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

Photo Credit: Jake Egbert

Effective: April XX, 2024-April XX, 2029

Prepared for
The City of Happy Valley

HAPPY VALLEY, OR
EST. 1965

Updated:
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This Natural Hazard Mitigation Plan was prepared by:

CLACKAMAS COUNTY

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

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Purpose

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

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

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

Happy Valley adopted their addendum to the Clackamas County Multi-jurisdictional NHMP on **[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 Happy Valley to update their NHMP.

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

Convener

The Happy Valley Director of Public Safety serves as the NHMP addendum convener. The convener of the NHMP will take the lead in implementing, maintaining, and updating the addendum to the Clackamas County NHMP in collaboration with the designated convener of the Clackamas County NHMP (Clackamas County Resilience Coordinator).

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

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

The Happy Valley HMAC was comprised of the following representatives:

- Convener, Steve Campbell, Director of Public Safety
- Co-convener, Chris Randall, Public Works Director
- Chris Alfino, Senior Planner
- Sally Curran, City Engineer
- Mark Ennis, Building Official
- Jaimie Lorenzini, Administrator
- Chris Sliwka, Public Works Supervisor
- Laura Terway, Planning Manager

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

NHMP Implementation and Maintenance

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

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

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

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

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

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

Implementation through Existing Programs

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

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

Capability Assessment

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

Existing Authorities

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

Comprehensive Plan

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

The Happy Valley Comprehensive Plan contains specific goals and policies for the developed and undeveloped areas of the City that are intended to improve the quality of existing areas and assure that new areas are built out in a manner compatible with the established character of the City.

The current Happy Valley Comprehensive Plan is a 1984 Plan that was reorganized and redesigned in 2017 to enable the Plan text and graphics to be more easily viewed electronically. This 2017 update

includes the goals and policies of the Rock Creek Comprehensive Plan (2001) and East Happy Valley Comprehensive Plan (2009), and the Transportation System Plan (TSP) Update (2016). The 2023 Pleasant Valley North Carver Comprehensive Plan, an addition to the City's Comprehensive Plan covering the 2,700 acre urban reserve on the east side of Happy Valley, adopted overall policy framework and vision for Pleasant Valley /North Carver, including a resilient, connected transportation system.

The Natural Environment Chapter of the Comprehensive Plan includes Natural Environment Goals and Policies addressing Statewide Planning Goals 5, 6, and 7 (Natural Hazards). This chapter states its goal is to accommodate population growth while protecting new development against such hazards as erosion, flooding, and the mass movement of earth or landslides, and preserving important natural features.[1]

The Natural Environment Chapter includes a Buildable Lands Inventory that was revised based on four factors: steep slopes, geologic hazards, drainage channels, and flood hazards. It limits development to slopes of 20% or less and includes special regulations protecting steep slopes (steep slope development overlay) to specifically minimize seismic and landscape hazards and soil erosion associated with development of steep or unstable slopes.

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

Land Use Regulations

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

Community Development and Planning play an integral role in and facilitates land use development patterns through implementation of the City's Comprehensive Plan(s) and Land Development Code while supporting environmental regulations and economic needs. They work closely with the County and neighboring jurisdictions to ensure plans are aligned.

Example applicable codes include:

Title 15 Buildings and Construction

Chapter 15.24 Flood Damage Prevention

It is the purpose of this ordinance to promote public health, safety, and general welfare, and to minimize public and private losses due to flood conditions. This flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage.

Title 16, Land Development Code

Chapter 16.32 Steep Slopes Development Overlay Zone

Of the 1,440 acres in the City, 690 acres, or nearly half of the total area of the City, exceeds a 15 percent slope. Land areas over 20 percent slopes are normally considered not developable because of a combination of hazards. Through this code, allowed intensity of development is correlated with the degree of natural hazard. The City made minor amendments to the Land Development Code to reduce the allowable density allowed near streams and on sloped areas (LDC Chapter 16.32 and 16.34).

Chapter 16.35 Flood Management Overlay Zone

[1] City of Happy Valley Comprehensive Plan, City of Happy Valley, 2017 Graphic Revision.

This code, adopted in 2009, establishes a flood management area overlay zone, which is delineated on the flood management area map incorporated by reference. The flood management areas mapped include land contained within the one hundred (100) year floodplain, flood area and floodway as shown on the Federal Emergency Management Agency flood insurance maps (dated June 17, 2008).

The standards that apply to the flood management areas apply in addition to local, state, or Federal restrictions governing floodplains or flood hazard areas, including the standards in Chapter 15.24, Flood Damage Prevention.

Structural Building Codes

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

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

Public Works

The City of Happy Valley Public Works Department is the operations side of the city. Their role is to provide, operate and maintain the City's transportation infrastructure, city facilities, and parks/trail system. Much of their work is associated with the reduction of hazards to the community and the implementation of resilience measures.

City Administration

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

Policies and Programs

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

City of Happy Valley Wildfire Assessment Program, May 2022

This report assesses fuel load and fire risk, determines appropriate mitigation measures, and develops a long-term vegetation management program. The report highlighted the areas that were most at risk for wildfire, and provided recommendations for mitigation measures that could be taken to reduce the risk. The City Council recognized the importance of this work and sought out grants to help fund the mitigation efforts, begin to implement the vegetation mitigation plan for each described site location. Over one hundred sites were mitigated in the first year following the completion of the assessment, and completing the remaining risk reduction projects remains a priority for the community.

Happy Valley Transportation System Plan, March 2023

The Transportation System Plan (TSP) prepares Happy Valley for accommodating traffic within the city in the best manner possible through 2040. The TSP's big picture view allows it to guide the city in developing and maintaining acceptable transportation network performance more efficiently than a piecemeal or unorganized approach.

Parks, Recreation, and Open Space Plan, January 2021

This Master Parks Plan creates a vision for an innovative, inclusive, and interconnected system of parks, trails and open spaces that promotes outdoor recreation, health and environmental conservation.

Community Wildfire Protection Plan

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

National Flood Insurance Program

Happy Valley participates in the National Flood Insurance Program. The Planning Department is responsible for administering the day-to-day activities of the city's floodplain program.

Specifically, the floodplain manager:

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

Community Emergency Response Teams (CERT)

The Happy Valley CERT, which is managed by the Clackamas Fire District, meets at Happy Valley City Hall. Their mission is to help communities become resilient in the face of local disasters and promote community connections.

NFPA Firewise

The National Fire Protection Association's (NFPA) Firewise program has been a great success in the community. There are two recognized Firewise communities in good standing within the city – Spring Mountain Homeowners Association and Happy Valley Heights Homeowners Association.

Personnel

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

Emergency Management: Steve Campbell, Director of Public Safety, Chris Randall, Public Works Director

Public Information Officer: Steve Campbell, PIO

Floodplain Manager: Chris Alfino, Senior Planner

Grant writing (for Public Works or emergency management): Jaimie Lorenzini, Admin

Capital improvement planning: Sally Curran, City Engineer

Capital improvement execution: Chris Randall, Public Works Director

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

Capital Projects

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

- 122nd/129th "S" Curve Street Improvement Project (curb, sidewalks, storm drain improvements)
- Superblock Phase 1 (curb/sidewalk/storm drain improvements SE Ridgecrest Rd)
- Superblock Phase 2 (curb/sidewalk/storm drain improvements SE Ridgecrest Rd, SE 132nd and SE King Rd
- Coyote Way Storm Drain Improvements
- Natalya and Christilla Ln Storm Drain Improvements

Ongoing projects that enhance the City's resilience include:

- Happy Valley Library expansion (2023-2024)

Mitigation Successes

The community has several examples of mitigation success including the following projects funded through FEMA Hazard Mitigation Assistance and the Oregon Infrastructure Finance Authority's Seismic Rehabilitation Grant Program[2].

FEMA Funded Mitigation Successes

- DR4562-55: Library Hazardous Fuels Reduction ($6,399.75) - pending
- DR4562-56: Parks Hazardous Fuels Reduction Project ($62,951.70) - pending

Seismic Rehabilitation Grant Program Mitigation Successes

- Sunnyside Elementary (Phase Two of 2015-2017 grant award, $1,500,000).

Other Mitigation Successes

A $433 million seismic retrofit/ school upgrade bond was (3-487) passed in 2016 for the North Clackamas School District, which addressed the different needs of schools throughout the school district. The bond

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

turned Rock Creek Middle School into a comprehensive high school [Adrian C Nelson] to deal with overcrowding, as well as added six classrooms to Happy Valley Middle School.

