plan for the development of the city. The plan documents the city's approach to the allocation of available resources for meeting current and anticipated future needs. It was revised in its entirety in 2000 and updated in June 2020 (October 2018 version).

The Comprehensive Plan includes implementation measures related to flooding (implementing the NFIP and Title 3 of Metro's Urban Growth Boundary Functional Plan), storm drainage, water provision and water conservation, fire protection, etc. Policy 4.1.5 includes implementation measures to protect people and property from natural hazards.

According to the [Comprehensive Plan](#), land has been designated for public, industrial, commercial, and residential use. The [Significant Resource Overlay Zone \(SROZ\) map](#) identifies areas where development is prohibited. The SROZ includes 780 acres of land and has a 25-foot buffer zone where building applications and city staff work together to decide on the ultimate “no build” boundary for individual sites.¹

Planned updates to the jurisdiction’s Goal 7 element or its broader comprehensive plan will reflect the data and findings within this NHMP and integrate analyses of future climate and natural hazard impacts into the community’s long-range plans.

Land Use Regulations

Existing land use policies that define zoning and address hazardous conditions provide another source of mitigation capability.

Title 3 of the Metro Urban Growth Management Functional Plan

This policy requires the city to balance any fill in the floodplain with a corresponding cut that excavates an equal amount of material. In addition, Title 3 requires the city to regulate the area of inundation from the 1996 flood in addition to the area with a 1% chance of flooding as identified on National Flood Insurance Program (NFIP) maps.

Municipal Development Codes

The Community Development Department includes divisions responsible for planning, building, engineering, natural resources, economic development, and urban renewal. The Community Development Department implements the policies and master plans of the Wilsonville Comprehensive Plan to guide growth and ensure that appropriate infrastructure (roads, utility capacity, parks, public facilities, etc.) is available for predicted city expansion needs. They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

The Wilsonville Planning and Land Development Ordinance, otherwise known as the Development Code, is Chapter 4 of the Wilsonville Municipal Code.

[Section 4.172 Flood Plain Regulations](#) These regulations were last updated in 2018. They regulate the 100-year flood plain identified by the Federal Insurance Administration (FIA) in the "Flood Insurance Study for Clackamas County and Incorporated Areas dated effective June 17, 2008, and displayed on FIA Floodway and Flood Insurance Rate Maps dated effective June 17, 2008. They ensure the City and its residents and businesses, continued eligibility in the National Flood Insurance Program by complying with the requirements of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

[Wilsonville Code Chapter 8 - Environment](#) This section of the City code details City Stormwater regulations as they apply to system users, spills, sediment and erosion control, and other pertinent information.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

¹ Wilsonville, Oregon. 2015 Development Code. § [4.139.00](#) thru [4.139.11](#)

The Wilsonville Community Development Department administers and enforces the 2022 Oregon Fire Code, the 2022 Oregon Structural Specialty Code, Mechanical Specialty Code, Plumbing Specialty Code, Electrical Specialty Code, and Residential Specialty Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

Public Works

The City of Wilsonville Public Works Department is composed of the divisions responsible for maintaining the City's stormwater system, wastewater system, water system, streets, and facilities. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

City Administration

The City Council of Wilsonville has the responsibility of developing and adopting the annual city budget. Integrating hazard mitigation goals and projects into the annual budget is key to implementing the plan. The City Council tries to broadly address resilience planning needs while it determines city and departmental priorities and looks for multiple-impact projects wherever possible. They also work with staff to apply for federal and state grant funding to pursue larger projects that are outside of general fund capacity.

Policies and Programs

This Plan directs Wilsonville and Clackamas County to explore integration into other planning documents and processes. Wilsonville has made significant progress in integrating the NHMP into its portfolio of planning processes and programs over the last five years.

Wastewater Treatment Plant Master Plan, 2023

The Wastewater Treatment Plant Master Plan identifies improvements required through the planning period (through 2045) to comply with requirements of the plant's National Pollutant Discharge Elimination System (NPDES) permit and potential future regulatory requirements, while accommodating growth identified in the 2018 City of Wilsonville Comprehensive Plan. Proposed improvements are recommended to three buildings within the Wastewater Treatment Plant to address seismic issues identified in this study.

Total Maximum Daily Loads (TMDLs) Implementation Plan, 2020

Total Maximum Daily Loads define the amount of pollutants that can be present in a water body without causing water quality criteria to be exceeded. Extensive water quality monitoring and modeling (for temperature, bacteria, and mercury) has been completed to establish Total Maximum Daily Loads for the Willamette River. The City's first Willamette River TMDL Implementation Plan was approved by the Oregon Department of Environmental Quality (DEQ) in 2008. The City submitted its updated TMDL Implementation Plan to the DEQ in 2020.

NPDES MS-4 Permit

The Stormwater division must ensure that the work is done in compliance with the National Pollutant Discharge Elimination System (NPDES) Permit. This Division is committed to an ongoing education program for its employees and the community to keep up with the evolving changing technology, rules, and regulations.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The NHMP will also be integrated into the City's Capital Improvement Plan, to be adopted by early 2024.

National Flood Insurance Program

Wilsonville participates in the National Flood Insurance Program. The Engineering (administration) and Building (enforcement) Departments are responsible for administering the day-to-day activities of the city's floodplain program.

Specifically, the floodplain manager:

- maintains and administers Wilsonville's floodplain regulations;
- reviews and issues floodplain development permits;
- maintains elevation certificates for all new and substantially improved structures (and maintains an extensive database of historic elevation certificates);
- ensures that encroachments do not occur within the regulated floodway;
- implements measures to ensure that new and substantially improved structures are protected from flood losses;
- maintains floodplain studies and maps and makes this information available to the public;
- maintains a flood information website with digital flood insurance rate map (DFIRM) data;
- conducts site visits to assess conditions and provide technical assistance to the public;
- maintains a library of historical flood related information;
- informs the public of flood insurance requirements; and
- conducts outreach and training about flood hazards and development within the floodplain.

Personnel

The following Wilsonville personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Public Works Director, Delora Kerber

Public Information Officer: Communications and Marketing Director, Bill Evans

Floodplain Manager: Community Development Director (Chris Neamtzu)

Capital improvement planning: City Engineer (Zach Weigel)

Capital improvement execution: City Engineer (Zach Weigel)

Wilsonville does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

Capital Projects

Wilsonville has implemented recommendations from the last NHMP into its capital improvement projects, including:

The following mitigation-related or resilience projects have been completed:

- A \$77.5 million bond measure (34-133) was passed in 2006 by southeast Portland metro-area voters to correct seismic safety deficiencies at Tualatin Valley Fire and Rescue Fire Station 52 and to replace Fire Station 56. O
- DOT has seismically upgraded Boone Bridge, but specifics on this project are not known.
- The Villebois development created a diversion to fix the flooding problem at Inza R. Wood Middle School.
- The sewer lift station in Memorial Park was relocated to avoid future flooding.
- The Rivergreen Stormwater Outfall project addressed runoff and groundwater seepage that caused significant erosion on the Willamette Riverbank. The city constructed a bioswale, rerouted stormwater discharges, and completed bank stabilization projects to prevent further erosion and stabilize areas of the bank that had been impacted by erosion.

Ongoing projects that enhance the City's resilience include:

- Stormwater Master Plan (to be complete in 2024)
- City of Wilsonville Public Works Complex – includes EOC, two seismically resilient buildings
- French Prairie Bridge Project – not constructed, concept only
- Water Treatment Plant Expansion
- Water Intake Facility – hardened banks of Willamette and seismic
- West Side Level B Reservoir and Off-Site Improvements – design (30%), construction in summer/Fall 2024.
- 5th Street/Kinsman Extension
- Meridian Middle School
- Boeckman Road Corridor Project – bridge over Boeckman Creek (landslide area).
- Boeckman Canyon Sanitary Sewer project -- currently under construction
- Primary School in Frog Pond – Frog Pond Elementary School (under construction open AY24-25)

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)².

FEMA Funded Mitigation Successes

- None identified.

Seismic Rehabilitation Grant Program Mitigation Successes

- None identified.

Other Mitigation Successes

² The Seismic Rehabilitation Grant Program (SRGP) 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.

- A \$77.5 million bond measure (34-133) was passed in 2006 by southeast Portland metro-area voters to correct seismic safety deficiencies at Tualatin Valley Fire and Rescue Fire Station 52 and to replace Fire Station 56.
- DOT has seismically upgraded Boone Bridge, but specifics on this project are not known.

Capital Resources

Wilsonville maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Communication Towers: Clackamas County cellular tower C-800 (emergency communications only) on reservoir site.

Critical facilities with power generators for use during emergency blackouts include: City Hall, Public Works, Police Department, Transit Department, Water Plant, Wastewater Plant. All facilities have e-power (emergency generator power). All but library and community center.

Food pantries include: Wilsonville Community Sharing – tenant in existing building and will become one in another building (part of Oregon Food Bank)

Fueling storage: SMART Fleet Complex

Findings

Several important findings from this capability assessment informed the design of the Plan’s mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

Wilsonville staff are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the community can undertake in any year. The city relies upon its relationships with the County and other cities within its region to expand its operations.

Reliance upon outside funding streams and local match requirements

Wilsonville operates on a limited budget with many conflicting priorities. This leaves few opportunities for using local financial resources to implement hazard mitigation work. They lean heavily upon state and federal grant funds as the primary means for securing mitigation funding. Hazard mitigation grants such as HMGP and BRIC require 10-25% local funding match, as well as extra staff capacity and expertise to navigate the application process and manage the funding.

Leveraging Partnerships with Public and Nonprofit Entities

Regional planning displayed in Community Wildfire Protection Planning process demonstrates the City’s ability to effectively share information and identify priority needs.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions, and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3(iv), *Mitigation Strategy*.

The City’s mitigation strategy (action items) was first developed during the 2009 NHMP planning process and revised during subsequent NHMP updates. During these processes, the HMAc assessed the City’s risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table WA-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAc decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown with orange highlight. The City will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five years. Although this methodology provides a guide for the HMAc in terms of implementation, the HMAc has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table WA-1 Action Items

		Impacted Hazard										Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost	
1	Develop public education programs to inform the public about methods for mitigating the impacts of natural hazards.	X	X	X	X	X	X	X	X	X	Planning/ TVF&R, HMAC	Ongoing	Local Resources. DLCD TA, FEMA HMA	Low	
2	Continue vegetation management throughout the city.							X	X	X	Natural Resources/ Planning, Public Works, Parks	Ongoing	Local Resources. DLCD TA, FEMA HMA	Medium	
3	Conduct seismic evaluations of the Community Center and other critical and essential facilities and implement appropriate structural mitigation strategies.		X								Community Development, Public Works/ Building, Engineering	Long	Local Resources. DLCD TA, FEMA HMA	Medium	
4	Perform non-structural mitigation on public facilities to improve life safety standards.		X								Human Resources/ Building, Engineering	Ongoing	Local, State, Federal Grants and BRIC	Low to High	
5	Seismically retrofit Willamette Water Treatment Plant and Intake Facility		X								Engineering/ Building, Willamette Intake Facility Commission	Short	Local, State and Federal Grants and BRIC	High	
6	Complete the French Prairie Bridge, including accommodation of emergency vehicle passage.		X								Engineering/ Building	Long	Local and State	High	

Table WA-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
7	Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.				X						Community Development/ GIS, Planning	Ongoing	Local Resources. DLCD TA, FEMA HMA (FMA)	Low
8	Implement the recommendations found in the Stormwater Master Plan Update. Including, but not limited to: 1. Memorial Park Lift Station Relocation Project 2. Regional Park 7 and 8 Level Spreader 3. Charbonneau Stormwater Improvements, 4. Meridian Creek Culvert Replacement				X						Natural Resources/ Planning, Public Works	Ongoing	Local, State, Federal Grants and BRIC	Medium to High
9	Reduce negative effects from severe windstorm and severe winter storm events.							X	X		Community Development/ Public Works	Ongoing	Local Resources, FEMA HMA (FMA)	Low to High
10	Remove hazardous trees identified in the systemwide hazardous tree evaluation.							X	X	X	Community Development/ Public Works	Short	Local Resources, FEMA TA, FEMA HMA	Medium
11	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.							X			TVF&R/ Public Works, Parks and Recreation, Natural Resources	Ongoing	Local Resources, FEMA HMA, CWDG	Low to High

Source: Wilsonville NHMP HMA, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

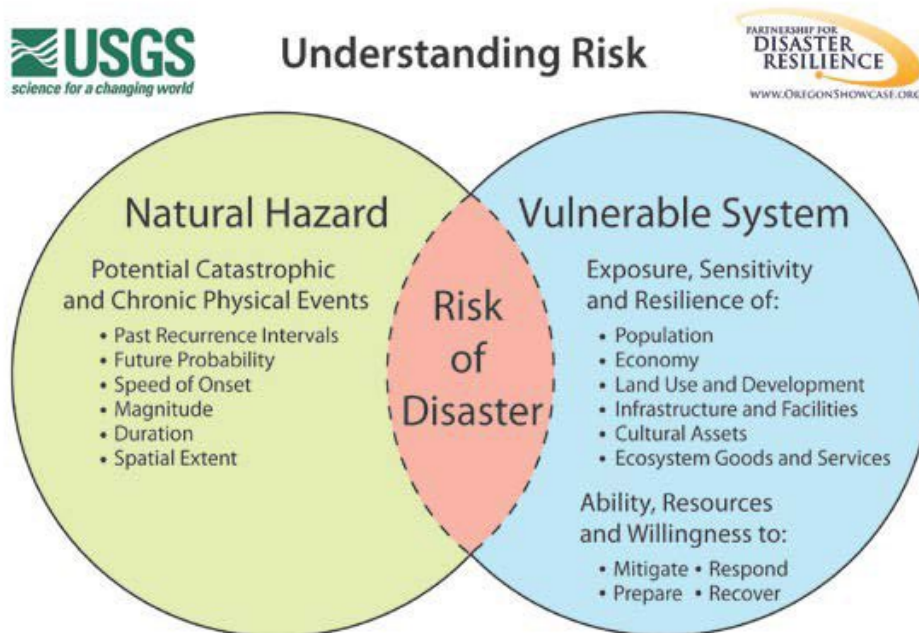
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure WA-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure WA-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The Wilsonville HMA developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Wilsonville, which are discussed throughout this addendum. Table WA-2 shows the HVA matrix for

Wilsonville listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) and one chronic hazard (extreme heat) rank as the top hazard threats to the City (Top Tier). Winter storm, wildfire, drought, and windstorm, comprise the next highest ranked hazards (Middle Tier), while flood, volcanic event, and landslide comprise the lowest ranked hazards (Bottom Tier).

Table WA-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Earthquake - Cascadia	2	45	100	35	182	1	<i>Top Tier</i>
Earthquake - Crustal	6	50	100	21	177	2	
Extreme Heat Event	16	35	70	56	177	3	
Winter Storm	16	30	70	49	165	4	<i>Middle Tier</i>
Wildfire	12	25	70	35	142	5	
Drought	10	15	50	56	131	6	
Windstorm	14	15	50	42	121	7	
Flood	8	15	30	42	95	8	<i>Bottom Tier</i>
Volcanic Event	2	15	50	7	74	9	
Landslide	6	15	20	21	62	10	

Source: Wilsonville HMA, 2023.

Community Characteristics

Table WA-3 and the following section provides information on City specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

The city is on Interstate 5 at the northern end of the Willamette Valley at 154 feet above sea level. Because of its location Wilsonville's climate is consistent with the Marine west coast climate zone, with warm summers and cool, wet winters. Wilsonville receives most of its rainfall between October and May, and averages 42 inches of rain, and less than one (1) inch of snow, per year.³

Population, Housing, and Income

Wilsonville has grown substantially since its incorporation in 1969 and has an area today of 7.5 square miles. It is in the western region of Clackamas County, located approximately 26 miles south of the Washington border and southwest of the City of Portland. The City is within the Willamette River watershed.

Between 2016 and 2022 the City grew by 3,574 people (15%; as of 2022 the population is 27,414). Between 2022 and 2045 the population is forecast to grow by 11% to 30,566.

Most of the population is White/Caucasian (73%) and about 18% of the population is Hispanic or Latino. The poverty rate is 9% (10% of children under 18, 10% for people 65 and older), 6% do not have health insurance, and 51% of renters pay more than 30% of their household income on rent (36% for owners). About 46% of the population has a bachelor's degree or higher (5% do not have a high school degree). Approximately 10% of the population lives with a disability (35% of population 65 and older), and 39% are either below 15 (22%) or over 65 (17%) years of age. About 13% of the population are 65 or older and living alone and 7% are single parents.

The City includes a diversity of land uses but is zoned primarily residential. About 53% of housing units are single-family, 45% are multifamily, and 2% are mobile homes. Less than five percent of homes (3%) were built before 1970; 69% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (48%) of housing units are owner occupied, 47% are renter occupied, less than 1% are seasonal homes, and 4% are vacant.

Transportation and Infrastructure

Located on Interstate 5, transportation has played a major role in shaping Wilsonville's community and economy. Wilsonville's Commercial areas are located near primary routes and residential development are nearby. Interstate 5 has two exits in Wilsonville, one in the North where Boones Ferry Road becomes Ellingsen Road, and one in the South at Wilsonville Road. The Kinsman Road expansion project was completed in 2018 and included expansion of sewer and drinking water pipelines.

Motor vehicles represent the dominant mode of travel through and within Wilsonville. Thirteen percent (13%) of renters and 1% of owners do not have a vehicle. Most workers drive alone to work (72%); 12% carpool, 2% use public transit, 2% either walk or use a bicycle, and 10% work at home. The City's public transit is provided by the South Metro Area Regional Transit (SMART) system, which operates seven routes within Wilsonville and connects with Portland's TriMet transit system at the Commerce Circle

³ "[Monthly Average for Wilsonville, OR](#)" The Weather Channel Interactive, Inc. Retrieved November 1, 2018.

Station. SMART also connects with both Canby's and Salem's public transit systems. The City of Wilsonville also hosts freight rail services provided by the Portland and Western Railroad. There are no port services available on Willamette River where it crosses through Wilsonville, but there is a recreational marina located across the river from Boones Ferry Park.

Economy

Wilsonville's proximity to major transportation routes and access to rail has made it a desirable place for commercial and industrial development. About 49% of the resident population 16 and over is in the labor force (12,714 people) and are employed in a variety of occupations including professional (29%), management, business, and financial (19%), sales (12%), office and administrative (12%), and construction, extraction, and maintenance (7%) occupations.

Wilsonville has an economic advantage due to its location at the north end of the Willamette Valley and its proximity to Portland. Wilsonville's industrial sites are made accessible through I-5 and I-205. High-tech companies in advanced imaging and design as well as distribution centers and manufacturers have located to Wilsonville. These companies included APCON, Inc., Coca-Cola Bottling of Oregon, Coherent, Crimson Trace Corp., FOODesign Machinery & Systems, Inc., FLIR Systems, InFocus, Kinetics, Mentor Graphics, OrePac, Rite Aid Distribution Center, Sysco Food Services, and Xerox Corporation.

Most workers residing in the city (85%, 10,114 people) travel outside of the city for work primarily to Portland and surrounding areas.⁴ A significant population of people travel to the city for work, (92% of the workforce, 19,832 people) primarily from Portland and surrounding areas.⁵

⁴ U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2021). Longitudinal-Employer Household Dynamics Program, accessed on January 8, 2024 at <https://onthemap.ces.census.gov>.

⁵ Ibid.

Table WA-3 Community Characteristics

Population Characteristics		Population	Household Characteristics	
		Growth		
2016 Population Estimate	23,740		Housing Units	
2022 Population Estimate	27,414	15%	Single-Family (includes duplexes)	5,681 53%
2045 Population Forecast*	30,566	11%	Multi-Family	4,863 45%
Race			Mobile Homes (includes RV, Van, etc.)	163 2%
American Indian and Alaska Native		1%	Household Type	
Asian		4%	Family Household	6,327 62%
Black/ African American		2%	Married couple (w/ children)	2,092 20%
Native Hawaiian and Other Pacific Islander		1%	Single (w/ children)	754 7%
White		73%	Living Alone 65+	1,364 13%
Some Other Race		< 1%	Year Structure Built	
Two or More Races		5%	Pre-1970	357 3%
Hispanic or Latino/a (of any race)			1970-1989	2,968 28%
Limited or No English Spoken	1,085	4%	1990-2009	5,078 47%
Vulnerable Age Groups			2010 or later	2,304 22%
Less than 5 Years	1,367	5%	Housing Tenure and Vacancy	
Less than 15 Years	4,490	17%	Owner-occupied	5,188 48%
65 Years and Older	3,820	15%	Renter-occupied	5,073 47%
85 Years and Older	616	2%	Seasonal	52 < 1%
Age Dependency Ratio		0.47	Vacant	394 4%
Disability Status (Percent age cohort)			Vehicles Available (Occupied Units)	
Total Disabled Population	2,564	10%	No Vehicle (owner occupied)	55 1%
Children (Under 18)	102	2%	Two+ vehicles (owner occupied)	3,775 73%
Working Age (18 to 64)	1,171	8%	No Vehicle (renter occupied)	638 13%
Seniors (65 and older)	1,291	35%	Two+ vehicles (renter occupied)	2,275 45%
Income Characteristics			Employment Characteristics	
Households by Income Category			Labor Force (Population 16+)	
Less than \$15,000	887	9%	In labor Force (% Total Population)	12,714 49%
\$15,000-\$29,999	788	8%	Unemployed (% Labor Force)	764 6%
\$30,000-\$44,999	1,089	11%	Occupation (Top 5) (Employed 16+)	
\$45,000-\$59,999	957	9%	Professional & Related	3,652 29%
\$60,000-\$74,999	1,136	11%	Management, Business, & Financial	2,405 19%
\$75,000-\$99,999	1,046	10%	Sales & Related	1,546 12%
\$100,000-\$199,999	3,206	31%	Office & Administrative	1,532 12%
\$200,000 or more	1,152	11%	Construction, Extraction, & Maint.	848 7%
Median Household Income			Health Insurance	
		\$78,508	No Health Insurance	1,437 6%
Gini Index of Income Inequality			Public Health Insurance	6,690 27%
		0.43	Private Health Insurance	19,468 80%
Poverty Rates (Percent age cohort)			Transportation to Work (Workers 16+)	
Total Population	2,303	9%	Drove Alone	9,034 72%
Children (Under 18)	476	10%	Carpooled	1,535 12%
Working Age (18 to 64)	1,474	10%	Public Transit	236 2%
Seniors (65 and older)	353	10%	Motorcycle	23 < 1%
Housing Cost Burden (Cost > 30% of household income)			Bicycle/Walk	301 2%
Owners with a Mortgage	1,315	36%	Work at Home	1,306 10%
Owners without a Mortgage	367	24%		
Renters	2,597	51%		

Source: U.S. Census Bureau, 2016-2021 American Community Survey; Portland State University, Population Research Center, "Annual Population Estimates", METRO 2040 Population Distributed Forecast (2021, [Exhibit A to Ordinance 21-1457](#)).

Note: ACS 5-year estimates represent average characteristics from 2012-2016 or 2017-2021. Sampling error may result in low reliability of data. This information or data is provided with the understanding that conclusions drawn from such information are the responsibility of the user. Refer to the original source documentation to better understand the data sources, results, methodologies, and limitations of each dataset presented.

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the City of Wilsonville. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical and essential to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more. Table WA-4 includes critical facilities identified in the DOGAMI Risk Report (2024) and assumed impact from individual hazards.

Table WA-4 Critical Facilities in Wilsonville

Critical Facilities by Community	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby-Molalla Fault Mw-6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Wildfire High or Moderate Risk
	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed
Boeckman Creek Primary School	-	X	X	-	-
Boones Ferry Primary School	-	-	-	-	-
Geneva Health Center and Urgent Care	-	-	X	-	-
Inza R. Wood Middle School	-	X	X	-	-
Lowrie Primary	-	-	-	-	-
Meridian Creek Middle	-	-	-	-	-
Tualatin Valley Fire and Rescue - Station 52	-	-	X	-	-
Tualatin Valley Fire and Rescue - Station 54	-	-	-	-	-
Tualatin Valley Fire and Rescue - Station 56	-	-	X	-	-
Victory Academy	-	X	X	-	-
Wilsonville High School	-	X	X	-	-
Wilsonville Public Works Complex (EOC #1)	-	-	X	-	-
City Hall (EOC #2)	-	X	X	-	-
Willamette River Water Treatment Plant	-	-	-	-	-
Wilsonville Sewage Treatment	-	X	X	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-38.

Note: TVF&R Station 54 and Willamette River Water Treatment Plant not included in the DOGAMI analysis.

Additional Critical Facilities not included in the DOGAMI Risk Report:

- Fleet Services
- Police Station
- Spring Ridge at Charbonneau (southeast shelter)

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

Arterial Roads:

- I-5
- 95th Avenue
- Barber Street
- Boberg Road
- Boeckman Road
- Boones Ferry Road
- Brown Road
- Canyon Creek Road
- Coffee Lake Drive
- Day Road
- Elligsen Road
- French Prairie Drive
- Grahams Ferry Road
- Kinsman Road
- Miley Road
- Parkway Avenue
- Parkway Center Drive
- Ridder Road
- Stafford Road
- SW Touchman
- Town Center Loop
- Wilsonville Road

Bridges:

- Arrowhead Creek Lane Bridge
- Barber Street Bridge
- Boeckman Road Bridge
- Boone's Bridge (I-5/Willamette River)
- Creek Lane Bridge
- I-5/Wilsonville Road, Boeckman Road, and Elligsen Road overpasses
- Wilsonville Road/Boeckman Creek Bridge

Other critical infrastructure:

- Charbonneau Reservoir
- City wells
- Communication Tower
- Communication Tower – Pioneer Court
- Communication Tower -- Villebois
- Communication Tower
- Electric substation
- Freight tracks
- First Student Fleet & Dispatch
- Kinder Morgan Gas Line
- Level B Reservoir
- Level C Reservoir
- Northwest Natural Gas Line
- Power lines
- Pump stations
- Republic Waste Services
- SMART Transit Facility
- Wastewater Treatment Plant
- Water Treatment Plant – Arrowhead Creek Lane

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public's ability to recover from the emergency. These facilities may include: community gathering places, commercial centers, and other public facilities such as school fields.

Schools

- Arts and Technology High
- Boeckman Creek Primary School
- Boones Ferry Primary School
- Clackamas Community College

- Frog Pond Elementary
- Inza R. Wood Middle School
- Learning Tree Pre-school (to 4th grade)
- Lowrie Primary School
- Mentor Child Development Center
- Meridian Creek Middle School
- Oregon Institute of Technology
- Wilsonville High School

Pharmacies

- McKesson HBOC distribution center
- Rite Aid
- Rite Aid distribution center
- Walgreens

Food Providers

- Costco (+ pharmacy)
- Fred Meyer's (+ pharmacy)
- Safeway
- Sysco
- Target (+ pharmacy)

Other Essential Facilities

- Coffee Creek Correctional Facility
- Community Center
- Library
- Parks and Recreation Facility
- Providence Medical Facility

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include:

- Arrowhead Creek
- Basalt Creek
- Boeckman Creek
- Boeckman Creek Crossing Trail
- Boones Ferry Park (cultural/historic asset)
- Canyon Creek
- Canyon Creek Park
- Charbonneau Golf Course
- Coffee Creek
- Coffee Creek Wetlands
- Community Garden
- Courtside Park
- Graham Oaks Nature Park and Trailhead (cultural/historic asset)
- Hathaway Park
- Memorial Park (cultural/historic asset)
- Meridian Creek
- Merryfield Park
- Palermo Park
- River Fox Park
- Sofia Park
- Town Center Park (cultural/historic asset)
- Tranquil Park
- Villebois park system
- Willamette River
- Willamette River Water Treatment Plant Park
- Willow Creek Landover Park

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include:

- Coffee Creek Correctional Facility
- Day care facilities
- Schools (see list under essential facilities)

Senior Care Facilities

- Avalon Adult Center
- Brookdale
- Marquis Care at Wilsonville
- Springridge Court at Charbonneau
- The Wilsonville

Other Facilities

- Charleston at Villebois
- Creekside Woods
- Rainwater Gardens at Villebois
- Renaissance at Villebois

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: Kinder Morgan Pipeline, Northwest Natural Pipeline, and Sysco.

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to the city of Happy Valley. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers, and are a concern during evacuation/notification during a hazard event include:

- APCON, Inc
- Argyle Square
- Charbonneau Village Town Center
- Coherent
- Crimson Trace Corporation
- DW Fitz
- FLIR Systems
- FOODesign Machinery and Systems, Inc
- Georgia Pacific
- Kinetics
- Mentor Graphics
- Old Town Square
- OrePac
- Pacific Foods Distribution Center
- Pacific Pride
- Prologic
- Republic Waste Management
- Rite Aid Distribution Center
- Rockwell Collins
- Southern Wine & Spirits
- Swire Coca-Cola of Oregon
- Sysco Food Services of Portland, Inc
- Tarr Fueling
- Wilsonville Chamber of Commerce
- Wilsonville Concrete
- Xerox Corporation

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the city for generations and new resident alike, it is the unique places, stories, and annual events that makes the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life- enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

Cultural and historic assets include: CREST Environmental Learning Center, Fir Point Farm, Murase Plaza, Old Town (Historic), Oregon Korean War Museum, and Tauchman House in Boones Ferry Farm. Due to their historic nature many of these facilities are vulnerable to the earthquake hazard.

Hazard Characteristics

Drought

The HMAC determined that the City’s probability for drought is **high** and that their vulnerability to drought is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

The City of Wilsonville Public Works Department manages Wilsonville’s water supply. Wilsonville houses one large water intake facility and water treatment plant, which provides water to both the City of Wilsonville and the City of Sherwood. The City draws its water supply from the Willamette River. The City of Wilsonville and Tualatin Valley Water District (TVWD) have plans to develop additional facilities at Wilsonville to expand its water supply by 2026. This expanded infrastructure will also supply water to Beaverton and Hillsboro residents. In addition to the Willamette water supply, Wilsonville also has eight local emergency wells available for use in the event of a drought.

Vulnerability Assessment

Due to insufficient data and resources, Wilsonville is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table WA-4.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁶ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the City’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

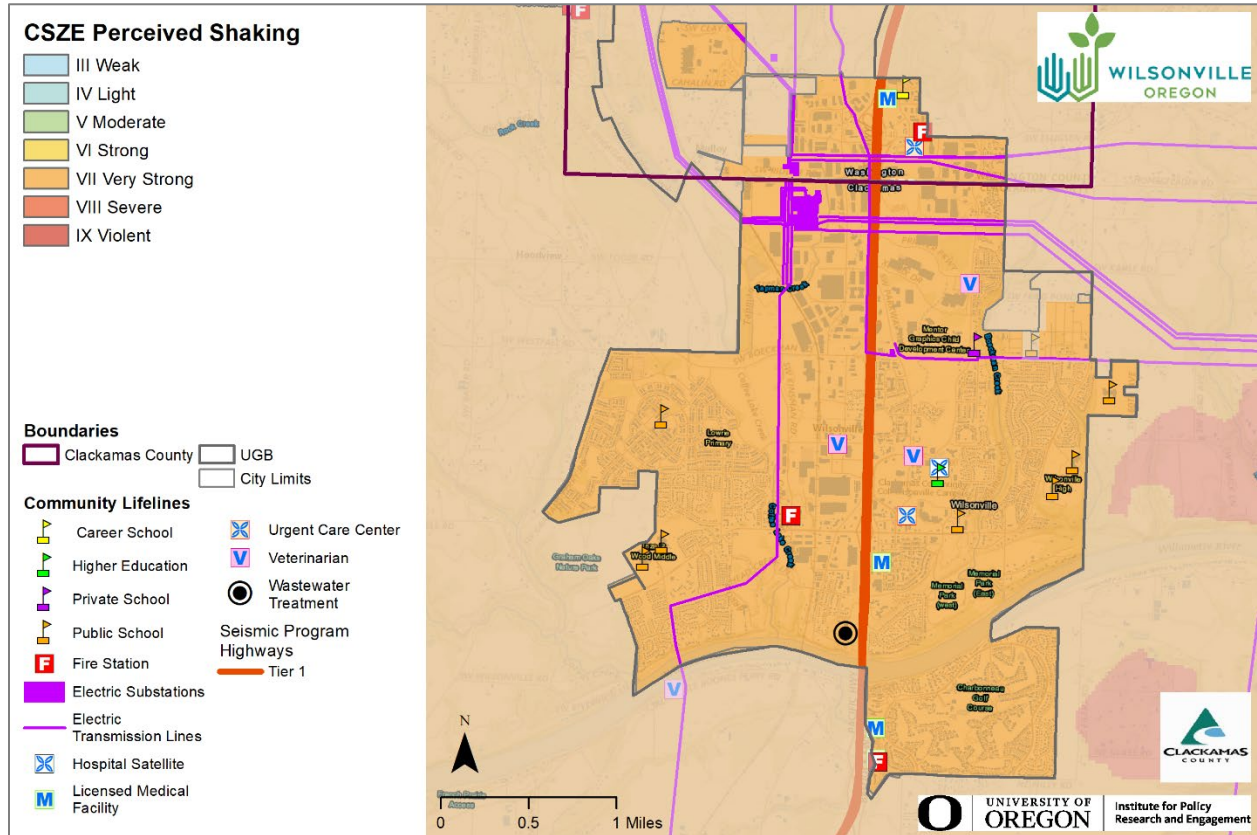
Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Wilsonville as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Wilsonville as well.

⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Wilsonville Fault Zone (discussed in the crustal earthquake section).

Figure WA-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Figure WA-2 Cascadia Subduction Zone Expected Shaking



Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.⁷

⁷ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

The city's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the city predominately within the "Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

Community assets located in the center of the city include Flir Systems, FOODesign Machinery & Systems, Inc., Pacific Pride, WES commuter rail station, Mentor Graphics Child Development Center, and a pump/lift station. Another high impact area is located within Charbonneau and includes the Charbonneau Village Town Center. If a large earthquake were to occur the biggest vulnerability would be reaching the Charbonneau neighborhood because it is located across the Willamette River from the rest of the city. The Boone Bridge that provides access to Charbonneau has had seismic retrofit work done, but this does not guarantee use in a large event. Additionally, Wood Middle School is in a high impact area.

Earthquake (Crustal)

The HMAC determined that the City's probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *The probability rating decreased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Wilsonville as well. Figure WA-3 shows a generalized geologic map of the Wilsonville area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the City limits as red and orange.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

There are two potential crustal faults and/or zones near the City that can generate high-magnitude earthquakes. These include the Gales Creek-Mt. Angel Structural Zone and Portland Hills Fault Zone (discussed in greater detail below). Other nearby faults include the Bolton fault and Oatfield faults which run through the city west and east side respectively, Canby-Molalla structural zones located west of the city, and the Mt. Hood Fault in eastern Clackamas County. Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993, Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Canby-Molalla Fault Zone

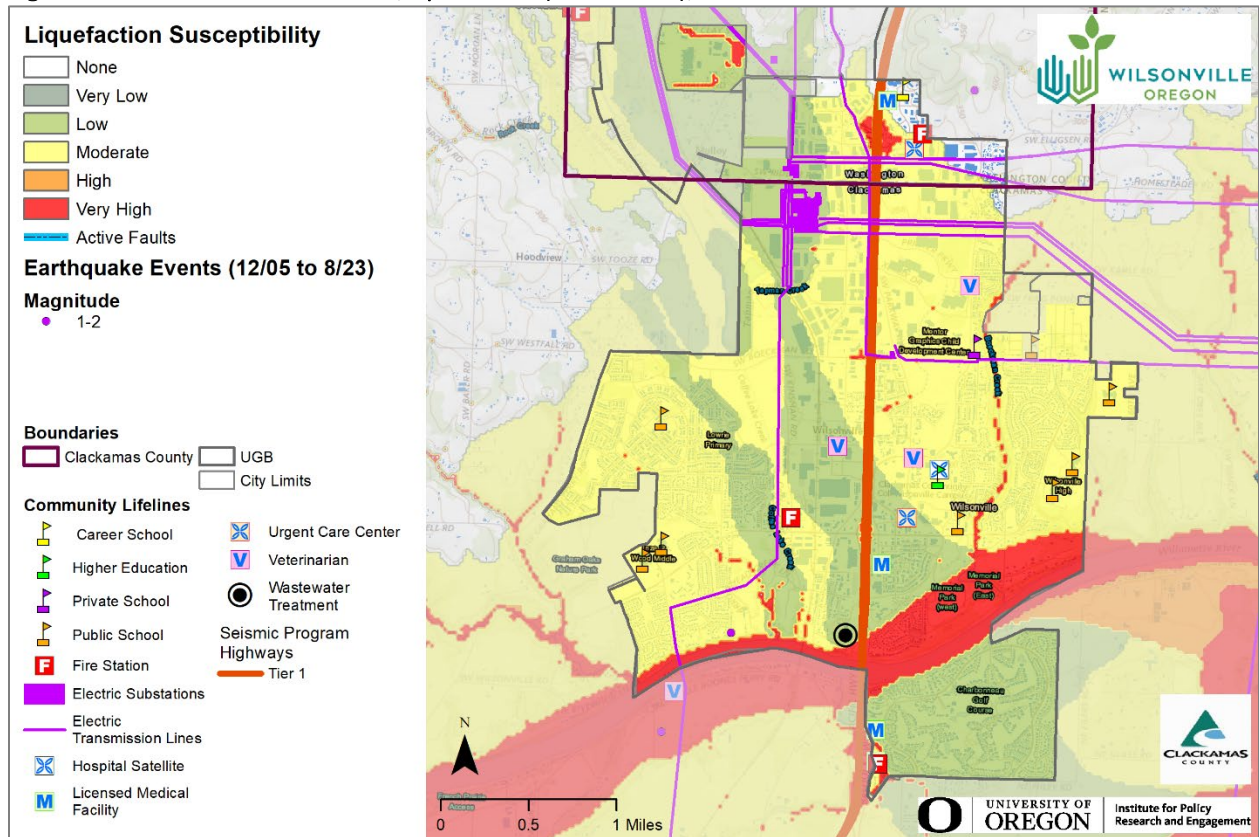
The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Wilsonville in northern Oregon.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years

ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 11 miles northeast of Wilsonville.

Figure WA-3 Active Crustal Faults, Epicenters (1971-2008), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided at the end of the crustal earthquakes hazard section.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the community profile, approximately 36% of residential buildings were built prior to 1990, which increases the City’s vulnerability to the earthquake hazard. Information on specific public buildings’ (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table WA-5; each “X” represents one building within that ranking category. Of the facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), one (1) have a very high (100% chance) collapse potential and two (2) have a high (greater than 10% chance) collapse potential.

For a list of facilities and infrastructure vulnerable to this hazard, see the Community Assets Section and Table WA-4.

Table WA-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Arts & Technology High (29796 SW Town Center Loop E)	n/a	X			
Boeckman Creek Primary (6700 SW Wilsonville Rd)	Clac_sch71	X			
Boones Ferry Primary (11495 SW Wilsonville Rd)	Clac_sch84	X			
CCC Wilsonville Campus (29353 Town Center Loop E)	Clac_coc08				X
Inza R. Wood Middle (11055 SW Wilsonville Rd.)	Clac_sch92			X,X	
Wilsonville High (6800 SW Wilsonville Rd)	Clac_sch77	X			
Learning Tree Day School (29880 Town Center Loop W)	n/a	2007 RVS report did not include structural appendix for this facility			
Lowrie Primary School (28995 SW Brown Rd)	n/a	2007 RVS report did not include structural appendix for this facility			
Meridian Creek Middle School (6300 SW Hazel St)	n/a	2007 RVS report did not include structural appendix for this facility			
Fire Facilities					
Fire Station 52 (TVF&R) (29875 Kinsman Rd) see mitigation successes	Clac_fir34	X			
Fire Station 56 & South Operating Center (TVF&R) (8445 Elligsen Rd) see mitigation successes	Clac_fir54	2007 RVS report did not include structural appendix for this facility			
Police Facilities					
Police Station (30000 Town Center Loop E)	n/a				
Hospital					
Providence Medical Plaza (29345 SW Town Center Loop)	n/a	2007 RVS report did not include structural appendix for this facility			

Source: [DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.](#)
 “*” – Site ID is referenced on the [RVS Clackamas County Map](#)

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Table WA-6 shows the permanent resident population that are vulnerable to injury or death (casualty) and the buildings in the City that are susceptible to liquefaction and landslides, it does not predict that damage will occur in specific areas due to either liquefaction or landslide. More population and property are exposed to higher degrees of expected damage or casualty under the Portland Hills Fault “wet” scenario than in any other scenario.

Table WA-6 Expected damages and casualties for the CSZ fault and Portland Hills fault: earthquake, soil moisture, and event time scenarios

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	5,492	5,492	5,492	5,492
Building Value (\$ Million)	4,410	4,410	4,410	4,410
Building Repair Cost (\$ Million)	291	423	406	681
Building Loss Ratio	7%	10%	9%	15%
Debris (Thousands of Tons)	155	196	196	283
Long-Term Displaced Population	147	894	181	1,616
Total Casualties (Daytime)	199	315	255	505
Level 4 (Killed)	7	14	9	24
Total Casualties (Nighttime)	38	100	50	173
Level 4 (Killed)	1	3	1	6

Source: DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8, 12-9, 12-10, and 12-11.

