MULTNOMAH COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

2023 Revision

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ACKNOWLEDGMENTS AND PLAN NOTES

Thanks to all those who contributed to the development of the plan, especially the Steering Committee members and others who provided content. These contributors are named in Chapter 4. A special thanks to Anna Bergman of Multnomah County Emergency Management for copy editing the plan.

This plan describes natural disasters that have occurred in this area over thousands of years. Descriptions of natural hazard events include recounting of severe damage and loss of life, and in some cases include photos. Vulnerability analysis of future events may include predictions of major injury or death. Understanding risk is an important purpose of this plan, and while care has been taken to not sensationalize descriptions and images in a way that may be traumatizing, readers of the plan should be aware that these events are recounted.

People living in this area, both before and since the establishment of Multnomah County, have lived through many severe natural hazard events. This plan is dedicated to all of those residents, and to memorialize those who have lost their lives in disasters. While natural disaster risk cannot be eliminated, it is hoped that the efforts of those who contributed to this plan will reduce future loss of life and help foster more equitably resilient communities.

U.S. Department of Homeland Security
FEMA Region 10
130 228th Street, SW
Bothell, WA 98021-9796

FEMA

August 24, 2023

Ms. Anna Feigum
State Hazard Mitigation Officer
Oregon Military Department
Office of Emergency Management
P.O. Box 14370
Salem, Oregon 97309

Dear Ms. Feigum:

The Federal Emergency Management Agency (FEMA) Region 10 completed a pre-adoption review of the draft Multnomah County Hazard Mitigation Plan. The attached Mitigation Plan Review Tool documents the Region's review and compliance with all required elements of 44 CFR Part 201.6, as well as identifies the jurisdictions participating in the planning process. This letter serves as Region 10's commitment to approve the plan upon receiving documentation of its adoption by participating jurisdictions.

Formal adoption documentation must be submitted to FEMA Region 10 by at least one jurisdiction within one calendar year of the date of this letter, or the entire plan must be updated and resubmitted for review. Once FEMA approves the plan, the jurisdictions are eligible to apply for FEMA Hazard Mitigation Assistance grants.

Please contact Erin Cooper, Regional Mitigation Planning Program Manager, at 202- 856-1927 or erin.cooper@fema.dhs.gov with any questions.

Sincerely,

Wendy Shaw, P.E.
Risk Analysis Branch Chief
Mitigation Division

Enclosures

WS:v1

Chapter 1 - Introduction

Local hazard mitigation planning is the foundation of a long-term strategy to reduce losses from severe natural disasters and break cycles of repeated effects from natural disasters. This plan creates a framework for risk-based decision-making to reduce future loss of life and impacts to people, property, natural systems and the economy.

1.1 What is Hazard Mitigation?

Hazard mitigation is any *sustainable* action that reduces or eliminates long-term risk from *future* disasters[1]. Mitigation is taking action now to reduce the severity of those predictable future events. Acting on mitigation strategies over time is the best way to ensure that communities will be physically, socially, and economically resilient to future natural disasters.

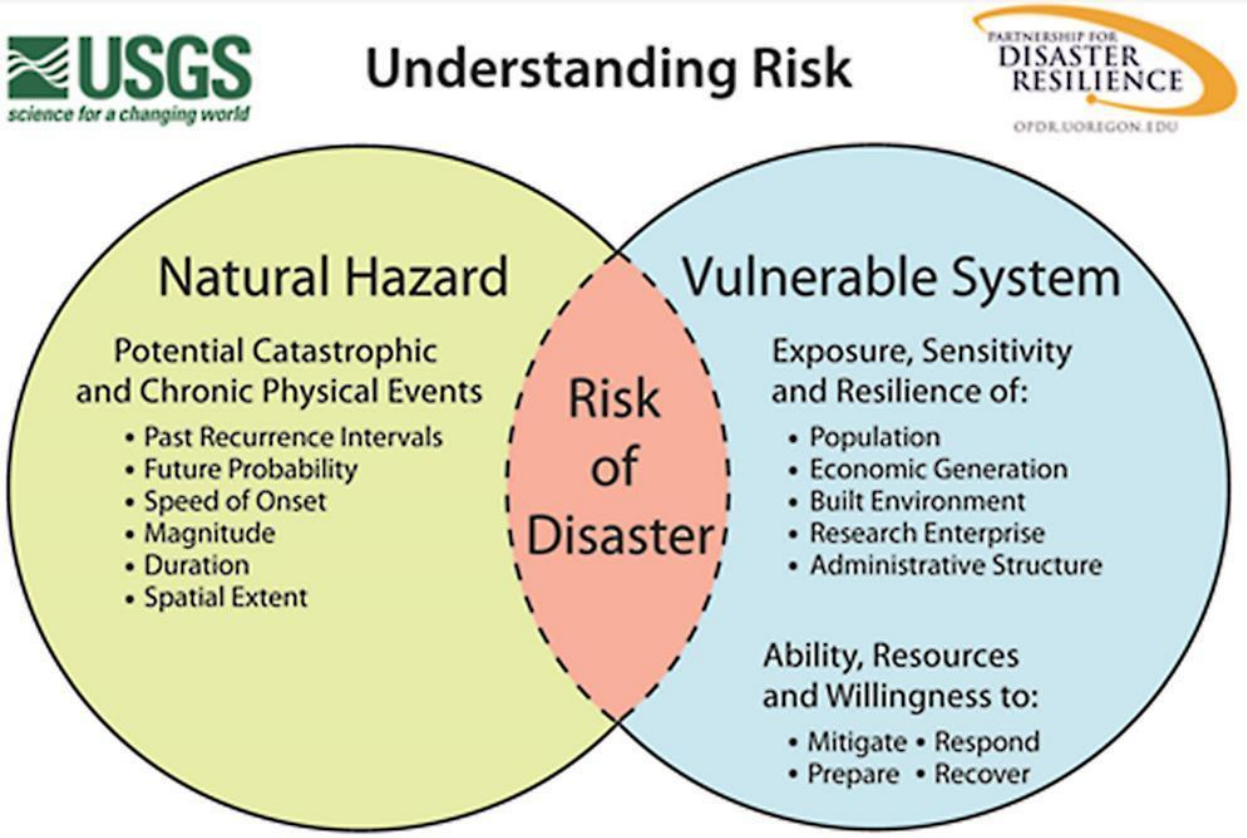

Figure 1 Natural hazard risk exists where there is an intersection between where hazards occur and who and what is located in those places. Diagram from the Oregon Partnership for Disaster Resilience and United States Geological Survey.

[1] FEMA, Hazard Mitigation Assistance Grants

What sets mitigation apart from preparedness, recovery, and response in the Federal Emergency Management Agency (FEMA) disaster cycle is the focus on starting and completing actions *before* something happens. Mitigation actions are designed to reduce future harm and response needs, instead of simply being reactive to events.

This approach saves money—on average six dollars saved for every dollar spent[2] according to FEMA research—and keeps people safer. Preparedness and response plans are initiated when disaster strikes, but those efforts can become more efficient because a successful mitigation plan has already reduced the risk of loss by addressing the most significant vulnerability to residents, critical infrastructure, businesses, homes and natural resources.

Figure 2 - FEMA Disaster Cycle showing the different timelines of emergency management.

Many natural disasters have relationships to natural landscapes, such as steep slopes, floodplains, and forests. This means that natural hazards often happen in the same locations and repeatedly cause danger, damage, and health impacts in those locations. Therefore, hazard mitigation action is often focused in these areas, and can work to break these cycles of disaster and loss. Some disasters occur on countywide or regional scales, and harm is more determined by built environments, and are most likely to continually impact those with existing health conditions, lack of resources, having been underserved by past mitigation planning work, facing historical discrimination and disinvestment in their communities, or other factors. In this case, people in widely different locations can be the most harmed by repeating disaster cycles, so mitigation strategies should identify and attempt to address cycles of loss caused by these social and economic disparities.

Hazard mitigation strategies can reduce existing risk through very different approaches. For example, relocating a specific building out of a frequently flooded area or helping to ensure that

[2] According to analysis performed by the National Institute of Building Sciences – see FEMA Fact Sheet for the analysis for different specific hazards.

everyone with existing respiratory health conditions have the ability to access clean air spaces during smoke events.

Strategies may also seek to make development less vulnerable to hazards before it is built or during construction. Examples would be requiring new structures to be elevated above predicted flood levels or by building structures to better withstand future earthquakes or forest fires.

Hazard mitigation plans are designed to involve the input of stakeholders from different perspectives to ensure plans use the best available data, are aligned with the needs of the entire community, and are in alignment with other plans, such as comprehensive plans, capital improvement plans, and climate action plans.

1.2 Natural Hazard Mitigation Plan (NHMP) Purpose

The purpose of this NHMP is to:

- Document the known risks from natural hazards and the extent to which communities and other entities will suffer loss in future events.
- Establish an action plan for participating communities and special districts, by identifying priorities and indicating their commitment to implementing strategies that will increase community resilience.
- Maintain eligibility for FEMA mitigation grants and identify other funding sources, which will increase the chance of successfully implementing identified risk reduction priorities.

Hazard mitigation plans are evaluated by State and Federal partners to ensure they meet statutory requirements set forth in Code of Federal Regulations (44 CFR §201.6). The code sets minimum standards that all hazard mitigation plans in the United States must meet, and FEMA approval is required before they can be locally adopted.

1.3 Participating Jurisdictions/Districts

Local governments and special districts within a county may develop a plan by themselves, or may join into a multi-jurisdictional plan. In the 2017 version of this plan, the Cities of Fairview, Gresham, Troutdale, and Wood Village, and Multnomah County came together to produce a combined plan for the first time. This update continues this collaborative approach among city and county jurisdictions, and also adds seven Special District partners.

This update adds the six entities making up the Columbia Corridor Drainage Districts - four current districts, a combined joint contracting authority (the Columbia Corridor Drainage Districts Joint Contracting Authority (CCDDJCA)), and the future combined organization of the four current districts (Urban Flood Safety and Water Quality District (UFSWQD)). The CCDDJCA and UFSWQD are recognized so that at a future date when the districts are officially joined, the full organization will already be a participating partner in this plan. The four current districts in this plan are:

- Multnomah County Drainage District #1 (MCDD)
- Peninsula Drainage District #1 (PEN 1)

- Peninsula Drainage District #2 (PEN 2)
- Sandy Drainage Improvement Company (SDIC)

As special districts of Oregon, the Columbia Corridor Drainage Districts are limited purpose units of government, and the hazard mitigation strategies identified herein are subject to their flood safety statutory authorities. The term Columbia Corridor Drainage Districts (Districts) will be used for the remainder of the plan and will refer to all six entities.

The Port of Portland, which operates the Portland International Airport (PDX), Troutdale Airport, and marine terminals in Multnomah County, is also a participating Special District in this plan.

Each participating jurisdiction or district has individually met the requirements of 44 CFR §201.6, but work has been combined into a single volume to reduce duplication of effort and providing opportunities for collaboration and communication to increase hazard resilience across jurisdictional boundaries. Each participating entity has a separate chapter, which includes local information, location specific risk data, and individual mitigation strategies.

Click to jump to jurisdictional/district chapter

City of Fairview	**City of Gresham**	**City of Troutdale**
City of Wood Village	**Multnomah County**	**Columbia Corridor Drainage Districts**
Port of Portland	In order to meet Federal code requirements: • Each jurisdiction/district performed public engagement to ensure their constituents had input in the revised plan. • Each jurisdiction/district developed individual mitigation strategies that are responsive to public input and reflect local priorities and capacity. • Each jurisdiction/district will formally adopt the entire plan.	

Two cities in Multnomah County—the City of Portland and the City of Maywood Park—are not part of this plan. Portland has a standalone plan[3] that was updated in 2022. Maywood Park does not have a hazard mitigation plan. Some information in this plan overlaps with boundaries of these cities, because of Special District service areas and services provided across the entire county by Multnomah County.

There are also numerous other Special Districts[4] in Multnomah County that do not have an NHMP. Those districts are eligible to create plans in the future individually, or as a partnership with other communities or districts.

The Cities of Fairview, Gresham, Troutdale and Wood Village provide vulnerability data, community input and mitigation strategies within their incorporated limits. Multnomah County mitigates all natural hazard risk in unincorporated areas, and also provides or coordinates services that may span across the entire county for some hazards.

The Columbia Corridor Drainage Districts serve locations that overlap both incorporated and unincorporated areas while critical Port of Portland facilities addressed in this plan are located within the City of Portland.

1.4 How the Plan is Organized

The flow of information in this plan is designed to:

1. Describe the community to understand who and what are at most risk from natural hazards;
2. Describe the natural hazards faced in Multnomah County–their likelihood of happening, locations of highest risk, and vulnerability created;
3. Combine these elements of risk and consider them with the specific capacity and needs of each participating jurisdiction to determine actionable risk reduction strategies.

The hazards included in this plan are; **earthquake, flood, landslide, severe weather, volcano, and wildfire and wildfire smoke**. These are the natural hazards that are most likely to impact Multnomah County and have existing probability and vulnerability data, and are consistent with natural hazard types described by FEMA and the State of Oregon.

Mitigation actions in this plan are contained within each jurisdictional/special district chapter. Actions are defined in those tables by which hazard they are designed to mitigate, or as multi-hazard if they address more than one hazard. All jurisdictions or districts have mitigation strategies for every natural hazard that they have assessed as a risk priority. As this is a multi-jurisdictional plan, each participating entity does not have equal exposure to the included hazards.

[3] Portland's plan is called a Mitigation Action Plan (MAP)

[4] Special districts are defined as local agencies outside of local government that deliver specific services to specific communities. Other examples of special districts are water districts, fire districts, school districts, and parks districts. According to the Special District Association of Oregon, there over 1,000 districts like this in Oregon. Districts must have a mitigation plan in order to manage their own FEMA mitigation grants.

Using the Maps in this Plan

Many of the maps used in this plan come from interactive map websites, and can therefore be used to locate risk elements down to the property level. The static maps in the plan can be used for an overall dimension and location of risk, but it is recommended plan readers use the linked sites to be able to view risk in different ways and at different scales.

Maps which have an interactive web link available to the public have a link at the top. Within the link, the layers used for that map are shown. To access this data, one should follow the link and then use the named layers to create the map. The maps in this plan typically use a layer at the second level of data organization – click the box for the first layer and then open sub-layers in that category by clicking the arrow to the left of the box.

Not all of the maps have the same interface, but are all ArcGIS Online maps and use the same symbol to open layers, shown to the right. Clicking on this icon will open a panel that will show the layers needed to recreate a map.

The primary interactive mapping applications used in this volume are:

- DOGAMI HazVu – Statewide geohazards viewer, with risk mapping for most of the hazards included in this plan, and includes LIDAR terrain mapping.
- DOGAMI SLIDO – Statewide landslide information layer with a number of different risk dimensions related to landslides, including LIDAR terrain mapping.
- Metro Map – Metro government public map with layers for the metro region, including outdoor recreation areas, city and district boundaries, and habitat and natural hazards. Also includes tax lots for the entire metro planning area.
- Multnomah County Land Use Planning Reference Map – Includes planning and zoning maps, regulatory layers, natural hazard overlays, and aerial photos.
- Oregon Wildfire Risk Explorer (Planning Tool) – Statewide wildfire risk mapping layers, hosted by the Oregon Department of Forestry and Oregon State University. To access layers, first click on the 'Go To Layers' button.

The FEMA National Flood Hazard Layer is a FEMA site with national flood insurance rate maps. These maps are not used in this plan, because of difficulty scaling them to large areas, but they are the best reference for homeowners or local governments to review regulatory flood risk information.

1.5 Updates to the 2017 NHMP

The previous version of the Multnomah County Multi-Jurisdictional Natural Hazards Mitigation Plan became effective on November 29, 2017. FEMA requires NHMPs be updated every five years to capture new risk data and demographic changes, and reflect recent natural hazard events, revised local priorities, and changes to federal, state and local policies.

Between 2017 and the official start of the new update process of the plan, all of the participants joined together in a maintenance phase, meeting twice in 2018 and 2019 and once in 2020 to discuss the mitigation planning progress. The formal update to the plan began in early 2021. The COVID-19 pandemic caused a significant delay in the kickoff to the update process and

continued to limit the ability to perform outreach and participant coordination through 2022. Plan participants met online through 2022 to develop shared plan elements and coordinate local strategies.

This version of the plan intends to build on the success of the 2017 multi-jurisdictional process, by maintaining coordination between jurisdictions and adding new partners with crucial resilience roles. The overall format of the plan has not changed significantly–most of the changes in this version come from new data and studies that have refined risk awareness, and by significant natural hazard events that have occurred over the last five years that have shaped mitigation priorities. However, there are some changes that have been made to the plan format and to hazard definitions that should be noted.

- In this version, each participating entity has a breakout chapter which lists specific vulnerability information and action strategies. Unlike in the 2017 plan, mitigation actions are not shared between entities. While some actions put forth by different participants may be very similar, each one is collected separately to best reflect specific populations served and differing resources and priorities among participants.
- The natural hazards included in the plan are unchanged from 2017, but there are important expansions of two chapters. The Severe Weather chapter is now organized into four sub-hazards–Extreme Heat, Winter Storm, Wind Storm and Drought. The Wildfire chapter now includes expanded information about Wildfire Smoke.
- Mitigation strategies have been revised because of the completion of previous actions and changing priorities based on recent hazard events, new risk data, and a continuing effort to ensure actions are equitable for those facing the most severe risks from future events.

1.6 Equitable Natural Hazard Mitigation Planning

This NHMP continues to recognize that all members of the community are not impacted equally by natural disasters. Some community members are at more risk and face greater barriers to resilience and recovery, for a number of possible reasons. A hazard mitigation approach which uses a ‘one size fits all’ approach and does not recognize these different levels of risk will not adequately or efficiently support historically underserved populations, will fail to build full community resilience, and will make social and economic disparities worse after a disaster.

Natural hazard mitigation is closely linked with environmental justice[5] principles, which are the work to prevent environmental benefits and burdens from being distributed unfairly. There is a common perception that because natural hazards are so wide ranging in impact, they harm everyone and act as an ‘equalizer’[6]. Yet research shows this is not the case, and that natural hazards around the world cause the most harm to those who have the least means and resources to recover. Impacts of climate change are only making the severity of events more severe and frequent, heightening unequal impacts.

[5] EPA Environmental Justice factsheet

[6] Incorporating Environmental Justice Into Hazard Mitigation Plans, *Environmental Law Institute*, Rebecca Kihslinger and Fiona Osborn; October 4, 2021

The 2017 version of this plan already highlighted equity as a part of the plan vision, working to ensure that equity was a key consideration in identifying and implementing mitigation and disaster recovery actions. This plan update seeks to continue to develop a shared understanding among participants of how hazard mitigation can become more inclusive and be proactive in creating strategies that reduce existing disparities in risk and hazard recovery.

Addressing the whole community[7] requires an understanding that while an equal solution for all may initially seems fair, it does not address historical inequalities and current differences in age, financial resources, housing stability, neighborhood investment, health or ability, and access to government services.

The difference between equity and equality is illustrated in the graphic below. In the first picture, everyone has been provided the same resource, but the bicycle does not support each person successfully. An equitable solution provides a bicycle that meets the specific needs of each recipient. In mitigation planning, this means that successfully reducing risk in the most meaningful and efficient way requires understanding how the distribution of resources will actually reduce risk and for whom.

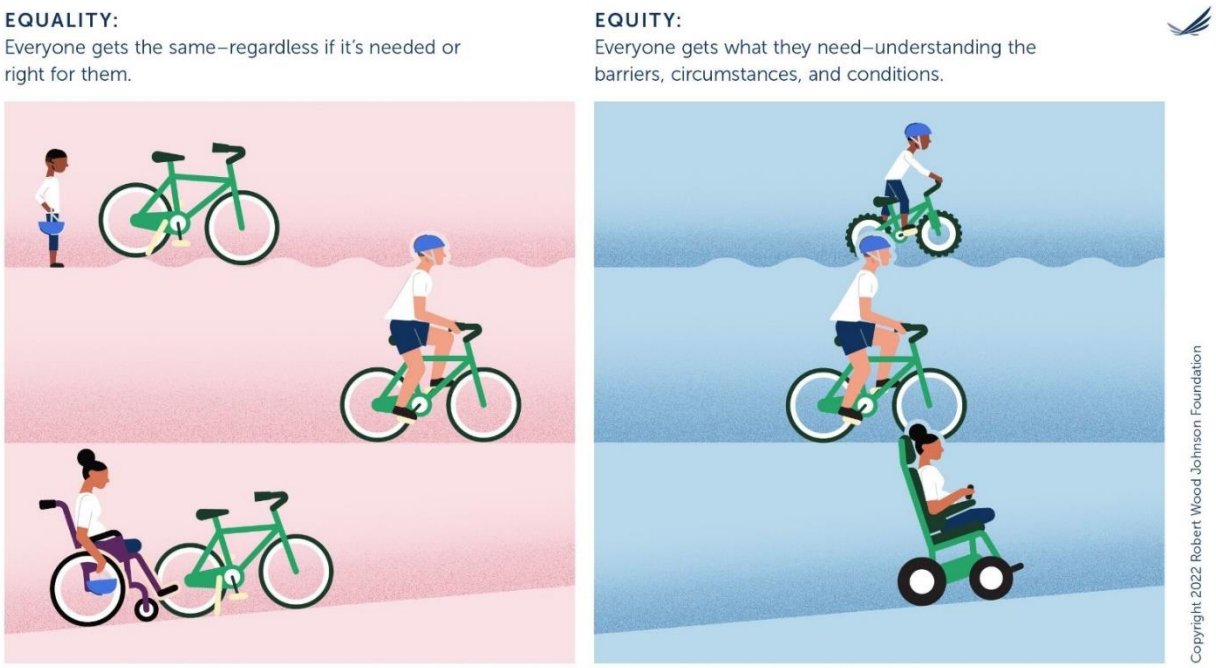

Figure 3 - Visualizing Equality vs Equity

Equitable mitigation success should be measured by assessing who was most impacted in loss of life or financial harm in past disasters, making quantifiable reductions of vulnerability to those most at risk, and increasing engagement with historically underserved populations

[7] FEMA uses the term whole community in its National Preparedness Goal, as a way to define the full scope of those who must be part of inclusive mitigation planning.

and community organizations to better understand how natural hazard events and distribution of mitigation resources are affecting their communities.

Each participating entity in this plan has their own jurisdictional strategy for improving the equitable delivery of their governmental services. The mitigation actions applied by each participant reflects the specific place they are at in developing a local equity strategy and the different communities they each serve.

The Community Profile section described different demographic and economic factors in Multnomah County and touches on how different communities may be impacted differently by the natural hazard events included in this plan.

1.7 Multnomah County Five-Year Mitigation Report 2017-2022

1.7.1 Natural Hazard Events

Multnomah County was affected by a number of natural hazard events since the 2017 NHMP was adopted, including multiple fatal incidents. These events, in some cases, exceeded even the most extreme expectations of scope and severity of hazards, especially those most influenced by climate change. The impact of these events has most significantly altered the prioritization of hazard risk among plan participants.

Below is a selection of these events. These events, and others, are described more fully in the hazard chapters for each type of event.

June 2021 Heat Dome

- A record heat event that broke the all-time temperature record of 107 degrees in Multnomah County for three straight days and peaked at 116 degrees. During this extraordinary heat wave, 69 people in Multnomah County died from hyperthermia.

2017 Eagle Creek Fire

- The largest wildfire in Multnomah County in over 100 years, the Eagle Creek Fire started in September and burned nearly 50,000 acres across Multnomah and Hood River Counties. No deaths occurred because of the fire, but structures were destroyed, major evacuations were required, and recreational and other natural resource areas were significantly impacted.

2020 September Wildfire Smoke Event

- The 2020 wildfire season was one of the most destructive in recent Oregon history, and smoke from major fires in the region blew into Multnomah County, leading to air quality dubbed ‘the worst in the world’ and exceeding the top of the unhealthy air risk scale[8]. For three days, nearly the entire county had extremely hazardous air quality levels to health. Acute respiratory health impacts were noted, and the long term health effects are as yet unknown but expected to be significant.

[8] Health risk categorization for wildfire smoke tops out at 500, a level exceeded by a Portland air quality monitor during this event.

2017 Winter Storms

- A number of winters over the last five years saw impacts from flooding, snow and cold temperatures, but none as severely as in the winter of 2016-2017. January 2017 was one of the coldest, snowiest months in Multnomah County in decades, and at least six deaths were caused by hypothermia.

2021 Dodson Landslide

- One fatality occurred due to a landslide, during a heavy rain event in January 2021, in a high-risk landslide portion of unincorporated eastern Multnomah County that had partially burned in the 2017 Eagle Creek Fire.

These were the most significant events, but other events occurred, including additional severe heat and cold events that also caused deaths. Some flooding damage occurred in the time period, and there were other wildfire smoke events, although those events where within the range of normal anticipated impacts (if more frequent).

1.7.2 Climate Change

The severity of climate-related natural hazard events over the last five years reflects the concern of participating entities that these types of events will become even more frequent and extreme. The plan largely uses climate change forecasts from the 2021 Oregon Fifth Climate Assessment published by the Oregon Climate Change Research Institute (OCCRI). How climate change has increased the potential scope and severity of each hazard described in this plan is each hazard-specific chapter.

1.7.3 Population and Demographics

Multnomah County communities continued to experience population growth in the last five years, although growth has slowed to some degree, especially from the peaks of rapid suburban development through the early 2000s. Growth has occurred primarily in locations already within the Urban Growth Boundary through new development in incorporated areas and increased density and redevelopment in urban cores. Intersections of new hazard risk are especially pronounced for climate hazards that affect all residents. Because there has not been any expansion of urban growth limits, there has been a limited increase of new development into locations with high flood, wildfire or landslide risk – although there are areas within city limits that face these hazards and have seen increased development.

Continued in-migration continues to reflect the need for risk communication for those who have not experienced natural hazard events in Multnomah County and may not know of larger threats, such as earthquakes, that have not occurred for a long time.

Some specific population trends can be observed that may impact mitigation planning strategies. The population of older adults is growing very quickly across the county and communities are also continuing to become more racially and linguistically diverse. A deeper look at county demographics can be found in the Community Profile chapter.

1.7.4 COVID-19 Impacts

Local mitigation work was significantly hampered by COVID-19. Although the pandemic, like other disease epidemics, is not considered to be a natural hazard as defined by this plan, COVID-19 created a significant disruption in mitigation planning and project development. As of 2023, the pandemic continues to alter outreach and engagement work.

The pandemic has also provided an opportunity to test real-world applications of long-term disaster response and measure the effectiveness of mitigation planning related to public health risk. COVID-19 impacts were disproportionately harmful to those with existing health conditions, those with risks caused by housing status or employment type, and those with barriers to receiving government information and services. In both response and recovery, this incident has created a new lens to continue to evaluate how actions throughout the disaster cycle can be used to reduce health, social and economic disparities during and after all types of events.

1.7.5 New Studies and Regulatory Developments

A number of new risk or vulnerability studies since 2017 have refined the understanding of where natural hazard events are likely to occur in Multnomah County and what the potential losses will be from future disasters.

Earthquake

- The Oregon Department of Geology and Mineral Industries (DOGAMI) published a Regional Earthquake Impact Analysis in 2018 for three area counties, including Multnomah County. The analysis provides new, more detailed vulnerability data for two earthquake scenarios, and is the primary source for describing earthquake risk in this plan.

Flood

- DOGAMI coordinated with the Columbia Corridor Drainage Districts to publish a 2018 Special Paper to assess flood risk for the levee system. The assessment provides detailed vulnerability analysis from a major levee breach, Multnomah County's most dangerous flood scenario.
- FEMA completed a flood-map update process in 2019 for the Lower Columbia-Sandy Watershed, creating new Flood Insurance Rate Maps (FIRMs) for portions of Troutdale, Gresham, and unincorporated Multnomah County. The remainder of the county has maintained FEMA flood maps issued before 2017.

Landslide

- DOGAMI published two reports relating to landslide risk in Multnomah County: a detailed vulnerability assessment of the western and central parts of the county in 2018 and a historic landslide inventory of the eastern portion in 2017. Because of these reports, highly localized landslide risk mapping exists throughout the entire county, and serves as the primary source for landslide hazard in this plan.

Wildfire

- The Oregon Department of Forestry (ODF) created the Oregon Wildfire Explorer to host wildfire risk data, much of it generated from the Pacific Northwest Quantitative Wildfire Risk Assessment produced via the U.S. Forest Service (USFS) in 2018. This project collected best available data into a single risk and vulnerability mapping tool with applications for planners and the general public.
- Senate Bill 762, passed by the Oregon Legislature and signed into law by the Governor in summer 2021, included a directive for additional wildfire risk mapping throughout Oregon. As of mid-2022, the implementation of those maps was postponed. These maps will become the best available data when re-released, expected to be some time in 2023.

Wildfire Smoke and Extreme Heat

- The Regional Disaster Preparedness Organization (RDPO), the U.S. Environmental Protection Agency (EPA), and Metro joined to produce a 2021 risk reduction report for Extreme Heat and Wildfire Smoke, collecting risk assessment information and suggested mitigation strategies for each hazard.

All-Hazard Assessments

- As part of the new FEMA flood study for the Lower Columbia-Sandy watershed, DOGAMI created a risk report combining all existing natural hazard risk map data with an updated inventory of buildings and facilities. This study provides a streamlined analysis of multi-hazard risk for much of Troutdale and portions of Gresham, levee districts at the mouth of the Sandy River, and unincorporated Multnomah County.

Climate and Health

- A Regional Climate and Health Monitoring Report was released in 2019 and updated in 2021. The report provides data on health conditions impacted by climate change, including heat and unhealthy air quality.
- The Sixth Oregon Climate Assessment was published in January 2023. This continued the release schedule of assessments, with previous versions released since the last version of the NHMP in 2021, 2019, and 2017.

Social Vulnerability

- Metro has undertaken a Social Vulnerability Tools (SVT) project to expand census tract level data info available from the U.S. Census, through improved data tools and additional data sources. The project incorporated input through community engagement to identify what data gaps exist and how well demographic information captures needs. The tools were not ready at the time of this plan's completion, but will be integrated into future updates.

The last five-year period has also seen an increase in federal and state investment in hazard mitigation. In particular, the State of Oregon has passed legislation to address climate change and wildfire risk, and has restructured the state's Department of Emergency Management (OEM) with increases in support for local mitigation activities and grants management.

FEMA continues to be the primary external funder of local hazard mitigation, through the Hazard Mitigation Assistance grant umbrella. Pre-disaster and post-disaster grants are available, with

post-disaster funds being made available to Oregon communities because of wildfire, COVID, winter storms, and other disasters.

FEMA published its most recent National Mitigation Investment Strategy in 2021, highlighting the importance of mitigation to align national resilience-building efforts. The 2021 Infrastructure Investment and Jobs Act provided FEMA with $6.8 billion to, in part, support climate-based resilience mitigation, especially for underserved communities.

A previous pre-disaster grant funding program was revised by FEMA into the BRIC (Building Resilient Infrastructure and Communities) program to highlight priorities in larger-scale, longer-term infrastructure mitigation and move away from reactive post-disaster spending. The grant also continues to support mitigation planning and advanced assistance projects. Flood Mitigation Assistance grants remain for flood-focused projects, including buyouts of properties suffering from repetitive flood losses.

1.8 Plan Adoption and Implementation

Each participating entity must individually adopt the plan in order for the plan to become effective in that jurisdiction. The adoption process may be different for each participating entity. As soon as at least one participating entity has adopted the plan and that plan has been approved by FEMA, the five-year update requirement timeline begins again.

In the years before the next update process begins, the participating entities will continue to meet twice per year to assess the mitigation strategies and identify updates and other plan improvements.

The NHMP is not required to be a static document that only changes on the five-year update cycle. The plan will be available electronically and as the Steering Committee continues to meet in a maintenance phase, continuing annual edits will be considered in order to be more responsive to new risk data and research, lessons learned from coming disasters, and ongoing community input and engagement.

1.9 Plan Goals, Objectives, Mission

The vision and goals of this plan are the long-term blueprint for creating a more resilient community, and reducing future losses to natural hazards indicated in the risk assessment. Community resilience to natural hazards is the ability of communities to withstand or rapidly recover from a disaster or catastrophic event.

The vision of the participating entities in this plan is to foster a disaster-resilient community in which:

- Risk-consciousness at all societal and economic levels is forefront in decision making;
- Efforts to reduce risk are conducted with inclusiveness and collaboration;
- Reducing disparities in impacts from natural disasters is a key consideration in identifying and implementing mitigation actions;
- The risk to health and safety of all citizens from disaster events is minimized;
- Impacts to the economy, the built and natural environment and cultural resources are reduced;

- Planning is not static but gives consideration to future conditions - especially climate change related impacts where detailed analysis of risk has not yet occurred.

The goals identified to reach that vision:

- Goal 1 – Strengthen the capacity of the whole community to reduce risk by increasing hazard awareness.
- Goal 2 - Create partnerships to fully leverage funding, and other implementation and policy opportunities.
- Goal 3 – Develop mitigation actions that leverage strengths and reduce vulnerabilities to community systems and lifelines.
- Goal 4 – Prioritize mitigation strategies that reduce disparities in risk to historically underserved and underrepresented communities.
- Goal 5 – Prioritize mitigation strategies with high benefit-to-cost ratios, those that reduce risk from multiple or cascading hazards, those that address problems identified in other plans, and those made more feasible by having public support.

Chapter 2 – Community Profile

The purpose of the community profile is to collect different characteristics of Multnomah County that help define who and what is at risk from natural hazards. Impacts from natural hazards will differ depending on where they occur and the ability residents and visitors to the county have to withstand and recover from them. Mitigation investments should be made with the knowledge of how people, property, infrastructure and natural resources will be impacted differently by future disasters.

Descriptions of the community do not necessarily capture every element of risk and vulnerability faced, but information has been collected from a number of sources to provide a detailed overview. Work will continue to further refine how the community should best be defined for future planning.

Data for boundaries, demographics and hazard information is based on the boundaries of Multnomah County as established 168 years ago. It should be acknowledged that the area now known as Multnomah County has been inhabited for thousands of years, and that residents of this area have been greatly impacted by major natural disasters long before colonial expansion or Oregon statehood. Evidence of pre-Statehood major hazard events exists primarily through geological records, but also from recounts from the original residents of this land.

2.1 Political and Physical Geography

2.1.1 Political Boundaries

Multnomah County was created on December 24, 1854, from an eastern portion of Washington County and a northern portion of Clackamas County. Multnomah County is bordered by Columbia County and the Columbia River on the north, Hood River County on the east, Clackamas County on the south, and Washington County on the west. Multnomah County is the smallest county by area in Oregon at about 465 square miles. Despite its small size, Multnomah County is Oregon's most populous county, making it, by far, the most densely populated county in Oregon[9]. Population density has implications for natural hazard mitigation - the total number of people threatened by natural disasters are the highest of any Oregon county in nearly every dimension of risk, and urban areas have risks associated with multi-story buildings and urban heat islands.

[9] Multnomah County is more than twice as densely populated as the next most dense county in Oregon, Washington County. Multnomah County has a little over 1,600 people per square mile.