Capital Resources

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

Communication Towers: one on City property

Critical facilities with power generators for use during emergency blackouts: City Hall, Emergency Operations Center, Happy Valley Library, Happy Valley Police Station, and Happy Valley Public Works.

Warming or cooling shelters: the Happy Valley Library

Fueling storage: 4000 gallons stored at Happy Valley Public Works

Findings

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

Staffing Limitations and Capacity

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

Reliance upon outside funding streams and local match requirements

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

Leveraging Partnerships with Public and Nonprofit Entities

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

Mitigation Plan Mission

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

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

The mission of the NHMP is to:

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

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

Mitigation Plan Goals

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

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

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

Goal 1: Protect Life and Property

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

Goal 2: Enhance Natural Systems

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

Goal 3: Augment Emergency Services

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

Goal 4: Encourage Partnerships for Implementation

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

Goal 5: Promote Public Awareness

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

Goal 6: Advance Equity and Inclusion

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

Mitigation Strategy

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

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

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

Action Items

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

Table HV-1 Action Items

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
1	Develop, enhance, and implement public education programs to inform the public about methods for mitigating the impacts of natural hazards.	X	X	X	X	X	X	X	X	X	Planning/ Public Works, Public Safety, Building, Planning Commission, Finance	Ongoing	Local Resources. DLCD TA, FEMA HMA	Low
2	Integrate the goals and action items from the Natural Hazards Mitigation Plan into existing regulatory documents and programs, where appropriate.	X	X	X	X	X	X	X	X	X	Planning/ Public Works, Building, Engineering, Planning Commission	Ongoing	Local Resources. DLCD TA, FEMA HMA-C&CB	Low to Medium
3	Implement the vegetation management activities identified in the Wildfire Mitigation Assessment.				X	X		X	X	X	Economic and Community Development/ Planning, Public Works	Ongoing	Local Resources. DLCD TA, FEMA HMA	
4	Conduct seismic evaluations of the Community Policing Center, Public Works Complex, and identified shelters and implement appropriate structural and non-structural mitigation strategies.		X								Economic and Community Development, Public Works/ Building, Engineering	Long	Local Resources, State, Federal Grants, FEMA HMA, SRGP	Low to High
5	Design and construct Public Works facility to include seismic resiliency to accommodate for a backup EOC.		X								Public Works/ Economic and Community Development, Building, Engineering	Short	Local Resources, State, Federal Grants, FEMA HMA	High

		Impacted Hazard									Implementation and Maintenance			
Action Item #	Statement	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Lead/ Partners	Timeline	Potential Funding Source	Estimated Cost
6	Ensure continued compliance in the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.				X						Economic and Community Development/ GIS, Public Works	Ongoing	Local Resources, DLCD TA, FEMA HMA-C&CB	Low
7	Increase capacity of culverts throughout the city by implementing projects identified in the Clackamas Water Environment Services Storm System Master Plan.				X						Economic and Community Development/ Engineering, Public Works	Ongoing	Local Resources, FEMA HMA (FMA)	Medium to High
8	Reduce negative effects from severe windstorm, severe winter storm, and extreme heat events.			X					X	X	Economic and Community Development/ Public Works, Engineering, Building	Ongoing	Local Resources, FEMA HMA-C&CB	Low to High
9	Reduce negative effects from severe windstorm, severe winter storm through undergrounding existing utility lines.								X	X	Public Works/ Economic and Community Development, Engineering, Building	Ongoing	Local Resources, FEMA HMA, Utilities	High
10	Promote fire-resistant strategies for new and existing developments (e.g., drought and fire-resistant landscaping and defensible space).	X						X			Planning/ Engineering, Building, Planning Commission, Clackamas Fire District #1	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low

		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
11	Work with Firewise Communities to conduct community-based fuel reduction demonstration projects in the wildland-urban interface.							X			Community Services/ Parks and Recreation, Clackamas Fire District #1	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM, Firewise	Low to High
12	Coordinate wildfire mitigation action items through the Clackamas County Community Wildfire Protection Plan	X						X			Clackamas Fire District #1/ Economic and Community Development, Public Works	Ongoing	Local Resources, FEMA HMA, CWDG, ODF, OSFM	Low to High

Source: Happy Valley NHMP 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

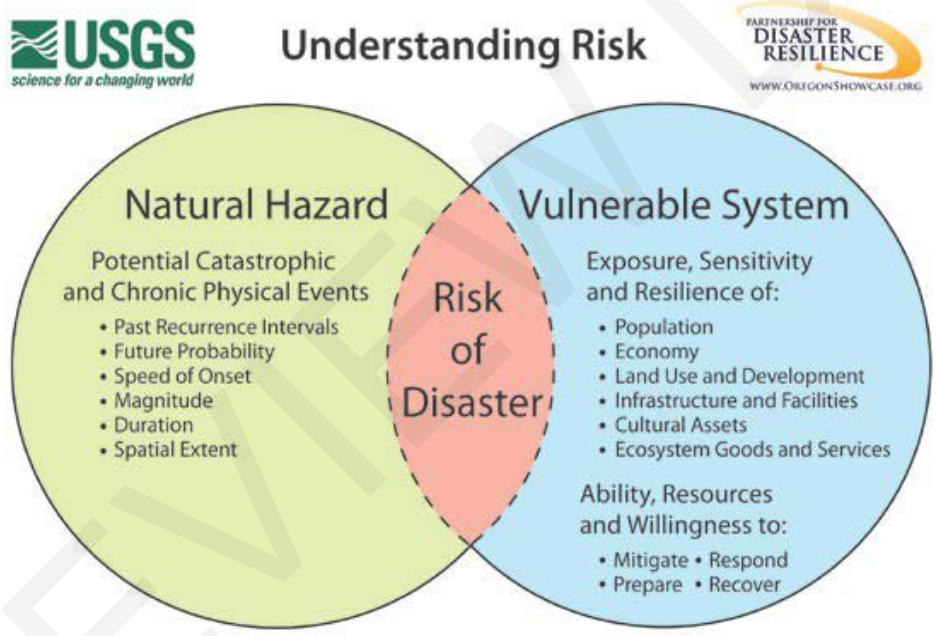
Risk Assessment

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 HV-1. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure HV-1: Understanding Risk



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

Hazard Analysis

The Happy Valley HMAC developed their hazard vulnerability assessment (HVA), using their previous HVA and the County's HVA as a reference. Changes from their previous HVA and the County's HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Happy Valley, which are discussed throughout this addendum. Table HV-2 shows the HVA matrix for Happy Valley listing each hazard in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. One

catastrophic hazard (Cascadia Subduction Zone earthquake) and two chronic hazards (winter storm and wildfire) rank as the top hazard threats to the City (Top Tier). Crustal earthquake, landslide, and extreme heat event comprise the next highest ranked hazards (Middle Tier), while drought, flood, windstorm, and volcanic event comprise the lowest ranked hazards (Bottom Tier).

Table HV-2 Hazard Analysis Matrix

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Winter Storm	18	35	80	56	189	1	*Top Tier*
Earthquake - Cascadia	2	45	100	35	182	2	
Wildfire	12	30	70	49	161	3	
Earthquake - Crustal	6	25	100	21	152	4	*Middle Tier*
Landslide	10	25	60	56	151	5	
Extreme Heat	10	35	70	35	150	6	
Drought	16	20	30	56	122	7	*Bottom Tier*
Flood	16	20	30	56	122	8	
Windstorm	14	15	50	42	121	9	
Volcanic Event	2	15	50	7	74	10	

Source: Happy Valley HMAC, 2023.

Community Characteristics

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

Geographically, the City is located in the northwestern region of Clackamas County, about 18 miles south of the Washington border and 10 miles southeast of downtown Portland. The City is 497 feet above sea level and located at the northern end of the Willamette River watershed (Willamette Valley).

Because of its location Happy Valley's climate is consistent with the Marine west coast climate zone, with warm summers and cool, wet winters. Happy Valley receives most of its rainfall between October and May, and averages 49 inches of rain, and two (2) inches of snow, per year.[7]

Population, Housing, and Income

Happy Valley was incorporated in 1965 and remained a small community until the late 1990s, when it became one of the fastest-growing cities in Oregon. Today, the city has an area of 11.58 square miles. Between 2016 and 2022 the City grew by 8,009 people (43%; as of 2022 the population is 26,689). Between 2022 and 2045 the population is forecast to grow by 115% to 57,362.

