

Clackamas River Water Addendum to the Clackamas County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photo Credit: Clackamas River Water

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The Special District of Clackamas River Water

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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 [DATE TBD, 2024]. FEMA Region X approved the Clackamas County NHMP on [DATE TBD, 2024] and the District’s addendum on [DATE TBD, 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 [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 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 HMAAC 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.

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 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

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.

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.

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.

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. 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.

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 CRW-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
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

		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	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
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

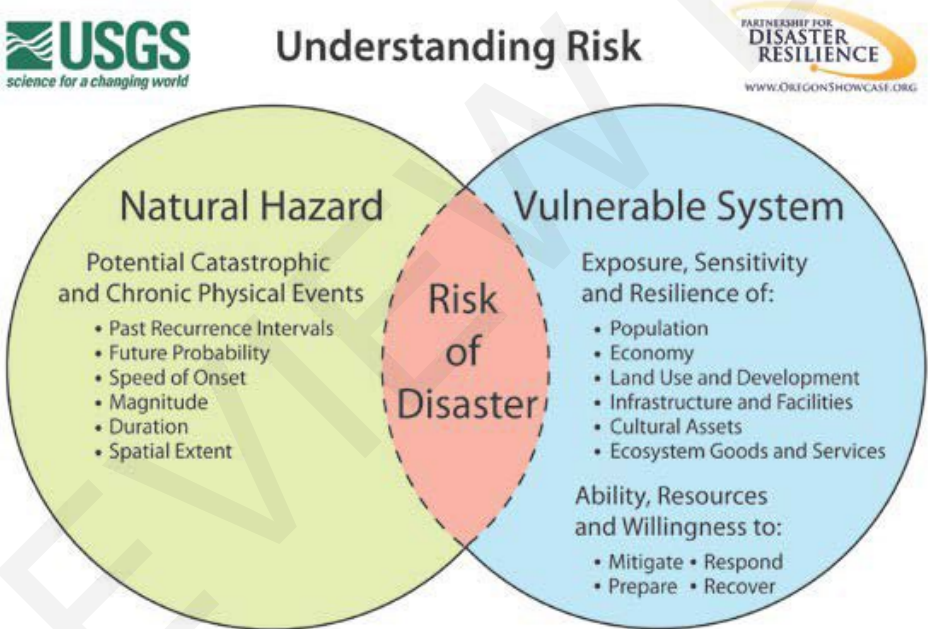
Risk Assessment

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.