Cascadia Subduction Zone Scenario

The City of Wilsonville is expected to have a 7% building loss ratio with a repair cost of \$291 million under the CSZ “dry” scenario, and an 10% building loss ratio with a repair cost of \$423 million under the CSZ “wet” scenario.⁸ The city is expected to have around 199 daytime or 38 nighttime casualties during the CSZ “dry” scenario and 315 daytime or 100 nighttime casualties during the CSZ “wet” scenario. It is expected that there will be a long-term displaced population of around 147 for the CSZ “dry” scenario and 894 for the CSZ “wet” scenario.⁹

Portland Hills Fault Scenario

The City of Wilsonville is expected to have a 9% building loss ratio with a repair cost of \$406 million under the CSZ “dry” scenario, and a 15% building loss ratio with a repair cost of \$681 million under the CSZ “wet” scenario.¹⁰ The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 255 daytime or 50 nighttime casualties during the Portland Hills Fault “dry” scenario and 505 daytime or 173 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 181 for the Portland Hills Fault “dry” scenario and 1,616 for the Portland Hills Fault “wet” scenario.¹¹

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table WA-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and

⁸ DOGAMI, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon (2018, O-18-02), Tables 12-8 and 12-9.

⁹ Ibid, Tables 12-8 and 12-9.

¹⁰ Ibid, Tables 12-10 and 12-11

¹¹ Ibid, Tables 12-10 and 12-11.

the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))¹² provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard.

Cascadia Subduction Zone event (M9.0 Deterministic): 619 buildings (6 critical facilities), are expected to be damaged for a total potential loss of \$538.4 million (a loss ratio of about 10%). About 1,285 residents may be displaced (about 5% of the population).

Crustal event (Canby-Molalla fault M6.8 Deterministic): 1,704 building (11 critical facilities) are expected to be damaged, for a total potential loss of \$1.62 billion (a loss ratio of about 29%). About 4,597 residents may be displaced (about 18% of the population).

Portland Hills Fault M6.8 Deterministic: The City of Wilsonville is expected to have a 9% building loss ratio with a repair cost of \$406 million under the CSZ “dry” scenario, and a 15% building loss ratio with a repair cost of \$681 million under the CSZ “wet” scenario. The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 255 daytime or 50 nighttime casualties during the Portland Hills Fault “dry” scenario and 505 daytime or 173 nighttime casualties during the Portland Hills Fault “wet” scenario. It is expected that there will be a long-term displaced population of around 181 for the Portland Hills Fault “dry” scenario and 1,616 for the Portland Hills Fault “wet” scenario.

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

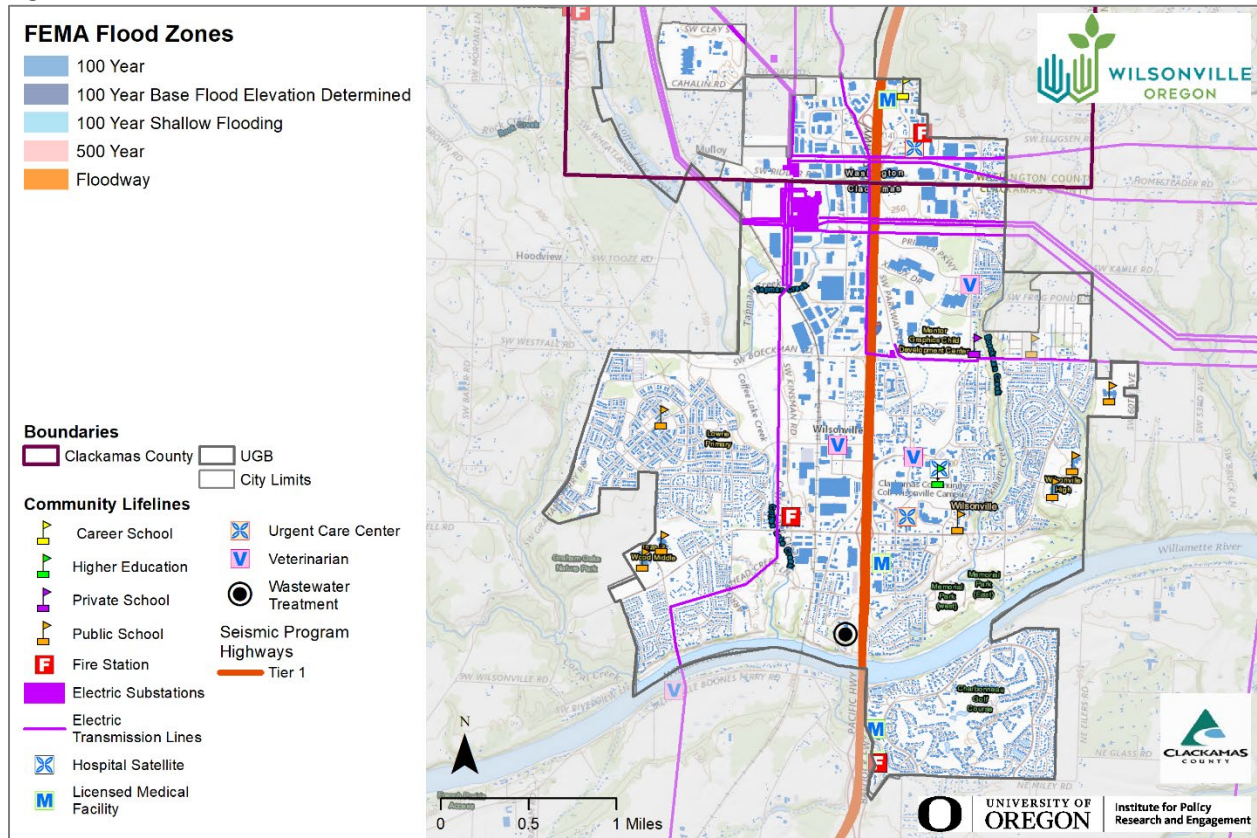
The HMAC determined that the City’s probability of flooding is **moderate** and that their vulnerability to flooding is **low**. *The probability rating did not change and the vulnerability rating increased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure WA-4 illustrates the flood hazard area for Wilsonville.

Portions of Wilsonville have areas of floodplain (special flood hazard areas, SFHA). These include the Willamette River, Coffee Creek, Basalt Creek, Boeckman Creek, Meridian Creek, Arrowhead Creek, Corral Creek, and South Tributary. The geographic location of the flooding hazard was determined using the designated FEMA 100-year floodplain data, as well as the inundation line for the 1996 flood. The flood hazard includes portions of Boeckman Road, a large area along Seely Ditch between the confluence of Basalt Creek, Coffee Creek, and South Tributary. Impacted community assets include one pump station, and fewer than five homes.

¹² DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-37.

Figure WA-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

Fortunately, most of the flood hazard is included in the Significant Resource Overlay Zone (SROZ), where development is prohibited. The SROZ includes 780 acres of land and has a 25-foot buffer zone where building applications and city staff work together to decide on the ultimate “no build” boundary for the site. The SROZ map includes a few areas where the 1996 flood extended beyond the FEMA 100-year flood boundaries. These areas include portions of Corral Creek, spots in Memorial Park, and an area just west of Memorial Park.

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners, and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Wilsonville outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The largest flooding event to affect Wilsonville was the February 1996 flood. The high-water level meant tributaries could not drain into the Willamette River, which led to localized flooding on several backed-up creeks. Flooding also occurred at culverts and drainage choke points near Sun Place, Commerce Circle, and a pathway near Inza R. Wood Middle School. The La Quinta Hotel on Sun Place experienced a few inches of flooding to the first floor. The culverts that frequently cause flooding are owned and maintained by the Oregon Department of Transportation. The worst flooding occurred along the Willamette River. Portions of Memorial Park flooded but the sewer lift station was unaffected because Public Works sandbagged the facility and pumped out water for days. Three homes on Montgomery Way and Rose Lane were flooded; two homes had flooding in their living spaces and one home had storage space flooding.

The extent of flooding hazards in Wilsonville primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow. In the past flooding has occurred along Main Street and other roadways due to urban flooding. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table WA-4.

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**¹³ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report 5 buildings (no critical facilities) could be damaged for a total potential loss of \$201,000 (a building loss ratio of less than 1%). About 37 residents may be displaced by flood (less than 1% of the population).

National Flood Insurance Program (NFIP)

FEMA's Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. The last Community Assistance Visit (CAV) for Wilsonville was on January 14, 2009. Wilsonville does not participate in the Community Rating System (CRS). The Community Repetitive Loss record identifies no (0) Repetitive Loss Property¹⁴ and zero (0) Severe Repetitive Loss Properties¹⁵.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"¹⁶ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to

¹³ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon (2024)*, Table A-37.

¹⁴ A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than \$1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

¹⁵ A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding \$5,000 and with cumulative amount of such claims payments exceeding \$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

¹⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the City’s probability for landslide is **low** and that their vulnerability to landslide is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Wilsonville does not have a history of landslides. This is due to the relatively flat topography within the UGB as well as the City’s requirements of geological analysis on slopes of 25% or greater, usually located along stream embankments, before extensive tree removal, excavation, or construction occurs.

Although landslides have not occurred in Wilsonville, steep slopes do exist along the banks of the Willamette River. Four neighborhoods have been built near these slopes including Day Dream Ranch, Cedar Point, Edgewater, and Charbonneau. Canyon Creek Apartments are built on a moderate hill near the creek.

Landslide susceptibility exposure for Wilsonville is shown in Figure WA-5. Most of Wilsonville demonstrates a low to moderate landslide susceptibility exposure. Approximately 6% of Wilsonville has very high or high, and approximately 21% moderate, landslide susceptibility exposure.¹⁷

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above and within Figure WA-5.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table WA-5.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Natural Hazard Risk Report for Clackamas County

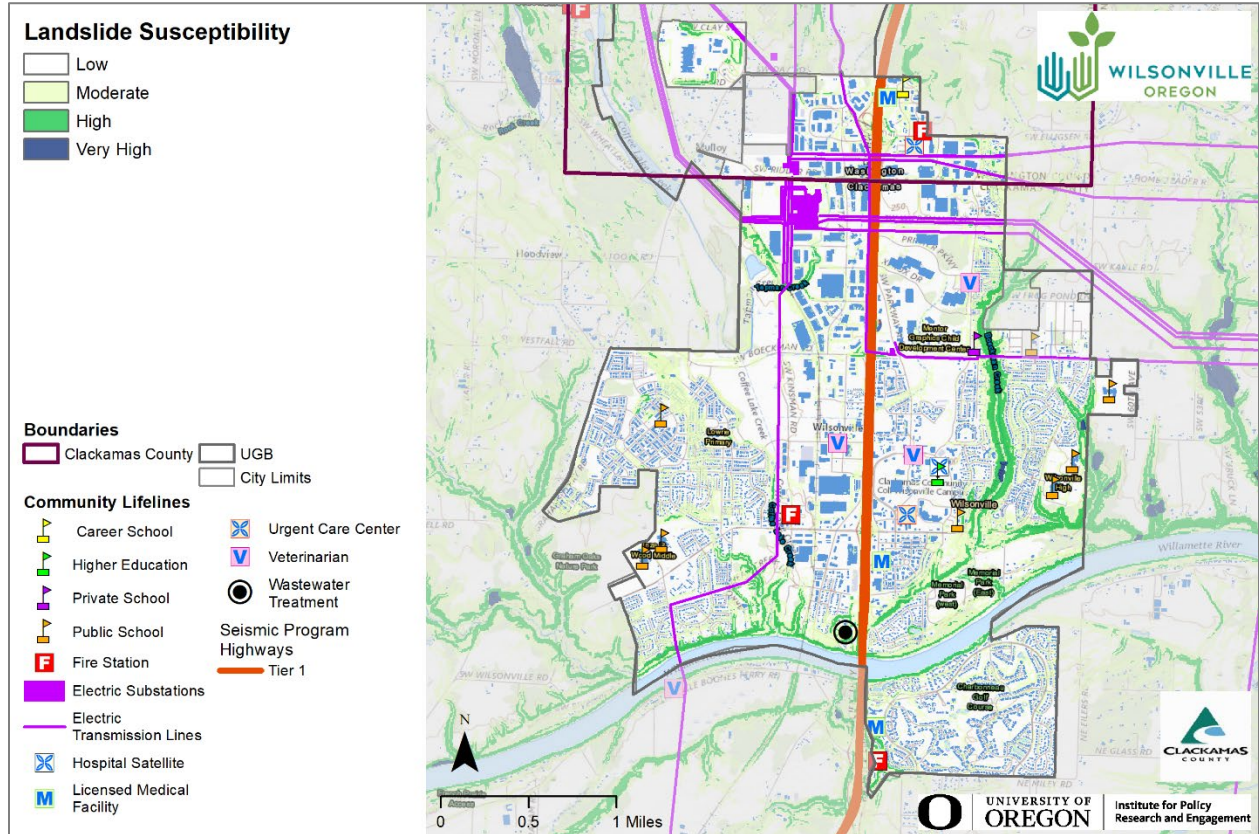
The **Risk Report** (DOGAMI, [2024](#))¹⁸ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

¹⁷ DOGAMI. [Open-File Report, O-16-02](#), *Landslide Susceptibility Overview Map of Oregon* (2016)

¹⁸ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-37.

According to the Risk Report 91 buildings (no critical facilities) are exposed to the *high and very high landslide susceptibility* hazard for a total exposure of \$5.5 million (a building exposure ratio of about 1%). About 512 residents may be displaced by landslides (about 2% of the population).

Figure WA-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the City’s probability for extreme heat events is **high** and that their vulnerability is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the City as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The City of Wilsonville has experienced life-threatening consequences to vulnerable populations from recent extreme heat events. Changes in climate indicate that the area should expect to see more extreme heat events.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁹ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the City’s probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Wilsonville.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris. Additionally, transportation and economic disruptions result as well. Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied

¹⁹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the City’s probability for winter storm is **moderate** and that their vulnerability to winter storm is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

The biggest impact of winter storms is congestion on roadways. Interstate 5 bisects Wilsonville into east and west sections. When I-5 backs up many of Wilsonville’s transportation networks become congested. This is especially true if snow on I-5 is not plowed. Wilsonville has minimal construction on steep slopes but the Canyon Creek Apartment Complex has steep driveways which may be difficult to traverse in freezing weather.

Most winter storms typically do not cause significant damage, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter and commercial traffic as noted above.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”²⁰ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

²⁰ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Vulnerability Assessment

Due to insufficient data and resources, Wilsonville is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets Section and Table WA-4.

Volcanic Event

The HMAC determined that the City's probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of volcanic event hazards, history, as well as the location, extent, and probability of a potential event within the region. Volcanoes are located near Wilsonville, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Wilsonville's relative distance from volcanoes, the city is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the city may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the city could experience a heavier coating of ash.

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, [2024](#))²¹ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard.

The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the City's probability for wildfire is **moderate**, and that their vulnerability to wildfire is **moderate**. *These ratings did not change since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan](#) (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Wilsonville is found in the following chapter: Chapter 9.13: Tualatin Valley Fire and Rescue.

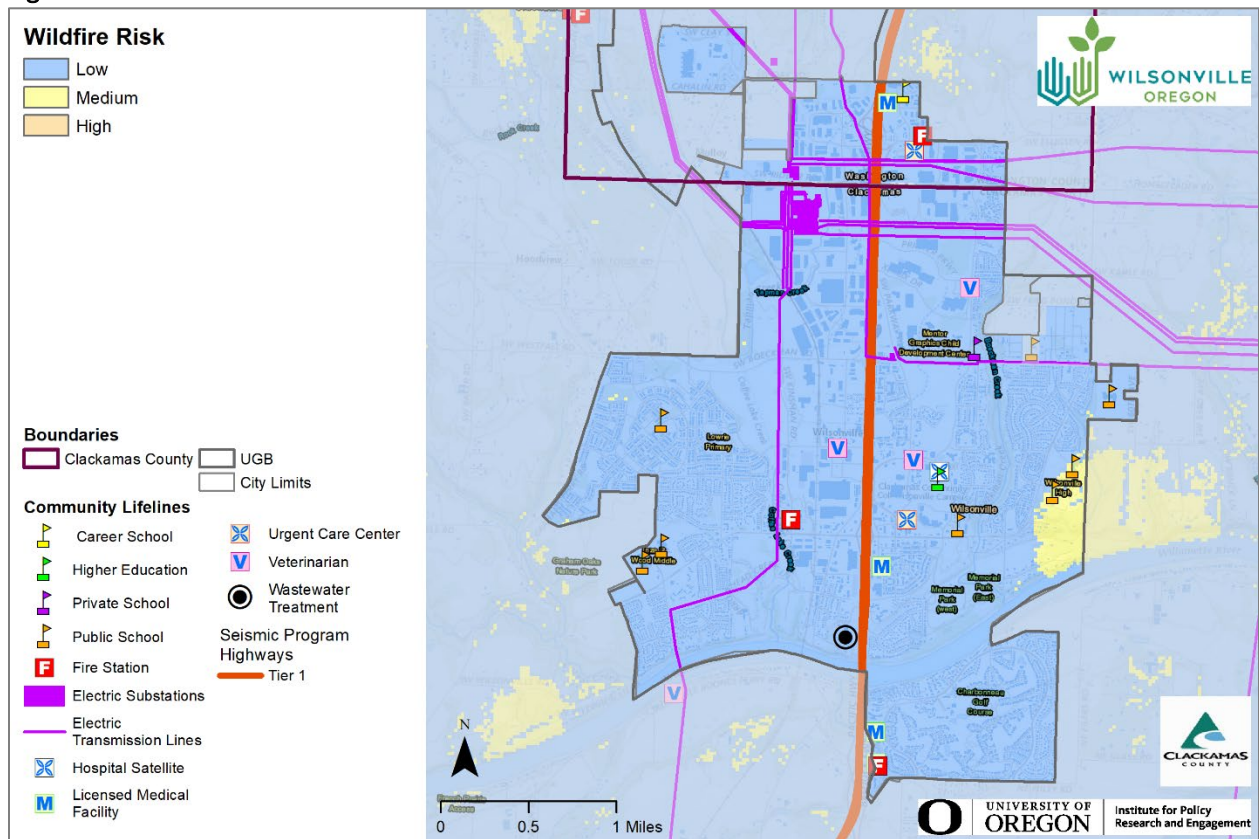
²¹ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-37.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather and urbanization conditions are primarily at cause for the hazard level. Wilsonville has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. Figure WA-6 shows overall wildfire risk in Wilsonville.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Wilsonville, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

Figure WA-6 Wildfire Risk



The forested hills within, and surrounding Wilsonville are interface areas including the Beckman Creek Corridor, Xerox Woods, Burnerts Orchard, the Living Enrichment Center (LEC), Metro Graham Oaks Nature Park, the area north of Elligsen Road near fire station 56, and the area east of Wilsonville High

School, where access would be a problem. High and Medium Priority Communities at Risk (CARs) within the City include: Graham Oaks Nature Park (part of Ladd Hill CAR) and Boeckman Creek.²²

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four feet under normal weather conditions.²³ However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Vulnerability Assessment

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the City as well. Wilsonville's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The City will update the City's wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Natural Hazard Risk Report for Clackamas County

The **Risk Report (DOGAMI, 2024)**²⁴ provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 49 buildings (no critical facilities) are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of \$25.6 million replacement value (a building replacement value exposure ratio of less than 1%). About 235 residents may be displaced by wildfires (less than 1% of the population).

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"²⁵ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

²² Clackamas County Community Wildfire Protection Plan, *Wilsonville Fire Department* (2018), Table 10.13-1.

²³ [Oregon Wildfire Risk Explorer](#), date accessed November 9, 2018.

²⁴ DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-37.

²⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Attachment A: Action Item Changes

Table WA-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table WA-1).

Previous NHMP Actions that are Complete:

Multi-Hazard #2, “Integrate the goals and action items from the Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.” Complete. Part of NHMP implementation program.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

Flood #2, “Coordinate with the Oregon Department of Transportation (ODOT) to increase the capacity of culvert.” No longer relevant. Conducted as part of stormwater planning.

Table WA-7 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Multi-Hazard #2	-	Complete	No
Multi-Hazard #3	#2	Not Complete	Yes
Earthquake #1	#3	Not Complete	Yes
Earthquake #2	#4	Not Complete	Yes
Earthquake #3	#5	Not Complete	Yes
Earthquake #4	#6	Not Complete	Yes
Flood #1	#7	Not Complete	Yes
Flood #2	-	Complete	No
Flood #3	#8	Not Complete, revised	Yes
Severe Weather #1	#9	Not Complete	Yes
-	#10	New	-
Wildfire #1	#11	Not Complete	Yes

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from March 19, 2024 through April 16, 2024 on the City's website via a link to the County's website (February 26 – March 31, 2024). The plan was also posted and announced on the County's website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

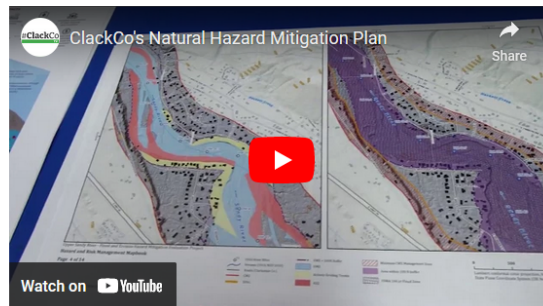
A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

County Website Posting



COMMUNITY

Natural Hazards Mitigation Plan



Clackamas County seeks public comment on update to Natural Hazard Mitigation Plan

Clackamas County is currently in the process of updating their existing Natural Hazard Mitigation Plan (NHMP). This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program. With re-adoption of the plan, Clackamas County will maintain its eligibility to apply for federal funding towards natural hazard mitigation projects.

This local planning process includes a wide range of representatives from city and county government, emergency management personnel, and outreach to members of the public in the form of an electronic survey. This mitigation plan also affects the cities of Canby, Estacada, Gladstone, Happy Valley, Lake Oswego, Milwaukie, Molalla, Oregon City, Sandy, West Linn, and Wilsonville, and the special districts of Clackamas Fire District, Clackamas River Water, Colton Water District, and Oak Lodge Water Services.

Please submit comments by Friday, March 8, 2024 via email to ccdm@clackamas.us.

Draft plan by section

Draft 2024 Volume I – Clackamas County Natural Hazard Mitigation Plan

Draft 2024 Volume II – Jurisdictional Addenda

- Canby Addendum
- Clackamas Fire District Addendum
- Clackamas River Water Addendum
- Colton Addendum
- Estacada Addendum
- Gladstone Addendum
- Happy Valley Addendum
- Lake Oswego Addendum
- Milwaukie Addendum
- Molalla Addendum
- Oak Lodge Addendum
- Oregon City Addendum
- Sandy Addendum
- West Linn Addendum
- Wilsonville Addendum

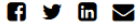
Draft 2024 Volume III – Annexes

- Mitigation Success Example
- Mitigation Factsheet

City Website Posting

[Home](#) / [Natural Hazards Mitigation Plan](#)

Natural Hazards Mitigation Plan



The City of Wilsonville is in the process of updating its Natural Hazards Mitigation Plan (NHMP), which provides a set of goals, action items, and resources designed to reduce risk from future natural disaster events.

This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management (OEM) utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program.

With re-adoption of the plan, the City of Wilsonville will maintain its eligibility to apply for federal funding toward natural hazard mitigation projects. The local planning process is informed by a wide range of representatives from city, special districts, and county government, emergency management personnel, as well as outreach to the public.

Engaging in mitigation activities provides jurisdictions with a number of 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.

An electronic version of the updated draft Wilsonville NHMP addendum is available for formal public comment until **April 16, 2024**. To view the draft plan, please visit this [link](#) or see PDF attached.

If you have any questions or wish to submit comments regarding the Wilsonville NHMP addendum or the update process in general, please contact: Martin Montalvo, Public Works Operations Manager, at (503) 570-1560 or montalvo@ci.wilsonville.or.us; or Michael Howard, Director for the Oregon Partnership for Disaster Resilience at (541) 346-8413 or mrhoward@uoregon.edu.

GUESTBOOK

Wilsonville NHMP Public Comment

An electronic version of the updated draft Wilsonville NHMP addendum is available for formal public comment beginning **March 19, 2024**. The public comment period will close on **April 16, 2024**. The City of Wilsonville is asking for public comment regarding this draft. To view the draft please visit this [link](#).

Who's Listening

Martin Montalvo


Public Works Operations Manager
City of Wilsonville

Phone (503) 570-1560

Email montalvo@ci.wilsonville.or.us



Documents

 [Wilsonville Natural Hazards Mitigation Plan \(2.98 MB\) \(pdf\)](#)

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1: March 20, 2023

During this meeting, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: December 11, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.

Clackamas Fire District Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: Clackamas Fire District

Effective:

September 12, 2024 – September 11, 2029

Prepared for
Clackamas Fire District

Updated:
July 15, 2024, (Resolution # 24-03)
September 16, 2019, (Resolution # 2020-02)



CLACKAMAS FIRE DISTRICT #1

This Natural Hazard Mitigation Plan was prepared by:



Planning grant funding provided by:



Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS



CLACKAMAS FIRE DISTRICT

Here for you

RESOLUTION 24-03

A Resolution Adopting the Clackamas Fire District Representation in the Updates to the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan

Whereas, the Clackamas Fire District recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the Clackamas Fire District has fully participated in the FEMA prescribed mitigation planning process to prepare the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

Whereas, the Clackamas Fire District has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the Clackamas Fire District to the impacts of future disasters within the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*; and

Whereas, these proposed projects and programs have been incorporated into the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

Whereas, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, June 11, 2024) contingent upon this official adoption of the participating governments and entities;

Whereas, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

Whereas, the NHMP is in an on-going cycle of development and revision to improve it's effectiveness; and



Whereas, the Clackamas Fire District adopts the NHMP and directs the Fire Chief to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

Now, therefore, be it resolved, that the Clackamas Fire District adopts *the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan; and

Be it further resolved that the Clackamas Fire District will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

Adopted this 15th day of July, 2024

James Syring
James Syring (Aug 19, 2024 20:02 PDT)

President, Board of Directors

Jay Cross
Jay Cross (Aug 20, 2024 10:20 PDT)

Secretary, Board of Directors

Purpose

This is an update of the Clackamas Fire District (CFD, Fire District) addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Clackamas Fire District adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 15, 2024. FEMA Region X approved the Clackamas County NHMP and the Fire District's addendum on September 12, 2024. With approval of this NHMP the Fire District is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through September 11, 2029.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of the NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community's environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that Clackamas County citizens, and public, and private partners can take while working to reduce the Fire District's risk from natural hazards. These statements of direction form a bridge between the broad mission statement, and serve as checkpoints, as agencies, and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

The Fire District concurs with the goals developed during the Clackamas County planning process (Volume I, Section 3). All NHMP goals are important and are listed below in no 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.

Below is a list of the NHMP goals:

GOAL #1: PROTECT LIFE AND PROPERTY

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

GOAL #2: ENHANCE NATURAL SYSTEMS

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

GOAL #3: AUGMENT EMERGENCY SERVICES

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

GOAL #4: ENCOURAGE PARTNERSHIPS FOR IMPLEMENTATION

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

GOAL #5: PROMOTE PUBLIC AWARENESS

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

GOAL #6: ADVANCE EQUITY AND INCLUSION

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption* and 44 CFR 201.6(a)(3), *Participation*.

This Clackamas Fire District addendum was added to the Clackamas County NHMP in 2019. In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption, and federal approval of this NHMP ensures that the Fire District will remain eligible for pre- and post-disaster mitigation planning and project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Institute for Policy Research and Engagement (IPRE) collaborated with the Oregon Department of Emergency Management (OEM), Clackamas County, and the Fire District to update their NHMP.

The Clackamas County NHMP and Clackamas Fire District addendum are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The Clackamas Fire District HMAC guided the process of developing their NHMP addendum.

Convener

Clackamas Fire District's Assistant Chief of Strategic Operations served as the designated convener of the NHMP development and will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from the Clackamas Fire District HMAC met formally and informally, to discuss updates to their addendum (Volume III, Appendix B). This addendum reflects decisions made at the designated meetings and during subsequent work and communication between the Fire District's convener and OPDR.

The Clackamas Fire District HMAC was comprised of the following representatives:

- Convener, Brian Stewart, Assistant Chief
- Phil Schneider, Division Chief
- Brent Olson, Division Chief
- Shawn Olson, Battalion Chief

The HMAC served as the local review body for the NHMP's update.

NHMP Implementation and Maintenance

The CFD Board of Directors will be responsible for adopting the Clackamas Fire District addendum to the Clackamas County NHMP. This addendum designates the HMAC, and a convener to oversee the development, and implementation of action items. Because the Fire District addendum is part of the County's multi-jurisdictional NHMP, the Fire District will look for opportunities to partner with the County. The Fire District's HMAC will convene after re-adoption of the Clackamas Fire District NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities and Fire District to report on NHMP implementation, and maintenance during their meetings. The CFD Emergency Manager will serve as the convener and will be responsible for assembling the HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing, and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating, and training new HMAC members on the NHMP, and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction's website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public in the Fire District; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other Fire District plans and programs including their [Strategic Plan](#) and the [Clackamas County Community Wildfire Protection Plan](#) as well as the [Clackamas County NHMP](#), and the [State of Oregon NHMP](#).

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the Fire District. Plans and policies already in existence have support from district residents, businesses, and policy makers. Where possible, Clackamas Fire District will implement the NHMP's recommended actions through existing plans and policies. Many land-use and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Future development without proper planning may result in worsening problems associated with natural hazards. In addition, Metro, the regional government for Clackamas, Multnomah, and Washington counties, determines many land use laws for the tri-county region and sets the urban growth boundary. The entire Portland Metro area is subject to tremendous growth pressures due to its desirable location and the restrictions on urban sprawl placed by urban growth boundary requirements.

Clackamas Fire District currently has the following plans that relate to natural hazard mitigation: [Clackamas County Community Wildfire Protection Plan: Clackamas Fire District \(CFD\)](#) and [Strategic Plan](#). For a complete list visit the Fire District's [website](#).

Capability Assessment

The Capability Assessment identifies and describes the ability of Clackamas Fire District to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., structural building codes, stormwater master plan update, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other planning documents (i.e., plan integration), adopting engineering standards and regulations that account for best practices in structural hardening, and incorporating mitigation into system maintenance and enhancement. The extent to which a district or multi-jurisdictional effort leverages these approaches is an indicator of that community's or organization's capabilities.

Strategic Planning

Existing policies that define service provision and address hazardous conditions provide a source of mitigation capability.

Comprehensive Planning in Clackamas County takes place at the County level and relevant information is included in the County NHMP (Volume 1).

Clackamas Fire District #1 is one of the largest fire protection districts in Oregon, serving nearly 220,000 permanent residents and covering nearly 228 square miles. 300 career firefighters and administrative personnel, with a cadre of volunteer firefighters, respond to tens of thousands of incidents annually from 22 strategically located fire stations. The district has grown since the adoption of the last NHMP through the opening of the Damascus Station in April 2019. The fire district has an intergovernmental agreement with the City of Sandy for the joint operation of Station 18 and has entered into a new intergovernmental agreement with the City of Gladstone to operate their fire station and provide fire protection services.

In order to ensure that Clackamas Fire District #1 provides the resources that are required to respond to the current and future service demands, a Standards of Cover (SOC) document is maintained.

The CFD Board of Directors has adopted a [Strategic Plan for 2023-2026](#) that are used to determine organizational priorities. These strategic goals reinforce the importance of resilience and hazard mitigation planning. The adopted Strategic Goals include goals, objectives, and key performance indicators for two organizational priorities: Our People and Emergency Response. The 2018 NHMP goals were incorporated into this Strategic Plan, including securing funding for fire station remodeling, public outreach and education, and communication system improvements.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code. CFD falls under Clackamas County's Building Codes.

Capital Improvement Planning & Budgeting

The CFD Board of Directors has the responsibility of developing and adopting the annual budget. Integrating hazard mitigation goals and projects into the annual budget in the future will be key to implementing the NHMP.

Unlike other large fire agencies, Clackamas Fire has historically operated without an emergency services optional levy to fund firefighter positions and equipment. To make strategic and long-term investments in equipment and staffing, Clackamas Fire formed Future Funding Taskforce, which ultimately recommended that the district consider an enhanced services levy. Clackamas Fire hosted community engagement events in 2022 and 2023 during the levy development process. After evaluating community and district needs, district leadership finalized the levy elements, and the Board of Directors referred a levy to the May 2023 ballot.

The enhanced services levy provides new financial resources to the district to fund enhanced firefighter staffing and equipment. The levy will allow Clackamas Fire to:

- Hire 62 additional firefighters;
- Enable increased staffing across most fire stations;
- Provide 24/7 career staffing at two rural fire stations (Logan and Clarkes) that are critical to wildfire and emergency response;
- Supply quick response vehicles to improve response efficiency in high-volume service areas;
- Invest in equipment and operational costs connected to emergency and wildfire mitigation, prevention, and response.

The FY 2023-24 budget began implementation of the levy funding by establishing 24 new firefighter positions and investing in equipment and apparatus to support the mission. FY 2023-24 was also the first year of Clackamas Fire's full contract for service with Sandy Fire District.

Programs & Projects

This Plan directs CFD and Clackamas County to explore integration into other planning documents and processes. CFD has made significant progress in integrating the resilience efforts into its portfolio of planning programs and projects over the last five years.

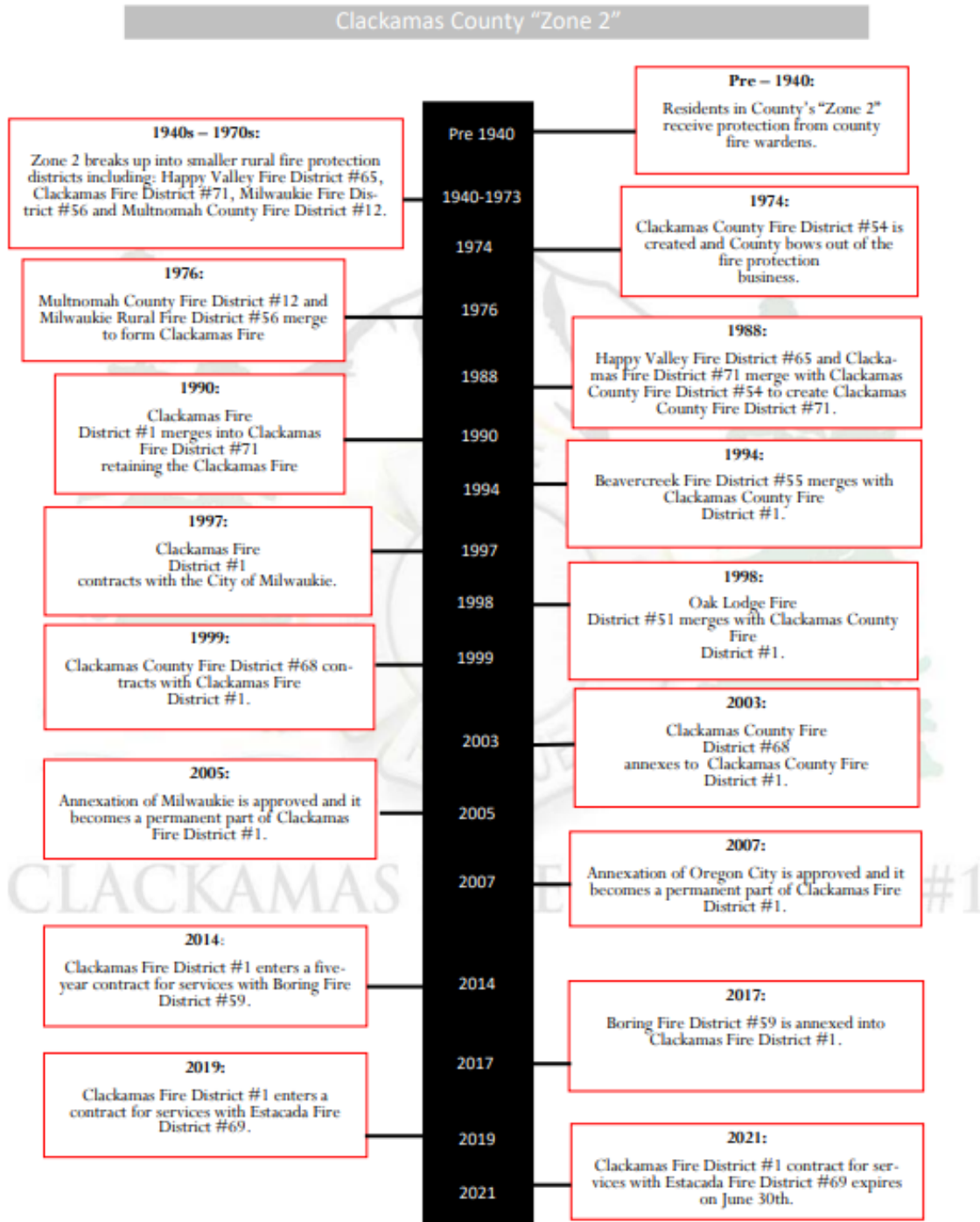
Fire District Expansion

In the last decade, the Fire District has experienced rapid population and construction growth rates. Those rates are expected to increase as buildable residential property and suitable industrial land continue to be developed. The Fire District must plan for additional increases as the more suburban and rural areas are urbanized and the population centers become more densely populated through infill and increased regional planning efforts.

Over the last five years, the District has worked hard to expand its capacity. The District graduated 24 new community volunteers in 2020 to help support operations and held an additional academy for community volunteers in the fall of 2021. The Wildland Fuels Mitigation crew "Crew 30" was a new crew added in the FY2020-21 after the Fire District received Worksource grant funding. The grant funds up to 22 positions specifically geared towards training and employing persons to repair the effects from

the 2020 wildfires in Clackamas County. In addition, these persons were trained and outfitted to be able to respond to wildfires as a suppression resource throughout the state on a contracted basis.

The following is a timeline displaying major events (through 2022) in the history of Clackamas Fire District #1¹:



¹ Clackamas Fire District, [Annual Budget 2021-2022](#).

Public Awareness Campaigns

CFD encourages residents to develop personal [Wildfire Action Plans](#). This campaign encourages residents to take personal responsibility to be prepared for wildfire evacuation. During High Fire Danger days, residents are encouraged to monitor media for information on wildfire and be ready to implement their personal plan.

CFD maintains an active website with community resources on Wildfire and structural fire prevention. The website includes Ready, Set, Go! Information and Essential Supplies checklists for evacuation. The [Siren Newsletter](#) is a digital repository that chronicles the latest updates, events, and achievements of the district and “reflects the unwavering commitment of our team to ensuring the safety and well-being of our residents.”

In 2023-2024, CRW is planning on hiring a full time Public Outreach/Communication employee to enhance abilities to meet the information needs of stakeholders.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex and into the District’s capital improvement planning. The CWPP is expected to be adopted in 2024.

Personnel

Clackamas Fire District is governed by a Board of Directors. The Board of Directors consists of five members elected to staggered four-year terms by voters within the CFD Service Area (Figure CFD-1). The Board of Directors is responsible for identifying problems and opportunities within the Fire District and then addressing those issues through policy. The Board of Directors, in turn hire a fire chief, who serves as the administrative head of the Fire District.

The following divisions within the fire district have a role in natural hazards mitigation:

The **Office of Business Services** is comprised of support departments including Fire Prevention and the Fire Marshal’s Office, Community Services, and Human Resources. The division provides support to other divisions and provides public education and community involvement regarding fire prevention and medical aid.

The **Office of Emergency Services** includes departments responsible for emergency response, fire suppression, and related function. It includes highly skilled and cross trained firefighter/paramedics and firefighters (EMTs) that respond to medical emergency alarms. The office operates from 24 fire stations and has approximately 300 career and volunteer firefighters.

The **Office of Financial Services** is responsible for strategic financial planning, financial reporting, and accounting. Tasks of the office include financial forecasting and planning, budget development and administration, financial reporting, general accounting, payroll, and debt management. This office also includes Fleet and Logistics. The **Fleet Division** is responsible for maintaining the fleet of fire and emergency apparatus and staff vehicles. The division also maintains and repairs apparatus and vehicles from the Canby and Gladstone fire departments through intergovernmental agreements.

The **Office of Strategic Services** is comprised of support and planning functions including Technology Services, GIS Services, sUAS Operations, Planning, and Facilities. This office provides support for internal planning, community and district assessment, and operations.

These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. There is limited capacity to expand upon their capabilities or workloads.

Findings

Several important findings from this capability assessment informed the design of the Plan's mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

CFD staff are assigned hazard mitigation responsibilities as a part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the agency can undertake in any year. CFD relies upon its relationships with Clackamas County and other cities and fire districts within its region and on community volunteers to expand its operations.

Reliance upon outside funding streams

CFD operates on a limited budget with many conflicting priorities. Additionally, there are restrictions on many revenue sources in relation to where the funds may be spent. Grants and loans can provide revenue sources for large resilience projects that cannot be covered by levies and tax revenue, etc.

