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

Photo Credit: City of Estacada

Effective: April XX, 2024-April XX, 2029

Prepared for
The City of Estacada

CITY OF ESTACADA
unexpected / untamed / unforgettable

Updated:
Date, 2024, (Resolution # 2024-xx)
May 13, 2019, (Resolution # 2019-013)
April 22, 2013
November 23, 2009

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

Planning grant funding provided by:

FEMA

Federal Emergency Management Agency (FEMA)

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

Additional Support Provided by:

OEM

Oregon Department of Geology and Mineral Industries 1937

Table of Contents

List of Tables

List of Figures

Purpose

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

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

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

Estacada adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on [DATE TBD, 2024]. FEMA Region X approved the Clackamas County NHMP on [DATE TBD, 2024] and the City's addendum on [DATE TBD, 2024]. With approval of this NHMP the City is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through [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 city will remain eligible for pre- and post-disaster mitigation project grants.

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

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

Convener

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

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

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

The Estacada HMAC was composed of the following representatives:

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

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

NHMP Implementation and Maintenance

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

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

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

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

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

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

Implementation through Existing Programs

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

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

Capability Assessment

The Capability Assessment identifies and describes the ability of the City of Estacada to implement the mitigation strategy and associated action items. Capabilities can be evaluated through an examination of broad categories, including: existing authorities, policies, programs, funding, and resources.

Existing Authorities

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

Comprehensive Plan

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

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

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

Regulations

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

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

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

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

Structural Building Codes

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

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

Staffing Resources

Community Development Department

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

Public Works

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

City Administration

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

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

Policies and Programs

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

GIS Update

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

TMDL Plan

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Capital Projects

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

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

Ongoing projects

- Seismic rehabilitation of the Estacada High School gym

Wastewater Treatment Plant Upgrade

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

Upcoming projects include:

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

Capital Resources

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

Findings

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

Staffing Limitations and Capacity

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

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

Reliance upon outside funding streams and local match requirements

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

Leveraging Partnerships with Public and Nonprofit Entities

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

Mitigation Plan Mission

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

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

The mission of the NHMP is to:

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

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

Mitigation Plan Goals

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

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

All the NHMP goals are important and are listed below in no order of priority. Establishing community priorities within action items neither negates nor eliminates any goals, but it establishes which action items to consider implementing first, should funding become available.

Goal 1: Protect Life and Property

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

Goal 2: Enhance Natural Systems

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

Goal 3: Augment Emergency Services

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

Goal 4: Encourage Partnerships for Implementation

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

Goal 5: Promote Public Awareness

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

Goal 6: Advance Equity and Inclusion

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

Mitigation Strategy

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

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

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

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

Mitigation Successes

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

FEMA Funded Mitigation Successes

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

Seismic Rehabilitation Grant Program Mitigation Successes

- 2023: Estacada High School Gymnasium ($2,498,072) (to be complete in 2024)
- 2021: River Mill Elementary School ($1,928,855)
- 2017: Estacada Middle School ($1,065,500)
- 2017: Estacada Rural Fire District 69: Main Fire Station ($702,794)
  (Note: A new facility is expected to be constructed in the next few years.)

Other Successes:

- Wade Creek stormwater project

Action Items

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

[1] The Seismic Rehabilitation Grant Program (SRGP) is a state of Oregon competitive grant program that provides funding for the seismic rehabilitation of critical public buildings, particularly public schools, and emergency services facilities.

Table EA-1 Actions

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

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

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

Source: Estacada NHMP HMAC, updated 2023
Cost: Low (less than $50,000), Medium ($50,000-$100,000), High (more than $100,000)
Timing: Ongoing (continuous), Short (1-2 years), Medium (3-5 years), Long (5 or more years)
Priority Actions: Identified with orange highlight

Risk Assessment

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

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

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

Figure EA-1: Understanding Risk

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

Hazard Analysis

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

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

Table EA-2 Hazard Analysis Matrix

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

Source: Estacada HMAC, 2023.