A majority of the population is White/Caucasian (64%) and about 18% of the population is Hispanic or Latino. Twenty percent (20%) identify as Asian. Over 18% of the population speaks a language other than English at home, and 7% of the total population speaks English less than "very well".

The poverty rate is 4% (3% of children under 18, 5% for people 65 and older), 4% do not have health insurance, and 47% of renters pay more than 30% of their household income on rent (31% for owners). About 49% of the population has a bachelor's degree or higher (5% do not have a high school degree). Approximately 14% of the population lives with a disability (41% of population 65 and older), and 35% are

either below 15 (24%) or over 65 (11%) years of age. About 9% of the population are 65 or older and living alone and 17% are single parents.

Over the last several years, the City of Happy Valley has annexed more than 1,000 acres of land that had been primarily in the western portion of the former Damascus area. New development has complied with the standards of the Oregon Building Code and the city's development code.

The City includes a diversity of land uses but is zoned primarily residential. About 87% of housing units are single-family, 13% are multifamily, and 1% are mobile homes. Less than one-tenth of homes (9%) were built before 1970 and 81% were built after 1990. Newer homes are more likely to be built to current seismic, flood, wildfire, and other hazard standards. Almost two-thirds (83%) of housing units are owner occupied, 14% are renter occupied, less than 1% are seasonal homes, and 3% are vacant.

Transportation and Infrastructure

Happy Valley is roughly 6 miles from Portland. Its proximity has made it a desirable place for commercial and industrial development. Happy Valley's Commercial areas are located near the primary routes of SE Sunnyside Road (provides access to Highway 205), SE 172nd Avenue, and Highway 212. Residential development is located nearby commercial areas, with most residential areas located in the northern part of the City.

Motor vehicles represent the dominant mode of travel through and within Happy Valley. Twenty-three percent (8%) of renters and 2% of owners do not have a vehicle. Most workers drive alone to work (74%); 5% carpool, 3% use public transit, 1% either walk or use a bicycle, and 14% work at home. The City's public transit is provided by TriMet, which, subject to a 2022 Revised Service Concept "Forward Together", operates four bus routes and one light rail transit line to serve the greater Happy Valley area.

Happy Valley does not have any industrial rail access. The Metro Regional Freight Plan identifies Highway 212 as a main roadway route and 172nd Avenue as a road connector for freight and commercial truck movement throughout the region. A multi-lane highway is proposed along the Highway 212/224 corridor to accommodate expected population growth.

Economy

Happy Valley's proximity to major transportation routes and access to rail has made it a desirable place for commercial and industrial development. Happy Valley's commercial sites are made accessible through Highways 205 and 224. Happy Valley is predominately residentially zoned, but also has commercial and campus industrial areas. The Urban and Rural Strategic Investment Zone provides 15-year property tax abatements on facilities and equipment to industries such as production, high tech, and manufacturing.

About 50% of the resident population 16 and over is in the labor force (11,741people) and are employed in a variety of occupations including professional (29%), management, business, and financial (24%), sales (12%), office and administration (9%), and construction, extraction, and maintenance (5%) occupations.

Happy Valley has an economic advantage due to its location at the north end of the Willamette Valley and its proximity to Portland. A significant portion of the land available for industrial development in Clackamas County is in the Happy Valley area. There are currently new expansions in existing industries currently underway with available industrial land in the Industrial Parks.[3]

[3] Economic Development (2019). City of Happy Valley. https://www.cityofHappy Valley.com/ed

Most workers residing in the city (97%, 10,452 people) travel outside of the city for work primarily to Portland and surrounding areas.[4] A significant population of people travel to the city for work, (92% of the workforce, 4,402 people) primarily from Portland and surrounding areas.[5]

[4] U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (2002-2020). Longitudinal-Employer Household Dynamics Program, accessed on August 17, 2023 at https://onthemap.ces.census.gov.

[5] Ibid.

Table HV-3 Community Characteristics

Population Characteristics		Population Growth
2016 Population Estimate	18,680	
2022 Population Estimate	26,689	43%
2045 Population Forecast*	57,362	115%
Race		
American Indian and Alaska Native		< 1%
Asian		20%
Black/ African American		1%
Native Hawaiian and Other Pacific Islander		< 1%
White		64%
Some Other Race		2%
Two or More Races		7%
Hispanic or Latino/a (of any race)		18%
Limited or No English Spoken	1,559	7%
Vulnerable Age Groups		
Less than 5 Years	975	4%
Less than 15 Years	5,286	23%
65 Years and Older	3,166	14%
85 Years and Older	549	2%
Age Dependency Ratio		0.56
Disability Status (Percent age cohort)		
Total Disabled Population	1,515	6%
Children (Under 18)	98	1%
Working Age (18 to 64)	565	4%
Seniors (65 and older)	852	27%

Household Characteristics		
Housing Units		
Single-Family (includes duplexes)	6,632	87%
Multi-Family	965	13%
Mobile Homes (includes RV, Van, etc.)	65	1%
Household Type		
Family Household	5,978	80%
Married couple (w/ children)	2,435	33%
Single (w/ children)	768	10%
Living Alone 65+	412	6%
Year Structure Built		
Pre-1970	699	9%
1970-1989	765	10%
1990-2009	3,804	50%
2010 or later	2,394	31%
Housing Tenure and Vacancy		
Owner-occupied	6,334	83%
Renter-occupied	1,098	14%
Seasonal	17	< 1%
Vacant	213	3%
Vehicles Available (Occupied Units)		
No Vehicle (owner occupied)	139	2%
Two+ vehicles (owner occupied)	5,270	83%
No Vehicle (renter occupied)	91	8%
Two+ vehicles (renter occupied)	444	40%

Income Characteristics		
Households by Income Category		
Less than $15,000	256	3%
$15,000-$29,999	290	4%
$30,000-$44,999	540	7%
$45,000-$59,999	312	4%
$60,000-$74,999	608	8%
$75,000-$99,999	766	10%
$100,000-$199,999	2,809	38%
$200,000 or more	1,851	25%
Median Household Income		$131,980
Gini Index of Income Inequality		0.42
Poverty Rates (Percent age cohort)		
Total Population	925	4%
Children (Under 18)	185	3%
Working Age (18 to 64)	585	4%
Seniors (65 and older)	155	5%
Housing Cost Burden (Cost > 30% of household income)		
Owners with a Mortgage	1,407	31%
Owners without a Mortgage	351	19%
Renters	518	47%

Employment Characteristics		
Labor Force (Population 16+)		
In labor Force (% Total Population)	11,741	50%
Unemployed (% Labor Force)	316	3%
Occupation (Top 5) (Employed 16+)		
Professional & Related	3,420	29%
Management, Business, & Financial	2,795	24%
Sales & Related	1,354	12%
Office & Administrative	1,089	9%
Construction, Extraction, & Maint.	631	5%
Health Insurance		
No Health Insurance	1,008	4%
Public Health Insurance	5,081	22%
Private Health Insurance	19,232	82%
Transportation to Work (Workers 16+)		
Drove Alone	8,552	74%
Carpooled	610	5%
Public Transit	341	3%
Motorcycle	0	0%
Bicycle/Walk	158	1%
Work at Home	1,632	14%

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

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

Community Lifelines

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

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

Critical Facilities

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

Table HV-4 Critical Facilities in Happy Valley

Critical Facilities by Community	Flood 1% Annual Chance 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
Academy for Kids	-	-	-	-	-
Beatrice Morrow Cannady Elementary	-	-	-	-	-
Clackamas Fire District #1 - Station 5	-	X	-	-	-
Clackamas Fire District #1 - Station 6	-	X	-	-	-
Clackamas Fire District #1 - Station 7	-	X	-	-	-
Clackamas Fire District #1 - Station 8	-	X	-	-	-
Clackamas Fire District #1 - Training Center	-	-	-	-	-
Happy Valley City Hall/Emergency Operations Center	-	-	-	-	-
Happy Valley Middle School	-	X	-	-	-
Happy Valley Police Department	-	-	-	-	-
Public Works Complex					
Providence Medical Group - Happy Valley	-	X	-	-	-
Rock Creek Middle School	-	X	-	-	-
Scouters Mountain Elementary	-	X	-	-	-
Spring Mountain Elementary School	-	-	-	-	-
Sunnyside Montessori House	-	-	-	-	-
The Goddard School - Clackamas	-	-	-	-	-
Valley View Day School	-	X	-	-	-
Verne A. Duncan Elementary	-	X	-	-	-

Source: DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-20.
Highlighted cells are tentative and to be confirmed by DOGAMI in their Final Report (expected April 2024)