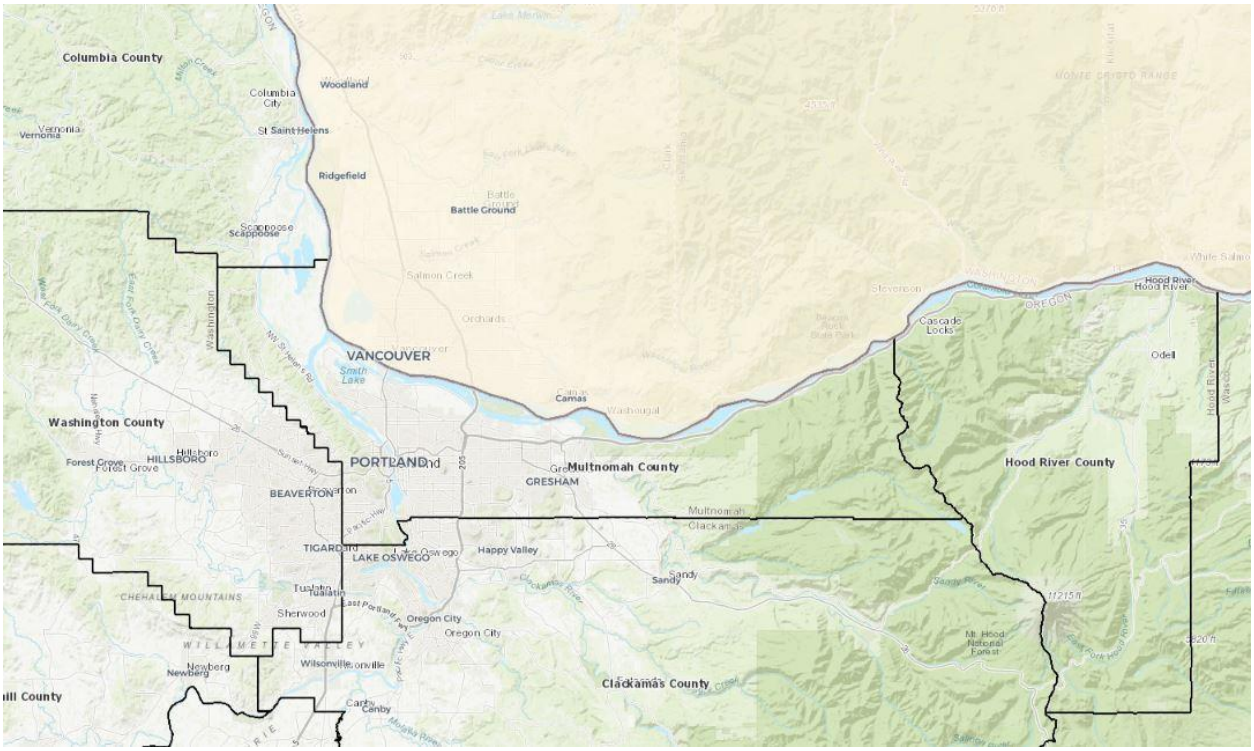

Figure 4 - Multnomah County Boundaries

2.1.2 Cities and Unincorporated Areas

Multnomah County has six incorporated cities—Fairview, Gresham, Maywood Park, Portland, Troutdale and Wood Village. The City of Portland also extends into Washington County. The City of Lake Oswego has around 2,500 residents inside Multnomah County, but is primarily located in Clackamas County and mitigation planning for Lake Oswego has only been conducted through that county. Outside of the central core of cities are large unincorporated areas, including rural communities with varying populations. The county has a number of Special Districts across the county, which overlap city and county boundaries.

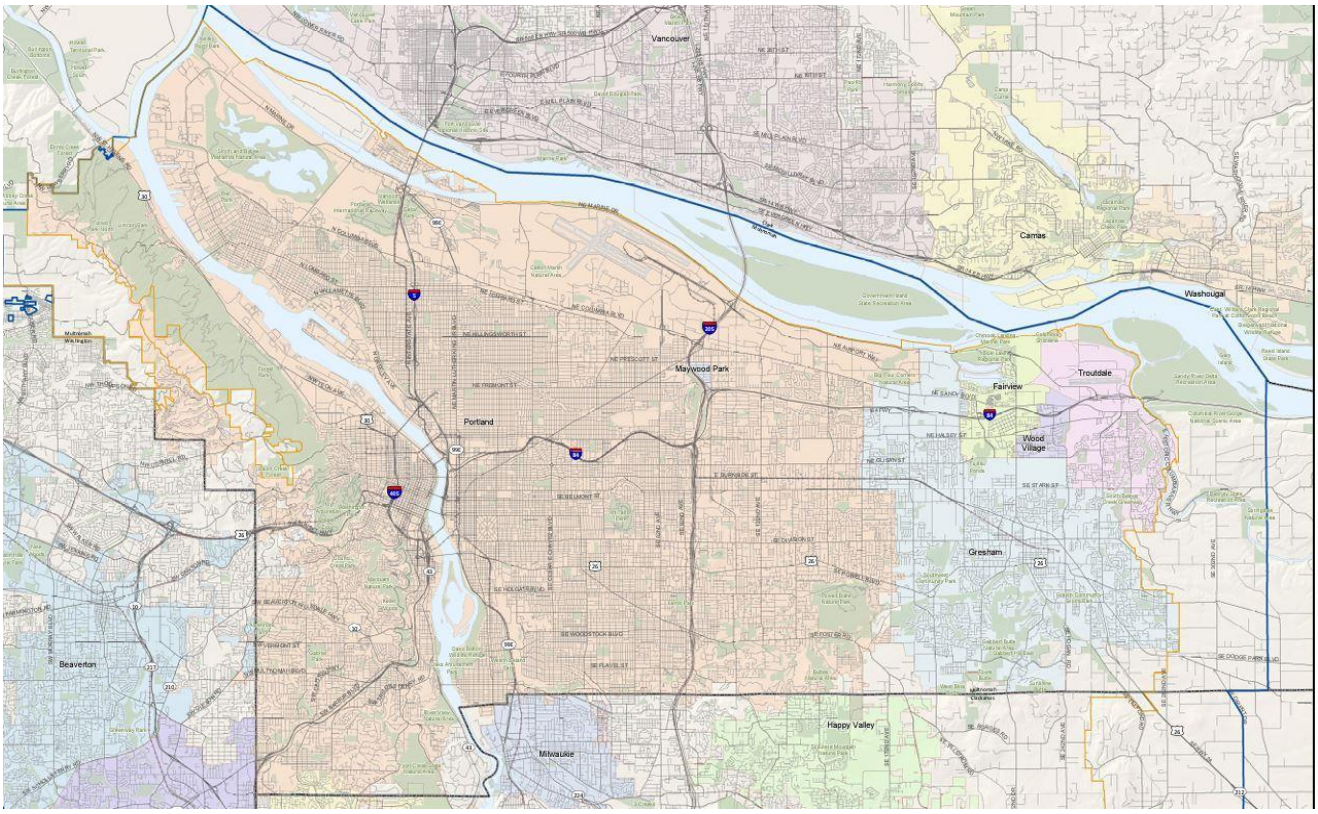

Figure 5 - Metro Map showing boundaries of the Cities of Portland (Orange), Fairview (Yellow), Gresham (Light Blue). Troutdale (Pink), and Wood Village (Light Purple).

The City of Portland is located centrally and makes up about 80% of Multnomah County's population and about 30% of the county's land area. This creates distinct western and eastern portions of the county. All of the participating cities in this plan are located east of Portland, and unincorporated areas span eastward from the eastern boundaries of those cities to the county line. All county areas to the west and northwest of Portland are unincorporated.

2.1.3 Columbia Corridor Drainage Districts

The participating Columbia Corridor Drainage Districts serve a long stretch of land along the Columbia River and, as a group, overlap the city boundaries of Fairview, Gresham, Portland and Troutdale, as well as portions of unincorporated Multnomah County. The combined Urban Flood Safety & Water Quality District (UFSWQD), expected in the next few years, will be a single district combining all of the boundaries shown in the map below.

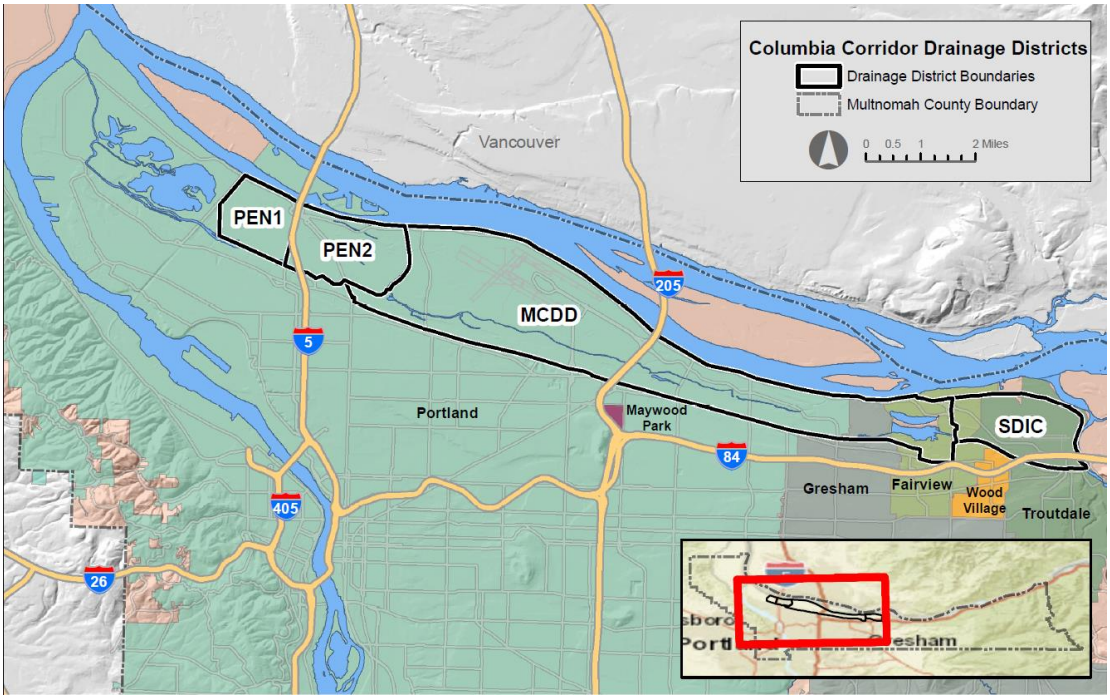

Figure 6 - Columbia Corridor Drainage District Boundaries. From left to right – Peninsula 1, Peninsula 2, Multnomah County Drainage District, Sandy Drainage Improvement Company

2.1.4 Port of Portland

The Port of Portland owns and operates the Portland International Airport (PDX), Oregon's major commercial airport, including significant air cargo operations, and owns the largest container shipping terminal serving the Portland Metropolitan region and much of Oregon. Mitigation efforts identified in this plan are for facilities located within Multnomah County only, but the mitigation efforts themselves support the region and the State.

The Port of Portland's two airports in Multnomah County also lie close to the Columbia River and are within the service areas of Columbia Corridor Drainage Districts. Marine Terminal 6, is on the Columbia River but is not within Drainage District boundaries. PDX and Terminal 6 are also located entirely within the City of Portland.

2.1.5 Other Land Management Areas

The eastern portion of Multnomah County includes extensive areas of state and federal lands, including the Mount Hood National Forest and other United States Forest Service lands. Tracts of managed timberland owned by the Federal Bureau of Land Management exist on both sides of the county. State lands are primary managed by Oregon State Parks or Oregon Fish and Wildlife. Large areas managed by the City of Portland include Forest Park on the west side of the county and the Bull Run Watershed on the east side.

An interactive version of this map can be found here (Administrative Boundaries – Land Management/Ownership)

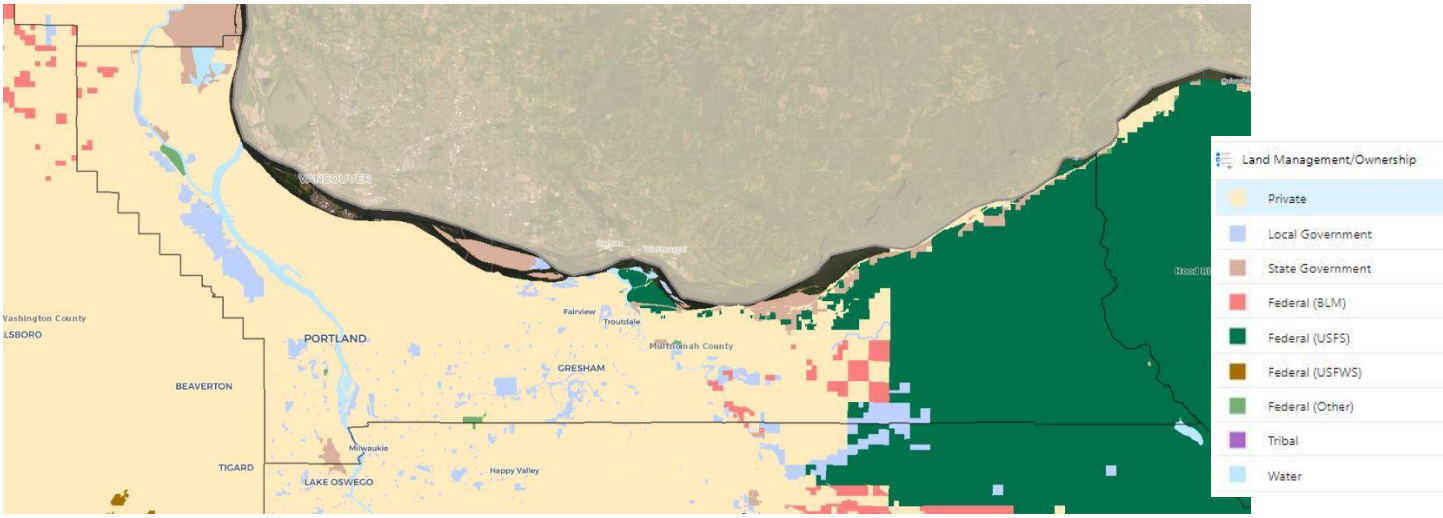

Figure 7 - Local, state and federal land management areas. Map from Oregon Wildfire Explorer, data from Bureau of Land Management (2015)

2.1.6 Geological and Geographical Features

The topography of Multnomah County varies from extremely flat to mountainous. The flattest areas are those in the historical floodplains of the Columbia and Willamette Rivers. Steep forested slopes exist in the Columbia River Gorge, Mount Hood National Forest and Gresham's East Buttes in the eastern portion of the county and in Forest Park and the Tualatin Mountains in the western portion. The highest point in Multnomah County is Buck's Peak at an elevation of 4,751 feet, located on the county's eastern boundary with Hood River County.

An interactive version of this map can be found here (Slope – Slope Steepness)

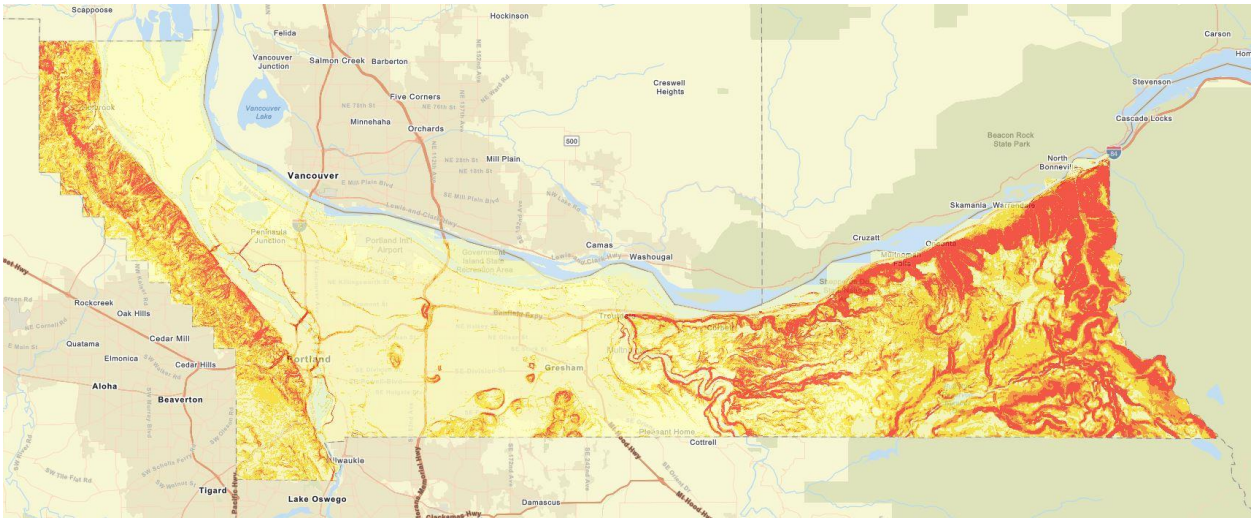

Figure 8 - Map showing Multnomah County slopes, with the darker colors being the steeper grades. Map from Multnomah County Land Use Planning Reference Map

Areas with slopes are primarily forest. Developed land is the dominant land cover in the center of the county. The largest agricultural areas lie in areas immediately east of Troutdale and Gresham, and on Sauvie Island in the northwestern part of the county.

[An interactive version of this map can be found here]

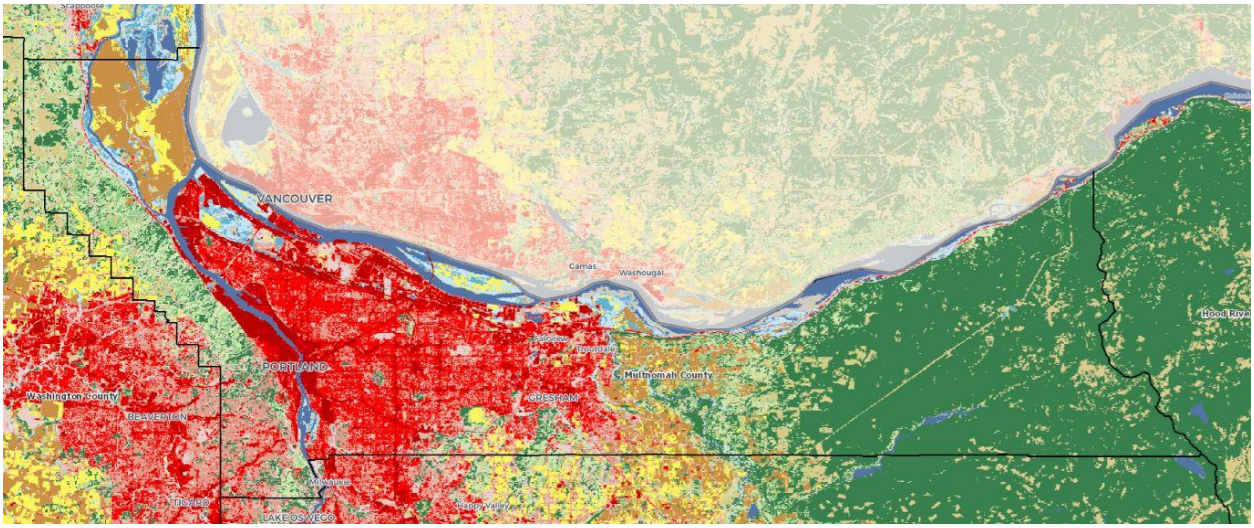

Figure 9 - Multnomah County land cover showing areas of urban development (red), agriculture (cultivated crops in brown and pasture in yellow), evergreen forest (dark green) and mixed conifer-deciduous forest (light green). Map from the 2019 National Land Cover Database.

Multnomah County is located in a highly geologically active area. There are several active earthquake faults within the county and other regional faults that could cause damage. The County is also expected to be impacted by the Cascadia Subduction Zone, a major offshore meeting of continental plates. A Cascadia Subduction Zone earthquake is the most likely earthquake scenario predicted to reoccur and will have major impacts across the Pacific Northwest. The county also is close to active volcanoes, including Mount Hood in Clackamas County, Oregon, and Mount St. Helens in Washington State. Maps of subduction zone and crustal faults are found in the Earthquake chapter, and the Volcano chapter has data about nearby eruption risk.

The two largest rivers in Multnomah County are the Columbia River, which forms the northern boundary of the county, and the Willamette River, which flows through the center of Portland until reaching a confluence with the Columbia River at Kelley Point. The natural floodplain of the Columbia River is flat and low-lying, and contains a number of wetlands, sloughs, side channels, and other areas prone to ponding during rain events. Man-made levees and embankments are prevalent in this area.

An interactive version of this map can be found here (Water – Rivers and Streams)

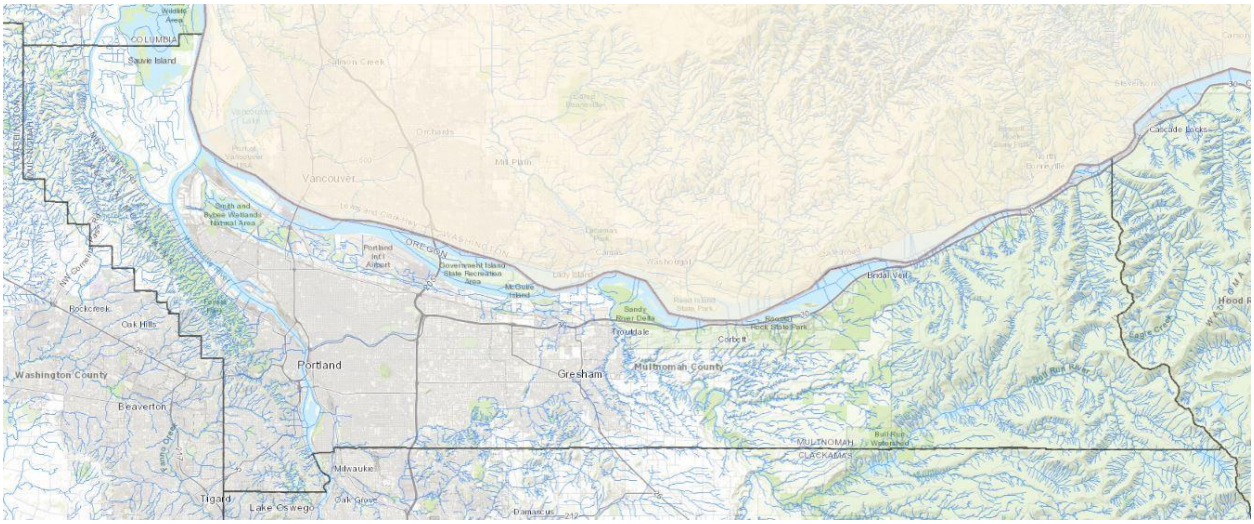

Figure 10 - Map showing mapped rivers and streams in Multnomah County, shown in blue. Map hosted by the Oregon Wildfire Explorer, with data from the 2017 USGS National Hydrography Dataset.

The Willamette River is constrained by urban development through much of its route through Multnomah County, although its natural floodplain also remains present in some locations with associated lakes and wetlands. Flood controls, including flood walls and engineered embankments are present, narrowing the channel as it passes through Portland.

The Sandy River, also a tributary of the Columbia River, is another important county river with high recreational and ecological value. The Sandy River is notable for being part of a volcanically active sediment transport system coming from the highlands of Mount Hood, making it extremely prone to flooding and erosion. Levee systems occur at the confluence of the Sandy and Columbia Rivers.

Floodplains on these rivers are mapped by the Federal Emergency Management Agency (FEMA) as part of the National Flood Insurance Program. Many other tributaries, streams, creeks and wetlands are also mapped through this program, and these smaller flooding sources can be prone to flash flooding or ponding. Additional creeks and ponding areas exist in the county, but have not been mapped for flood risk by FEMA because of their remoteness or small drainage area. The Flood Chapter has specific locations where mapped streams intersect with development and create flood risk.

An interactive version of this map can be found at this link (Flood Hazard – Effective FEMA Flood Data)

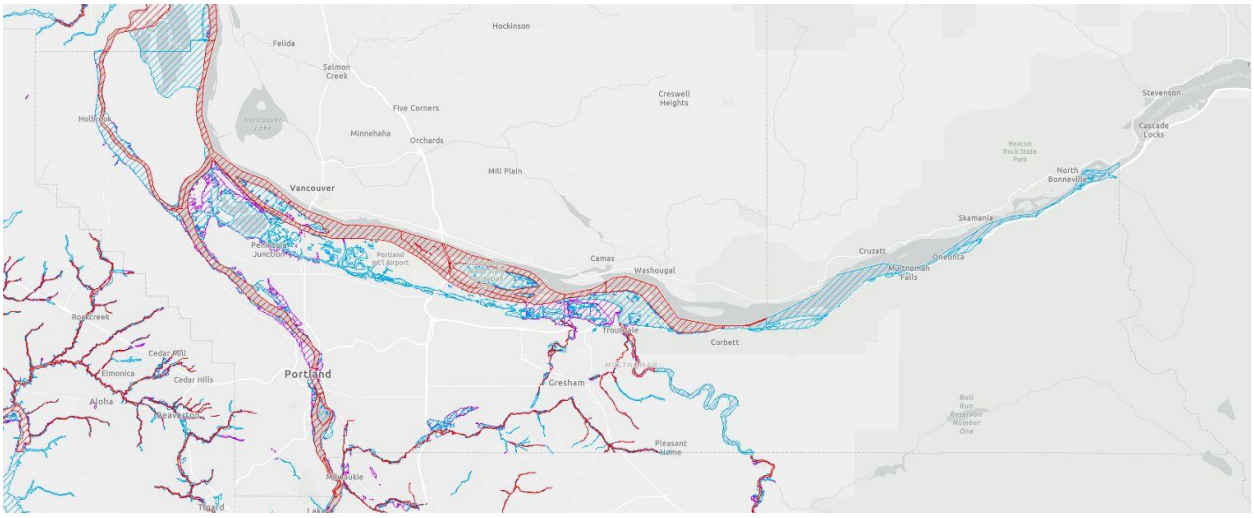

Figure 11 - Map showing areas mapped by FEMA's National Flood Insurance Program (NFIP). Areas in red hatching are the regulatory floodway, areas with the fastest and most dangerous floodwaters during a flood. The blue areas are those predicted to flood in a 1% annual chance (100 year) flood. Purple areas are those predicted to flood in a 0.2% annual chance (500 year) flood. Map from DOGAM's HazVu website, with information from FEMA's National Flood Hazard Layer (NFHL).

There are several small lakes and ponds in the county, including Blue Lake, Fairview Lake, Fairview Creek and its tributaries, Salish Ponds, Sturgeon, Bybee and Smith Lakes, Force Lake, Whitaker Ponds and Johnson Lake. Many of these county lakes are remnants of old channels of the Columbia River and located within the Columbia Slough, a 60-mile waterway that drains the Columbia River watershed in the interior portion of the levee drainage system.

2.2 Climate

The climate across Multnomah County is generally moderate, with wet winters and dry summers. Several climatic factors contribute to hazard vulnerability in Multnomah County. Heavy winter and spring rains can result in flooding and cause landslides. Cold winter snaps result in short duration sub-freezing temperatures, ice, snow and high winds most years. Summers can be mild, but are also increasingly likely to have high-heat events, which may be especially dangerous because of a lack of residential air conditioning and sudden temperature increases that can occur in late spring or early summer before peoples' bodies have adjusted to withstand hot weather.

Nearly all of the county's major climatic disasters have been regional in nature, affecting the entire county at once with minor variations in intensity and duration. Variations of impact may be based on location or elevation but perhaps are most significantly determined by effects caused by urban development and where those most at risk from harm are more likely to live.

2.2.1 Temperature and Precipitation

On average, December and January are the coldest and wettest months, and January has historically had the most snowfall. Temperatures begin to warm significantly by March, and snow later than that is very unusual. Rain amounts slowly drop off until July and August, when there is usually little precipitation. July and August are also the hottest months. Cooling down

usually begins in mid to late September or early October and significant rains typically begin to return in October.

The eastern side of the county has slightly colder winters with more snow and slightly warmer summers, caused by weather impacts of the Columbia River Gorge. The tables below show differences between Portland and Troutdale–with Troutdale located at low elevation at the mouth of the Gorge. Communities in the Gorge itself see these variations much more strongly.

Table 1 – Annual weather averages, observed at Troutdale Airport (National Weather Service)

Troutdale	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average High Temperature (F)	45.0	50.2	55.8	61.8	68.3	74.4	81.4	81.2	76.0	64.4	52.9	45.9	63.1
Average Low Temperature (F)	33.7	35.7	38.1	41.2	45.9	50.9	54.0	54.1	49.9	44.4	39.3	34.9	43.5
Average Total Precipitation (Inches)	6.32	4.88	4.52	3.53	2.69	1.99	0.71	1.05	1.95	3.72	6.45	7.09	44.90
Average Total Snowfall (Inches)	2.2	0.8	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.8	4.7

Table 2 – Annual weather averages, observed at Portland International Airport (National Weather Service)

Portland	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average High Temperature (F)	46.6	50.6	55.9	61.1	67.1	73.0	79.2	79.7	75.0	63.2	52.1	46.1	62.5
Average Low Temperature (F)	37.0	38.4	40.8	43.8	48.4	53.2	57.1	57.6	54.3	47.7	41.3	36.9	46.4
Average Total Precipitation (Inches)	6.17	4.83	4.66	3.35	2.61	1.66	0.70	0.92	1.67	3.36	6.69	6.76	43.37
Average Total Snowfall (Inches)	1.1	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.9	3.1

Precipitation is significantly higher in the West Hills and Tualatin Mountains in western Multnomah County and high elevation areas in eastern Multnomah County than in the valley. Parts of the West Hills and Tualatin Mountains may average 70 inches of annual precipitation and high elevations in eastern Multnomah County may average 150 inches. Risks of rain-triggered landslides are much higher in these locations.

On average, the northern Willamette region experiences only five days per year of measurable snow, and some years have none at all at low elevation. Cold air from east of the Cascade Mountains often moves westward through the Columbia River Gorge and funnels into the Portland Metropolitan Region. If a wet Pacific storm reaches the area at the same time as cold westward winds from the Gorge, significant snow or ice storms can result. Ice storms can take the form of freezing rain, sleet, and hail.

2.2.2 Climate Change

Changes in temperature and precipitation from climate change in Multnomah County are expected to be severe, with summer temperatures becoming more extreme and winter precipitation having increased periods of intense rain. Extreme weather of all types is expected to become more unpredictable.

Potential effects of climate change are detailed for each hazard in their specific chapters. The hazards included in this plan that are expected to be the most impacted by a warming climate are extreme heat, wildfire and drought. Flooding is also expected to become more common and intense because of altered winter weather patterns, which will also increase the risk of landslides. The general disruption of weather patterns may also impact the severity of windstorms and snow or ice storms.

The predominant climate change scenario used in this plan is RCP (Representative Concentration Pathway) 8.5. This scenario is a conservative estimate of future conditions, where there is not significant change to the current trend of emissions and warming. This scenario is one of the primary models used by the Fifth Oregon Climate Assessment, the main source for climate change information in this plan.

2.3 Demographics

Population demographics for city and county jurisdictions are based on incorporated limits at the time of data collection – note that not all demographic totals are from the same census or year of estimation. The most recent available data was used for each statistical subset.

The Columbia Corridor Drainage Districts serve populations that are protected from flood by the levee systems that these districts manage. This population is also part of different city and unincorporated area populations. In most cases, federal census tracts that come closest to the district boundaries have been used, but those totals will be slightly oversampled and have some internal duplication. To give demographic context to the future Urban Flood Safety and Water Quality District (UFSWQD), totals for the MCDD are equivalent, as MCDD already includes all of the census tracts used in individual district counts.

- PEN 1 and PEN 2 – Tract 72.02 (tract boundary is the closest geographical reference for both districts)
- MCDD – Tracts 72.02, 73, 102
- SDIC – Tract 102

Population demographics are not provided for the Port of Portland which has no residential population. Information is provided for those traveling through or working at Port facilities.

For demographic statistics relating to unincorporated Multnomah County, census tracts have also been used to estimate populations. These tracts are also not perfect matches to the areas described, but provide the best available estimate for demographic purposes. The tracts may include small areas that overlap with city counts. Unincorporated enclaves inside the Urban Growth Boundary are not included in counts. The four areas used for unincorporated Multnomah County are:

- The West Hills - Tract 70.02
- The West Hills and Sauvie Island - Tract 71
- West of the Sandy River - Tract 104.02
- East of the Sandy River - Tract 105

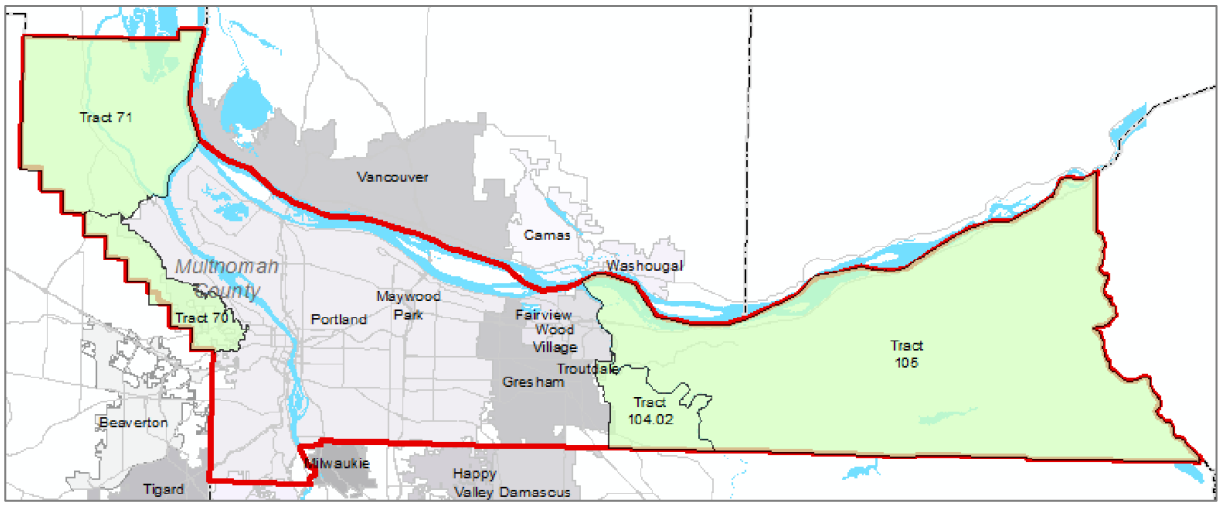

Figure 12 - Map showing census tracts used for demographic estimations in unincorporated Multnomah County. Map from Multnomah County Comprehensive Plan with data from the US Census Bureau.

2.3.1 Population

Multnomah County's population as of the United States 2020 Census is 815,428[10] people. This represents a 4.9% increase since the 2014/2015 estimates used in 2017 NHMP. In that time, the county's population has grown at a slightly more rapid rate than Oregon as a whole. Growth has principally occurred in cities, while unincorporated areas have grown more slowly, or declined in population due to annexations by neighboring cities.

To count those served by the Columbia Corridor Drainage Districts, population estimates from a 2018 flood study conducted by the Oregon Department of Geology and Mineral Industries (DOGAMI) are used. The DOGAMI study estimated population based on the number of residential structures within each district boundary. These totals still overlap with those of cities and the unincorporated County and are estimates, but are more accurate than using tract boundaries. Note that the population for the SDIC is much lower than population used from census tract estimation in other demographic categories, because of this refinement.

[10] US Census 2020, in 2021 the Census estimated a County population of 803,377, a decline of over 12,000 people. Portland State Population Center data is used for population estimates in this plan. Their 2022 estimate for Multnomah County is 810,242 people.

Table 3 – Population Totals and Change Since 2017 NHMP Totals (US Census, 2020)

	2020		2014/2015		Population Change 2014/2015-2020	
	Population	% of County	Population	% of County	Population Change	Percent Change
Oregon	4,237,256	-	4,013,845	-	182,771	4.6%
Multnomah County	815,428	100%	777,490	100%	37,938	4.9%
Incorporated Areas	798,698	98.0%	750,040	96.5%	48,650	6.5%
Fairview	10,424	1.3%	8,940	1.1%	584	6.5%
Gresham	114,247	14.0%	107,065	13.8%	7,182	6.7%
Maywood Park	829	0.1%	750	0.1%	79	10.5%
Portland	652,503	80.0%	613,355	78.9%	39,148	6.4%
Troutdale	16,300	2.0%	16,020	2.1%	280	1.7%
Wood Village	4,387	0.5%	3,910	0.5%	477	12.2%
Unincorporated Areas	16,738	2.0%	27,450	3.5%	-10,712	-39.0%
West Hills	2,857	0.4%	8,104	1.0%	-5,247	-64.7%
Sauvie Island & West Hills	2,771	0.3%	2,650	0.3%	121	4.4%
West of Sandy River	6,298	0.8%	6,181	0.8%	117	1.9%
East of Sandy River	3,947	0.5%	4,308	0.6%	-361	-0.1%
Columbia Corridor Drainage Districts (UFSWQD)	7,436					
PEN 1 (2018 DOGAMI est.)	15					
PEN 2 (2018 DOGAMI est.)	2,480					
MCDD (2018 DOGAMI est.)	4,927					
SDIC (2018 DOGAMI est.)	14					

2.3.2 Population Distribution

98% of Multnomah County residents live in incorporated cities, and 94% of county residents live in either Portland or Gresham. Population is highly concentrated in the center of the county. The cities in this plan and unincorporated areas make up about 20% of the total population, but services provided by Multnomah County and the Special Districts in this plan affect the entire county, making the scope of hazard mitigation strategy extensive.