Community Characteristics

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

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

Population, Housing, and Income

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

Between 2016 and 2021 the City grew by 2,218 people (70%; as of 2022 the population is 5,373). Between 2022 and 2040 the population is forecast to grow by 29% to 6,922.

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

[2] "Monthly Average for Estacada, OR" The Weather Channel Interactive, Inc. Retrieved November 25, 2018.

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

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

Transportation and Infrastructure

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

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

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

Economy

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

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

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

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

[4] Ibid.

Table EA-3 Community Characteristics

Population Characteristics		Population Growth
2016 Population Estimate	3,155	
2022 Population Estimate	5,373	70%
2040 Population Forecast*	6,922	29%
Race		
American Indian and Alaska Native		2%
Asian		2%
Black/ African American		< 1%
Native Hawaiian and Other Pacific Islander		0%
White		92%
Some Other Race		0%
Two or More Races		4%
Hispanic or Latino/a (of any race)		18%
Limited or No English Spoken	0	0%
Vulnerable Age Groups		
Less than 5 Years	263	6%
Less than 15 Years	797	18%
65 Years and Older	654	15%
85 Years and Older	245	6%
Age Dependency Ratio		0.50
Disability Status (Percent age cohort)		
Total Disabled Population	621	14%
Children (Under 18)	42	4%
Working Age (18 to 64)	238	9%
Seniors (65 and older)	341	52%

Household Characteristics		
Housing Units		
Single-Family (includes duplexes)	1,256	81%
Multi-Family	144	9%
Mobile Homes (includes RV, Van, etc.)	153	10%
Household Type		
Family Household	1,004	71%
Married couple (w/ children)	382	27%
Single (w/ children)	570	40%
Living Alone 65+	158	11%
Year Structure Built		
Pre-1970	328	21%
1970-1989	239	15%
1990-2009	557	36%
2010 or later	429	28%
Housing Tenure and Vacancy		
Owner-occupied	1,204	78%
Renter-occupied	204	13%
Seasonal	42	3%
Vacant	103	7%
Vehicles Available (Occupied Units)		
No Vehicle (owner occupied)	21	2%
Two+ vehicles (owner occupied)	937	78%
No Vehicle (renter occupied)	66	32%
Two+ vehicles (renter occupied)	56	27%

Income Characteristics		
Households by Income Category		
Less than $15,000	79	6%
$15,000-$29,999	269	19%
$30,000-$44,999	137	10%
$45,000-$59,999	62	4%
$60,000-$74,999	157	11%
$75,000-$99,999	165	12%
$100,000-$199,999	501	36%
$200,000 or more	38	3%
Median Household Income		$75,000
Gini Index of Income Inequality		0.36
Poverty Rates (Percent age cohort)		
Total Population	729	17%
Children (Under 18)	0	0%
Working Age (18 to 64)	551	21%
Seniors (65 and older)	178	27%
Housing Cost Burden (Cost > 30% of household income)		
Owners with a Mortgage	762	72%
Owners without a Mortgage	0	0%
Renters	83	41%

Employment Characteristics		
Labor Force (Population 16+)		
In labor Force (% Total Population)	1,884	43%
Unemployed (% Labor Force)	150	7%
Occupation (Top 5) (Employed 16+)		
Professional & Related	309	16%
Production	287	15%
Office & Administrative	253	13%
Management, Business, & Financial	251	13%
Transportation and Material Moving	222	12%
Health Insurance		
No Health Insurance	262	6%
Public Health Insurance	1,484	34%
Private Health Insurance	3,064	71%
Transportation to Work (Workers 16+)		
Drove Alone	1,395	76%
Carpooled	244	13%
Public Transit	0	0%
Motorcycle	0	0%
Bicycle/Walk	71	4%
Work at Home	103	6%

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

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

Community Lifelines

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

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

Critical Facilities

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

Table EA-4 Critical Facilities

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

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-16

Highlighted cells are tentative to be confirmed by DOGAMI in their final Risk Report (expected April 2024)

Additional Critical Facilities not included in the DOGAMI Risk Report:

Critical Infrastructure

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

Essential Facilities

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

Environmental Facilities

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

Vulnerable Populations

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

Hazardous Materials

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

Economic Assets/Population Centers

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

Cultural and Historic Assets

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

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

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

Hazard Characteristics

Drought

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

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

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

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

Vulnerability Assessment

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

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[5] drought, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is projected to become more frequent in Clackamas County by the 2050s.

