Oak Lodge Water Services Addendum
to the Clackamas County Multi-Jurisdictional Hazard Mitigation Plan

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Effective: April xx, 2024-April xx, 2029

Prepared for
Oak Lodge Water Services

OAK LODGE WATER SERVICES

Adopted:
Date, 2024, (Resolution # 2024-xx)

This Natural Hazard Mitigation Plan was prepared by:

CLACKAMAS COUNTY

UNIVERSITY OF OREGON | School of Planning, Public Policy and Management | Institute for Policy Research and Engagement

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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 [DATE TBD, 2024]. FEMA Region X approved the Clackamas County NHMP on [DATE TBD, 2024] and the OLWS addendum on [DATE TBD, 2024]. With approval of this NHMP the Authority is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through [DATE TBD-1, 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 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 supportedand 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 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

		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
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

		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

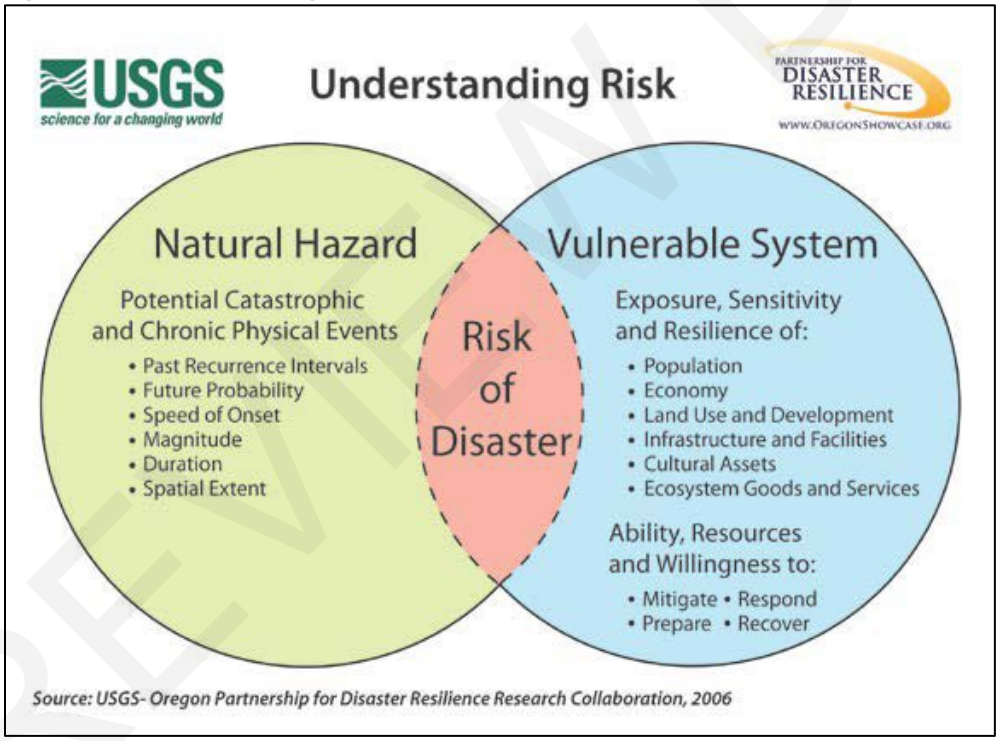
Risk Assessment

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 theidentified hazards overlap with or have an impact on theimportant 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 invulnerability 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 flock 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.