Additional Critical Facilities not included in the DOGAMI Risk Report:

Possible Shelters:

- Abundant Life Church
- Ashley Meadows Park
- Church of Jesus Christ of Latter-Day Saints
- Ella V. Osterman
- Fire Training Center (Pleasant Valley Golf Course)
- Happy Valley Park
- Hidden Falls Nature Park
- Hood View Park
- Happy Valley Library
- Mount Talbert Nature Park
- Southern Lights Park

Hospitals:

- Happy Valley Urgent Care
- Columbia Clinic
- Kiser Hospital
- Oregon Pediatrics
- Providence Immediate Care
- Willamette Hospital

Critical Infrastructure

Infrastructure that provides necessary services for emergency response include:

Arterials

*designates road maintained by others

- 132nd Avenue
- 152nd/147th/145th Avenues
- 162nd Avenue
- 172nd Avenue
- Carver Road/Hwy 212*
- Clatsop Street
- Foster Road
- Hwy 224*
- Idleman Road
- King Road
- Ridge Crest Road
- 122nd/129th Avenues
- Mount Scott Blvd
- Sunnyside Road

Bridges

- 152nd and Sunnyside Road
- Hwy 212

Other Critical Infrastructure

- Gas lines
- Radio/cell phone towers
- Sunrise Water Authority
- Telephone lines
- Water and sanitary sewer pump stations
- Water reservoirs

Essential Facilities

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

Schools

- Cannady Elementary School
- Happy Valley Elementary/Middle School
- Rock Creek Middle School
- Scouters Mountain Elementary
- Spring Mountain Elementary
- Verne A. Duncan Elementary
- Happy Valley Grange
- South Happy Valley

Churches

- Emmanuel Community Church
- Happy Valley Baptist Church
- Happy Valley Evangelical Church
- New Hope Community Church
- Sunnyside Foursquare Church

Environmental Facilities

Environmental assets are those parks, green spaces, wetlands, and rivers that provide an aesthetic and functional ecosystem service for the community include: Clackamas River waterfront property, Eagle Landing Golf Course, Happy Valley Park, Happy Valley Wetland Park, Hidden Falls Park, Mitchell Creek, Mount Scott Park, Mt. Talbert, Pleasant Valley Neighborhood Park, Rebstock Park, Rock Creek, Scouters Mountain and adjacent green space.

Vulnerable Populations

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

Memory Care & Assisted Living Facilities

- Happy Valley Adult Care Home
- Sunnyside Meadows Memory Care
- Monterey Court Memory
- Miracle Heights
- Morning Star Assisted Living
- Peaceful Care House
- Glenmore Gracious Retirement Living
- The Springs at Happy Valley
- Graceful Living Adult Care Home

Child Care Centers in Happy Valley/Clackamas

- Happy Valley Preschool and Childcare
- Happy Valley Childs Kingdom
- Therese's Childcare
- Clackamas Day School
- Sunnyside KinderCare
- Cadence Academy Preschool
- Valley View Day school

Other Vulnerable Populations

- Carver Mobile Home Park
- Day Spring Mobile Home Park
- Happy Valley Mobile Manor

Hazardous Materials

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

type of critical facility. Those sites that store, manufacture, or use potentially hazardous materials include: Camp Withycombe, Davis Trucking, and Fred Meyer Fuel.

Economic Assets/Population Centers

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

Economic Centers

- Community of Carver
- Davis Trucking
- Downtown Damascus
- East and West Happy Valley Crossroads
- Happy Valley Town Center
- Industrial properties on Hwy 212
- Sunnyside Village
- Sunnyside Village Plaza

Cultural and Historic Assets

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

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

- Pete French Round Barn

Hazard Characteristics

Drought

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

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

The Sunrise Water Authority distributes water to the City of Happy Valley through 200 miles of pipe from the Clackamas River Water and North Clackamas County Water Commission treatment plants on the Clackamas River. The water is pumped to thirteen different reservoirs scattered throughout the service territory at varying elevations. The system is a gravity fed system. Water is also extracted from wells located in the unincorporated community of Damascus during periods of peak water use and in case of drought conditions.

Vulnerability Assessment

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

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[6] drought, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is projected to become more frequent in Clackamas County by the 2050s.

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

Earthquake (Cascadia Subduction Zone)

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

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

Within the Northern Willamette Valley/Portland Metro Region, three potential faults and/or zones can generate high-magnitude earthquakes. These include the Cascadia Subduction Zone, Gales Creek-Newberg-Mt Angel Structural Zone, Portland Hills Fault Zone, and the Canby-Molalla Fault Zone (discussed in the crustal earthquake section).

Figure HV-2 displays relative shaking hazards from a Cascadia Subduction Zone earthquake event. As shown in the figure, most of the city is expected to experience very strong shaking (orange), while areas around the city will experience severe shaking (light red) (shown by the red northeast corner) in a CSZ event.

Cascadia Subduction Zone

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in approximately 1700 A.D.[7]

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

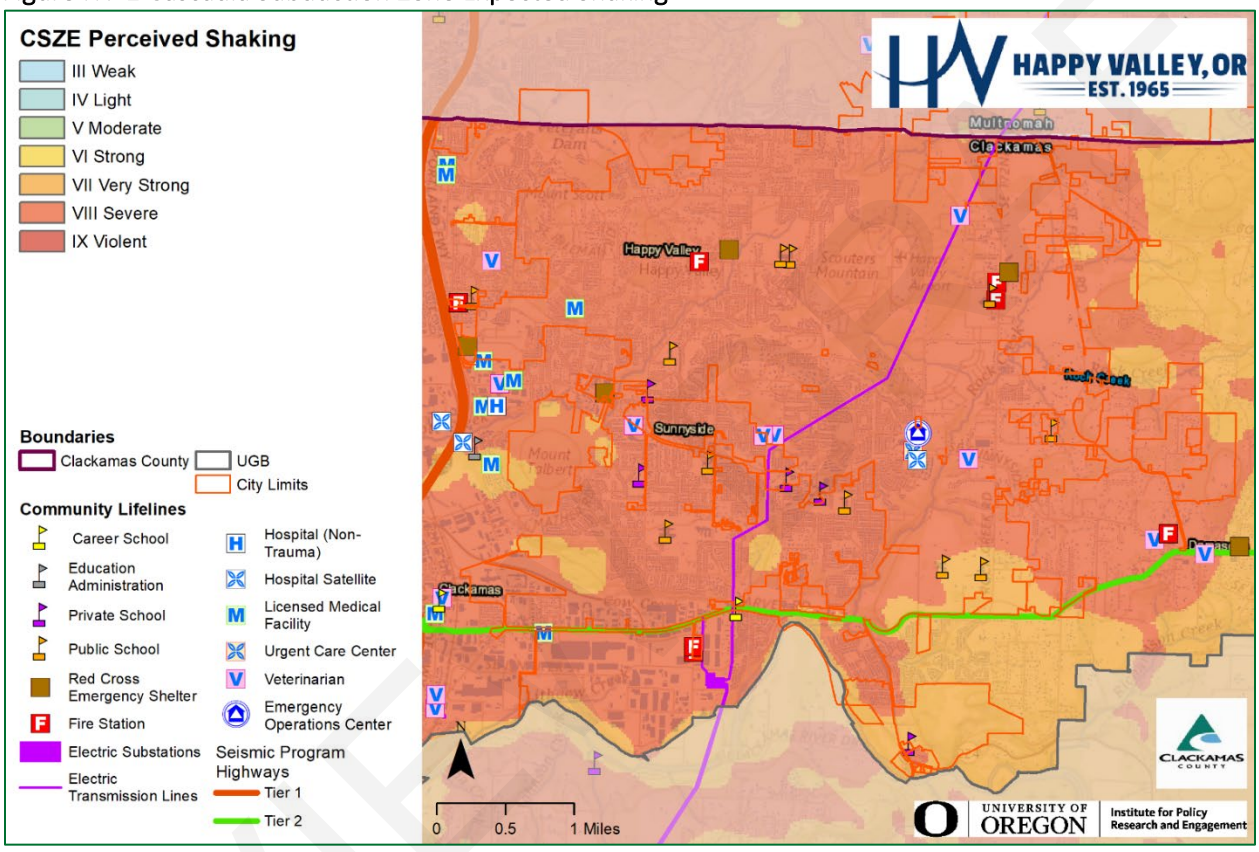
[6] Oregon Climate Change Research Institute, *Future Climate Projections, Clackamas County, Oregon*. February 2023.