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

Earthquake (Cascadia Subduction Zone)

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

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

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

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

Cascadia Subduction Zone

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

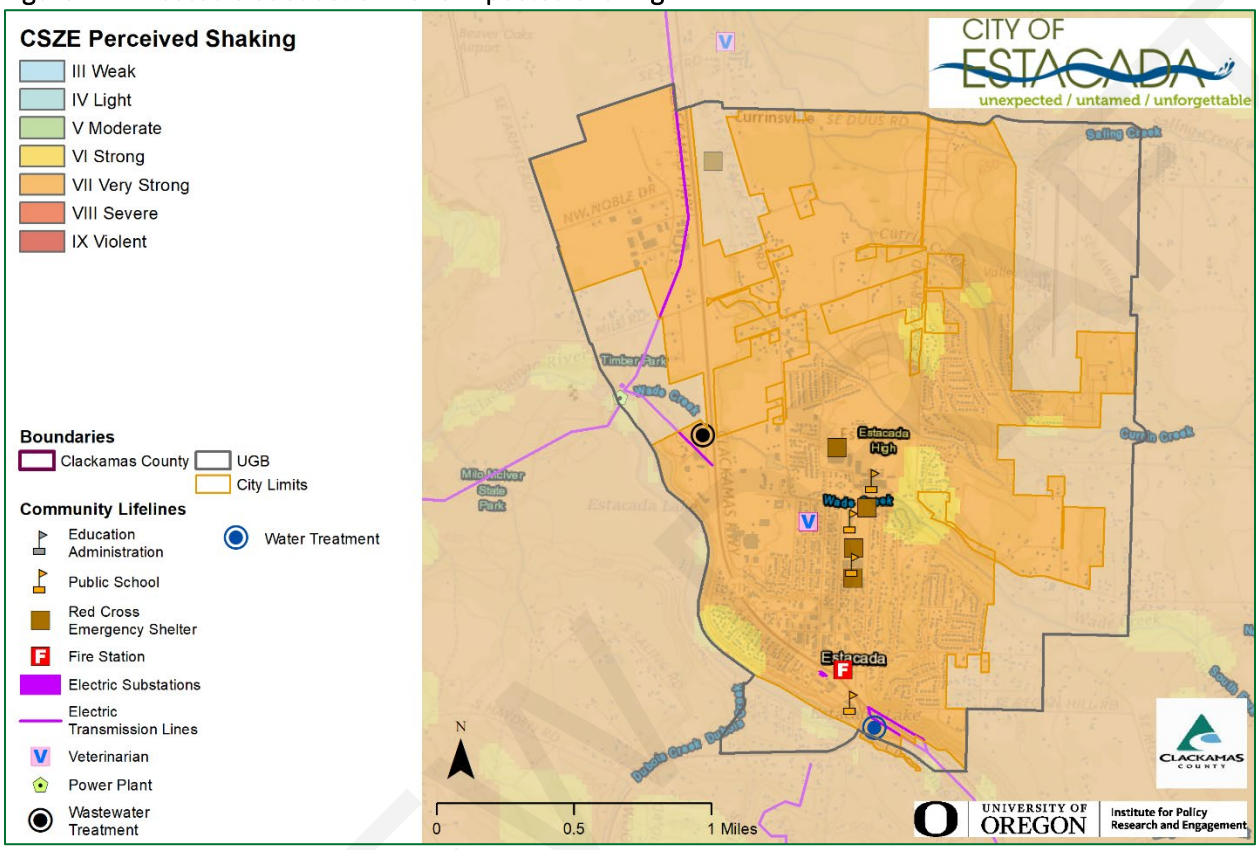
The city's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the city a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides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