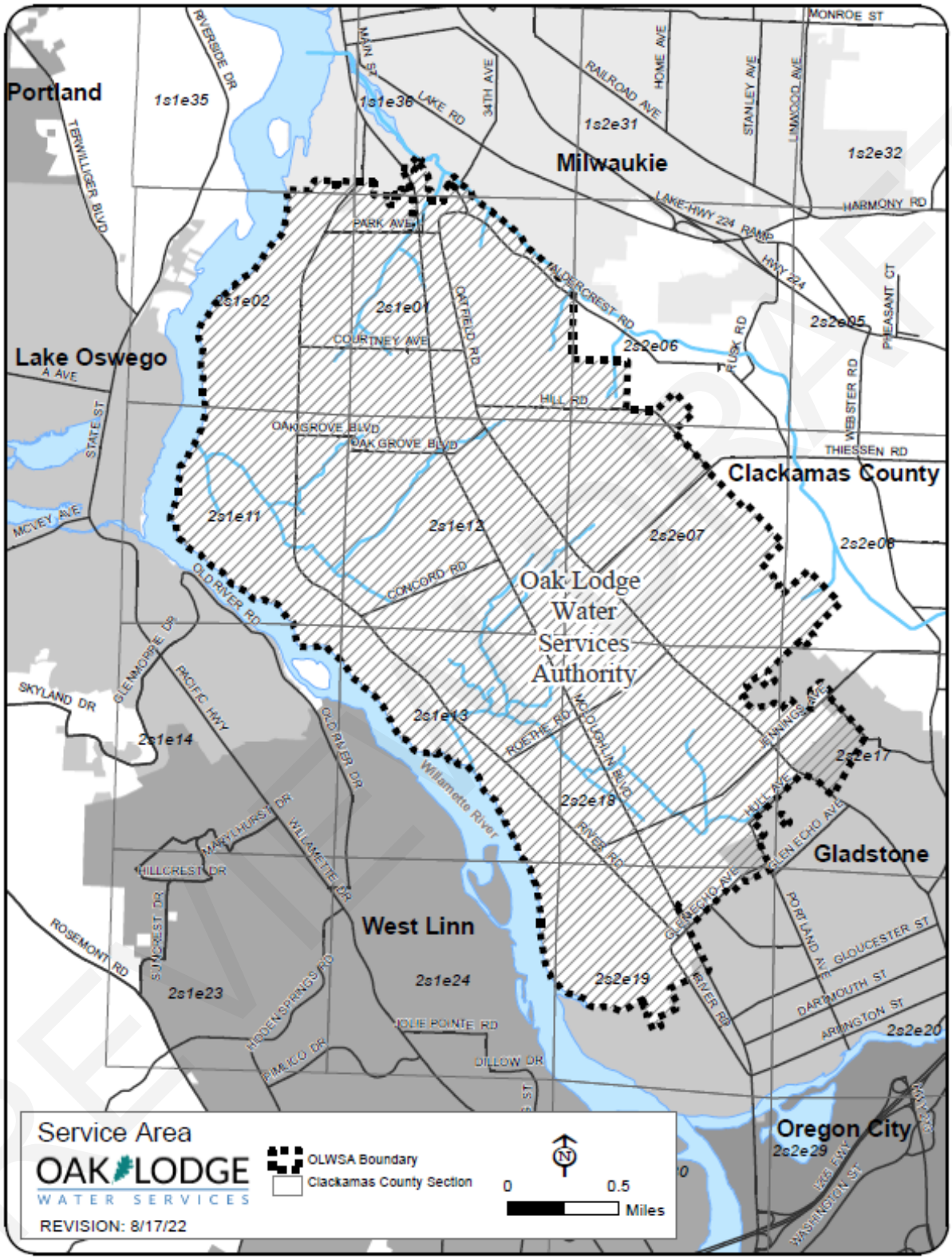
Transportation/Infrastructure

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, Rivervilla 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 thoroughlydescribes the characteristics of the profiled hazards, history, aswell as the location, extent, and probability of potential eventswithin 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 thelocation 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 suchevents 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)