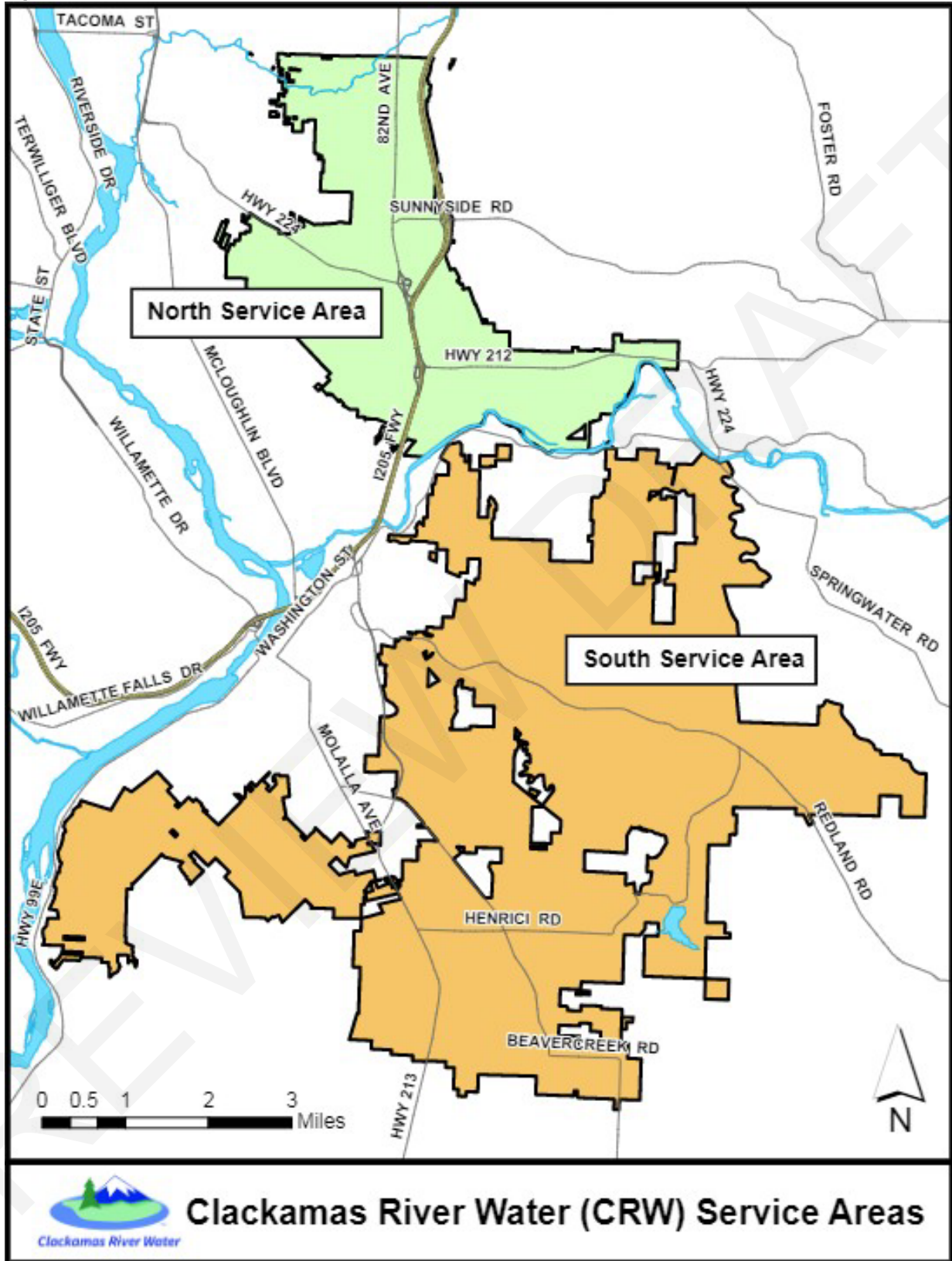
The District's primary facilities are located adjacent to or near the Clackamas River. Other major river systems in the area include the Columbia and Willamette. All water treated by Clackamas River Water is "run of the river"; it is caught as it flows down the river. As a result, it is subject to natural 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
Other Assets												

Name/Number	System	Identified Hazard Exposure											
		DR	EQ	EH	FL	HB	PA	LS	VE	WF	WN	WS	
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.