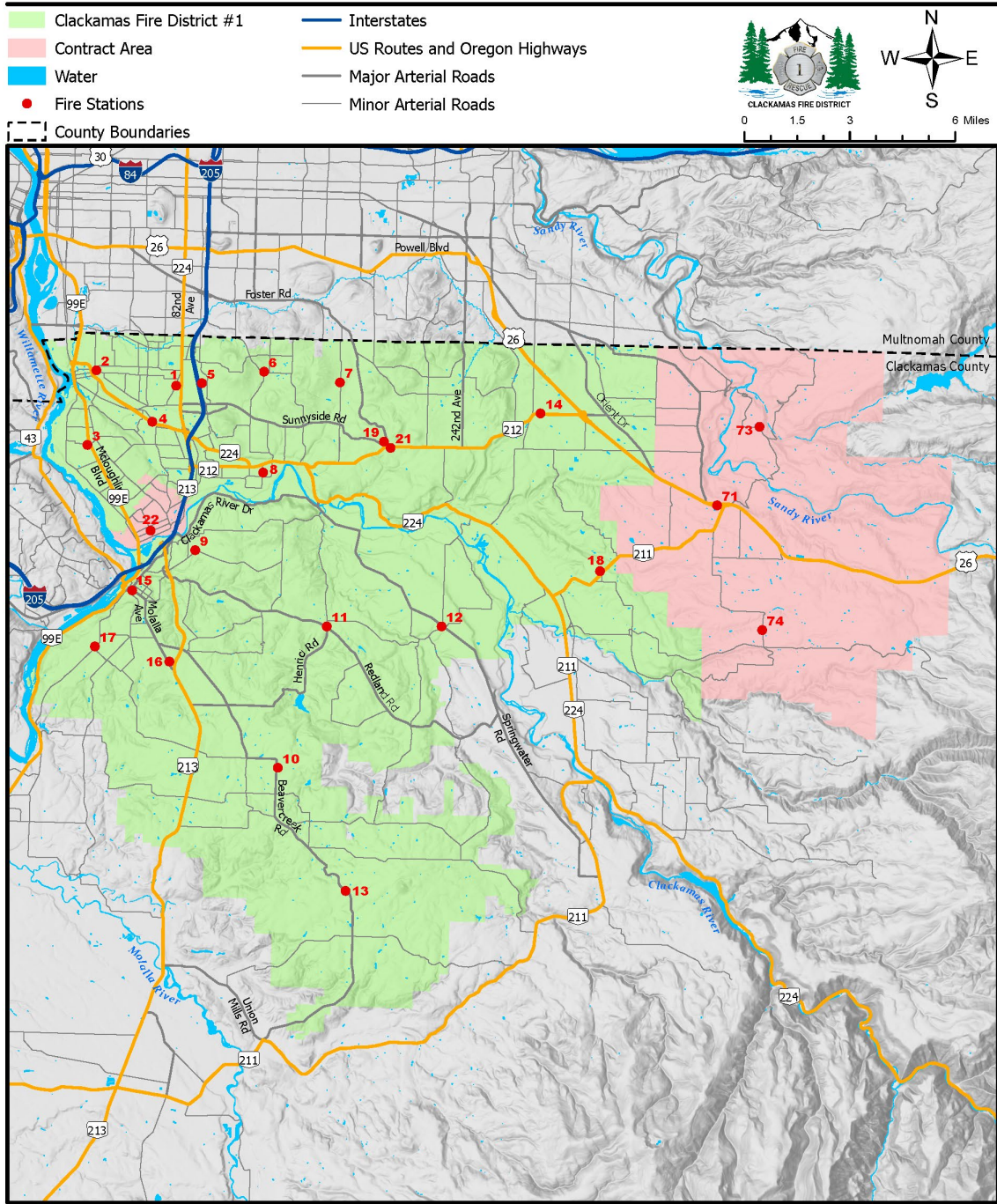
Multi-document transparency

CFD works to ensure all its capital plans are integrated into one master Capital Improvement budget. Integration of the goals of this budget with the goals and assessment of the NHMP will further the development of resilience measures within the agency's work program.

Figure CFD-1 Clackamas Fire District Service Area Map

CLACKAMAS FIRE DISTRICT

FIRE DISTRICT AND CONTRACT AREA OVERVIEW



6/29/2023 12:30 PM Source:

[Clackamas Fire District](#)

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The Fire District’s mitigation strategy (action items) were first developed during the 2019 NHMP planning process and revised during the subsequent NHMP update. During these processes, the HMAc assessed the Fire District’s risk, identified potential issues, and developed a mitigation strategy (action items).

During the 2023 update process, the City re-evaluated their mitigation strategy (action items). During this process action items were updated, noting if the action is complete, not complete and whether the actions were still relevant; any new action items were identified at this time (see Attachment B for more information on changes to action items).

Action Items

Table CFD-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAc decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown in **bold** text with grey highlight. The Fire District will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAc in terms of implementation, the HMAc has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table CFD-1 Action Items

		Impacted Hazard										Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost	
1	Continue to enhance education programs aimed at mitigating natural hazards and reducing risk.	X	X	X	X	X	X	X	X	X	Emergency Management/ Business Services	Ongoing	Local Resources, OEM, FEMA, DLCD	Low	
2	Continue to conduct seismic evaluations and start projects implementing appropriate structural and non-structural mitigation strategies.		X								Facilities/ Emergency Services	Long	Local Resources, FEMA HMA, SRGP	Low to High	
3	Continue to coordinate with the County and Cities to make stations a priority for plowing and ensure up-to-date knowledge of plowing routes.									X	Emergency Management/ Business Services	Short	Local Resources	Low	
4	Continue to coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan.							X			Fire Prevention / Business Services, Emergency Services	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low to High	
5	Continue to promote legal, safe, and responsible debris collection and burning through public outreach and education.							X			Fire Prevention/ Business Services	Short	Local Resources	Low	
6	Continue to promote fire-resistant strategies for new and existing developments.							X			Fire Prevention/ Business Services	Short	Local Resources	Low	
7	Continue to increase participation in land use reviews of residential structures in the Timber/Agriculture Zone.							X			Fire Prevention/ Business Services	Long	Local Resources	Low	

Table CFD-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
8	Continue to conduct a Community Meeting to educate community on defensible space, and measures that can be taken to reduce structural ignitability.							X			Fire Prevention/ Business Services	Short	Local Resources	Low
9	Continue to obtain structural ignitability data by conducting structural triage assessment data collection (including GPS points) for homes in Communities at Risk.							X			Fire Prevention/ Business Services	Ongoing	Local Resources	Low
10	Work with partners to develop redundant 911 and civilian communication network.							X			Fire Prevention/ Business Services	Short	Local Resources	Low
11	Sustain and expand Firewise adapted communities' program.							X			Fire Prevention/ Business Services	Short	Local Resources	Low

Source: Clackamas Fire District HMAC, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

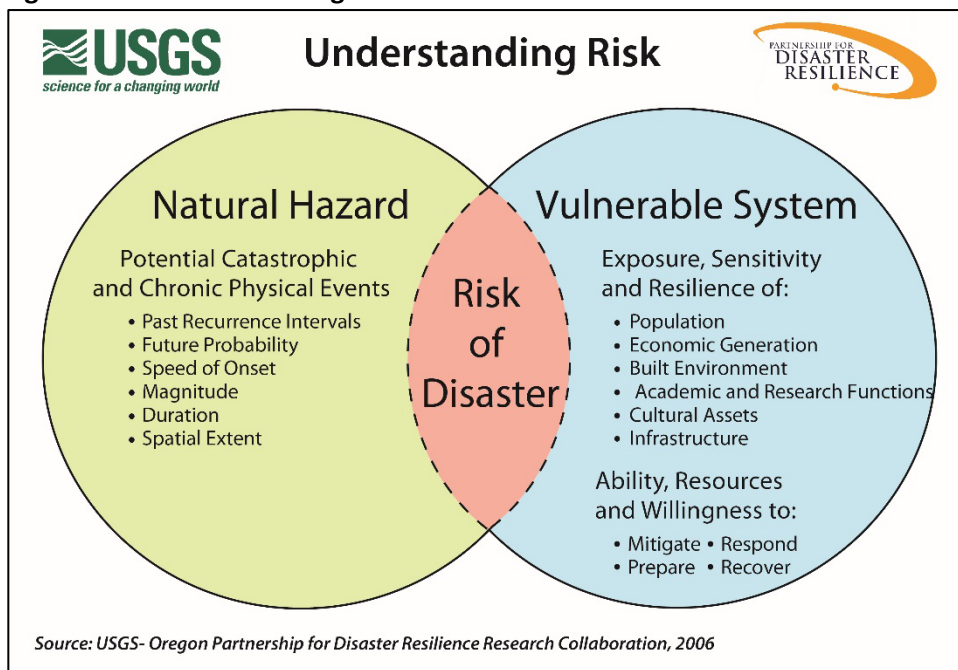
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein, and within Volume I, Section 2, and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure CFD-2. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure CFD-2 Understanding Risk



Hazard Analysis

The Clackamas Fire District HMAAC developed their hazard vulnerability assessment (HVA), using the County’s HVA as a reference. Changes from the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Clackamas Fire District, which are discussed throughout this addendum.

Table CFD-2 shows the HVA matrix for Clackamas Fire District listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with sense of hazard priorities but does not predict the occurrence of a hazard.

Two catastrophic hazards (Cascadia Subduction Zone earthquake and a Crustal earthquake event such as from the Portland Fault) and two chronic hazards (wildfire and winter storm) rank as the top hazard threats to the Fire District (Top Tier). The extreme heat, windstorm, drought, and flood hazards comprise the next highest ranked hazards (Middle Tier), while volcanic event and landslide comprise the lowest ranked hazards (Bottom Tier).

Table CFD-2 Hazard Analysis Matrix – Clackamas Fire District

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Wildfire	18	35	80	56	189	1	Top Tier
Earthquake - Cascadia	2	45	100	35	182	2	
Earthquake - Crustal	6	50	100	21	177	3	
Winter Storm	12	35	70	56	173	4	
Extreme Heat Event	10	35	70	35	150	5	Middle Tier
Windstorm	14	25	50	56	145	6	
Drought	10	15	50	56	131	7	
Flood	16	15	40	49	120	8	
Volcanic Event	2	35	50	7	94	9	Bottom Tier
Landslide	14	15	20	35	84	10	

Source: Clackamas Fire District HMAAC, 2023

Community Characteristics

Table CFD-4 and the following section provides information on Fire District specific demographics and assets. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the Fire District specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation. New development has complied with the standards of the [Oregon Building Code](#) per County and city development codes.

The Fire District’s service area is near the southern limits of the Portland metro-area. The Fire District serves the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City and the unincorporated areas of Barton, Beaver Creek, Boring, Carus, Carver, Central Point, Clackamas, Clarkes, Damascus, Eagle Creek, Highland, Hillsvie, Holcomb, Kelso, Jennings Lodge, Oak Grove, Redland, South End, Sunnyside, and Westwood.

The Fire District has grown in land area over the years as it merged with to provided expanded service levels and to expand the scope of services with the economies of scale of modern fire agencies.

Temperatures range from monthly average lows in the mid-30°F range in the winter months (December/January coldest) to average highs in the mid-80°F range in the summer months (July/August hottest). The average annual precipitation ranges within the district but is typically in the 40 to 50-inch range with most precipitation falling between October and April.

Transportation/Infrastructure

Transportation has played a major role in shaping the communities within the service area of the Fire District. Interstate 205 runs from the western edge through the Fire District and north; State Highway 99E (or McLoughlin Blvd.) runs along the western border of the Fire District; Highway 213 runs north to south through the central part of the Fire District; Highway 212/224 runs from Interstate 205 east towards the Fire Districts eastern boundary.

Today, mobility plays an important role in the area and the daily experience of its residents and businesses as they move from point A to point B. Motor vehicles represent the dominant mode of travel through, and within the Fire District. Most communities within the Fire District's service area are provided public transportation by Tri-Met which provides daily local bus services to numerous community transit centers. The Fire District's service area is also accessed by the Union Pacific Railroad main line and Amtrak, which travels northeast to southwest carrying both passengers and freight.

Economy

The Fire District is located within the greater Portland region, resulting in easy access to downtown Portland and surrounding communities. Fire District service area residents are mostly employed in professional and related occupations.²

For additional information on the characteristics of the Fire District, in terms of geography, environment, population, demographics, employment and economics, as well as housing and transportation see Volume II addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City, and Volume III, Appendix C, *Community Profile*. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation.

² Social Explorer, Table B17008, U.S. Census Bureau, 2012-2016 American Community Survey Estimates.

Community Assets

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of Clackamas Fire District. It is important to note that the facilities identified as “critical” and “essential” are characterized differently than the structural code that identifies buildings as “essential” and “non-essential.” The structural code uses different language and criteria and therefore have completely different meanings than the buildings identified in this addendum. Considering the Fire District specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Critical Facilities

Facilities that are critical to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more.

Table CFD-3 Critical Facilities in Clackamas Fire District

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby- Molalla Fault Mw- 6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk	Volcanic Lahar - 1% Annual Chance
Critical Facilities by Community	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed	Exposed	Exposed
Clackamas Fire District - Station 1	-	X	-	-	-	-	-
Clackamas Fire District - Station 2	-	X	-	-	na	-	na
Clackamas Fire District - Station 3	-	-	-	-	-	-	-
Clackamas Fire District - Station 4	-	-	-	-	-	-	-
Clackamas Fire District - Station 5	-	X	-	-	na	-	na
Clackamas Fire District - Station 6	-	X	-	-	na	-	na
Clackamas Fire District - Station 7	-	X	-	-	na	-	na
Clackamas Fire District - Station 8	-	X	-	-	na	-	na
Clackamas Fire District - Training Center	-	-	-	-	na	-	na
Clackamas Fire District - Station 9	-	-	-	-	na	-	na
Clackamas Fire District - Station 10	-	-	-	-	-	-	-
Clackamas Fire District - Station 11	-	-	-	-	-	-	-
Clackamas Fire District - Station 12	-	X	-	-	-	-	-
Clackamas Fire District - Station 13	-	-	-	-	-	-	-
Clackamas Fire District - Station 14	-	X	-	-	-	-	-
Clackamas Fire District - Station 15	-	X	X	-	na	-	na
Clackamas Fire District - Station 16	-	X	-	-	na	-	na
Clackamas Fire District - Station 17	-	-	-	-	na	-	na
Clackamas Fire District - Station 18	-	-	-	-	-	-	-
Clackamas Fire District - Station 19	-	-	-	-	-	-	-
Clackamas Fire District - Station 20	-	-	-	-	-	-	-
Clackamas Fire District - Station 21	-	-	-	-	-	-	-
Clackamas Fire District - Station 22	-	-	-	-	na	-	na

	Flood 1% Annual Chance	CSZ 9.0 Earthquake Moderate to Complete Damage	Canby- Molalla Fault Mw- 6.8 Moderate to Complete Damage	Landslide High and Very High Susceptibility	Channel Migration Zone	Wildfire High or Moderate Risk	Volcanic Lahar - 1% Annual Chance
Critical Facilities by Community	Exposed	>50% Prob.	>50% Prob.	Exposed	Exposed	Exposed	Exposed
Clackamas Fire District - Station 71: Sandy	-	-	-	-	-	-	-
Clackamas Fire District - Station 73: Roslyn	-	-	-	-	-	-	-
Clackamas Fire District - Station 74: Dover	-	-	-	-	-	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (2024), Table A-24.

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public’s ability to recover from the emergency.

- Fires Stations
- Fuel Cells
- Fleet Logistics
- Training and Wellness (Office)
- Training and Wellness (Facility)
- Administrative Building

Hazard Characteristics

Drought

The HMAC determined that the Fire District’s probability for drought is **high** and that their vulnerability to drought is **low**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

Vulnerability Assessment

Due to insufficient data and resources, Clackamas Fire District is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section. For specific information for communities within the Fire District’s service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Mitigation Activities

The existing drought hazard mitigation activities are conducted at the county, regional, state, and federal levels and are described in the Clackamas County NHMP.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”³ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the Fire District’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Clackamas Fire District as well. The causes and characteristics of an earthquake event are appropriately described within the Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Clackamas Fire District as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Portland Hills Fault Zone, and Gales Creek-Newberg-Mt. Angel Structural Zone (discussed in the crustal earthquake section).

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.⁴

Figure CFD-3 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the Fire District is expected to experience very strong shaking (orange), while areas near rivers and streams will experience severe (light red) to violent (dark red) shaking in a CSZ event.

Ground shaking can mix groundwater and soil, liquefying and weakening the ground that supports buildings and severing utility lines. This is a special problem in low lying areas adjacent to rivers where the water table is shallow and the soils are subject to liquefaction. For example, the fine-grained alluvial soils along the banks of the Willamette and Clackamas Rivers and area creeks are likely subject to this hazard.

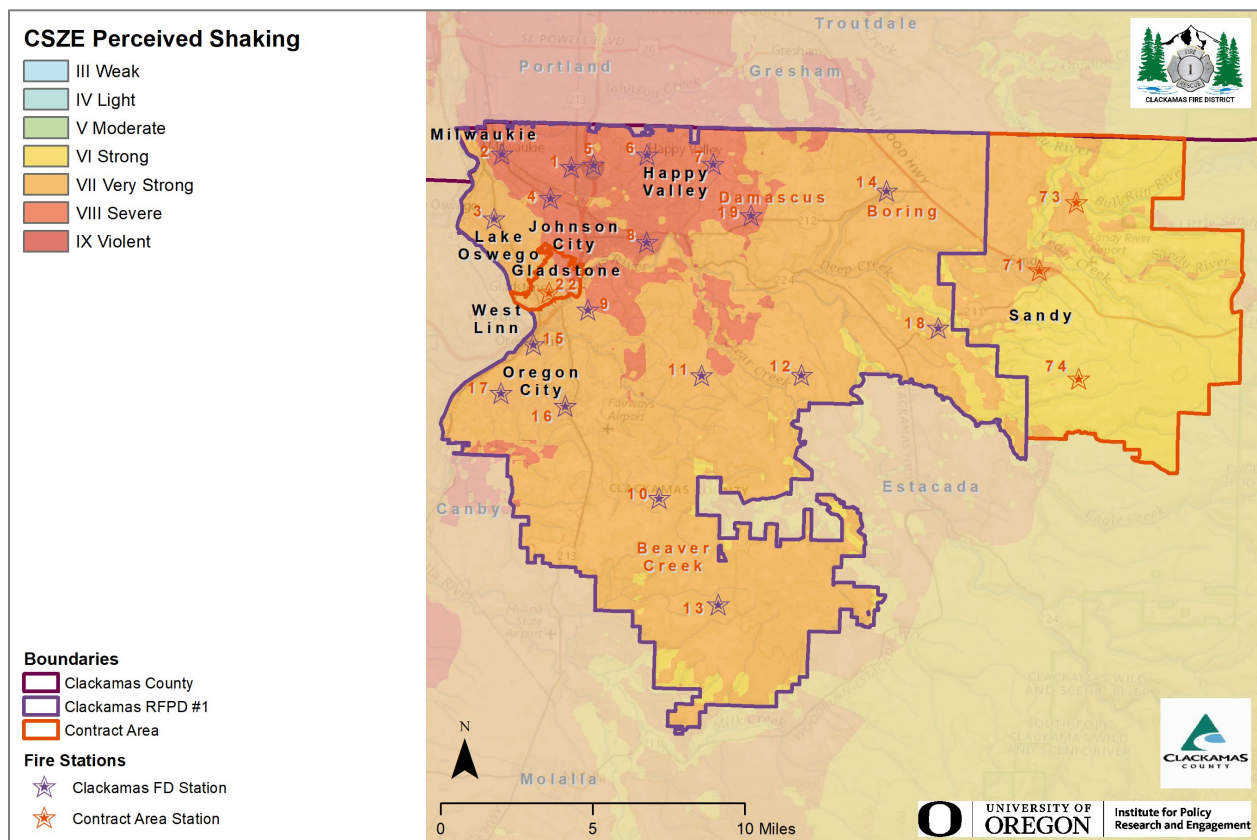
³ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

⁴ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

The Fire District’s proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the Fire District a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the Fire District predominately within the “Valley Zone” (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

Older buildings and the sewer system in the Fire District are most vulnerable to damage. Earthquakes shift soil that could cause landslides. Transportation routes and economic areas within the Fire District can also be affected. Demand on resources such as Emergency Service (Fire and Ambulance) would also increase.

Figure CFD-3 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.
 Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
 Note: To view hazard detail click this [link](#) to access Oregon HazVu

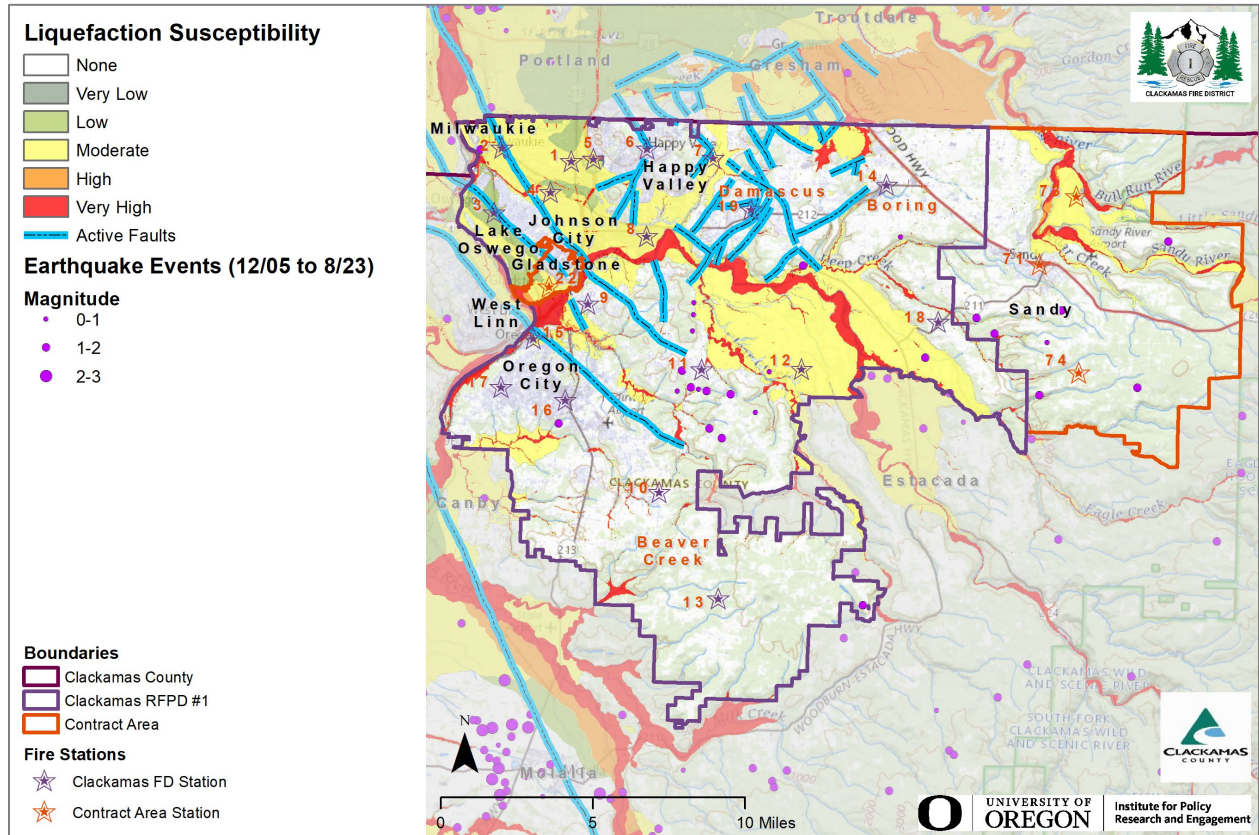
Earthquake (Crustal)

The HMAC determined that the Fire District’s probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is

likely to affect the Fire District as well. Figure CFD-4 shows a generalized geologic map of the Fire District service area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the service area as red and orange.

Figure CFD-4 Active Crustal Faults, Epicenters (2005-2023), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.
 Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
 Note: To view hazard detail click this link to access Oregon HazVu

There are several potential crustal faults and/or zones near, or within, the Fire District’s service area that can generate high-magnitude earthquakes. These include the Gales Creek-Mt. Angel Structural Zone, Bolton Fault, Oatfield Fault, Canby-Molalla structural zones, Damascus-Tickle Creek fault zone, and Portland Hills Fault Zone (discussed in greater detail below). Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years

ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and extends into the Fire District service area through Milwaukie and near Oregon City.

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)), findings from that report relevant to the Fire District’s service area are provided in Volume I, Section 2 and within the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Seismic building codes were implemented in Oregon in the 1970s, however, stricter standards did not take effect until 1991 and the early 2000s. As noted in the community profile, approximately 64% of residential buildings (primarily single-family residential) with the Fire District service area were built prior to 1990 (30% before 1970), which increases the service areas vulnerability to the earthquake hazard. Information on specific public buildings’ (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table CFD-7; each “X” represents one building within that ranking category. Of the Fire District facilities evaluated by DOGAMI using their Rapid Visual Survey (RVS), none have a very high (100% chance) or a high (greater than 10% chance) collapse potential.

Table CFD-4 Rapid Visual Survey Scores

Facility	Location	Site ID*	Level of Collapse Potential			
			Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Station 1 – Town Center 11300 SE Fuller Rd (ca. 1983)	Milwaukie	Clac_fir09	X			
Station 2 – Milwaukie 3200 SE Harrison St (ca. 1993)	Milwaukie	Clac_fir26	X			
Station 3 – Oak Grove 2930 SE Oak Grove Blvd (ca. 1997)	Milwaukie	Clac_fir27	X			
Station 4 – Lake Road 6600 SE Lake Rd (ca. 1999)	Milwaukie	Clac_fir08	X			
Station 5 – Mt Scott 9339 SE Causey Ave (ca. 2003)	Happy Valley	None	<i>2007 RVS report did not include structural appendix for this facility.</i>			
Station 6 – Happy Valley 12901 SE King Rd (ca. 2000)	Happy Valley	Clac_fir13	X			
Station 7 – Pleasant Valley 10921 SE 172 nd (ca. 2004)	Happy Valley	None	<i>2007 RVS report did not include structural appendix for this facility.</i>			
Station 8 – Clackamas 16100 SE 130 th Ave (ca. 1985)	Happy Valley	Clac_fir11 Clac_fir12	X X			
Station 9 – Holcomb 300 Longview Way (ca. 1974)	Oregon City	Clac_fir29	X			

Facility	Location	Site ID*	Level of Collapse Potential			
			Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Station 10 - Beavercreek 22310 S Beavercreek Rd (ca. 2000)	County	Clac_fir14	X			
Station 11 – Redland 18265 S Redland Rd (ca. 2000)	County	Clac_fir25	X			
Station 12 – Logan 18081 S Harding Rd (ca. 1980)	County	Clac_fir24	Mitigated per 2013-2014 SRGP grant.			
Station 13 – Clarkes 25675 S Beavercreek Rd (ca. 1955)	County	Clac_fir04	Mitigated per 2013-2014 SRGP grant.			
Station 14 – Boring 28655 SE Hwy 212 (ca. 1969)	County	Clac_fir22	X			
Station 15 – John Adams 624 7t St (ca. 1921)	Oregon City	Clac_fir35	X			
Station 16 – Hilltop 19340 Molalla Ave (ca. 2018)	Oregon City	Clac_fir36	Mitigated/rebuilt per 2013-2014 SRGP grant.			
Station 17 – South End 19001 South End Rd (ca. 2004)	Oregon City	Clac_fir51	X			
Station 18 – Eagle Creek 32200 SE Judd Rd (ca. 1999)	County	Clac_fir47	X			
Station 19 - Damascus 19750 SE Damascus Ln (ca. 2019)	County	None	2007 RVS report did not include structural appendix for this facility.			
Station 20 – Highland 22295 S Lower Highland (ca. 1960) – storage only	County	Clac_fir28	X			
Station 21 – Centennial Park 20100 SE Hwy 212 (ca. 1976)	County	Clac_fir46	X			
Station 22 – Gladstone (555 Portland Ave) see mitigation successes	Gladstone	Clac_fir19	X			
Station 71 - Sandy (17460 Bruns Ave) see Mitigation Successes	Sandy	Clac_fir37	X			
Station 73 – Roslyn (13120 SE Ten Eyck Rd)	Sandy	Clac_fir42	X			
Station 74 - Dover (24545 SE Firwood Rd)	Sandy	Clac_fir43	X			

Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.
“*” – Site ID is referenced on the RVS Clackamas County Map

Note 1: **Bold** indicates facilities that have been seismically retrofitted or rebuilt.

For a list of additional facilities and infrastructure vulnerable to this hazard see the Community Assets section. In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. There is a low probability that a major earthquake will result in failure of upstream dams.

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be a much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Earthquake Regional Impact Analysis

In 2018 DOGAMI completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Their study focused on damage to buildings, and the people that occupy them, and to two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and night time (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damaged varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios, however, the impact is considerably less than it is to the transportation routes. Additional, capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts. For specific information for communities within the Fire District’s service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Recommendations from the report included topics within Planning, Recovery, Resiliency: Buildings, Resiliency: Infrastructure Improvements, Resiliency: Essential and Critical Facilities, Enhanced Emergency Management Tools, Database Improvements, Public Awareness, and Future Reports. The recommendations of this study are largely incorporated within this NHMPs mitigation strategies (Table CFD-1 and Volume I, Section 3). For more detailed information on the report, the damage estimates, and the recommendations see: *Earthquake regional impact analysis for Clackamas, Multnomah, and Washington Counties, Oregon* (2018, [O-18-02](#)).

Mitigation Activities

Many buildings in Clackamas Fire District have been seismically upgraded. A \$29 million general obligation bond was approved in 2015 and seismic retrofit grant awards per the [Seismic Rehabilitation Grant Program](#)⁵ were funded to retrofit Fire Station 12 (2013-2014 grant award, \$94,552), Fire Station 13 (2013-2014 grant award, \$71,582), and Fire Station #16 (2013-2014 grant award, \$483,062).

Future Projections

Future development (residential, commercial, industrial, and infrastructure) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

The HMAC determined that the Fire District's probability for flood is **moderate** and that their vulnerability to flood is **low**. *The probability rating did not change and the vulnerability rating decreased since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent and probability of a potential event. Portions of Clackamas Fire District have areas of floodplains (special flood hazard areas, SFHA). These include areas along Willamette River, Clackamas River, and creeks within the service area (Figure CFD-5). Other portions of Clackamas Fire District, outside of the mapped floodplains, are also subject to flooding from local storm water drainage. Not all flood prone areas are subject to damage. Several valleys, such as the upper reaches of Abernethy Creek, are still in or near their natural state. Flooding of such areas causes no damage to human development and may help the riparian habitat.

Vulnerability Assessment

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage and economic loss from business interruption. It is important for the Fire District to be aware of flooding impacts and assess its level of risk.

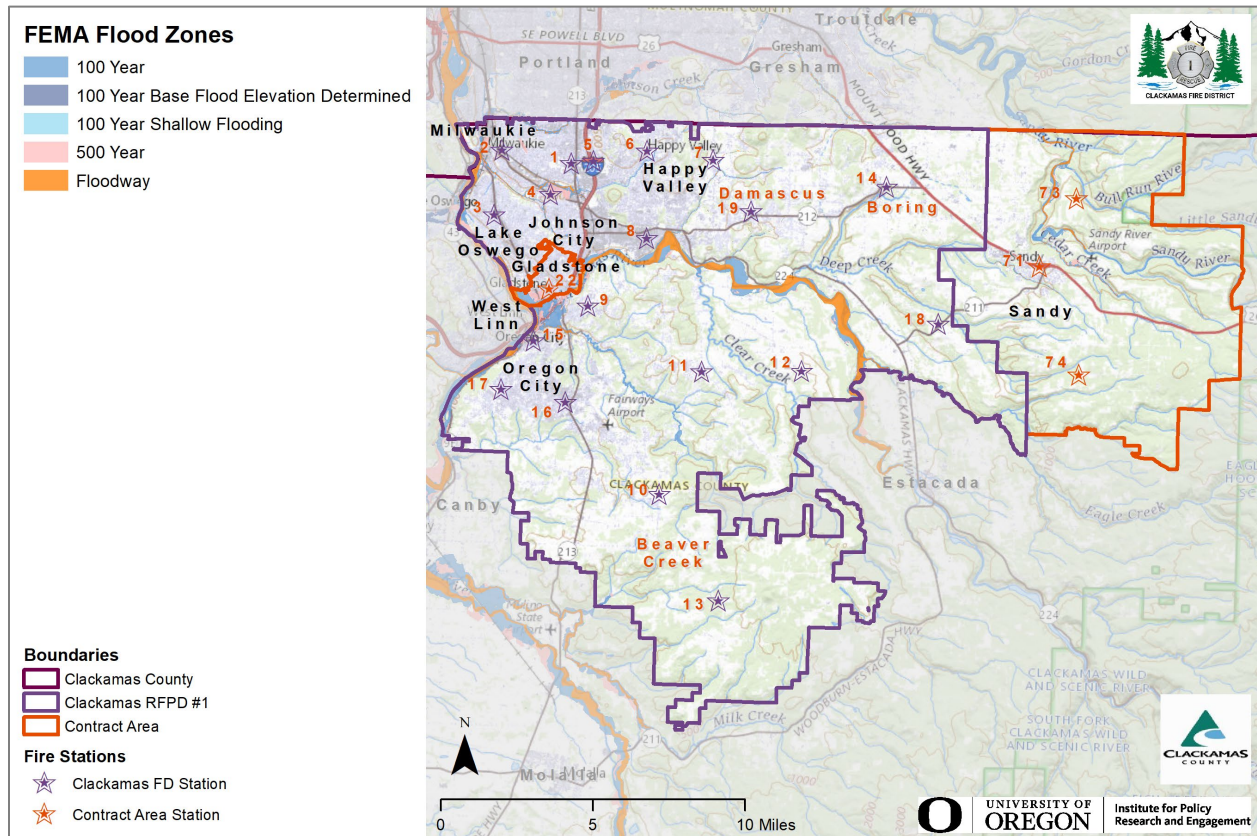
The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of the Fire District outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

Most of the buildings affected by flooding are in the lowest parts of the Fire District's service area. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section. For specific information for communities within the Fire District's service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

⁵ The Seismic Rehabilitation Grant Program (SRGP) 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.

Figure CFD-5 Special Flood Hazard Area



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this link to access Oregon HazVu

National Flood Insurance Program (NFIP)

FEMA updated the Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) for Clackamas County in 2018 (effective January 19, 2018). The Fire District is not a community which has authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction. The cities of Happy Valley, Johnson City, Milwaukie, Oregon City and Clackamas County participate in the National Flood Insurance Program (NFIP).

There are no repetitive loss or severe repetitive loss properties owned or operated by the Fire District. For specific information for communities within the Fire District’s service area see Volume I, Section 2 (Table 2.11 for more information) and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Mitigation Activities

The existing flood hazard mitigation activities are conducted at the city, county, regional, state, and federal levels and are described in the Clackamas County NHMP and city addenda.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁶ winter flood risk at mid- to low elevations in Clackamas County, where temperatures are near

⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

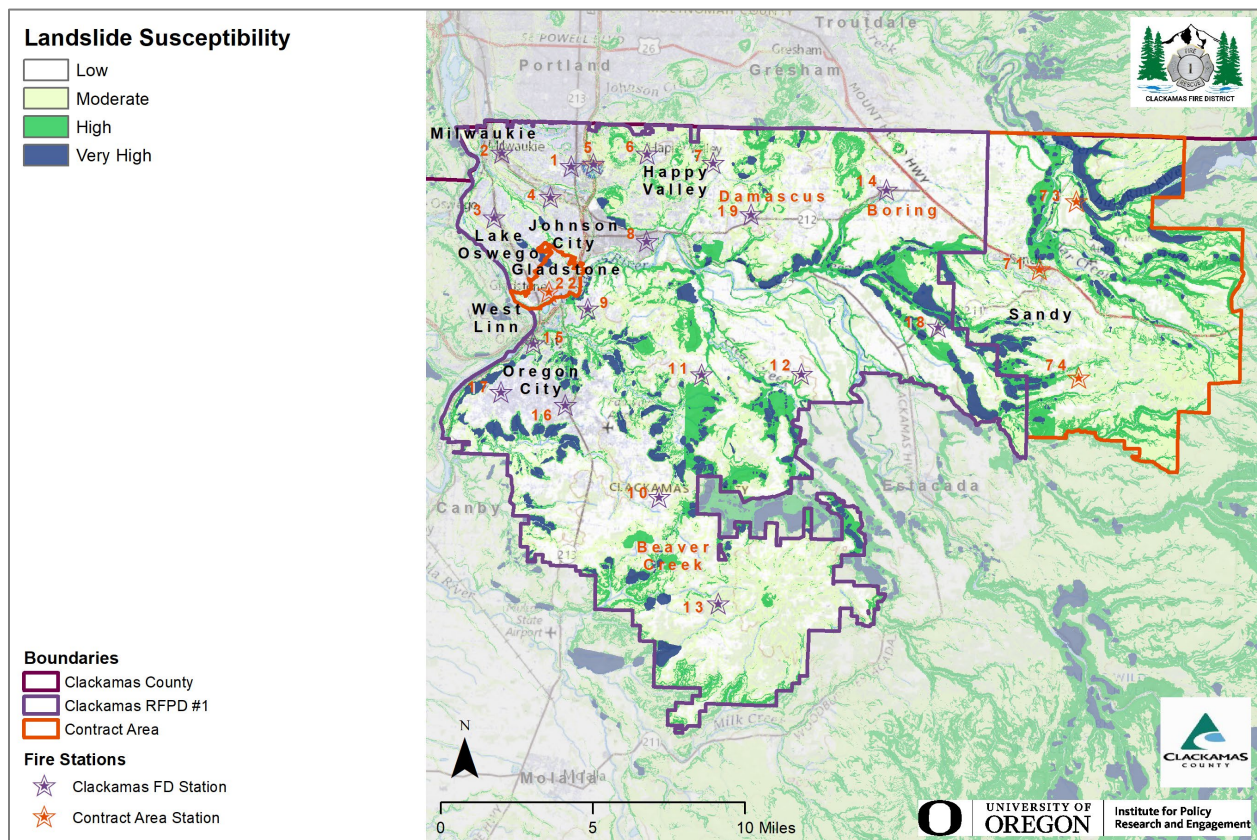
freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the Fire District’s probability for landslide is **moderate** and that their vulnerability to landslide is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. Landslide susceptibility exposure within the Fire District’s service area is shown in Figure CFD-6. Most of the Fire District’s service area demonstrates a low to moderate susceptibility to landslide exposure. *Note that even if an area has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard and assets.*

Figure CFD-6 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Landslides destroy or damage anything on the sliding hillside or in the path of the slide. This includes buildings, houses, and streets. Sometimes, a small amount of settlement occurs, giving the owner time to shore up or retrofit the building to prevent further damage. Many property owners in the Fire

District's service area have built retaining walls and replaced slide prone soils with rock to help prevent landslides. However, if an entire hillside fails, the buildings may be destroyed, and the streets washed out or covered in debris.

The most common type of landslides in Clackamas County are slides caused by erosion and flooding. Slides move in contact with the underlying surface, are generally slow moving and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)), general findings from that report are provided above and within Figure CFD-6. For specific information for communities within the Fire District's service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Potential landslide-related impacts are adequately described within Volume I, Section 2 and include infrastructural damages, economic impacts (due to isolation and/or arterial road closures), property damages and obstruction to evacuation routes. Rain-induced landslides and debris flows can potentially occur during any winter in Clackamas County and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section.

Mitigation Activities

Clackamas Fire District works to mitigate future landslide hazards to its fire stations and other critical facilities. Additional landslide hazard mitigation activities are conducted at the city, county, regional, state, and federal levels and are described in the Clackamas County NHMP and city addenda.

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather in can account for a variety of intense and potentially damaging weather events. These events include windstorms and winter storms. The following section describes the unique probability and vulnerability of each identified weather hazard. Other more abrupt or irregular events such as hail are also described in this section.

Extreme Heat

The HMAC determined that the Fire District's probability for extreme heat events is **moderate** and that their vulnerability is **moderate**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the Fire District as well.

A severe heat episode or "heat wave" occurs about every two to three years and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days we have temperatures greater than or equal to 90-degrees Fahrenheit and 100-degrees Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The Fire District has not experienced any life-threatening consequences from the few extreme heat events in the past, though with the changing climate expect to see more extreme heat events with potentially greater risk to the Fire District's service area population.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"⁷ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the Fire District's probability for windstorm is **high** and that their vulnerability to windstorm is **moderate**. *These ratings did not change since the previous NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by ice, freezing rain, flooding and very rarely, snow. Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes and tornadoes are generally negligible for the Fire District.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages and storm-related debris. Additionally, transportation and economic disruptions result as well.

Damage from high winds generally has resulted in downed utility lines and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves and debris clog drainage-ways, which in turn causes localized urban flooding.

⁷ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the Fire District’s probability for winter storm is **high** and that their vulnerability to winter storm is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter and early spring months. Severe winter storms affecting the Fire District’s service area typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Most winter storms typically do not cause significant damage; however, they are frequent and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter and commercial traffic.

Vulnerability Assessment

Due to insufficient data and resources, Clackamas Fire District is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Assets section. For specific information for communities within the Fire District’s service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Mitigation Activities

Clackamas Fire District has made progress to reduce the effects of storms. Most utilities leading to fire stations are underground, but in case of power outages the Fire District’s critical facilities have back up power generation. Clackamas County Public Health operates heating and cooling centers for the region. Additional severe weather hazard mitigation activities are conducted at the city, county, regional, state, and federal levels and are described in the Clackamas County NHMP and city addenda.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁸ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

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

⁸ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

wettest day and wettest consecutive five days per year is projected to increase by an average of 15% (range 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Volcanic Event

The HMAC determined that the Fire District’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of volcanic hazards, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the Fire District service area as well. Clackamas Fire District is unlikely to experience anything more than volcanic ash during a volcanic event.