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

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

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

Figure EA-2 Cascadia Subduction Zone Expected Shaking



Source: Map created by Oregon Partnership for Disaster Resilience.
Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
Note: To view hazard detail click this link to access Oregon HazVu

Earthquake (Crustal)

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

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

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

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

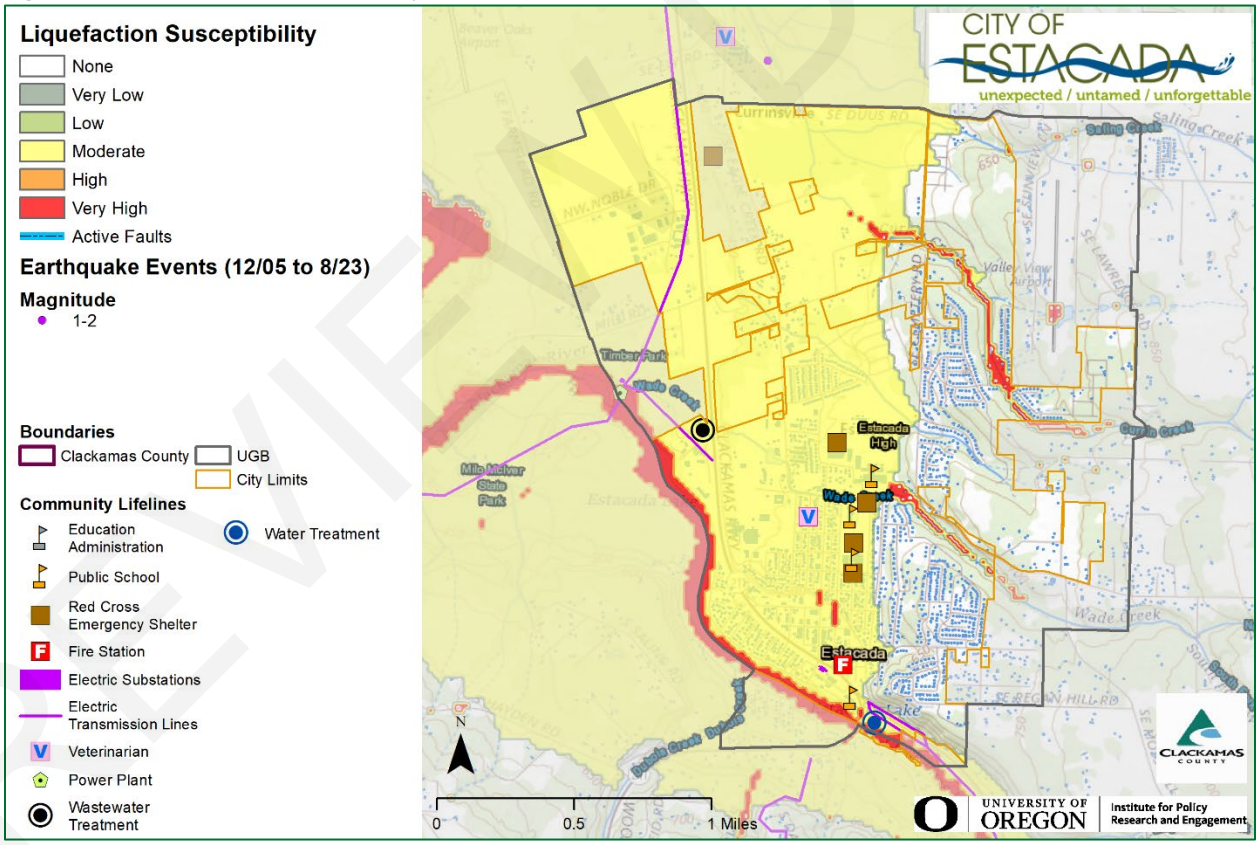
Canby-Estacada Fault Zone

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

Portland Hills Fault Zone

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

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



Source: Map created by Oregon Partnership for Disaster Resilience.
Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
Note: To view hazard detail click this link to access Oregon HazVu

Vulnerability Assessment

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

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

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

Table EA-5 Rapid Visual Survey Scores

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

Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.
"*" – Site ID is referenced on the RVS Clackamas County Map

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

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

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

Earthquake Regional Impact Analysis

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

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

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

Cascadia Subduction Zone Scenario

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

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

[8] Ibid, Tables 12-8 and 12-9.