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

and shaking is expected to be strong and widespread - an event will be disruptive to daily life and commerce and the main priority is expected to be restoring services to business and residents.

The majority of Happy Valley is located within the strong to very strong zone for expected earthquake shaking. An area of concern is located outside the City limits along Highway 205, which has an area of violent expected shaking. The destruction of Highway 205 could impede post disaster assistance to the City.

Figure HV-2 Cascadia Subduction Zone Expected Shaking



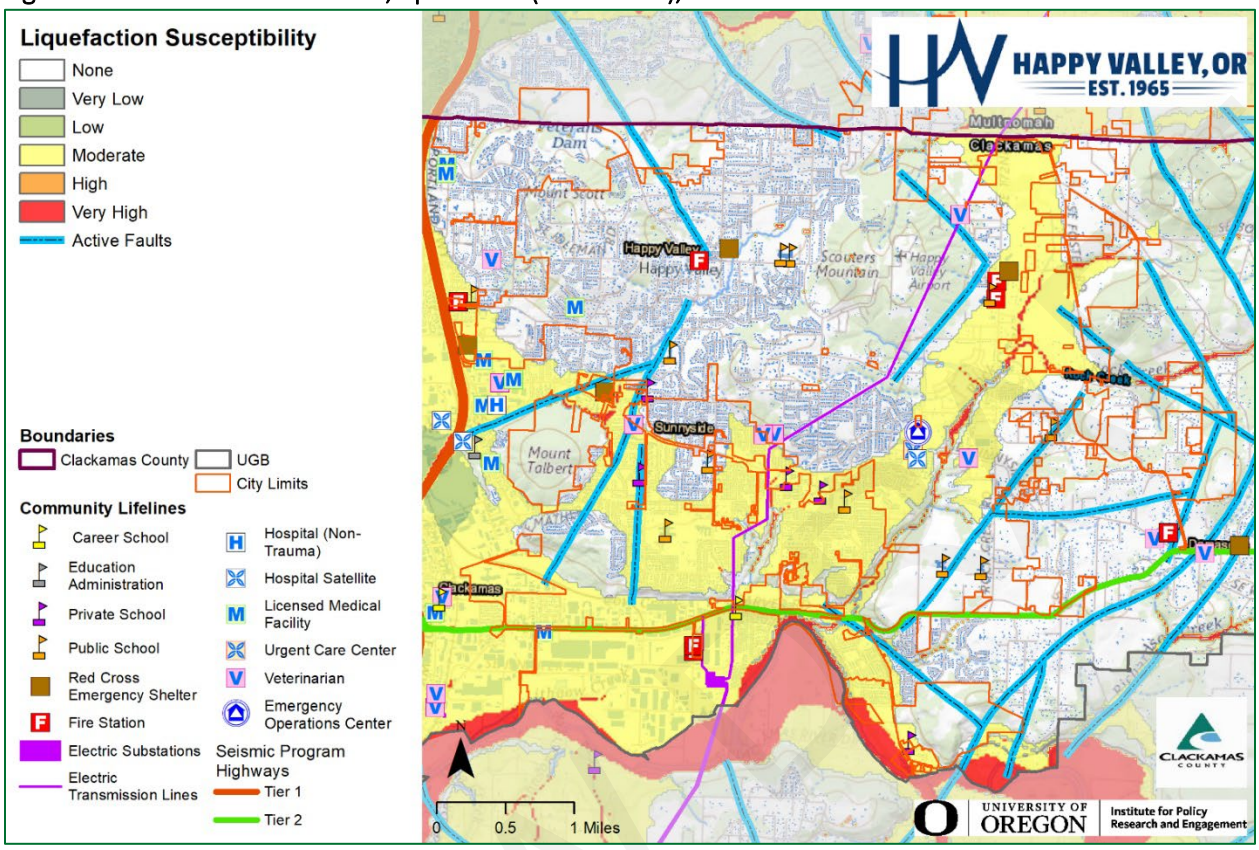
Source: Map created by Oregon Partnership for Disaster Resilience.
Data: Oregon Department of Geology and Mineral Industries. Preparedness Framework Implementation Team (IRIS v3).
Note: To view hazard detail click this link to access Oregon HazVu

Earthquake (Crustal)

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

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

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



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

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

There are several potential crustal faults and/or zones to the west of the City that can generate high-magnitude earthquakes. Among them are the Damascus-Tickle Creek Fault Zone (shown in Figure HA-3) and the Portland Hills Fault Zone about five (5) miles west of Happy Valley. Other nearby faults include the Oatfield faults which run to the west of the Portland Hills Fault Zone. While there are no reported recent earthquakes within Happy Valley limits, historical records count over 56 earthquakes in the Portland-metro area. The more severe ones occurred in 1877, 1880, 1953 and 1962. The most recent severe earthquake was the March 25, 1993 Scotts Mills quake. It was a 5.6 magnitude quake with aftershocks continuing at least through April 8.

Damascus-Tickle Creek Fault Zone

The Damascus-Tickle Creek Fault zone consists of numerous short northeast- and northwest-trending faults that form a broad, northeast-trending fault zone. The area is on the southern margin of the Portland basin and the faults fold and offset rocks of the Pliocene formation. The length of these faults is 16 km and some fault strands may have controlled the locations of eruptive vents. The fault zone is located approximately seven (7) miles from Portland and runs underneath the City of Happy Valley.

Portland Hills Fault Zone

The Portland Hills Fault Zone is a series of NW-trending faults that vertically displace the Columbia River Basalt by 1,130 feet and appear to control thickness changes in late Pleistocene (approx. 780,000 years ago) sediment. The fault zone extends along the eastern margin of the Portland Hills for 25 miles and lies about 5 miles west of Happy Valley.

Vulnerability Assessment

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

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

Table HV-5 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Cannady Elementary** (18031 SE Vogel Road)	-	2007 RVS report did not include structural appendix for this facility; built 2019.			
Duncan Elementary (14898 SE Parklane Drive)	-	2007 RVS report did not include structural appendix for this facility; built 2009.			
Mount Scott Elementary* (11201 SE Stevens Road)	Clac_sch70	X,X			
Oregon Trail Elementary* (13895 SE 152 Drive)	Clac_sch75		X		
Scouters Mountain Elementary (10811 SE 172nd Ave)	-	2007 RVS report did not include structural appendix for this facility.			
Sunnyside Elementary* (13401 SE 132nd Avenue) See Mitigation Successes	Clac_sch22	X	X, X, X		
Spring Mountain Elementary (11645 SE Masa Lane)	Clac_sch80	X			
Happy Valley Elementary (13865 SE King Road)	Clac_sch18		X, X, X		
Rock Creek Middle (14897 SE Parklane Drive)	-	2007 RVS report did not include structural appendix for this facility.			

Facility	Site ID*	Level of Collapse Potential			
		Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Clackamas High* (14489 SE 122nd Avenue)	*Clac_sch27*	X			
Clackamas High – East Campus* (14331 SE 132nd Avenue)	Clac_sch25	X			
Fire Facilities					
Station 5 – Mt Scott (9339 SE Causey Ave)	Clac_fir21	X			
Station 6 – Happy Valley (12901 SE King Road)	Clac_fir23	X			
Station 7 – Pleasant Valley (10921 SE 172nd)	Clac_fir07	X			
Station 8 – Clackamas (15990, 16100 SE 130th Avenue)	Clac_fir06	X			

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

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

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

Earthquake Regional Impact Analysis

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

The Portland Hills fault scenario created greater damages than the Cascade Subduction Zone scenario due primarily to its placement relative to population centers and regional assets; however, at distances

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

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

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

	Cascadia Subduction Zone (M9.0)		Portland Hills Fault (M6.8)	
	"Dry" Soil	"Wet" Saturated Soil	"Dry" Soil	"Wet" Saturated Soil
Number of Buildings	5,856	5,856	5,856	5,856
Building Value ($ Million)	2,692	2,692	2,692	2,692
Building Repair Cost ($ Million)	59	75	243	318
Building Loss Ratio	2%	3%	9%	12%
Debris (Thousands of Tons)	28	32	79	100
Long-Term Displaced Population	8	89	118	552
Total Casualties (Daytime)	41	50	179	217
Level 4 (Killed)	2	2	10	13
Total Casualties (NIghttime)	5	11	30	65
Level 4 (Killed)	0	0	1	2

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

Cascadia Subduction Zone Scenario

The City of Happy Valley is expected to have a 2% building loss ratio with a repair cost of $59 million under the CSZ "dry" scenario, and a 3% building loss ratio with a repair cost of $75 million under the CSZ "wet" scenario.[10] The city is expected to have around 41 daytime or 5 nighttime casualties during the CSZ "dry" scenario and 50 daytime or 11 nighttime casualties during the CSZ "wet" scenario. It is expected that there will be a long-term displaced population of around 8 for the CSZ "dry" scenario and 89 for the CSZ "wet" scenario.[11] (See Risk Report content for additional information.)