Vulnerability Assessment

Due to insufficient data and resources, Clackamas Fire District is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section.

Due to the Fire District’s relative distance from volcanoes, its service area is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the service area may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the service area could experience a heavier coating of ash.

Mitigation Activities

The existing volcano hazard mitigation activities are conducted at the county, regional, state, and federal levels and are described in the Clackamas County NHMP.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the Fire District’s probability for wildfire is **high** and that their vulnerability to wildfire is **moderate**. *These ratings did not change since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan \(CWPP\)](#) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Clackamas Fire District is found in the following chapter: Chapter 9.3: Clackamas Fire District, Chapter 9.6: Gladstone Fire Department, and Chapter 9.11: Sandy Fire District.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions. Weather, and urbanization conditions are

primarily at cause for the hazard level. Clackamas Fire District does not regularly experience wildfire within its urbanized service area, but the Fire District service area has abundant wooded areas, particularly in the south, southeast, and east that are a concern in the case of a wildfire event.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes the Fire District's service area, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

The forested hills within and surrounding the Fire District service area are interface areas. High and medium Priority Communities at Risk (CARs) within the Fire District service area include the following high priority areas: Forest Park/Leisure Woods, Diane Drive Shelly Road, Redland Road/Fishers Mill area/Logan, Clarkes/Beavercreek, Beaver Lake, Canemah Bluffs, Scouters Mountain, and Mount Talbert; Gladstone area high priority CARs: Parkway Woods, Billy Goat Island, Dahl Beach; Sandy area high priority CARs: Wildcat Mountain, Hope Lake, Cedar Creek/Sandy Rim, Firwood, Bull Run Area. Medium priority CARs: 3 Creeks, Holcomb; Gladstone area: Risley Wetlands.⁹

Most of the Fire District service area has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four-feet under normal weather conditions. However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Vulnerability Assessment

Due to insufficient data and resources, Clackamas Fire District is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets section.

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the Fire District service area as well. Clackamas Fire District's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. Figure CFD-7 shows overall wildfire risk in the Fire District service area. The Fire District will update their wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP). For specific information for communities within the Fire District's service area see Volume I, Section 2 and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

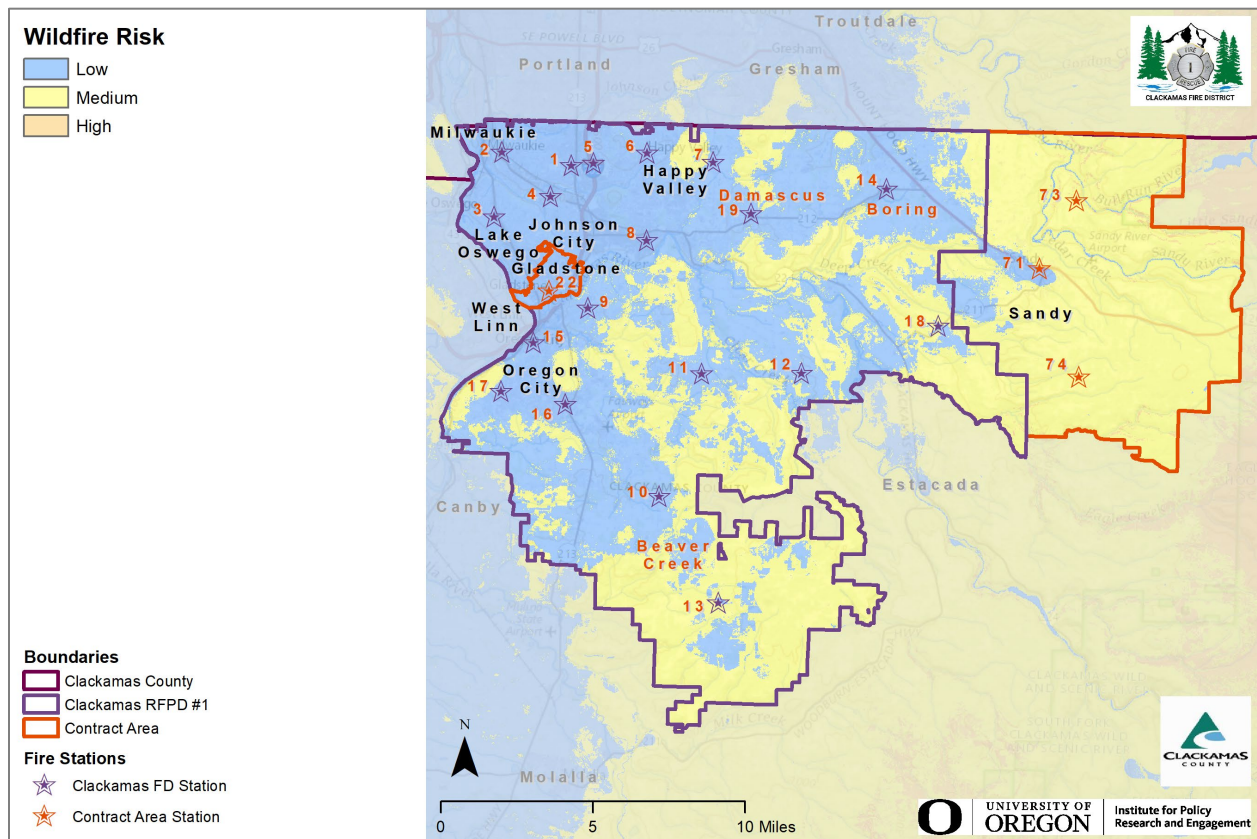
Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

⁹ Clackamas County Community Wildfire Protection Plan, *Clackamas Fire District* (2018), Table 18, 24, 33.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹⁰ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

Figure CFD-7 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Mitigation Activities

Clackamas Fire District uses several mitigation tools to reduce the service area’s risk to wildfires. Clackamas Fire District’s offers numerous education opportunities including school programs, public presentations, media events, and safety fairs. They work with Clackamas County and Happy Valley, Johnson City, Milwaukie, and Oregon City to review pre-construction plans and develop fire codes. They promote the use of defensible space, fire-resistant building materials and roofing, and community

¹⁰ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

preparedness. Additionally, the Fire District inspects buildings for fire code compliance, enforces open burning regulations, and offers juvenile fire setter counseling and follow-up.

Please review the [Clackamas County Community Wildfire Protection Plan \(CWPP\)](#), Volume I, Section 2 for additional information on this hazard.

Attachment A: Action Item Changes

Table MO-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. Actions identified as still relevant are included in the updated action plan (Table MO-1).

Previous NHMP Actions that are Complete:

Severe Weather #1: “Continue to ensure that all response vehicles have chains for driving on snow and ice.” This is considered part of normal operations.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table CFD-5 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Earthquake #1	#2	Not Complete	Yes
Severe Weather #1	-	Complete	No
Severe Weather #2	#3	Not Complete	Yes
Wildfire #1	#4	Not Complete	Yes
Wildfire #2	#5	Not Complete	Yes
Wildfire #3	#6	Not Complete	Yes
Wildfire #4	#7	Not Complete	Yes
Wildfire #5	#8	Not Complete	Yes
Wildfire #6	#9	Not Complete, revised	Yes
-	#10	New	-
-	#11	New	-

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from February 1 through March 8 on the District’s website. The plan was also posted and announced on the County’s website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

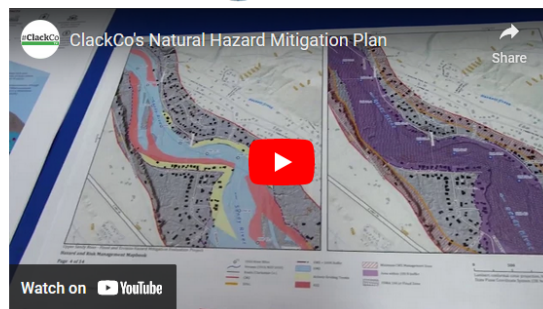
A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan’s content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting



COMMUNITY

Natural Hazards Mitigation Plan



Clackamas County seeks public comment on update to Natural Hazard Mitigation Plan

Clackamas County is currently in the process of updating their existing Natural Hazard Mitigation Plan (NHMP). This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program. With re-adoption of the plan, Clackamas County will maintain its eligibility to apply for federal funding towards natural hazard mitigation projects.

This local planning process includes a wide range of representatives from city and county government, emergency management personnel, and outreach to members of the public in the form of an electronic survey. This mitigation plan also affects the cities of Canby, Estacada, Gladstone, Happy Valley, Lake Oswego, Milwaukie, Molalla, Oregon City, Sandy, West Linn, and Wilsonville, and the special districts of Clackamas Fire District, Clackamas River Water, Colton Water District, and Oak Lodge Water Services.

Please submit comments by Friday, March 8, 2024 via email to ccdm@clackamas.us.

Draft plan by section

Draft 2024 Volume I – Clackamas County Natural Hazard Mitigation Plan

Draft 2024 Volume II – Jurisdictional Addenda

- Canby Addendum
- Clackamas Fire District Addendum
- Clackamas River Water Addendum
- Colton Addendum
- Estacada Addendum
- Gladstone Addendum
- Happy Valley Addendum
- Lake Oswego Addendum
- Milwaukie Addendum
- Molalla Addendum
- Oak Lodge Addendum
- Oregon City Addendum
- Sandy Addendum
- West Linn Addendum
- Wilsonville Addendum

Draft 2024 Volume III – Annexes

- Mitigation Success Example
- Mitigation Factsheet

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1: May 30, 2023

During this meeting, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the district.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: August 1, 2023 and again on November 13, 2024 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the district's capabilities assessment.
- Reviewed, confirmed, and prioritized the district's mitigation strategies.

Clackamas River Water Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: Clackamas River Water

Effective:

September 12, 2024 – September 11, 2029

Prepared for
The Special District of Clackamas River Water

Updated:
July 18, 2024, (Resolution # 01-2025)



This Natural Hazard Mitigation Plan was prepared by:



Planning grant funding provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

Resolution 01-2025

A Resolution Adopting the Clackamas River Water Representation in the Updates to the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan

Whereas, CLACKAMAS RIVER WATER recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, CLACKAMAS RIVER WATER has fully participated in the FEMA prescribed mitigation planning process to prepare the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

Whereas, CLACKAMAS RIVER WATER has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of CLACKAMAS RIVER WATER to the impacts of future disasters within the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*; and

Whereas, these proposed projects and programs have been incorporated into the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

Whereas, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, July 11, 2024) contingent upon this official adoption of the participating governments and entities;

Whereas, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

Whereas, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

Whereas, CLACKAMAS RIVER WATER adopts the NHMP and directs the Emergency Manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

Now, therefore, be it resolved, that CLACKAMAS RIVER WATER adopts *the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan; and

Be it further resolved that CLACKAMAS RIVER WATER will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X to enable final approval of the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

Adopted this 18th day of July, 2024



Sherry French, Board President



Naomi Angier, Board Secretary

Purpose

This is an update of the Clackamas River Water addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets the following requirements:

- Multi-Jurisdictional Plan Adoption §201.6(c)(5),
- Multi-Jurisdictional Participation §201.6(a)(3),
- Multi-Jurisdictional Mitigation Strategy §201.6(c)(3)(iv), and
- Multi-Jurisdictional Risk Assessment §201.6(c)(2)(iii).

Updates to Clackamas River Water’s addendum are further discussed throughout the NHMP and within Volume III, Appendix B, which provides an overview of alterations to the document that took place during the update process.

Clackamas River Water adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 18, 2024. FEMA Region X approved the Clackamas County NHMP and the District’s addendum on September 12, 2024. With approval of this NHMP the District is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2024.

NHMP Process, Participation and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption and federal approval of this NHMP ensures that CRW will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Department of Emergency Management (OEM), Clackamas County, and CRW to update their NHMP.

The Clackamas County NHMP, and CRW addendum, are the result of a collaborative effort between District rate payers, citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The CRW HMAC guided the process of updating the NHMP.

Convener

The Clackamas River Water Emergency Manager serves as the NHMP addendum convener. The convener of the NHMP addendum will take the lead in implementing, maintaining, and upgrading the addendum in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from CRW's HMAC served as the project steering committee in 2023 and met formally, and informally, to develop, review, and revise CRW's NHMP addendum with a focus on the NHMP's risk and resilience assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and collaboration with the Clackamas County Resilience Coordinator, and the OPDR. Relevant information is highlighted in more detail throughout this document and within Volume III, Appendix B.

The CRW HMAC was comprised of the following representatives:

- Convener, Beth McGinnis, Emergency Manager
- Todd Heidgerken, General Manager/Public Information Officer
- Adam Bjornstedt, Chief Engineer

The HMAC served as the local review body for the NHMP update.

NHMP Implementation and Maintenance

The Clackamas River Water Board of Commissioners will be responsible for adopting the District's addendum to the Clackamas County NHMP. This addendum designates the HMAC and a convener to oversee the development and implementation of action items. Because the CRW addendum is part of the County's multi-jurisdictional NHMP, the District will look for opportunities to partner with the County and other interdependent agencies and jurisdictions.

The District's HMAC will convene after adoption of the District NHMP addendum on an annual schedule. The County is meeting on a semi-annual basis and will provide opportunities for the cities and districts to report on NHMP implementation and maintenance during their meetings. The District Emergency Manager will serve as the Water District convener and will be responsible for assembling the CRW HMAC. The HMAC will be responsible for:

- Reviewing existing action items to determine suitability of funding
- Keeping elected officials, ratepayers and the public informed of the mitigation process
- Reviewing existing, and new risk assessment data to identify issues that may not have been identified at NHMP creation
- Educating and training new HMAC members on the NHMP, and mitigation actions in general
- Assisting in the development of funding proposals for priority action items
- Discussing methods for continued public involvement;
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The district will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction's website (for more information see Volume I, Section 4).

The district will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies, the public, and the District; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs. The mitigation plan works in conjunction with other District plans and programs as well as the County Comprehensive Land Use Plan, Capital Improvement Plan (CIP), and building codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein intended to be implemented through existing plans and programs within the District. Plans and policies already in existence have support from district residents, businesses, and policy makers. Where possible, the District will implement the NHMP's recommended actions through existing plans and policies. Many strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Future development without proper planning may result in worsening problems associated with natural hazards. Metro, the regional government for Clackamas, Multnomah, and Washington counties, determines many land-use laws for the Tri-County region and sets the urban growth boundary. The entire Portland Metro area is subject to tremendous growth pressures due to its desirable location and the restrictions on urban sprawl placed by urban growth boundary requirements.

Capability Assessment

The Capability Assessment identifies and describes the ability of Clackamas River Water (CRW) to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources. As applicable the 2019 NHMP was integrated into these authorities/documents over the last five years (e.g., land use regulations, capital improvement plan, water system master plan, etc.).

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other planning documents (i.e., plan integration), adopting engineering standards and regulations that account for best practices in structural hardening, and incorporating mitigation into system maintenance and enhancement. The extent to which a district or multi-jurisdictional effort leverages these approaches is an indicator of that community's or organization's capabilities.

Strategic Planning

Existing policies that define service provision and address hazardous conditions provide a source of mitigation capability.

Clackamas River Water serves approximately 80,000 customers on a retail and wholesale basis in an unincorporated portion of western Clackamas County. Comprehensive Planning in Clackamas County takes place at the County level and relevant information is included in the County NHMP (Volume 1).

The CRW Board of Directors has adopted strategic goals that are used to determine organizational priorities. These strategic goals reinforce the importance of resilience and hazard mitigation planning. The first adopted Strategic Goal states:

1. Ensure a reliable water supply for the communities we serve by investing in infrastructure and emergency preparedness.
 - a) Develop common methodologies to prioritize, communicate, and execute CRW infrastructure improvements.
 - b) Develop targeted, consistent, and comprehensive maintenance programs that achieve stewardship goals for built infrastructure.
 - c) Manage, maintain, and improve District’s Emergency Preparedness (EP) programs and initiatives.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

CRW falls under Clackamas County’s Building Codes and Fire Code.

Capital Improvement Planning & Budgeting

The CRW Board of Directors has the responsibility of developing and adopting the annual budget. Integrating hazard mitigation goals and projects into the annual budget in the future will be key to implementing the NHMP.

The Biennial Budget 23-25, adopted June 8, 2023, is the primary capital improvement plan for the District. Capital improvements are prioritized based on evaluation criteria: age, capacity, water quality, and resilience.

Budgeted capital improvements are accounted for in the Capital Improvement Projects (CIP) Fund, separate from the General Fund. Projects within this fund are based upon the Water System Master Plan, Water Treatment Plant Facilities Plan, Strategic Goals, and projects of other jurisdictions that affect CRW infrastructure.

Programs & Projects

This Plan directs CRW and Clackamas County to explore integration into other planning documents and processes. Although CRW has not previously been included in the County-wide NHMP, it has made significant progress in integrating the resilience efforts into its portfolio of planning programs and projects over the last five years.

The purpose of these documents is to outline short to long term planned improvements to infrastructure and equipment and provide the context for how the District will accomplish our mission to:

“Provide high quality, safe drinking water to our customers at rates consistent with responsible planning for the health of our district.”

Water System Master Plan

Approved by the State of Oregon in April 2019, this plan outlines significant improvements and replacement projects throughout the distribution system. Additional planning efforts through fiscal years 2020 and 2021 identified improvement projects to the water treatment plant.

AWIA Risk Assessment

In 2018 the America’s Water Infrastructure Act (AWIA) was signed into law. It required water-service providers to conduct a risk and resilience assessment (RRA) and develop a subsequent emergency response plan (ERP) prior to June 30, 2021. The law also mandates that the that the RRA and ERP are updated every 5 years. The District completed the AWIA Risk Assessment in December 2020. Recommendations from this plan, which include references to the 2018 NHMP, include resilience in capital projects and planning.

Water Management and Conservation Plan

CRW recently updated its water management and conservation plan (WMCP), which was reviewed and approved by the Oregon Water Resources Department and adopted by the CRW Board. The WMCP is used to guide the District’s water management strategies. Included in the plan is a curtailment plan that is triggered when there are water deficiencies (either experienced or anticipated) in the CRW water system.

Public Awareness Campaigns

CRW encourages water users to turn off irrigation in the fall during the time when fish will be migrating up stream in the Clackamas River. The campaign is coordinated by the Clackamas River Water Providers and uses the message, “Fish on the Run, Irrigation Done”. The public outreach effort to create awareness of the interdependencies of the river flows and fish needs has been in existence for three years.

In 2023-2024, CRW is planning on hiring a full time Public Outreach/Communication employee to enhance abilities to meet the information needs of stakeholders.

Water Treatment Plant Facilities Plan

In 2020, the District developed a Facilities Plan for its Water Treatment Plant to help meet long-term planning needs, particularly as the plant nears 60 years of operation and technological advances may provide enhanced performance to meet current or future regulatory requirements.

Emergency Drinking Water Framework for Clackamas River Water Providers

This region-wide framework for drinking water provided a \$30,000 grant to explore what the regional water system will look like a post-Cascadia Subduction Zone earthquake and what strategies for mitigation and reclamation are available to get water to the community in the month following an event. The final plan will include annexes for each agency’s Emergency Operations Plan, with strategies, basin-wide operational recommendations, and actions.

Community Wildfire Protection Plan

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex and into the District’s capital improvement planning. The CWPP is expected to be adopted in early 2024.

Capital Improvement Planning

CRW adopted an updated Capital Planning Strategy Memorandum in 2021. This Strategy influenced the adoption of a Six Year Capital Improvement Plan (CIP), which incorporates resilience projects into the short- and medium-term budget planning for CRW.

Personnel

The following CRW personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Beth McGinnis, Emergency Manager

Public Information Officer: Todd Heidgerken, General Manager; PIO dispatched from the County

Grant writing (for Public Works or emergency management): Adam Bjornstedt, Chief Engineer; Beth McGinnis, Emergency Manager

Capital improvement planning: Adam Bjornstedt, Chief Engineer

Capital improvement execution: Adam Bjornstedt, Chief Engineer

These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. There is limited capacity to expand upon their capabilities or workloads.

Capital Projects

CRW has implemented many resilience related projects over the last five years, including a water tower seismic reinforcement. Capital improvement projects within the last five years related to resilience include:

- Water transmission/distribution main replacements (replaced substandard, unrestrained pipe with new restrained pipe)
- New reservoir construction (meeting current ASCE and AWA seismic standards)
- New pump station construction with emergency generator
- Studies: Water treatment plant, SCADA master plan

Mitigation Successes

The District has several examples of mitigation success including the following projects funded through FEMA [Hazard Mitigation Assistance](#) and the Oregon Infrastructure Finance Authority's [Seismic Rehabilitation Grant Program](#)¹.

FEMA Funded Mitigation Successes

- 2023: DR4562-23: CRW Facilities Emergency Power Study AA (\$123,133)
- 2023: DR4562-30: 1-205 Waterline Crossings Mitigation (\$950,268)
- 2023: DR4562-33: Redland Road Waterline - Ferguson to Bradley (\$1,182,111)
- 2005: PDMC-PJ-10-OR-2005-001: Clackamas River Water System Seismic and Ice Storm Retrofit Project (\$335,702.96) - life safety only.

Capital Resources

CRW maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Critical facilities with power generators for use during emergency blackouts include the Water Treatment Plant and the Hattan Road Pump Station. Two portable generators that are deployable are also available for emergency use (although the plug systems are not interoperable with other agencies' pump stations). Fueling storage is located at the Operations Facility.

¹ The Seismic Rehabilitation Grant Program (SRGP) 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.

Findings

Several important findings from this capability assessment informed the design of the Plan’s mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

CRW staff are assigned hazard mitigation responsibilities as a part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the agency can undertake in any year. CRW relies upon its relationships with Clackamas County and other cities and the Clackamas River Water Providers and Regional Water Providers Consortium (part of RDPO) within its region and on community volunteers to expand its operations.

Reliance upon outside funding streams

CRW operates on a limited budget with many conflicting priorities. Current revenues are not enough to keep up with all the capital needs of CRW. Additionally, there are restrictions on many revenue sources in relation to where the funds may be spent. Grants and loans can provide revenue sources for large resilience projects that cannot be covered by System Development Charges, etc.

Multi-document transparency

CRW works to ensure all its capital plans are integrated into one master Capital Improvement budget. Integration of the goals of this budget with the goals and assessment of the NHMP will further the development of resilience measures within the agency’s work program.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community’s environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions, and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

The District’s mitigation strategy (action items) evolved over time, building on the foundation of the Oregon Resilience Plan created in 2013 and gaining clear focus as part of the extensive planning and assessment efforts recently completed by CRW. Those efforts including the AWIA RRA (2020), Water System Master Plan (2019), and Treatment Plant Facilities plan (2021).

Each planning effort involved the identification of hazards and risk, determination of probability and hazard impact, cost analysis, and project selection criteria. Those assessments served as sources for our core mitigation action items. Recent events such as the COVID-19 pandemic and the extensive wildfire damage in 2020 amplified the recognition and need for increased public preparedness and improved system resilience through natural hazard mitigation.

The action items were reviewed, updated, and relocated to this addendum. They will be revised during subsequent Clackamas County NHMP updates and integrate District risk, identified issues, and accomplishments.

Action Items

Table CRW-1 documents the title of each action along with, the lead implementor, partners, timeline, cost, and potential funding resources. The HMAC decided to modify the prioritization of action items in this update to reflect current conditions (risk assessment), needs, and capacity (see Attachment A for more information). High priority actions are shown in orange highlight. CRW will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority. Refer to Attachment A for changes to actions since the previous NHMP.

Table CRW-1 Action Items

		Impacted Hazard											Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Algal Blooms	Pandemic	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
1	Conduct Seismic Analysis study: Conduct In-Depth Seismic Analysis of treatment plant, pump stations and reservoirs (North and South)		X										Engineering/ Water Resources, Distribution	Short	Local Resources, CIP, FEMA HMA- C&CB	High
2	Develop SCADA Master Plan: Develop master plan and enhance SCADA infrastructure to increase resilience to natural and cyber hazards	X	X		X	X	X	X	X	X	X		Water Resources/ Engineering	Short	Local Resources, CIP, FEMA HMA- C&CB	Medium to High
3	Develop Seismic Pipeline Program: Develop Seismic System Program to assess transmission and distribution pipelines (North and South System)		X										Engineering/ Distribution	Ongoing	Local Resources, CIP	Low
4	Install Reservoir Seismic Isolation: Install seismic valves at existing tanks (North and South System)		X										Engineering/ Water Resources	Medium	Local Resources, CIP, FEMA HMA	Medium
5	Conduct Water Pump Station Upgrades: Implement pump station repair and rehabilitation, and seismic upgrades.	X	X		X			X					Engineering/ Water Resources	Long	Local Resources, CIP, FEMA HMA	High
6	Implement Low Lift Pump Station Flood Mitigation: Conduct a Flood Mitigation Study and implement mitigation efforts at the Raw Water Intake (Low Lift PS)	X			X								Engineering/ Water Resources	Long	Local Resources, CIP, DLCD TA, FEMA HMA- C&CB	High
7	Develop and Implement Emergency Drinking Water Framework As part of regional planning efforts, purchase additional provisional water trailers and treatment trailer. Consider mitigation, extraction, and delivery through a basin wide lens. Develop options for new interties, and other bulk water sources.	X	X		X	X	X	X	X	X	X		Engineering/ Administration	Medium	Local Resources, CIP, FEMA HMA – C&CB	Medium

Table CRW-1 Action Items

		Impacted Hazard											Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Algal Blooms	Pandemic	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
8	Integrate Earthquake Early Warning into SCADA master plan: Subscribe and integrate to Shake Alert System		X										Engineering/ Administration	Short	Local Resources, CIP	Low
9	Develop Seismic Backbone Replacement Program: Develop a backbone pipeline replacement program for key locations, critical facilities, and emergency distribution points.		X										Engineering/ Distribution	Long	Local Resources, CIP, FEMA HMA	High
10	Assess Water Treatment Process Enhancements: Consider treatment process enhancements to mitigate raw water impacts from future changing conditions	X			X	X	X	X			X	X	Water Resources/ Engineering	Long	Local Resources, CIP, FEMA HMA – C&CB	High
11	Install Emergency Power Supplies: Install back-up power generation for remote water facilities		X		X	X	X	X	X	X			Engineering/ Water Resources	Long	Local Resources, CIP, FEMA HMA	High
12	Debris Management Plan: Participate in the development of a regional debris management plan. Focus on maintaining CRW assets, including maintaining access along transportation routes. Consider debris clearing and debris removal.		X		X	X	X	X	X	X			Engineering/ Administration	Short	Local Resources, CIP, FEMA HMA – C&CB	Low

Source: Clackamas River Water NHMP HMA, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

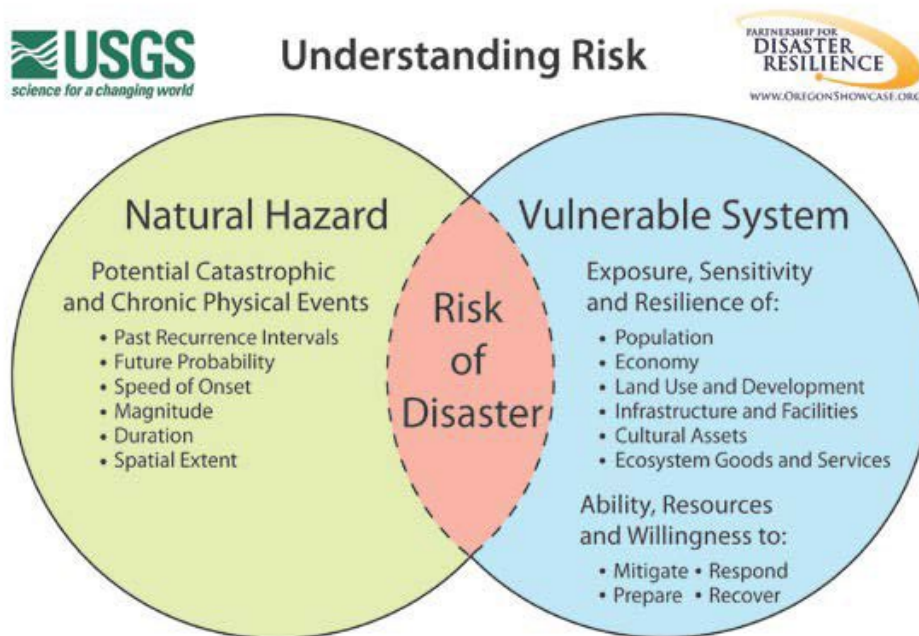
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure CRW-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure CRW-1: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The CRW HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County’s HVA as a reference. Changes from their previous HVA and the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to CRW, which are discussed throughout this addendum. Table CRW-2 shows the HVA matrix for CRW listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the district with a sense of

hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) and two chronic hazards (wildfire and winter storm) rank as the top hazard threats to the CRW (Top Tier). Drought, flood, and windstorm comprise the next highest ranked hazards (Middle Tier), while pandemic, harmful algal blooms, volcanic event, and landslide comprise the lowest ranked hazards (Bottom Tier). *Note: the HMAC opted to not assess the extreme heat event hazard.*

Table CRW-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Earthquake - Cascadia	2	45	100	35	182	1	Top Tier
Earthquake - Crustal	6	50	100	21	177	2	
Wildfire	16	30	70	56	172	3	
Winter Storm	14	30	70	56	170	4	
Drought	10	15	50	56	131	5	Middle Tier
Flood	16	20	30	56	122	6	
Windstorm	14	15	50	42	121	7	
Pandemic	10	45	50	14	119	8	Bottom Tier
Harmful Algal Blooms	10	15	40	28	93	9	
Volcanic Event	2	20	50	14	86	10	
Landslide	6	15	20	21	62	11	

Source: Molalla HMAC, 2023.

Community Characteristics

This section provides information on CRW specific demographics and assets by area. Many of these community characteristics can affect how natural hazards impact communities, and how communities choose to plan for natural hazard mitigation.

System Overview

Clackamas River Water is a special district, regional water service provider organized under Chapter 264 of the Oregon Revised Statutes (ORS). CRW serves a population of about 50,000 directly, and up to 80,000 people when the populations of wholesale customers are included.

CRW, created in July 1995 by the consolidation of the Clackamas Water District and Clairmont Water District, primarily serves customers in unincorporated Clackamas County, including areas adjacent to Milwaukie, Gladstone, Happy Valley, and Portland.

The District’s service area is in the southeastern section of the Portland metropolitan area, approximately 14 miles from downtown Portland. The area, which covers 42.6 square miles, is largely single-family residential and multi-family, although it is home to Precision Castparts and Clackamas Town Center, along with several large grocery chains and food processing businesses (Figure CRW-2). Access to the district is provided by four major highway systems: Interstate 205 and State Highways 212, 213, and 224.

Future growth potential for CRW’s service area is expected to be minimal. New development is very limited within District boundaries due to land use restrictions south of the Clackamas River and lack of developable space north of the river.

Infrastructure maintained by CRW includes: almost 13,000 customer connections, 206 miles of water and wastewater pipes, 14 reservoirs, 24 million gallons in storage, and 13 pump stations. Residential and

commercial customers north of the Clackamas River are part of the North (Clackamas) Service Area. This service area encompasses parts of unincorporated Clackamas County, including areas adjacent to Milwaukie, Gladstone, Happy Valley, and Portland. Customers in the North Service Area receive water that is produced by Clackamas River Water's water treatment plant.

The exception to the CRW North water supply boundary is the Redland Pressure Zone (RPZ) between the North and South service area. The RPZ has historically been provided water from the South Fork Water Treatment Plant as part of the South System.

In 2020, the district completed the 152nd Ave reservoir, Hattan Pump Station, and added storage at the Redland reservoir site allowing the CRW treatment plant to supply water to the Redland Pressure Zone. Future improvements by CRW will serve additional pressure zones in the South service area with North system water, which will improve regional resilience by providing backup water supply to Oregon City, West Linn and other interdependent public water suppliers in the region.

Residential and commercial customers south of the Clackamas River are part of the South (Clairmont) Service Area. This service area encompasses parts of unincorporated Clackamas County and areas adjacent to Oregon City. Customers in the South Service Area receive water that is treated by South Fork Water Board but serviced by Clackamas River Water. Customers in the Redland Pressure Zone receive CRW treated water from the North system, as noted above.

The Clackamas River is the main source of water for the CRW service areas. Raw river water is collected by intakes in the Clackamas River and flow by gravity through debris removal traveling screens. Pumps then lift the water 70 feet to the 23.5 million gallons per day (MGD) treatment plant. As the water enters the plant, chlorine is added to disinfect the water. Coagulants are added to aid flocculation. Contact basins are used to provide time for flocculation and settling. Following the contact basins, a filter aid is added before the flow enters the filters. Filter layers are composed of anthracite coal, silica sand and garnet sand. After filtration the flow receives pH and chlorine adjustment before entering the 1.2-million-gallon (MG) clearwell. Finished water is pumped from the clearwell to residential and commercial District customers, other water providers and throughout the system for fire protection. Reservoirs throughout the distribution system provide additional storage and gravity feed to customers.

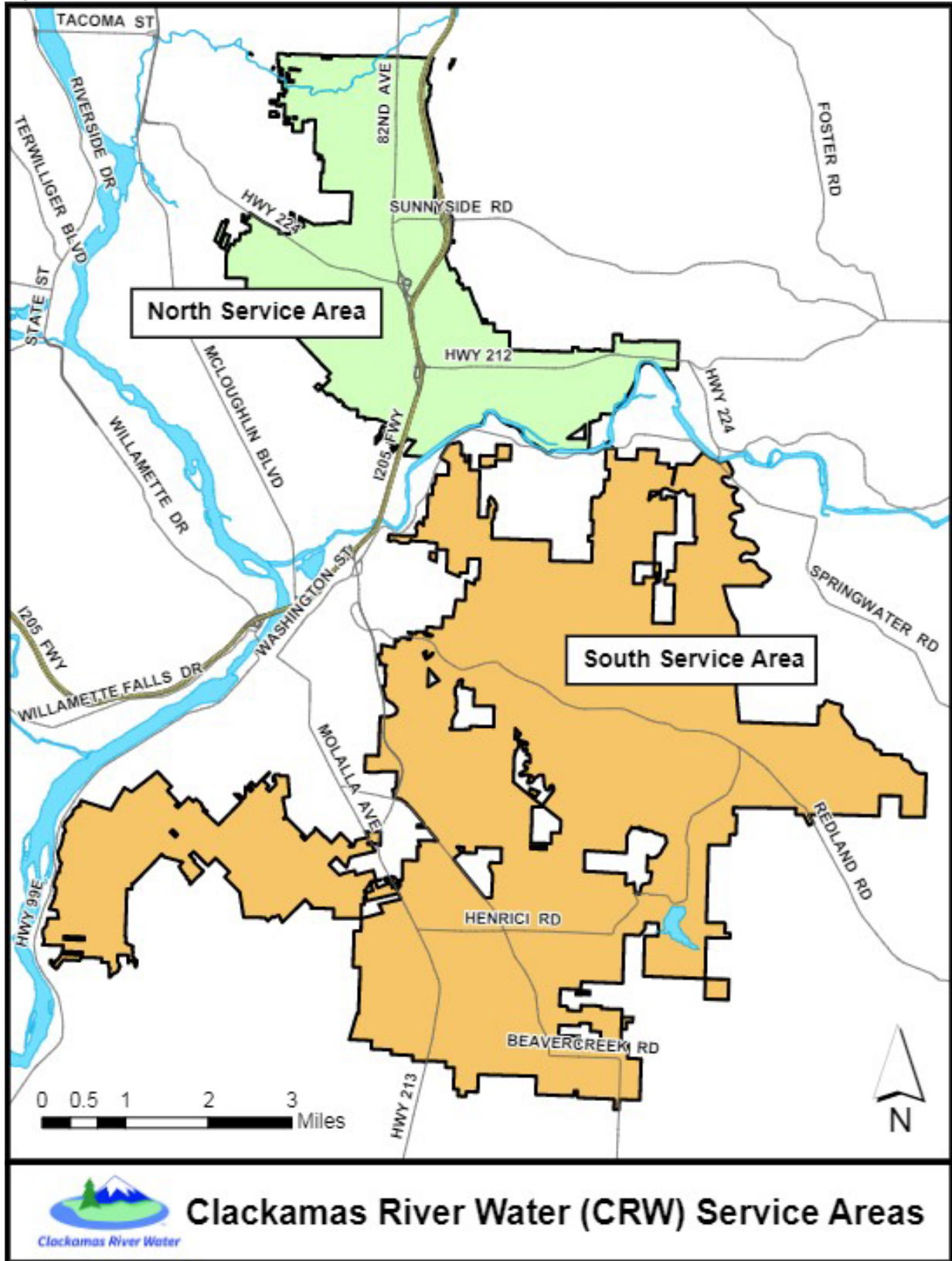
The District's primary facilities are located adjacent to or near the Clackamas River. Other major river systems in the area include the Columbia and Willamette. All water treated by Clackamas River Water is "run of the river"; it is caught as it flows down the river. As a result, it is subject to natural fluctuations brought on by changing seasons or abnormally wet or dry weather.

The District has experienced significant weather events that have impacted their ability and how they serve customers. Events ranging from significant ice storms to heat domes have an impact on water delivery and use. It is typical for this area to experience significantly reduced stream flow for the Clackamas River in the summer and early fall.

Water Rights

CRW is a member of the Clackamas River Water Providers, a group of agencies that separately hold water rights along the Clackamas River. This group consists of CRW, South Fork Water Board (SFWB) (which includes the Cities of West Linn and Oregon City), Sunrise Water Authority, North Clackamas County Water Commission (includes Oak Lodge Water Services District and the City of Gladstone), the City of Lake Oswego, the City of Tigard, and the City of Estacada. Most of the cities noted are part of the County NHMP. CRW holds three certificated surface water rights authorizing the total use of up to 30.1 MGD from the Clackamas River for municipal use.

Figure CRW-2 CRW Service Areas



Source: Clackamas River Water

Interconnections with other Systems

CRW's drinking water system is interconnected with several other public water systems (e.g., wholesale water and emergency interties) that allow the exchange of water during emergency or water shortage events. The District will continue to look for mitigation opportunities to implement emergency interconnections with neighboring water providers.

Community Demographics

The Clackamas County NHMP contains information about the specific demographics of the County as a whole. That data is reflective of the characteristics of and incorporated by reference into the District's NHMP.

Existing land use information is provided in Table CRW-3 to supply context for the impact of natural hazards on the entire CRW service area, and to add clarity to hazard impact differences between the natural hazard rankings of CRW and the County NHMP.

Table CRW-3 Existing Land Use Information

Land Use Category	Acreage	Percent of Total
North System		
Single Family Residential	2,114	37.1%
Industrial	1,464	25.7%
Vacant	705	12.4%
Commercial	646	11.3%
Rural	283	5.0%
Multi-Family Residential	226	4.0%
Agriculture	133	2.3%
Unknown	107	1.9%
Forest	16	0.3%
Total	5,695	100%
South System		
Forest	5,656	29.2%
Single Family Residential	5,327	27.5%
Rural	3,552	18.3%
Agriculture	3,090	15.9%
Vacant	1,239	6.4%
Commercial	321	1.7%
Unknown	181	0.9%
Industrial	24	0.1%
Multi-Family Residential	4	0.0%
Total	19,396	100%

Source: Metro GIS Data

The Oregon Metro Research Center (Metro) publishes household, employee, and population growth forecasts for jurisdictions within its regional boundary, which includes all of CRW's service area.

A demographic analysis of CRW's retail water service area was performed using data from Metro's 2015- 2040 Distributed Forecast (Scenario #1610), adopted in 2016 by Metro Ordinance 16-1371. The 2015 dataset contained the most recent forecasts at the time the demographic analysis was performed.

Table CRW-4 Metro Projections for CRW

	2015	2020	2025	2030	2035	2040	Average Annual Growth
North System							
Employment	27,782	29,852	31,922	33,992	36,062	38,132	1.3%
Population	29,086	29,918	30,750	31,582	32,414	33,247	0.5%
Households	11,491	11,971	12,451	12,931	13,410	13,890	0.8%
South System							
Employment	2,085	3,035	3,985	4,935	5,886	6,836	4.9%
Population	18,158	19,928	21,697	23,467	25,236	27,006	1.6%
Households	6,441	7,193	7,944	8,696	9,448	10,200	1.9%

Source: Metro

Consumers and Customers

CRW has a number of critical and high-volume customers. The following list summarizes CRW commercial/industrial customers by type for the North and South Service areas:

- Fire Service Customers: 374
- Multi-Family Customers: 192
- Church Customers: 32
- Government Customers: 19
- School District Customers: 18
- Commercial Customers: 892
- Industrial Customers: 55
- Seasonal – Irrigation Customers: 103
- Wholesale Customers: 3
- Other District Customers: 4
- Mobile Home Parks: 41
- Medical Customers: 15

Community Lifelines

Critical Facilities, Critical Infrastructure, & Essential Facilities

The District’s assets were identified and assessed as part of the AWIA RRA in 2020. The table below lists the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of CRW.