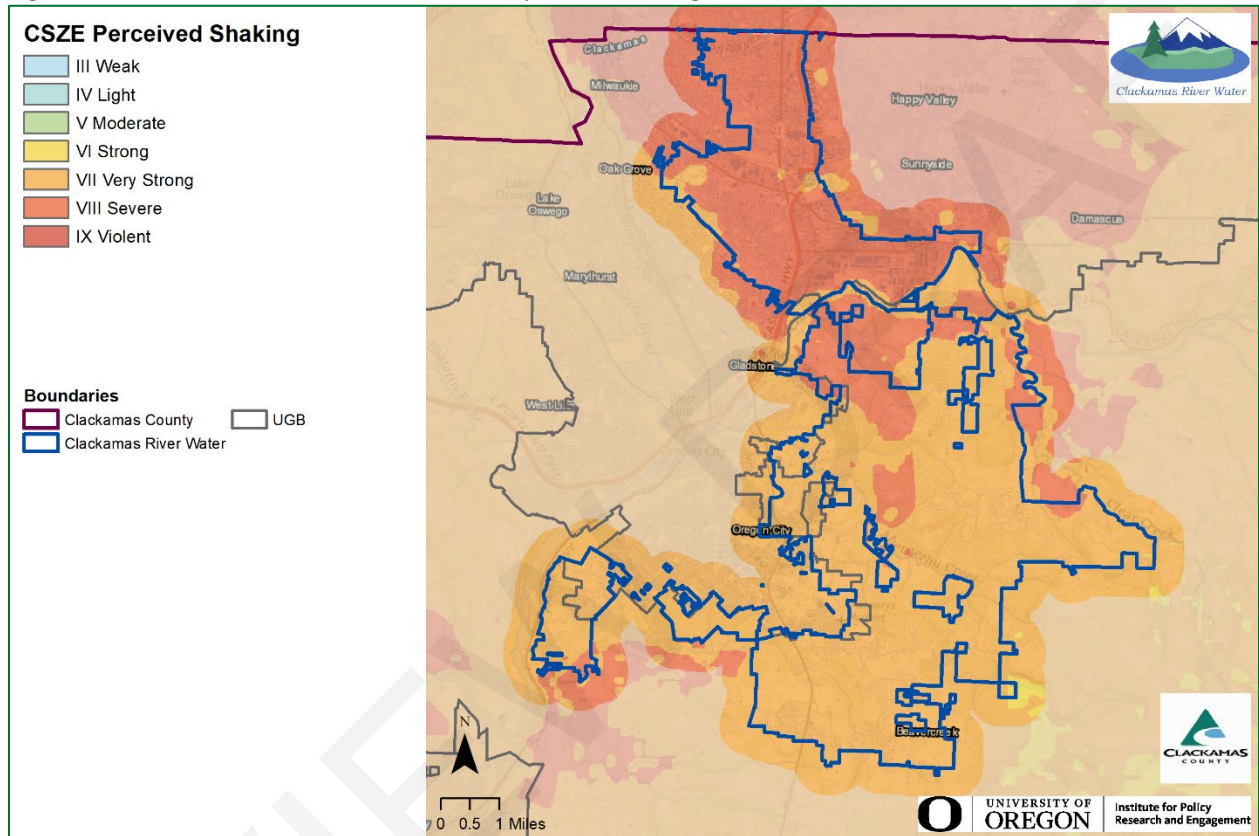
Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-

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 HMAC 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.