The region's Urban Growth Boundary (UGB) restricts high-density development outside of pre-defined growth limits, creating areas where current and future development are expected to occur most intensely now and in the future.

The map below shows the distribution of housing units in the county, indicating the extreme difference between central city areas, suburban edges, and rural portions of the county. This difference requires mitigation that is reflective of the different needs of urban and rural residents.

An interactive version of this map can be found at this link (Planning and Cadastral – Estimated Housing Density)

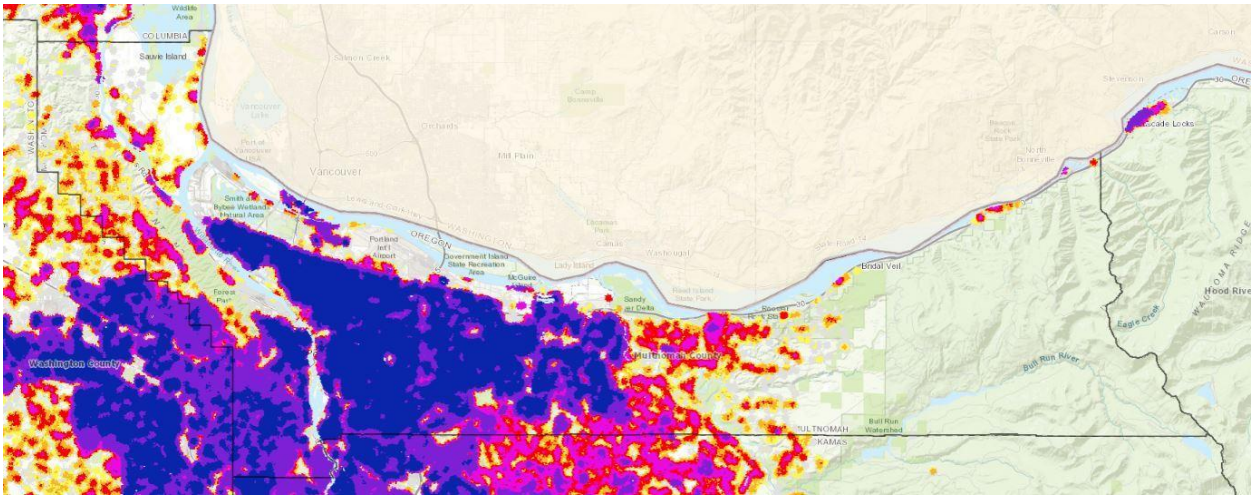

Figure 13 - Map showing housing density in Multnomah County, via the Oregon Wildfire Explorer with data from the 2013 ORNL Landscan analysis. The darkest color represents more than 3 houses per acre. Lighter colored areas in orange or yellow represent locations with one house per 10-40 acres and area with no overlying color have less than one house per 40 acres.

Development density can have positive or negative ramifications on natural hazard resilience, with differences caused by social conditions and the built and natural environment. Those living in multi-story buildings are typically more at risk from structural earthquake damage. Densely developed areas with limited tree canopy see higher temperatures and more risk to health from heat, and that effect is increased even more for those living on higher apartment floors. Those in low-density parts of the county are more likely to be at risk from landslide and wildfire, as those hazards correspond with land characteristics such as steep slopes that make them less likely to be compatible with dense development.

When a localized disaster occurs in a dense area, it will impact many more people and the need for shelter, evacuation and other support may be overwhelming. Urban residents may be less prepared for the long-term loss of power and municipal water and sewer systems. However urban areas also have more redundancies – a greater variety of ways to access transportation routes, health care, food, power and other necessities when large-scale damage or disruption occurs[11]. Parts of rural Multnomah County may be heavily reliant on a single transportation route to get to resource sites in spread out locations, and those routes may become impassable during disasters.

[11] How Density Makes Us Safer During Natural Disasters, *Bloomberg*, Vishaan Chakrabarti, September 19, 2013

Unincorporated areas have a higher proportion of older adults than cities, and those older adults may be at greater risk from harm due to that lack of readily accessible resources. Some higher density areas have the highest rates of poverty, with the most residents who lack resources to evacuate before or after a disaster, or to stockpile supplies. Denser areas are also likely to have higher proportions of people who speak languages other than English and who may be less likely to receive emergency warnings, alerts and pre-disaster messaging. Those in rural areas may also be less likely to get emergency information, because of less reliable communications infrastructure.

2.3.3 Population Projection

Growth projections for Multnomah County are conducted by Metro, as part of its 50-year growth plan. Estimates were developed in 2016 with projections at five-year intervals until 2060. This most recent estimate put the population of Multnomah County, depending on scenarios, at roughly between 1 million to 1.3 million people by 2060. This would represent a continuing slowing of growth from the previous 35 years due to trends in birth rates, immigration, housing, and other economic factors. Estimates are not provided on the municipal level. Within the Portland Metropolitan Area, Hispanic populations are predicted to grow the most, and the population of all races and genders is expected to continue to become older on average. Growth is expected to continue to occur mostly within cities.

Additional growth will add to risk in all the dimensions described in this plan, including new housing or commercial development in areas with known natural hazard risks and a subsequent increased population of people at high risk from future events.

2.3.4 Daytime Population

Disaster resilience is also influenced by those who are in Multnomah County temporarily, because they are less likely to have disaster preparedness awareness and vulnerability information for the locations where they are working or visiting.

Estimates of earthquake vulnerability performed by the Oregon Department of Geology and Mineral Industries (DOGAMI) make separate casualty estimates for day and night. The county's populations swells during the day, and those present in the day are more likely to be located in multi-story buildings that are more likely to be built of masonry and therefore at higher risk of damage or collapse. Daytime populations may also be more likely to be trapped away from home and require transport, shelter, and reunification services. In DOGAMI's earthquake analysis, daytime vulnerability of injury and death is increased by three to four times compared to a nighttime event[12].

2.3.5 Migrant and Seasonal Farmworkers

In 2018, the Oregon Health Authority published estimates of the population of those in migrant or seasonal farmworker households. Multnomah County's estimate was 3,173 people[13], about

[12] Data from DOGAMI report O-18-02, Earthquake regional impact analysis for Clackamas, Multnomah, and Washington counties, Oregon. The report quantifies total casualties (defined as minor injuries, injuries requiring hospitalization, and fatalities) at 11,400-16,700 in the day and 2,800-5,600 at night. The lower and upper totals are dependent on another factor, whether the event happens when soils are wet or dry.

[13] Estimates of Migrant and Seasonal Farmworkers in Agriculture, 2018 Update, Oregon Health Authority, Mallory Rahe, June 2018, Table 1, County level migrant and seasonal farmworked estimates, p.8

2% of the Oregon total. This total is a slightly increase from the previous 2013 estimate. Migrant and seasonal farmworkers face increased direct risk from hazards, especially when working outdoors or living in unweatherized housing during high heat or wildfire smoke events. Other disasters may pose high risk for harm as well, as these workers and their families may not be aware of local hazard risks and may be harder to reach with preparation, evacuation or response messaging because of temporary living locations and limited English proficiency.

2.3.6 Tourists and Other Visitors

Approximately 5.4 million overnight visitors came to Multnomah County in 2019[14]. While this number presumably declined after the onset of COVID-19, a return to pre-pandemic numbers would mean millions of people per year in temporary stays roughly split between hotels/motels and private homes. Summer is the high season for visitors, creating potential for health effects from extreme heat and wildfire smoke. In general, tourists may not be aware of natural hazard risks or emergency notification or response procedures and lack emergency supplies. Tourists across Multnomah County may quickly become vulnerable during a disaster.

The Portland International Airport is Oregon's largest airport, with nearly 20,000,000 travelers passing through in 2019 for personal or business travel. The number of passengers dropped sharply during the peak of the COVID-19 pandemic, and is now returning to pre-pandemic levels. The large number of people using the airport at a given time will require a large safety and sheltering response in a major natural disaster. The airport is also one of the county's largest job sites, employing about 10,000 people.

2.3.7 Population by Age

Children and older adults are often among the most vulnerable age groups in a natural disaster. Older adults may have more difficulty evacuating from acute danger and be more likely to have health conditions that may increase their vulnerability to disaster, especially during extreme heat, cold, hazardous air quality and long-term power loss. There may also be a need for specific strategies to assist older adults in hazard preparation, risk awareness, and safety during emergencies. Children may have difficulty coping with disasters and become extremely vulnerable when separated from caregivers. Children are also at greater risk from climate-related health hazards, especially unhealthy air.

Compared to data used in the 2017 version of this plan, Multnomah County has seen a significant increase in older adults, defined here as those age 65 and over. This trend is mirrored across Oregon. The total number of children under the age of 18 has dropped in Multnomah County since 2015. However, there are still more children than older adults in Multnomah County in all participating entities except for the City of Fairview. The unincorporated area of Sauvie Island and the West Hills, and some areas served by the Columbia Corridor Drainage Districts also have more older adults than children.

Of participants in this plan, Troutdale, Wood Village and Gresham have the highest percentages of children. The unincorporated areas on the west side of the county have the highest proportion of those over the age of 65.

[14] Oregon Travel Impacts, Statewide Impacts 1992-2019p, Dean Runyan Associates for the Oregon Tourism Commission, April 2020, p.161

Table 4 – Population by Age and Change Since 2017 NHMP Totals (US Census American Community Survey, 2019 – Table S1601)

Community	Under 18 years	Percent of Total Population	Change Since 2014/15	65 or Over	Percent of Total Population	Change Since 2014/15
Oregon	862,816	20.4%	+0.3%	767,496	18.1%	+24.1%
Multnomah County	149,667	18.4%	-1.6%	113,135	13.9%	+24.9%
Fairview	1,549	14.9%	-31.2%	1,740	16.7%	+34.5%
Gresham	26,359	23.1%	-4.5%	15,572	13.6%	+18.2%
Maywood Park	273	32.9%	+34.8%	142	17.1%	+1.4%
Portland	113,464	17.4%	+0.2%	85,802	13.1%	+23.0%
Troutdale	4,760	29.2%	+5.9%	1,493	9.2%	+8.0%
Wood Village	1,440	32.8%	+15.8%	322	7.3%	+4.7%
Unincorporated Areas						
West Hills	679	23.8%		636	22.2%	
Sauvie Island & West Hills	338	12.2%		686	24.8%	
West of Sandy River	1,706	27.1%		978	15.5%	
East of Sandy River	924	23.4%		723	18.3%	
Columbia Corridor Drainage District Areas (UFSWQD)						
MCDD	1,689	13.4%		1,975	15.6%	
PEN1 and PEN2	541	14.5%		529	14.2%	
SDIC	1,088	15.3%		1,360	19.1%	

2.3.8 Population with Disability

Hazard planning for those with disabilities is an essential requirement for equitable mitigation. There is a large diversity of types of disabilities, each of which requires analysis as to what mitigation strategies will be most beneficial for those groups in disasters. Most importantly, it is essential to consider how natural disasters impact people differently and how mitigation strategies may support or leave out different disabled populations in their implementation.

Some broad risks to disabled groups from hazards are less accessibility to disaster messaging, physical barriers to evacuation, interruption of caregiver support, long-term loss of power (preventing use of powered medical devices and maintaining refrigerated medication), and heightened risk from climate impacts such as heat and unhealthy air because of existing health conditions.

The US Census uses federally-designated disability categories, which may not fully align with categories and terminologies used by disability communities themselves or in other government service contexts. Some non-visible disabilities are not captured by these categories and respondents who feel their disability does not fit in this classification may not be counted as disabled. The census categories are:

- **Hearing difficulty:** Deaf or having serious difficulty hearing.
- **Vision difficulty**: Blind or having serious difficulty seeing, even when wearing glasses.
- **Cognitive difficulty:** Because of a physical, mental or emotional problem, having difficulty remembering, concentrating or making decisions.
- **Ambulatory difficulty:** Having serious difficulty walking or climbing stairs.
- **Self-care difficulty:** Having difficulty bathing or dressing.
- **Independent living difficulty:** Because of a physical, mental or emotional problem, having difficulty doing errands alone such as visiting a doctor's office or shopping.

Census data of persons with disabilities has other limitations that may also lead to undercounting that then creates barriers to resources[15]. Census disability data is self-reported through surveys, and not collected during Decennial Censuses. Respondents may under-report their symptoms or not answer because of societal stigma toward disability[16]. Census processes are also believed to undercount those with disabilities because of insufficient accessible technology for internet response. The intersection of disability with other undercounted demographic groups, such as people of color, non-English speaking communities, and those with housing instability may also contribute to undercounting.

The most recent Federal survey count shows that Multnomah County as a whole has a slightly smaller percentage of those reporting disability than Oregon as a whole. Rural communities generally have higher reported levels of disability however many of the groups that are habitually undercounted in census surveys are also those with higher rates of disability and are more likely to live in metropolitan areas. Rural areas of Multnomah County have a similar or lower rate of reported disability than incorporated areas.

Of those communities participating in this plan, the Cities of Fairview and Gresham have the largest proportion of disability populations, both slightly higher than the state average. Nearly 100,000 people in Multnomah County reported having one or more of the disabilities tracked by the census in the most recent count.

The most important strategy for understanding risk to disability communities remains disability community engagement and inclusivity in pre-disaster planning.

[15] Count Everyone, Include Everyone, *National Disability Rights Network* , October 2021, p. 13

[16] The Census Bureau and Disability Data, *TheRespectAbility Report*, Ian Malesiewski, July 13, 2021

Table 5 – Population by Type of Disability (US Census American Community Survey, 2020 – Table S1810)

Community	Persons with a Disability	% of Total	Hearing Difficulty	Vision Difficulty	Cognitive Disability	Ambulatory Difficulty	Self-Care Difficulty	Independent Living Difficulty
Oregon	592,689	14.0%	190,325 (4.6% of all people)	97,777 (2.4% of all people)	241,437 (6.2% of all people)	274,925 (7.0% of all people)	105,663 (2.7% of all people)	200,719 (6.1% of all people)
Multnomah County	98,985	12.1%	26,660 (3.3%)	17,327 (2.2%)	45,826 (6.0%)	41.996 (5.5%)	18,459 (2.4%)	34,900 (5.3%)
Incorporated Cities								
Fairview	1,498	14.4%	466 (5.0%)	296 (3.2%)	656 (7.0%)	770 (8.2%)	204 (2.2%)	628 (6.7%)
Gresham	16,778	14.9%	4,406 (4.0%)	2,743 (2.5%)	7,723 (7.0%)	7,540 (6.9%)	3,786 (3.4%)	6,226 (5.7%)
Maywood Park	232	28.0%	48 (3.9%)	10 (0.8%)	68 (5.6%)	126 (10.3%)	83 (6.8%)	105 (8.6%)
Portland	76.620	11.7%	20,662 (3.2%)	13,473 (2.1%)	35,850 (5.6%)	31,836 (4.9%)	13,773 (2.1%)	26,688 (4.1%)
Troutdale	1,486	9.1%	373 (2.3%)	266 (1.6%)	623 (3.8%)	777 (4.7%)	223 (1.4%)	544 (3.3%)
Wood Village	350	8.0%	102 (2.5%)	67 (1.7%)	171 (4.2%)	136 (3.4%)	84 (2.1%)	194 (4.8%)
Unincorporated Planning Areas								
West Hills	204	7.1%	74 (2.6%)	20 (0.7%)	34 (1.2%)	96 (3.4%)	0 (0.0%)	37 (1.3%)
Sauvie Island & West Hills	472	17.0%	258 (9.3%)	61 (2.2%)	213 (7.7%)	170 (6.1%)	8 (0.3%)	77 (2.8%)
West of Sandy River	555	8.8%	121 (1.9%)	94 (1.5%)	202 (3.2%)	218 (3.5%)	100 (1.6%)	203 (3.2%)
East of Sandy River	447	11.3%	162 (4.1%)	63 (1.6%)	202 (5.1%)	111 (2.8%)	98 (2.5%)	86 (2.2%)
Columbia Corridor Drainage District Areas (UFSWQD)								
PEN 1 and PEN 2	341	9.1%	101 (2.7%)	40 (1.1%)	149 (4.0%)	117 (3.1%)	37 (1.0%)	61 (1.6%)
MCDD	1,525	12.1%	441 (3.5%)	171 (1.4%)	682 (5.4%)	675 (5.3%)	206 (1.6%)	517 (4.1%)
SDIC	1,031	14.5%	294 (4.1%)	108 (1.5%)	409 (5.7%)	494 (6.9%)	142 (2.0%)	387 (5.4%)

Residential Care Homes

Care homes for adults and children are key critical facilities for the care of at-risk residents, many of whom are disabled.

Multnomah County's Department of Human Services (DCHS) provides licensing and oversight of care homes through its Aging, Disability, and Veterans Services Division (ADVSD) and Intellectual and Developmental Disabilities Division (IDD). DCHS maintains mapping of these facilities as a way to understand their risks, monitor their resilience to hazards, and ensure response support is provided during disasters. Care facilities are a priority for long-term resilience evaluation and support.

Pre-Existing Health Conditions

Those with pre-existing health conditions are mentioned throughout this plan as being at high risk, especially from climate-related hazards. Some existing respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD) are not expressly included in disability census rates, but are a high risk factor for harm from heat and unhealthy air. Cardiovascular disease and other conditions can also raise risks. A more complete list of risk factors is located in the chapters for Severe Weather and Wildfire and Wildfire Smoke.

DCHS and the Multnomah County Health Department (MCHD) have the ability to provide case manager support, health resources, and specific safety messaging to clients based on their health risk factors.

2.3.9 Population by Race or Ethnicity

Multnomah County is considerably more racially diverse than Oregon as a whole, with a higher proportion of Black and African-American, Asian, Native Hawaiian and Pacific Islander and multi-racial populations. Multnomah County has, overall, a lower proportion of Hispanic and Latino residents than the state, but that statistic is skewed by the size and demographics of the City of Portland. Every participating city in this plan has a higher than state average proportion of Hispanic or Latino residents, and it is the fastest growing ethnic demographic in those communities as well.

It is necessary to recognize the distribution of residents by race and ethnicity, because communities of color face increased risk from natural hazards, due to historical and ongoing social and economic discrimination. Historic and current community investment decisions have affected where people live and what governmental services and resources have been made available. The physical locations of communities of color have been at higher risk of hazards such as flood, and characteristics of the built environment such as housing without seismic safety retrofitting and less tree canopy increase the potential severity of earthquake and heat hazards respectively in neighborhoods with a high proportion of residents of color.

Hazard resilience has also been diminished in communities of color by inequitable distribution of post-disaster support. Recent research has shown that FEMA has provided more support to white disaster victims than people of color, and less support to communities with a higher percentage of non-white residents[17]. These disparities may reflect a correlation with existing inequality, such as in lowered real estate values, which are then used to determine how much aid is provided after a disaster. The effect has been that white residents have seen wealth increase after disasters because of governmental support while non-white residents have lost wealth in the same incidents.

In order to prevent these race-based disparities from being continued or increased, it is necessary to maintain awareness of where communities of color are most likely to live in Multnomah County and which disasters are most likely to impact those communities. Mitigation resources can then be prioritized to those who will face the largest challenges to accessing resilience resources and sharing in equitable recovery.

[17] Why Does Disaster Aid Often Favor White People?, *New York Times*, Christopher Flavelle, June 7, 2021.

Table 5 – Population by Race and Ethnicity (US Census, 2020 – Table P2)

Community	Race							Ethnicity
	African American	American Indian & Alaskan Native	Asian	Native Hawaiian & Pacific Islander	Other Race	Two or More Races	White	Hispanic or Latino
Oregon	1.9%	1.0%	4.5%	0.4%	0.5%	6.1%	71.7%	13.9%
Multnomah County	5.4%	0.7%	7.5%	0.6%	0.6%	6.8%	65.9%	12.7%
Incorporated Cities								
Fairview	5.4%	0.9%	6.3%	1.1%	0.4%	6.8%	58.9%	20.3%
Gresham	5.0%	0.8%	5.9%	1.1%	0.5%	6.1%	59.6%	21.0%
Maywood Park	2.7%	0.0%	7.0%	0.0%	0.6%	4.8%	76.1%	8.8%
Portland	5.7%	0.7%	8.0%	0.6%	0.6%	7.0%	66.4%	11.1%
Troutdale	2.2%	0.6%	5.4%	0.6%	0.5%	6.1%	69.9%	14.7%
Wood Village	1.8%	0.6%	3.9%	0.8%	0.2%	5.0%	45.0%	42.8%
Unincorporated Areas								
West Hills	0.8%	0.4%	9.5%	0.1%	2.4%	9.5%	77.1%	5.4%
Sauvie Island & West Hills	0.3%	1.2%	2.5%	0.3%	2.3%	9.4%	83.4%	6.4%
West of Sandy River	1.4%	0.9%	3.7%	0.2%	3.4%	9.6%	80.8%	8.2%
East of Sandy River	0.5%	0.3%	1.4%	0.3%	1.5%	7.4%	88.5%	4.5%
Columbia Corridor Drainage District Areas (UFSWQD)								
PEN 1 and PEN 2	11.8%	2.9%	5.9%	1.4%	0.8%	6.4%	56.6%	19.6%
MCDD	7.8%	2.4%	6.9%	0.1%	0.5%	5.8%	62.2%	22.1%
SDIC	5.0%	2.1%	8.1%	0.7%	0.4%	5.6%	56.4%	25.4%

Wood Village, Fairview, and Gresham have the largest non-white populations. Wood Village has the largest Hispanic/Latino population, while Fairview and Gresham have the largest proportions of African-American/Black, American Indian/Alaskan Native, and Pacific Islander populations. Areas served by the Columbia Corridor Drainage Districts are also more racially and ethnically diverse than the county as a whole. The unincorporated areas on both sides of the county have the lowest proportions of non-white residents.

2.3.10 Population by Primary Language Spoken

Nearly 20% of Multnomah County residents over the age of five do not speak English as their primary language at home and almost 8% speak English less than ‘very well’ as recorded by the

United States Census. These numbers are both higher than the Oregon average, reflecting the racial, ethnic, and linguistic diversity of Multnomah County. This also indicates a higher percentage of immigrants and refugees, who face additional barriers to mitigation resources beyond language access.

In Multnomah County, over 150,000 people do not speak English at home and about 60,000 have limited English proficiency. It is essential that communities and districts provide multilingual communication relating to natural hazard risks. Multnomah County has about 28% of Oregon's total population of people with limited English proficiency.

Table 6 – Population By English-language proficiency and language other than English spoken at home (US Census American Community Survey, 2019 – Table S1601)

Community	Population 5 years & over	Speak English only at home	% of total	Speak a language other than English at home	% of total	Speak English less than 'very well'	% of total
Oregon	3,948,032	3,354,986	84.7%	603,049	15.3%	216,654	5.5%
Multnomah County	767,016	614,476	80.1%	152,540	19.9%	60,019	7.8%
Incorporated Cities	749,936	599,025	79.9%	150,911	20.1%	59,611	8.0%
Fairview	9,033	7,216	79.9%	1,817	20.1%	601	6.7%
Gresham	103,168	75,743	73.4%	27,425	26.6%	11,445	11.1%
Maywood Park	1,160	1,113	95.9%	47	4.1%	16	1.4%
Portland	618,217	501,662	81.1%	116,555	18.9%	45,119	7.3%
Troutdale	14,801	11,744	79.3%	3,057	20.7%	1,261	8.5%
Wood Village	3,557	1,547	43.5%	2,010	56.5%	1,169	32.9%
Unincorporated Areas	17,080	15,451	90.5%	1,629	9.5%	408	2.4%
West Hills	3,137	2,610	83.2%	527	16.8%	133	4.2%
Sauvie Island & West Hills	2,432	2,181	89.7%	251	10.3%	97	4.0%
West of Sandy River	6,305	5,458	86.7%	847	13.4%	240	3.8%
East of Sandy River	3,880	3,439	88.6%	441	11.4%	100	2.6%
Columbia Corridor Drainage District Areas (UFSWQD)							
PEN 1 and PEN 2	3,055	2,136	70.0%	919	30.1%	268	8.8%
MCDD	10,321	6,853	66.4%	3,468	33.6%	1,361	13.2%
SDIC	6,178	3,783	61.2%	2,395	38.8%	1,054	17.1%

Not only does Multnomah County have a large proportion of residents with limited English proficiency, it also has a wide variety of represented native languages, making simple translation and outreach planning insufficient. In the 2014 5-year American Community Survey

Estimate, 30 separate languages or language groups were identified[18] as having at least 70 speakers with limited English proficiency.

Communities which do not speak English or Spanish may lack reliable access to documents and messages translated into their native language, and need additional resources for natural hazard risk communication. All residents with limited English proficiency may especially rely on relatives and social networks for information.

Of the participating communities to this plan, Wood Village has by far the highest proportion of residents not speaking English at home, as the only community with a majority of residents speaking a language other than English at home. Wood Village also has the highest proportion of residents with limited English proficiency. Gresham has the second highest proportion of each category. The City of Portland has low proportions of residents with limited English proficiency in Downtown and the Central City, but levels in Southeast Portland are similar to that in Gresham and Wood Village, making that area of East Multnomah County a particular focus area for multilingual communication and outreach.

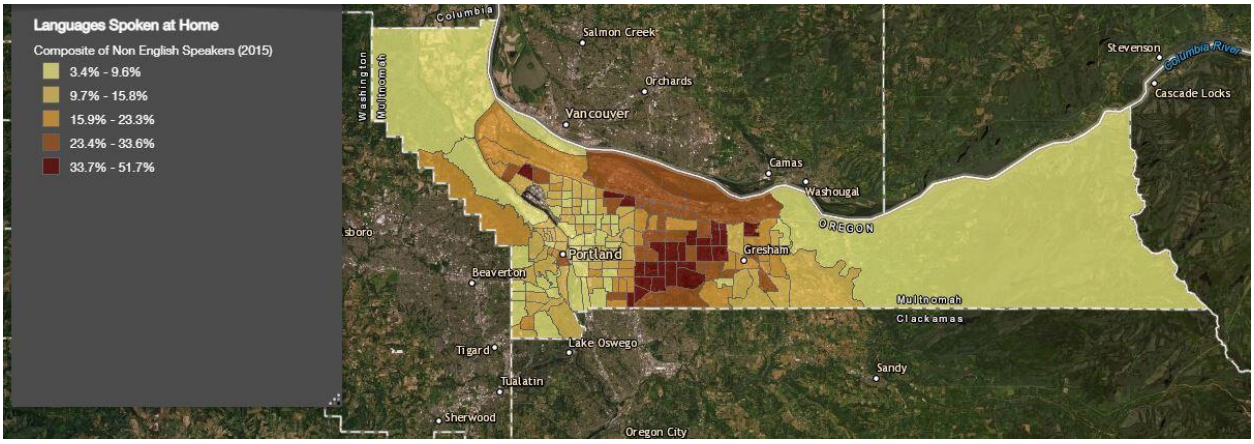

Figure 14 - Map showing frequency of non-English speaking household by census tract. Data from 2015 American Community Survey.

2.4 Socioeconomics

2.4.1 Poverty

Research indicates that poverty is a driver of risk from natural hazards[19]. There are a number of reasons why a household experiencing poverty may be more at risk from harm in a natural hazard event. Some of these reasons are that lower-income individuals and families may be:

- more likely to live in high-hazard areas due to historic and current housing market outcomes;

[18] The most common languages recorded, in order of frequency, were Spanish, Vietnamese, Chinese, Russian, Tagalog, Korean, Japanese, Arabic, Khmer, Serbo-Croatian, Laotian, Hmong, French, Thai, Persian, German, Hindi, Portuguese, Italian, Greek, Hungarian, Urdu, and French Creole. A number of other languages were classified into broader language groups.

[19] From Poverty to Disaster and Back: a Review of the Literature, *Economics of Disasters and Climate Change*, S. Hallegatte, A. Vogt-Schilb, J. Rozenberg, M. Bangalore, C. Beaudet, Issue 4 (2020), ps. 223-247

- less able to prepare for disasters because of the cost of purchasing and maintaining supplies;
- more likely to have employment that puts them more at risk from natural hazards due to requiring working outside or in unreinforced buildings;
- less able to evacuate before or during a disaster and relocate temporarily or permanently after a disaster; and
- more likely to have difficulty rebuilding after a disaster.

The official poverty rate is a federally designated calculation. In the 2020 Census, poverty rates were found to have declined in Multnomah County over the last five years due to economic growth, demographic changes, and displacement of low-income residents from the county. Gresham and Portland still have higher poverty rates than Oregon as a whole. Gresham and Fairview have higher rates of child poverty, while Portland has the highest rate of poverty among older residents. Unincorporated areas have the lowest poverty rates in the county.

Table 7 – Population by poverty rate and poverty rate by age (US Census American Community Survey, 2020 – Table S1701)

Community	Total Population	People in Poverty	Poverty Rate	Change Since 2014	Under 18 Poverty Rate	65 and Over Poverty Rate
Oregon	4,096,744	506,588	12.4%	-4.3%	15.0%	8.0%
Multnomah County	795,408	104,861	13.2%	-5.3%	16.8%	10.3%
Fairview	9,382	830	8.8%	-8.2%	27.4%	4.3%
Gresham	109,322	17,568	16.1%	-7.5%	26.2%	8.0%
Maywood Park	1.224	99	8.1%	+3.3%	7.3%	0.7%
Portland	637,260	83,223	13.1%	-5.2%	15.1%	11.1%
Troutdale	16,348	1,418	8.7%	-7.7%	11.2%	4.0%
Wood Village	4,013	501	12.5%	-17.8%	16.6%	0.0%
Unincorporated						
West Hills	3,364	130	3.9%		0.0%	1.6%
Sauvie Island & West Hills	2,460	177	7.2%		0.6%	2.1%
West of Sandy River	6,657	364	5.5%		0.4%	0.9%
East of Sandy River	4,140	285	6.9%		1.2%	0.8%
Columbia Corridor Drainage District Areas (UFSWQD)						
PEN1 and PEN2	3,155	363	11.5%		2.8%	1.6%
MCDD	9,951	892	9.0%		1.6%	0.7%
SDIC	6,362	367	5.8%		2.6%	1.0%

In 2019, Multnomah County released a report on poverty in the county. The report noted that the Federal designation of poverty undercounts those who are unable to meet basic needs and lack resources to participate as full and equal members in society. While the Federal poverty rate (from the earlier estimate) found Multnomah County to have a 16% poverty rate, the 2019 study found 34% of County residents met that threshold. The study also identified 8% of county residents in deep poverty, and therefore most vulnerable to the risk factors described above.

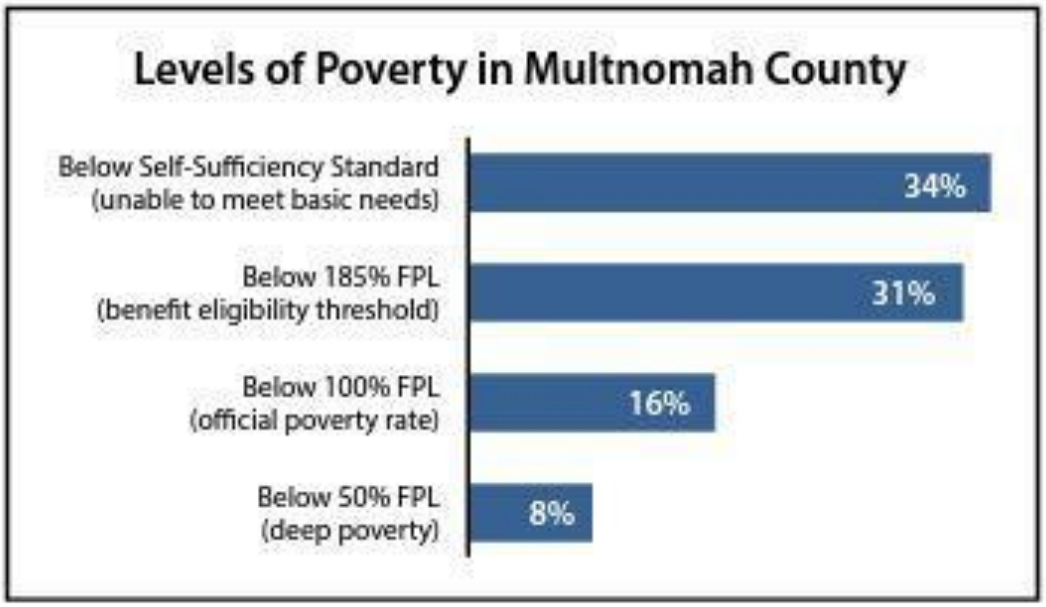

Figure 15 - Poverty rates in Multnomah County. FPL is the Federal Poverty Rate used in Census poverty counts. Data from the 2019 Poverty in Multnomah County report.

2.4.2 Economic Sectors

The largest employment sectors in Multnomah County are[20]:

- Trade, Transportation and Utilities (18.2%)
- Professional and Business Services (16.3%)
- Education and Health Services (15.4%)
- Government (14.1%)
- Leisure and Hospitality (11.4%)

Vulnerability based on employment type is hard to forecast, although Multnomah County has a large percentage of office sectors that may increase the impacts of seismic hazard because of workplace risk. The sectors themselves are subject to disruption from damaged or disrupted transportation systems. Leisure and hospitality is a key sector in Multnomah County, and is more significant than in other regional counties. A significant disaster that interrupted tourism could reduce economic resilience in much the same manner as has happened throughout the COVID-19 pandemic[21]. Services, private education, and retailing were the other sectors most disrupted by the pandemic.

The construction sector is slightly smaller than that of regional neighbors. Despite being a highly urbanized county, Multnomah County does have agricultural and forestry sectors that could be harmed by wildfire, landslide, and other hazards and pose specific hazards from heat and smoke to outdoor workers.

[20] United States Bureau of Labor Statistics, Occupational Employment and Wage Statistics, May 2021.

[21] State of Oregon Employment Department, Portland Metropolitan Area's Economic Recovery Successes and Ongoing Challenges, May 9, 2022, Amy Vander Vliet

2.5 Housing

2.5.1 Unhoused Residents

Not all residents of Multnomah County have fixed addresses, and Census data does not effectively capture numbers of people without stable housing. Multnomah County's unhoused population, especially those who are unsheltered, face some of the most severe and repeated risks from natural hazards.

Multnomah County conducts a Point In Time (PIT) census of unhoused residents approximately every two years. The most recent PIT census found 5,228 people experiencing homelessness on January 26, 2022. This was a 23% increase from the 2019 census, when 4,015 people were counted.

3,057 people in the 2022 count (about 59%) were unsheltered, meaning they lived outdoors and did not have access to emergency shelter or transitional housing. The proportion of those unsheltered while experiencing homelessness has increased since 2019 by about 1,000 additional unsheltered residents in the previous three years.

Those considered to be experiencing chronic homelessness–with a disabling condition and having been homeless for a year or more–made up 66.5% of those unsheltered in 2019[22], a sharp increase from 2017. 72% of people counted in 2019 identified at least one disability, with 25% having a chronic health condition and/or physical disability. Unsheltered residents were primarily located in Portland, but about 5% were located in Gresham and another 4% in 'East County', an area including the other cities in this plan and unincorporated areas stretching to the eastern county line. People of color were overrepresented in 2022, making up about 40% of the total count.

The high proportion of chronic health conditions among unhoused residents indicates acute risks from heat and smoke, especially considering the difficulty these residents have in evacuating dangerous areas or creating spaces with climate control or filtered air. Emergency severe weather shelters have been used to provide safer spaces during climate disasters.

Climate hazards have been the most deadly natural hazard[23] for unsheltered residents, with winter storms and extreme heat causing the greatest loss of life over the last five years. Hazards requiring evacuation may also present greater risk to the unhoused, as they may live in areas out of sight to responders and have less ability to receive warnings and evacuation alerts.