Portland Hills Fault Scenario

The City of Happy Valley is expected to have a 9% building loss ratio with a repair cost of $243 million under the CSZ "dry" scenario, and a 12% building loss ratio with a repair cost of $318 million under the CSZ "wet" scenario.[12] The long-term displaced population and casualties are greatly increased for all the Portland Hills Fault scenarios. The city is expected to have around 179 daytime or 30 nighttime casualties during the Portland Hills Fault "dry" scenario and 217 daytime or 65 nighttime casualties during the Portland Hills Fault "wet" scenario. It is expected that there will be a long-term displaced population of around 118 for the Portland Hills Fault "dry" scenario and 552 for the Portland Hills Fault "wet" scenario.[13]

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

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-xx)[8] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the earthquake hazard. According to the Risk Report the following population and property within the study area may be impacted by the profiled events:

Cascadia Subduction Zone event (M9.0 Deterministic)

327 buildings, and (10 critical facilities), are expected to be damaged for a total potential loss of $254 million (a loss ratio of 6.5%). About 396 residents may be displaced.

Crustal event (Canby-Molalla fault M6.8 Deterministic)

77 buildings are expected to be damaged (0 critical facilities), for a total potential loss of $53.4 million (a loss ratio of 1.4%). About 66 residents may be displaced (0.3% of population).

Future Projections

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

Flood

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

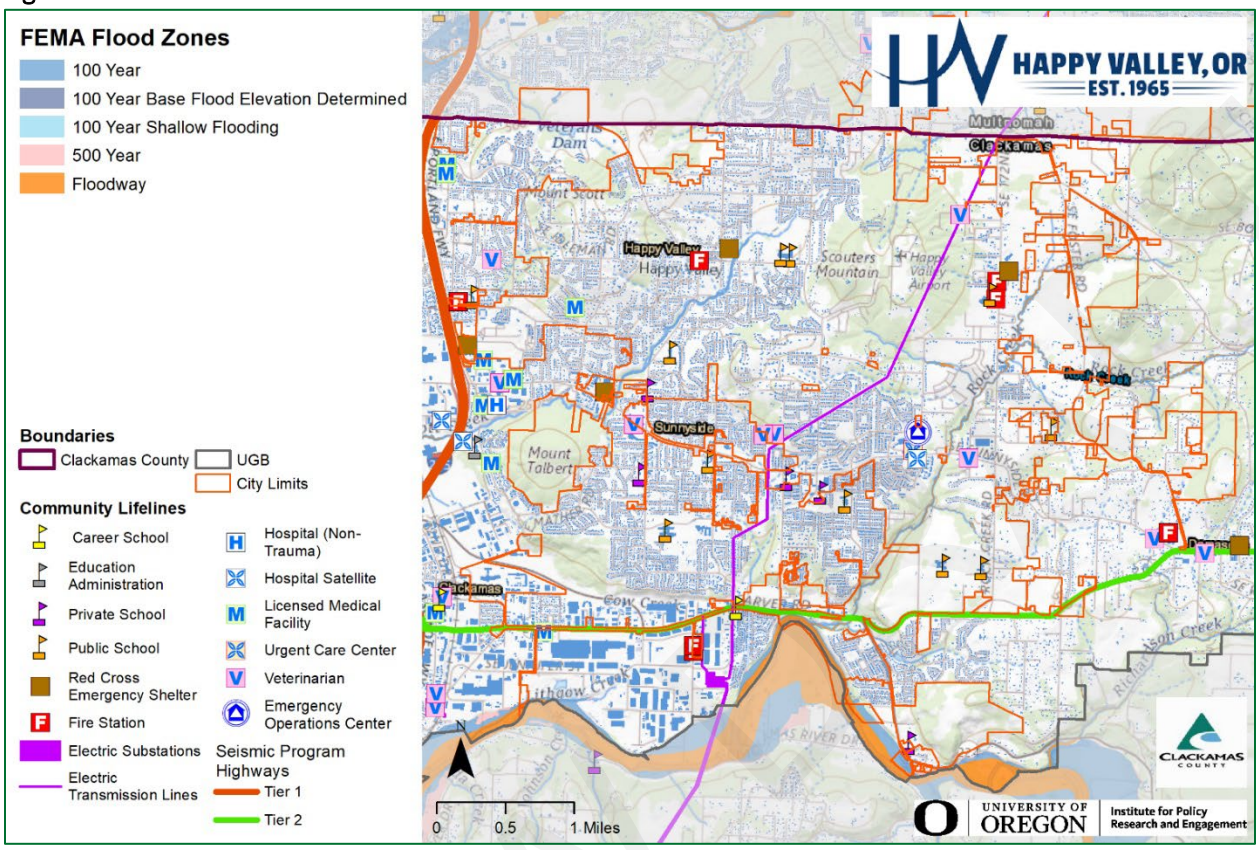
Volume I, Section 2 describes the characteristics of flood hazards, history, as well as the location, extent, and probability of a potential event. Figure HV-4 illustrates the flood hazard area for Happy Valley.

Portions of Happy Valley have areas of floodplain (special flood hazard areas, SFHA). These include the Mount Scott Creek, Rock Creek, and part of the Clackamas River. Though flooding occurs on the southern side of Clackamas River and Happy Valley is not affected. The geographic location of the flooding hazard was determined using the designated FEMA 100-year floodplain data, as well as the inundation line for the 1996 flood. There is potential flood impact along SE 192nd and SE 172nd Avenues, as well as near the newly annexed land along Carver Road (otherwise known as Highway 212/224).

Typically, roads are covered with water in urban flooding events, and water will occasionally overflow manholes in some parts of the city. Newer homes are built on higher ground to avoid flooding issues, and many older homes have pumps within their crawlspaces to avoid flood events.

[8] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-19.

Figure HV-4 FEMA Flood Zones



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

Vulnerability Assessment

Happy Valley has a Flood Management Overlay Zone that creates standards for building within the flood zone and does not allow net fill.

Floods can have a devastating impact on almost every aspect of the community, including private property damage, public infrastructure damage, and economic loss from business interruption. It is important for the City to be aware of flooding impacts and assess its level of risk.

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

For mitigation planning purposes, it is important to recognize that flood risk for a community is not limited only to areas of mapped floodplains. Other portions of Happy Valley outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage. Other portions of Happy Valley outside of the mapped floodplains may also be at relatively high risk from over bank flooding from streams too small to be mapped by FEMA or from local storm water drainage.

The extent of flooding hazards in Happy Valley primarily depends on climate and precipitation levels. Additionally, withdrawals for irrigation and drinking water, as well as stream and wetland modifications or

vegetation removal can influence water flow. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table HV-4.

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-xx)[9] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the flood hazard.

According to the Risk Report 40 building are expected to be damaged (0 critical facilities), for a total potential loss of $1.5 million (a loss ratio of < 1%). About 68 residents may be displaced (0.3% of population).

National Flood Insurance Program (NFIP)

FEMA's Flood Insurance Study (FIS), and Flood Insurance Rate Maps (FIRMs) are effective as of June 17, 2008. The City complies with the NFIP through enforcement of their flood damage prevention ordinance and their floodplain management program. Their flood prevention code section is based on the Oregon Model Flood Hazard Prevention code, which includes provisions addressing substantial improvement/substantial damage. The Community Repetitive Loss record does not identify and Repetitive Loss Properties [10] or Severe Repetitive Loss Properties[11].

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[12] winter flood risk at mid- to low elevations in Clackamas County, where temperatures are near freezing during winter and precipitation is a mix of rain and snow, is projected to increase as winter temperatures increase. The temperature increase will lead to an increase in the percentage of precipitation falling as rain rather than snow. The projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region. Vulnerable populations adjacent to floodways (including the unhoused, manufactured home communities, and campground occupants) will be more at risk as the winter flood risk increases.

Landslide

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

Volume I, Section 2 describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. While Happy Valley has a hilly terrain, there has only been a few landslides over the years. In 1996 a hillside in the Mt. Scott area slide into a homeowner's yard and continued past the home towards Foster Road with no injuries or severe damage sustained. In the Development Code, Chapter 16.32 deals with the

[9] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-19.