Table CRW-5 Lifeline Summary

Name/Number	System	Identified Hazard Exposure										
		DR	EQ	EH	FL	HB	PA	LS	VE	WF	WN	WS
Source Water												
Clackamas River	-	X				X			X			
Groundwater Well #1	-	X	X									
Intake Facility	-		X		X				X	X		
Water Treatment Plant	-		X			X			X	X	X	X
Reservoirs												
Otty #1 Reservoir	North		X						X	X		
Otty #2 Reservoir	North		X						X	X		
Otty #3 Reservoir	North		X						X	X		
Mather Reservoir	North		X						X	X		
152 nd Ave Reservoir	North		X						X	X		
Barlow Crest Reservoir	South		X						X	X		
Hunter Heights #1 Reservoir	South		X						X	X		
Hunter Heights #2 Reservoir	South		X						X	X		
Redland #2 Reservoir	South		X						X	X		
Redland #3 Reservoir	South		X						X	X		
Well #1 Reservoir	South		X						X	X		
Henrici #1 Reservoir	South		X						X	X		
Henrici #2 Reservoir	South		X						X	X		
Beavercreek #1 Reservoir	South		X						X	X		
Beavercreek #2 Reservoir	South		X						X	X		
Pump Stations												
90 th Street Pump Station	North		X						X	X	X	X
Harmony Pump Station	North		X						X	X	X	X
Kirkwood Pump Station	North		X						X	X	X	X
Barlow Crest Pump Station	South		X						X	X	X	X
Hunter Heights Pump Station	South		X						X	X	X	X
Hattan Road Pump Station	South		X						X	X	X	X
Redland Pump Station	South		X						X	X	X	X
Holly Lane Pump Station	South		X						X	X	X	X
• Well #1 Pump Station	South		X						X	X	X	X
• Beavercreek Pump Station	South		X						X	X	X	X
Glen Oak Pump Station	South		X						X	X	X	X

Table CRW-5 Lifeline Summary

Name/Number	System	Identified Hazard Exposure										
		DR	EQ	EH	FL	HB	PA	LS	VE	WF	WN	WS
Other Assets												
Pipelines/Distribution System	-		X						X			X
Back-up Generators	-		X									
Administration Buildings	-		X					X		X		
CRW Staff	-						X					
Supervisory Control and Data Acquisition (SCADA) System	-		X								X	X
Business/Information Technology System	-		X								X	X

Source: Information provided by Clackamas River Water

Hazard Descriptions:

DR = Drought

EQ = Earthquake

EH = Extreme Heat

FL = Flood

HB = Harmful Algal Blooms

PA = Pandemic

LS = Landslide

VE = Volcanic Event

WF = Wildfire

WN = Windstorm/Tornado

WS = Winter Storm

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community. CRW owns Riverside Park, a community use property that contains a boat ramp with access to the Clackamas River, Clackamas County Little League facilities, Clackamas County Sherrif’s River Patol boat garage, picnic pavilion, and additional outdoor recreation greenspace.

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include schools, childcare centers, adult care centers, and other vulnerable residential complexes (such as mobile home parks and campgrounds).

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include the water treatment plant, operations facility, local gas stations, etc.

Hazard Characteristics

Drought

The HMAC determined that the District’s probability for drought is **high** and that their vulnerability to drought is **low**. *The probability rating increased and the vulnerability rating did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

CRW is concerned about drought in that it reduces the quantity of water available and increases the risk of wildfires. Wildfires may impact facilities and staff but may also cause acute and chronic water quality concerns.

A historical occurrence of drought impacted operations and triggered Water Management and Conservation plan curtailments in 2015.

Vulnerability Assessment

Due to insufficient data and resources, CRW is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifeline Section.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”² 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the District’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Molalla as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Molalla as well.

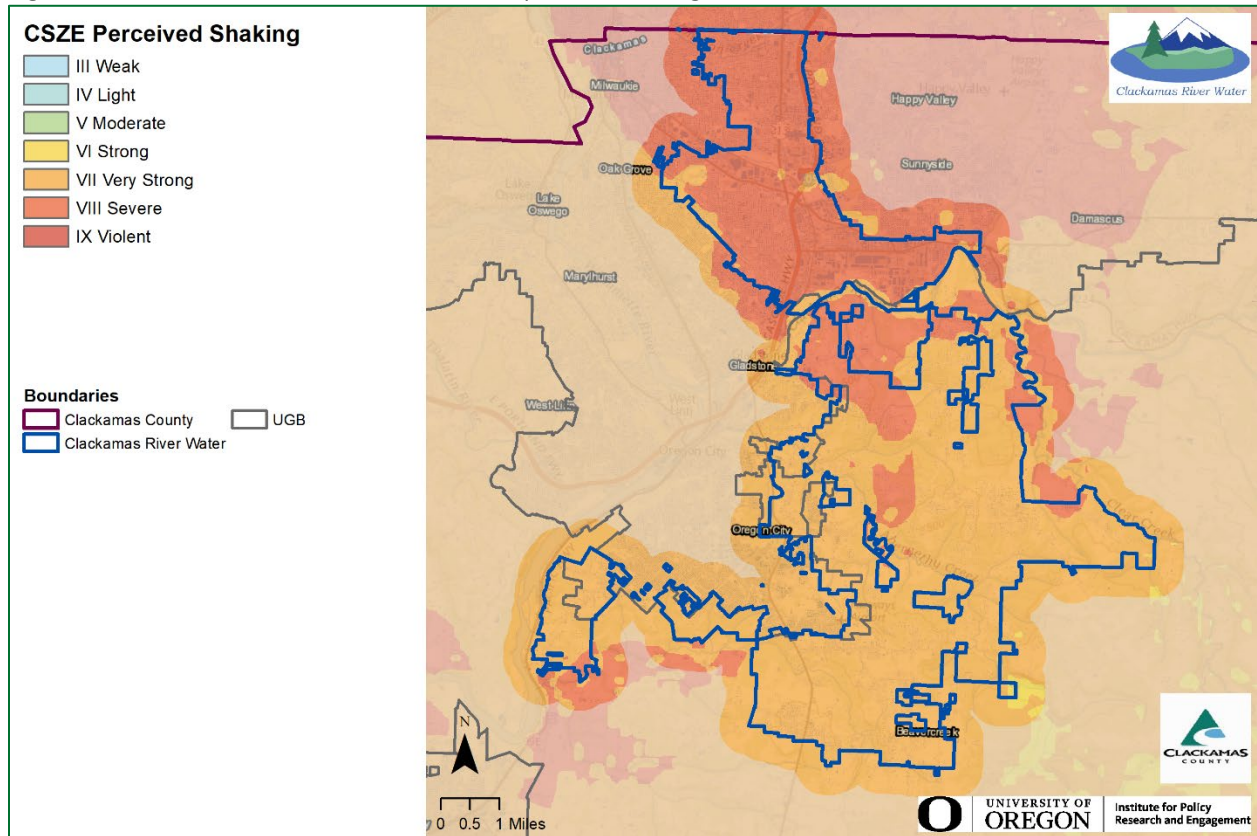
Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-

² Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Molalla Fault Zone (discussed in the crustal earthquake section).

Figure CRW-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the District is expected to experience very strong shaking (orange), while areas around the District will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Figure CRW-3: Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.
 Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
 Note: To view hazard detail click this [link](#) to access Oregon HazVu

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.³

The District’s proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the District a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the

³ The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

State into four distinct zones and places the District predominately within the “Valley Zone” (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

The District is partially within the severe shaking area, and there is significant area around the District that have severe and very severe shaking if a large earthquake were to occur.

Earthquake (Crustal)

The HMAP determined that the District’s probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect CRW as well. Figure CRW-3 shows a generalized geologic map of the CRW area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the district limits as red and orange.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

The Canby-Molalla Fault runs through the center of the district and can generate high-magnitude earthquakes. The District is also near the Portland Hills Fault Zone (discussed in greater detail below). Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993, Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8. In December 2017 a 4.0 tremor was felt in Clackamas County along the same epicenter as the 5.6 quake; this time no damage occurred.

Canby-Molalla Fault Zone

The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Molalla in northern Oregon.

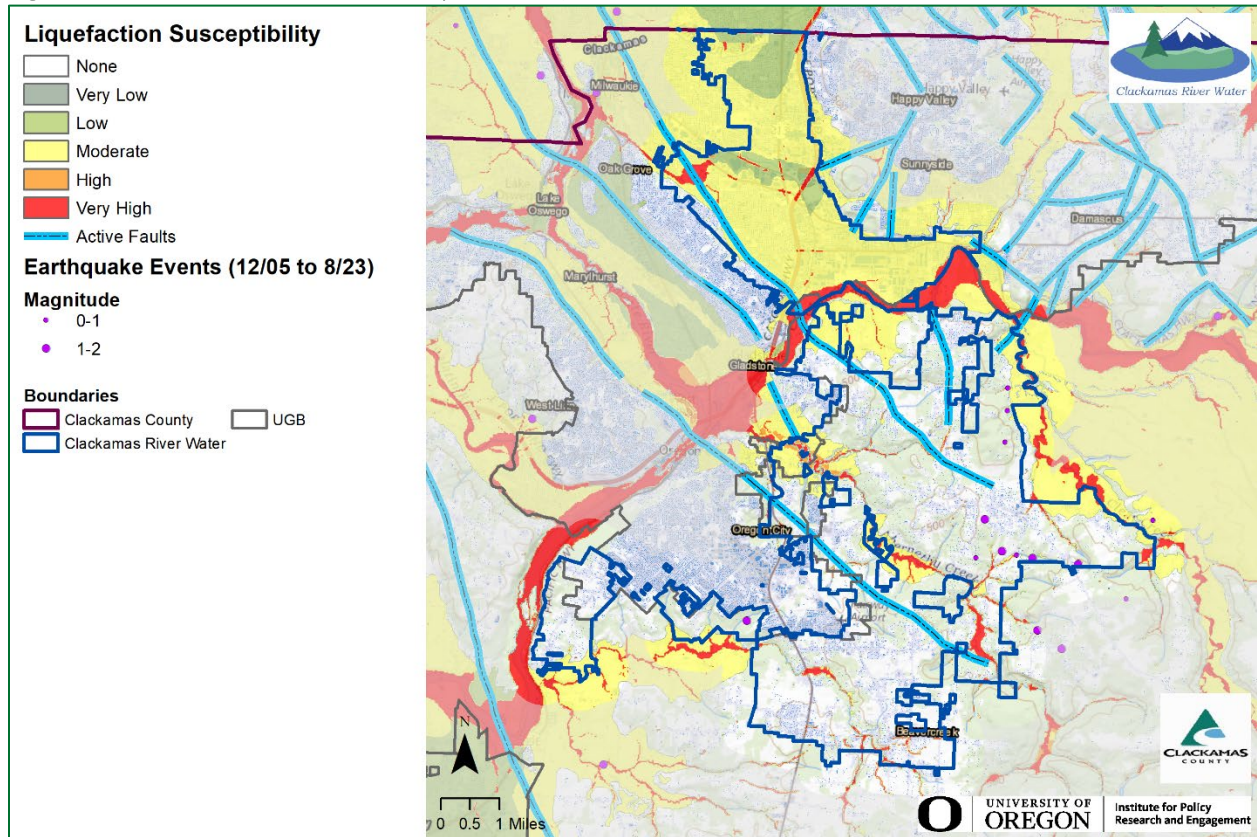
Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 15 miles northeast of Molalla.

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Figure CRW-4 Active Crustal Faults, Epicenters (2005-2023), and Soft Soils



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric

distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Further findings from the DOGAMI report are provided at the end of the crustal earthquakes hazard section within the County-wide assessment (See Volume I).

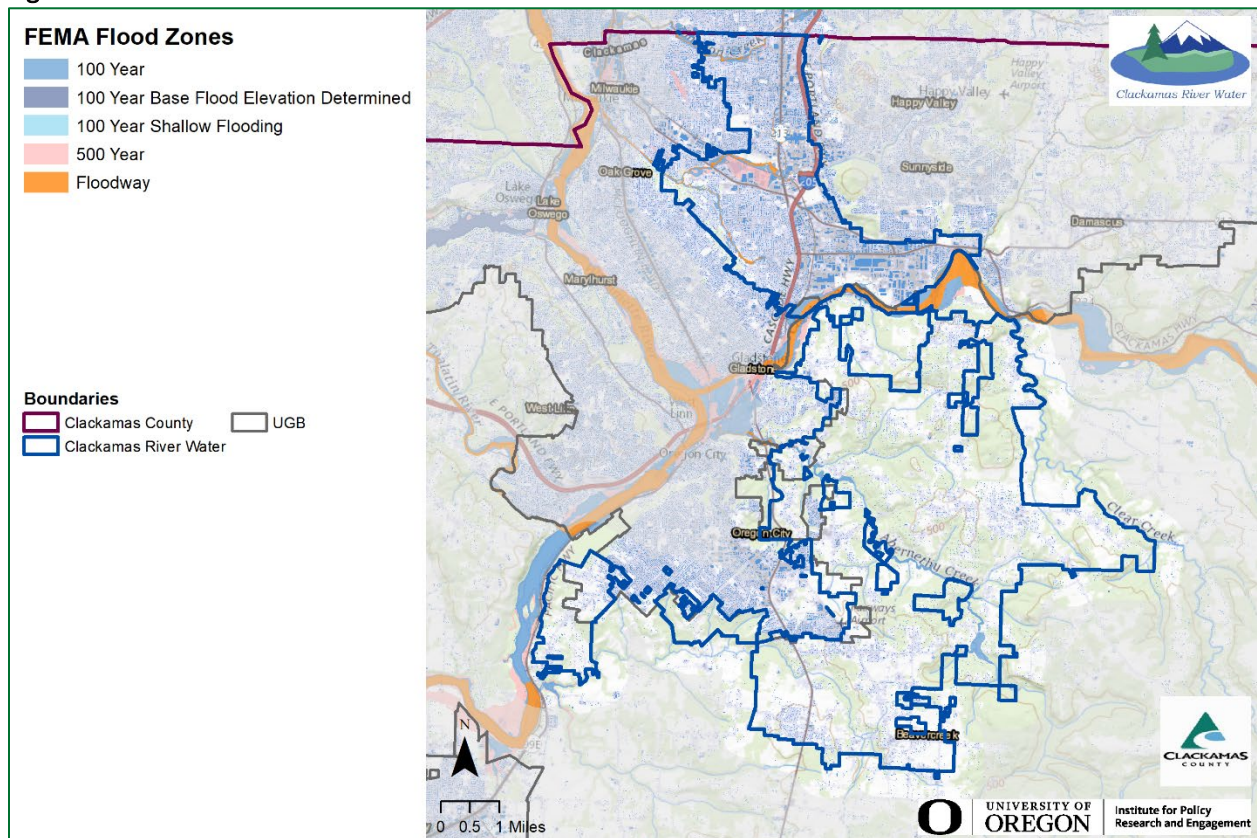
Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. Older infrastructure (pipes, pump stations, and reservoirs) maintained by CRW are at risk to earthquake damage.

Flood

The HMAC determined that the District's probability of flooding is **high** and that their vulnerability to flooding is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure CRW-4 illustrates the flood hazard area for the district.

Figure CRW-5 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

CRW assets are in an area that has an overall low susceptibility to flooding from the Clackamas River. However, the CRW intake pump station is barely above the 100-year flood level.

There have been 7 river crests between 38-45 feet between 2003 & 2012. During the flood of 1996, the river was within 2 feet of flooding the CRW intake pumping station, which had to be shut down for approximately 24 hours due to high turbidity and silt build up in the intake.

Vulnerability Assessment

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the District to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of the District outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The extent of flooding hazards in the District primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifeline Section.

National Flood Insurance Program (NFIP)

FEMA updated the Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) in 2018 (effective January 19, 2018). Clackamas River Water is not a community which has authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction. The cities of Happy Valley, Johnson City, Milwaukie, Oregon City and Clackamas County participate in the National Flood Insurance Program (NFIP).

There are no repetitive loss or severe repetitive loss properties owned or operated by the District. For specific information for adjacent communities to the District's service area see the Clackamas County NHMP Volume I, Section 2 (Table 2-12 for more information) and the addenda for the cities of Happy Valley, Johnson City, Milwaukie, and Oregon City.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"⁴ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

⁴ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond District boundaries are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifeline Section.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC opted to not assess the extreme heat hazard. The District's service area is entirely contained within Clackamas County and the cities of . Please see the applicable County and City hazard profiles for applicable information on characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region.

Windstorm

The HMAC determined that the District's probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for cRW.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris.

Additionally, transportation, and economic disruptions result as well. Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Annual historical high wind occurrences have caused short term power outages anywhere from a few hours to several days.

Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the District's probability for winter storm is **high** and that their vulnerability to winter storm is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the District typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Winter Storms or deep freezes which cause damage to pipes and other assets have been recorded in the area. Recent snow and ice storms occurred in 1978, 1998, 2004, and 2017. Typical impacts include frozen meters and sensing lines, and ruptured pipes and short term power outages normally lasting less than 24 hours. During the winter snow/ice storm in February 2021, there was restricted critical infrastructure site access and power failures that impacted operations for several days.

Most winter storms typically do not cause significant damage; however, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter and commercial traffic as noted above.

Vulnerability Assessment

Due to insufficient data and resources, Molalla is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Lifeline Section.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"⁵ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

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

⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

(range 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Volcanic Event

The HMAC determined that the District’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **moderate**. *These ratings did not change since the previous version of this NHMP.*

Volume I, Section 2 describes the characteristics of volcanic event hazards, history, as well as the location, extent, and probability of a potential event within the region. Volcanoes are located near Molalla, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Molalla’s relative distance from volcanoes, the District is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the District may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the District could experience a heavier coating of ash.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the District’s probability for wildfire is **high**, and that their vulnerability to wildfire is **moderate**. *These ratings did not change since the previous version of this NHMP.*

The [Clackamas County Community Wildfire Protection Plan](#) (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather and urbanization conditions are primarily at cause for the hazard level. CRW has abundant wooded areas that are a concern in the case of a wildfire event. Figure CRW-6 shows overall wildfire risk in the District. The two most recent fires include the 36 Pit Fire in September 2014 and the Riverside Fire in September 2020. The Bull Run Reservoir Fire, near Portland, also had a huge impact on the District, as they are a large producer of wholesale water. The City of Sandy is connected to Bull Run and has difficulty when water availability from that reservoir is constrained.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes CRW, is the most heavily populated portion of the county and is characterized

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁶ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

Harmful Algal Blooms

The HMAC determined that the District’s probability for harmful algal blooms is **moderate** and that their vulnerability to harmful algal blooms is **low**. *These ratings did not change since the previous version of this NHMP.*

Harmful algal blooms (HABs) occur when colonies of algae grow rapidly, release toxins or deplete oxygen levels and can become harmful to plants, animals and humans. HABs with cyanotoxins that includes Benthic algae have been detected upstream of the CRW Water Treatment Plant in North Fork Reservoir and Timothy Lake in the Clackamas River Watershed during low flow and high heat conditions almost every summer.

Vulnerability Assessment

Due to insufficient data and resources, CRW is currently unable to perform a quantitative risk assessment for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifelines Section.

Future Projections

Warming temperatures and drought will combine to increase the likelihood of harmful algal blooms. Higher concentrations of HABs could increase risks to vulnerable populations, as well as pets and livestock.

Pandemic

The HMAC determined that the District’s probability for pandemic is **low** and that their vulnerability to pandemic is **high**. *These ratings did not change since the previous version of this NHMP.*

Pandemics are a natural disaster not typically found in NHMPs. They are hazards that are not physically affecting the environment, but rather ones that are physically affecting the people living in the environment.

Disease is a sickness, illness, or loss of health⁷ Terms such as disease outbreaks, epidemics, and pandemics are often used to describe situations where multiple cases of infection are identified.

⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

⁷ Centers for Disease Control and Prevention (CDC). “Definition of Disease.” Retrieved October 4, 2016 from <http://www.cdc.gov/vaccines/terms/glossary.html>

“The amount of a particular disease that is usually present in a community is referred to as the baseline or endemic level of the disease. This level is not necessarily the desired level, which may in fact be zero, but rather is the observed level.”⁸

The Centers for Disease Control and Prevention (CDC) states, “While some diseases are so rare in a given population that a single case warrants an epidemiologic investigation (e.g., rabies, plague, polio), other diseases occur more commonly so that only deviations from the norm warrant investigation” The following definitions are all from the CDC:⁹

- **Sporadic** refers to a disease that occurs infrequently and irregularly.
- **Endemic** refers to the constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area.
- **Hyperendemic** refers to persistent, high levels of disease occurrence.

Occasionally, the amount of disease in a community rises above the expected level.

- **Epidemic** refers to an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area.
- **Outbreak** carries the same definition of epidemic but is often used for a more limited geographic area.
- **Cluster** refers to an aggregation of cases grouped in place and time that are suspected to be greater than the number expected, even though the expected number may not be known.
- **Pandemic** refers to an epidemic that has spread over several countries or continents, usually affecting many people.

Understanding how and why a particular disease spreads requires a multi-disciplinary study of biology, culture, society, economics, environment, and technology. Diseases are caused by viruses, bacteria, or protozoa, which infect humans in a variety of ways. Some are water borne, air borne, or food borne; others are transmitted via interpersonal contact or contact with a vector, such as a mosquito. Norovirus and influenza are examples of familiar viruses. Examples of bacteria are E. coli and streptococcus. Cryptosporidium and giardia are caused by protozoa.

The fatality rate of a disease outbreak depends upon:

- The number of people who become infected.
- The severity of disease caused by the virus (its virulence).
- The vulnerability of affected populations.
- The effectiveness of preventive steps.¹⁰

As a regional employment, recreational, residential, retail and health care hub, CRW’s region draws many non-residents daily into the area, multiplying the opportunities for further disease exposure and transmission among both visitors and residents. Recognizing this expanse of exposure is important; it is possible that a disease related issue could impact a large portion of the region’s population. The most

⁸ CDC. “Lesson 1: Introduction to Epidemiology. Section 11: Epidemic disease occurrence. In Principles of epidemiology in public health practice: An introduction to applied epidemiology and biostatistics (Self-Study Course SS1978)” (3rd ed.) U.S. Department of Health and Human Services, Office of Workforce and Career Development, 18 May 2012.

⁹ Centers for Disease Control and Prevention. “Mission, role, and pledge”. Retrieved 9 Sep, 2016 from <https://www.cdc.gov/about/organization/mission.html>

¹⁰ WebMD. “What are epidemics, pandemics, and outbreaks?” Retrieved 9 Sep. 2016 from: <http://www.webmd.com/cold-and-flu/what-are-epidemics-pandemics-outbreaks>.

recent pandemic impacting the District was the COVID 19 pandemic (DR-4499, 2020 to 2023) which has had widespread global implications. As of May 2023, there have been more than 85,000 documented cases of COVID-19 in Clackamas County including 663 deaths.¹¹ Within CRW the COVID-19 pandemic impacted operations due to remote work schedules of approximately 30 percent of CRW staff.

Vulnerability Assessment

Due to insufficient data and resources, the CRW is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. However the impacts of COVID-19 and state/local lockdowns has given significant insight into future pandemics.

The vulnerabilities and impacts to people, property, and the environment from diseases vary widely. People with access and functional needs are more susceptible to impacts. Older populations and populations with preexisting health conditions are significantly more at-risk in pandemic scenarios. In addition, communities of color, “essential” workers¹², homeless populations, and low-income workers are more likely to be exposed to infectious diseases in their daily lives.¹³

Future Projections

Vulnerable populations within Jackson County, including children, elderly, those living with disabilities, and unhoused individuals, will be a greater risk to emerging infectious diseases in the future.

¹¹ “Track Covid-19 in Clackamas County, Ore.” New York Times, updated 4 Jan. 2024, <https://www.nytimes.com/interactive/2023/us/clackamas-oregon-covid-cases.html>, Accessed 4 Jan. 2024.

¹² First responders, medical staff, manual laborers, tradesman, food service employees, transportation workers, and educators, to name a few.

¹³ (U.S. EPA, n.d.-b).

Attachment A: Action Item Changes

Table CRW-4 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table CRW-1).

Previous NHMP Actions that are Complete:

CRW #10, “Address Wildfire Hazard Mitigation:Develop a Wildfire Assessment and Mitigation Plan.” Complete. Addressed via other plans including EOP and CWPP.

Previous NHMP Actions that are Not Complete and No Longer Relevant:

None identified.

Table CRW-6 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
CRW #1 (G-01)	#1	Not Complete	Yes
CRW #2	#2	Not Complete	Yes
CRW #3 (P-02)	#3	Not Complete	Yes
CRW #4 (ST-01)	#4	Not Complete	Yes
CRW #5 (PS-05)	#5	Not Complete	Yes
CRW #6	#6	Not Complete	Yes
CRW #7	#7	Not Complete, revised	Yes
CRW #8	#8	Not Complete, revised	Yes
CRW #9	#9	Not Complete	Yes
CRW #10	-	Complete	No
CRW #11	#7	Not Complete, revised	Yes
CRW #12	#10	Not Complete	Yes
CRW #13	#11	Not Complete	Yes
-	#12	New	-

Attachment B: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from February 22 through March 8, 2024 on the District’s website and sent postcards to their critical customer list. The plan was also posted and announced on the County’s website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan’s content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting

Natural Hazard Mitigation Plan Approval

Clackamas River Water recently received Federal Emergency Management Agency (FEMA) approval of its first Natural Hazard Mitigation Plan (NHMP). The next step will be FEMA to review the plan and approve it. The public comment period closes February 29. Following FEMA approval of the CRW plan, the CRW Board will adopt the plan. The plan will be incorporated as an addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan.

[Natural Hazard Mitigation Plan](#) 



NHMP development was part of an extensive CRW planning process and demonstrates CRWs commitment to improving the resilience of the water system by identifying and preparing to undertake actions that can reduce the impacts of natural and human caused events, such as earthquake, ice storm, wildfire, and CYBER attacks which can negatively impact the public water supply.

Once adopted the NHMP will help guide the districts hazard mitigation efforts now and in the future as CRW works towards becoming a more disaster resilient water utility. The plan was developed in cooperation with Clackamas County Disaster Management (CCDM), Oregon Emergency Management (OEM), and FEMA.

This planning process was a community effort between District ratepayers, the public, county agencies, other special districts, cities, and other interested parties. Should you have any questions or comments about the NHMP or questions about the District’s resilience and emergency preparedness efforts please contact Beth McGinnis at bmcginnis@crwater.com or by calling (503) 722-9229.

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1 and #2: April 7 and May 30, 2023

During this meeting, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the District.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: December 4, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the District's capabilities assessment.
- Reviewed, confirmed, and prioritized the District's mitigation strategies.

Colton Water District Addendum to the Clackamas County Multi-Jurisdictional Hazard Mitigation Plan

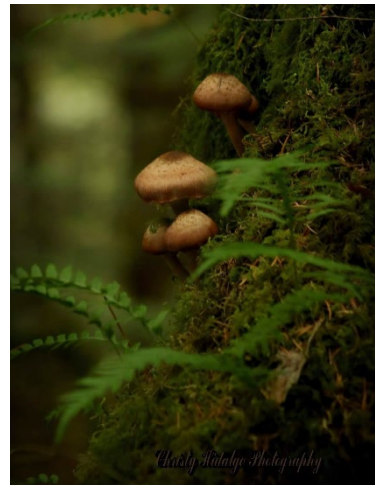
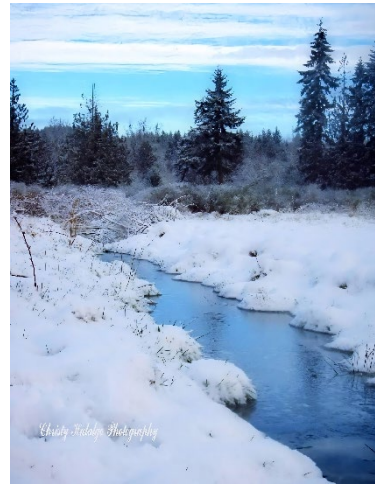


Photo Credits: Teresa Bricker, Chief Todd Gary (Colton RFPD #70), Christy Hidalgo Photography

Effective:

September 12, 2024 – September 11, 2029

Prepared for
Colton Water District



Colton Water District

Adopted:
June 18, 2024, (Resolution # 2024-03)

This Natural Hazard Mitigation Plan was prepared by:



UNIVERSITY OF
OREGON

School of Planning, Public
Policy and Management

Institute for Policy
Research and Engagement

Planning grant funding provided by:

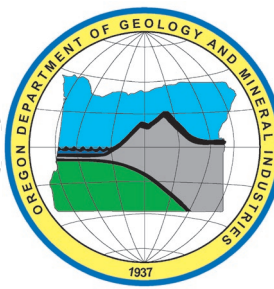


FEMA

Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

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Photo Credit: Chief Todd Gary, Colton RFPD #70, Riverside Fire



FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

Resolution # 2024-03

A Resolution Adopting the Colton Water District Representation in the Updates to the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan

Whereas, the COLTON WATER DISTRICT recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the COLTON WATER DISTRICT has fully participated in the FEMA prescribed mitigation planning process to prepare the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

Whereas, the COLTON WATER DISTRICT has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of the COLTON WATER DISTRICT to the impacts of future disasters within the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan*; and

Whereas, these proposed projects and programs have been incorporated into the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

Whereas, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, May 29, 2024) contingent upon this official adoption of the participating governments and entities;

Whereas, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and


Whereas, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

Whereas, the COLTON WATER DISTRICT adopts the NHMP and directs the DISTRICT MANAGER to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

Now, therefore, be it resolved, that the COLTON WATER DISTRICT adopts *the Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan; and

Be it further resolved, that the COLTON WATER DISTRICT will submit this Adoption Resolution to the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region10 officials to enable final approval of the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

Adopted this 18 day of June, 2024



Certifying Official

Purpose

This document serves as the Colton Water District (CWD) addendum to the Clackamas County Multi-Jurisdiction Natural Hazards Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Basic Plan) which serves as the NHMP foundation and Volume III (Appendices) which provide additional information. This addendum meets all the requirements of Title 44 CFR §201.6 including:

- Multi-jurisdictional **Plan Requirements** §201.6(a)(4),
- Multi-jurisdictional **Planning Process** §201.6(b)(1-3),
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii),
- Multi-jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv),
- Multi-jurisdictional **Plan Maintenance Process** §201.6(c)(4), and
- Multi-jurisdictional **Plan Adoption** §201.6(c)(5).
- Multi-Jurisdictional **Participation** §201.6(a)(3),

This is the first addendum to the County NHMP for CWD and builds on other recent CWD planning efforts detailed further in this document.

CWD adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on June 18, 2024. FEMA Region X approved the Clackamas County NHMP and the District’s addendum on September 12, 2024. With approval of this NHMP the District is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through September 11, 2029.

A description of the jurisdiction specific planning and adoption process follows, along with community specific action items. Information about CWD’s risk relative to the natural hazards relevant to the County is documented in the addendum’s Risk Assessment section. The section considers how CWD’s risk differs from or matches that of the County’s. Additional information on Risk Assessment is provided within the Clackamas County NHMP’s Section 2 –Risk Assessment.

Mitigation Plan Mission

The NHMP mission states the purpose and defines the primary functions of the NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community’s environment or priorities change.

CWD concurs with the mission statement developed during the Clackamas County planning process (Volume I, Section 3):

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that Clackamas County citizens, and public, and private partners can take while working to reduce the CWD's risk from natural hazards. These statements of direction form a bridge between the broad mission statement and serve as checkpoints, as agencies, and organizations begin implementing mitigation action items.

CWD concurs with the goals developed during the Clackamas County planning process (Volume I, Section 3). All NHMP goals are important and are listed below in no order of priority. Additionally, the Clackamas County NHMP goals align well with the CWD Strategic Goal to:

Ensure a reliable water supply for the communities we serve by investing in infrastructure and emergency preparedness.

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.

Below is a list of the NHMP goals:

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

NHMP Process, Participation, and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(S), Plan Adoption, and 44 CFR 201.6(a)(3), Participation.

This CWD addendum was first developed in 2023. The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Institute for Policy Research and Engagement (IPRE) collaborated with the Oregon Department of Emergency Management (OEM), and Clackamas County to update the Clackamas County multi-jurisdictional NHMP in 2019. CWD was not engaged in that process but utilized the outcomes of the historical efforts in the development of this NHMP Addendum. It is the intent of CWD to participate in the next County NHMP update and align with the County schedule.

The Clackamas County NHMP and CWD addendum are the result of a collaborative effort between District rate payers, citizens, elected officials, public agencies, non-profit organizations, the private sector, and regional organizations. Information contained in the County NHMP – Volumes I to III and the Community Wildfire Protection Plan was utilized in the development of this plan. The CWD Hazard Mitigation Action Committee (HMAC) was formed and guided the process of developing the District's NHMP. Development of the District's NHMP was completed by community volunteers and CWD board members.

Convener

The CWD Manager serves as the NHMP addendum convener. The convener of the NHMP addendum will take the lead in implementing, maintaining, and upgrading the addendum in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from CWD's HMAC served as the project steering committee and met formally, and informally, to develop, review, and revise CWD's NHMP addendum with a focus on the NHMP's risk and resilience assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and collaboration with Clackamas County. The CWD Addendum has been incorporated into Volume II of the County NHMP.

The CWD HMAC was comprised of the following representatives:

- Teresa Bricker, Board of Commissioners
- Ken Carroll, Board of Commissioners
- Pete Dorstert, Superintendent
- Todd Gary, Fire Chief, Colton Rural Fire Protection District #70
- Alan Gross, Board of Commissioners
- Betty Hodges, District Manager and Convener
- Carl Stephens, Board of Commissioners
- Colin Wait, Board of Commissioners

The HMAC served as the local review body for the NHMP.

NHMP Implementation and Maintenance

The CWD Board of Commissioners will be responsible for adopting the District’s addendum to the Clackamas County NHMP. This addendum designates the HMAC, and a convener to oversee the development, and implementation of action items. Because the CWD addendum is part of the County’s multi-jurisdictional NHMP, CWD will look for opportunities to partner with the County and other interdependent agencies and jurisdictions to mitigate common hazards and improve resilience in the community and region.

CWD’s HMAC will convene after adoption of CWD’s NHMP addendum on an annual schedule. The District convener will participate as requested by the County in order to provide opportunities for participating jurisdictions (cities and special districts) to identify opportunities for joint mitigation efforts and report on NHMP implementation, and maintenance. The District Manager will serve as the Water District convener and will be responsible for assembling the CWD HMAC.

The HMAC will be responsible for:

- Reviewing existing action items to determine suitability for funding
- Keeping elected officials, ratepayers and the public informed of the mitigation process
- Reviewing existing, and new risk assessment data to identify issues that may not have been identified at NHMP creation
- Educating and training new HMAC members on the NHMP, and mitigation actions in general
- Assisting in the development of funding proposals for priority action items
- Discussing methods for continued public involvement
- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness)
- Documenting successes, and lessons learned during the year

The District will utilize the same implementation and maintenance process identified in Volume I, Section 4. The convener will remain active in the County’s implementation, maintenance process (Volume I, Section 4) and participate in the County HMAC meetings that occur.

The District will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The district will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies, the public, and the District; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs.

The mitigation plan works in conjunction with other District plans and programs as well as the County Comprehensive Land Use Plan, Capital Improvement Plan (CIP), and building codes, as well as the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein (and in Attachment A) are intended to be implemented through existing plans and programs within the District. Plans and policies already in existence have support from district residents, businesses, and policy makers. Where possible, the District will implement the NHMP's recommended actions through existing plans and policies. Many strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

CWD has approximately 500 retail water service connections that serve the community within the service districts in an unincorporated portion of western Clackamas County. Comprehensive Planning takes place at the County level and relevant information is included in the County NHMP (Volume 1).

Capability Assessment

The Capability Assessment identifies and describes the ability of the CWD to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources.

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Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting design standards and codes that account for best practices in structural hardening, and codifying mitigation into development requirements. The extent to which an authority, municipality, or multi-jurisdictional effort leverages these approaches is an indicator of that community's or organization's capabilities.

Governance Structure

CWD is governed by a five-member Board of Commissioners elected to alternating four-year terms by District voters. The Board of Commissioners, with support from the District's management team, and citizen engagement, define the District's vision, mission, goals, and strategic objectives, set policies, and approve the District's operating budget which reflects the outcomes of extensive planning efforts,

priorities, and action items developed with review and approval from citizen members of the budget committee.

Memorandum of Understanding Colton Water District/Colton RFPD #70, 2023

This memorandum between the CWD and the Colton Rural Fire Protection District was entered into to ensure there is enough potable water to meet the needs of CWD's customer base during any fire emergency either inside or outside of the water district boundary, avoid causing a public health hazard by using all the potable water, and coordinate efforts during declared fire emergencies.

Rules and Regulations

CWD Board of Directors rules and regulations that establish the conditions by which the District conducts its business and operations and how Customers may receive service. Existing policies that define service provision and address hazardous conditions provide a source of mitigation capability.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

The CWD falls under Clackamas County's Building Codes and Fire Code.

Board of Commissioners

The Board of Commissioners has the responsibility of developing and adopting the annual budget. Integrating hazard mitigation goals and projects into the annual budget in the future will be key to implementing the NHMP. The district does not levy any tax funds and relies strictly on water revenue from customer payments, new water meter hookups, and miscellaneous revenue to fund staffing and operations.

Programs & Projects

This Plan directs CWD and Clackamas County to explore integration into other planning documents and processes. Although the District has not previously been included in the County-wide NHMP, it has made progress in integrating the resilience efforts into its portfolio of planning programs and projects over the last five years.

Water System Master Plan (2012)

The *CWD Water System Master Plan (WSMP)*, completed in 2012, recommended expanding or replacing the current water treatment plant (constructed in 1981). This recommendation included seismic resiliency, replacement of the current filtration system with membrane filtration system, automated monitoring system, new chlorine system (replace chlorine gas system with sodium hypochlorite), and back-up power generation. The automated monitoring system will allow monitoring of plant operations without having to be onsite during emergencies.

An update of this plan is scheduled for within the next five years.

Community Wildfire Protection Plan (2024)

The Clackamas County Community Wildfire Protection Plan (CWPP) will be incorporated into this Plan as a functioning annex. The CWPP is expected to be adopted in early 2024.

Capital Improvements

- In 1996, a waterline replacement project was completed from the water treatment plant to the storage tank. In addition, sections of 6" asbestos-cement (AC) waterlines were replaced with 10" Polyvinyl chloride (PVC) pipe.
- In 2001, waterline replacement continued in several more sections of the service area. In addition, a new 318,000 gallon storage tank at the water treatment plant was constructed.
- In 2005, existing 6" PVC waterlines were replaced with 10" and 8" pipe.
- In 2022, an emergency generator was installed at the District's water treatment plant.
- In 2023, a 50,000 gallon tank for non-potable water for firefighting was brought online at the water treatment plant.
- In 2022, plans to develop a Water/fire Infrastructure Project began. This could involve the addition of a one-million-gallon storage tank for firefighting or development of infrastructure for additional non-potable water available for firefighting. Grant funding is currently being pursued for this project.

Future Projects

The District is developing a capital improvement fund for future projects identified in the Master Plan. Funds that had been going towards bond payments in the past now go towards future construction projects.

The District is currently exploring water infrastructure projects at \$5.7 million dollars or more, for which they will need to apply for grants. The list includes treatment plant upgrades in the amount of \$3.2 million and replacing waterline on Oswalt Road at \$2.5 million. Additional improvement projects include seismic upgrades, plant operations during power outages, improving the water intake on Jackson Creek, Jackson Creek water rights to prevent summer use restrictions, Canyon Creek water rights, upgrading additional water distribution lines to 10" and additional support for forest fire suppression.

Shared grant opportunities exist with Colton Rural Fire Protection District. These agencies could partner to develop grants for a water tank on Green Mountain Rd., upgrading the dead end four-inch transmission line, a 10,000-gallon tank at the Elwood fire station, and a 1,000,000-gallon seismic protected reservoir.

Personnel

The following District and Colton Rural Fire Protection District personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: CWD District Manager, CWD Superintendent, and Colton Rural Fire Protection District Chief

Public Information Officer: CWD District Manager, CWD Superintendent, and Colton Rural Fire Protection District Chief

Capital improvement planning: Colton Water Board of Commissioners

Capital improvement execution: Colton Water Board of Commissioners and CWD Staff

CWD does not have any employees solely designated to Emergency Management or Mitigation. They are a very small water district with two part-time employees. These personnel integrate hazards and

resilience planning into their greater work programs to the best of their abilities. There is limited capacity to expand upon their capabilities or work loads. CWD relies upon emergency management services from Colton RFPD #70 and Clackamas County.

Capital Resources

CWD has access to several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

Communication Towers: Clackamas County 800mhz tower located on Goat Mountain

Critical facilities with power generators for use during emergency blackouts include: Water District Treatment Plant & Colton Fire Protection District Station

Warming or cooling shelters: Three Colton schools (grade school, middle school and high school); Colton Rural Fire Department

Community shelters: Three Colton churches, Camp Colton

Food pantries: Colton Helping Hands Food Bank, Colton Market, Colton Café, and Clyde & Bob’s 76

Fueling storage: Colton Market Fuel, Clyde and Bob’s 76 Station

Findings

Several important findings from this capability assessment informed the design of the Plan’s mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

District staffing is severely limited. Employees are assigned hazard mitigation responsibilities as a (small) part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the agency can undertake in any year. The District relies upon its relationships with the County and the Fire District to expand its operations.