Risk to unsheltered residents from wildfire may be high in forests, along grassy levees, and other areas of the county with wildfire fuel, especially since unsheltered residents may increase fire risk due to the use of open cooking or warming fires. In the 2022 count, 10% of unsheltered residents were identified as living in woods or other open space. Flooding is also a major concern for unsheltered residents, with heightened risk along the Columbia Corridor levee system, the Sandy River Delta (also known as Thousand Acres), the Springwater Corridor along Johnson Creek, and other locations.

[22] At the time of writing, some details from the 2022 count had not yet been released.

[23] COVID-19 is not considered a natural hazard for the purpose of this plan.

Those living in temporary or emergency shelters or transitional housing rely on those facilities being resilient to seismic and climate hazards and having plans in place for evacuation or relocation.

2.5.2 Population by Housing Type

The type and quality of permanent housing makes a big difference in terms of impacts from different natural hazards.

Multi-family residences can be at higher risk from damage in earthquakes because older masonry buildings fare worse in seismic events than wood-framed homes. Collapse of multi-story buildings can lead to higher casualties, and evacuation of multi-family housing can be more difficult, especially when combined with power loss, building damage or poor visibility.

Those living on higher floors of uncooled spaces will experience greater risk during extreme heat events, as heat rises through the day and holds higher temperatures over warm nights. A correlation in deaths was found in the July 2021 Heat Dome event for those living on the third floor or higher of non-climate controlled spaces and readings have shown ambient temperatures as much as 30 degrees higher at that height than ground floor spaces outside of urban heat island areas.

Mobile homes also carry different levels of risk as compared to site-built housing. Mobile homes can be moved off their foundations by earthquake or wind if not tied down adequately, suffer more damage from floods, and may lack equivalent levels of weatherization or central climate control.

Multi-family dwellings and mobile homes make up a larger share of lower cost housing as well, so residents may already have fewer resources to prepare and more barriers to recovery. These dwellings are also more likely to be rental housing, which adds additional risk, as noted in the Housing Tenure section below.

Multnomah County has a larger proportion of multi-family housing than the State of Oregon as a whole. Troutdale and unincorporated portions of the county are the only locations with more single-family housing than the state average. The county has a much smaller rate of mobile homes than the rest of the state, except in Wood Village where they make up nearly a third of total housing units. Fairview, the areas served by the Columbia Corridor Drainage Districts, and some unincorporated portions of the county also have a rate of mobile homes at or above the state average.

Table 8 – Housing units by housing type (US Census American Community Survey, 2020 – Table DP04)

Community	Total Housing Units	Single-Family (detached or attached, not including Mobile Homes)		Multi-Family (two or more units)		Mobile Homes	
		Number	% of Total	Number	% of Total	Number	% of Total
Oregon	1,788,855	1,217,191	68.0%	427,380	23.9%	138,033	7.8%
Multnomah County	368,041	220,144	59.8%	140,515	38.2%	6,315	1.7%
Incorporated Cities							
Fairview	4,325	2,287	52.9%	1,724	39.9%	314	7.3%
Gresham	41,866	24,948	59.6%	15,689	37.5%	1,172	2.8%
Maywood Park	449	420	93.5%	29	6.5%	0	0
Portland	293,208	172,767	58.9%	116,683	39.8%	3,271	1.1%
Troutdale	5,467	4,108	75.1%	1,126	20.6%	216	4.0%
Wood Village	1,201	585	48.7%	227	18.9%	389	32.4%
Unincorporated Areas							
West Hills	1,243	1,225	98.6%	18	1.4%	0	0.0%
Sauvie Island & West Hills	1,213	1,063	87.6%	18	1.5%	97	8.0%
West of Sandy River	2,230	2,108	94.5%	87	3.9%	35	1.6%
East of Sandy River	1,602	1,432	89.4%	12	0.7%	124	7.7%
Columbia Corridor Drainage District Areas (UFSWQD)							
PEN 1 and PEN 2	1,404	767	54.6%	419	29.8%	153	10.9%
MCDD	4,321	2,716	62.9%	731	16.9%	759	17.6%
SDIC	2,737	1,808	66.1%	273	10.0%	606	22.1%

2.5.3 Housing Age

The age of a structure can be a good indicator of its ability to withstand hazard events. Seismic building standards were not introduced into the Oregon Building Code until 1974 and standards were increased again in 1995 to protect against shaking from a modeled 9.0 Cascadia Subduction Zone earthquake[24]. Buildings built these years which have not been retrofitted will be particularly susceptible to ground shaking and liquefaction from a large earthquake.

[24] Earthquake Design History, A Summary of Requirements in the State of Oregon, State of Oregon Building Codes Division, February 7, 2012

Other building code updates in high risk locations have included higher wind load standards or promotion of wildfire-resilient building materials. Older homes are also more likely to have been built in high-risk areas before some hazards were well understood or mapped.

Risk from older housing slowly lessens over time as it is retrofitted or replaced by new construction. However, census estimates do not indicate much change in housing age in Multnomah County since the last version of the plan, as numbers are also affected by annexations and variation in data estimates.

Multnomah County has a large portion of pre-1970 housing, but this is dominated by the City of Portland's many old neighborhoods. The cities included in this plan have more development built from 1970 through 1989 than before 1970, representing their rapid growth during that time span and indicating a likely higher level of seismic resilience. Unincorporated areas have a mix of pre-1970 and newer construction, depending on the location.

Table 9 – Housing units by housing age (US Census American Community Survey, 2020 – Table DP04)

Community	Total Housing Units	Pre 1970		1970 to 1989	
		Number	Percent of Total	Number	Percent of Total
Oregon	1,788,855	596,222	33.3%	529,262	29.6%
Multnomah	368,041	177,685	48.3%	77,996	21.2%
Incorporated Cities					
Fairview	4,325	571	13.2%	964	22.3%
Gresham	41,866	9,288	22.2%	18,622	44.5%
Maywood Park	449	406	90.4%	9	2.0%
Portland	293,208	165,756	56.5%	51,209	17.5%
Troutdale	5,467	444	8.1%	2,326	42.5%
Wood Village	1,201	344	28.6%	417	34.7%
Unincorporated Areas					
West Hills	1,243	449	36.1%	80	6.4%
Sauvie Island & West Hills	1,213	421	34.7%	435	35.9%
West of Sandy River	2,230	578	25.9%	898	40.3%
East of Sandy River	1,602	726	45.3%	560	35.0%
Columbia Corridor Drainage District Areas (UFSWQD)					
PEN 1 and PEN 2	1,404	233	16.6%	156	11.1%
MCDD	4,321	578	13.4%	847	19.6%
SDIC	2,737	197	7.2%	691	25.2%

2.5.4 Housing Tenure

The percentage of residents living in rental units has been slowly declining in Multnomah County, except in the City of Portland where there has been a slight increase. Unincorporated Multnomah County has a very small percentage of renters, while Fairview and Gresham have similar proportions to Portland.

Table 10 – Housing units by housing tenure (US Census American Community Survey, 2020 – Table DP04)

Community	Renter Occupied Housing Units	Renter Occupied Percent of Total	Renter Occupied Percent of Total - 2013	Owner Occupied Housing Units	Owner Occupied Percent of Total
Oregon	611,573	37.2%	38.0%	1,031,006	62.8%
Multnomah County	152,777	45.6%	45.8%	182,072	54.4%
Fairview	1,954	45.6%	48.1%	2,328	54.4%
Gresham	17,988	45.0%	47.5%	21,944	55.0%
Maywood Park	39	9.2%	14.1%	387	90.8%
Portland	129,967	46.9%	46.6%	147,175	53.1%
Troutdale	1,734	32.6%	34.0%	3,584	67.4%
Wood Village	347	31.3%	40.1%	761	68.7%
Unincorporated Areas					
West Hills	93	7.5%	14.7%	1,150	92.5%
Sauvie Island & West Hills	195	18.7%	13.1%	846	81.3%
West of Sandy River	387	19.3%	20.7%	1,617	80.7%
East of Sandy River	180	12.5%	21.4%	1,256	87.5%
Columbia Corridor Drainage District Areas (UFSWQD)					
PEN1 and PEN2	524	40.6%	-	766	59.4%
MCDD	1,123	27.4%	-	2,979	72.6%
SDIC	519	19.5%	-	2,138	80.5%

Those living in rental housing may be at higher risk from natural hazards because of relationships between rental housing and income and housing quality. In past earthquakes in other locations, rental housing has been found to be disproportionately damaged, and in the 2021 Heat Dome, those living in rental apartments without air conditioning made up a high proportion of hyperthermia deaths.

Renters are also likely to have less control in making their homes more disaster resilient and are less likely to have insurance or financial resources to allow them to recover from disaster.

Demographics of renters are also likely to intersect with traditionally underserved communities. For example, in the City of Portland's 2021 State of Housing report[25], rentership rates were found to be above 70% for Black and Hawaiian/Pacific Islander residents and above 60% for Hispanic/Latinx and Native American residents, while the rate for the city as a whole was below 50%.

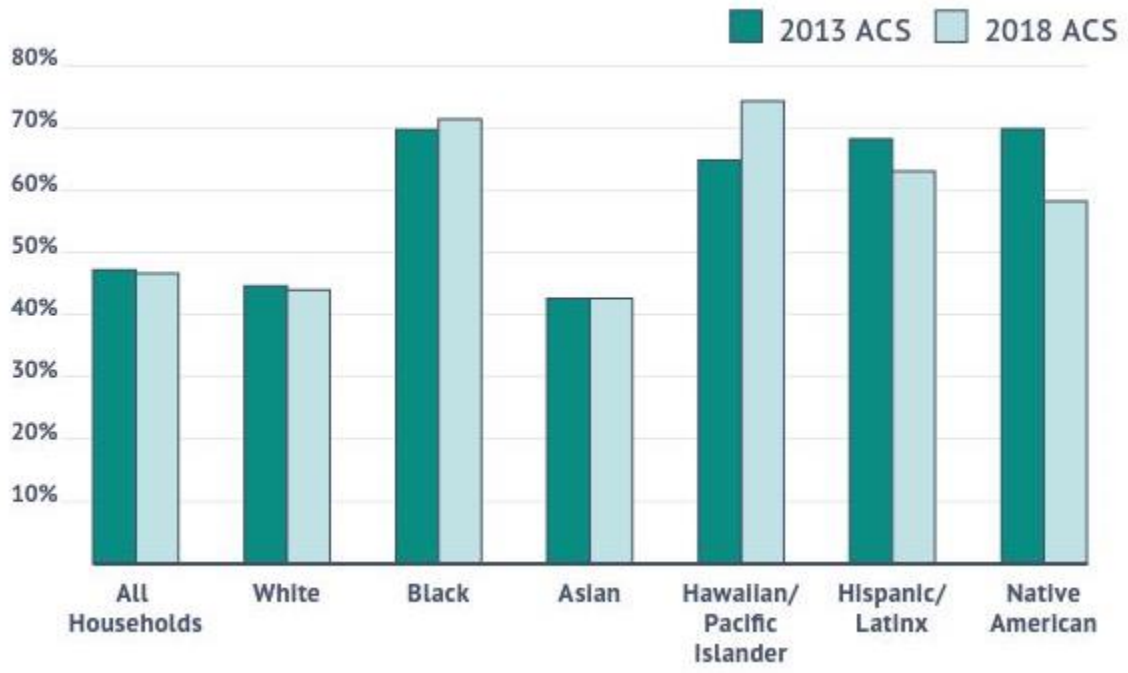

Figure 16 - Table showing rentership rates by race or ethnicity in the City of Portland. Data from the US Census American Community Surveys of 2013 and 2018

2.6 Land Use and Development

As noted in the population distribution section, urban land uses (dark gray below) are most prevalent in the center of the county.

An interactive version of this map can be found here (Land Use and Land Cover – Existing Vegetation Type)

[25] 2021 State of Housing Report, Portland Housing Bureau, p. 23

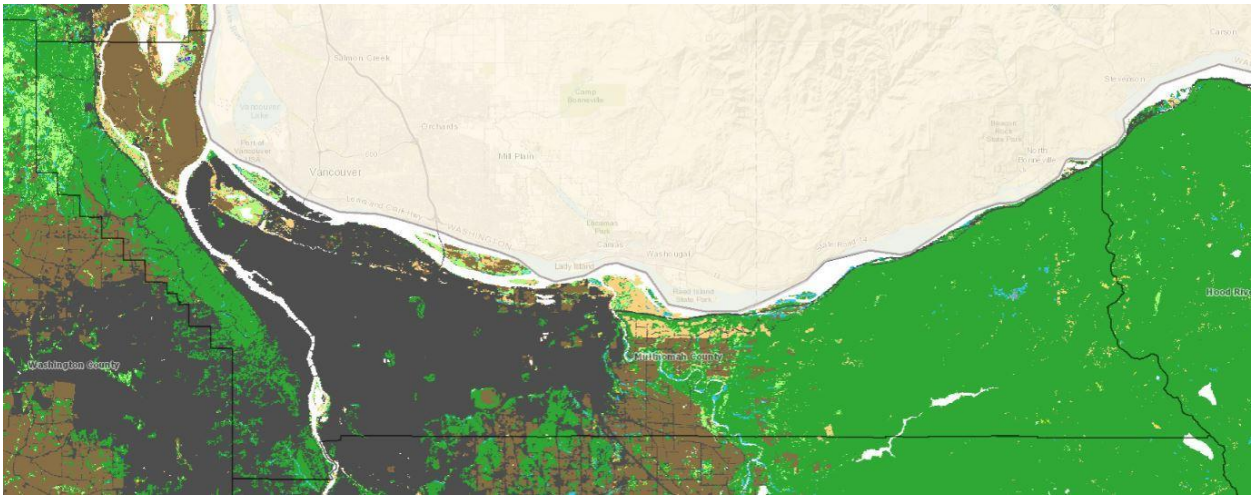

Figure 17 - Map showing vegetation types in Multnomah County. Dark grey is developed land, green is forest, brown is agricultural, and orange is grassland. Map from Oregon Wildfire Explorer via data from LANDFIRE.

The Urban Growth Boundary (UGB) identifies specific parts of the county for development to accommodate housing for the following 20 years, based on detailed growth projections. The UGB has not been expanded in Multnomah County for over 20 years, indicating the boundaries established at that time have been considered sufficient to accommodate future urban growth. Areas outside of the UGB are reserved for low-density development and the maintenance of farming, forestry, and recreational open space.

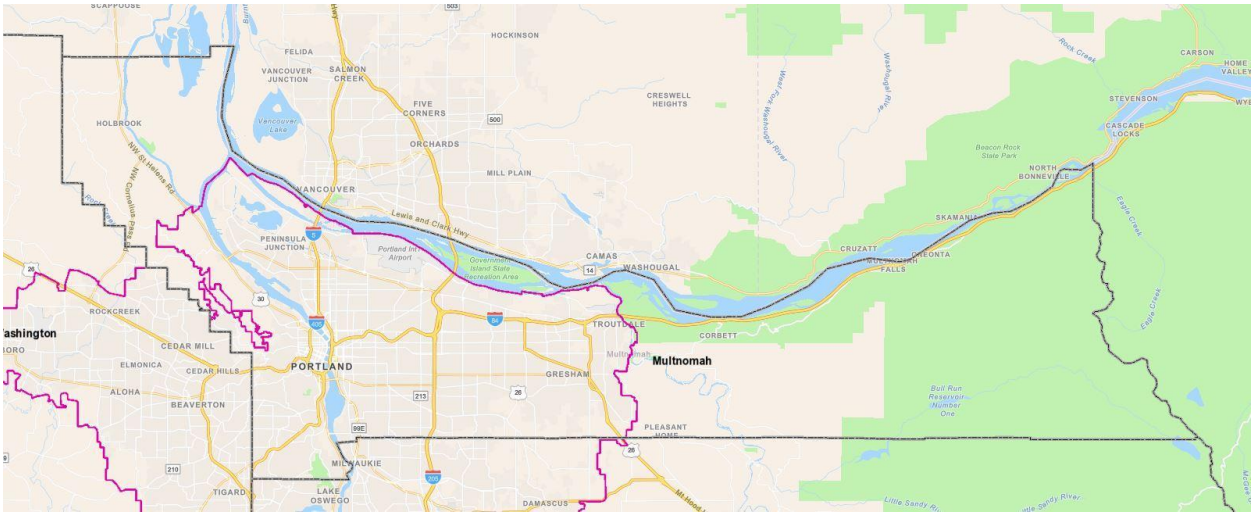

Figure 18 - Portland Metropolitan Area Urban Growth Boundary shown as a pink outline.

Areas outside of the UGB may be classified as Urban and Rural Reserves. Urban reserves are areas considered to be suitable for longer-term expansion of urban growth and would likely be the next location for expansion of the UGB. Rural reserves are those areas with high-value working farms or forests or important natural features, and are designated to remain in those uses for at least 50 years. The only Urban Reserve as of 2022 in Multnomah County is an area called East of Gresham on the Urban/Rural Reserves map. Rural Reserves cover nearly the entirety of the western unincorporated portion of the county and much of the area east of Gresham and south of the Sandy River. Areas outside of the UGB may still add low-density

development which may become threatened by all hazards, but especially those most likely to occur in rural areas, such as wildfire and landslide.

An interactive version of this map can be found at this link – (Urban Growth Boundary + Urban and Rural Reserves)

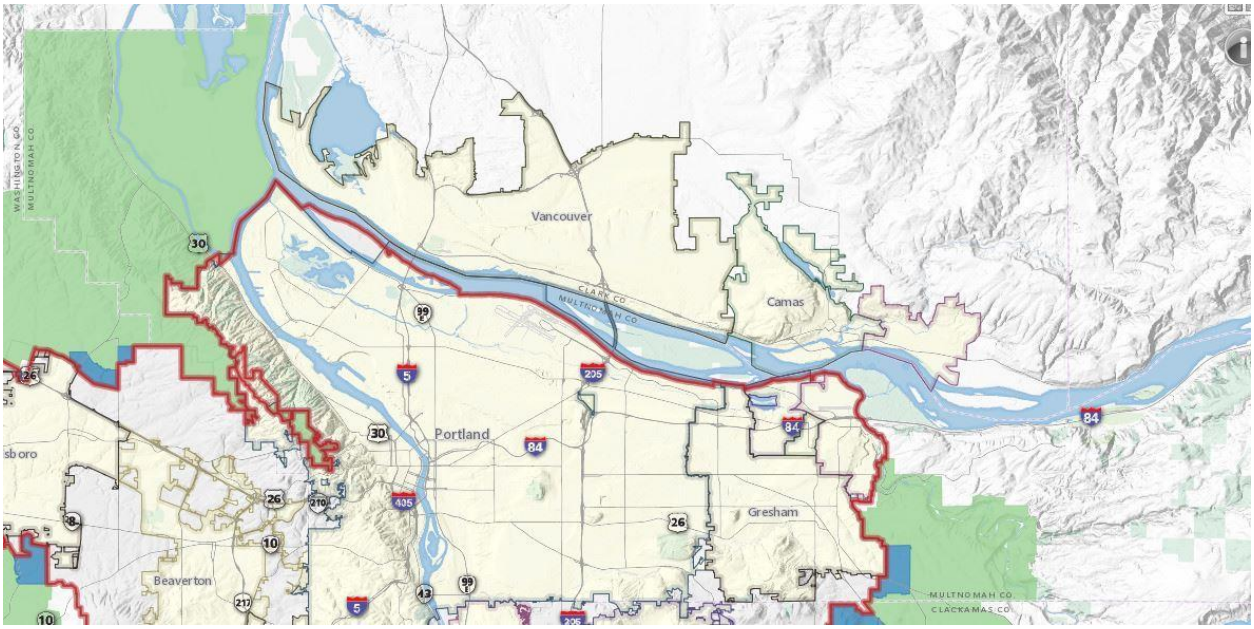

Figure 19 - Map showing the Portland Metropolitan Area Urban Growth Boundary (outlined in red), Urban Reserves (blue), and Rural Reserves (green). Data from Metro.

2.6.1 Comprehensive Plans and Zoning/Building Codes

Oregon cities and counties are required to have a comprehensive plan that is consistent with State Planning Goals and outlines long-term strategies for sustainable development. Oregon's State Planning Goal 7 refers to Areas Subject to Natural Hazards, so long-term growth strategies relating to hazards and corresponding growth management issues can be found in each jurisdictional comprehensive plan. Local zoning and land development codes are the short-term mechanisms for implementing comprehensive plan goals.

The Columbia Corridor Drainage Districts and Port of Portland have different strategic planning processes that outline how future development and capital investments will consider natural hazard resilience. The special districts are subject to land use and zoning ordinances in the jurisdictions where they operate.

The northeastern portion of the county lies in the Columbia River Gorge National Scenic Area, which has a Management Plan and set of code requirements developed by the Columbia River Gorge Commission and the U.S. Forest Service. The most recent plan was issued in 2020 and includes management strategies relating to climate action and wildfire risk reduction.

Each city in this plan and the county has a Floodplain Development Ordinance in their code as a requirement of their participation in the National Flood Insurance Program. This ordinance specifies locally-enforced requirements for flood-resilient development.

Construction standards for new or substantially rebuilt structures can be an important factor in natural hazard resilience. Building codes in Oregon are administered locally, but set at the state

level. Oregon uses the 2019 Oregon Structural Specialty Code (OSSC) for commercial buildings, the 2021 Oregon Residential Specialty Code (ORSC) for stick-built residential buildings and the 2010 Oregon Manufactured Dwelling Installation Specialty Code (OMDISC) for manufactured homes.

Generally, state building codes are min/max codes, meaning they are not allowed to be strengthened or weakened at the local level. But there are some predefined higher building standards that can be accessed by local communities with particular natural hazard risks. For example, the City of Troutdale has a stronger code for wind resistance because of persistent high winds from the Columbia River Gorge, and the State of Oregon has recently passed legislation for communities to strengthen fire codes in locations with extremely high wildfire risk.

2.7 Natural Resources

Multnomah County's rich natural resources are a major factor in its livability and economy. Despite the county's dense population, open space and urban nature has been reserved for natural resource economies and recreation. While natural resources are vulnerable in their own right to the hazards in this plan and create hazard, they also contribute to community resilience.

2.7.1 Tree Canopy

Trees in both urban and rural locations can be a risk factor to life and property when they fall during winter storms and windstorms, and trees, especially when dead or weakened by disease or pests, are a wildfire risk. But trees also play a crucial role in mitigating climate-change driven hazards, and increasing tree canopy levels is a goal among communities across the region.

Urban neighborhoods with low amounts of trees suffer significantly increased temperatures during heat waves because of lack of shade and the urban heat island effect—sunlight being absorbed and reflected by pavement and roofs. Urban street trees absorb and hold heat and filter pollutants from the air. Across the county, trees are also important in absorbing flood runoff and holding slopes in place during periods of heavy precipitation.

In urban residential areas, a lack of street trees is most common in neighborhoods with more residents of color and higher rates of poverty, which exacerbates risk for those residents with pre-existing health conditions. The Rockwood neighborhood in Gresham is an example of a high-risk area where a lack of trees and social inequality have combined to create higher levels of vulnerability to heat events.

An interactive version of this map can be found at this link

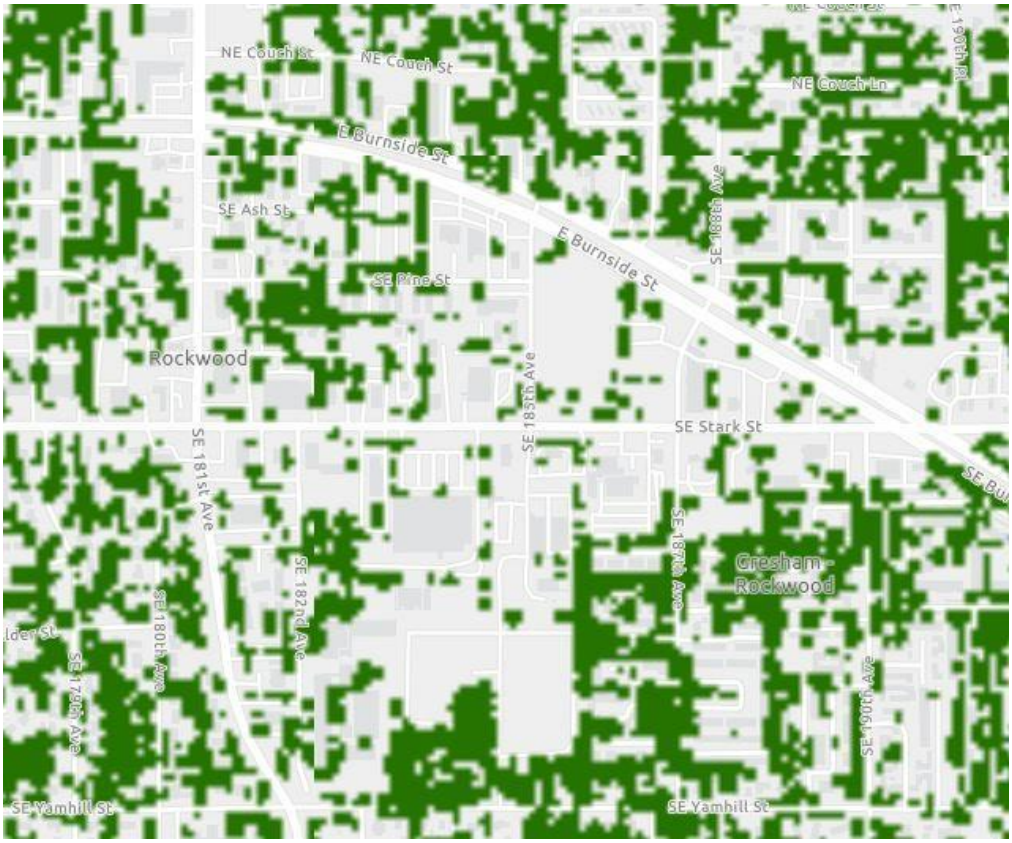

Figure 20 - A map showing locations of trees in the Rockwood neighborhood of Gresham. The triangular area bounded by E Burnside Street, SE Stark Street, and SE 181st Avenue has been identified as a high-priority area for tree planting to reduce urban heat island impacts. Map data comes from Metro and is available for all areas within the Urban Growth Boundary for comparison.

A recent study in the City of Portland found a loss of 823 acres of tree canopy between 2015 and 2020[26]. This finding is considered to be within the study margin of error and would be a change from a significant increase in the city's tree canopy over the previous fifteen years. No reasons are yet known for the decline or if the decline is statistically significant, but some possibilities are tree loss from storms, increased development, and increased tree mortality caused by climate change. The City of Portland will conduct its next count in 2025 to assess if these losses are a new trend. It is currently unknown if this effect is being repeated in other Multnomah County cities.

[26] Tree Canopy Monitoring: Protocol and Monitoring from 2000-2020; Portland Parks and Recreation, A. DiSalvo, J. Ramsey, N. Rossmiller, February 2022

2.7.2 Parks and Natural Areas

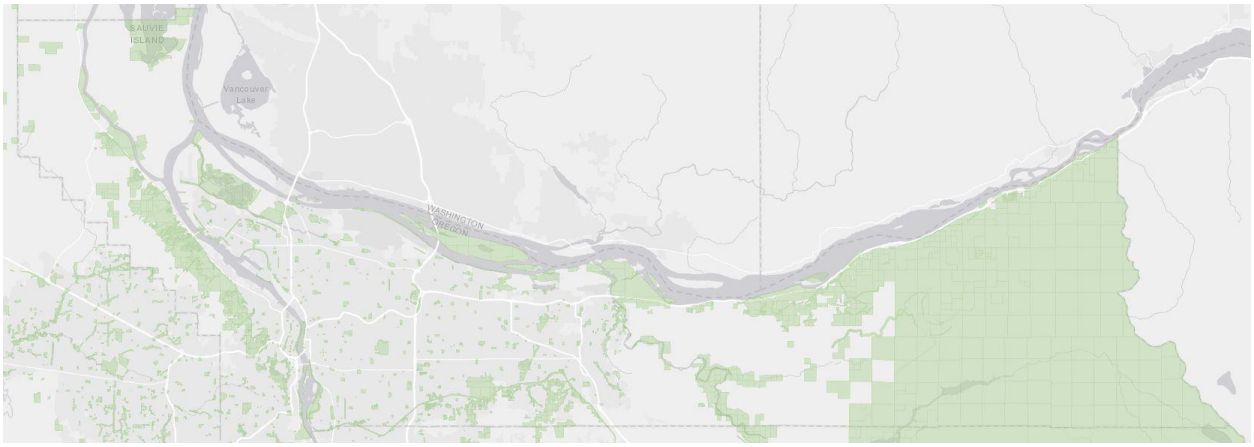

Figure 21 - Map showing location of public parks and other publicly-owned open space in Multnomah County, shown in green. Not all areas shown in green are publically accessible.

Parks in Multnomah County are operated by its cities, Metro, and State and Federal agencies. Some of the most notable parks are Forest Park (City of Portland), the Mount Hood National Forest (U.S. Forest Service), Sauvie Island Wildlife Refuge (Oregon Fish and Wildlife), Government Island (Oregon Parks and Recreation/Metro), and Oxbow Park (Metro). All of the cities included in this plan have multiple city parks. Multnomah County does not operate parks. Some publicly accessible open space is maintained for the operations of the Columbia Corridor Drainage Districts. The Port of Portland also owns natural areas in Multnomah County, with public access varying according to site.

Parks are maintained as an important public amenity, to support habitat resilience, and provide resilience to natural hazards especially when used to maintain floodplains and steep slopes. Parks are vulnerable to acute damage from extreme weather and longer-term risk from climate change that promotes invasive species and causes increased tree death.

2.8 Historic and Cultural Resources

Historic and cultural resources—which may include structures, objects, sites, and districts– provide unique insight into Multnomah County's past. Examples of these resources are unique architecture, pre-colonial artifacts, burial sites, roads and bridges, earthworks, artwork, landforms, and battlefields. These types of resources are vulnerable to many of the natural hazards cited in this plan as of particular concern in Multnomah County.

The National Register of Historic Places is an official registry for these resources. There are over 7,000 properties in Multnomah County listed individually or as part of Historic Districts. While most of those are in the City of Portland, the Cities of Fairview, Gresham, and Troutdale and unincorporated Multnomah County all have one or more listed properties.

2.9 Infrastructure and Community Lifelines

Infrastructure is the basic physical and organizational structures and facilities needed for the day-to-day operation of the entities that make up this plan.

Community lifelines include physical infrastructure for transportation energy, water, wastewater and communications – and also include public safety, health care, food systems and other services that have physical locations but are also direct human services that are essential to hazard resilience. Mitigating impacts to lifelines are a key strategy of FEMA's National Response Framework.

Work on this plan has included local public works and facilities stakeholders, and used input and published materials from infrastructure partners to help identify system vulnerabilities.

Many elements of lifelines and physical infrastructure are also included in this plan as critical facilities, a list which fills in the remaining gaps of service types not included in this section.

2.9.1 Transportation

Roads

Multnomah County is served by an extensive network of interstate highways, state highways, and locally maintained roads and streets. Key roads are essential infrastructure for mitigating disaster, as their resilience will define the ability for evacuation, movement of emergency vehicles, and transport for disaster support. Roads are also a major disaster vulnerability.

The Regional Disaster Preparedness Organization (RDPO) and Metro partnered to update an inventory of Regional Emergency Transportation Routes in 2021. The next phase of the project in 2023 will be to prioritize the routes and develop operational guidance.

The Oregon Department of Transportation (ODOT) maintains a 2012 report on Seismic Lifeline resiliency during a Cascadia Subduction Zone earthquake. ODOT has more recently worked toward developing a statewide inventory of emergency triage routes to prioritize future state road resilience investments.

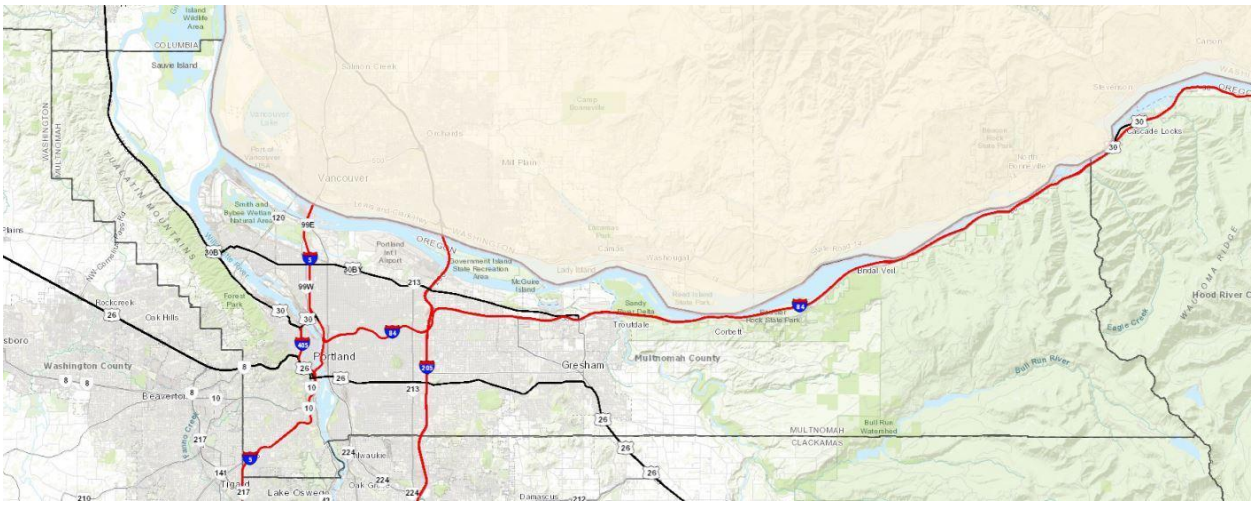

Figure 22 - Map showing the locations of major interstate (red) and state (black) highways in Multnomah County.

Interstate 5 runs north-south through the county and is the major route connecting Oregon with Washington and California. Interstate 84 originates on its western boundary in Multnomah County and travels eastwards through the Columbia River Gorge to Eastern Oregon, Idaho and Utah. Interstate 205 is a bypass highway that routes traffic through the eastside of Portland and

connects with I-5 both south and north of Multnomah County. Interstate 405 is a short bypass highway that routes traffic from I-5 through downtown Portland and connects to State Highway 26 going west.

State Highway 26 is the most used state route, connecting Multnomah County to the Oregon Coast to the west and to Mount Hood and Central Oregon to the east. Highway 30 connects Multnomah County to Columbia County and the Oregon Coast from the northwest. State Highway 99 runs north-south into Clackamas County on the south.

A key local road outside of Portland is NW Cornelius Pass Road, which cuts across the West Hills and is an important commuting route between Multnomah County and Washington County. Other key routes are listed by community or district in their respective chapters.

Bridges

The Multnomah County landscape is crisscrossed by bridges across major rivers, gorges and canyons. There are around 500 bridges in Multnomah County, including highway bridges, rail bridges and city and county bridges. The number of bridges creates natural hazard vulnerabilities, as they operate as essential transportation lifelines in disasters. Not only do bridges allow safe river crossings, many of them also carry critical infrastructure, such as water and sewer distribution lines. If bridges fail during disaster, it will create cascading impacts to response and recovery.

Of the eleven major Willamette River crossings that link the east and west sides of the county, six are operated by Multnomah County, three by the Oregon Department of Transportation (ODOT), one by Union Pacific, and one by Metro. The Sellwood Bridge (Multnomah County) was replaced in 2016 and a project is currently underway to replace the Burnside Bridge (Multnomah County) with a more seismically stable span. A new seismically-stable transit and pedestrian bridge, the Tilikum Crossing (TriMet), was completed in 2015 and is also designed to provide river crossing by emergency vehicles in a disaster. The Hawthorne Bridge (Multnomah County), Broadway Bridge (Multnomah County), Steel Bridge (Union Pacific) and St. John's Bridge (ODOT) continue to have major vulnerability to earthquakes.

There are three major bridge spans across the Sandy River in Multnomah County. The Highway 84 Sandy River Bridge was replaced in 2004. The Troutdale Bridge, an ODOT crossing built in 1912, is planned for repairs beginning in 2024 that will reduce potential flood damage. The Stark Street Bridge (Multnomah County) was built in 1914 and retains significant vulnerability.