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

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

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

Steep Slopes Development Overlay Zone. The Overlay Zone limits the potential residential density and facilitates transferring the development away from slope constrained lands. This provides special protection on lands within "transition slope areas" and "conservation slope areas".

Although there have been few landslides to occur in Happy Valley, steep slopes that do exist include Scouters Mountain, The Reserve, Rock Creek, Mt. Scott, Mt. Talbert, and the area east of SW 145th Avenue.

Landslide susceptibility exposure for Happy Valley is shown in Figure HV-5. Most of Happy Valley demonstrates a moderate to high landslide susceptibility exposure. Approximately 16% of Happy Valley has very high or high, and approximately 49% moderate, landslide susceptibility exposure.[17]

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

Vulnerability Assessment

DOGAMI completed a statewide landslide susceptibility assessment in 2016 (O-16-02), general findings from that report are provided above and within Figure HV-5.

Potential landslide-related impacts are adequately described within Volume I, Section 2, and include infrastructure damages, economic impacts (due to isolation, and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides, and debris flows can potentially occur during any winter, and thoroughfares beyond City limits are susceptible to obstruction as well. For a list of facilities and infrastructure vulnerable to this hazard see the Community Assets Section and Table HV-5.

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

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-xx)[13] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the landslide hazard.

According to the Risk Report 428 buildings are exposed to the *high and very high landslide susceptibility* hazard (0 critical facilities) for a total exposure of $256 million (a building exposure ratio of 6.6%). About 1,901 residents may be displaced by landslides (a population exposure ratio of 7.3%).

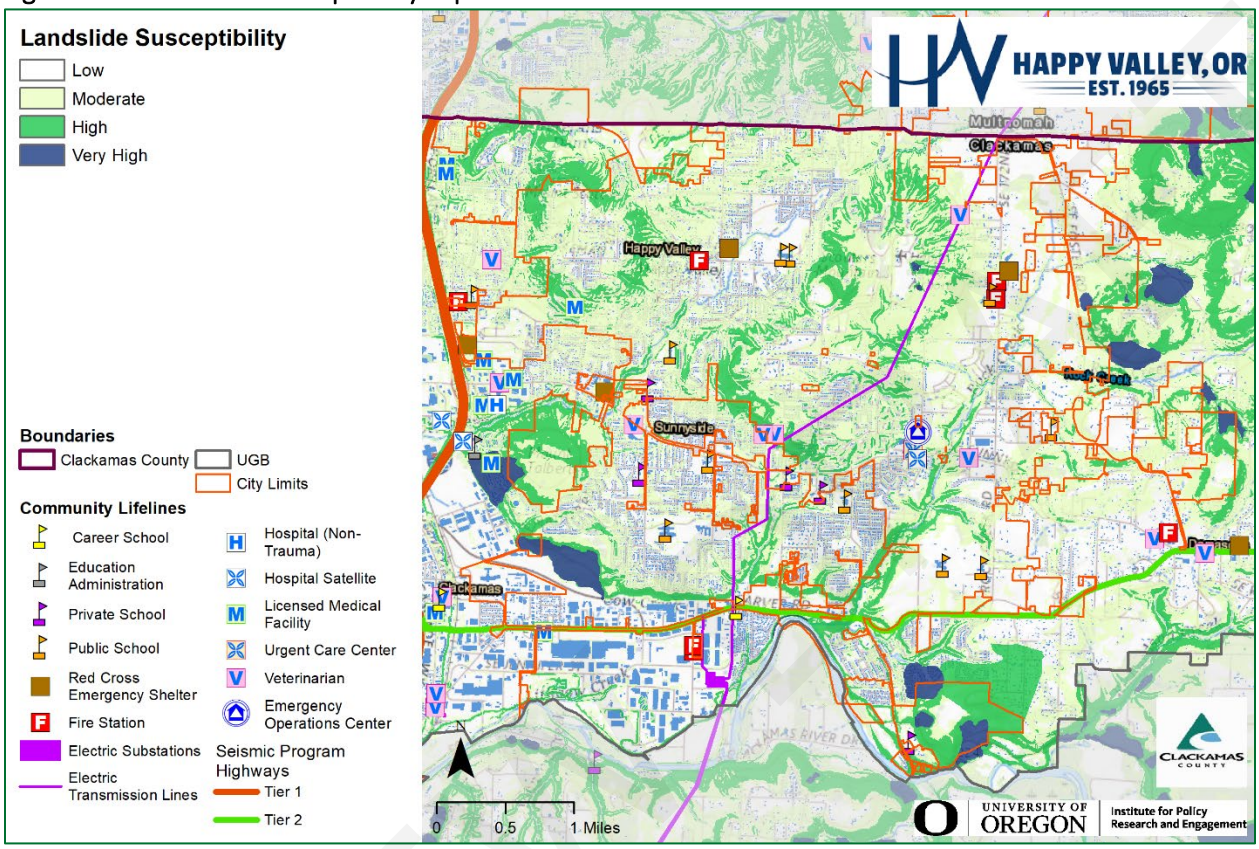
Future Projections

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

[13] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-19.

landslides. Future development along slopes or adjacent to riverbanks will be a greater risk of impact from this hazard.

Figure HV-5 Landslide Susceptibility Exposure



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

Severe Weather

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

Extreme Heat

The HMAC determined that the City's probability for extreme heat events is **moderate** and that their vulnerability is **moderate** *These ratings increased since the previous version of this NHMP.*

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

A severe heat episode or "heat wave" occurs about every two to three years, and typically lasting two to three days but can last as many as five days. A severe heat episode can be defined as consecutive days of upper 90s to around 100. Severe heat hazard in the Portland metro region can be described as the average number of days with temperatures greater than or equal to 90-degrees, or 100-degrees, Fahrenheit. On average the region experiences 13.6 days with temperatures above 90-degrees

Fahrenheit, and 1.4 days above 100-degrees Fahrenheit, based on new 30-year climate averages (1981-2010) from the National Weather Service – Portland Weather Forecast Office.

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

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[14] the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Clackamas County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 12 (range 3–21) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–11°F) by the 2050s. Higher temperatures and longer/more extreme heat events will have negative impacts upon vulnerable populations such as those over 65+, children, those living in older or temporary housing, and field workers.

Windstorm

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

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

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

In general, Happy Valley is more susceptible to windstorms than other communities in Clackamas County because the city is situated at a higher elevation and closer to the Columbia Gorge. Damage from high winds generally has resulted in downed utility lines, and trees usually limited to several localized areas. Electrical power can be out anywhere from a few hours to several days. Outdoor signs have also suffered damage. If the high winds are accompanied by rain (which they often are), blowing leaves, and debris clog drainage-ways, which in turn may cause localized urban flooding.

Future Projections

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

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

Winter Storm (Snow/Ice)

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

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

The biggest impact of winter storms is congestion on roadways. Due to the steeper slopes of some communities, freezing weather can cause steep roadways to become difficult to traverse. Most winter storms typically do not cause significant damage, they are frequent, and have the potential to impact economic activity. Road and rail closures due to winter weather are an uncommon occurrence but can interrupt commuter, and commercial traffic as noted above.

Vulnerability Assessment

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

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[15] cold extremes will become less frequent and intense as the climate warms. In Clackamas County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 6 (range -3– -8) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the coldest night of the year is projected to increase by an average of 6°F (range 0– 11°F) by the 2050s.

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

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

Volcanic Event

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

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

Volume I, Section 2 describes the characteristics of volcanic event hazards, history, as well as the location, extent, and probability of a potential event within the region. Volcanoes are located near Lake Oswego, the closest of which are Mount Hood, Mount Adams, Mount Saint Helens, Mount Rainier, and the Three Sisters.

Vulnerability Assessment

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

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-xx)[16] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the volcanic event (lahar) hazard. The Risk Report did not identify population or property within the study area that may be impacted by the profiled volcanic event (lahar) hazard.

Future Projections

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

Wildfire

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

The Clackamas County Community Wildfire Protection Plan (CWPP) is hereby incorporated into this NHMP addendum by reference, and it will serve as the wildfire section for this addendum. The following presents a summary of key information; refer to the full CWPP for a complete description, and evaluation of the wildfire hazard. Information specific to Happy Valley is found in the following chapters: Chapter 9.3: Clackamas Fire District #1.