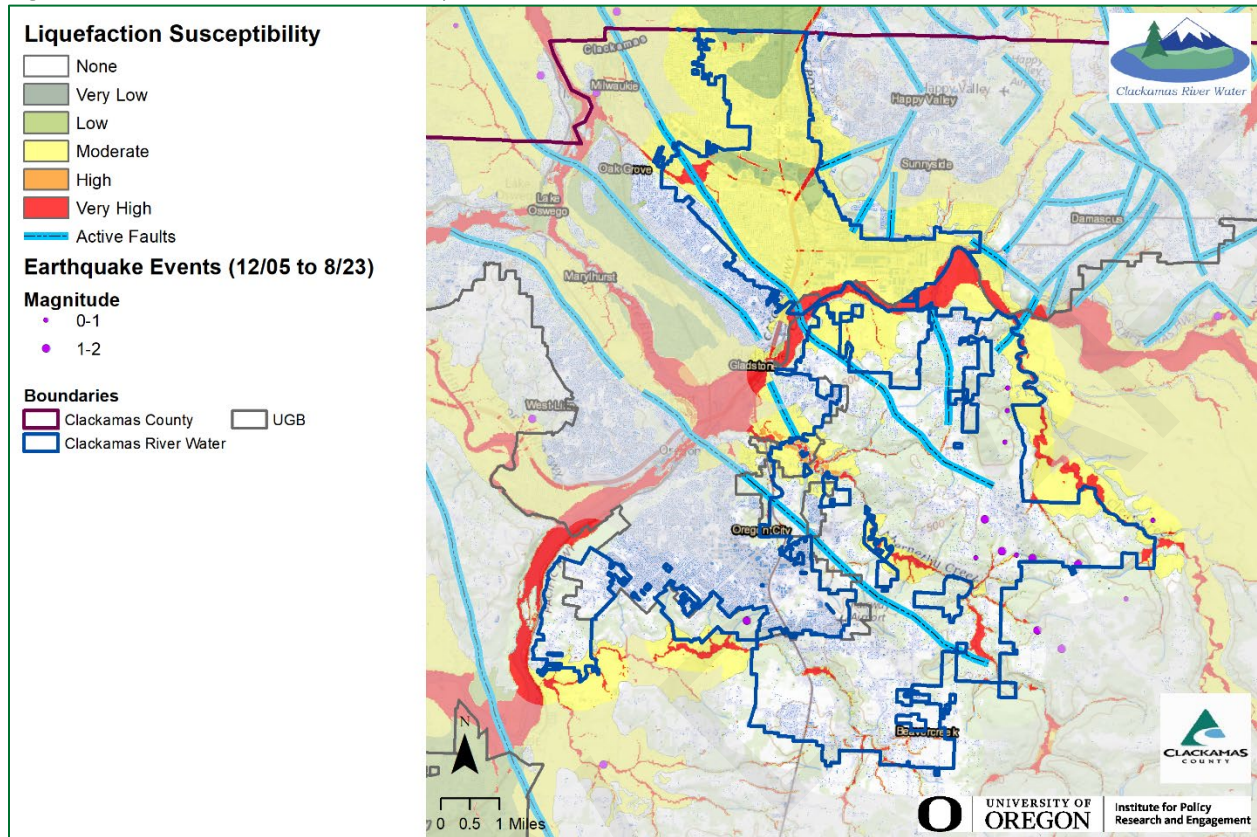
Portland Hills Fault Zone

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).

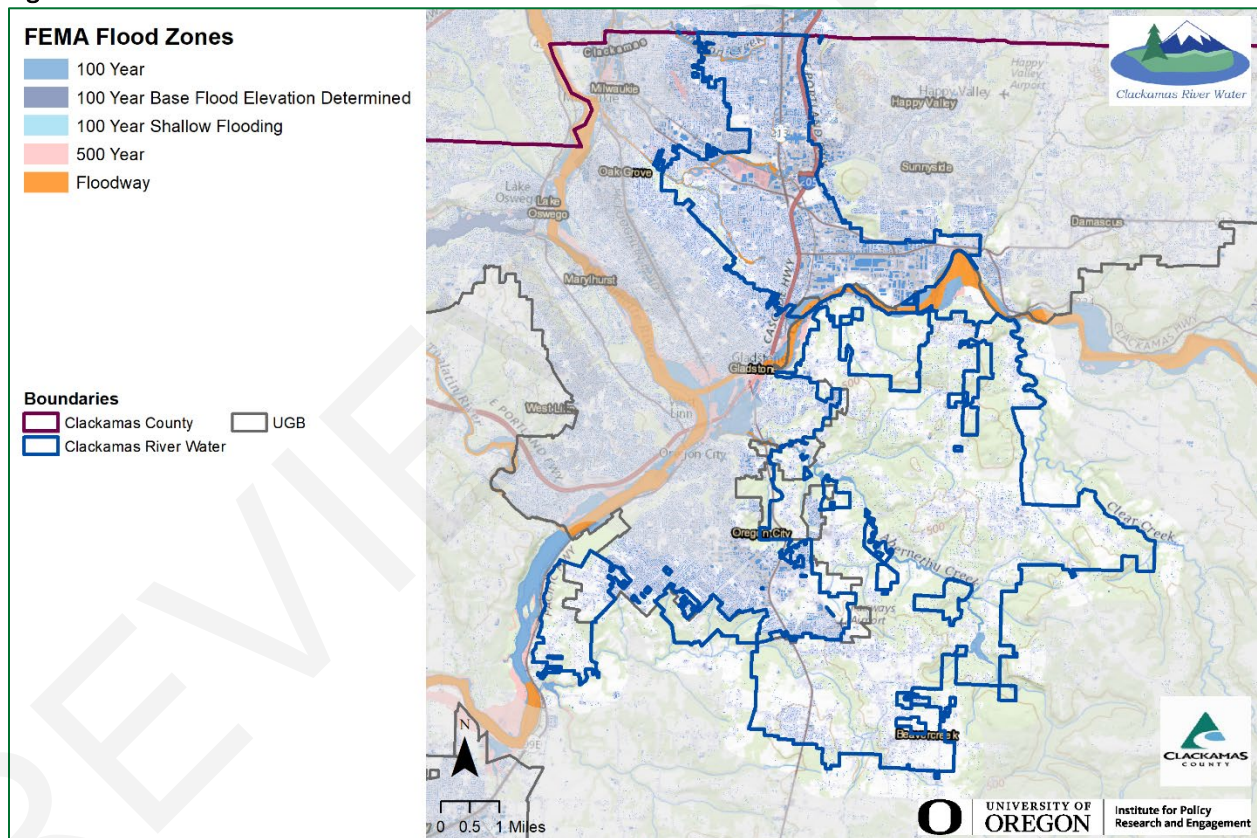
Seismic building codes were implemented in Oregon in the 1970s; however, stricter standards did not take effect until 1991 and early 2000s. Older infrastructure (pipes, pump stations, and reservoirs) maintained by CRW are at risk to earthquake damage.