The Sauvie Island Bridge (Multnomah County) spans the Multnomah Channel, and is the only connection between the Sauvie Island community and the rest of the county. The bridge was rebuilt in 2008 to withstand a seismic event.

Public Transportation

TriMet is the regional body that administers light rail, streetcar and bus service across much of Multnomah County, connecting internal locations as well as to locations in Washington and Clackamas Counties. The public transportation system is another key method of movement of people across the county, and faces similar vulnerabilities as road and bridge systems that it shares.

Public transportation has developed some unique resilience components and vulnerabilities as well. Bus and train service has become an essential piece of movement to and from emergency shelters, especially for those without housing. Conversely, extreme weather can cause system delays and stoppages during periods where personal transportation may be disrupted and need for emergency shelter is highest.

Air and Marine Transportation Facilities

Significant air and marine facilities are operated by the Port of Portland in the region. Within Multnomah County, Port facilities include the Portland International Airport (PDX), the Troutdale Airport, and marine terminals along the Columbia and Willamette Rivers. As the Port of Portland is a participant in this plan, detailed information about air and marine core capacities and vulnerabilities can be found in its district chapter.

Rail

Significant amount of freight rail service passes through Multnomah County. Nearly all Class I rail routes are operated by Burlington Northern and Santa Fe (BNSF) or Union Pacific (UP). These two companies also operate a number of important rail yards and terminals to manage freight and equipment. Rail networks are important connectors for economic activity and are also vulnerable to impact from earthquakes, landslides, wildfires and floods. Some important infrastructure is under private rail company ownership, including bridges and embankments in flood-prone areas.

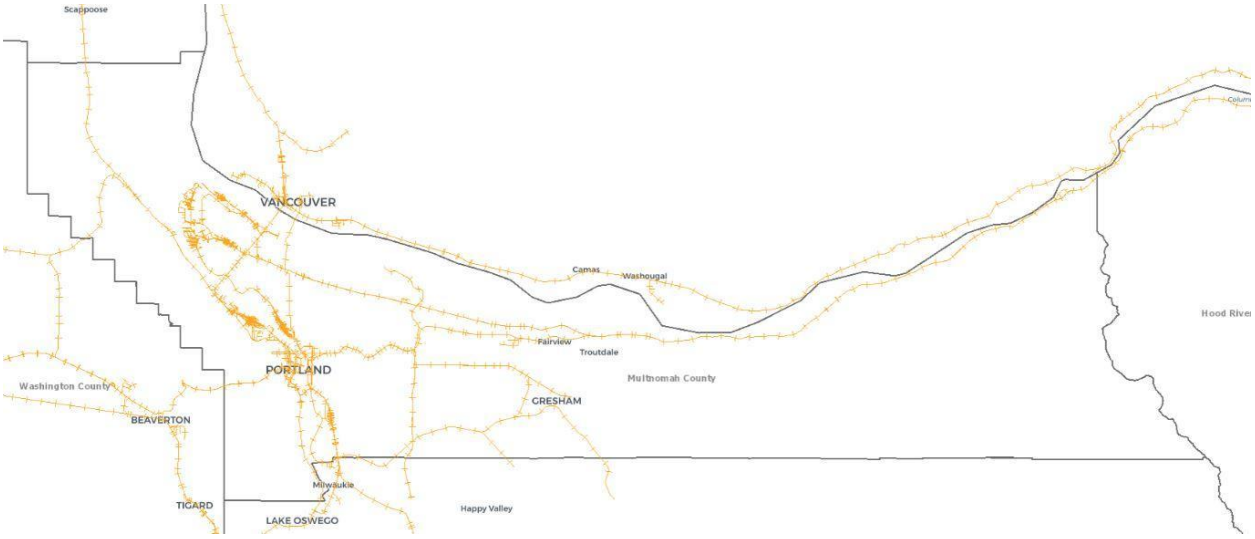

Figure 23 - Map showing location of rail routes in Multnomah County (orange).

Passenger rail is served by Amtrak, using the rail infrastructure owned by the above-mentioned freight companies.

2.9.2 Utilities

Water

Drinking water systems in Multnomah County are subject to threat from seismic events that could damage infrastructure. Landslides, floods and fires could impact water quality due to sedimentation of surface waters. Most Multnomah County residents get water from either the

Bull Run Watershed or from aquifer wells located in the historic Columbia River floodplain. These water sources have created resilience to drought, as both sources recharge year-round, and are not reliant on melting snowpack to maintain water levels during the summer.

Bull Run Watershed

The Bull Run Watershed provides drinking water for nearly the entire City of Portland, and drinking water is also purchased by a number of other water districts. Runoff in the 102 square-mile watershed is collected in reservoirs, treated and then piped throughout the county.

Figure 24 - Photo of Bull Run Reservoir, from the City of Portland's About the Bull Run Watershed webpage.

A major risk to the Bull Run watershed is wildfire, which could result in landslide and slope erosion and subsequent sedimentation of the water supply. Water infrastructure could also be damaged by an earthquake, although the watershed is located in a less susceptible earthquake risk area than the Columbia River Aquifer wellfield.

Columbia River Aquifer Wells

The second-largest source of water are the aquifers located on the south side of the Columbia River.

This water source is not quite as plentiful as the Bull Run Watershed, but is resilient to drought and also to sedimentation, since the water source is located below ground. Wells, pipes, reservoirs, treatment facilities and other infrastructure are still vulnerable, especially to seismic risk. The well field is located within soil liquefaction areas with high risk from seismic damage.

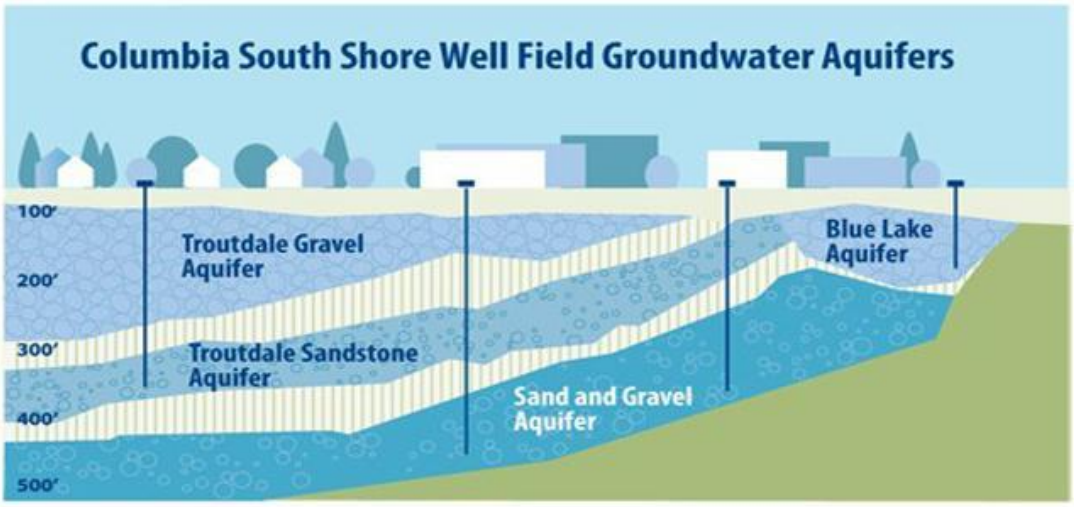

Figure 25 - Graphic showing operation of Columbia South Shore aquifer wells. Figure from the Portland Water Bureau's About the Columbia South Shore Well Field webpage

Water Utilities

The following utilities serve residents of Multnomah County. The source of water as of 2022 is included.

- Burlington Water District – Serves 280 people as of June 2020 in the unincorporated community of Burlington in the Northwest portion of Multnomah County. Water comes from the Portland Water Bureau's Bull Run Reservoir, supplemented by the Columbia South Shore Well Field.

- City of Fairview – Serves most of the City of Fairview (a small portion of the city is served by the Rockwood Water People's Utility District) via wells located within the municipal limits.

- City of Gresham – Has served the City of Gresham with water mostly from the City of Portland's Bull Run Reservoir and supplemented by the Columbia South Shore Well Field. As part of a partnership with the Rockwood People's Utility District, Gresham will fully replace that water supply with water from local aquifer wells by 2026.

- City of Troutdale – Troutdale serves 15,000 residents and 200 businesses with potable water. The water is drawn from six aquifer wells in the city and is stored in four reservoirs.

- City of Wood Village – Wood Village provides water to residents from three independent wells in the Troutdale Aquifer. The city maintains three reservoirs for storage.

- Corbett Water District – Provides water to 1,100 addresses via 65 miles of pipe over 11,000 acres centered in the unincorporated community of Corbett. Water comes from

the North Fork and South Fork of Gordon Creek[27], making this district one of the only ones in Multnomah County that uses surface water.

- Lusted Water District – Serves about 1,200 people east of and adjacent to the City of Gresham. Water is purchased from the City of Portland and comes from the Bull Run Reservoir, supplemented by the Columbia South Shore Well Field.

- Palatine Hill Water District – Serves about 1,580 people in Multnomah (80%) and Clackamas County (20%) on the west bank of the Willamette River. Water is purchased from the City of Portland, coming from the Bull Run Reservoir and supplemented by the Columbia South Shore Well Field.

- Pleasant Home Water District – Serves about 1,415 people in unincorporated Multnomah County southeast of Gresham. Water is purchased from the City of Portland, and comes from the Bull Run Reservoir and supplemented by the Columbia South Shore Well Field.

- Portland Water Bureau – The Portland Water Bureau is the largest water provider in Multnomah County and the region, serving nearly one million people from the Bull Run Watershed and Columbia South Shore Well Field. The Portland Water Bureau has more than 2,200 miles of water mains and delivers about 100 million gallons of water daily.

- Rockwood Water People's Utility District (RWPUD) – Serves about 66,000 people in Portland, Gresham and Fairview. Water has historically mostly come from the Portland Water Bureau's Bull Run Reservoir, supplemented by the Columbia South Shore Well Field. Increasingly, RWPUD has been developing its own aquifer wells and is partnering with Gresham Water as part of the Cascade Groundwater Alliance.

- Sunrise Water Authority – Service area is primarily in Clackamas County around Happy Valley, with a very small area in Multnomah County north of SE Clatsop Street. Water is taken from the Clackamas River and groundwater wells.

- Valley View Water District – Serves about 400 customers in unincorporated southwestern Multnomah County. Water is purchased from the Portland Water Bureau, coming from the Bull Run Reservoir and supplemented by the Columbia South Shore Well Field.

- West Slope Water District – Serves 10,300 people almost entirely in Washington County, but with a small service area in southwestern Multnomah County adjacent to the Valley View Water District. Water is purchased from the City of Portland and comes from the Bull Run Reservoir and supplemented by the Columbia South Shore Well Field.

Wastewater and Stormwater Management

Sewer infrastructure is at risk from seismic events which can damage underground and aboveground conveyance pipes and treatment facilities. Flood, landslides and wildfire can also

[27] 2021 Corbett Water District Annual Water Quality Report

damage aboveground infrastructure. Each city in the plan maintains wastewater systems as part of city utility programs:

- City of Fairview – Maintains sewer conveyance infrastructure, with sewage treatment performed via contract by the City of Gresham.
- City of Gresham – Treats 13 million gallons of sewage daily for 114,000 residents, including residents of Fairview and Wood Village.
- City of Troutdale – Treats 1.4 million gallons of sewage daily, via 50 miles of sewer lines and eight pump stations.
- City of Wood Village – maintains sewer conveyance lines, with 13 miles of gravity sewer, 300 manholes and three pumping stations. Sewage treatment is performed via contract by the City of Gresham.

The Port of Portland and Columbia Corridor Drainage Districts are served by municipal providers, consistent with utility service boundaries at each location.

Multnomah County does not provide wastewater services. Residents outside of municipal treatment areas get septic system permits through the City of Portland. Two additional wastewater service providers operate in Multnomah County. Clean Water Services, the primary wastewater utility in Washington County, serves a small number of customers in western unincorporated Multnomah County between the City of Portland and Washington County. The Dunthorpe-Riverdale Sanitary Sewer District serves 571 residents in the unincorporated Dunthorpe neighborhood in southwest Multnomah County. The district is managed by Multnomah County with service contracted through the City of Portland.

In areas with impervious surfaces, management of stormwater is important to prevent flooding and erosion during heavy rain and snow events. Stormwater runoff can also damage water quality and habitats. Improving the resilience of stormwater systems can be a mitigation strategy to reduce flooding or to make the systems, which are often combined with wastewater systems, more resilient to seismic damage or flood overflow.

Each of the participating cities in the plan provide stormwater services within their municipal boundaries by having storm sewer infrastructure and management plans. Multnomah County provides stormwater services along county roads inside city limits and in unincorporated areas that are dense enough to require stormwater management planning. The Columbia Corridor Drainage Districts have stormwater management as a primary function, and operate pumping stations to manage stormwater in the internal wetlands behind the levees. The Port of Portland has its own storm sewer and stormwater management plan, which includes the treatment of deicing solution before it is carried into local watercourses.

Electricity

The Oregon Public Utility Commission regulates electric utilities to manage risk statewide from earthquake and wildfire. Power infrastructure is at risk from a seismic event, and can cause or be damaged by wildfire. Long-term power outages are a major vulnerability for some of Multnomah County's most at-risk residents, and local power utilities participate in hazard mitigation planning to reduce risk of fire and share strategies for supporting customers during outages.

The Bonneville Power Administration (BPA) provides wholesale electricity to local providers from the Bonneville Dam in eastern Multnomah County, the only major power generation facility in the county. The dam also provides flood protection during high water events. BPA operates high-tension power lines in Multnomah County and coordinates in wildfire mitigation efforts.

Four electricity providers provide services directly to residences and businesses in Multnomah County:

- Portland General Electric (PGE) – A private utility which is the largest power provider in Oregon and the primary electric utility in Multnomah County, completely serving all cities other than Portland as well as most unincorporated areas.
- PacifiCorp (Pacific Power) – A private utility which is the second-largest electricity provider in Oregon. Service in Multnomah County is located in Central and North/Northeast Portland, including the Portland International Airport and part of the Multnomah County Drainage District.
- Cascade Locks City Electric – A city utility provided by the City of Cascade Locks in Hood River County. Service extends across the county line into Multnomah County through the Columbia River Gorge ending roughly at NE Henderson Road.
- Columbia River Public Utility District (Columbia River PUD) – A community owned utility that serves 19,000 meters, almost entirely in Columbia County. A small service area in Multnomah County extends along State Highway 30 to the northern county line.

Liquid Fuel

Multnomah County includes the Critical Energy Infrastructure (CEI) hub, Oregon's largest liquid fuel terminal. The CEI Hub is located in the City of Portland along the Willamette River in an area with wet soils and high seismic risk.

The terminal holds about 90% of Oregon's refined gasoline, making it a critical piece of statewide infrastructure that is essential to day-to-day economic activity and disaster response and recovery. Increasing the resilience of the facility to earthquakes is an urgent mitigation need that is being pursued, but is complex because of the size, importance, and vulnerability of the terminal.

Oregon Senate Bill 1567 was passed in 2022, and gives the Oregon Department of Environmental Quality the authority to evaluate the seismic vulnerability of fuel tanks and require facilities to develop a risk minimization plan. A rules advisory committee is currently working on implementation policy, with an aim to have new rules completed by Fall 2023 and perform facility assessments by Summer 2024.

In addition to gasoline, the CEI hub also holds and transfers jet fuel, natural gas, and many other liquid fuels. Other infrastructure at risk beyond the tanks themselves at the facility are electrical substations, pipelines and transmission lines.

Delivery of natural gas to homes and businesses is provided by NW Natural, a private utility based in Portland, to all of Multnomah County. NW Natural coordinates with regional bodies in emergency management and hazard mitigation work. Increasing the resilience of major transmission mains to seismic risk is a priority, with flexible piping a key strategy. NW Natural also promotes the installation of excess flow valves to restrict the flow of gas to a meter if a main is damaged.

Communications

Several providers of telecommunications services operate in Multnomah County, providing phone and internet service. Landline phone service continues to be especially important in rural areas, with older populations and locations where cellular service may not be reliable because of mountainous topography.

Communications resilience is essential for messaging during disasters. Loss of power to cell towers because of fire or earthquake damage can be mitigated through redundancies and power backup systems. Messaging before or during disasters is guided by the Oregon State Emergency Alert System Plan and through coordination of regional emergency management partners, using opt-in or universal alert tools.

211 is a non-profit organization funded by state and municipal contracts to connect residents with governmental resources and help identify which resources can support them. 211 is a key partner in directing response resources but also supports at-risk communities to become more familiar with governmental resources and programs that may increase disaster resilience.

Television and radio stations, newspapers, and other news websites also play an essential role in risk messaging.

2.9.3 Emergency Services

Fire Services

Nine fire departments serve locations across Multnomah County, including through contract agreements with cities and Rural Fire Protection Districts. Fire services are critical hazard mitigation partners.

- *Cascade Locks Fire* (responds to calls by opt-in residents in a structurally unprotected area in the northeastern corner of the county, near the border with Hood River County)
- *Corbett Fire*
- *Gresham Fire* (also provides contracted fire service to the Cities of Fairview, Troutdale, and Wood Village, and to Rural Fire District 10 in unincorporated Multnomah County)
- *Lake Oswego Fire* (serves areas in the City of Lake Oswego located in Multnomah County and provides contracted fire service to Riverdale Rural Fire District 11)
- *Port of Portland Fire and Rescue* (responds to the Portland International Airport and surrounding properties through mutual aid agreements and to other jurisdictions when requested)
- *Portland Fire and Rescue*
- *Sauvie Island Fire*
- *Scappoose Fire*
- *Tualatin Valley Fire and Rescue*

Wildland fire response is coordinated through the Oregon Department of Forestry (ODF) and the U.S. Forest Service (USFS). ODF serves rural portions of the county through offices in Molalla (east) and Forest Grove and Columbia City (west). USFS supports firefighting response in the Mount Hood National Forest and the Columbia River Scenic Area. ODF also provides wildfire protection for State Parks.

More detailed wildfire information can be accessed in the 2011 Multnomah County Wildfire Protection Plan, which is currently in an update process.

Law Enforcement

Four police agencies provide police service to Multnomah County. These resources are crucial public safety partners during response, and can serve as partners in mitigation planning by assisting in the identification of response gaps and community-based vulnerability.

- *Gresham Police*
- *Multnomah County Sheriff's Office* (provides service in unincorporated Multnomah County and contracted service to the Cities of Fairview, Troutdale, and Wood Village)
- *Port of Portland Police* (responds to the Portland International Airport and surrounding properties through mutual aid agreements and to other jurisdictions when requested)
- *Portland Police Bureau*

2.9.4 Critical Facilities

A 2017 inventory of Critical Facilities is contained in Annex F- Human-Caused and Technological Hazard Identification and Risk Assessment. Critical facilities among partners are divided into three categories.

Emergency Services Critical Facility Inventory

- Ambulance Services
- Fire Stations
- Hospitals
- Licensed Medical Facilities
- Law Enforcement Facilities
- Urgent Care Centers

Administrative Critical Facility Inventory

- Airports
- City Halls
- Community Centers
- County Assets
- Libraries
- Marine Terminals (newly added)
- Pump Stations (newly added)

Special Population Critical Facilities

- Childcare Facilities
- Homeless Shelters
- Jails
- Residential Care Facilities
- Schools

New Critical Facility Data

In this update, the Critical Facility data has been largely maintained from the 2017 plan, with two new categories of critical facility—pump stations and marine terminals—added to reflect the inclusion of the Columbia Corridor Drainage Districts and Port of Portland into this plan. A more thorough update of specific critical facility locations and types is a priority action put forth in this plan, and is hoped to be undertaken before the next required NHMP update. A challenge for maintaining a critical facility inventory is that some types of facilities included are numerous and are constantly changing. For those types of facilities, it is essential that current risk mapping is available and used when siting new facilities that will become essential post-disaster lifelines. Upcoming recovery planning will also work to provide additional stakeholder input into post-disaster lifeline identification.

Other important changes to Critical Facility analysis are:

- Increasing the City of Troutdale's City Hall locations from one to three after the closure of the previous City Hall and the dispersal of city administration to three separate sites.
- Adding the overpass bridge at NE 238th Avenue and Interstate 84 to the City of Wood Village.

Chapter 3 – Hazard Identification and Risk Assessment

The hazard identification and risk assessment chapter identifies the most significant natural hazards in Multnomah County and describes how each of the has impacted communities in the past, and what we know about the potential for future impacts. Mitigation strategies are then built from this analysis of risk.

There are six natural hazards used in this plan with some additional subsets of hazards within those six hazards. All of the participating entities in the plan could face some risk from all of the hazards, but the risk to each is not equal. Each participating jurisdiction or district has conducted a local risk analysis to prioritize hazard risk in order to identify mitigation strategies that will address the hazards of highest risk. The local risk analysis is included in each jurisdiction/district chapter.

Human-caused and technological hazards are not included in this plan, but hazard identification and risk assessment for some of those hazards are included in a 2017 report included in this plan as an annex.

For each of the six natural hazards, assessment of risk is determined by looking at four dimensions:

- An **Overview**, which defines the hazard, and explores different ways the hazard can happen,
- A **History**, which lists recent and historic events to provide context on frequency and impact when these disasters have occurred,
- An analysis of **Probability –** how likely the event is to happen again, using data from the history section and from research conducted when available.
- A consideration of **Scope and Extent**, which parts of the county will be impacted by the hazard and how the impact may differ between locations, using research data when available, and
- A description of **Vulnerability** – once understanding how likely the event is to occur and where it is most likely to cause impacts, an analysis of people, property, infrastructure and natural resources that would be impacted by a disaster, with consideration around who would face disparate impacts from the event.

3.1 Earthquake

All of the jurisdictions and districts in this plan face dangerous susceptibility to earthquakes, with damage expected to be primarily caused by ground shaking, soil liquefaction and landslides. Different areas in Multnomah County will see differing levels of damage intensity from an earthquake event, based on the location from the earthquake epicenter, the depth and type of earthquake, local bedrock and soils, and the types of building construction where people are located when the earthquake hits. Infrastructure—including levees, major transportation facilities, roads, bridges and buried and aboveground utilities—are also expected to suffer severe, long-term damage across Multnomah County from future earthquakes.

Large earthquakes are rare in Multnomah County, which somewhat moderates risk. However, the long time period between earthquakes allowed development to occur without awareness of this danger, and seismically-resilient construction standards were not broadly adopted in Oregon until state building code updates in 1993. Updated building codes have made new construction significantly more resilient, but many vulnerabilities remain and a significant earthquake remains the natural hazard event most likely to cause widespread and long-term damage and displacement in Multnomah County.

Risk awareness of a Cascadia Subduction Zone megathrust earthquake has been heightened over the last 20 years, because of powerful similar earthquakes in the Indian Ocean and off the coast of Japan, and popular reporting of potential impacts of a similar earthquake off the coast of Oregon.

Earthquake Types

There are four types of naturally-occurring earthquakes that could impact Multnomah County. All types of earthquakes are measured by their magnitude with instruments that amplify and record ground movements. Magnitude is noted using a number and decimal point – such as the M6.8[28] Nisqually earthquake in Washington in 2001. Magnitude does not always directly determine the amount of damage caused, because impacts may depend on how close the epicenter is to development and how deep the epicenter is located below the ground. Amounts of damage caused will also be affected by types of soils, seasonal conditions, and the density and type of development closest to the epicenter.

- *Subduction Zone Earthquakes*

A subduction zone occurs where two continental plates meet and one is pushed under the other. As the plate is pushed under, or subducted, it creates a tremendous amount of pressure. When the plate eventually ‘rips’ and bounces back it creates a massive shock wave. The largest recorded earthquakes on the planet have all been subduction zone earthquakes. The Ring of Fire - a huge circle of geologically active locations around the Pacific Ocean from Asia to South America to the Pacific Northwest - is caused by a number of subduction zones.

[28] M6.8 means a magnitude of 6.8. Magnitudes are based on a calculation of recorded levels of shaking and converted to a familiar scale. The magnitude scale is logarithmic, meaning that each whole number increase (4.0 to 5.0 for example) represents a tenfold increase in shaking.

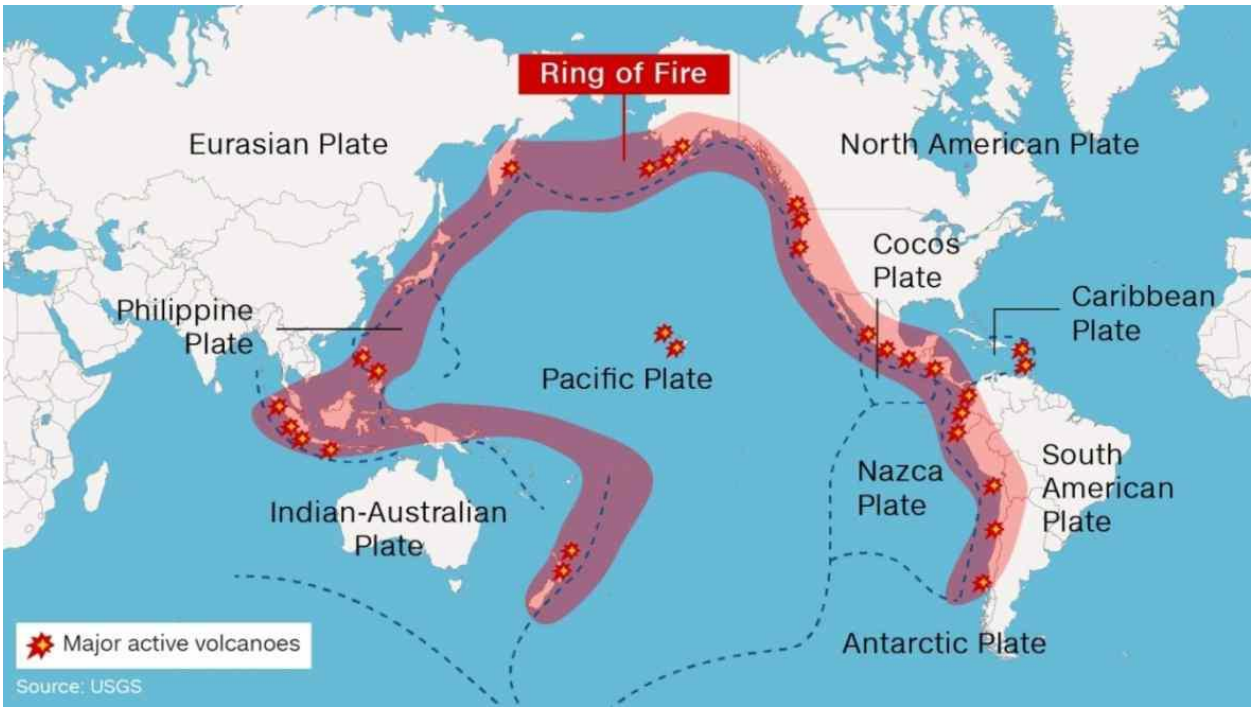

Figure 26 - Map showing the Ring of Fire, including active volcanoes located along the ring.

Local risk of subduction zone earthquake comes from the pushing of several pieces of oceanic floor (Juan de Fuca Plate, Gorda Plate, and other smaller pieces) under the North American continental crust about 70-100 miles off the western coast of the United States and Canada. This subduction zone extends about 600 miles from British Columbia in Canada to Northern California.

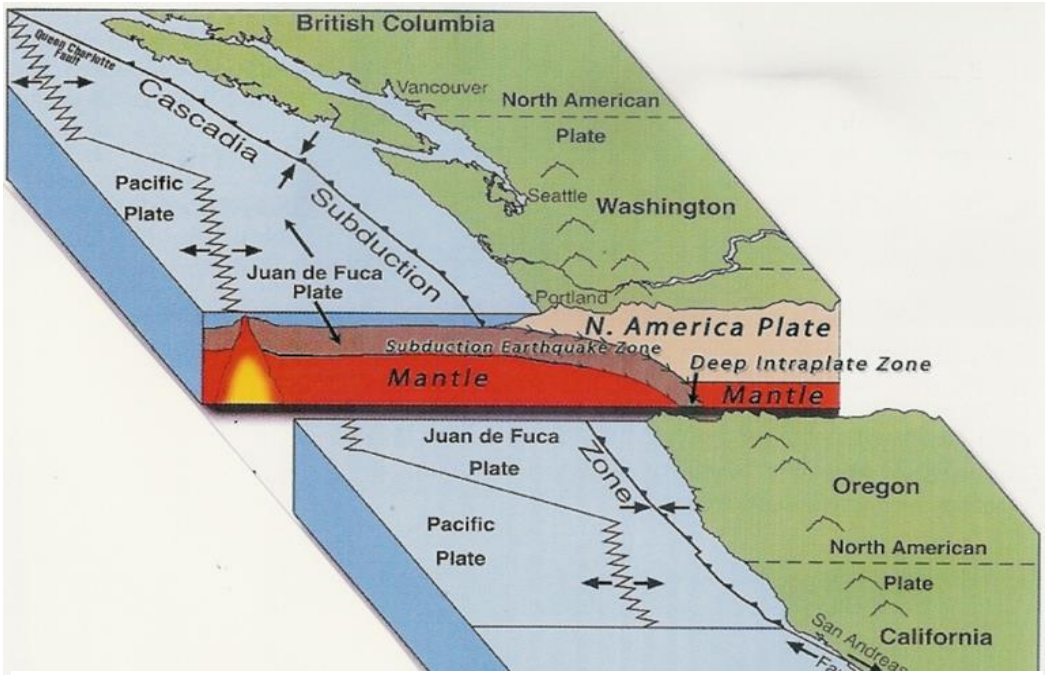

Figure 27 – USGS Diagram showing the subduction of plates below the Cascadia region. The Subduction Zone line shows where plates meet and one is pushed under the other, eventually being pushed into the mantle beneath the Pacific Northwest landmass.

Since subduction zones occur at continental boundaries in coastal locations, tsunamis are a common associated hazard. Subduction zone earthquakes often have long gaps of time between events, but in Oregon they have historically occurred more frequently than damaging crustal earthquakes. The

last major earthquake of this type in the Pacific Northwest occurred in 1700 and has been estimated to have had a magnitude of around 9.0.

- *Crustal Earthquakes*

Crustal earthquakes occur when blocks of rock slip against each other, much closer to the earth's surface than subduction zones. These earthquakes are mapped by faults—fractures in the rock that cause these slips and may be very short or extend hundreds of miles. Many faults in Multnomah County have been mapped, but there may be more that have not yet been discovered, because of a lack of study and no currently understood evidence of past seismic activity.

An interactive version of this map can be found here (Earthquake Hazard – Active Faults)

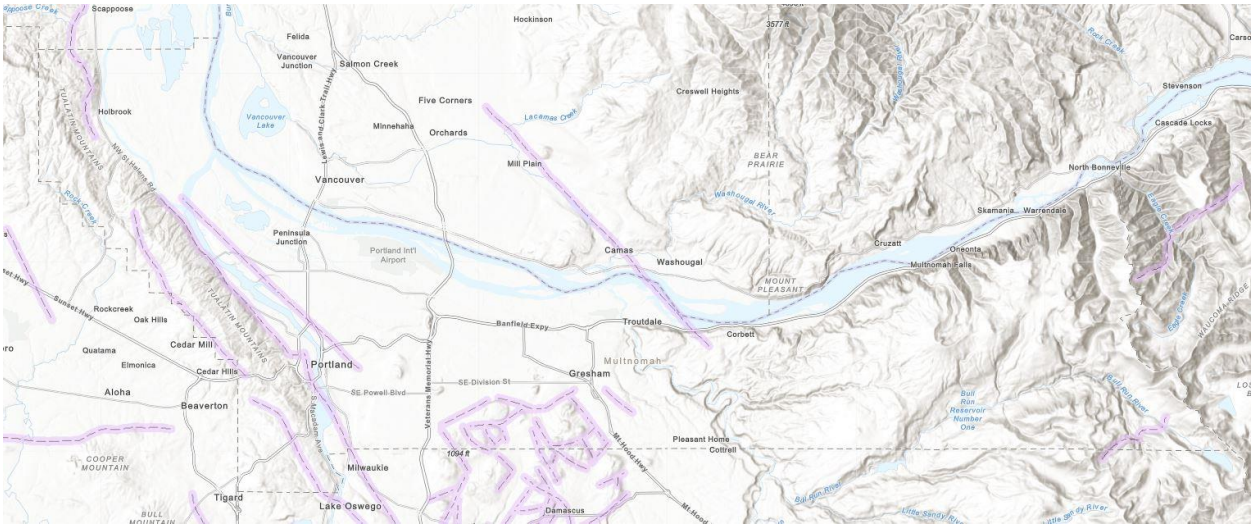

Figure 28 - Map showing known earthquake faults in Multnomah County. Map hosted on DOGAMI's HazVu website.

Crustal earthquakes are less powerful than subduction zone earthquakes, but because they occur closer to the surface and faults may run directly under populated areas, they also have tremendous damage potential. These types of earthquakes are common in California, with the San Andreas Fault being a well-known example.

Oregon has not had the same historical frequency of crustal earthquakes as neighboring states, and the likelihood of a large event in Multnomah County is considered to be significantly less likely than a subduction zone earthquake. However, a major earthquake on the Portland Hills fault could cause more local damage than a Cascadia Subduction Zone event.

- *Intraplate Earthquakes*

Unlike subduction zone and crustal quakes, intraplate earthquakes happen within a single plate. This may occur because of subduction effects above the plate or in locations where old rifts have been reactivated. This type of earthquake is difficult to predict both in frequency and location.

The 2001 Nisqually Earthquake was a recent intraplate earthquake, causing billions in damage in the Southern Puget Sound area of Washington and making buildings sway in Portland. The last known significant intraplate earthquake to occur in Oregon was in 1962—a 4.5 magnitude event near Corvallis[29]. Because the frequency and location of future intraplate earthquakes are largely unknown, risk is managed through preparation for the more predictable types of earthquakes. Intraplate earthquakes are not as strong as subduction zone earthquakes and are much deeper than crustal quakes, but can still cause considerable damage.

- *Volcanic Earthquakes*

Volcanic earthquakes usually occur in swarms as magma moves beneath a volcano. This type of earthquake is not usually strong enough to cause damage to structures or infrastructure, but can indicate increasing volcanic activity (see Volcano section). Small earthquake swarms continue to occur beneath Mount Hood, but very few have been large enough to be felt even in communities at the mountain.

Five-Year Report, 2017-2022

- *Events*

No significant earthquakes occurred in Multnomah County between 2017 and 2022. A number of normal low-intensity tremors have occurred, but no injuries or damages have occurred due to earthquakes over the last five years.

- *New Data and Analyses*

Since the Adoption of the 2017 Plan, the Regional Disaster Preparedness Organization (RDPO) provided funding in 2018 for the Oregon Department of Geology and Mineral Industries (DOGAMI) to create the *Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon*. This report contains the best available data for understanding impacts from the two most likely earthquake scenarios in the Portland Metropolitan Region.

An additional crustal earthquake scenario was modeled for another DOGAMI analysis – the 2020 *Natural Hazards Risk Report for the Lower Columbia-Sandy Watershed, Oregon*. The analysis provides building damage estimates within this East County watershed for a large crustal earthquake in the Mount Hood Fault Zone.

In July 2021, a Resiliency Assessment (RRAP) for Oregon transportation systems was published to resolve knowledge gaps, inform risk management decisions, identify opportunities for increasing transportation system resilience, and improve critical partnerships. The State of Oregon had previously published a 2018 report on improving resilience by 2025, including a planned update of the 2013 Oregon Resilience Plan.

Also in 2021, the first phase of an update to Regional Emergency Transportation Routes (ETRs) was published through the RDPO. The first phase of the update revised selected routes, based on improved road and bridge vulnerability information, detailed landslide mapping, and enhanced understandings of social vulnerability. A second phase, to be completed in 2023, will

[29] Lifelines and earthquake hazards along the Interstate 5 Urban Corridor: Cottage Grove to Woodburn, Oregon; United States Geological Survey, 2004

prioritize routes and provide operational guidance. The Oregon Department of Transportation (ODOT) simultaneously worked on a statewide analysis of triage routes, looking to identify the highest priority infrastructure programs to ensure post-disaster movement through counties and regions statewide.