Reliance upon outside funding streams

CWD operates on a limited budget with many conflicting priorities. Current revenues are not enough to keep up with all the capital needs. Additionally, there are restrictions on many revenue sources in relation to where the funds may be spent. Grants and loans can provide revenue sources for large resilience projects and district planning.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The CWD’s mitigation strategy is comprised of the “Action Items”. Planning these action items involved the identification of hazards and risks, determination of probability and hazard impact, cost analysis, and project selection criteria. Those assessments along with historical events and the extensive wildfire damage of the 2020 Riverside wildfire amplified the recognition and need for increased public preparedness and improved system resilience through natural hazard mitigation.

Action Items

Table CWD-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAc prioritized action items to reflect current conditions (risk assessment), needs, and capacity. High priority actions are shown with orange highlight. The District will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAc in terms of implementation, the HMAc has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority.



Photo Credit: Christy Hidalgo Photography

Table CWD-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
1	<p>Replace Water Treatment Plant</p> <p>The current water treatment plant (constructed in 1981) needs to be replaced. This will include upgrades to ensure seismic resilience, fitting a new membrane filtration system, adding an automated monitoring system, new chlorine system, and back-up power generation.</p>	X	X	X	X			X		X	CWD Superintendent	Short	DEQ, FEMA HMA	High
2	<p>Replace Asbestos-cement Distribution Lines</p> <p>Replace approximately 3 miles of substandard 6" asbestos-cement (AC) distribution lines with 6" PVC pipe. This AC distribution line has become brittle with age and has played a major role in water loss due to leaks.</p>	X	X							CWD Superintendent	Medium	FEMA HMA, EPA	High	
3	<p>Improve Surface Raw Water Intake</p> <p>Improve the CWD's antiquated surface raw water intake to include a protective structure with a side inlet and intake water monitoring system. Intake is located in heavily wooded area on Jackson Creek. Storm debris is a serious issue that requires manual cleaning often in severe weather.</p>				X			X	X	X	CWD Superintendent	Short	Customer Fees, EPA, FEMA HMA	Low
4	<p>Water Loss Improvement</p> <p>CWD's <i>Water System Master Plan</i> dated 2012 sites a five-year water loss audit (2007-2012) that resulted in 23-30% water loss. Action item #2 and #6 are related to this project.</p>	X		X							CWD Superintendent	Ongoing	Customer Fees, EPA, FEMA HMA	Medium

Table CWD-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost
5	Water Storage Seismic Stability Replace two above ground water storage reservoirs (475,000 and 318,000 gallons) with seismically constructed tanks or replace both tanks with a one-million gallon seismically constructed tank. Inspection by Dyer Engineering concluded that neither storage tank can be upgraded to meet the current seismic safety standards as described in the 2022 Oregon Structural Specialty Code. Both tanks need to be replaced.		X								CWD Superintendent	Medium	Customer Fees, FEMA HMA	High
6	Water Meter Replacements CWD has approximately 500 mechanical water meters. Replacing these meters with digital meters with telemetry functionality meters will improve efficiency and conservation (identify leaks faster) and provide a safer and quicker meter reading without having to access customers' property.	X									CWD Superintendent	Medium	Customer Fees, EPA, FEMA HMA	Medium
7	Replace Substandard Fire Hydrants Upgrade all substandard fire hydrants within the district that do not meet adequate flow.							X			CWD Superintendent	Medium	Customer Fees, FEMA HMA	Low
8	New Storage Tank for Firefighting Install a new 60,000 gallon water storage tank on Canyon Creek and hydrant for non-potable water to be used for firefighting.	X						X			CWD Superintendent	Medium	Customer Fees, FEMA HMA	High

Table CWD-1 Action Items

Action Item #	Statement	Impacted Hazard									Implementation and Maintenance				
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead	Timeline	Potential Funding Source	Estimated Cost	
9	Increase Pipe Size for Firefighting Flow Replace 13,860 feet of 4" PVC water distribution line with 6" PVC water distribution line for adequate firefighting flow.	X							X			CWD Superintendent	Long	FEMA HMA	High
10	Connect Dead-end Distribution Lines Install 4,100 feet of 6" pipe to connect (loop) dead-end distribution lines within the CWD. Dead-end distributions lines can lead to water stagnation, requires disinfectants, effects water pressure and requires manual flushing.								X			CWD Superintendent	Long	FEMA HMA	High
11	Expanded Water Rights CWD needs to pursue obtaining surface water rights to prevent summer use restrictions for Jackson and Canyon Creeks.	X							X			CWD Staff and Board of Commissioners	Short	Customer Fees	Low
12	Update the Water System Master Plan Existing 2012 plan must be updated to incorporate new understanding of hazards and current conditions of facilities and resources to meet projected growth through 2045.	X	X	X	X	X	X	X	X	X	X	CWD Staff and Board of Commissioners	Short	Customer Fees	Low

Source: Colton Water District NHMP HMA, 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three 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.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure SA-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure CWD-3: Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

The CWD HMAAC developed their hazard vulnerability assessment (HVA), using the County’s HVA as a reference. Table CWD-2 shows the HVA matrix for CWD listing each hazard in order of rank from high to low. Conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. One chronic hazard (wildfire) and two catastrophic hazards (Cascadia Subduction Zone earthquake and Crustal earthquake) rank as the top hazard threats to the District (Top Tier). Winter storm, extreme heat event, drought, and flood comprise the next highest ranked hazards (Middle Tier), while windstorm, volcanic event and landslide comprise the lowest ranked hazards (Bottom Tier).

Table CWD-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Wildfire	18	35	80	56	189	1	Top Tier
Earthquake - Cascadia	2	45	100	35	182	2	
Earthquake - Crustal	6	50	100	21	177	3	
Winter Storm	12	30	70	49	161	4	Middle Tier
Extreme Heat Event	10	35	70	35	150	5	
Drought	10	15	50	56	131	6	
Windstorm	14	15	50	42	121	7	
Landslide	14	15	20	63	112	8	Bottom Tier
Flood	2	15	20	21	58	9	
Volcanic Event	2	10	20	7	39	10	

Source: CWD HMAAC, 2023.

Volume I, Section 2 of the Clackamas County NHMP thoroughly describes the characteristics of the profiled hazards, history, as well as the location, extent, and probability of potential events within the County. Generally, an event that affects the County, or applicable cities where the District facilities are located, is likely to affect the District as well. Similarly, the causes and characteristics of hazard events are appropriately described within Volume 1, Section 2 as well as the location and extent of potential hazards. Lastly, previous occurrences are well documented within Volume 1, Section 2 and the community impacts described by the County, or applicable City, would generally be the same for the District.

Community Characteristics

History

The CWD was established in 1920 with the purpose of serving a small number of residents in rural southeast Clackamas County, Oregon. The original system consisted of an infiltration gallery on Canyon Creek. In 1965, the District’s water source was moved to Jackson Creek for improved water quality. In 1981, a new treatment plant, distribution system improvements, and a new reservoir were constructed to serve the area.

Since the completion of the updated water system in 1981, the District has undertaken three major distribution improvement projects, which were based on the recommendations outlined in the District’s 1993 Colton Water Study.

- In 1996, a waterline replacement project was completed from the water treatment plant to the storage tank. In addition, sections of 6" asbestos-cement (AC) waterlines were replaced with 10" Polyvinyl chloride (PVC) pipe.
- In 2001, waterline replacement continued in several more sections of the service area. In addition, a new 318,000 gallon storage tank at the water treatment plant was constructed.
- The third project, completed in 2005, included replacement of existing 6" PVC waterlines with 10" and 8" pipe.

Transportation/Infrastructure

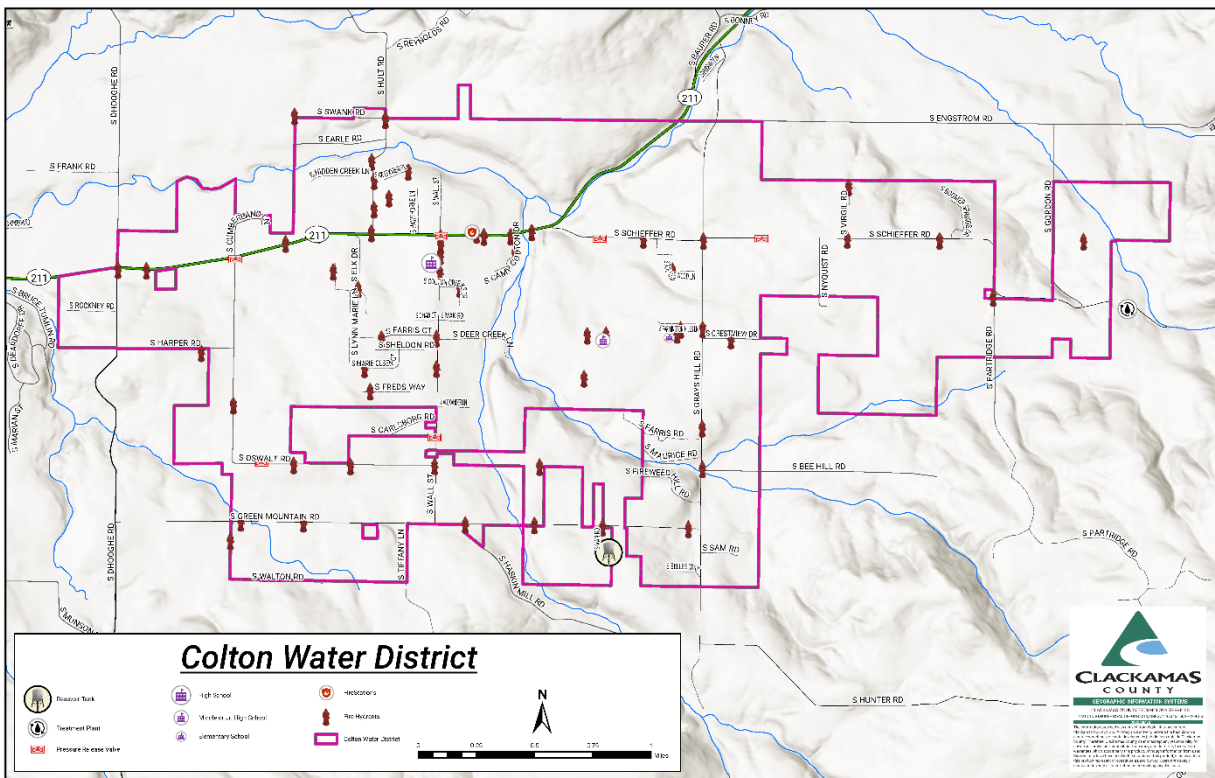
As an unincorporated area, Colton relies upon ODOT and Clackamas County for road/bridge maintenance. The primary highway is Oregon Hwy 211.

Economy

Colton is a small unincorporated community located in Clackamas County, Oregon on Oregon Hwy 211. There are a few small commercial/industrial businesses including: COLTONTEL, Colton Café, Colton Market, Clydes & Bob's 76, Wilcox, Colton Production, Helping Hands. In addition, Colton Rural Fire Protection District #70 protects 5,500 residents, seven businesses, three schools, and three community churches.

CWD has 500 customer connections (serving 1,500 people), 55 fire hydrants, and 18 miles of distribution pipe.

Figure CWD-1 Water Distribution System and Service Area



Source: Colton Water District, December 2023

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the District. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community's resilience.

The community lifelines identified below were identified by CWD. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Critical Facilities

Facilities that are critical to response and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer, and water facilities, hospitals, bridges, roads, shelters, and more.

- Colton Water Treatment Plant, 23850 S Schieffer Road, Colton
 - Back-up Generator
- Reservoir #1 – Treatment Plant, 23850 S Schieffer Road, Colton
- Reservoir #2 – Van Road
- Water Diversion on Jackson Creek
- Pipelines/Distribution System

Fire Stations

- Colton Rural Fire Protection District #70, 20987 S Hwy 211, Colton

Potential Shelter Sites

Churches

- Colton Lutheran Parrish, 20858 S. Hwy 211 Colton
- Colton Community Church 21128 S Highway 211, Colton
- Canyon Creek Bible Fellowship 21302 S Highway 211, Colton

Schools

- Colton Elementary School, 30439 S Grays Hill Rd, Colton
- Colton Middle School, 21580 S Schieffer Rd, Colton
- Colton High School, 30205 S Wall St, Colton

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

Eighteen miles of water distribution lines that support 55 fire hydrants, Oregon State Hwy 211 and subsequent bridges.

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well as those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include childcare centers, schools, adult care centers, mobile home parks, and campgrounds.

Hazard Characteristics

Drought

The HMAC determined that the District’s probability for drought is **high** and that their vulnerability to drought is **low**.

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

CWD is very concerned about drought in that it reduces the quantity of water available and increases the risk of wildfires. Drought contributed to the deadly Riverside Fire in 2020 that came very close to burning the community of Colton. Historical occurrences of drought have impacted operations and triggered water restriction for the community. CWD has been placed on water restrictions several times over the past few years. Wildfires have impacted CWD facilities and drained potable water stores to fight the fires.

Vulnerability Assessment

Due to insufficient data and resources, CWD is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”¹ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction’s ability to provide water for irrigation or commercial and household use.

Earthquake (Cascadia Subduction Zone)

The HMAC determined that the District’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**.

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect CWD as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well

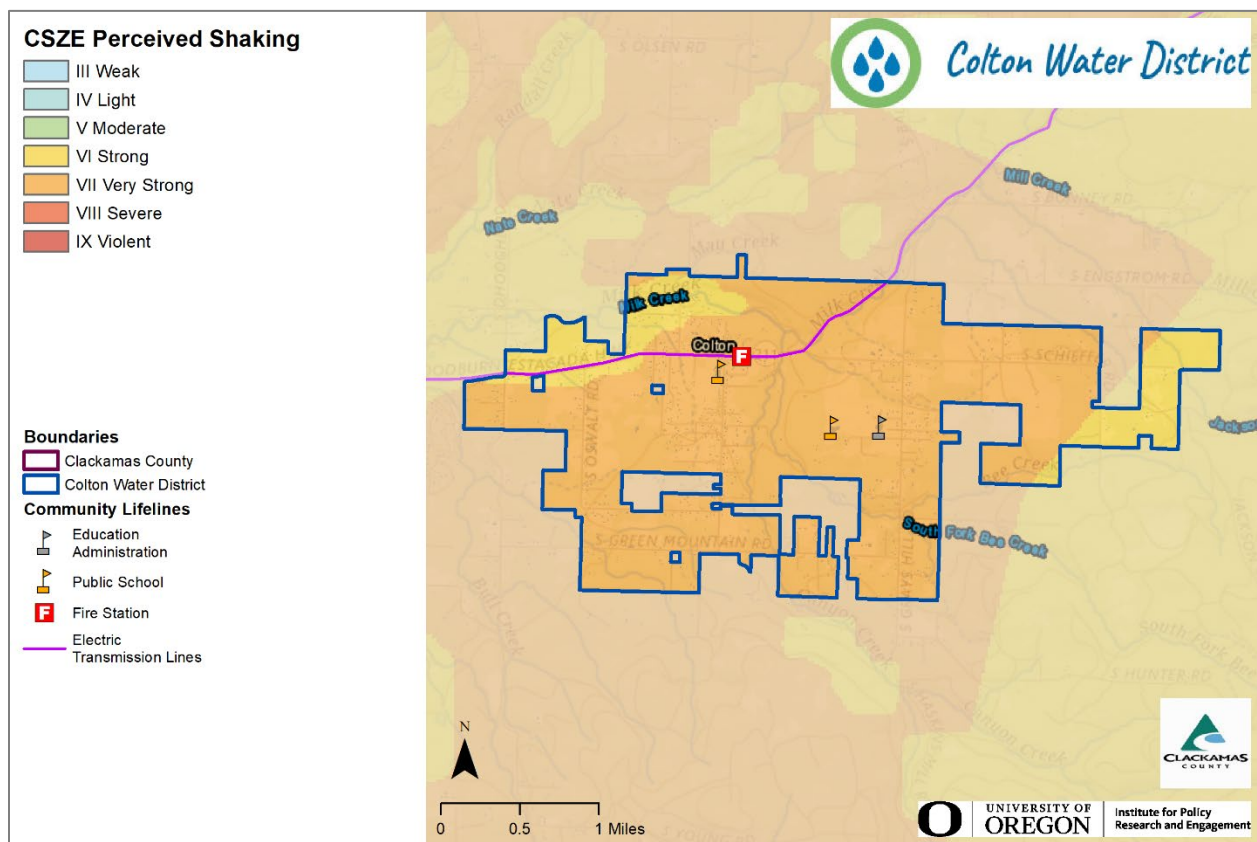
¹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for CWD as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Molalla Fault Zone (discussed in the crustal earthquake section).

Figure CWD-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the District is expected to experience very strong shaking (orange), while areas around the District will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Figure CWD-2 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and

5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.²

The District's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the District a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places the District predominately within the "Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

The District is not within the severe shaking area, though there is significant area around the area that have severe and very severe shaking if a large earthquake were to occur. These areas include Highway 211, which could result in Colton having access issues from emergency vehicles and other response efforts. There have been instances of water lines and facilities impacted by earthquake induced landslides within the County.

Earthquake (Crustal)

The HMAC determined that the District's probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**.

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect CWD as well. Figure CWD-3 shows a generalized geologic map of the Colton area that includes the areas for potential regional active faults, earthquake history (1971-2008), and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the District limits as red and orange.

Crustal faults are located within Clackamas County and therefore CWD is vulnerable to crustal earthquakes.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

The Canby-Molalla Fault and Portland Hills Fault Zone can generate high- magnitude earthquakes. Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993, Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Canby-Molalla Fault Zone

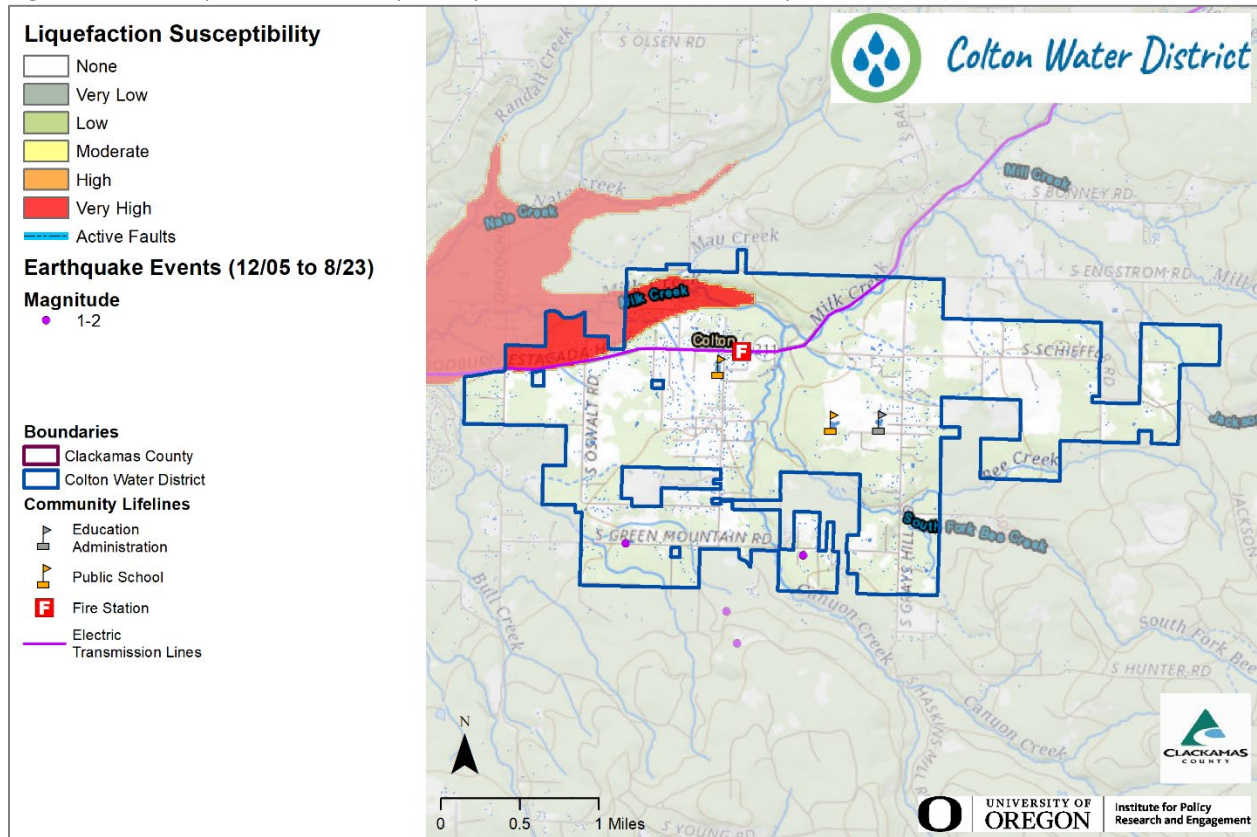
The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Molalla in northern Oregon.

² The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies northeast of Colton.

Figure CWD-3 Liquefaction Susceptibility, Active Faults, and Earthquake Events (2005-2023)



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults ([O-18-02](#)). Findings from that report are provided in Volume 1.

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. As noted in the profile, approximately 90% of the District's facilities and pipes were built or installed prior to 1990, which increases the District's vulnerability to the earthquake hazard.

Future Projections

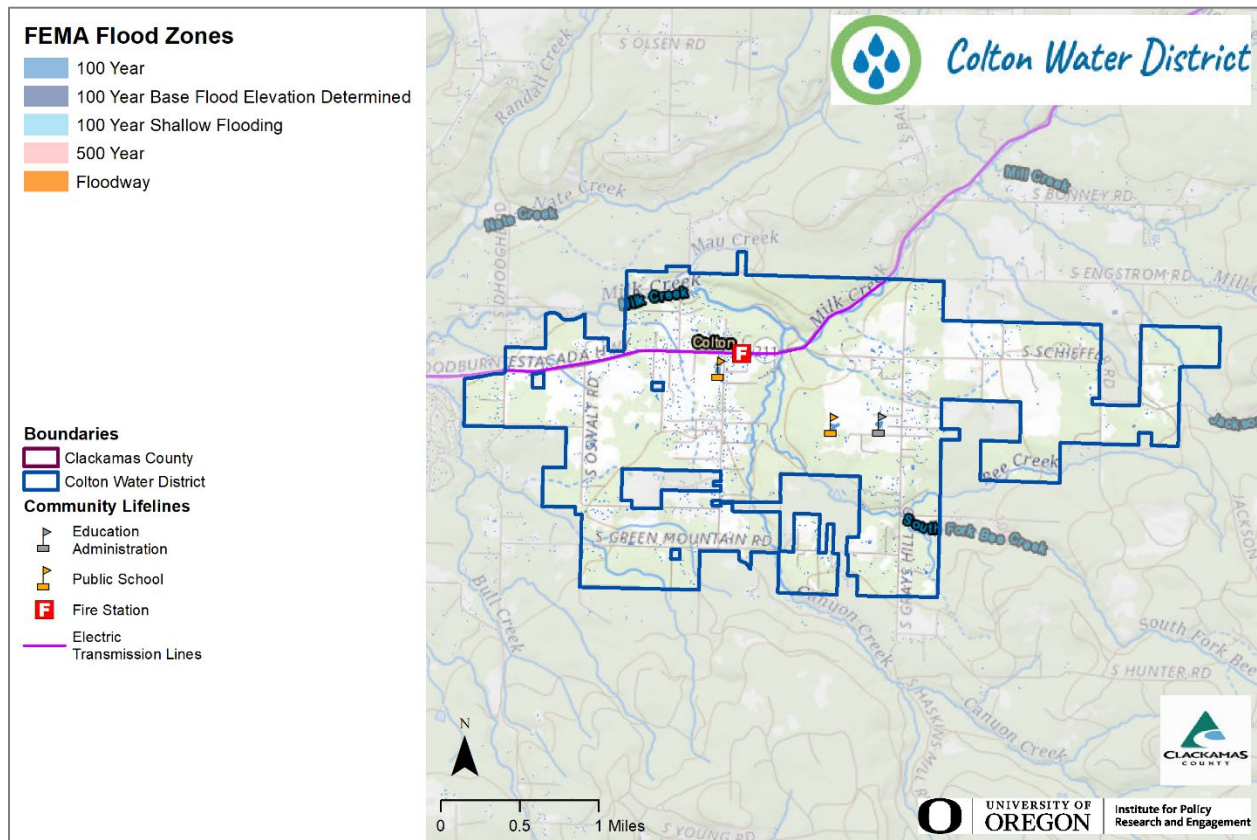
Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

The HMAC determined that the District’s probability of flooding is **low** and that their vulnerability to flooding is **low**.

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure CWD-4 illustrates the flood hazard area for CWD.

Figure CWD-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

CWD assets are in an area that has an overall low susceptibility to flooding.

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the District to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Colton outside of the mapped floodplains

may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The extent of flooding hazards in the CWD primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”³ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the District’s probability for landslide is **high** and that their vulnerability to landslide is **low**.

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. CWD assets are located in a heavily forested, mountain area. Recent wildfires and continued logging operations present a substantial risk of landslides.

Landslide susceptibility exposure for CWD is shown in Figure CWD-5. Most of CWD demonstrates a moderate to high landslide susceptibility exposure. There are no areas within CWD that have very high landslide susceptibility exposure. There are a large number of high landslide susceptibility exposure areas in the forested hills to the southeast.

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 ([O-16-02](#)).

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond district boundaries are susceptible to obstruction as well.

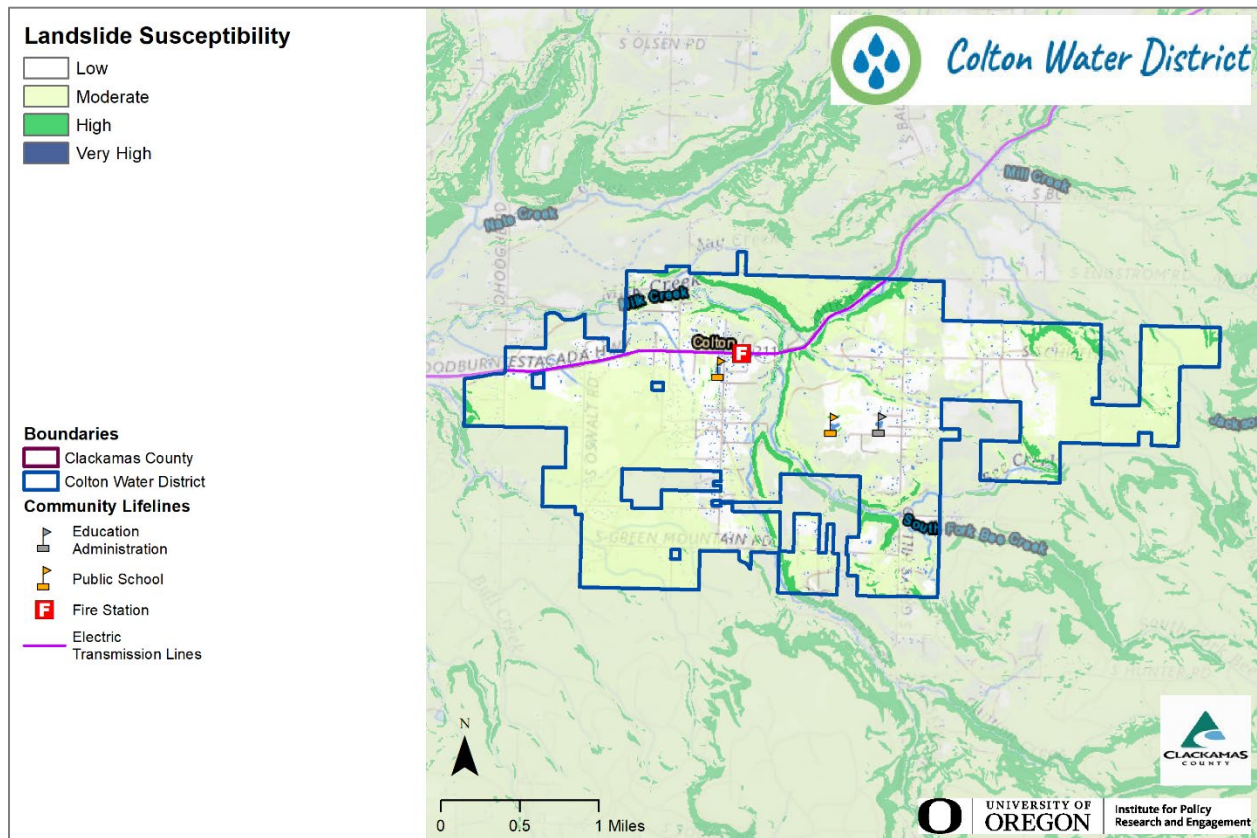
The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

³ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Figure CWD-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the District's probability for extreme heat events is **moderate** and that their vulnerability is **moderate**.

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the District as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

Extreme heat produced by complex heat domes are a recent feature of the weather in the Pacific Northwest. The recent heat dome recorded in 2021 stressed communities, infrastructure, crops, and caused additional drying of forestlands already dry from drought conditions. Demand for water surges during these events.

CWD has not experienced any life-threatening consequences from the few historical extreme heat events. However, changes in climate indicate that the area should expect to see more extreme heat events.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"⁴ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

The HMAC determined that the District's probability for windstorm is **moderate** and that their vulnerability to windstorm is **low**.

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for CWD.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris. Additionally, transportation, and economic disruptions result as well.

⁴ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Damaging high-speed windstorms have been recorded in the area. Historical annual high-wind events have caused temporary and multi-day power outages. Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a 24-48 hours to a week. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.



Photo Credit: KPTV News

Winter Storm (Snow/Ice)

The HMAC determined that the District’s probability for winter storm is **moderate** and that their vulnerability to winter storm is **moderate**.

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the District typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Freezing temperatures, ice and/or snow that cause damage to pipes and other assets have been recorded in the area. Recent snow and ice storms occurred in 1978, 1998, 2004, 2017, 2019, and 2021. The 2021 storm left lots of trees and power lines down blocking roads. Typical impacts include frozen meters and sensing lines, and ruptured pipes and short term power outages typically last less than 24 hours.

Most winter storms typically do not cause significant damage; however, they are frequent, and have the potential to impact economic activity. Road closures due to winter weather are an uncommon occurrence but can interrupt commuter, and commercial traffic as noted above.

Vulnerability Assessment

Due to insufficient data and resources, CWD is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁵ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Volcanic Event

The HMAC determined that the District’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **low**.

Volume I, Section 2 describes the characteristics of volcanic event hazards, history, as well as the location, extent, and probability of a potential event within the region. CWD is located near two active volcanoes;

⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Mount Hood and Mount St. Helens. CWD's assets are not in an area susceptible to volcanic proximity hazards (lava flow, and lahars etc.); however CWD's assets are subject ash fall. Upstream lahars are not expected on Jackson Creek since there is no direct access to volcanos in the upper watershed.

Vulnerability Assessment

Due to the District's relative distance from volcanoes, CWD is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, the District may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash. If Mount Hood erupts, however, the District could experience a heavier coating of ash.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

Wildfire

The HMAC determined that the District's probability for wildfire is **high**, and that their vulnerability to wildfire is **moderate**.

The Clackamas County Community Wildfire Protection Plan (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to CWD is found in the following chapter: Chapter 9.9: Colton Rural Fire Protection District #70.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location, and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather and urbanization conditions are primarily at cause for the hazard level. CWD has not experienced a wildfire within its limits, but the District has abundant wooded areas that are a concern in the case of a wildfire event. CWD is in a mountainous and heavily forested area; therefore, at high risk for natural or human caused wildfire. The mountainous topography along with abundant fuel (vegetation) and weather contributed to the two most recent fires: 36 Pit Fire in 2014, the Unger Road Fire and the Riverside Fire in 2020. Figure CWD-6 shows wildfire risk in CWD and Figure CWD-7 shows wildfire risk and large fire history including the 2020 Riverside and Unger Rd fires.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

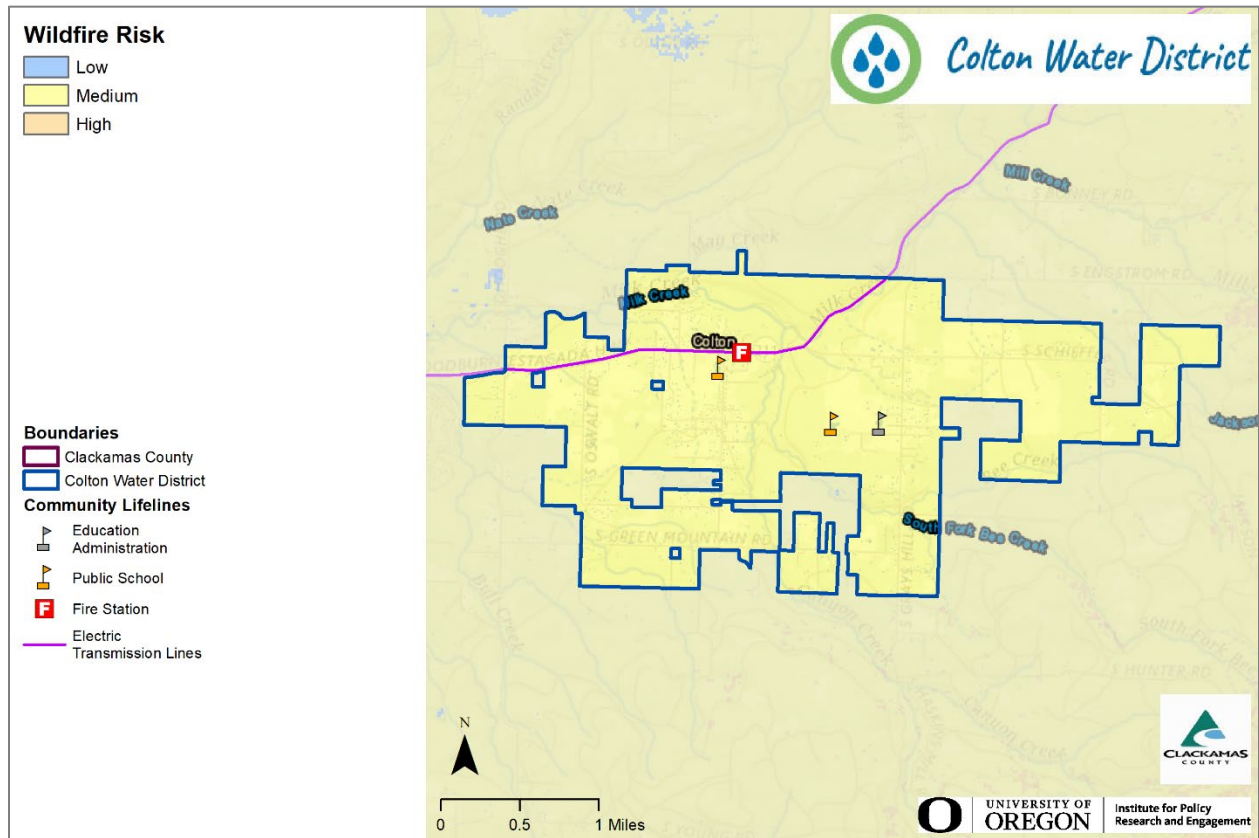
Vulnerability Assessment

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the Water District as well. Colton Fire District's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire

risk. The District will update their wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Figure CWD-6 Wildfire Risk



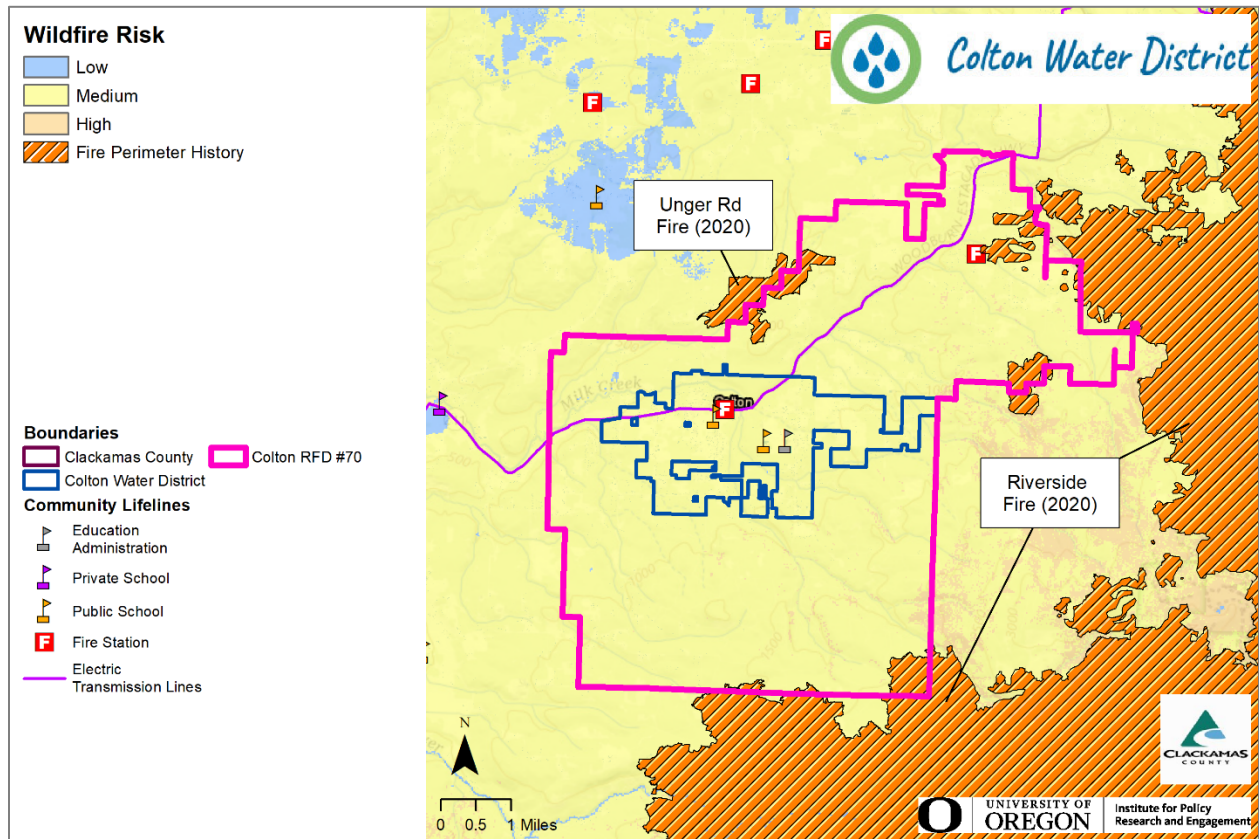
Source: Map created by Oregon Partnership for Disaster Resilience.
 Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).
 Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁶ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Figure CWD-7 Wildfire Risk and Large Fire History



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer's CWPP Planning Tool



Photo Credit: Teresa Bricker

Attachment A: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from January 31 through February 29, 2024 on the District's website and the Molalla Pioneer. The plan was also posted and announced on the County's website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting

Colton Water District seeks additional public input on their addendum to the Clackamas County Natural hazards Mitigation Plan

Clackamas County Molalla

Posted on February 14, 2024

Colton Water District is in the process of developing their Natural Hazards Mitigation Plan (NHMP). This work is being performed in cooperation with the University of Oregon's Institute for Policy Research and Engagement – Oregon Partnership for Disaster Resilience and the Oregon Department of Emergency Management (OEM) utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program. With re-adoption of the plan, CWD will gain eligibility to apply for federal funding towards natural hazard mitigation projects. This local planning process includes a wide range of representatives from city, special districts, and county government, emergency management personnel, and outreach to members of the public. A natural hazards mitigation plan provides communities with a set of goals, action items, and resources designed to reduce risk from future natural disaster events. Engaging in mitigation activities provides jurisdictions with a number of 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. An electronic version of the updated draft of the Colton Water District NHMP addendum will be available for formal public comment beginning January 31, 2024. To view the draft, please visit the Colton Water District website. If you have any questions regarding the Colton Water District NHMP addendum or the update process in general, please contact: Betty Hodges, Colton Water District Manager at (503) 824-2500 or email at bh@coltonwater.org; or Michael Howard, Director for the Oregon Partnership for Disaster Resilience at (541) 346-8413 or mrhoward@uoregon.edu. Publish February 14, 2024 MOP316774

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the development process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to develop the NHMP and to make the NHMP as comprehensive as possible. The HMAC met formally on the following dates (additional meetings were held with the County on February 17, June 14, 2023 and January 9, 2024):

Meeting #1: March 21 and April 7, 2023

During this meeting, the HMAC:

- Reviewed the previous Clackamas County NHMP, and were provided updates on hazard mitigation planning, the NHMP development and update process, and project timeline.
- Provided recent history of hazard events in the district.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Provided mitigation strategies (actions).
- Reviewed the implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #2: November 16, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the district's capabilities assessment.
- Reviewed, confirmed, and prioritized the District's mitigation strategies.

Oak Lodge Water Services Addendum to the Clackamas County Multi-Jurisdictional Hazard Mitigation Plan



Photo Credits: Oak Lodge Water Services

Effective: September 12, 2024 - September 11, 2029

Prepared for
Oak Lodge Water Services



Adopted:
July 9, 2024, (Resolution # 2024-0030)

This Natural Hazard Mitigation Plan was prepared by:



Planning grant funding provided by:



Federal Emergency Management Agency (FEMA)

Project Award Number: DR-4562-39-P-OR

Additional Support Provided by:



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FEMA

September 12, 2024

Tootie Smith, Chair
Clackamas County
2051 Kaen Road
Oregon City, Oregon, 97045

Reference: Approval of the Clackamas County Multi-jurisdictional Hazard Mitigation Plan

Dear Chair Smith:

In accordance with applicable¹ laws, regulations, and policy, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10 has approved the Clackamas County multi-jurisdictional hazard mitigation plan for the following jurisdictions:

Clackamas County	City of Canby	City of Estacada
City of Gladstone	City of Happy Valley	City of Lake Oswego
City of Milwaukie	City of Molalla	City of Oregon City
City of Sandy	City of West Linn	City of Wilsonville
Clackamas Fire District #1	Clackamas River Water	Colton Water District
Oak Lodge Water Services		

The approval period for this plan is from September 12, 2024 through September 11, 2029.