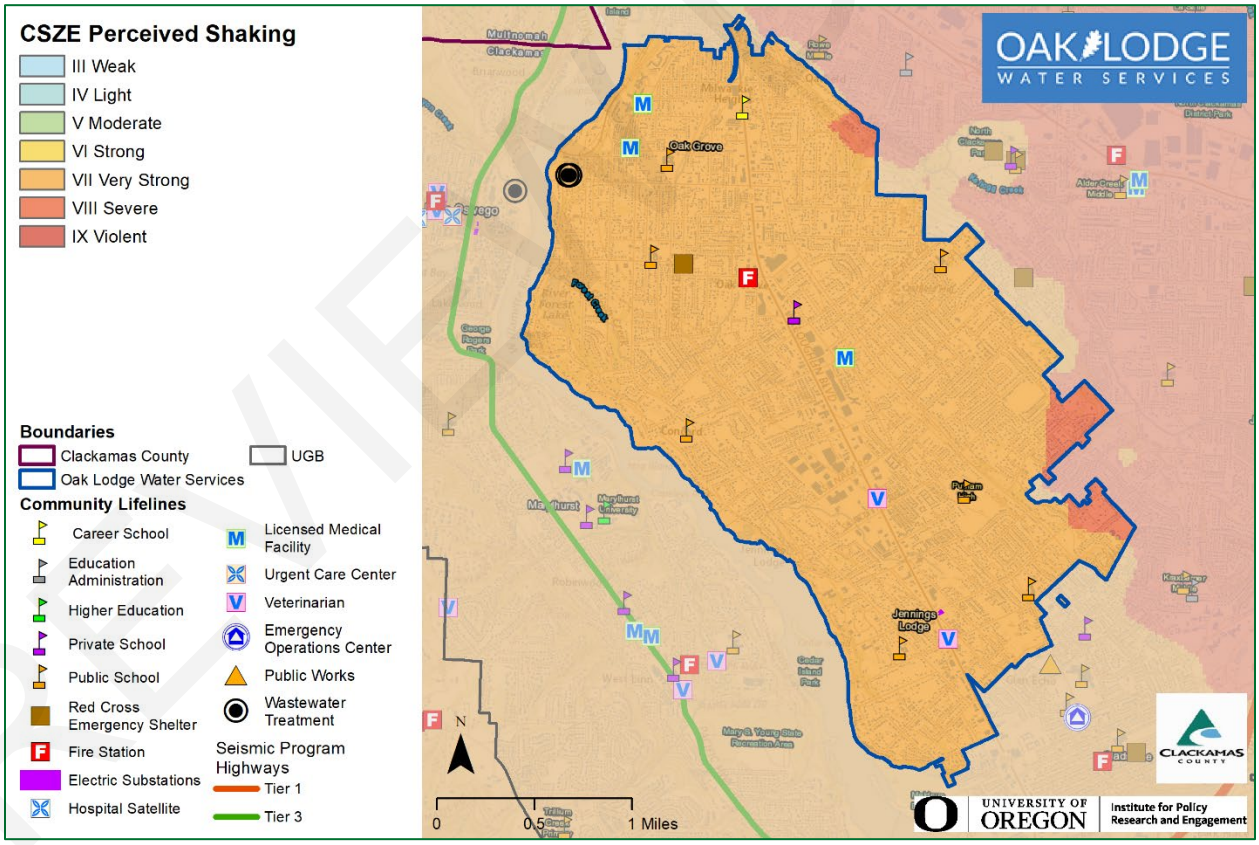
The HMAC determined that the Authority's probability for a Cascadia Subduction Zone (CSZ) earthquake is **moderate** and that their vulnerability to a CSZ earthquake is **high**.

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 are 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



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 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