Portland Hills Fault Scenario

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

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

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

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

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

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-XX)[11] provide hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report the following population and property within the study area may be impacted by the profiled events:

[9] Ibid, Tables 12-10 and 12-11

[10] Ibid, Tables 12-10 and 12-11.

[11] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-15.

Cascadia Subduction Zone Scenario

The City of Estacada is expected to experience damage to 104 buildings (7 critical facilities). These structures are expected to be damaged for a total potential loss of $47.6 million (a loss ratio of 7.1%). About 39 residents may be displaced.

Canby-Molalla Fault Scenario

With this crustal fault, 18 buildings are expected to be damaged, no critical facilities, for a total potential loss of $10.9 million (a loss ratio of 1.6%). Less than 10 residents may be displaced.

Future Projections

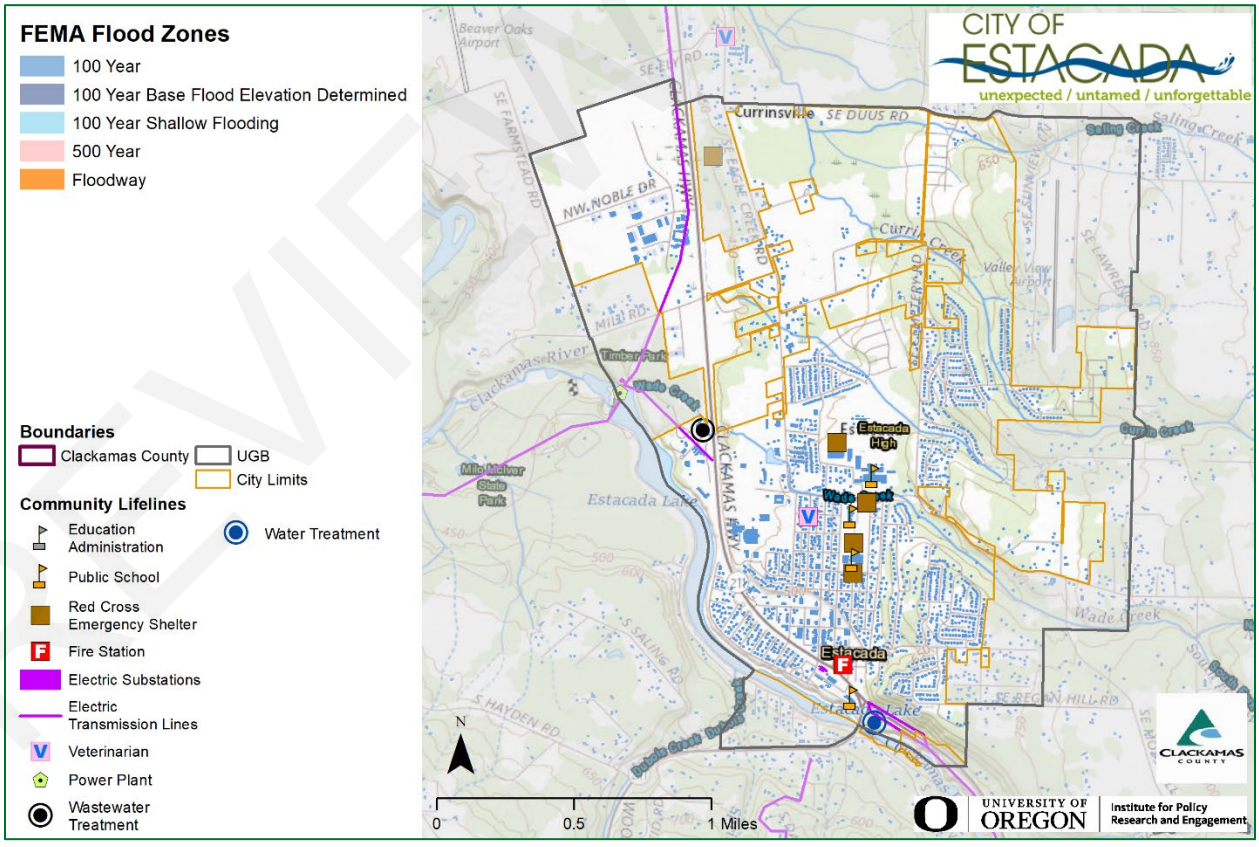
Future development (residential, commercial, or industrial) within Clackamas County will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of high development and building standards. Reducing risks to vulnerable populations should be considered during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