A 2022 study, *Impacts of Fuel Releases from the CEI Hub Due to a Cascadia Subduction Zone Earthquake* was commissioned by the Portland Bureau of Emergency Management (PBEM) and the Multnomah County Office of Sustainability. The study quantifies risk and impacts from fuel storage tank seismic failure at the Critical Energy Infrastructure Hub in Northwest Portland. An overview, and risks to participating entities in this plan, is included later in this chapter.

- *Early Warning System*

ShakeAlert, a United States Geological Service earthquake early warning system, became available in Oregon on March 11, 2021. The system uses sensitive field sensors to detect earthquake shock waves and send out a signal that can be received before a shock wave reaches populated areas. Warnings can be sent seconds to tens of seconds before the effects of the earthquake are felt, giving people time to quickly take protective action. This warning can be received on cell phones, with some communication methods being automatic and some opt-in, depending on a person's phone.

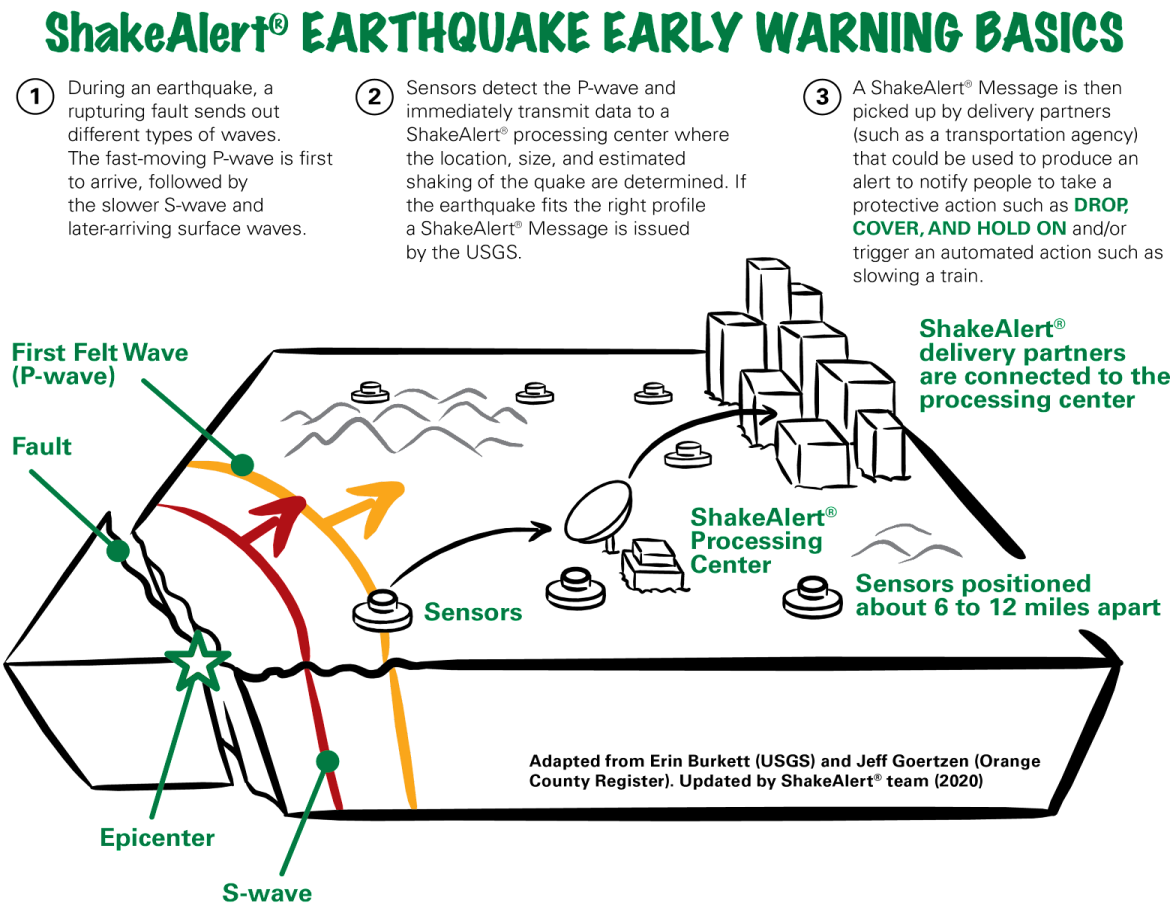

Figure 29 - ShakeAlert Basics

For participating entities in this plan, ShakeAlert offers potential for creating automatic infrastructure responses to the early warning. Some possibilities include opening or closing valves, opening automatic doors to prevent them from being stuck closed when power is lost, starting backup generators, halting air operations, and opening or closing bridges. Developing programs to take advantage of the system will be an ongoing mitigation opportunity for county jurisdictions and districts in coming years.

Other Mitigation Trends

Many notable improvements to resilience of critical infrastructure have been initiated or completed in the last five years. A number of these projects are described in the jurisdictional/district chapters, and include assets with regional and statewide significance, such as a resilient Portland International Airport runway, the Columbia River Levee System and the Burnside Bridge.

Because so much of the planning area related to this document is located in earthquake impact zones, all new built development carries some earthquake risk. New development occurring within the Urban Growth Boundary in areas with significant soil liquefaction hazard will still be threatened.

Continued public engagement around earthquake risk continues to be essential. Public awareness attained a high level around 2015, with factors such as the major earthquakes in Japan and New Zealand in 2011, and the publication of a 2015 article in *The New Yorker*[30] about the extreme risks of a Cascadia Subduction Zone earthquake. Risk awareness of earthquakes remained relatively high in survey responses gathered for this plan update, but the continuing influx of new residents, the infrequency of earthquakes, and the higher current visibility of weather hazards makes risk communication for earthquakes an ongoing need.

Climate Change Impacts

There is no proven link that a warmer climate will lead to increased earthquake risk. There is some evidence that small earthquakes can be affected by increased precipitation, drought, and groundwater pumping—but these effects are not likely to increase the likelihood of the earthquakes that are the focus of this plan.

3.1.1 Earthquake Impacts, Locations and Extent

All parts of Multnomah County are at risk from large earthquakes. Almost any large earthquake regionally will be felt across the area. However, some parts of Multnomah County will see greater impacts, depending on the location of the earthquake, the types of soils, and the types of buildings and infrastructure present. Based on expected locations of future earthquakes, eastern Multnomah County has somewhat less vulnerability than Portland and western portions of the County, except in areas with high susceptibility to soil liquefaction.

[30] The Really Big One, *The New Yorker*, Kathryn Schulz, July 20, 2015

- *Cascadia Subduction Zone*

Effects from a Cascadia Subduction Zone earthquake will be strongest on the Oregon Coast and lessen as the shock wave travels eastward. Effects will be mild east of the Cascades. The western portion of Multnomah County will experience more shaking from a Cascadia Subduction Zone event, and wet, low-lying areas throughout the county will be impacted by soil liquefaction. Landslides will also occur across the county, but especially on the west side of the county in locations where high landslide vulnerability already exists.

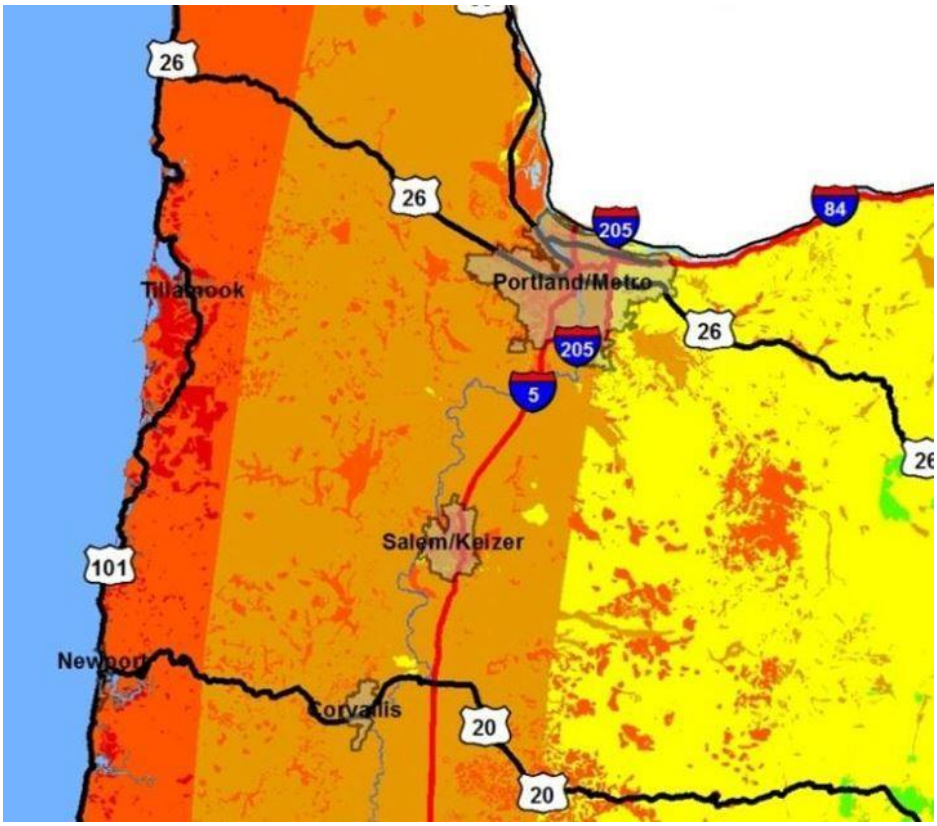

Figure 30 - A diagram showing expected shaking from a Cascadia Subduction Zone Earthquake. Orange is heavy shaking, light orange is moderate shaking, yellow is light shaking, and green is very light shaking. The strongest effects will be felt on the coast and lessen as the shock moves inland – but note that areas with wet soils in the Portland Metropolitan Area will feel shaking about as strongly as many coastal areas. Eastern Multnomah County sees a decline in shaking beginning roughly east of Highway 205. Map from the 2013 Oregon Resilience Plan.

Portland Hills Faults

A Portland Hills crustal earthquake will also impact the entire county, but ground shaking effects will be strongest closest to the fault. In those areas closest to the fault line, shaking will be significantly stronger than a subduction zone event, although likely for a much shorter amount of time. Because of the lower magnitude, areas farthest away in East County will feel less shaking in most cases than from a subduction zone event.

Mount Hood Fault Zone

The earthquake scenario modeled for the Lower Columbia-Sandy watershed in the Mount Hood Fault Zone will have its epicenter outside of Multnomah County. Effects will be strongest along Multnomah County's easternmost border with Hood River County all the way to the Columbia River, but impacts will be significantly moderated by the time the shock waves reach densely populated areas west of the Sandy River. Landslides in the Columbia River Gorge could be a significant danger.

Earthquake Impacts

Ground Shaking/Acceleration

The amount of ground shaking that occurs in an earthquake can be increased by the properties of the soil. Seismic waves move faster through hard rock and dense soils, while softer rock or soil will slow down waves and cause them to accumulate and strengthen.

Since ground liquefaction is also most likely to occur in soft, wet soils, severe ground shaking and liquefaction areas are often located in the same place, and the impacts of amplified shaking contribute to the severity of liquefaction in these areas.

Much of the area of participating cities and districts will see fairly uniform ground shaking, although elevated risk is notable in areas within the Columbia River floodplain. Multnomah County has significant differences between unincorporated areas on the east and west sides of the county.

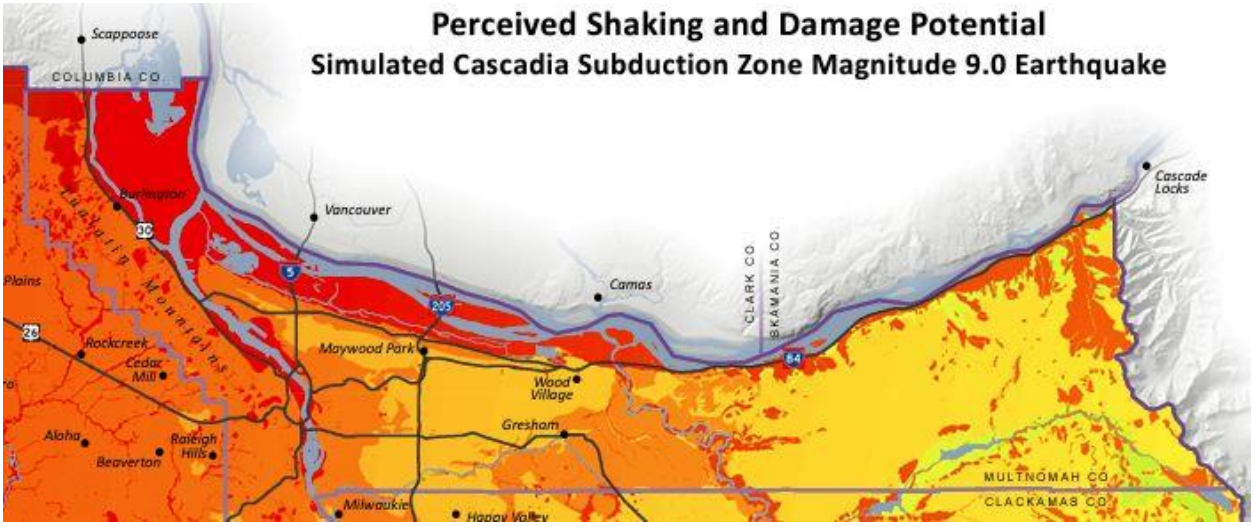

Figure 31 - Shaking and damage from a M9.0 Cascadia Subduction Zone event. Red indicates predicted moderate/heavy shaking and damage, orange indicates moderate shaking and damage and yellow is low/moderate shaking and damage. Graphic from DOGAMI publication O-18-02, Appendix E, Plate 6.

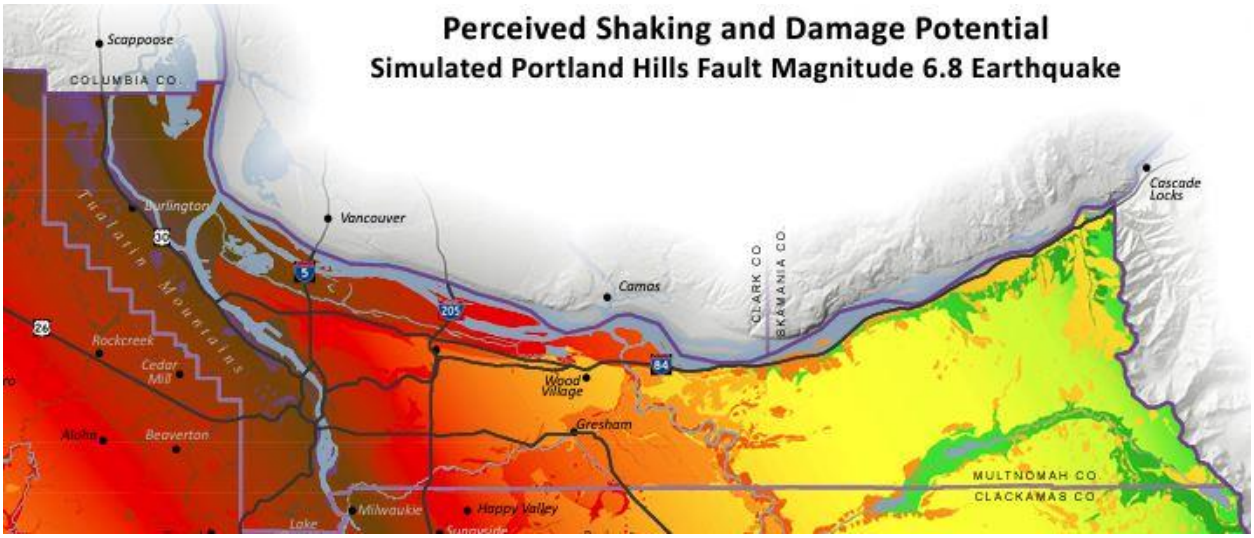

Figure 32 - Shaking and damage from a M6.8 Portland Hills crustal earthquake event. Dark red indicates violent shaking and heavy damage, red indicates moderate/heavy shaking and damage, orange indicates moderate shaking and damage, yellow is low/moderate shaking and damage, and green is low shaking and damage. Graphic from DOGAMI publication O-18-02, Appendix E, Plate 7.

Figure 33 - DOGAMI map showing expected shaking from a M6.9 crustal earthquake on the Mount Hood fault. Map from DOGAMI publication O-20-06, Risk Report for the Lower Columbia-Sandy Watershed, Plate 4.

Soil Liquefaction (including Lateral Spreading and Settling)

Liquefaction is a process where the strength of soil is reduced by water pressure exerted during an earthquake. When this occurs, the soil takes on properties of a liquid and loses much of its ability to support building foundations, bridges, roads, retaining walls, dams, levees and other engineered supports requiring soil stability. This effect is extremely damaging in earthquakes, often causing structural failure, and areas with this risk will suffer the most property damage. Huge amounts of silt may be left behind on the surface as debris.

Multnomah County has significant areas with soils at risk for liquefaction. Loose sandy and silty soils that are saturated with moisture have the highest risk. Areas in historical floodplains and wetlands are the most susceptible.

[An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)]

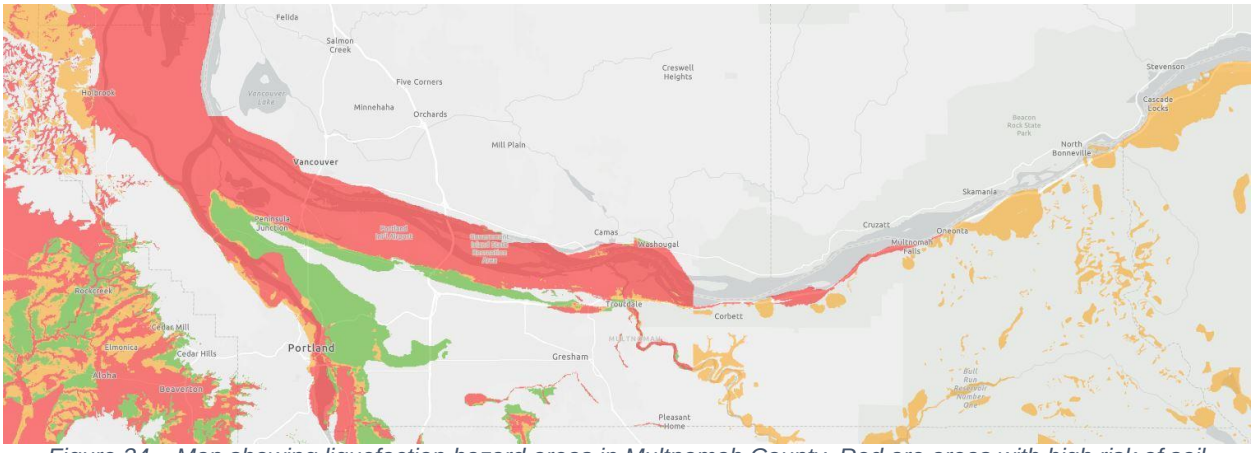

Figure 34 – Map showing liquefaction hazard areas in Multnomah County. Red are areas with high risk of soil liquefaction in an earthquake of any type, orange is moderate risk and green is lower risk. Areas without color are not significantly impacted by liquefaction effects. Map from DOGAMI HazVu site.

Lateral spreading is an effect of soil liquefaction. As the soil begins to act like a liquid, it will spread out even on very slight slopes, causing roads to separate, buried pipelines to break, and shallow foundations to shift and crack.

Figure 35 - Road damage caused by lateral spreading in Thurston County, Washington, an impact of the 2001 Nisqually Intraplate Earthquake. Photo – DOGAMI Archive

Settling is another soil liquefaction effect, when the ground lowers due to soil impacts below the surface. As with spreading, uneven settling will break foundations and roads and threaten underground infrastructure.

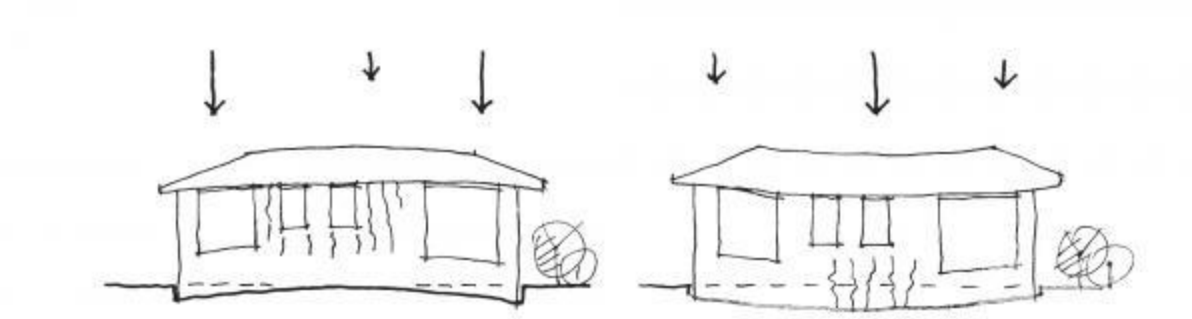

Figure 36 - A form of settling, called differential settling where different areas of soil under a foundation settle at different rates, causing stress to foundations or structural walls. Illustration from BRANZ Seismic Resilience (New Zealand organization to promote building resilience)

Earthquake-Induced Landslides

Earthquakes are a key trigger of large landslides. The risk factors for earthquake-caused landslides are the same as any landslide risk—areas where there have been past landslides and areas with steep slopes and unstable soil types. Landslide risk areas are shown in the Landslide chapter.

Post-earthquake landslides are worrisome because there are likely to be many of them at once, especially if an earthquake occurs during a time of year when soils are wet. These landslides may block roads and reduce the ability to evacuate people or bring in relief supplies to the region. The likely locations of post-earthquake landslides has been a key consideration in determining priority evacuation routes.

Volcanic Activity

Volcanic chains form around subduction zones, as pressure and heat of the grinding plates turn rock into molten magma. However, there is no evidence that a subduction zone earthquake would directly lead to renewed volcanic activity at Mount Hood.

Tsunamis and Seiches

Tsunamis result from earthquakes which cause a sudden rise or fall of the ocean floor, creating an enormous wave. A surge could extend up the Columbia River, perhaps as far inland as Multnomah County. However, because of the considerable distance from the coast, the effects are expected to be minimal.

A similar earthquake phenomenon are seiches—waves from sloshing of inland bodies of waters such as lakes, reservoirs or rivers. Seiches may damage docks, other shorefront structures and dams. Seiches could cause localized damage to reservoirs and tanks in Multnomah County, but this impact has not been studied in detail.

3.1.2 Earthquake Probability and History

- *Probability*

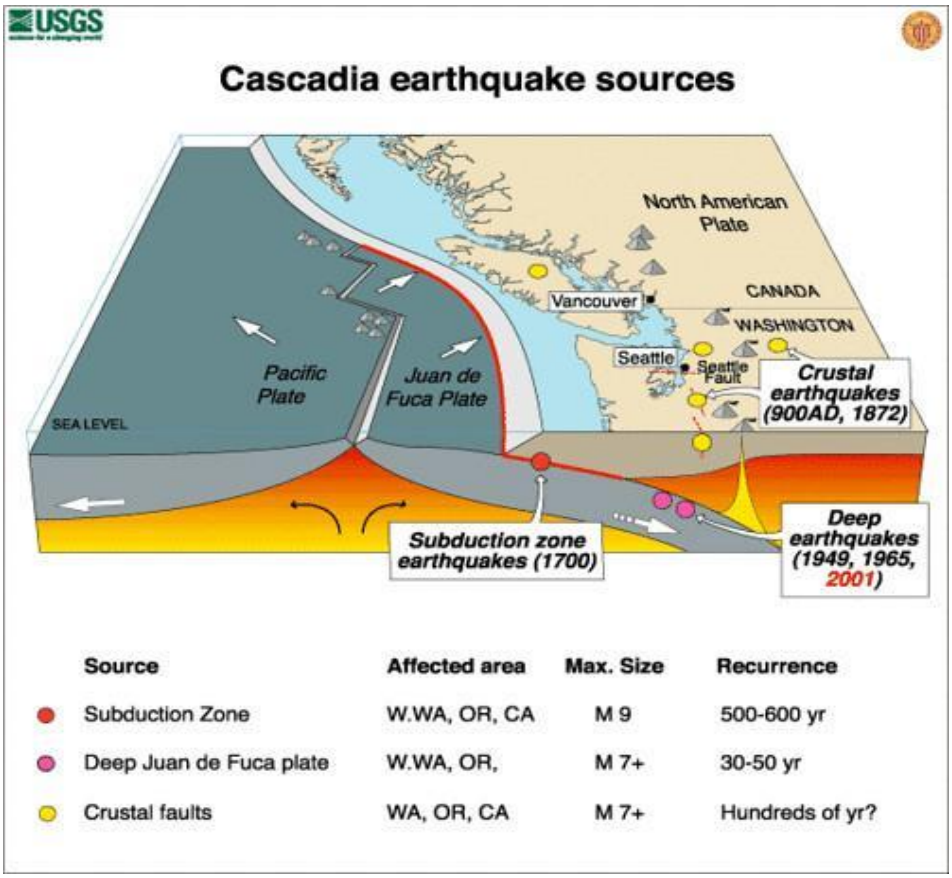

Figure 37 - Graphic showing estimated return periods for the different types of earthquakes in the Pacific Northwest. Deep earthquakes are the same as Intraplate Earthquakes. Diagram from the United States Geological Survey. As noted below, Intraplate and Crustal Earthquakes have not occurred as frequently in Oregon as in other parts of the Cascadia Region.

Cascadia Subduction Zone

The last major earthquake on the Cascadia Subduction Zone occurred on January 26, 1700. The exact date and even time of the earthquake are known through accounts of people living in coastal areas of the Pacific Northwest, tsunami records from Japan, and through study of tree rings of ghost forests that submerged into tidal flats.

The 1700 Cascadia Megathrust was an event comparable to the scenarios currently used for earthquake planning across Oregon. The 1700 earthquake is believed to have been caused by a rip of over 600 miles along the subduction zone and with an estimated magnitude of 8.7-9.2, similar to the Great Tohoku earthquake in Japan in 2011 and the Indian Ocean earthquake and tsunami in 2004.

The 1700 earthquake is believed to have caused complete destruction of coastal communities as the ground suddenly sank three to six feet and large tsunamis swamped low-lying coastal areas.

The paleo-scientific record shows 18 Cascadia Subduction Zone earthquakes of above M9.0 over the last 10,000 years, making an estimated recurrence of about once per 500-800 years. Smaller, but still substantial, quakes (M8.3-M8.5) have occurred another 10-20 times in that time span, although these have tended to occur in the southernmost part of the zone off of Southern Oregon and Northern California. The time between earthquakes has been variable, ranging from decades to centuries.

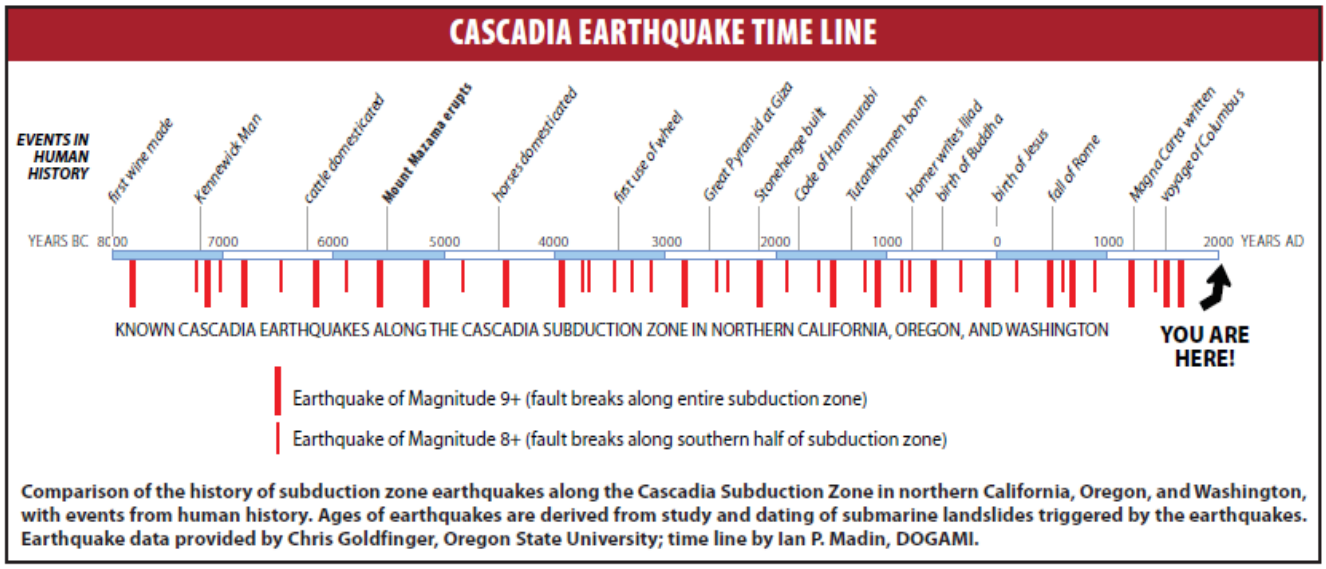

Figure 38 – 2010 Cascadia Earthquake Time Line, published by DOGAMI

Recent research has suggested that because of the length of time since the last event, the chance of Cascadia Subduction Zone earthquake similar to the 1700 event has around a 7-12% chance of occurring over the next 50 years[31]. The chance of a partial rupture that would have little effect to Northern Oregon is estimated at 37-43% over the next 50 years.

Crustal Earthquakes

Much of recent earthquake risk awareness in Oregon has been built around a major Cascadia Subduction Zone (CSV) earthquake. Crustal earthquakes are actually much rarer than CSV earthquakes in the local geological record, yet may be just as dangerous since the faults lie close to the surface and are located directly under densely populated areas. A large, local crustal earthquake would cause the same powerful shaking and liquefaction impacts and could be especially damaging to structures near the epicenter.

Numerous fault lines run through Multnomah County—beneath the West Hills/Tualatin Mountains, around the Gresham East Buttes, and across the Columbia River from the State of Washington to the Corbett area. Of the local faults, the Portland Hills Fault is considered to be

[31] DOGAMI Cascadia Earthquake Knowledge Points for Emergency Managers and the Public, June 2022

the most dangerous, because of its observed history of earthquake and location directly in the county's most densely populated center.

Evidence suggests that the Portland Hills Fault has ruptured twice in the last 15,000 years, which indicates a higher probability (every 7,500 years or so) than was expressed by this plan in 2017. Other fault zones near Multnomah County, such as Gales Creek and Mount Hood, have ruptured more recently and may cause earthquakes more frequently than the Portland Hills Fault. The Gales Creek Fault Zone, just west of Multnomah County, is thought to have last had a major earthquake about 1,000 years ago, with a roughly 4,000 year period between the most recent three events[32]. Another recent discovery has been that a large crustal earthquake occurred on the Mount Hood Fault Zone in the last 500-700 years[33], and may have caused a large landside that blocked the Columbia River in the Bonneville area. There is evidence that Mount Hood Fault Zone earthquakes may be more frequent than in the other zones mentioned here, but there is still uncertainty about recurrence intervals and how ruptures occur.

The most recent significant crustal earthquake in northwestern Oregon was the Scotts Mills earthquake in March 1993. Known as the 'Spring Break Quake', it had a magnitude of 5.6 and was centered on the Mount Angel Fault about 34 miles south of Portland. The earthquake caused about $30 million in damage, primarily to unreinforced masonry buildings. Minor structural damage was reported in Portland and Gresham[34].

For the purposes of estimating vulnerability in their Regional Earthquake Impact Analysis, DOGAMI used a magnitude 6.8 Portland Hills event as a realistic catastrophic scenario. For the multi-hazard study of the Lower Columbia-Sandy River Watershed in Eastern Multnomah County, a magnitude 6.9 event in the Mount Hood Fault Zone was also used for a building damage vulnerability analysis.

- *Case Study: Christchurch Earthquake*

The 2011 earthquake in Christchurch, New Zealand, has been used as a case study for potential earthquake impacts in the Portland Metropolitan Area, and especially as an important reminder of the risk of lower intensity crustal earthquakes. Christchurch has notable similarities to this region, being located near a large water body with developed areas on liquefaction-prone soils and numerous unreinforced masonry buildings in the city center built before the implementation of seismic building codes.

This earthquake had a magnitude of only 6.3, and is believed to have been an aftershock of a M7.1 quake in 2010. The impacts of the 2011 quake were much higher than the larger 2010 quake. The reasons for this was that the epicenter was shallower and located closer to the city than in 2011. It also occurred during a weekday, meaning more people were in large buildings that may have been weakened by the initial quake.

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[32] Multiple Holocene Earthquakes on the Gales Creek Fault, Northwest Oregon Fore-Arc, *Bulletin of the Seismological Society of America*, A.E. Horst, A.R.. Streig, R.E. Wells, J. Bershaw, 2021

[33] The Mount Hood fault zone, active faulting at the crest of the dynamic Cascade Range, north-central Oregon, USA, *From Terranes to Terrains: Geologic Field Guides on the Construction and Deconstruction of the Pacific Northwes*t, Ian Madin, Ashley Streig, Scott Bennett, Geological Society of America, September 2021

[34] The Scotts Mills, Oregon, Earthquake of March 25, 1993: Intensities, Strong-Motion Data and Teleseismic Data, US Geological Service, Open-Fire Report 94-163, 1994, p.8

The Christchurch earthquake killed 185 people and 6,659 people suffered major injuries. Around 7,000 homes were 'red-zoned'—deemed to be on land too unsafe to rebuild. Another 7,000 homes became newly considered to be vulnerable to flood because of land subsidence and the spread of wet soils. 1,354 commercial buildings had to be demolished—826 in the City Center and 528 in suburban areas[35]. Parts of the Central Business District remained cordoned off for 29 months due to the risk of further building collapse.

Figure 39 - Cleanup after the 2011 Christchurch Earthquake

Sixty percent of the 185 deaths occurred in a single building collapse, at a five-story commercial building built in 1986. Another 18 people died in a separate multi-story commercial building collapse, and eight people died when masonry fell from a large building onto a bus.

New Zealand is a seismically active nation, but had not had a high-fatality earthquake since 1931. The location of the 2011 aftershock was on a fault that had only been identified because of the 2010 quake, and this fault system had been considered low-risk, with lengths of time between events similar to crustal faults in Multnomah County. This earthquake indicated the requirement for maintaining awareness of risk, and the continuing vulnerability of buildings built before the implementation of modern seismic standards.

Intraplate Earthquakes

As noted in the introduction to this chapter, estimating probabilities of intraplate earthquakes is difficult, because the forces that cause them are difficult to study. In the lower Puget Sound region, intraplate earthquakes have been the most common major earthquakes over the last century. The region between Olympia and Seattle was struck in 1949, 1965 and 2001 with intraplate quakes that did tens or hundreds of millions of dollars of damage. It is believed that the underground formation of rock below the Cascadia Subduction Zone in Washington is

[35] All data – Insurance Council of New Zealand – Challenges to Recovery

responsible for this cluster, and Oregon has not shown the same risk. The only notable event in Oregon of this type in the last century was a M4.5 earthquake that occurred near Corvallis in 1962. Still, intraplate earthquakes are not yet able to be modeled and estimated for probability, and could still be a risk to Multnomah County.

Intraplate earthquakes have the deepest epicenters of all earthquakes. Other characteristics noted in Washington earthquakes are that intraplate earthquakes are felt over a larger distance and have not had aftershocks.

3.1.3 Earthquake Vulnerability

The 2018 report by the Oregon Department of Geology and Mineral Industries (DOGAMI) is the current standard for evaluating vulnerability in Multnomah County, and is supplemented by other site-specific studies. The DOGAMI report used two scenarios—a large offshore Cascadia Subduction Zone earthquake and a major crustal earthquake on the Portland Fault in Western Multnomah County—to evaluate injury, damage, building loss, displacement, debris and other impacts.