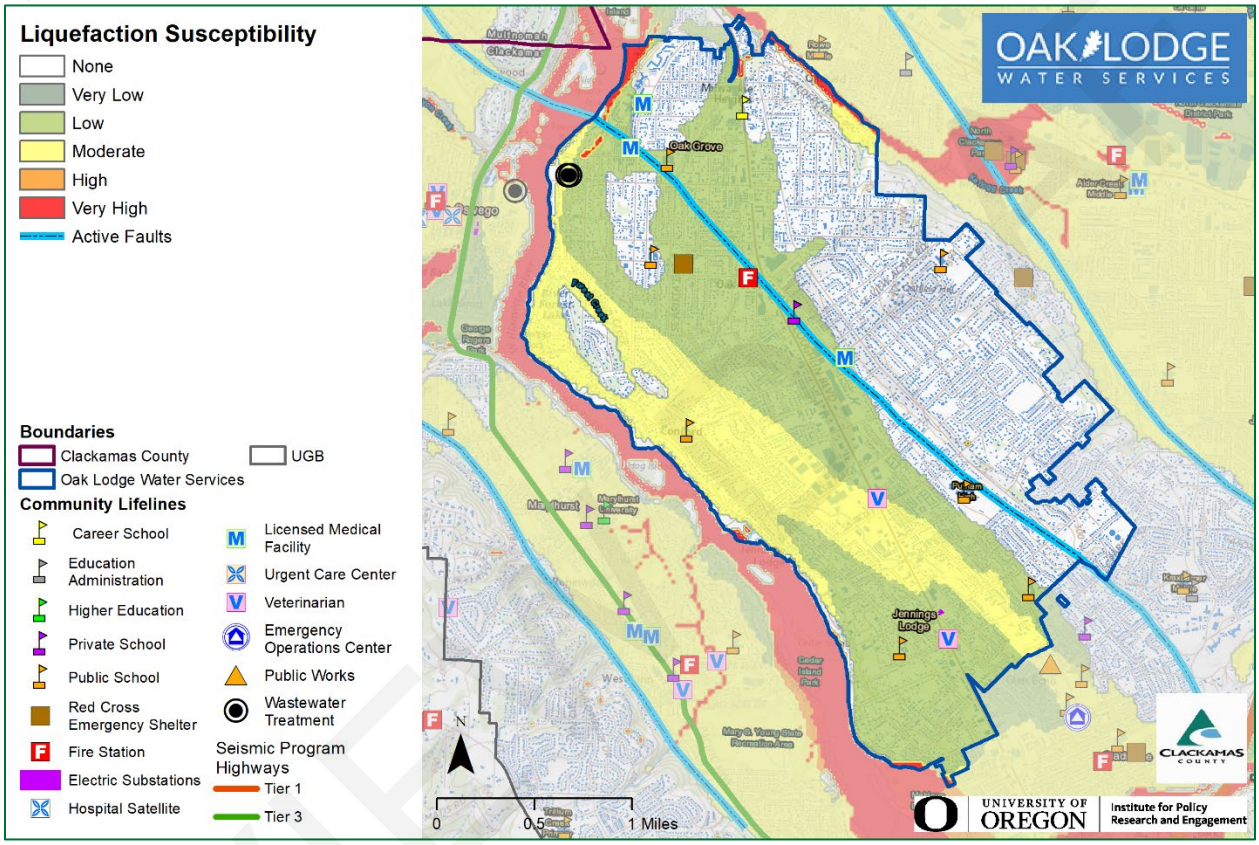
The Canby-Molalla Fault Zone is a series of NE-trending fault that vertically displace the Columbia River Basalt with discontinuous aeromagnetic anomalies that represent significant offset of Eocene basement and volcanic rocks. The fault zone extends for 31 miles from the vicinity of Tigard south through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



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 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.

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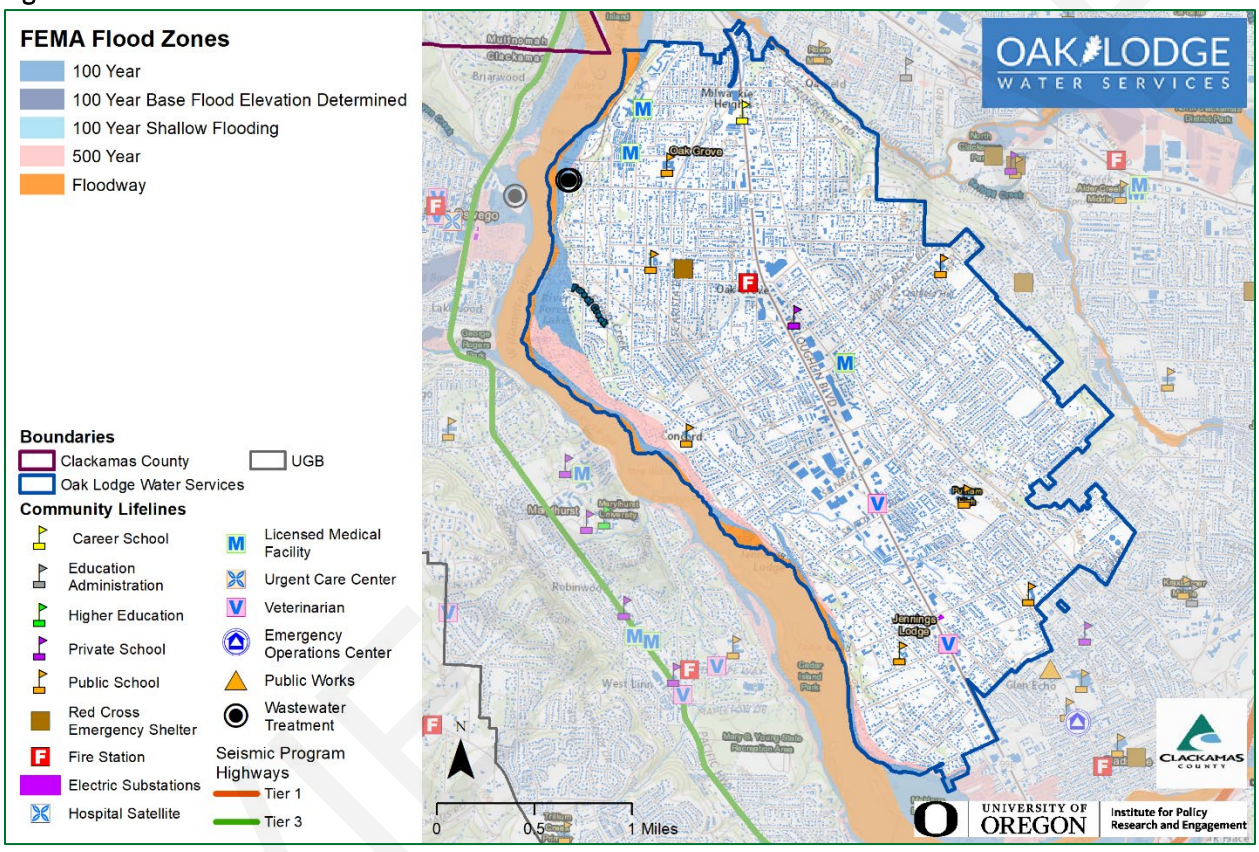
Figure OL-5 FEMA Flood Zones