Flood

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

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

Figure EA-4 FEMA Flood Zones



Source: Map created by Oregon Partnership for Disaster Resilience.
Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
Note: To view hazard detail click this link to access Oregon HazVu

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

Vulnerability Assessment

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

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

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

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

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

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, O-24-XX)[12] provide hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

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

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[13] winter flood risk at mid- to low elevations in Clackamas County, where temperatures are near freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow. The projected increases in total precipitation, and in rain

[12] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-15.

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

relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

National Flood Insurance Program (NFIP)

FEMA's Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. There are no special flood hazard areas within the City. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program, although the City does not have a delineated Special Flood Hazard Area (SFHA). There have been no Community Assistance Visits (CAV) and the City does not participate in the Community Rating System (CRS). The Community Repetitive Loss record does not identify any Repetitive Loss Properties[14] or Severe Repetitive Loss Properties[15].

Landslide

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

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

Landslide susceptibility exposure for Estacada is shown in Natural Hazard Risk Report for Clackamas County. The Risk Report (DOGAMI, O-24-XX) provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

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

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

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

---

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

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

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

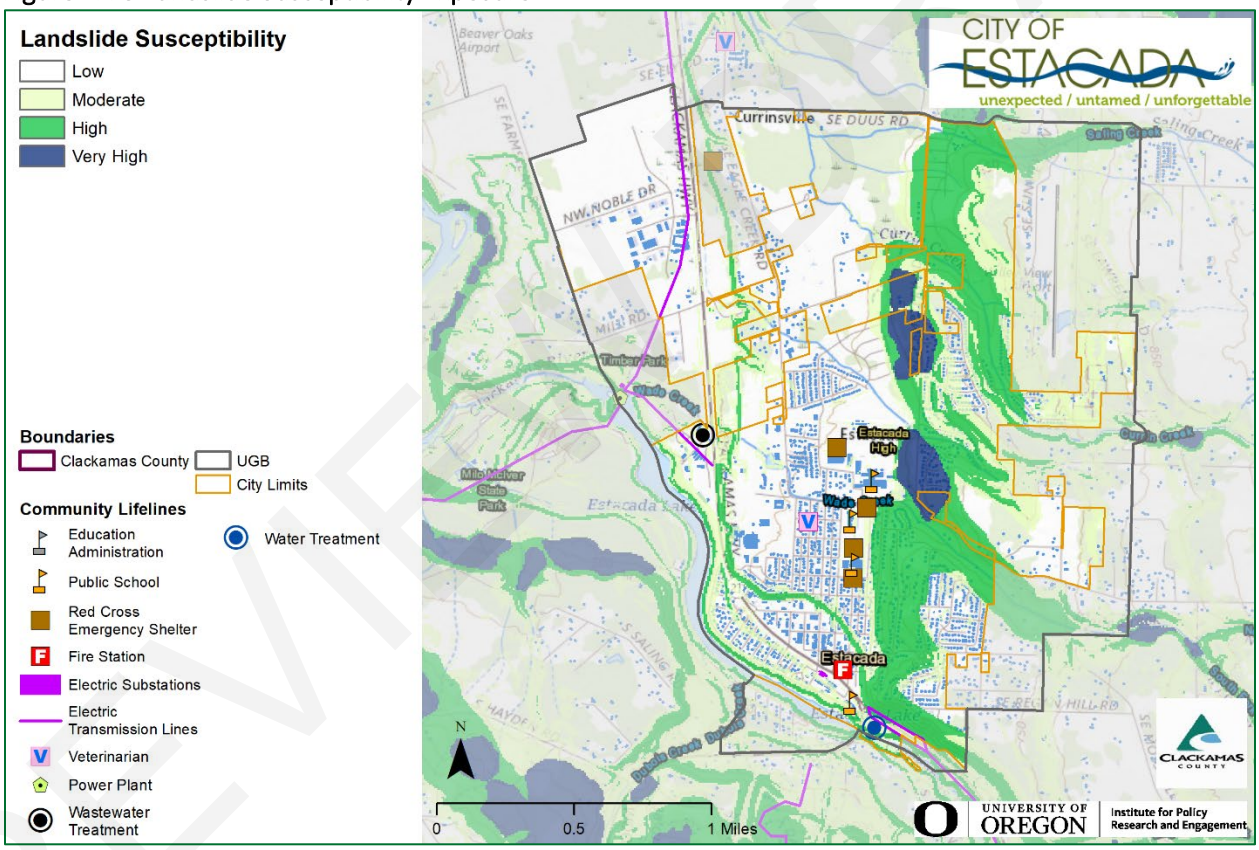
Vulnerability Assessment

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

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

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

Figure EA-5 Landslide Susceptibility Exposure



Source: Map created by Oregon Partnership for Disaster Resilience.
Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
Note: To view hazard detail click this link to access Oregon HazVu

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, O-24-XX)[17] provide hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

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

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute report presents a threshold based on recent precipitation (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on the 15 days prior to the previous 3 days). By the 2050s under the higher emissions scenario, the average number of days per year in Clackamas County on which the landslide risk threshold is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric, which is based on precipitation, does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development, can increase risks of landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Severe Weather

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

Extreme Heat

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

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

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

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