Study Methodology

Daytime vs Nighttime Scenario

The time and day that a significant earthquake hits Multnomah County will likely be a key factor in the number of injuries and deaths caused. During a workday, many more people will be clustered in locations more likely to be built with unreinforced masonry, while single-story wood-framed construction associated with homes is much less likely to collapse. The HAZUS Advanced Engineering Building Model (AEBM) used in the analysis showed that about 3% of completely damaged wood-framed homes would collapse, compared to 15% of completely damaged unreinforced masonry buildings. Most of the unreinforced masonry buildings in Multnomah County are located in the City of Portland, but many residents of communities in this plan commute to Portland for work, school, business, and entertainment – and Multnomah County would support mass sheltering, health and human services throughout the county.

Dry vs Wet Soil Conditions

The time of year is also extremely important for predicting earthquake impacts. When soils are wet, and more prone to liquefaction and landslide, the casualty and building damage in most Multnomah County jurisdictions is more than doubled and the rate of people displaced long-term is increased even more. For the purpose of the study, wet soil was considered to be fully saturated, to develop a worst-case scenario. Actual losses would be likely to fall somewhere between the wet and dry estimates, depending on groundwater depths at the time of the event.

Impacts

Injury and Casualties

The Hazus AEBM model was used to estimate casualties. The estimates use aggregated daytime occupancy rates based on a set people per square foot assumption. The analysis only

includes death and injury suffered by those inside buildings. As was seen in Christchurch, significant risk can also occur to people outside buildings from falling stone, debris, and glass. A number of other potential casualty causes were not modeled, such as loss of power to support life-sustaining medical equipment, post-earthquake fires, collapsed bridges, and impacts from hazardous materials spills and fires.

A projection of deaths and life-threatening injuries in jurisdictions in this plan is shown below. DOGAMI also modeled slight and moderate injuries—those able to be treated at the scene or requiring hospitalization but not being life-threatening. In the worst-case scenario (wet soils during the daytime), all of Multnomah County (including Portland and Maywood Park) was projected to experience 11,824 slight injuries, 3,397 moderate injuries, 487 life-threatening injuries and 950 deaths. Based on the numbers shown below, the City of Portland, as expected, would suffer the bulk of loss of life, but Wood Village was the only city to have no death or life-threatening injury in each scenario.

Totals have also been calculated for the census tracts most closely aligned to Columbia Corridor Drainage Districts—these overlap with portions of totals for Portland as well as Gresham, Fairview, Troutdale, and Unincorporated Multnomah County. These have been italicized to indicate that they may be duplicative with other totals—and because of the census tracts not fitting district boundaries, they also duplicate totals within the districts themselves. The higher totals for the PEN1 and PEN2 drainage districts and MCDD underline the greater susceptibility of loss in more western locations in the County.

Table 11 – Cascadia Subduction Zone, M9.0 – Casualties - Death and Life Threatening Injury (DOGAMI O-18-02 - 2018 Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon)

Community	Dry Soil+Daytime (death/life-threatening injury)	Dry Soil+Nighttime (death/life-threatening injury)	Wet Soil+Daytime (death/life-threatening injury)	Wet Soil+Nighttime (death/life-threatening injury)
All of Multnomah County (Including Cities of Portland and Maywood Park)	621/318	122/62	950/487	236/124
City of Fairview	0/0	0/0	3/2	1/0
City of Gresham	9/5	1/1	27/14	10/5
City of Troutdale	2/1	0/0	12/6	1/1
City of Wood Village	0/0	0/0	0/0	0/0
Unincorporated Multnomah County	5/2	1/1	10/5	4/2
PEN1 and PEN2 (Tract 72.02)	40/21	4/2	78/40	10/5
MCDD (Tracts 72.02, 73, 102)	92/48	12/6	196/100	29/15
SDIC (Tract 102)	5/3	0/0	36/18	2/1

Using the same analysis for the Portland Hills earthquake scenario returned extremely similar casualty results for the participating cities in this plan – but the county total is significantly higher when the City of Portland is included.

Table 12 – Portland Hills Fault, M6.8 – Casualties - Death or Serious Injury (DOGAMI O-18-02 - 2018 Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon)

Community	Dry Soil+Daytime (death/life-threatening injury)	Dry Soil+Nighttime (death/life-threatening injury)	Wet Soil+Daytime (death/life-threatening injury)	Wet Soil+Nighttime (death/life-threatening injury)
All of Multnomah County (Including Cities of Portland and Maywood Park)	1,805/920	432/223	2,237/1,146	633/335
City of Fairview	0/0	0/0	3/2	1/0
City of Gresham	6/3	1/1	33/17	15/8
City of Troutdale	1/1	0/0	11/6	1/1
City of Wood Village	0/0	0/0	0/0	0/0
Unincorporated Multnomah County	9/5	4/2	16/9	8/4
PEN1 and PEN2 (Tract 72.02)	*67/35*	*7/4*	*95/49*	*11/6*
MCDD (Tracts 72.02, 73, 102)	*112/58*	*14/8*	*212/109*	*30/16*
SDIC (Tract 102)	*3/1*	*0/0*	*34/17*	*2/1*

Long-Term Displacement

Displacement of residents will be heightened by the difficulty in bringing in building inspectors after a disaster and conducting a large amount of home inspections before they can be reoccupied. As shown below, wet soils markedly increase displacement because of the cascading effect of many more buildings with some level of damage that will further slow inspection and re-occupation.

Note again that the City of Portland has much larger amounts of displacement than the cities included in this plan, especially in a Portland Hills disaster.

Table 13 – Cascadia Subduction Zone, M9.0 – Long-Term Displacement (DOGAMI O-18-02 - 2018 Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon)

Community	Dry Soil - Number of People Displaced	Wet Soil - Number of People Displaced
All of Multnomah County (Including Cities of Portland and Maywood Park)	9,736	37,461
City of Fairview	71	335
City of Gresham	399	4,244
City of Troutdale	12	245
City of Wood Village	55	55
Unincorporated Multnomah County	335	1,891
PEN1 and PEN2 (Tract 72.02)	*131*	*730*
MCDD (Tracts 72.02, 73, 102)	*467*	*1,729*
SDIC (Tract 102)	*53*	*349*

Table 14 – Portland Hills, M6.8 – Long-Term Displacement (DOGAMI O-18-02 - 2018 Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon)

Community	Dry Soil - Number of People Displaced Long-Term	Wet Soil - Number of People Displaced Long-Term
All of Multnomah County (Including Cities of Portland and Maywood Park)	50,842	120,124
City of Fairview	39	305
City of Gresham	314	6,734
City of Troutdale	11	281
City of Wood Village	12	12
Unincorporated Multnomah County	1,320	3,505
PEN1 and PEN2 (Tract 72.02)	*257*	*833*
MCDD (Tracts 72.02, 73, 102)	*557*	*1,893*
SDIC (Tract 102)	*34*	*355*

Building Damage

The Hazus AEBM model was also used to estimate structural losses. Losses were based on aggregations of generic building models rather than specific building characteristics, due to the large scope of the analysis. As with injury and casualty and displacement totals, these estimates seem very specific but should be understood to represent a point within a range of potential outcomes.

Despite that limitation, DOGAMI was able to use a very accurate building inventory, including the specific information for the structure's type (construction material), age and use. The model divides structures into five potential damage states ('no damage' is not shown in the table below) to calculate total losses.

Damage State		Description
	**Slight**	Small plaster cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneers. Small cracks are assumed to be visible with a maximum width of less than 1/8 inch (cracks wider than 1/8 inch are referred to as "large" cracks).
	**Moderate**	Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
	**Extensive**	Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations.
	**Complete**	Structure may have large permanent lateral displacement or be in imminent danger of collapse due to cripple wall failure or failure of the lateral load resisting system; some structures may slip and fall off the foundation; large foundation cracks. Three percent of the total area of buildings with Complete damage is expected to be collapsed, on average.

Figure 40 - Graphic showing description of different damage levels in a severe earthquake scenario

Total damages by jurisdiction/district are shown below. Note that day or nighttime differences are only relevant to casualties and not to building damage. Wet soils again make a very large difference in building damage, except in Wood Village. The structure loss ratio is the percentage loss of the total structural value in the jurisdiction. Percentage of building loss rises significantly when the City of Portland is included.

Table 15 – Cascadia Subduction Zone, M9.0 – Building Damage Cost and Loss Ratio (DOGAMI O-18-02 - 2018 Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon)

Community	Dry Soil/Structure Building Repair Cost	Dry Soil/Structure Building Loss Ratio	Wet Soil/Structure Building Repair Cost	Wet Soil/Structure Building Loss Ratio
All of Multnomah County (Including Cities of Portland and Maywood Park)	$13,340,000,000	12%	$20,489,000,000	18%
City of Fairview	$24,000,000	2%	$58,000,000	6%
City of Gresham	$314,000,000	3%	$726,000,000	7%
City of Troutdale	$77,000,000	4%	$169,000,000	10%
City of Wood Village	$9,000,000	2%	$9,000,000	2%
Unincorporated Multnomah County	$249,000,000	7%	$565,000,000	16%
PEN1 and PEN2 (Tract 72.02)	*$1,046,729,792*		*$1,776,308,736*	
MCDD (Tracts 72.02, 73, 102)	*$2,498,733,368*		*$4,248,832,760*	
SDIC (Tract 102)	*$146,673,784*		*$471,622,352*	

As with casualties, the analysis for the Portland Hills earthquake scenario returned similar results for the participating cities and districts. Unincorporated Multnomah County was an exception, because of areas on the west side of the County where shaking would be significantly stronger. For unincorporated Multnomah County as a whole, the structure loss is about double from a Portland Hills earthquake compared to a Cascadia Subduction Zone event. When looking at the county in total, including Portland, damages and loss levels significantly exceed that of a Cascadia Subduction Zone event.

Table 16 – Portland Hills, M6.8 – Building Damage Cost and Loss Ratio (DOGAMI O-18-02 - 2018 Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon)

Community	Dry Soil/Damage Building Repair Cost	Dry Soil/Loss Building Loss Ratio	Wet Soil/Damage Building Repair Cost	Wet Soil/Loss Building Loss Ratio
All of Multnomah County (Including Cities of Portland and Maywood Park)	$32,287,000,000	28%	$42,747,000,000	37%
City of Fairview	$30,000,000	3%	$65,000,000	6%
City of Gresham	$459,000,000	4%	$1,114,000,000	10%
City of Troutdale	$67,000,000	4%	$167,000,000	10%
City of Wood Village	$10,000,000	2%	$10,000,000	2%
Unincorporated Multnomah County	$636,000,000	18%	$1,030,000,000	28%
PEN1 and PEN2 (Tract 72.02)	*$1,587,720,064*		*$2,118,925, 696*	
MCDD (Tracts 72.02, 73, 102)	*$2,562,585,440*		*$3,010,380,800*	
SDIC (Tract 102)	*$134,851,328*		*$467,413,728*	

Building loss was also modeled for the Mount Hood Fault Zone scenario, but just within the Lower Columbia-Sandy watershed[36]. A slightly different methodology was used, indicating the number of buildings that would be considered uninhabitable (red-tagged) and those with moderate damage and partially inhabitable (yellow-tagged). Loss totals and ratios allow comparison – overall significantly less damage is expected from this earthquake compared to the other scenarios. Note that the totals and ratios are only for structures in the watershed. Unincorporated Multnomah County faces the most impact, with severe loss in the easternmost parts of the County.

[36] Most of Troutdale and portions of Gresham and Unincorporated Multnomah County

Table 17 – Mount Hood Fault, M6.9 – Casualties, Death or Serious Injury
LOWER COLUMBIA-SANDY WATERSHED ONLY **(DOGAMI O-20-06 - 2020 Natural Hazard Risk Report for the Lower Columbia-Sandy Watershed)**

Community	Yellow-Tagged Buildings	Red-Tagged Buildings	Structure Loss	Structure Loss Ratio
City of Gresham	8	1	$8,959,000	0.3%
City of Troutdale	5	14	$10,994,000	0.8%
Unincorporated Multnomah County	48	81	$40,903,000	3.0%

Debris

Debris from collapsed or damaged buildings will create a huge task to manage during recovery. Debris will block emergency routes and other forms of movement and require a massive logistical effort to load, move, sort and store heavy materials. Debris totals may be higher than listed in the DOGAMI study, as it does not include debris from landslides, damaged bridges and roads, structures other than buildings, and sand and silt raised to the surface during liquefaction. To put the numbers in perspective, a single truckload may carry about 25 tons of material. When Portland is included, debris is approximately doubled across the county during a Portland Hills quake compared to a Cascadia Subduction quake.

Table 18 – Cascadia Subduction Zone, M9.0 – Tons of Debris Created (DOGAMI O-18-02 - 2018 Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon)

Community	Dry Soil/Tons of Debris	Wet Soil/Tons of Debris
All of Multnomah County (Including Cities of Portland and Maywood Park)	7,724,000	10,395,000
City of Fairview	12,000	29,000
City of Gresham	143,000	279,000
City of Troutdale	39,000	83,000
City of Wood Village	6,000	6,000
Unincorporated Multnomah County	117,000	216,000
PEN1 and PEN2 (Tract 72.02)	*596,267*	*882,708*
MCDD (Tracts 72.02, 73, 102)	*1,438,812*	*2,158,201*
SDIC (Tract 102)	*84,213*	*239,944*

Table 19 – Portland Hills, M6.8 – Tons of Debris Created (DOGAMI O-18-02 - 2018 Earthquake Regional Impact Analysis for Clackamas, Multnomah, and Washington Counties, Oregon)

Community	Dry Soil/Tons of Debris	Wet Soil/Tons of Debris
All of Multnomah County (Including Cities of Portland and Maywood Park)	15,658,000	19,270,000
City of Fairview	12,000	29,000
City of Gresham	165,000	376,000
City of Troutdale	29,000	77,000
City of Wood Village	4,000	4,000
Unincorporated Multnomah County	205,000	329,000
PEN1 and PEN2 (Tract 72.02)	*824,035*	*1,031,712*
MCDD (Tracts 72.02, 73, 102)	*1,620,815*	*2,323,264*
SDIC (Tract 102)	*71,002*	*231,485*

Transportation System Impacts

Air and Marine

A 2015 Corporate Seismic Risk Assessment completed for the Port of Portland evaluated the seismic performance, identified potential improvements and estimated the benefits of improvements for nineteen high value assets. Separately, these assets were found to deliver approximately two billion dollars in regional economic value.

Since the time, the Port has made seismic resilience investments at Marine Terminal 6 and the Portland International Airport (PDX). Investments at PDX include the construction of new seismically resilient facilities, and the on-going terminal expansion project, which includes many seismic improvements. More recent reviews of the runways at PDX estimate that without mitigation, runways at PDX could be out of service by approximately one year. A 2021 study by the National Institute of Building Sciences found that mitigating one runway at PDX could help avoid more than seven billion dollars in losses in Oregon, and would provide 50 dollars in benefit for every dollar spent.

Port buildings were considered in the DOGAMI analysis, and expected losses can be extrapolated from loss ratios. Damage to runways, marine berths, and other associated non-building structures were not captured.

More details on the Port of Portland's Resilient Runway project and other specific earthquake vulnerabilities and mitigation strategies can be found in the Port of Portland Chapter.

Roads and Bridges

The Regional Emergency Transportation Routes report collected vulnerability information for the susceptibility of prioritized roads to lateral spreading impacts of landslides and of the current seismic stability of bridges. These roads are intended to be the routes needed for emergency vehicles to travel after a disaster and provide services to residents and visitors who may be isolated from relief. There are numerous identified emergency routes across the county that retain high susceptibility to damage. The process of prioritizing routes for improved resilience, or identifying where alternative routes can be established, is an ongoing mitigation project.

The Burnside Bridge replacement project will establish a key lifeline between the east and west sides of the county and will significantly increase the county's ability to create triage routes throughout the region in an emergency.

The DOGAMI analysis considered the probability of identified emergency routes being damaged. The study found that about 75% of all emergency route segments across Multnomah County had a 20-30% chance of being damaged by a Cascadia Subduction Earthquake. The number was even higher for a Portland Hills earthquake, with 95% of road segments having that probability. This analysis did not consider local roads that would not be priority routes for emergency vehicles. Some local roads are more resilient because they do not have bridges or overpasses, but all roads located in liquefaction or landslide threat areas will have risk of failure.

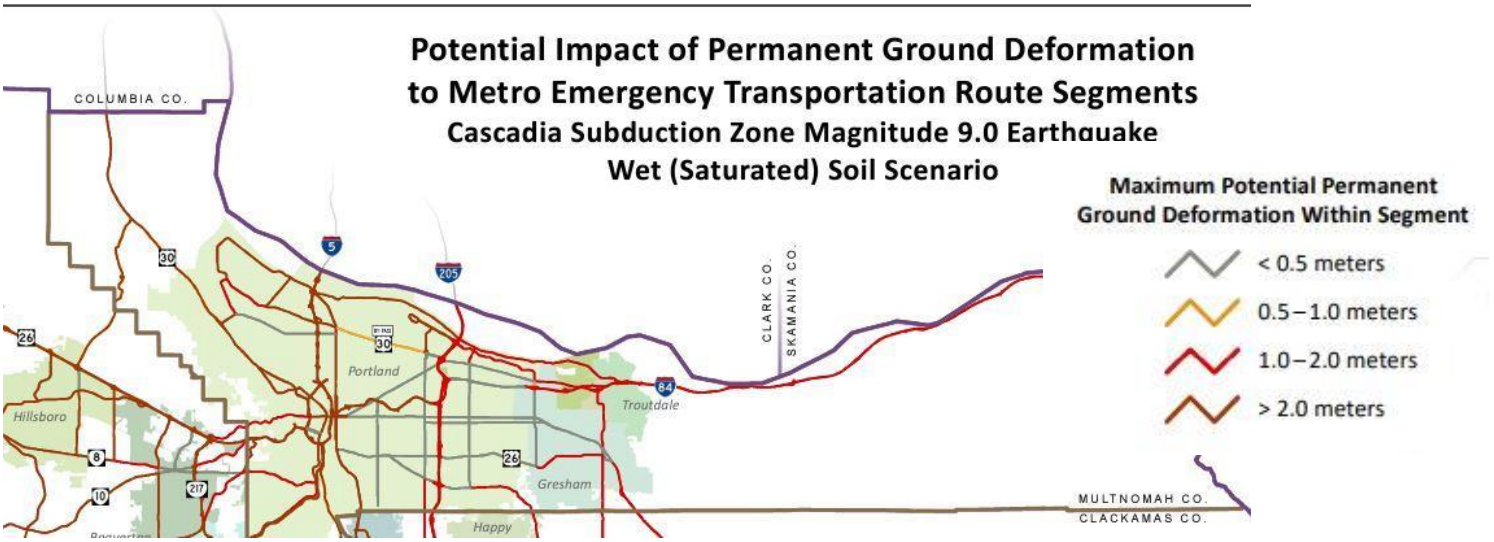

Figure 41 - Emergency Transportation Routes based on expected damage from a Cascadia Subduction Zone earthquake. Levels of damage are based on the amount of ground deformation at the location – levels are shown in the legend, from least impacted at the top to most impacted at the bottom. This map predates updates to Emergency Transportation Routes undertaken by the Regional Disaster Preparedness Organization. Map from the 2018 DOGAMI Earthquake Regional Impact Analysis.

A number of major bridge crossings are still highly vulnerable to seismic failure. Of bridges operated by Multnomah County, the Willamette River crossings at the Burnside Bridge, Broadway Bridge, Morrison Bridge and Hawthorne Bridge are all likely to suffer significant damage, as will the Sandy River crossing at the Stark Street Bridge. The Tilikum Crossing (completed in 2015), Sellwood Bridge (rebuilt in 2016) and Sauvie Island Bridge (rebuilt in 2008) are expected to survive earthquake scenarios, with some damage expected to bridge approaches.

Figure 42 - Graphic showing vulnerabilities of some Willamette River bridges to a seismic event. Multnomah County.

Other major river crossings in Multnomah County that are considered to be highly susceptible to seismic impacts are the Steel Bridge (owned by Union Pacific), the Ross Island Bridge (Oregon Department of Transportation - ODOT), the St. John's Bridge (ODOT), the I-5 Interstate Bridge (ODOT/Washington DOT), and the I-30 Troutdale Bridge (ODOT).

Figure 43 - Photo of the rebuilt Sellwood Bridge during the 2020 September wildfire smoke event. Photo – Motoya Nakamura, Multnomah County Communications.

Other Lifeline Impacts

CEI Hub

The Critical Energy Infrastructure Hub (CEI Hub) is located in Northwest Portland, along the Willamette River in a high-risk liquefaction area. The risk of the CEI Hub being damaged by earthquakes creates two vulnerabilities–the loss of liquid fuel supply to most of the State of

Oregon and a health and environmental catastrophe if the petroleum-based materials run into the river and create an airborne toxic plume.

The report *Impacts of Fuel Releases from the CEI Hub due to a Cascadia Subduction Zone Earthquake* was released in 2022 to quantify the risk of a CEI Hub seismic failure. Tanks built before 1993 (91% of the total) were estimated to lose 50-100% of their stored contents, while those built after 1993 with higher seismic standards were estimated to lose 10% of their stored contents. This amount of projected loss would be roughly equivalent to fuel spilled in the Deepwater Horizon disaster in the Gulf of Mexico in 2010, the largest marine oil spill in history. The fuel loss projections used the more likely Cascadia Subduction Zone quake as the scenario, but a Portland Hills crustal quake could be even more impactful, given the proximity of the hub to that fault.

The CEI Hub has 630 tanks with capacity of 350 million gallons of liquid material. About 90% of Oregon's liquid fuel supply passes through the hub. Over 150 types of material are stored at the hub, including gasoline and all of the jet fuel supplied to the Portland International Airport.

The impact report was developed jointly between the City of Portland Bureau of Emergency Management and the Multnomah County Office of Sustainability. The tanks are located in the City of Portland, but effects of a spill could impact those living and working in unincorporated areas and hazardous air quality could affect much of the county. All participating entities in this plan would likely suffer from fuel shortages and high fuel costs at a time with a critical need for medical evacuation, air and marine response traffic, emergency vehicles, and equipment needed for clearing debris and repairing infrastructure.

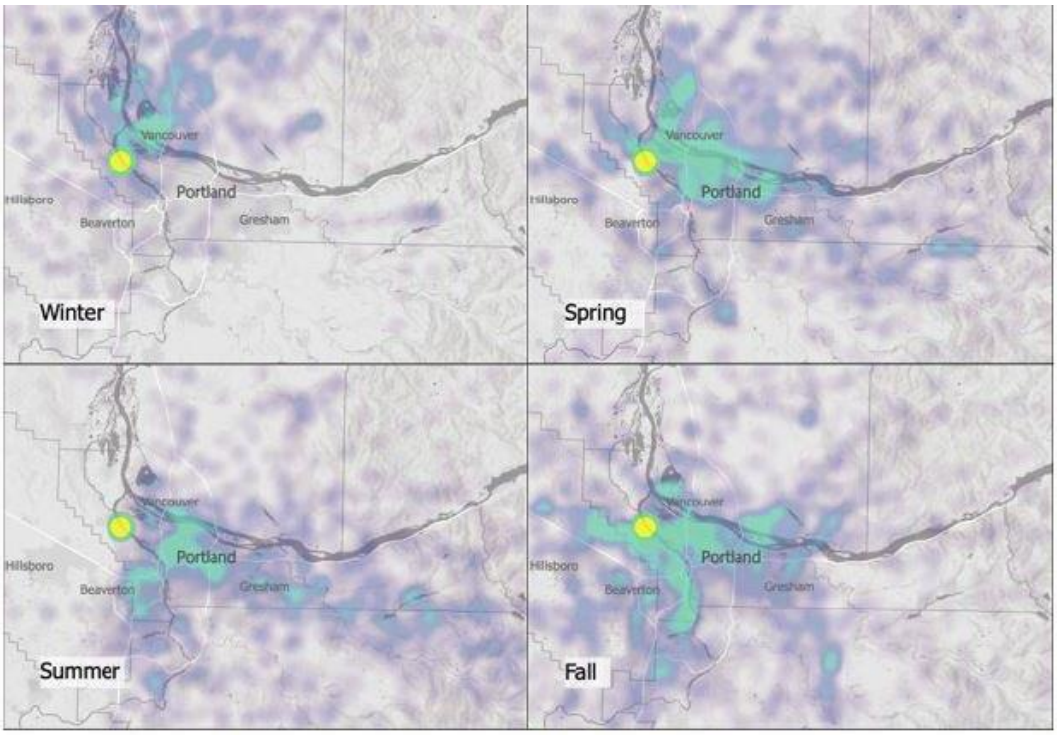

Figure 44 - Four models of a potential hazardous plume from burning material at the CEI Hub show how much of Multnomah County could be impacted by cascading hazards in a severe earthquake.

The report estimated that costs of fuel releases would range from $359 million to $2.6 billion, considering direct impacts to people, property, navigation, fisheries, recreation, human health, habitats and species, cleanup costs, cultural values, and fuel prices. The cost of this disaster making it more difficult to respond to other earthquake damage was not quantified.

Potential mitigation strategies for the CEI Hub were outlined in a 2019 report published by the Oregon Seismic Safety Policy Advisory Commission (OSSPAC). While federal entities such as the Coast Guard oversee safety and maintaining river navigation, those entities do not manage pre-event seismic risk. The report recommended mitigation authority being provided by the State of Oregon, and Senate Bill 1567 was passed in 2022 to require fuel storage site assessments and risk mitigation plans.

Electric Power

DOGAMI's 2018 report attempted to quantify the risk to electric power infrastructure in their scenarios. This analysis was conducted across the three-county report area, without specifics for cities, counties, or other units. The analysis found that in the worst-case wet soil scenario about 12% of power poles would have a 20-30% chance of experiencing major damage from lateral spreading.

The 2013 Oregon Seismic Resilience Plan estimated that communities in the Willamette Valley could expect to lose electricity for one to three months after a Cascadia Subduction Zone earthquake. Besides utility poles, power substations are another significant vulnerability.

Water and Wastewater

DOGAMI did not create estimates for water and wastewater infrastructure damages, but the 2013 Oregon Resilience Plan identified drinking water and sewer services being out of service from one month to one year in this region. Risks to water and wastewater infrastructure are to above and below-ground mains, reservoirs, tanks, pump stations and treatment facilities.

Levee Systems

Local levees are built out of silt and sand on top of a historic floodplain subject to liquefaction and are known for soil subsidence. A 2001 study by the United States Army Corps of Engineers (USACE) found that the likelihood of a major flooding event on the Columbia River and an earthquake happening at exactly the same time is extremely low.

A major earthquake from either the Portland Hills Fault or the Cascadia Subduction Zone could cause significant damage to critical levee system infrastructure, including pump stations, internal conveyance, and levee embankments. Recovering from this damage will likely take months to years, as can be expected based on analysis of comparable facilities in the 2013 Oregon Resilience Plan. Throughout the recovery and reconstruction of critical levee system infrastructure following a major earthquake, the area behind the levees will be exposed to a significantly higher risk of flooding caused by an earthquake, even from relatively frequent Columbia River high-water events. This risk and its duration are not captured in the USACE study.

The Flood section of this plan includes risk and vulnerability data compiled by DOGAMI in 2018, defining the post-earthquake flood risk that may exist for years of flood seasons after a large earthquake. Response planning is needed to prepare for this contingency.

Dam Impacts

Earthquakes can cause dam failures. The most common mode of earthquake-induced dam failure is slumping or settlement of earthen dams where the fill has not been properly compacted. If slumping occurs when a dam is full, overtopping of the dam can lead to rapid erosion, and dam failure is possible. Strong ground motions also can damage concrete dams. Furthermore, earthquakes can trigger landslides that flow into reservoirs and result in dam failure. Hydrologic weirs operated by Columbia Corridor Drainage Districts to control water levels are subject to liquefaction and significant shaking, and will be affected by a large earthquake.

Potential impact from dam failure is included in the Flood Chapter.

3.2 Flood

Flooding is a common hazard in the Pacific Northwest due to numerous watercourses that carry runoff and snowmelt in a wet climate. Historically, significant floods occurred in the northern Willamette Valley approximately every seven to fifteen years. All participating jurisdictions and districts in this plan face impacts from river and lake flooding and/or urban stormwater runoff. All participating entities in this plan also have flood hazards mapped through FEMA's National Flood Insurance Program (NFIP), which identifies zones with required mitigation requirements in participating communities.

Despite the significant history of flooding in Multnomah County, widespread vulnerability is not severe due to flood safety infrastructure and limited development in most of the county's highest risk areas, especially outside the City of Portland[37]. Vulnerability becomes much more significant in failure of flood safety infrastructure or catastrophic events beyond regulated probabilities. The risk of landslides during high-precipitation events may also be among the most dangerous local risks from flood. However, impacts from climate change (discussed later in this chapter) are increasing the possibility of extreme flooding and require continuing awareness of catastrophic flood event scenarios.

Flood risk from localized rain events in Multnomah County is highest between October and April. During this period, heavy winter or early spring rains may cause sudden snow and ice melt or fall on saturated or frozen ground. Atmospheric rivers are often the driver of sudden warming and unusually heavy rainfall amounts over several days. Historically, rain-on-snow events between December and February have caused the majority of the most severe flooding.

Figure 45 - Map showing the drainage basins of the Willamette (darker blue) and Columbia Rivers. Map from Portland Bureau of Environmental Services

The Columbia River faces its highest annual risk of floods between May and July due to rain-on-snow thawing events that may occur in other parts of the river's massive drainage basin and continuously raise river levels as the system moves west through Oregon. These flood events can be massive because of the size of the drainage area, although these floods will usually have days of notice based on forecasts from upstream gauges and dam holding levels.

Large portions of the planning area are protected by a 45-mile levee system along the Columbia River – 27 of those miles are maintained through the Columbia Corridor Drainage Districts included in this

[37] The City of Portland has significant risk from flooding along the Willamette River and Johnson Creek.

plan. Before the construction of flood control infrastructure, flooding was common in low-lying areas across the Columbia River floodplain. Since their construction, flood risk from the Columbia River has been reduced. However, due to the amount of development built behind this flood safety infrastructure in the years that followed levee construction, vulnerability to levee breach or overtopping due to high water is Multnomah County's most severe flood risk to life safety and property. A breach during high water on the Columbia River during the Flood of 1948 destroyed the City of Vanport and killed at least 15 people, making it the deadliest flood in Multnomah County in at least the last century.

Dams regulate water flows, but can also be a source of flooding when they fail or when large flow releases are required when exceeding safe storage levels.

Urban stormwater flooding occurs when natural drainage systems are altered and modified impervious landscapes such as parking lots, roads, and roofs speed up the movement of rain runoff. As development increases, these effects can become cumulative and more difficult to manage. These effects are mitigated through engineered stormwater systems and restoration of natural hydrological systems. Urban stormwater flooding can be more difficult to predict because of the complexity of interconnected management systems and new development patterns constantly being built or rebuilt. Stormwater flooding is also less likely to be mapped as an identified hazard area through the FEMA Flood Insurance Rate Map program, which may reduce risk awareness and decrease resilience provided by flood insurance.

Flooding is also a primary driver of landslides in Multnomah County. Flooding and debris flows are also worsened in wildfire burn areas, where vegetation has been removed and soil chemistry has been altered, reducing the ability of the soils to infiltrate stormwater and altering the movement of water below the ground's surface[38].

Multnomah County's largest rivers also have a tidal influence from the Pacific Ocean, which can add to flood conditions if other flood factors occur at the same time as high tides. Coastal tsunamis can also travel the 60 miles from the mouth of the Columbia River and cause minor impacts in Multnomah County.

Channel Migration

Channel migration is a natural process where streams and rivers move over time. This is a natural gradual process and can take years for significant movement to happen, but a significant flood event can result in a rapid change. This process also results in an erosion hazard created by the movement of river channels. This dynamic change to rivers can threaten structures near rivers with undercutting or flood damage, even when they are located outside of mapped high-risk flood zones. The Sandy River is one of the rivers most subject to channel migration in Oregon because of its high velocity during high precipitation events due to runoff from Mount Hood and its banks and deltas made up of soft volcanic silt that erodes quickly.

5-Year Report, 2017-2022

Hazard Events

[38] The Portland District of the US Army Corps of Engineers has developed materials on post-fire flooding.

Several flooding events occurred since the last version of this plan, beginning in the winter of 2017. February 5, 2017 saw 2.19 inches of rain at the Portland Airport, breaking the single day February record set in 1996. An atmospheric river arrived mid-month and brought additional heavy rain, causing street flooding and ponding in low-lying areas. February ended with 10.36 inches of precipitation to become the wettest February on record, again topping a previous high set in 1996. Despite the record rain, flooding in the communities and districts participating in this plan was minor.

However, high water continued through March and heavy rains continued to raise water levels on the Columbia River. On March 22, an encampment on the Columbia Slough had to be evacuated. The Columbia River peaked on March 31 at 22.7 feet, damaging the levees and again causing minor flooding in some low-lying areas. The Columbia Corridor Drainage Districts activated their Incident Management Team twice in 2017 to respond to the Columbia being at Minor Flood Stage. The April 2017 event lasted multiple weeks, causing concern for oversaturated levees.

Figure 46 - Levee sloughing damage near NE Bridgeton Rd., in Portland caused by high water during the Spring 2017 flood event. Photo Multnomah County Drainage District.

High water on the Columbia River occurred in spring of both 2018 and 2019. In both seasons, minor erosion and sinkholes damaged levees, requiring repairs. Another atmospheric river event in December 2020 led to road flooding and inundation of ponding areas. This was a short duration event with the most significant impacts occurring in streams, such as Johnson Creek in Portland, where a footbridge was washed away. The winter flood season continued into 2021. Heavy rains in January led to a fatal landslide in Dodson in unincorporated Multnomah County, an incident described in the Landslide chapter.

In mid-November 2021, an early-season atmospheric river deluged the region with around three inches of rain over two days. The most significant impact was at Fairview Lake, where difficulty accessing a pump station led to a water rise that flooded yards and caused some damage to neighborhood homes.

In June 2022, an atmospheric river from June 9th to 12th brought a succession of rainstorms throughout the region resulting in high water levels on the Columbia River and triggering elevated water levels in the Slough and at Fairview Lake.

New Study Data

- A *Flood Risk Assessment for the Columbia Corridor Drainage Districts* was published by DOGAMI in 2018 to better understand the significance of the levee system in protecting people and development from high-water events. The findings of this report are summarized in this chapter, providing detail of the vulnerability in levee-protected areas from breach or overtopping.

  The study bolstered the work of the Columbia Corridor Drainage Districts, which completed a 3-year New Start Feasibility Study with the United States Army Corps of Engineers (USACE) as a part of the Portland Metropolitan Levee System (PMLS) Project. In the project's Final Report & Environmental Assessment, it was determined that there would be substantial benefit to federal investment in improvements to the levee system and a proposal was created for Congress to invest in the Districts' levee system, including: creating a new setback levee, raising and widening sections of the levee, and providing backup power connections to pump stations. This will result in a more resilient system and provide a higher level of flood protection. If approved, construction could start as early as 2025.

- Most of Multnomah County uses flood study data from 2009 or earlier to analyze the hydrology and hydraulics of streams and rivers. However, a significant flood study revision was initiated by FEMA for the Lower Columbia-Sandy Watershed, and was published on February 1, 2019. Portions of Troutdale, Gresham and Unincorporated Multnomah County are in the Multnomah County portion of the revised watershed.

  This study used new engineering analysis, including more detailed ground elevation data, to revise flood scenarios on Burlingame Creek, Kelly Creek, and portions of the Sandy River and Beaver Creek. New approximate (less detailed) modeling was used to refine flood risk for some portions of Beaver Creek and the Sandy River. Flood risk boundaries were made more detailed with improved ground elevation data (without any revised engineering analysis) in other portions of Beaver Creek and a portion of the Columbia River.

  This revision updated 23 of the county's flood map panels under the National Flood Insurance Program. The remainder of Multnomah County's effective flood map panels continue to be last published on December 18, 2009. The 2009 publishing date reflects when the entire county received digitized maps—flood studies used in those areas may be from dates earlier than 2009. Another update – a revised study for Sauvie Island in unincorporated Multnomah County – is also underway and is expected to be completed in 2023.

- Five Letters of Map Revision (LOMRs) were completed between 2017 and 2022 in Multnomah County. These letters are locally initiated studies that upgrade flood studies based on revised engineering and ground surveys. They are published in real time to the online National Flood Hazard Layer and incorporated into paper maps when those are republished. These revisions were identified due to flood control work along Crystal Springs Creek (two) and Fanno Creek in Portland, on Beaver Creek in the City of Troutdale where a new culvert was installed at Cochran Road, and on Fairview Creek in Fairview and Gresham to reflect previous culvert improvements at NE Halsey Street and NE Fairview Ave/NE 223rd Ave.