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

Based on FEMA's review, the plan did not include all dam risk. Thus, the participating jurisdictions are not eligible for assistance from the HHPD Grant Program. If any participating jurisdictions with HHPDs are interested in this assistance, they should contact the FEMA Region 10 Hazard Mitigation Planning Team at FEMA-R10-MT_Planning@fema.dhs.gov, to learn more about how to include all dam risks in the plan.

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).

Chair Smith
September 12, 2024
Page 2

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, including adoption by the participating jurisdiction(s). Before the end of the approval period, please allow sufficient time to secure funding for the update, including the review and approval process. Please include time for any revisions, if needed, and for participating jurisdictions to formally adopt the plan after the review, if not adopted prior to submission. This will enable each jurisdiction to remain eligible to apply for and receive funding from FEMA's mitigation 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 program, please contact Joseph Murray, Mitigation Planner at (503) 378-2911 or joseph.murray@oem.oregon.gov, who coordinates these efforts for local entities.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief

Enclosures

cc: Stephen Richardson, Oregon Department of Emergency Management
Joseph Murray, Oregon Department of Emergency Management

JF:JG:WS

OAK LODGE WATER SERVICES

RESOLUTION NO. 2024-0030

A RESOLUTION ADOPTING OAK LODGE WATER SERVICES REPRESENTATION IN THE UPDATES TO THE CLACKAMAS COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

WHEREAS, Oak Lodge Water Services recognizes the threat that natural hazards pose to people, property and infrastructure 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 is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

WHEREAS, Oak Lodge Water Services has fully participated in the FEMA prescribed mitigation planning process to prepare the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

WHEREAS, the Oak Lodge Water Services has identified natural hazard risks and prioritized a number of proposed actions and programs needed to mitigate the vulnerabilities of Oak Lodge Water Services to the impacts of future disasters within the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan; and

WHEREAS, these proposed projects and programs have been incorporated into the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan that has been prepared and promulgated for consideration and implementation by the participating cities and special districts of Clackamas County; and

WHEREAS, the Oregon Department of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the Clackamas County, Multi-Jurisdictional Natural Hazards Mitigation Plan and pre-approved it (dated, May 29, 2024) contingent upon this official adoption of the participating governments and entities;

WHEREAS, the NHMP is comprised of three volumes: Volume I -Basic Plan, Volume II – Jurisdiction Addenda, and Volume III – Appendices, collectively referred to herein as the NHMP; and

WHEREAS, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

WHEREAS, Oak Lodge Water Services adopts the NHMP and directs the General Manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

NOW, THEREFORE, BE IT RESOLVED BY THE OAK LODGE WATER SERVICES BOARD OF DIRECTORS:

Section 1. To adopt the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan.

Section 2. OLWS will submit this Resolution to the Oregon Department of Emergency Management and the Federal Emergency Management Agency, Region X officials to enable final approval of the *Clackamas County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

INTRODUCED AND ADOPTED THIS 9th DAY OF JULY 2024.

OAK LODGE WATER SERVICES

By Susan Keil By Kevin Williams
Susan Keil, Chair Kevin Williams, Vice Chair

Purpose

This document serves as the Oak Lodge Water Services (OLWS) addendum to the Clackamas County Multi-Jurisdiction Natural Hazards Mitigation Plan (NHMP). This addendum supplements information contained in Volume I (Clackamas County NHMP Basic Plan) and serves as the foundation for OLWS's Hazard Mitigation Plan. Volume III (Appendices) provides additional information.

This addendum meets all the requirements of Title 44 CFR §201.6 including:

- Multi-Jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-Jurisdictional **Participation** §201.6(a)(3),
- Multi-Jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv) and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

This is the first addendum to the County NHMP for OLWS and builds on other OLWS planning efforts detailed further in this document.

OLWS adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on July 9, 2024. FEMA Region X approved the Clackamas County NHMP and the District's addendum on September 12, 2024. With approval of this NHMP the District is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through September 11, 2029.

NHMP Process, Participation, and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation*.

In addition to establishing a comprehensive community-level mitigation strategy, 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 mitigation projects. Local adoption and federal approval of this NHMP ensures that the OLWS will remain eligible for pre- and post-disaster mitigation project grants.

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Institute for Policy Research, and Engagement (IPRE) collaborated with the Oregon Department of Emergency Management (OEM), Clackamas County, and OLWS to update their NHMP.

The Clackamas County NHMP, and OLWS addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The OLWS HMAC guided the process of developing the NHMP.

The Clackamas County NHMP, and OLWS addendum, are the result of a collaborative effort between Clackamas County rate payers, citizens, public agencies, non-profit organizations, the private sector, and regional organizations. The OLWS Hazard Mitigation Action Committee (HMAC) was formed and guided the process of developing the OLWS NHMP.

Convener

The OLWS Public Works Director/OLWS Engineer serves as the NHMP addendum convener. The convener of the NHMP addendum along with the OLWS' HMAC will take the lead in implementing, maintaining, and

upgrading the addendum in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

Representatives from OLWS' HMAc served as the project steering committee and met formally, and informally, to develop and review the OLWS' NHMP addendum with a focus on the NHMP's risk and resilience assessment and mitigation strategy (action items).

This addendum reflects decisions made at the designated meetings and during subsequent work and collaboration with the Clackamas County Resilience Coordinator and the OPDR. Relevant information is highlighted in more detail throughout this document. The OLWS Addendum has been incorporated into Volume II of the Clackamas County NHMP.

Support during development of this HMAc was provided by the following staff and committee members:

- Convener – Brad Albert, Public Works Director/District Engineer
- Sarah Jo Chaplen, General Manager
- Kevin Williams, Board Member
- Neil Schulman, Executive Director, North Clackamas Watersheds Council
- Greg Wenneson, Oak Lodge Community Emergency Response Team (CERT)
- OLWS Staff, Outreach and Communications Specialist
- Lara Christensen, Water Quality Coordinator

Additional support for this effort was provided by Gianna Alessi, Natural Hazard Mitigation Planning Specialist, and Jay Wilson, Resilience Coordinator, Clackamas County Disaster Management.

NHMP Implementation and Maintenance

The OLWS Board of Directors will be responsible for adopting OLWS' addendum to the Clackamas County NHMP. This addendum designates the HMAc and a convener to oversee the development and implementation of action items. Because the OLWS addendum is part of the County's multi-jurisdictional NHMP, OLWS will look for opportunities to partner with the County and other interdependent agencies and jurisdictions.

The OLWS HMAc will convene on an annual schedule after adoption of the OLWS NHMP addendum. The County is meeting on a semi-annual basis and will provide opportunities for the jurisdictions (cities and special districts) to report on NHMP implementation and maintenance during their meetings. The OLWS HMAc convener, or their designee, will participate as requested by the County in order to provide opportunities for participating jurisdictions to identify opportunities for joint mitigation efforts and report on NHMP implementation and ongoing maintenance. The OLWS Public Works Director/OLWS Engineer, or their designee, will serve as the OLWS convener and will be responsible for assembling the OLWS HMAc.

The HMAc will be responsible for:

- Reviewing existing action items to determine suitability of funding;
- Reviewing existing and new risk assessment data to identify issues that may not have been identified at NHMP creation;
- Educating and training new HMAc members on the NHMP and mitigation actions in general;
- Assisting in the development of funding proposals for priority action items;
- Discussing methods for continued public involvement;

- Evaluating effectiveness of the NHMP at achieving its purpose and goals (use Table 26, Volume I, Section 4, as one tool to help measure effectiveness); and
- Documenting successes and lessons learned during the year.

The HMAC will be responsible for the following activities described in detail in Volume I, Section 4:

The jurisdiction will utilize the same implementation and maintenance process identified in Volume I, Section 4.

The jurisdiction will provide continued public participation during the plan maintenance process through periodic presentations to elected officials, public meetings, postings on social media, and/or through interactive content on the jurisdiction’s website (for more information see Volume I, Section 4).

The jurisdiction will utilize the same action item prioritization process as the County (for more information see Volume I, Section 4 and Volume III, Appendix E).

Implementation through Existing Programs

This NHMP is strategic and non-regulatory in nature, meaning that it does not necessarily set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies, the public, and OLWS; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs.

The mitigation plan works in conjunction with other Authority plans and programs as well as the Clackamas County Comprehensive Land Use Plan, Capital Improvement Plan (CIP), OLWS Rules and Regulations, the Clackamas County NHMP, and the State of Oregon NHMP.

The mitigation actions described herein are intended to be implemented through existing plans and programs within OLWS. Plans and policies already in existence have support from OLWS residents, businesses, and policy makers. Therefore, where possible, the OLWS will implement the NHMP’s recommended actions through existing plans and policies. Many strategic plans and master plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP’s action items through such plans and policies increases their likelihood of being supported and implemented. Implementation opportunities are further defined in action items when applicable.

Capability Assessment

The Capability Assessment identifies and describes the ability of Oak Lodge Water Services (OLWS) to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources.

Existing Authorities

Hazard mitigation can be executed at a local scale through three (3) methods: integrating hazard mitigation actions into other local planning documents (i.e., plan integration), adopting design standards and codes that account for best practices in structural hardening, and codifying mitigation into development. The extent to which an authority, municipality, or multi-jurisdictional effort leverages these approaches is an indicator of that community’s or organization’s capabilities.

OLWS is governed by a five-member Board of Directors elected to alternating four-year terms by OLWS voters. The Board of Directors, with support from the OLWS management team and citizen engagement, define the vision, mission, goals, and strategic objectives for OLWS. They set policies and approve the OLWS operating budget which reflects the outcomes of extensive planning efforts, priorities, and action items developed with review and approval from citizen members of the budget committee. During key decision making and planning processes ample opportunity for public participation is encouraged and provided for, including a public review and comment on the new OLWS NHMP Addendum.

OLWS serves approximately 29,000 customers on a retail water, wastewater, and watershed protection basis in an unincorporated portion of western Clackamas County. Comprehensive Planning takes place at the County level and relevant information is included in the County NHMP (Volume 1).

Regulations

Existing policies that define service provision and address hazardous conditions provide a source of mitigation capability.

The OLWS Board of Directors adopted new rules and regulations in 2022. These rules and regulations establish the conditions by which OLWS will conduct its business and operations and how customers may receive service.

Design and Construction Standards

The OLWS Design and Construction Standards establish and provide specific, technical direction for the design and construction of public sanitary sewer, public water, as well as public and private watershed protection projects. Through the adoption of these standards, OLWS endorses a comprehensive set of design and construction practices that are designed to deliver high quality improvements to OLWS customers. These standards are updated annually.

Structural Building Codes

The Oregon Legislature recently adopted updated building codes for both residential (2023 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code.

OLWS falls under Clackamas County's Building Codes and Fire Code.

Programs & Projects

This Plan directs OLWS and Clackamas County to explore integration into other planning documents and processes. Although OLWS has not previously been included in the County-wide NHMP, it has made significant progress in integrating the resilience efforts into its portfolio of planning programs and projects over the last five years.

OLWS currently has the following plans and policies that relate to natural hazard mitigation which will be regularly updated and integrated into the NHMP update:

Capital Improvement Plan

OLWS maintains individual master plans for each of its primary services. These plans are integrated into a 5-year Capital Improvement Plan (CIP).

The most recent CIP was adopted in 2024. This document monetarily prepares for the expansion and maintenance of wastewater and water systems as well as the provision of watershed protection services.

Projects within the CIP are prioritized and matched with projections of future revenues. Inclusion of a project within this document does not necessarily reflect a budgeted spending commitment, but it does provide a snapshot of the agency's priorities based on estimated future revenues.

Water Master Plan

The Water Master Plan (WMP) was adopted in 2020. It offers a 20-year outlook of the community's water resources, including available water supply, current and future demands, and emerging water quality considerations. It evaluates the condition of water infrastructure (pipelines, pump stations, tanks, etc.) and provides recommendations for replacement and repairs. Additionally, the WMP explores the system's ability to withstand unexpected emergencies such as fires, floods, or earthquakes. This plan is scheduled for updating in 2025.

AWIA Risk and Resilience Assessment

In 2018 the America's Water Infrastructure Act (AWIA) was signed into law. It required water-service providers to conduct a risk and resilience assessment (RRA) and develop a subsequent emergency response plan (ERP) prior to June 30, 2021. The law also mandates that the RRA and ERP are updated every 5 years. The AWIA Risk and Resilience Assessment for OLWS was originally completed in 2021. It is scheduled for update in 2026.

Industrial/Commercial Stormwater Inspection Program

Consistent with the OLWS National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit (effective date May 5, 2023), OLWS has implemented an Industrial/Commercial Facility Inspection Program to reduce the discharge of pollutants from the stormwater sewer system from industrial and commercial facilities. This program is outlined in the 2022 Stormwater Management Program (SWMP) Document.

Community Emergency Response Teams (CERT)

OLWS has a unique Community Emergency Response Team (CERT) program that trains residents in emergency management. It is a volunteer group comprised of Oak Grove and Jennings Lodge residents who want to make their community more resilient in natural and man-made emergencies. Their focus is on search and rescue training and community outreach, including organizing Emergency Preparation Fairs and the Emergency Water Program. Clackamas Fire District sponsors OLCERT, although their engagement is strongest with Oak Lodge Water Service (OLWS).

Emergency Water Program

OLWS has provided a number of water systems known as the Hurricane or Hurricane Pro that can purify up to 135 and 163 gallons respectively of water per hour under optimum conditions. OLCERT has recruited Water Stewards in OLWS neighborhoods to host the systems. In the event that the regular water supply is interrupted, these neighbors will have a drinking water source.

The purpose of these documents is to outline short to long term planned improvements to infrastructure and equipment and provide the context for how OLWS will accomplish our four core commitments:

- Protect Public Health
- Provide Excellent Customer Service
- Make Smart Investments and Work to Keep Rates Affordable

Personnel

The following OLWS personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Sarah Jo Chaplen, General Manager and Brad Albert, Public Works Director/OLWS Engineer

Public Information Officer: OLWS Staff, Outreach and Communications Specialist

Floodplain Manager: Clackamas County Disaster Management

Grant writing: Brad Albert, Public Works Director/OLWS Engineer

Capital improvement planning: Brad Albert, Public Works Director/OLWS Engineer

Capital improvement execution: Brad Albert, Public Works Director/OLWS Engineer with the Technical Services Team

OLWS does not have any employees solely designated to Emergency Management or Mitigation. These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. There is limited capacity to expand upon their capabilities or workloads. OLWS relies upon emergency management services from Clackamas County.

Capital Projects

OLWS has implemented many resilience related projects over the last five years, including a water tower seismic reinforcement. Current capital improvement projects within the 2024-2029 CIP related to resilience include:

- Tertiary Treatment Filtration Project, Wastewater Treatment Plant (to meet new permit requirements for DEQ) (2024-2025)
- Boardman & Arista Flooding abatement project – study to determine alternatives for abatement and implementation of preferred alternative (2024)
- Lift Station 5 Basin Rainfall-derived Infiltration and Inflow (RDII) project (2024-2027)
- Seismic study of 24-inch water supply line (2025)
- Water Pump Station at Clackamas River Water Generator (2025)
- Related planning project underway include:
 - Wastewater Master Plan
 - Water Management and Conservation Plan (2011, Update in progress)

Capital Resources

OLWS maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan.

OLWS is a part of the C800 communication system in Clackamas County. They have many towers and locations OLWS utilizes as part of the system in both Clackamas and Washington Counties.

Critical facilities with power generators for use during emergency blackouts include:

- Wastewater Treatment Plant, 13750 SE Renton Avenue
- Technical Services Building, 14611 SE River Road
- Oak Lodge Water Services Administration Building, 14496 SE River Road
- Valley View Reservoirs, 17611 SE Valley View Road
- View Acres Reservoirs, 4412 SE View Acres Road
- Pump Station #2, 1716 SE Oak Shore Lane
- Pump Station #3, 2704 SE Park Avenue
- Pump Station #5, 17560 SE Walta Vista Drive

Fueling storage:

- Wastewater Treatment Plant, 13750 SE Renton Avenue

Findings

Several important findings from this capability assessment informed the design of the Plan’s mitigation strategy and aided in prioritizing action items.

Staffing Limitations and Capacity

OLWS staff are assigned hazard mitigation responsibilities as a part of their larger job responsibilities. Restricted capacity reduces the breadth of the programming the agency can undertake in any year. OLWS relies upon its relationships with Clackamas County and other cities within its region and on community volunteers to expand its operations.

Reliance upon outside funding streams

OLWS operates on a limited budget with many conflicting priorities. Current revenues are not enough to keep up with all the capital needs of OLWS. Additionally, there are restrictions on many revenue sources in relation to where the funds may be spent. Grants and loans can provide revenue sources for large resilience projects that cannot be covered by System Development Charges, etc.

Multi-document transparency

OLWS works to ensure all its capital plans are integrated into one master Capital Improvement Plan and budget. Integration of the goals of this CIP with the goals and assessment of the NHMP will further the development of resilience measures within the agency’s work program.

Mitigation Plan Mission

The 2024 HMAC reviewed the previous NHMP Mission and Goals in comparison to the State NHMP Goals and determined that they would make necessary updates to include references to community lifelines and to advance equity and inclusion in hazard mitigation.

The NHMP mission states the purpose and defines the primary functions of NHMP. It is intended to be adaptable to any future changes made to the NHMP and need not change unless the community’s environment or priorities change.

The mission of the NHMP is to:

Enhance county resiliency and capacity to address natural hazards by promoting sound public policy and effective mitigation strategies designed to equitably reduce risk and impacts on community members, community lifelines, historic and cultural resources property, and ecological systems.

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

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that residents and public and private partners can take while working to reduce the risk from natural hazards. These statements of direction

form a bridge between the broad mission statement and action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Meetings with the HMAC, previous hazard event reports, and the previous NHMPs served as methods to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards.

All the NHMP goals are important and are listed below in no 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.

Goal 1: Protect Life and Property

- Develop and implement mitigation and climate adaptation projects and policies that aid in protecting lives by making homes, businesses, community lifelines, and other property more resilient to natural hazards and impacts from climate change.
- Establish mitigation projects and policies that minimize losses and repetitive damages from recurring disasters while promoting insurance coverage for severe hazards.
- Improve hazard identification and risk assessment information to inform and provide recommendations for enhanced resilience in new development decisions and promote preventative measures for existing development in areas vulnerable to natural hazards.

Goal 2: Enhance Natural Systems

- Incorporate natural hazard mitigation planning and activities into watershed planning, natural resource management, natural systems enhancement, and land use planning to protect life, property, and ecological system.

Goal 3: Augment Emergency Services

- Strengthen emergency operations by enhancing communication, collaboration, and coordination of natural hazard mitigation activities and policies across agencies at all levels and regions of government, sovereign tribal nations, and the private sector.

Goal 4: Encourage Partnerships for Implementation

- Improve communication, coordination, and participation among and with public agencies, community members, community lifelines, and private sector organizations to prioritize and implement hazard mitigation activities and policies.
- Enhance efforts toward identifying and optimizing opportunities across state agencies, surrounding communities, and private entities for resource sharing, mutual aid, and funding sources/support.

Goal 5: Promote Public Awareness

- Build community resilience and awareness and reduce the effects of natural hazards and climate change through community-wide engagement, collaboration, resource-sharing, learning, leadership-building, and identifying mitigation project-related funding opportunities.

Goal 6: Advance Equity and Inclusion

- Mitigate the inequitable impacts of natural hazards by prioritizing the directing of resources and efforts to build resilience and engagement in the most vulnerable communities least able to prepare, respond, and recover.
- Strengthen efforts aimed at increasing engagement, outreach, and collaboration with community and cultural organizations and agencies that are dedicated to providing services and support to vulnerable and underserved communities.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3)(iv), *Mitigation Strategy*.

The OLWS mitigation strategy (action items) are built on the foundation of the Oregon Resilience Plan and the master planning and assessment efforts recently completed by OLWS. Those efforts include the Water Master Plan (2020), the Wastewater Master Plan (2023), and the Capital Improvement Plan (2023-2028).

Each planning effort involved the identification of hazards and risk, determination of probability and hazard impact, cost analysis, and project selection criteria. Those assessments served as sources for our core mitigation action items. Recent events such as the COVID-19 pandemic, the extensive nearby wildfire damage in 2020, and localized flooding after recent ice storms recently amplified the recognition and need for increased public preparedness and improved system resilience through natural hazard mitigation.

The action items were identified, prioritized, and relocated to this addendum. They will be revised during subsequent Clackamas County NHMP updates and integrate risk, identified issues, and accomplishments.

Action Items

Table OL-1 documents the title of each action along with, the lead organization, partners, timeline, cost, and potential funding resources. The HMAC decided to prioritize action items to reflect current conditions (risk assessment), needs, and capacity. High priority actions are shown with orange highlight. OLWS will focus their attention, and resource availability, upon these achievable, high leverage, activities over the next five-years. Although this methodology provides a guide for the HMAC in terms of implementation, the HMAC has the option to implement any of the action items at any time. This option to consider all action items for implementation allows the committee to consider mitigation strategies as new opportunities arise, such as capitalizing on funding sources that could pertain to an action item that is not currently listed as the highest priority.

Table OL-1 Action Items

		Impacted Hazard											Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Algal Blooms	Pandemic	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
1	Conduct In-Depth Seismic Analysis of OLWS’s 24-inch water supply pipeline: Seismic Analysis is aligned with OLWS’s AWIA Risk and Resilience Assessment, Water System Master Plan and Oregon Resilience Plan.		X										Engineering	Short	Local Resources, CIP, FEMA HMA-C&CB	Medium
2	Backup Generator at Water Pump Station: Provide backup power source for OLWS potable water pump station at Clackamas River Water treatment plant, the secondary source for OLWS water supply.		X						X	X			Engineering	Short	Local Resources, CIP, FEMA HMA-C&CB	Low
3	Emergency Water Intertie with City of Milwaukie: A booster pump station and upsized pipe could be used to pump water from Milwaukie’s lower zone to OLWS’s lower zone to fill the Valley View tanks.	X	X					X	X	X			Engineering, Distribution	Short	Local Resources, CIP	High
4	Wastewater Mainline Rain-Derived Inflow and Infiltration: Reduce rain-derived inflow and infiltration to prevent sanitary sewer outflows through rehabilitation of manholes and wastewater pipes.		X										Engineering	Medium	Local Resources, CIP, FEMA HMA	High
5	Boardman and Arista Flood Mitigation: Address repeat flooding hazards caused by flat grades and beaver dams.				X								Engineering/ North Clackamas Watershed Council	Medium to Long	Local Resources, CIP, FEMA HMA	High
6	Update Data Layers Needed for Flood Attenuation: Updated data layers are needed to address repeat flooding hazards caused by flat grades and beaver dams.				X								Engineering/ North Clackamas Watershed Council	Medium	Local Resources, CIP, DLCD TA, FEMA HMA-C&CB	Low

Table OL-1 Action Items

Action Item #	Statement	Impacted Hazard											Implementation and Maintenance			
		Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Algal Blooms	Pandemic	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
7	Conduct Assessment of Best Locations for Floodplain Reconnection and Flood Attenuation: A comprehensive assessment is needed to address repeat flooding hazards caused by several environmental pressures.				X								Engineering/ North Clackamas Watershed Council	Medium	Local Resources, CIP, FEMA HMA – C&CB	High
8	Fire Flow Improvements: Upsize water distribution network components to meet fire suppression demands.		X					X					Engineering	Medium to Long	Local Resources, CIP, FEMA HMA	High
9	Fleet Resiliency Program: Additional field vehicles are necessary to protect and preserve the water, wastewater, and watershed protection programs and build resiliency resulting in more reliable systems.	X	X	X				X	X	X			Engineering	Ongoing	Local Resources, CIP	Medium
10	Seismic Backbone Replacement Program: Develop a backbone pipeline replacement program for key locations, critical facilities, and emergency distribution points.		X					X					Engineering	Long	Local Resources, CIP, FEMA HMA – C&CB	High
11	Public Awareness, Preparedness & Resiliency: In OLWS emergency planning and preparedness efforts, prioritizing public awareness, outreach and education increases resiliency.	X	X	X	X	X	X	X	X	X	X	X	HMAC	Ongoing	Local Resources, CIP	Low
12	Improve Facility Resiliency to Extreme Heat: Increase the capacity of the facility in the event of significantly higher than average water needs due to extreme heat			X									HMAC	Short	Local Resources, CIP, FEMA HMA	Medium

Table OL-1 Action Items

		Impacted Hazard											Implementation and Maintenance				
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Algal Blooms	Pandemic	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost	
13	Protect Employees Working in Extreme Heat: Example measure to prevent heat stress include drinking water frequently, resting in the shade to cool down, and wearing a hat and light-colored clothing.			X									HMAC	Short	Local Resources, CIP, FEMA HMA – C&CB	Low	
14	Assess Water Treatment Process Enhancements: Consider treatment process enhancements to mitigate raw water impacts from future changing conditions	X			X	X	X	X				X	X	Engineering	Long	Local Resources, CIP, FEMA HMA – C&CB	High

Source: Oak Lodge Water Services NHMP HMAC, updated 2023

Cost: Low (less than \$50,000), Medium (\$50,000-\$100,000), High (more than \$100,000)

Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)

Priority Actions: Identified with orange highlight

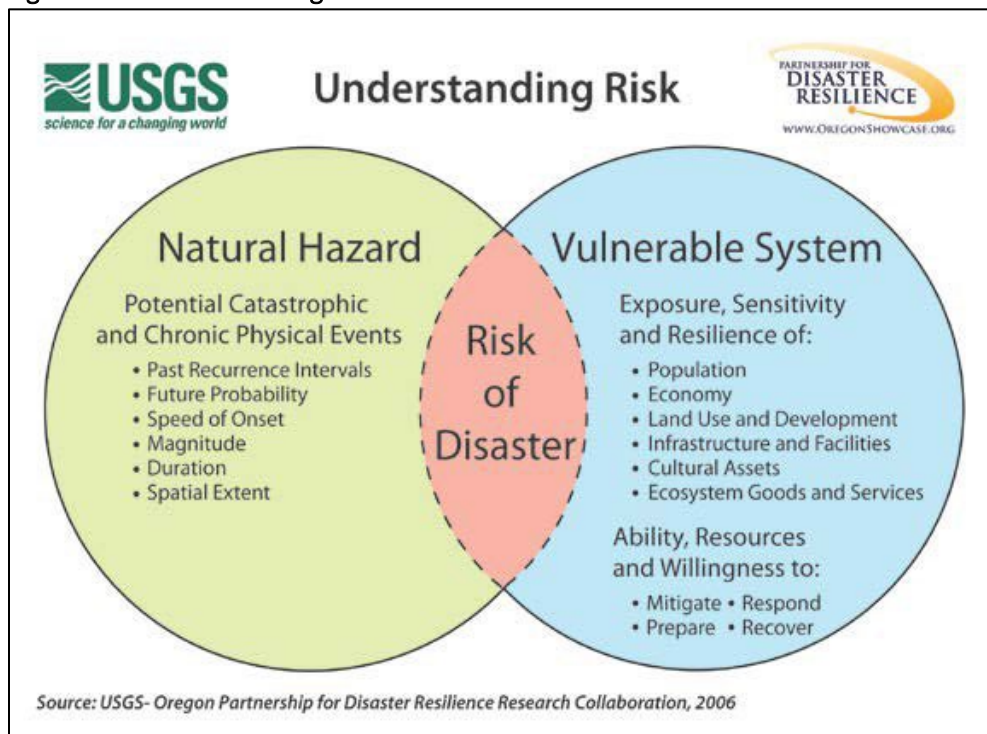
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) – Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three phases:

- **Phase 1** – Hazard Identification: Identify hazards that can affect the jurisdiction. This includes an evaluation of potential hazard impacts – type, location, extent, etc. and gathering/updating of information required to accurately address hazards.
- **Phase 2** – Vulnerability Assessment: Identification of important community assets and system vulnerabilities. Example vulnerabilities include people, businesses, homes, roads, historic places and drinking water sources.
- **Phase 3** – Risk Analysis: Evaluate the extent to which the identified hazards overlap with or have an impact on the important assets identified by the community.

The local level rationale for the identified mitigation strategies (action items) is presented herein and within Volume I, Section 3 and Volume III, Appendix C. The risk assessment process is graphically depicted in Figure OL-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure OL-1 Understanding Risk



Source: USGS – Oregon Partnership for Disaster Resilience Research Collaboration, 2006

Hazard Analysis

Using information from Clackamas County’s Hazard Vulnerability Assessment (HVA), OLWS HMAC developed a hazard vulnerability assessment (HVA). Changes from the County’s HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to OLWS, which are discussed throughout this addendum.

Table OL-2 shows the HVA matrix for OLWS listing each hazard in order of rank from high to low. The table shows that hazard scores are influenced by each of the four categories combined. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with sense of hazard priorities but does not predict the occurrence of a hazard. Two catastrophic hazards (Cascadia Subduction Zone earthquakes and crustal earthquakes) and two chronic hazards (flooding and winter storm) rank as the top hazards to OLWS (Top Tier). Wildfire, extreme heat event, windstorm, pandemic, and drought rank in the middle (middle tier). Harmful algal blooms, volcanic event, and landslide comprise the lowest ranked hazards (Bottom Tier).

Table OL-2 Hazard Analysis

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Earthquake - Cascadia	4	45	100	49	198	1	Top Tier
Earthquake - Crustal	6	50	100	21	177	2	
Flood	16	30	70	56	172	3	
Winter Storm	14	30	70	56	170	4	
Wildfire	16	25	70	49	160	5	Middle Tier
Extreme Heat Event	10	35	70	35	150	6	
Windstorm	14	15	50	42	121	7	
Pandemic	10	45	50	14	119	8	
Drought	10	15	50	42	117	9	
Harmful Algal Blooms	10	15	40	28	93	10	Bottom Tier
Volcanic Event	2	20	50	14	86	11	
Landslide	6	15	20	21	62	12	

Source: Molalla HMAC, 2023.

Community Characteristics

This section provides information on OLWS specific demographics and assets by area. Many of these community characteristics can affect how natural hazards impact communities, and how communities choose to plan for natural hazard mitigation.

System Overview

Oak Lodge Water Services Authority (OLWS) is joint water and sanitary services authority organized under Chapter 450 of the Oregon Revised Statutes (ORS). OLWS serves a population of about 29,000 directly, providing drinking water, wastewater, and watershed protection services over a 6.5 square mile service area.

Community infrastructure maintained by OLWS includes: 9,100 customer connections, 208 miles of water and wastewater pipes, 3,123 watershed protection catch basins, 773 fire hydrants, 1.5 billion gallons wastewater treated annually, and 15.6 million gallons of water storage.

The service area (Figure OL-2) encompasses parts of unincorporated Clackamas County, including areas adjacent to Milwaukie and Gladstone, and the areas of Oak Grove and Jennings Lodge. Although not formal cities, this portion of unincorporated Clackamas County is heavily urbanized with residential, commercial, and industrial development. Customers in the OLWS service area receive water that is produced by the North Clackamas County Water Commission’s water treatment plant, and most customers have their wastewater treated and cleaned by the OLWS wastewater treatment plant.

The Clackamas River is the main source of water for the OLWS service areas. Raw river water comes into the 20.0 million gallons per day (MGD) treatment plant by gravity through fish screens into a 38-foot-deep caisson. The water is then pumped up and out to slow sand filters and/or membrane filters. When using the membrane filters, Aluminum Chlorohydrate is added to create a pin floc to better aid in filtration. The slow sand filters are made up of a 12-inch layer of gravel with 36 inches of sand on top. The filters work using the top six inches of the sand, which includes a biological community of organisms that consume the pathogenic organisms coming from the raw river water. Alternatively, the mechanical membranes filter the pathogens out. After filtration, Sodium Carbonate is added to raise the pH of the water, and Sodium Hypochlorite is added for disinfection. The water then goes through a baffled clearwell to create contact time with Chlorine for complete disinfection of the water.

Finished water is pumped from the clearwell to residential and commercial OLWS customers, other water providers, and throughout the system for fire protection. Reservoirs throughout the distribution network provide additional storage and gravity feed to customers.

Water Rights

OLWS is a member of the Clackamas River Water Providers, a group of agencies that separately hold water rights along the Clackamas River. This group consists of the North Clackamas County Water Commission (NCCWC – which includes Oak Lodge Water Services Authority, Sunrise Water Authority, and the City of Gladstone), Clackamas River Water, South Fork Water Board (which includes the Cities of West Linn and Oregon City), the City of Lake Oswego, the City of Tigard, and the City of Estacada. Most of the cities noted are part of the County NHMP. As of July 1, 1970 NCCWC holds a non-certificated surface water right authorizing the total use of up to 40.07 MGD from the Clackamas River for municipal use. The surface water right is junior to three in-stream rights along the Clackamas River. At this time the NCCWC water treatment plant has a production capacity of 10 MGD, which limits the amount of water used from the surface water right.

Interconnections with other Systems

OLWS’s drinking water system is interconnected with several other public water systems (e.g., wholesale water and emergency interties) that allow the exchange of water during emergency or water shortage events. OLWS will continue to look for mitigation opportunities to implement emergency interconnections with neighboring water providers.

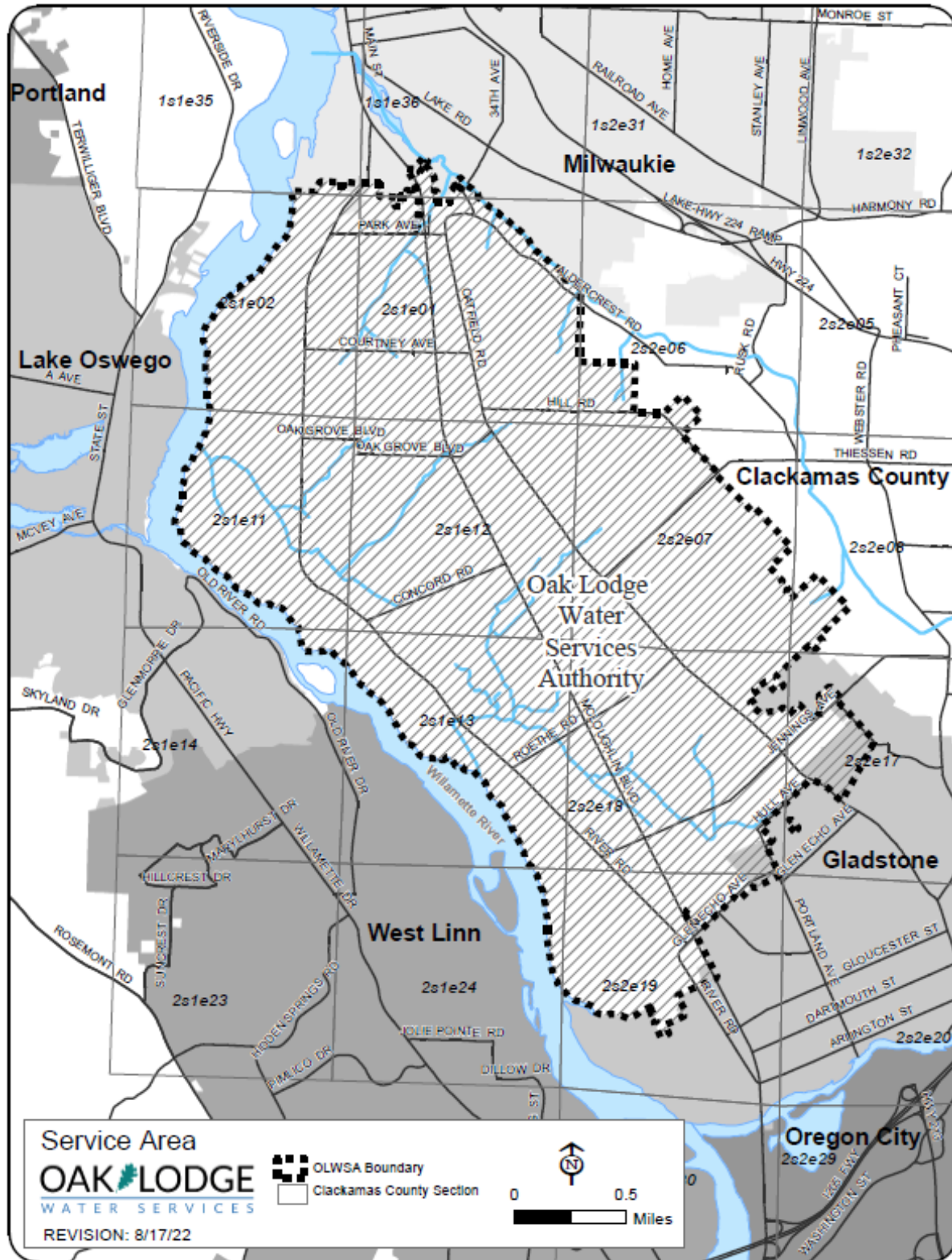
Transportation/Infrastructure

OLWS relies on the Clackamas County Department of Transportation and Development to maintain the local road system. Tri-Met Transportation provides bus and Max train service for the OLWS area. Motor vehicles represent the dominant mode of travel through and within the OLWS area.

Economy

The economic integrity of OLWS is made up of blue and white collar families, retirees, and mixed businesses. The local economy relies on local small businesses as well as larger franchises including grocers, health care, fast food, a preponderance of automotive focused dealerships, among others.

Figure OL-2 Oak Lodge Water System Service Area



Source: Oak Lodge Water Services - Water System Master Plan (2019)

Community Lifelines

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of the city. [Community Lifelines](#) are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function. Mitigating these facilities will increase the community’s resilience.

The community lifelines identified below were identified by the OLWS HMAC. This integrated network of assets, services, and capabilities are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function. Decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to maintain/reestablish these facilities and services following a hazard incident.

Table OL-3 lists the resources, facilities, and infrastructure that, if damaged, could significantly impact the public safety, economic conditions, and environmental integrity of OLWS.

Table OL-3 Lifeline Summary

Name/Number	System	Identified Hazard Exposure											
		DR	EQ	EH	FL	HB	PA	LS	VE	WF	WN	WS	
Wastewater Treatment Plant	Renton		X						X		X	X	X
Pump Station #2	Oak Shore Ln		X						X		X	X	X
Pump Station #3	Park Ave		X								X	X	X
Pump Station #4	River Forest Ln		X								X	X	X
Pump Station #5	Walta Vista Dr		X								X	X	X
Pump Station #6	Glen Echo		X								X	X	X
Pipelines/Distribution System	-		X		X				X				X
Reservoir 1 & 2	Valley View	X	X						X		X	X	X
Reservoir 3 & 4	View Acres	X	X						X		X	X	X
Other Assets													
Pipelines/Distribution System	-		X						X				X
Back-up Generators	-		X	X									
Administration Buildings	-		X						X		X		
OLWS Staff	-			X				X					
Supervisory Control and Data Acquisition (SCADA) System	-		X									X	X
Business/Information Technology System	-		X									X	X

Source: Information provided by Oak Lodge Water Services

Hazard Descriptions:
 DR = Drought
 EQ = Earthquake
 EH = Extreme Heat

FL = Flood
 HB = Harmful Algal Blooms
 PA = Pandemic
 LS = Landslide

VE = Volcanic Event
 WF = Wildfire
 WN = Windstorm/Tornado
 WS = Winter Storm

Critical Facilities

Facilities that are critical to government response, and recovery activities (i.e. life, safety, property, and environmental protection). These facilities include: 911 Centers, Emergency Operations Centers, Police, and Fire Stations, Public Works facilities, sewer and water facilities, hospitals, shelters, and more.

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include: sewer and water pipelines, pump stations, roads, bridges, and services for Clackamas County and Clackamas Fire District.

Essential Facilities

Facilities that are essential to the continued delivery of key government services, and/or that may significantly impact the public's ability to recover from the emergency. These facilities may include: OLWS buildings such as the Administration Building, pump stations, the OLWS Wastewater Treatment Plant, and other public facilities such as schools.

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic, and functional ecosystem services. Service areas functioning for the community include: Boardman Wetlands Nature Park, Riverville Park, Stringfield Park, the Trolley Trail, and the Willamette River.

Vulnerable Populations

Vulnerable populations, including seniors, disabled citizens, women, and children, as well those people living in poverty, often experience the impacts of natural hazards and disasters more acutely. Populations that have special needs or require special consideration include: seniors, disabled residents, families with children, and residents living at or below the poverty line.

Hazardous Materials

Facilities that, if damaged, could cause serious secondary impacts may also be considered "critical." Hazardous materials sites are particularly vulnerable to earthquake, landslide, volcanic event, wildfire, and winter storm hazards. A hazardous material facility is one example of this type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: certain businesses located along 99E or within the boundaries of OLWS.

Economic Assets/Population Centers

Economic assets include businesses that employ large numbers of people and provide an economic resource to OLWS. If damaged, the loss of these economic assets could significantly affect economic stability, and prosperity. Population Centers usually are aligned with economic centers and are a concern during evacuation/notification. Economic/Population centers that would cause concern during a hazard event include: Oak Grove Fred Meyer and the businesses located along 99E.