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

Weather, and urbanization conditions are primarily at cause for the hazard level. Happy Valley has not experienced a wildfire within City limits, but the city has abundant wooded areas that are a concern in the case of a wildfire event. Figure HV-6 shows overall wildfire risk in Happy Valley.

Clackamas County has two major physiographic regions: the Willamette River Valley in western Clackamas County and the Cascade Range Mountains in eastern and southern Clackamas County. The Willamette River Valley, which includes Happy Valley, is the most heavily populated portion of the county and is characterized by flat or gently hilly topography. The Cascade Range has a relatively small population and is characterized by heavily forested slopes. Eastern Clackamas County is at higher risk to wildfire than

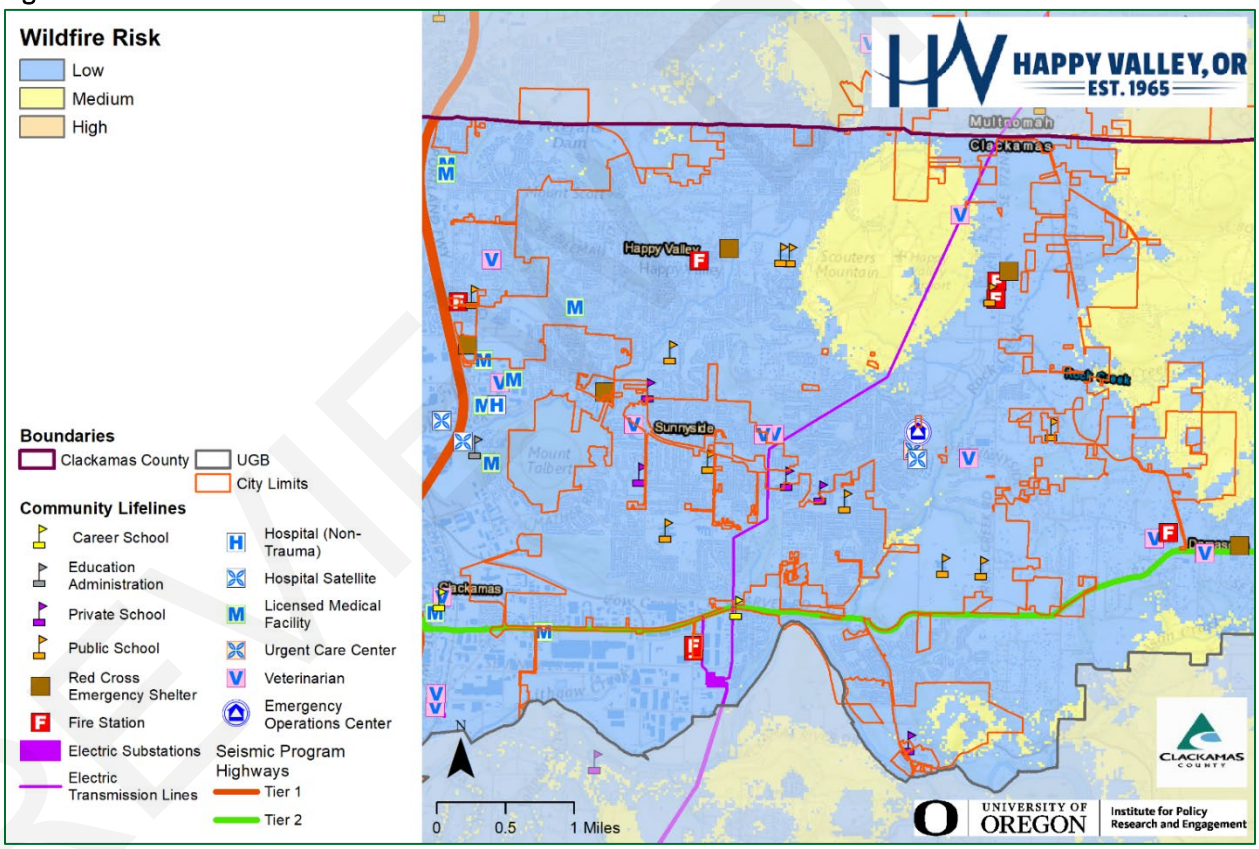
[16] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-23.

western portions of the county due to its dense forest land. Human caused fires are responsible for most fires in Clackamas County. In Happy Valley most instances of fire have been started by human activity, but the fires have been small enough to contain quickly and easily.

The forested hills within and surrounding Happy Valley that are interface areas include Mount Talbert, Scouter Mountain, Happy Valley Nature Trail, and the Highway 224 corridor. Scouters Mountain has a series of natural areas adjacent to homes and infrastructure, while Mount Talbert Nature Park has medium to high density residential development. Mount Talbert Nature Park has steep slopes and transient camps, which makes the area highly vulnerable to fire. High Priority Communities at Risk (CARs) within and around the city include: Mt. Talbert (high) and Scouters Mountain (high), which have been identified by the CFD #1 as important areas for fuel reduction projects.[18]

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four-feet under normal weather conditions.[19] However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts.

Figure HV-6 Wildfire Risk



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

Happy Valley is surrounded mostly by farmlands which creates a buffer from the forested areas. There are some areas of heavy tree coverage in the northeast and southern portions of the City. Identified High

and Medium Priority Communities at Risk (CARs) are all located outside of the City limits.[17] Wildfires are not a frequent occurrence within the city, but regional wildfires occasionally introduce pollutants within the city. Happy Valley sits in the bottom of a valley, and pollution from regional fires settles in the area, causing health concerns for residents.

Most of the city has less severe (moderate or less) wildfire burn probability that includes expected flame lengths less than four feet under normal weather conditions.[18] However, conditions vary widely and with local topography, fuels, and local weather (including wind) conditions. Under warm, dry, windy, and drought conditions expect higher likelihood of fire starts, higher intensity, more ember activity, and a more difficult to control wildfire that will include more fire effects and impacts. The city has completed 126 wildfire impact assessments on 100 properties over the last five years.

Vulnerability Assessment

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

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

Natural Hazard Risk Report for Clackamas County

The Risk Report (DOGAMI, O-24-xx)[19] provides hazard analysis summary tables that identify populations and property countywide that are vulnerable to the wildfire hazard.

According to the Risk Report 188 buildings are exposed to the *high and (or) moderate (medium) risk wildfire* hazard (no critical faclities) for a total exposure of $76.5 million replacement value (a building replacement value exposure ratio of 1.9%). About 603 residents may be displaced by wildfires (a population exposure ratio of 2.3%).

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Clackamas County,"[20] wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Clackamas County by 14 (range -6– 34) by the 2050s, relative to the historical baseline (1971–2000), under the higher emissions scenario. Similarly, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 29 (range 10–44) by the 2050s. Communities at risk to wildfire include those within the urban wildfire interface or along river or creek corridors, where fire can travel quickly. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

[17] Clackamas County Community Wildfire Protection Plan, *Happy Valley Fire Department* (2018), Table 10.13-1.

[18] Oregon Wildfire Risk Explorer, date accessed November 9, 2018.

[19] DOGAMI, *Multi-Hazard Risk Report for Clackamas County, Oregon* (O-24-XX, September 2023 Draft), Table A-19.

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

Attachment A: Action Item Changes

Table HV-8 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. All actions marked not complete are ongoing, are still relevant, and are included in the updated action plan (Table HV-1).

Previous NHMP Actions that are Complete:
Flood #3, "Maintain and implement surface water management plan."

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

Multi-Hazard #3, "Identify and pursue funding opportunities to develop and implement hazard mitigation activities." This is part of the existing NHMP implementation process.

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

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard #1	#1	Not Complete	Yes
Multi-Hazard #2	#2	Not Complete	Yes
Multi-Hazard #3	-	Not Complete	No
Multi-Hazard #4	#3	Not Complete, revised	Yes
Earthquake #1	#4	Not Complete, revised	Yes
-	#5	New	-
Flood #1	#6	Not Complete	Yes
Flood #2	#7	Not Complete, revised	Yes
Flood #3	-	Complete	No
Severe Weather #1	#8	Not Complete	Yes
-	#9	New	-
Volcanic Event #1	-	Not Complete	No
Wildfire #1	#10	Not Complete, revised	Yes
Wildfire #2	#11	Not Complete, revised	Yes
Wildfire #3	#12	Not Complete	Yes

Attachment B: Public Involvement Summary

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

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

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

Website Posting

To be provided

HMAC

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

Meeting #1 and #2: March 9 and May 24, 2023

During these meetings, the HMAC:

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

Meeting #2: December 14, 2023 (via remote conference)

During this meeting, the HMAC:

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