[17] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-15.

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

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[19] the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

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

Volume I, Section 2 describes the characteristics of windstorm hazards, history, as well as the location, extent, and probability of a potential event within the region. Because windstorms typically occur during winter months, they are sometimes accompanied by flooding and winter storms (ice, freezing rain, and very rarely, snow). Other severe weather events that may accompany windstorms, including thunderstorms, hail, lightning strikes, and tornadoes are generally negligible for Estacada.

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

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

Future Projections

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

Winter Storm (Snow/Ice)

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

Volume I, Section 2 describes the characteristics of winter storm hazards, history, as well as the location, extent, and probability of a potential event within the region. Severe winter storms can consist of rain,

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

freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

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

Vulnerability Assessment

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

Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding. The area most affected is Lake Shore Drive which runs parallel to the Clackamas River and is lined with large fir trees. The street has overhead power lines so power outages are frequent. Generally, the power does not stay out very long, but it has been out for up to three days at a time on Lake Shore Drive. Estacada's power grid is divided, so usually the power will go out in half the town at a time. Another potential problem is the heavily treed area behind the cemetery. Trees and branches blown over in this area during severe storms could affect the high school grounds.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[20] cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the coldest night of the year is projected to increase by an average of 6°F (range 0– 11°F) by the 2050s.

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor. In Clackamas County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. However, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 15% (range 0–31%) and 10% (range -1–26%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

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

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

Volcanic Event

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

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

Vulnerability Assessment

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

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, O-24-XX)[21] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

Future Projections

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

Wildfire

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

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

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

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

[21] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-15.

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

Vulnerability Assessment

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

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

Natural Hazard Risk Report for Clackamas County

The **Risk Report** (DOGAMI, O-24-XX)[22] provide hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 212 buildings are exposed to the *high and (or) moderate (medium) risk wildfire* hazard for a total exposure of $60.8 million (a building exposure ratio of 9.1%). About 826 residents may be displaced by wildfires (a population exposure ratio of 16%).