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 OLWS 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.

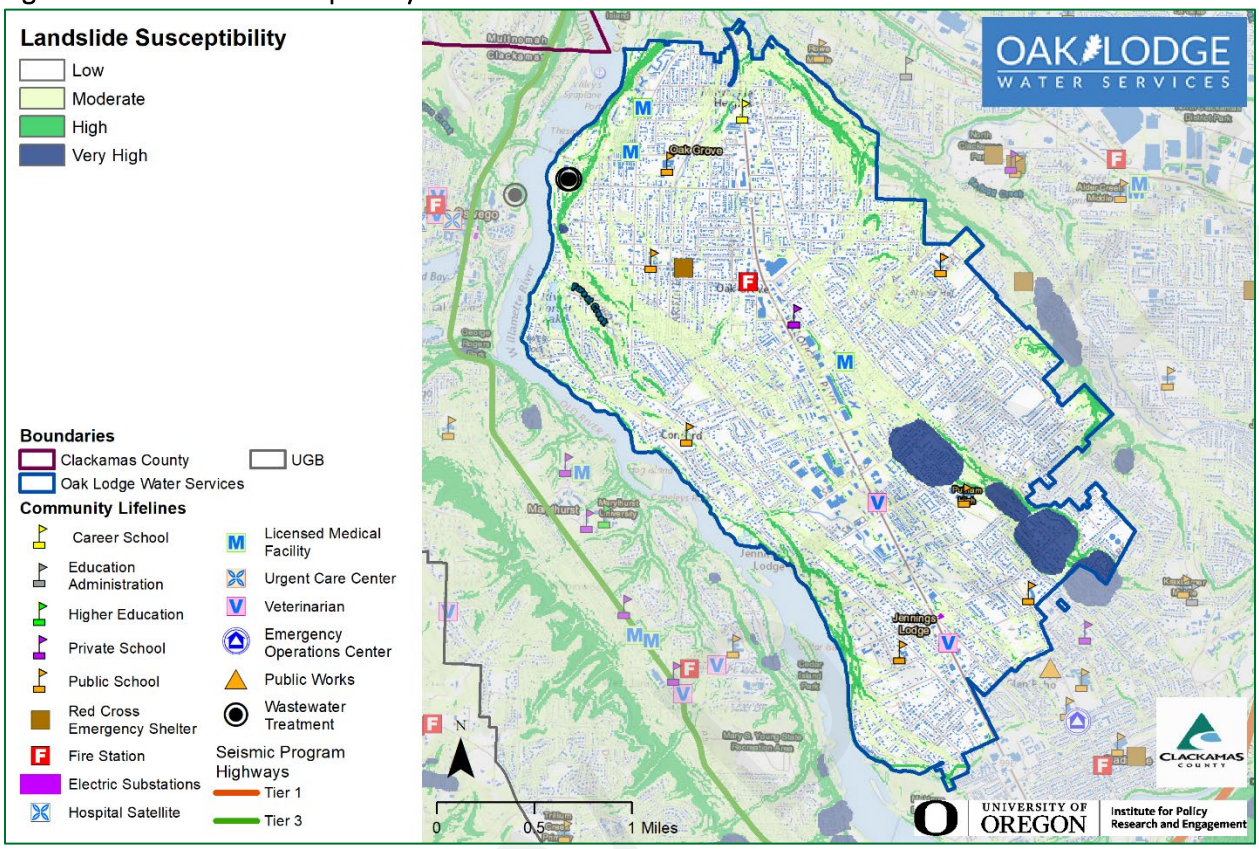
Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. OLWS does not have a history of landslides, although earthquake induced landslides have been known to impact water distribution pipes 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 OLWScould 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