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.

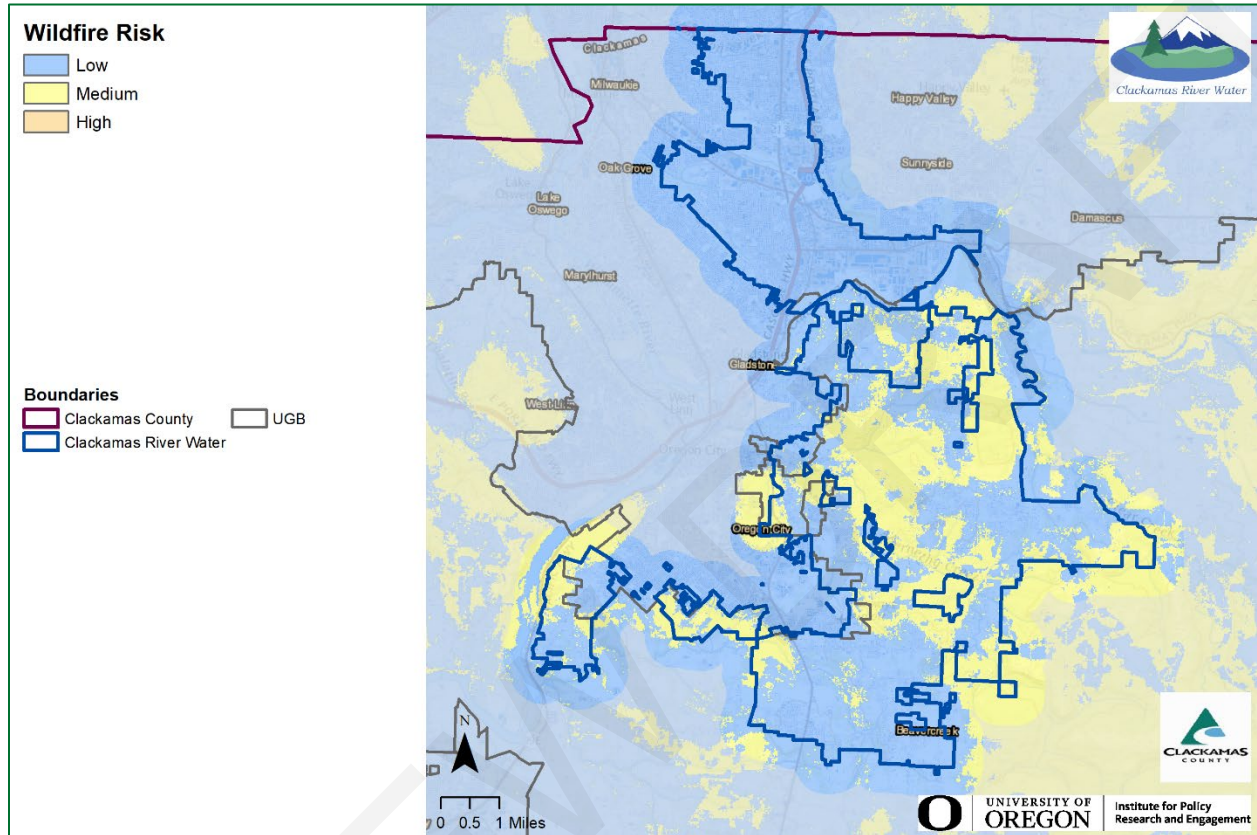
Volume I, Section 2 describes the characteristics of wildland fire hazards, history, as well as the location, extent, and probability of a potential event within the region. The location and extent of a wildland fire vary depending on fuel, topography, and weather conditions.

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

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 CRW-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

Vulnerability Assessment

The potential community impacts, and vulnerabilities described in Volume I, Section 2 are generally accurate for the District 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 District will update the District’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 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 XX through February XX on the District'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 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.