Cultural and Historic Assets

The cultural and historic heritage of a community is more than just tourist charm. For families that have lived in the area for generations and new residents alike, it is the unique places, stories, and annual events that make the community an appealing place to live. The cultural and historic assets are both intangible benefits and obvious quality-of-life-enhancing amenities. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

Hazard Characteristics

Volume I, Section 2 of the Clackamas County NHMP thoroughly describes the characteristics of the profiled hazards, history, as well as the location, extent, and probability of potential events within the County. Generally, an event that affects the County, or applicable areas where OLWS facilities are located, is likely to affect OLWS as well. Similarly, the causes and characteristics of hazard events are appropriately described within Volume 1, Section 2 as well as the location and extent of potential hazards. Lastly, previous occurrences are well documented within Volume 1, Section 2 and the community impacts described by the County, or applicable City, would generally be the same for OLWS.

Table OLWS-3 lists the various natural hazards in the general Clackamas County area which are applicable to OLWS, along with any observed impacts associated with the historical occurrence of such events within the OLWS service boundary.

Hazard Characteristics

Drought

The HMAC determined that the Authority's probability for drought is **moderate** and that their vulnerability to drought is **low**.

Volume I, Section 2 describes the characteristics of drought hazards, history, as well as the location, extent, and probability of a potential event. Due to the climate of Clackamas County, past and present weather conditions have shown an increasing potential for drought.

OLWS is concerned about drought in that it reduces the quantity of water available and increases the risk of wildfires. Wildfires may impact facilities and staff but may also cause acute and chronic water quality concerns.

A historical occurrence of drought impacted operations and triggered Water Management and Conservation plan curtailments in 2015.

Vulnerability Assessment

Due to insufficient data and resources, OLWS is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifeline Section.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"¹ 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 Clackamas County by the 2050s.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction's ability to provide water for irrigation or commercial and household use.

¹ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Earthquake (Cascadia Subduction Zone)

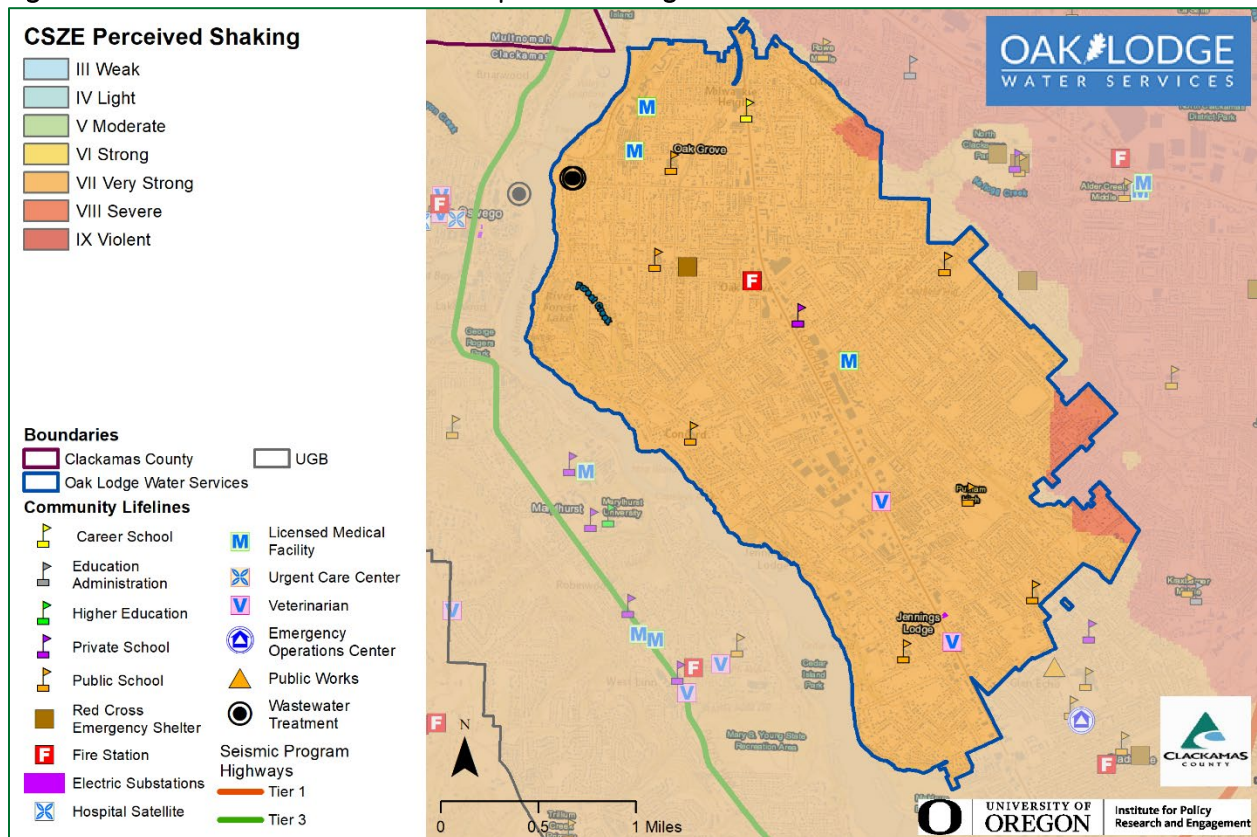
The HMAC determined that the Authority’s probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**.

Volume I, Section 2 describes the characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect Molalla as well. The causes and characteristics of an earthquake event are appropriately described within Volume I, Section 2 as well as the location and extent of potential hazards. Previous occurrences are well documented within Volume I, Section 2 and the community impacts described by the County would generally be the same for Molalla as well.

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Molalla Fault Zone (discussed in the crustal earthquake section).

Figure OL-3 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the OLWS area is expected to experience very strong shaking (orange), while areas around the OLWS area will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Figure OL-3: Cascadia Subduction Zone Expected Shaking



Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.²

The city's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give OLWS a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places OLWS predominately within the "Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). Within the Northwest Oregon region, damage and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

The Authority is partially within the severe shaking area, and there is significant area around the Authority that have severe and very severe shaking if a large earthquake were to occur.

Earthquake (Crustal)

The HMAC determined that the Authority's probability for a crustal earthquake is **low** and that their vulnerability to crustal earthquake is **high**.

Volume I, Section 2 describes the causes and characteristics of earthquake hazards, history, as well as the location, extent, and probability of a potential event. Generally, an event that affects the County is likely to affect OLWS as well. Figure OL-4 shows a generalized geologic map of the OLWS area that includes the areas for potential regional active faults and soft soils (liquefaction) hazard. The figure shows the areas of greatest concern within the Authority limits as red and orange.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building, and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any site. In many major earthquakes, damages have primarily been caused by the behavior of the soil.

The Canby-Molalla Fault runs through the center of the Authority and can generate high-magnitude earthquakes. The OLWS is also near the Portland Hills Fault Zone (discussed in greater detail below). Historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993, Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8. In December 2017 a 4.0 tremor was felt in Clackamas County along the same epicenter as the 5.6 quake; this time no damage occurred.

Canby-Molalla Fault Zone

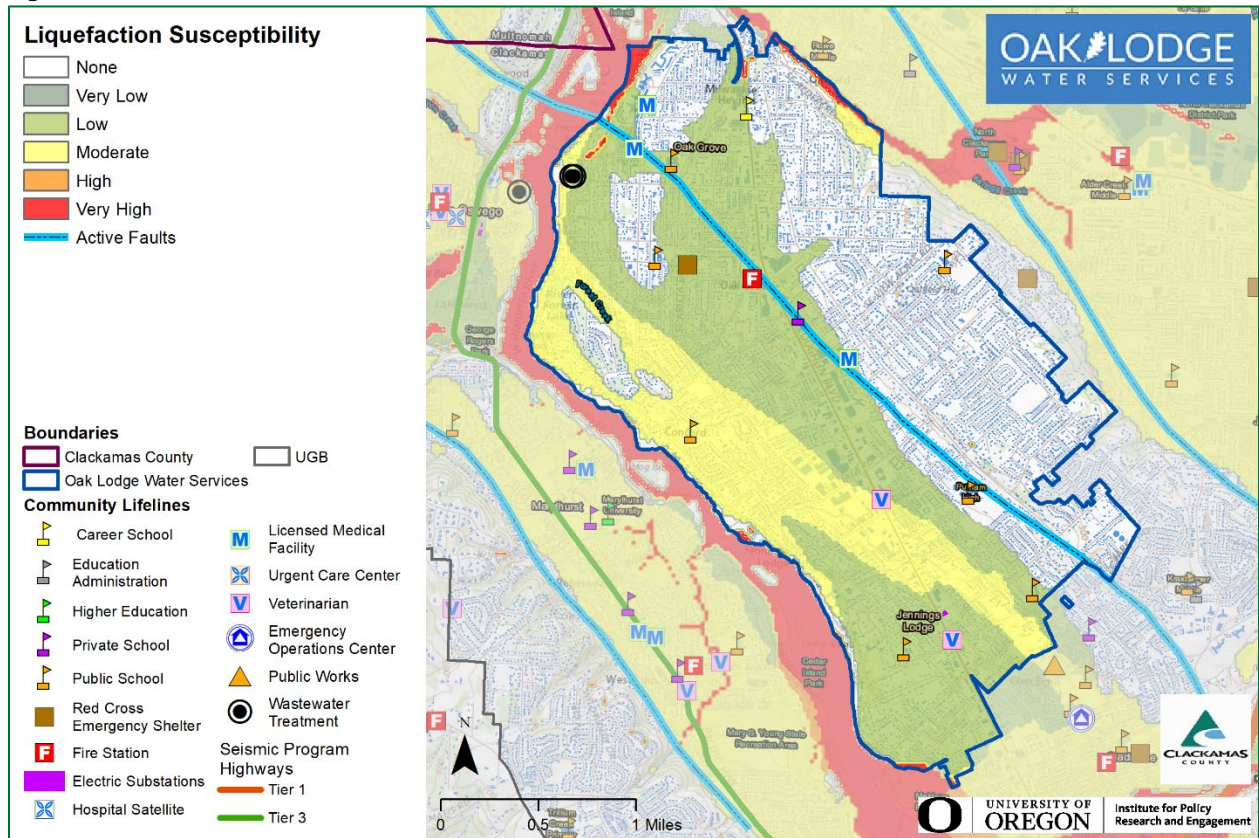
The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through the towns of Canby and Molalla in northern Oregon.

² The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. <http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf>

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles.

Figure OL-4 Active Crustal Faults and Soft Soils



Vulnerability Assessment

In 2018 the Department of Geology and Mineral Industries (DOGAMI) completed a regional impact analysis for earthquakes originating from the Cascadia Subduction Zone and Portland Hills faults (O-18-02). Their study focused on damage to buildings, and the people that occupy them, and on two key infrastructure sectors: electric power transmission and emergency transportation routes. Each earthquake was studied with wet and dry soil conditions and for events that occur during the daytime (2 PM) and nighttime (2 AM). Impacts to buildings and people were tabulated at the county, jurisdictional (city), and neighborhood unit level. Estimated damage varied widely across the study area depending on local geology, soil moisture conditions, type of building, and distance from the studied faults. In general, damage from the Cascadia Subduction Zone scenario was greater in the western portion of the study area, however, damage could still be significant in some areas east of the Willamette River. The report found that damage to high-value commercial and industrial buildings was high since many of these facilities are in areas of high to very high liquefaction hazard. Casualties were higher during the daytime

scenario (generally double) since more people would be at work and occupying non-wood structures that fare worse in an earthquake.

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances 15 or more miles from the Portland Hills fault the damages from the Cascadia Subduction Zone scenario generally were higher. In both the Cascadia Subduction Zone and Portland Hills Fault scenarios it is forecasted that emergency transportation routes will be fragmented, affecting the distribution of goods and services, conditions are worse under the Portland Hills Fault scenario. Portions of the electric distribution system are also expected to be impacted under both scenarios; however, the impact is considerably less than it is to the transportation routes. Additional capacity or redundancy within the electric distribution network may be beneficial in select areas that are likely to have greater impacts.

Further findings from the DOGAMI report are provided at the end of the crustal earthquakes hazard section within the County-wide assessment (See Volume I).

Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. Older infrastructure (pipes, pump stations, and reservoirs) maintained by OLWS are at risk to earthquake damage.

There have been instances of water lines and facilities impacted by earthquake induced landslides, including the potential impact to the main water transmission pipe located in soil that has the potential for liquefaction during earthquakes.

Future Projections

Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

The HMAC determined that the OLWS's probability of flooding is **moderate** and that their vulnerability to flooding is **moderate**.

Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. According to the National Weather Service, there have been several river crests between 26 and 30 feet from 1956-2023. Where the river level is typically under 7 feet in February, during the flood of 1996, the river crested at 28.55 ft (flood stage is 18 ft). It flooded the OLWS influent pump station, which had to be shut down for approximately 24 hours due to the nature of the floodwater inundation. Figure OL-5 illustrates the flood hazard area for the Authority.

Flooding also occurs from streams emanating from Oatfield Ridge (Rinearson, Boardman, and River Forest Creeks and their tributaries). These floods are sometimes chronic and block roadways and affect property. They can be exacerbated by increases in impervious surfaces from development (both current development and development predating stormwater standards in 1993), loss of wetlands, increasing severity of storms due to climate change, and undersized infrastructure (i.e. culverts) and inadequate maintenance of facilities such as stormwater treatment facilities and/or culverts.

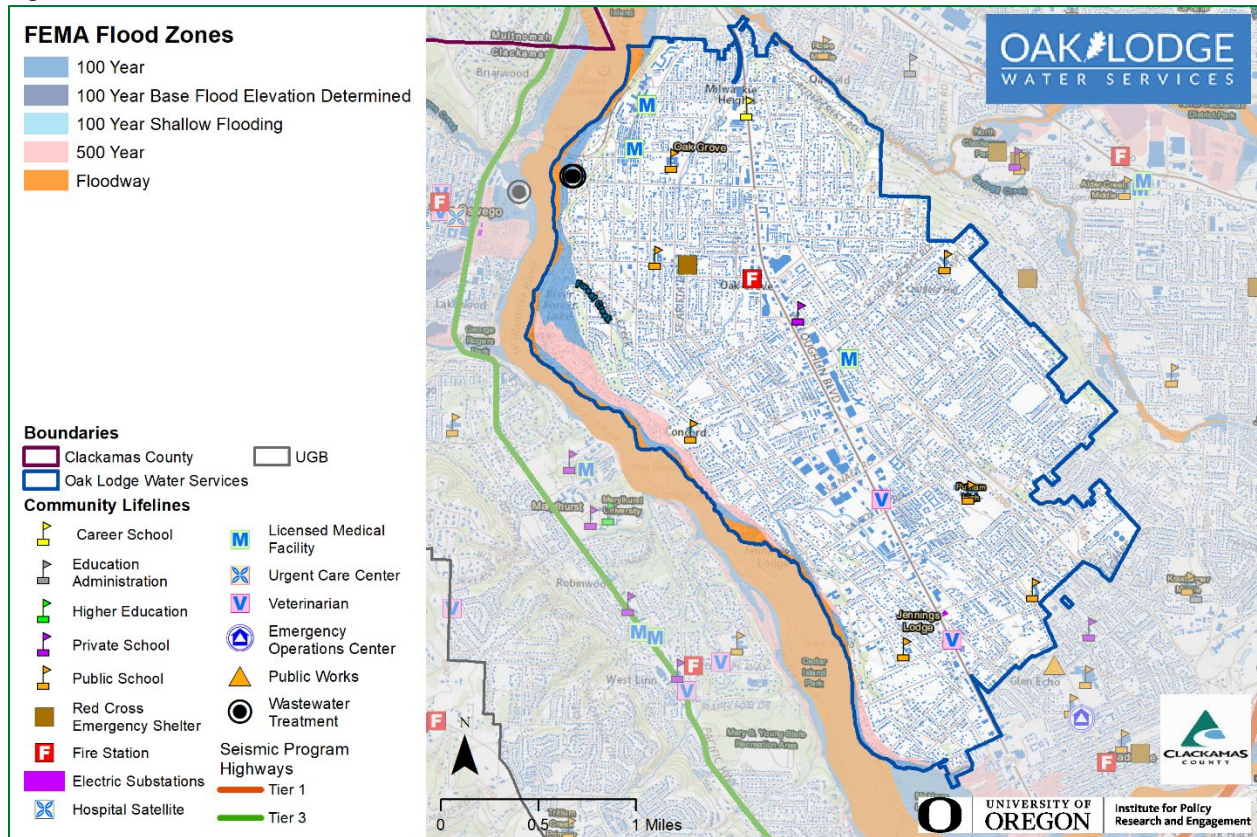
OLSW assets are in an area that is susceptible to flooding from the Willamette River. The OLWS Wastewater Treatment Plant is barely above the 100-year flood level.

According to the National Weather Service, there have been several river crests between 26 and 30 feet from 1956-2023. Where the river level is typically under 7 feet in February, during the flood of 1996, the

river crested at 28.55 ft (flood stage is 18 ft). It flooded the OLWS influent pump station, which had to be shut down for approximately 24 hours due to the nature of the floodwater inundation.

Flooding also occurs from streams emanating from Oatfield Ridge (Rinearson, Boardman, and River Forest Creeks and their tributaries). These floods are sometimes chronic and block roadways and affect property. They can be exacerbated by increases in impervious surfaces from development (both current development and development predating stormwater standards in 1993), loss of wetlands, increasing severity of storms due to climate change, and undersized infrastructure (i.e. culverts) and inadequate maintenance of facilities such as stormwater treatment facilities and/or culverts.

Figure OL-5 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the OLSW to be aware of flooding impacts and assess its level of risk.

The economic losses due to business closures often total more than the initial property losses that result from flood events. Business owners and their employees are significantly impacted by flood events. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business.

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of the OLSW outside of the mapped

floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The extent of flooding hazards in the OLSW primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or vegetation removal can influence water flow. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifeline Section.

National Flood Insurance Program (NFIP)

FEMA updated the Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) in 2018 (effective January 19, 2018). OLWS is not a community which has authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction. Clackamas County participates in the National Flood Insurance Program (NFIP).

There are no repetitive loss or severe repetitive loss properties owned or operated by the OLWS. For specific information for adjacent communities to the OLWS service area see the Clackamas County NHMP Volume I, Section 2 (Table 2-12 for more information).

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”³ winter flood risk at mid- to low elevations in Clackamas 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. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

The HMAC determined that the Authority’s probability for landslide is **low** and that their vulnerability to landslide is **low**.

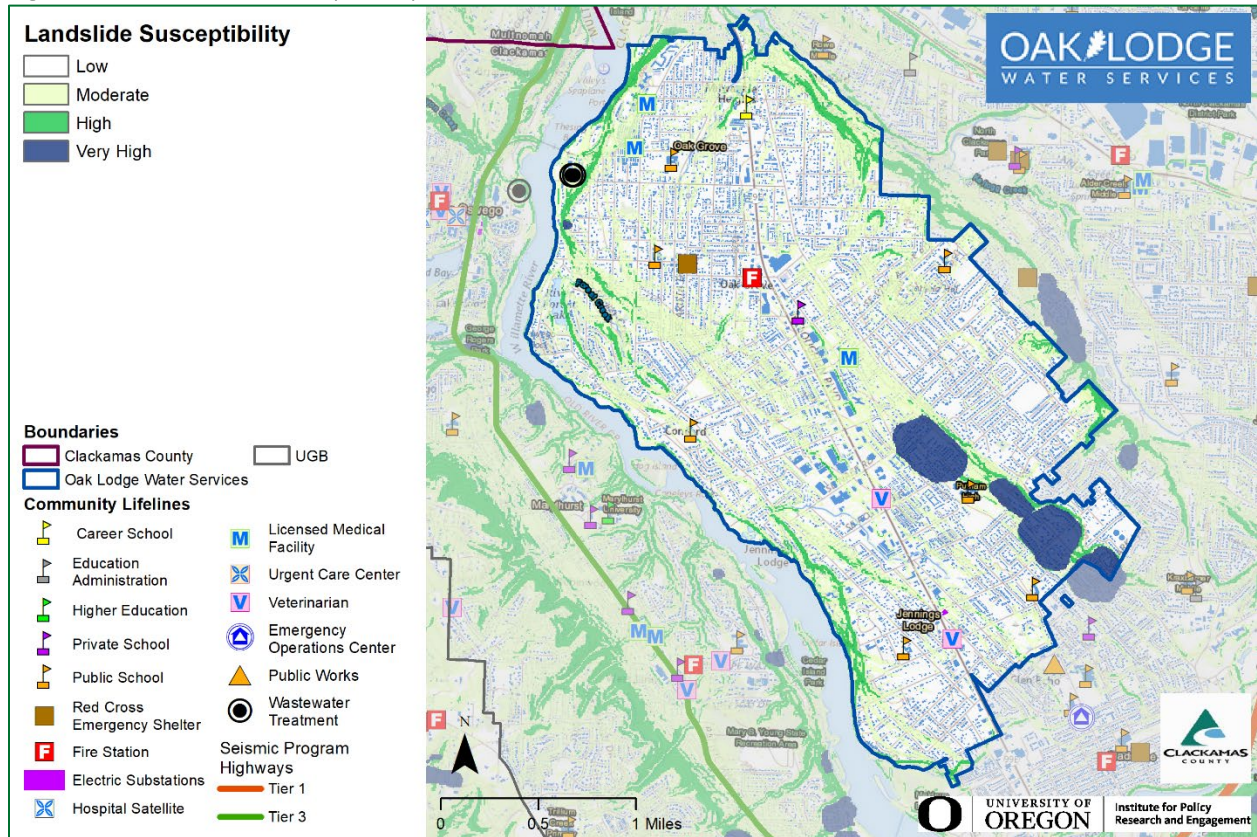
Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. OLWS does not have a history of landslides, although earthquake induced landslides have been known to impact water distribution pipes and infrastructure.

Landslide susceptibility exposure for OLWS is shown in Figure OL-6. Most of Molalla demonstrates a moderate landslide susceptibility exposure. There are areas within OLWS that have very high or high landslide susceptibility exposure.

Note that even if a jurisdiction has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard, and assets.

³ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Figure OL-6 Landslide Susceptibility



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).

Note: To view hazard detail click this [link](#) to access Oregon HazVu

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 (O-16-02), general findings from that report are provided above and within Figure OL-6.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond OLWS limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifeline Section.

The most common type of landslides are slides caused by erosion. Slides move in contact with the underlying surface, are generally slow moving, and can be deep. Rainfall-initiated landslides tend to be smaller; while earthquake induced landslides may be quite large. All soil types can be affected by natural landslide triggering conditions.

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on 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 Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk

depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

Severe weather can account for a variety of intense, and potentially damaging hazard events. These events include extreme heat, windstorms, and winter storms. The following section describes the unique probability, and vulnerability of each identified weather hazard.

Extreme Heat

The HMAC determined that the Authority's probability for extreme heat events is **moderate** and that their vulnerability is **moderate**.

Volume I, Section 2 describes the characteristics of extreme heat, history, as well as the location, extent, and probability of a potential event within the region. Generally, an event that affects the County is likely to affect the Authority as well.

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

The Authority has not experienced any life-threatening consequences from the few historical extreme heat events, although changes in climate indicate that the area should expect to see more extreme heat events resulting from hazards.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"⁴ the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas 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. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) 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 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

⁴ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Windstorm

The HMAC determined that the Authority's probability for windstorm is **high** and that their vulnerability to windstorm is **moderate**.

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for OLWS.

Volume I, Section 2 describes the impacts caused by windstorms, including power outages, downed trees, heavy precipitation, building damages, and storm-related debris. Additionally, transportation and economic disruptions result as well.

Damage from high winds generally has resulted in downed utility lines and trees, usually limited to several localized areas. Windstorms, combined with drought, wildfire risk, and climate and pest induced tree weakness (Emerald Ash Borer, Western Redcedar die-off) can increase risk of power outages from falling trees/limbs, and wildfire from downed power lines. Annual historical high wind occurrences have caused short term power outages anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Winter Storm (Snow/Ice)

The HMAC determined that the Authority's probability for winter storm is **high** and that their vulnerability to winter storm is **moderate**.

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the Authority typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

Winter Storms or deep freezes which cause damage to pipes and other assets have been recorded in the area. Recent snow and ice storms occurred in 2004 and 2017. Typical impacts include frozen meters and sensing lines, ruptured pipes and short-term power outages normally lasting less than 24 hours. During the winter snow/ice storm in February 2023 there was restricted critical infrastructure site access and power failures that impacted operations for multiple days.

Most winter storms typically do not cause significant damage; however, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter and commercial traffic as noted above.

Future Projections

According to the Oregon Climate Change Research Institute “Future Climate Projections, Clackamas County,”⁵ cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) 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 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas 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 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerable populations will be more likely to experience the negative impacts of winter storms in the future, particularly the unhoused and the elderly.

Vulnerability Assessment

Due to insufficient data and resources, OLWS is currently unable to perform a quantitative risk assessment, or exposure analysis, for the extreme heat, windstorm, and winter storm hazards. For a list of facilities and infrastructure vulnerable to these hazards see the Community Lifeline Section.

Volcanic Event

The HMAC determined that the Authority’s probability for a volcanic event is **low** and that their vulnerability to a volcanic event is **moderate**.

Volume I, Section 2 describes the characteristics of volcanic event hazards, history, as well as the location, extent, and probability of a potential event within the region. Volcanoes are located near Molalla, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

Due to Molalla’s relative distance from volcanoes, OLWS is unlikely to experience the immediate effects that eruptions have on surrounding areas (i.e., mud and debris flows, or lahars). Depending on wind patterns and which volcano erupts, however, OLWS may experience ashfall. The eruption of Mount St. Helens in 1980, for example, coated the Willamette Valley with a fine layer of ash and impacted drinking water treatment at the NCCWC treatment plant. If Mount Hood erupts, however, the OLWS could experience a heavier coating of ash.

Future Projections

Although the science of volcano predictions is improving, it remains challenging to predict a potential volcanic event. Ash fall, which will be the greatest impact, will impact the entire County. Impacts will be felt hardest by property managers (ranches, farmers, etc.) and by those relying upon clean surface water (for drinking water production and irrigation).

⁵ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Wildfire

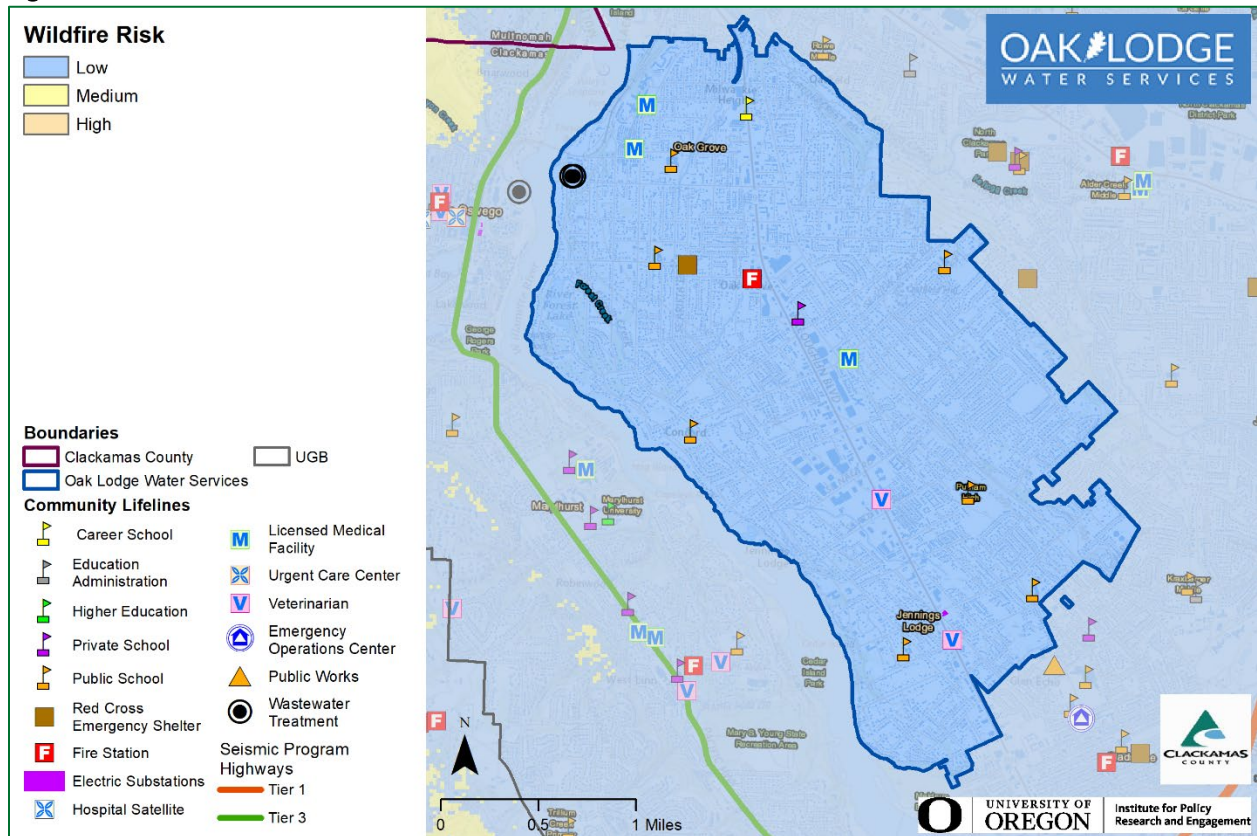
The HMAC determined that the Authority’s probability for wildfire is **moderate**, and that their vulnerability to wildfire is **moderate**.

The [Clackamas County Community Wildfire Protection Plan](#) (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard.

Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

Weather and urbanization conditions are primarily at cause for the hazard level. OLWS has abundant wooded areas that are a concern in the case of a wildfire event. Figure OL-7 shows overall wildfire risk in the OLWS. Recent fires include the nearby 36 Pit Fire in September 2014, the Riverside Fire, and the Elk Rock Island fire in 2020.

Figure OL-7 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.

Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).

Note: To view additional wildfire risk information click this [link](#) to access Oregon Explorer’s CWPP Planning Tool

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes OLWS, is the most heavily populated portion of the county and is

characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County.

Vulnerability Assessment

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the Authority as well. The Authority's fire response is addressed within the CWPP which assesses wildfire risk, maps wildland urban interface areas, and includes actions to mitigate wildfire risk. The Authority will update the Authority's wildfire risk assessment if the fire plan presents better data during future updates (an action item is included to participate in future updates to the CWPP).

Property can be damaged or destroyed with one fire as structures, vegetation, and other flammables easily merge to become unpredictable, and hard to manage. Other factors that affect ability to effectively respond to a wildfire include access to the location, and to water, response time from the fire station, availability of personnel, and equipment, and weather (e.g., heat, low humidity, high winds, and drought).

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"⁶ wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

Harmful Algal Blooms

The HMAC determined that the Authority's probability for harmful algal blooms is **moderate** and that their vulnerability to harmful algal blooms is **low**.

Harmful algal blooms (HABs) occur when colonies of algae grow rapidly, release toxins or deplete oxygen levels and can become harmful to plants, animals, and humans. HABs with cyanotoxins that includes Benthic algae have been detected upstream of the NCCWC Water Treatment Plant in North Fork Reservoir and Timothy Lake in the Clackamas River Watershed during low flow and high heat conditions almost every summer. HABs are an annual occurrence at River Forest Lake, posing a hazard to pets and people.

Vulnerability Assessment

Due to insufficient data and resources, OLWS is currently unable to perform a quantitative risk assessment for this hazard. For a list of facilities and infrastructure vulnerable to this hazard see the Community Lifelines Section.

Future Projections

Warming temperatures and drought will combine to increase the likelihood of harmful algal blooms. Higher concentrations of HABs could increase risks to vulnerable populations, as well as pets and livestock.

⁶ Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

Pandemic

The HMAC determined that the Authority's probability for pandemic is **low** and that their vulnerability to pandemic is **high**.

Pandemics are a natural disaster not typically found in NHMPs. They are hazards that are not physically affecting the environment, but rather ones that are physically affecting the people living in the environment.

Disease is a sickness, illness, or loss of health⁷ Terms such as disease outbreaks, epidemics, and pandemics are often used to describe situations where multiple cases of infection are identified.

"The amount of a particular disease that is usually present in a community is referred to as the baseline or endemic level of the disease. This level is not necessarily the desired level, which may in fact be zero, but rather is the observed level."⁸

The Centers for Disease Control and Prevention (CDC) states, "While some diseases are so rare in a given population that a single case warrants an epidemiologic investigation (e.g., rabies, plague, polio), other diseases occur more commonly so that only deviations from the norm warrant investigation." The following definitions are all from the CDC:⁹

- **Sporadic** refers to a disease that occurs infrequently and irregularly.
- **Endemic** refers to the constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area.
- **Hyperendemic** refers to persistent, high levels of disease occurrence.

Occasionally, the amount of disease in a community rises above the expected level.

- **Epidemic** refers to an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area.
- **Outbreak** carries the same definition of epidemic but is often used for a more limited geographic area.
- **Cluster** refers to an aggregation of cases grouped in place and time that are suspected to be greater than the number expected, even though the expected number may not be known.
- **Pandemic** refers to an epidemic that has spread over several countries or continents, usually affecting many people.

Understanding how and why a particular disease spreads requires a multi-disciplinary study of biology, culture, society, economics, environment, and technology. Diseases are caused by viruses, bacteria, or protozoa, which infect humans in a variety of ways. Some are water borne, air borne, or food borne; others are transmitted via interpersonal contact or contact with a vector, such as a mosquito. Norovirus and influenza are examples of familiar viruses. Examples of bacteria are E. coli and streptococcus. Cryptosporidium and giardia are caused by protozoa.

⁷ Centers for Disease Control and Prevention (CDC). "Definition of Disease." Retrieved October 4, 2016 from <http://www.cdc.gov/vaccines/terms/glossary.html>

⁸ CDC. "Lesson 1: Introduction to Epidemiology. Section 11: Epidemic disease occurrence. In Principles of epidemiology in public health practice: An introduction to applied epidemiology and biostatistics (Self-Study Course SS1978)" (3rd ed.) U.S. Department of Health and Human Services, Office of Workforce and Career Development, 18 May 2012.

⁹ Centers for Disease Control and Prevention. "Mission, role, and pledge". Retrieved 9 Sep, 2016 from <https://www.cdc.gov/about/organization/mission.html>

The fatality rate of a disease outbreak depends upon:

- The number of people who become infected.
- The severity of disease caused by the virus (its virulence).
- The vulnerability of affected populations.
- The effectiveness of preventive steps.¹⁰

As a regional employment, recreational, residential, retail and health care hub, OLWS's region draws many non-residents daily into the area, multiplying the opportunities for further disease exposure and transmission among both visitors and residents. Recognizing this expanse of exposure is important; it is possible that a disease related issue could impact a large portion of the region's population. The most recent pandemic impacting OLWS was the COVID 19 pandemic (DR-4499, 2020 to 2023) which has had widespread global implications. As of May 2023, there have been more than 85,000 documented cases of COVID-19 in Clackamas County including 663 deaths.¹¹ Within OLWS the COVID-19 pandemic impacted operations due to varied work schedules for OLWS staff to slow or stop the potential for infection.

Vulnerability Assessment

Due to insufficient data and resources, the OLWS is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard. However, the impacts of COVID-19 and state/local lockdowns has given significant insight into future pandemics.

The vulnerabilities and impacts to people, property, and the environment from diseases vary widely. People with access and functional needs are more susceptible to impacts. Older populations and populations with preexisting health conditions are significantly more at-risk in pandemic scenarios. In addition, communities of color, "essential" workers¹², homeless populations, and low-income workers are more likely to be exposed to infectious diseases in their daily lives.¹³

Future Projections

Vulnerable populations within Jackson County, including children, elderly, those living with disabilities, and unhoused individuals, will be a greater risk to emerging infectious diseases in the future.

¹⁰ WebMD. "What are epidemics, pandemics, and outbreaks?" Retrieved 9 Sep. 2016 from: <http://www.webmd.com/cold-and-flu/what-are-epidemics-pandemics-outbreaks>.

¹¹ "Track Covid-19 in Clackamas County, Ore." New York Times, updated 4 Jan. 2024, <https://www.nytimes.com/interactive/2023/us/clackamas-oregon-covid-cases.html>, Accessed 4 Jan. 2024.

¹² First responders, medical staff, manual laborers, tradesman, food service employees, transportation workers, and educators, to name a few.

¹³ (U.S. EPA, n.d.-b).

Attachment A: Public Involvement Summary

Members of the steering committee provided edits and updates to the NHMP prior to the public review period as reflected in the final document.

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from February 9 through March 31, 2024 on the City’s website. The plan was also posted and announced on the County’s website. There were no comments provided. Additional opportunities for stakeholders and the public to be involved in the planning process are addressed in Volume III, Appendix B.

A diverse array of agencies and organizations were provided an opportunity to provide input to inform the plan’s content through a variety of mechanisms including the opportunity for comment on the draft plan. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that work directly with and/or provide support to underserved communities and socially vulnerable populations. For more information on the engagement strategy see Volume III, Appendix B.

Website Posting



Customer Service What We Do About Us Your Community Planning & Engineering

THIS ITEM APPEARS ON

NATURAL HAZARDS
MITIGATION PLAN

Public Feedback and Participation Invited for OLWS 2023 Natural Hazard Mitigation Plan Addendum

(June 20, 2023) – OLWS is currently working with a team from Clackamas County Disaster Management to prepare an Addendum to Clackamas County’s updated “Natural Hazard Mitigation Plan” (NHMP). The plan is a requirement of the Federal Disaster Mitigation Act of 2000 (DMA 2000) and must be updated every five years in order to maintain eligibility for certain federal disaster assistance and hazard mitigation funding programs.

Development of the plan is under direction of Clackamas County’s Disaster Management in cooperation with a planning team of representatives from County departments, local municipalities, school districts, and other key stakeholders such as utility providers. The planning team is responsible to provide feedback required for the plan update, including the ranking of hazards and identification of strategic, cost-effective mitigation activities that may reduce future losses for the County and individual jurisdictions. Some mitigation activities may be eligible for future FEMA Hazard Mitigation Assistance (HMA) grant funding, such as: localized flood reduction measures, infrastructure retrofits, wildfire mitigation, and projects that provide immediate life-safety protection for people vulnerable to natural hazards like earthquakes and severe weather events.

Natural Hazards Mitigation Plan

Clackamas County’s 2024 Multi-jurisdictional Natural Hazards Mitigation Plan helps the county plan for actions that can lessen the impact of disasters...

About the NHMP Addendum

The OLWS NHMP Addendum is a section of the Clackamas County NHMP, which is a multi-jurisdictional plan that covers Clackamas County, including Oak Lodge Water Services Authority. The OLWS NHMP Addendum incorporates the concerns and needs of local stakeholders participating in the development of the Addendum.

OLWS is vulnerable to a variety of potential natural disasters, which threaten the loss of life and property in the County. Hazards such as earthquakes, flooding, wildfires, ice storms, and droughts have the potential for inflicting vast economic loss and personal hardship.

Examples of hazard mitigation include actions such as improvement of roads and culverts that experience repetitive flooding; strengthening public awareness and emergency preparedness to increase social resiliency; working to complete master plans and capital improvement plans for water and wastewater infrastructure; ensuring timely emergency communication to the public through notification systems; and conducting public awareness and education campaigns to help people to be prepared to take safe action before, during, or following a hazard event.

Public Feedback and Participation is Encouraged

As part of the planning process, gathering input from the public is an important and required step. OLWS seeks to gather feedback from residents and businesses from across our boundaries to incorporate into the plan:

[🔗 2023 OLWS NHMP Addendum PUBLIC REVIEW DRAFT](#)

The public is strongly encouraged to submit your comments, concerns, or questions regarding natural disasters and potential mitigation actions to be included into the plan update process. Please submit your feedback to info@olwsd.org. Deadline for public feedback and participation is July 6, 2023.

The public will have a continued opportunity to participate in the NHMP Addendum update in the coming months. A draft of the complete plan will be posted on the Clackamas County website for public review prior to submission of the plan to the Oregon Office of Emergency Management. Future press releases will be shared with the media to notify the public of these opportunities.

HMAC

The Hazard Mitigation Advisory Committee (HMAC) members possessed familiarity with the community and how it is affected by natural hazard events. The HMAC guided the update process through several steps including goal confirmation and prioritization, action item review and development, and information sharing, to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following date:

Meeting #1 and #2: April 7 and May 22, 2023

During these meetings, the HMAC:

- Reviewed the previous NHMP, and were provided updates on hazard mitigation planning, the NHMP update process, and project timeline.
- Updated recent history of hazard events in the city.
- Reviewed and confirmed the County NHMP's mission and goals.
- Reviewed and provided feedback on the draft risk assessment update including community vulnerabilities and hazard information.
- Reviewed and updated their existing mitigation strategy (actions).
- Reviewed and updated their implementation and maintenance program.
- Discussed the NHMP public outreach strategy.

Meeting #3: November 15, 2023 (via remote conference)

During this meeting, the HMAC:

- Confirmed and provided feedback on the final draft risk assessment update including community vulnerabilities and hazard information provided by DOGAMI (Risk Report).
- Reviewed and confirmed the city's capabilities assessment.
- Reviewed, confirmed, and prioritized the city's mitigation strategies.