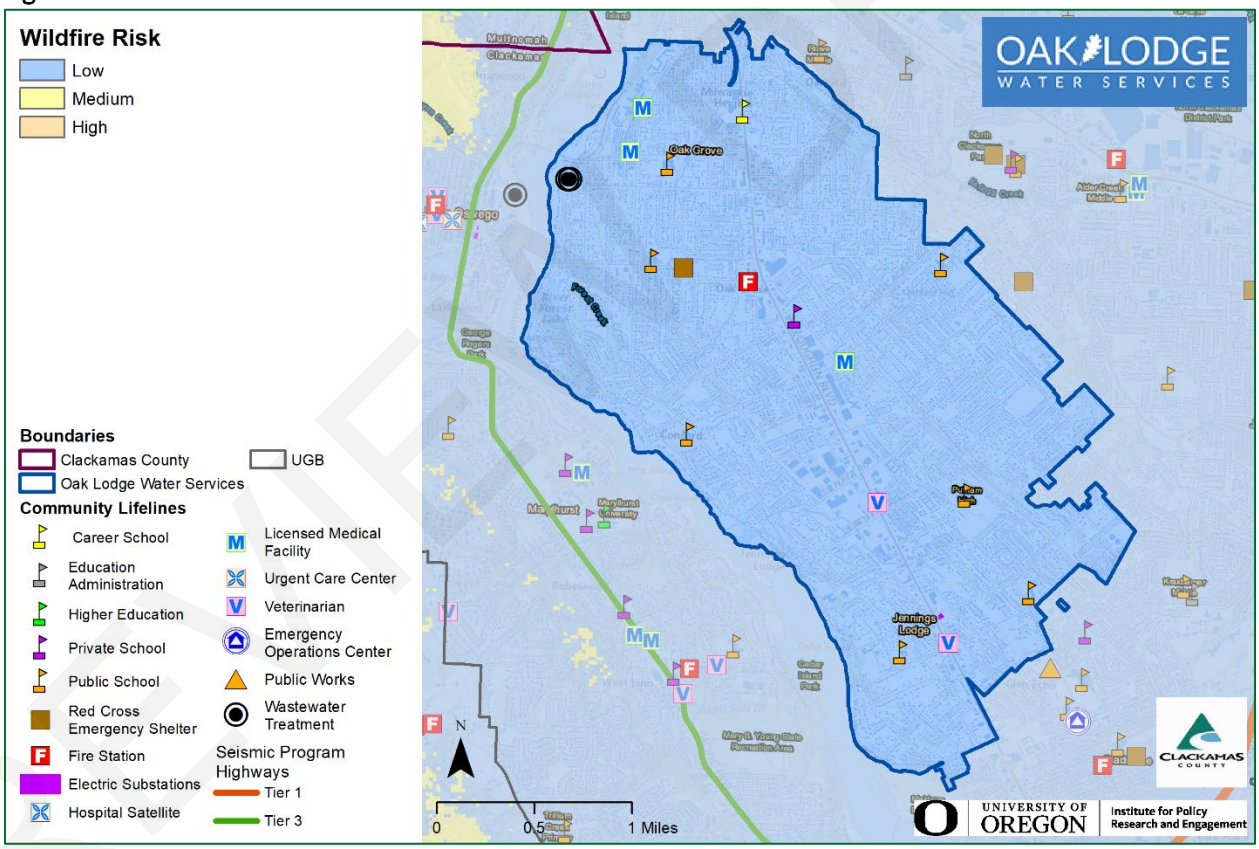
The HMAC determined that the Authority's probability for wildfire is **moderate**, and that their vulnerability to wildfire is **moderate**.

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 health[7] 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" workers[12], 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 January XX through February XX on the City's website. The plan was also posted and announced on the County's website. There were X 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

To be provided

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.