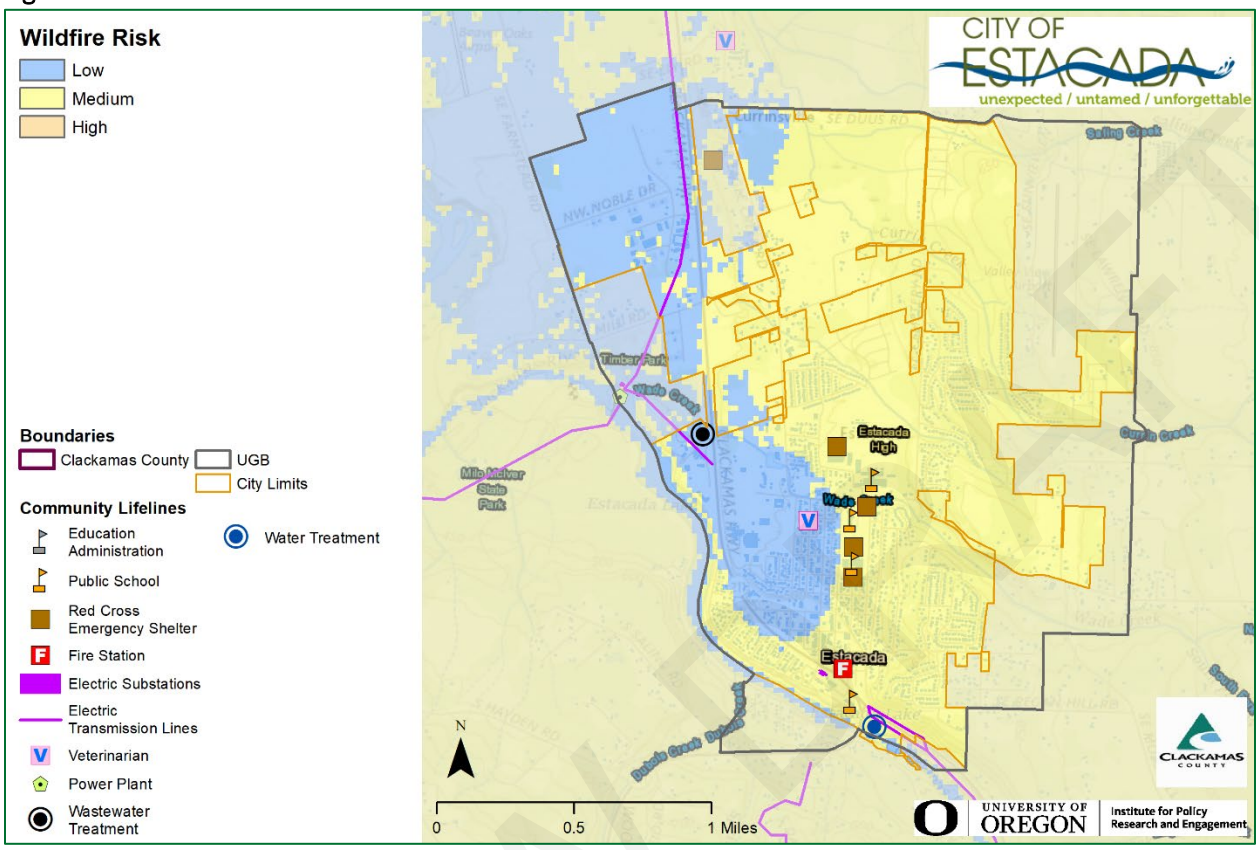
Future Projections

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

[22] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-15.

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

Figure EA-6 Wildfire Risk



Source: Map created by Oregon Partnership for Disaster Resilience.
Data: Oregon statewide wildfire risk map created by Oregon State University (unpublished). Preparedness Framework Implementation Team (IRIS v3).
Note: To view additional wildfire risk information click this link to access Oregon Explorer's CWPP Planning Tool

Attachment A: Action Item Changes

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

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

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

None identified.

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

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

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

Attachment B: Public Involvement Summary

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

To provide the public information regarding the draft NHMP addendum, and provide an opportunity for comment, an announcement (see below) was provided from January 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.

Outreach Events

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

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

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

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

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

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

Website Posting

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 6 and May 3, 2023

During these meetings, the HMAC:

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

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

During this meeting, the HMAC:

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