- Vulnerability in river and lake flood risk areas outside of levee protection continues to use data applied in the 2017 version of this plan, except in the location of the new flood study. DOGAMI also published a *Natural Hazard Risk Report for the Lower Columbia-Sandy Watershed*, which ran an updated vulnerability analysis for the entire watershed, and included a vulnerability assessment for channel migration threat.

Climate Change Impacts

A warmer climate is expected to make large rain events more intense. Warmer air can hold more water, which is released as precipitation. Atmospheric rivers—long narrow corridors that transport huge amounts of water vapor from tropical regions—are a common source of flooding in Oregon. These weather phenomena[39] cause flooding because of the duration and intensity of rainfall they bring, along with much warmer temperatures that cause rapid melting of snow. Approximately 25-30% of autumn and winter rains in Oregon and the majority of extreme precipitation events in autumn and winter are caused by atmospheric rivers.

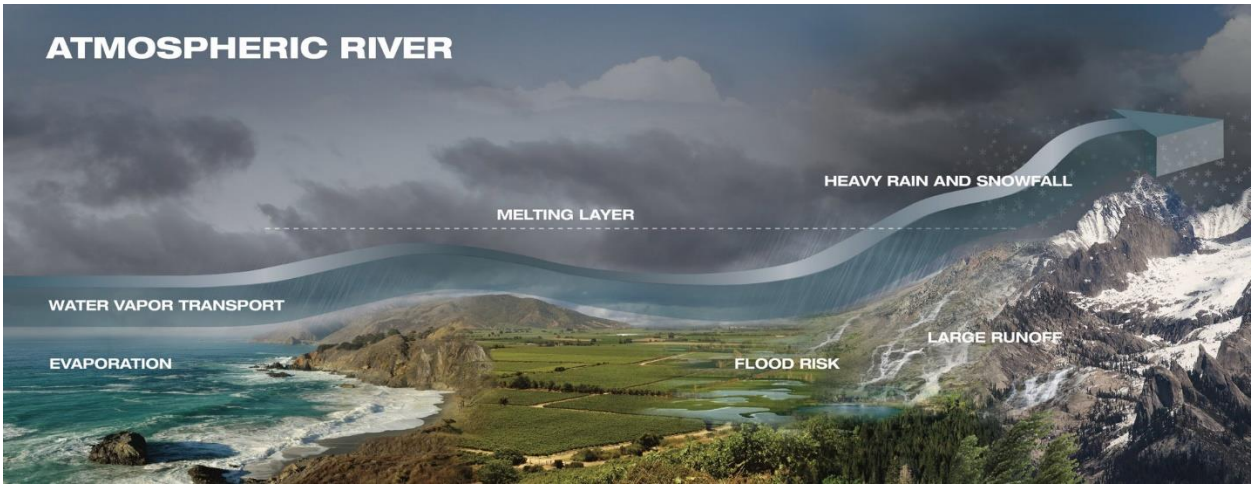

Figure 47 - Graphic showing the impact of atmospheric rivers on land. Image from NASA/JPL - CalTech

Under the high-emission scenario used in the Fifth Oregon Climate Report, days with atmospheric rivers are projected to increase 5-10% in Western Oregon by the end of the century. Because floods caused by rain have higher flood peaks than those driven by snowmelt, warmer winters could lead to increased flash flooding on creeks and tributaries.

[39] Informally known as 'rivers in the sky'

A study by the United States Geologic Survey and United States Army Corps of Engineers (USACE) found that potential warmer, wetter conditions in the region could lead to more wintertime rain-on-snow events, potentially increasing the flow of the Columbia River by 40%. Additionally, impact from sea-level rise during a large storm surge event (which could happen at the same time as a high water event flowing downstream) was shown by the same study to impact areas along the Willamette River (up to Willamette Falls) and Columbia River (up to the Bonneville Dam). The study estimated a 1.4 meter increase in water surface elevations along the Columbia Corridor Drainage District levee protection areas.

3.2.1 Flooding Location and Extent

Flooding can happen anywhere, but locations near identified flooding sources are the areas that are most likely to flood. FEMA-produced Flood Insurance Rate Maps (FIRMs) show the extent of floods expected in a 1% annual chance flood (also known as a 100-year flood[40]), and development in these areas is regulated by local Flood Management Ordinances in each Multnomah County city or county jurisdiction. Flood scenarios outside of the 1% annual chance, both smaller but more frequent events and larger, less frequent floods, are also provided by FEMA and other sources. This additional flood data can be used to inform risk and create optional local development standards.

The area of regulated flood hazard zone (1% annual chance) is called the *Special Flood Hazard Area* (SFHA). In these areas, homes are statistically more likely to be damaged by flood over the period of a 30-year mortgage than by house fire. Part of the SFHA in detailed flood maps is reserved for the *floodway*, an area with the highest velocity of water in a flood. In floodways, development is typically not allowed, but structures may be located in floodways when they were built before they were mapped, and infrastructure may still be built in floodways when it is built in a way that does not increase the flooding risk to others.

Not every potential source of flood is mapped under the Flood Insurance Rate Map program. Priorities for mapping are developed based on the size of the flood source and the likelihood of impact to development. Local communities can also initiate mapping studies when information is not available or is considered out of date, or when local stream restoration or infrastructure projects alter data.

FEMA produces a Flood Insurance Study (FIS)[41] for Multnomah County, which includes all of the flood analysis that has been performed to date. Different flood sources, and even different stretches of the same source will have different analysis dates, depending on when studies were performed. The most recent Flood Insurance Study for Multnomah County was published on February 1, 2019, to incorporate the revised study for the Lower Columbia-Sandy Watershed.

Current flood sources in Multnomah County with detailed studies are listed below. Some portions of these flood sources may have less detailed approximate studies.

[40] FEMA prefers the use of the term 1%-annual chance flood, because a '100-year flood' may happen many times or not at all over the course of a century.

[41] FEMA's Map Service Center has all documents regarding to the Flood Insurance Study. The National Flood Hazard Layer (NFHL) is an online mapping tool with real-time FEMA flood mapping that can be used to look up identified risk at any address.

- Beaver Creek
- Brick Creek
- Burlingame Creek
- Columbia River
- Fairview Creek
- Hogan Creek
- Johnson Creek
- Kelly Creek
- MacDonald Creek
- Multnomah Channel
- North Fork Johnson Creek
- Sandy River
- Sunshine Creek
- Unnamed Tributary to Rock Creek
- Willamette River

Additional flood sources with only approximate studies include Arata Creek, Brigman Creek, Butler Creek, McNutt Creek, Mitchell Creek, and a number of unnamed tributaries to already named sources. Additional approximate mapping exists for some drainage areas and lakes around Fairview Lake, Blue Lake and Smith and Bybee Lakes.

[An interactive version of this map can be found at this link (Flood Hazard – Effective FEMA Flood Data)]

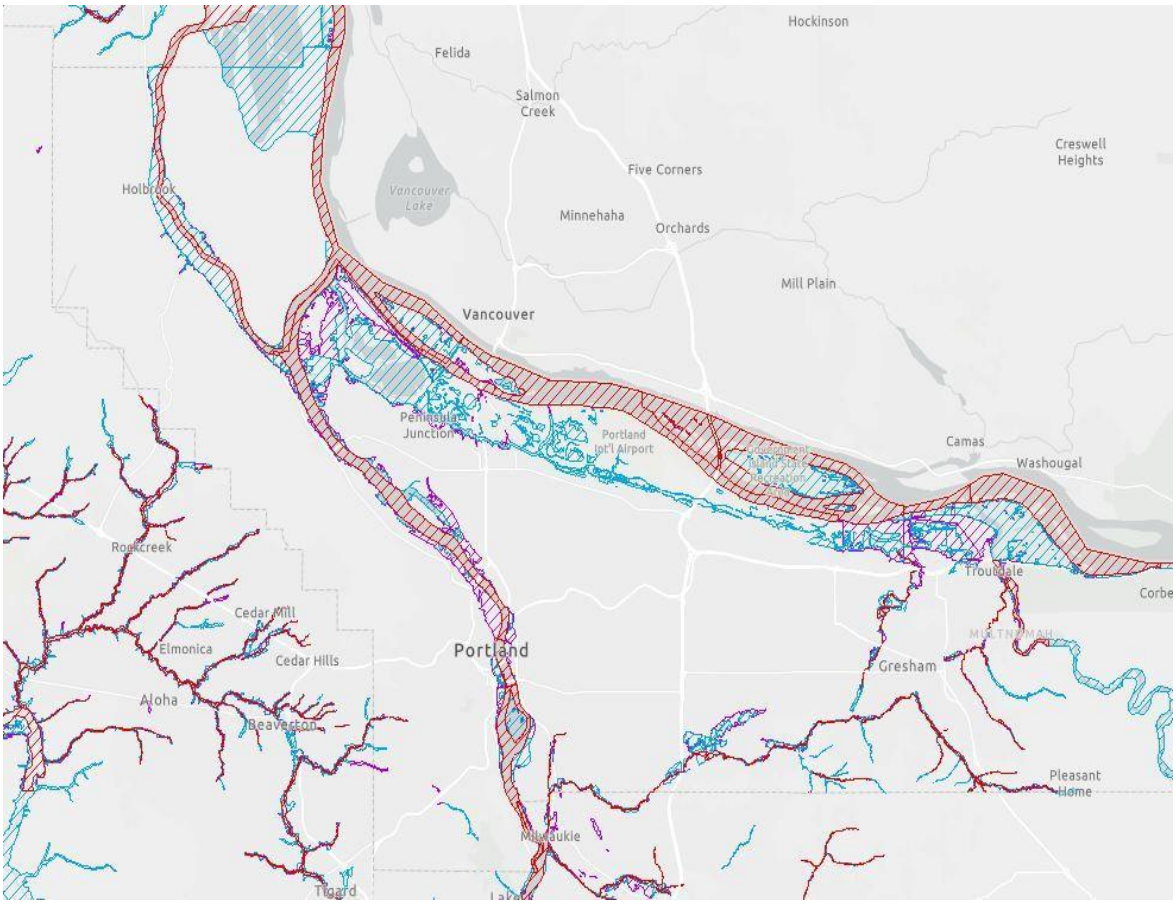

Figure 48 – DOGAMI Map showing FEMA identified flood risk zones in the western and central portions of Multnomah County. The areas hatched in red are floodways, the blue hatched areas are the Special Flood Hazard Area, and the purple areas are the 0.2% annual chance flood areas where regulation is optional. [FEMA's National Flood Hazard Layer] is the most up to date source for property-specific flood hazard designations.

An interactive version of this map can be found at this link (Flood Hazard – Effective FEMA Flood Data)

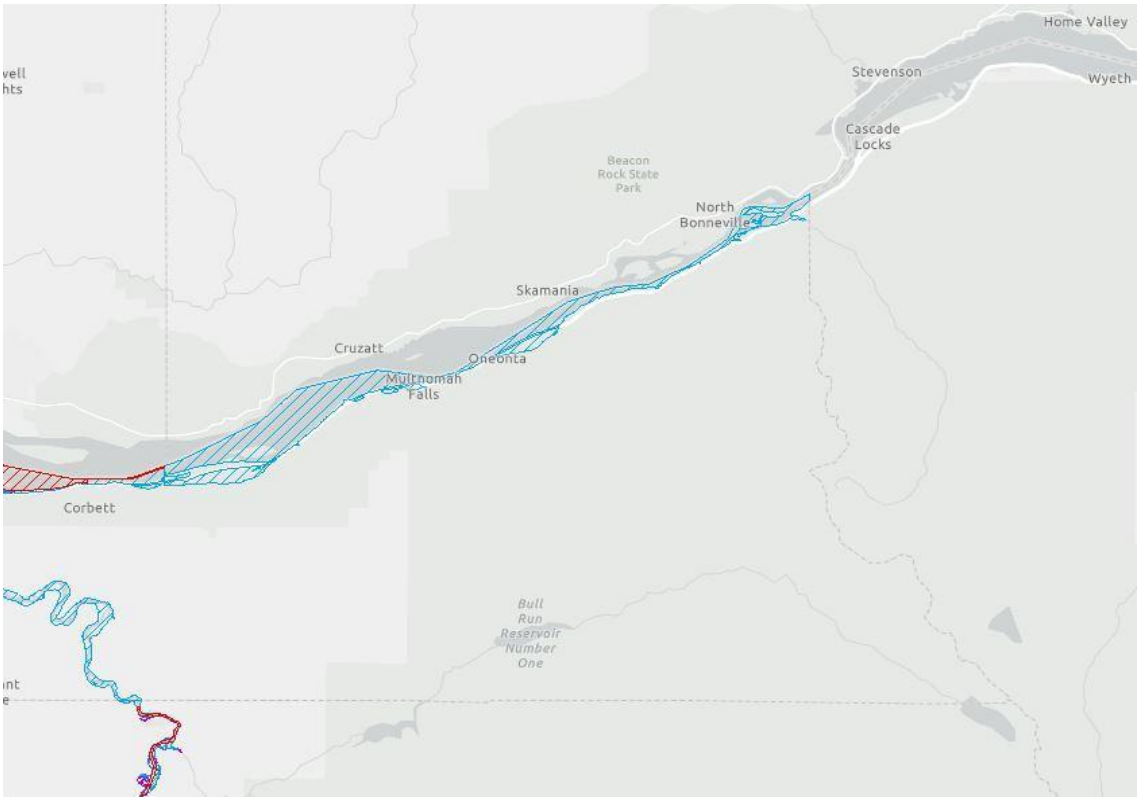

Figure 49 – DOGAMI Map showing FEMA identified flood risk zones in the eastern portion of Multnomah County. The areas hatched in red are floodways, the blue hatched areas are the Special Flood Hazard Area, and the purple areas are the 0.2% annual chance flood areas where regulation is optional. FEMA's National Flood Hazard Layer is the most up to date source for property-specific flood hazard designations.

Leveed Areas

Areas protected from flood by FEMA-accredited levee systems are typically not shown on FEMA maps as part of the SFHA because levee certification studies require them to be able to withstand a 1% annual chance flood. They may be indicated as lower risk zones or have printed language on the maps alerting people that the area is protected by a levee.

There are two levee areas located in low-lying areas along the Columbia River and Willamette Rivers in Multnomah County with five special districts dedicated to levee and drainage management:

- The four Columbia Corridor Drainage Districts along the Columbia River and Columbia Slough (included as participating districts to this plan), with 27 miles of levee (this area is identical to the managed floodplain area of the Urban Flood Safety & Water Quality District). The four districts are Peninsula Drainage District #1 (PEN1), Peninsula

Drainage District #2 (PEN2), Multnomah County Drainage District (MCDD) and Sandy Drainage Improvement Company (SDIC);

Figure 50 - Map showing the boundaries of the four current Columbia Corridor Levee Districts, along with the locations of the levees themselves and pump stations. Map from the Multnomah County Drainage District.

- Sauvie Island Drainage Improvement Company (SIDIC), which manages an 18-mile levee system along the Columbia and Willamette Rivers and Multnomah Channel on roughly the southern half of Sauvie Island. SIDIC is not a participating district to this plan, but a portion of unincorporated Multnomah County is protected by the district.

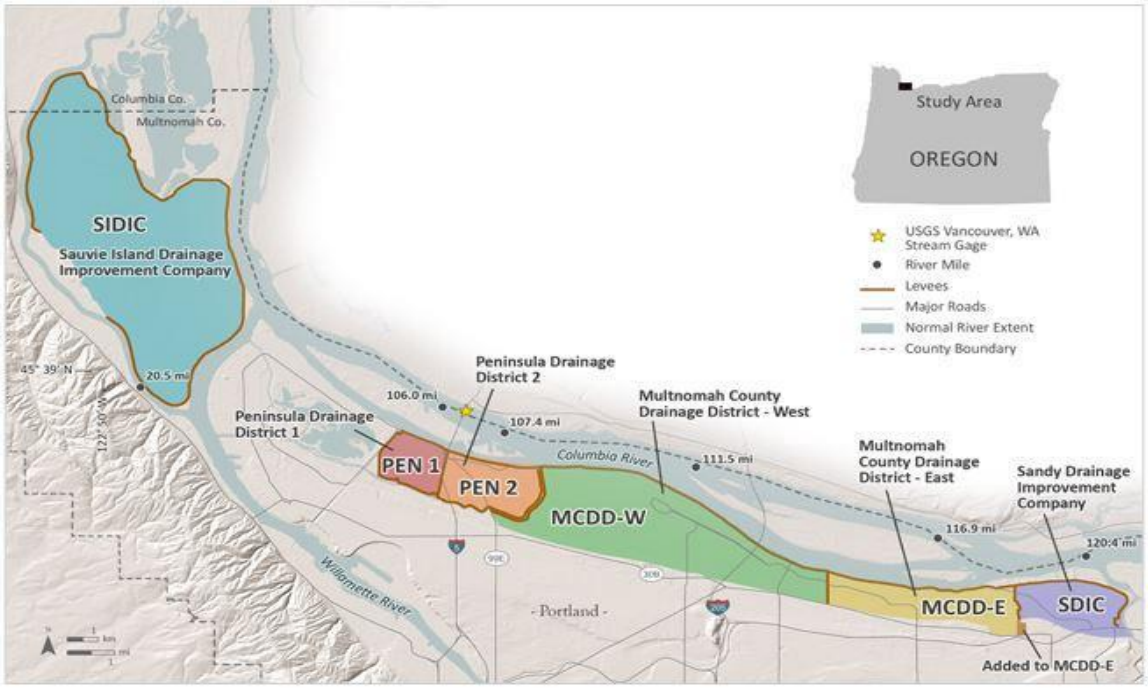

Figure 51 - Map showing the Sauvie Island Drainage Improvement Company (SIDIC) in relation to the Columbia Corridor Levee Districts

The four participating Drainage Districts and the combined Urban Flood Safety & Water Quality District make up a contiguous levee system with 27 total miles of levee. The levee system stretches from Smith Lake on the west to the Sandy River on the east, with the Columbia River as the northern boundary and the Columbia Slough/Columbia Boulevard as the approximate border on the south. It also includes four cross-levees that run adjacent to the Columbia River and Columbia Slough, providing extra protection between basins within the Districts.

The minimum standard used by FEMA for accreditation (44 CFR 65.10) is to reduce flood risk from a 1% annual chance flood. Some cities in the United States have opted to build protection to a less common and more severe flood such as a 0.5% annual chance (200-year) or 0.2% annual chance (500-year) flood elevation. Because river systems vary widely, the US Army Corps of Engineers selects a unique design standard for each levee's inclusion and rating in its Rehabilitation and Inspection Program.

For the Columbia Corridor levee system, the PEN 1 system was designed to withstand the magnitude of the local 1876 flood and is authorized at that level. The PEN 2 system is also authorized for the 1876 flood, but some modifications make certain portions of the system authorized for the design surface flood elevation of the 1894 flood, accounting for additional floodwater storage since dam construction in the 1950s. MCDD and SDIC levees are both authorized for this design water surface elevation. The design water surface elevation is a higher standard than the 1% annual chance flood used as a regulatory standard on FEMA Flood Insurance Rate Maps and increases the levee elevations from west to east, with the levees on the eastern end of the system at higher elevations.

All district levees are currently accredited by FEMA, but require reaccreditation by engineers, and that work is currently being undertaken. By the time this plan reaches its next renewal in

five years, the Districts will be dissolved and consolidated under a new District, currently called the Urban Flood Safety & Water Quality District (UFSWQD).

The Sauvie Island levee system is approximately 18 miles in length and is divided into four segments and managed by the Sauvie Island Drainage Improvement Company (SIDIC). The levee protects 11,200 acres of Sauvie Island from flooding. Construction began in the late 1930s from material dredged from the Columbia River and pits and canals dug on the island. The main Pump House was constructed in 1941 and holds four pumps capable of evacuating 125,000 gallons-per-minute of water at varying river levels. The interior of the drainage system consists of over 30 miles of canals and ditches to convey rain, seepage and spring water from the interior of the levee to the Multnomah Channel. This levee system has also been accredited by FEMA.

Dam Protection

Large dams provide flood protection by storing and systematically releasing water during high-water events. Smaller dams may serve just to hold water in reservoirs, and operate more as levees. In each case, areas that could be flooded by a dam failure are not mapped on FIRMs, which may decrease the awareness of risk in those areas.

Multnomah County has 26 dams identified by the Oregon Water Resources Department[42]. Eight are classified as being of high-risk, with five of those located in the City of Portland. The three high-hazard dams outside of Portland are located on the Columbia River (Bonneville Dam), in the protected Bull Run Watershed (Bull Run Reservoir) and on Rock Creek in western Multnomah County (Van Raden Dam). Failure of any dam could cause localized flood risk. The failure of the Lewis River dam in Washington could also cause minor effects to areas on the Columbia River in Western Multnomah County.

Urban Stormwater

Full extents of urban stormwater flooding are not typically mapped on FIRMs, although some low-lying urban areas may be captured in flood studies as ponding areas. The extent of where stormwater will overwhelm storm sewer systems is not captured in this plan, except for descriptions of areas that have required response to repeated street and yard flooding.

Jurisdictions in this plan all have Stormwater Management Programs to maintain and improve storm sewer systems. Mitigation actions in this plan may support work to improve these programs and reduce local flooding.

Channel Migration

Areas subject to channel migration are also not typically shown on FIRMs, but maps have been modeled by the Oregon Department of Geology and Mineral Industries (DOGAMI) to show potential channel movements on the Sandy River.

Different sections of the Sandy River in Multnomah County have different ways in which the channel may move. Upland areas with highly constrained channels will suddenly erode soft streambanks when water velocities increase in high water events. In the Sandy River Delta, at

[42] A full dam inventory is provided in the section on flood vulnerability.

the confluence with the Columbia River, slow flow and the continual depositing of sediments allows the river to meander and create secondary channels.
Areas with lahar deposits from volcanic eruptions are more prone to channel migration, because of the deposit of fine volcanic silt. The lahar risk zones and channel migration zones in Multnomah County are therefore very similar.

The four types of channel migration zones identified through local risk mapping are:

- Historical channels, which can be identified through historical records and LIDAR imaging and are considered likely to become channels again at some point in the future. Sandy River mapping shows historical channels that have existed between 1955 and 2009
- Disconnected migration areas, where erosion control or other development has prevented future migration
- Erosion zones, where there is a likelihood of erosion occurring in the next 100 years (as of 2009)
- Avulsion zones, where the catastrophic development of new channels or the reoccupation of abandoned channels is considered a risk

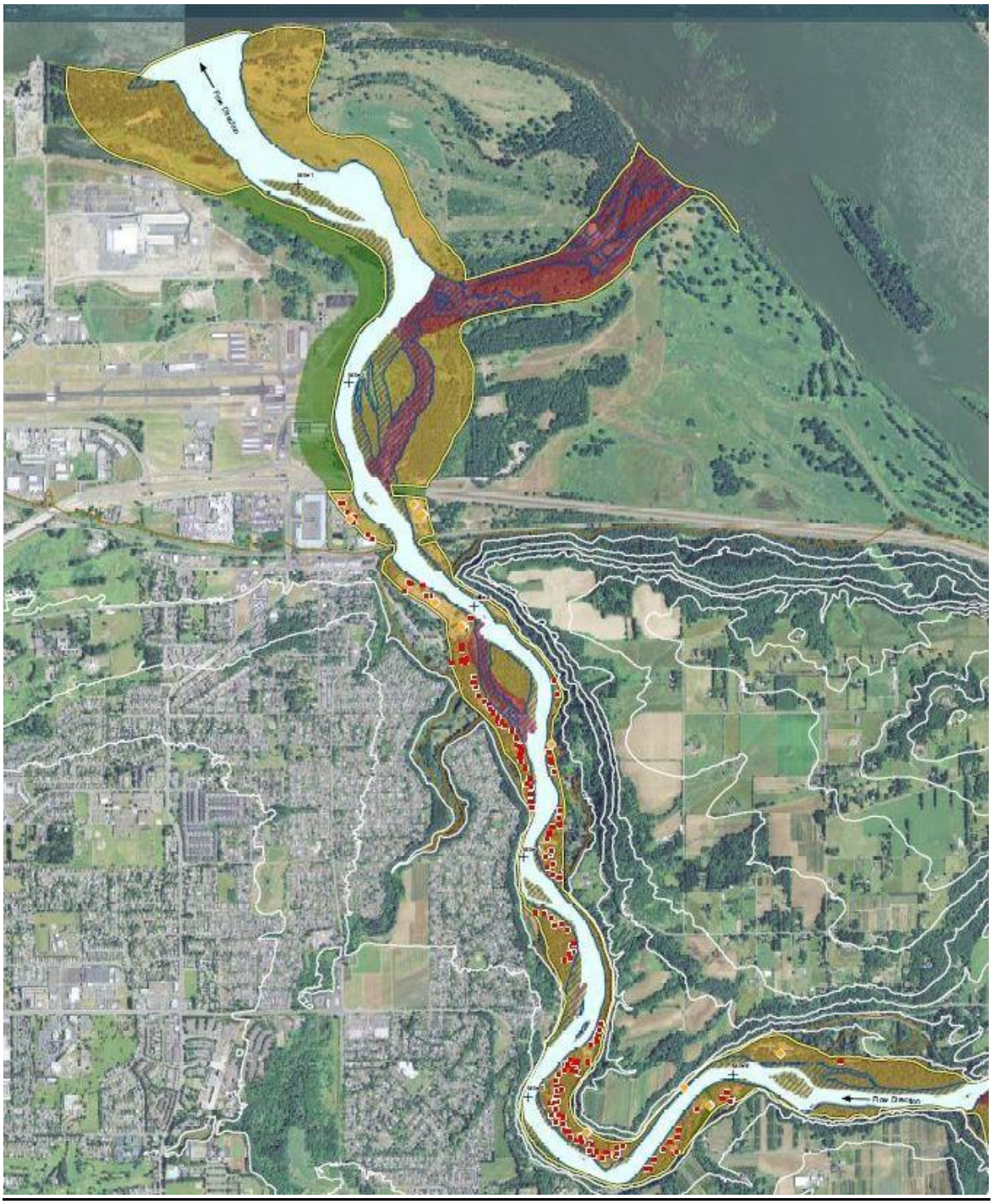

Figure 52 - DOGAMI map showing channel migration threat at the lower Sandy River and confluence with the Columbia River. Yellow areas are at risk from erosion, red areas are areas at risk of new river channels forming, blue hatched areas are former channels, and green areas are areas that were once channels but have become disconnected from the channel movement process. The small red squares are locations of structures.

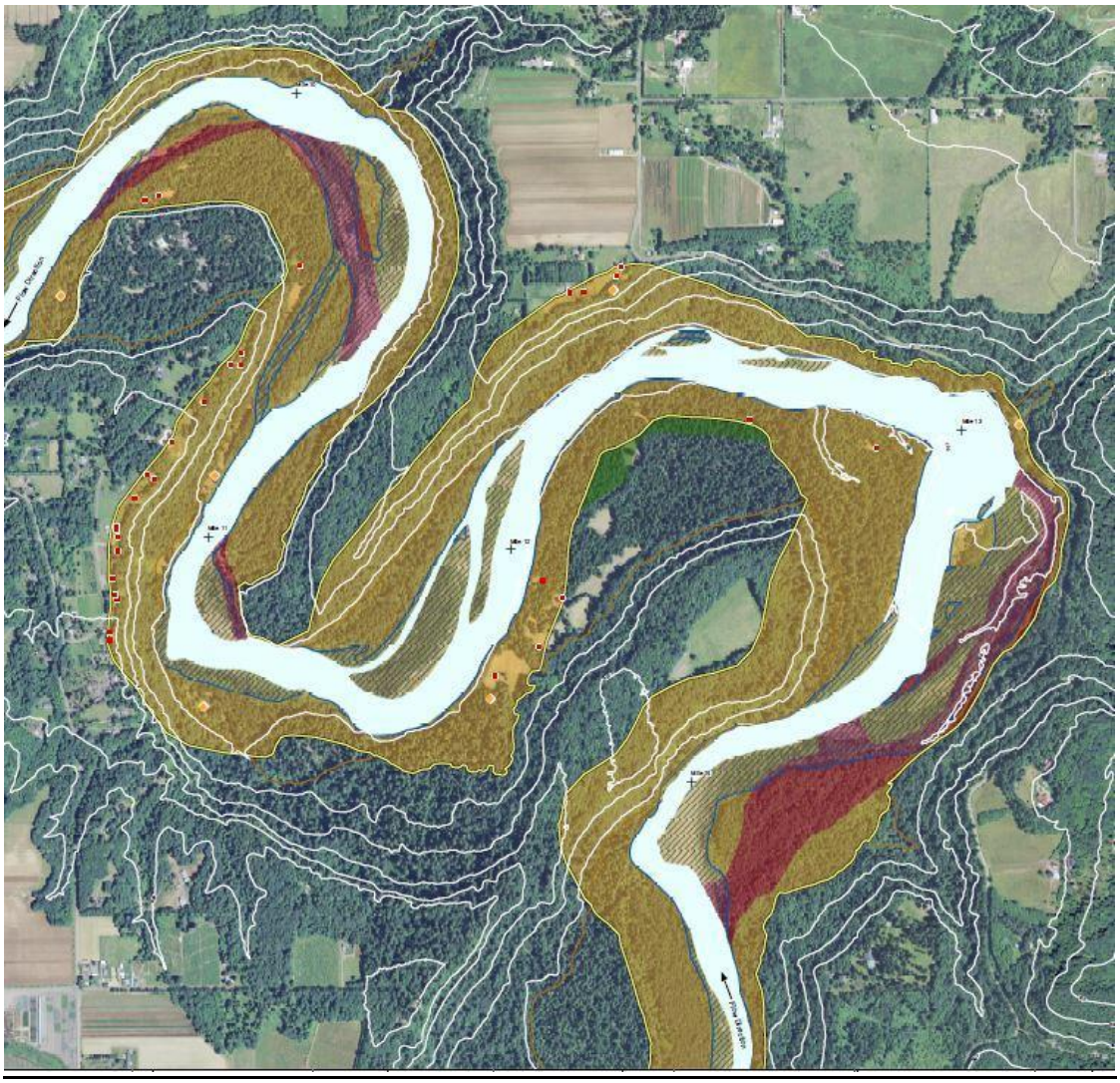

Figure 53 - DOGAMI map showing channel migration threat in the upstream portion of the Sandy River in Multnomah County. Yellow areas are at risk from erosion, red areas are areas at risk of new river channels forming, blue hatched areas are former channels, and green areas are areas that were once channels but have become disconnected from the channel movement process. The small red squares are locations of structures.

3.2.2 Flood Probability and History

The accepted standard for measuring probability of flood comes from Flood Insurance Studies published by FEMA as part of the National Flood Insurance Program. Participation in the program, which allows local residents to purchase Federal flood insurance, requires regulation of development within areas considered to have a 1% chance of flooding each year (100-year flood). Because of this regulatory tie-in, these mapped areas are generally used as a baseline for flood risk and protection strategies.

Other predicted flood frequencies are included in Flood Insurance Studies when a flood study has been detailed enough to provide that data. Many of the rivers and streams in Multnomah County also have flood heights provided for 5% annual chance (20-year), 2% annual chance (50-year), and 0.2% annual chance (500-year) events. Communities can use these other

probabilities to apply higher standards of flood protection regulation. The 0.2% annual chance area is printed on Flood Insurance Rate Maps (FIRMs) to provide additional risk information and guidance for protection against larger events, although any flood protection regulation in these areas is determined locally.

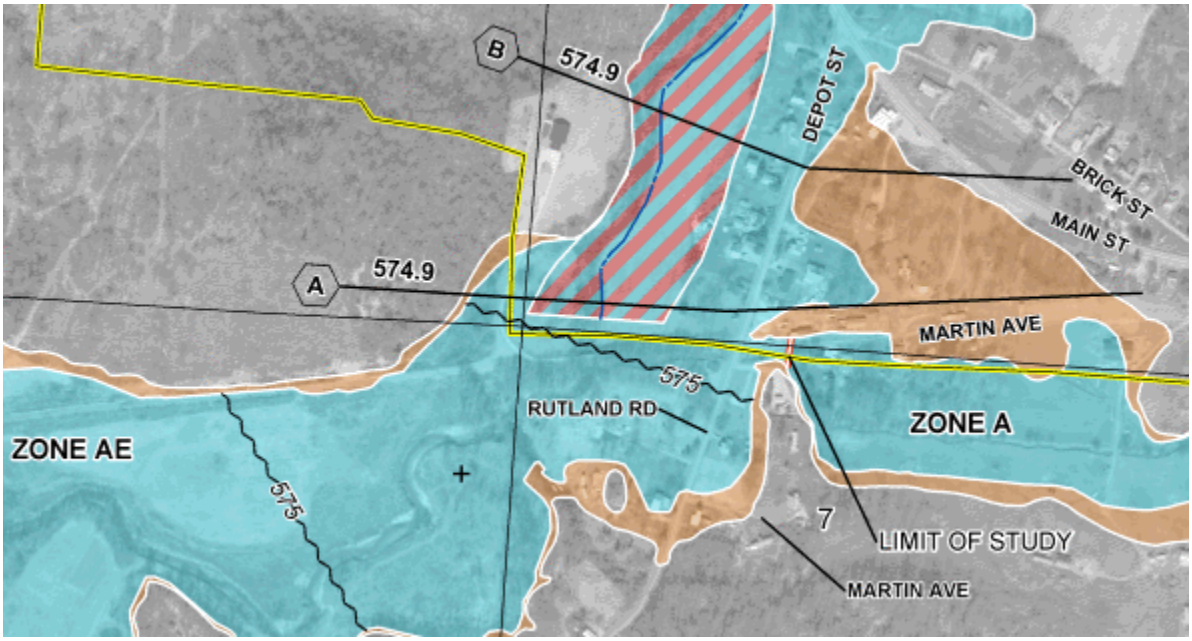

Figure 54 - An example of a Flood Insurance Rate Map. The Zones in blue labelled A or AE are the Special Flood Hazard Area (1% annual chance flood) and the red and blue hatched area is the Floodway, the area with the highest risk. The orange is the 0.2% annual chance flood, typically used as an advisory risk zone. The cross-sections (hexagons marked A and B) are where a flood study has been conducted and a flood elevation has been calculated. This elevation is used to determine how high above the ground new construction should be raised when inside the blue zones. These map elements are all shown on FEMA's National Flood Hazard Layer (NFHL), which can be used to look up individual properties.

Not every potential flood probability is mapped by Flood Insurance Studies. Priorities for mapping are developed based on the size of the flood drainage area and the likelihood of flood impact to population and development. Therefore flood probabilities in this plan are generally limited to areas studied by FEMA.

Some alternate flood modeling has theorized that actual flood probabilities are more frequent and of larger extents than those mapped by FEMA. This analysis may be bolstered by climate change effects, discussed above, which are usually not accounted for in FEMA flood studies[43]. FEMA has found that over 25% of flood damage claims[44] come from locations not shown as hazard areas on FIRMs.

Probabilities of unmapped urban stormwater events are most likely to be identified in local Stormwater Management Plans, and areas of highest concern may be included in specific Jurisdictional and District Chapters of this plan.

Probabilities of future channel migration may be linked to that of flooding events, although erosion patterns may occur more slowly over time in some areas. The maps used in the

[43] Communities may choose to regulate to a higher standard and develop maps showing additional flood risk zones.

[44] Fact Sheet: Myths and Facts About Flood Insurance, FEMA, June, 2019

previous section show potential extent of channel migration over set periods of time, but the probability of when, where or how quickly that movement will occur is difficult to calculate because of the complexity and dynamism of the process. For this reason, channel migration risk maps show all of the potential directions of movement over a set time period.

Dam Failure

Unlike other forms of flooding discussed in this chapter, dam failure is not usually linked to storm events. Most failures are caused by

- structural failure (30%), which may be linked to earthquakes or foundation defects.
- mechanical failure (36%), when failing gates, conduits of valves cause dams to fail to open or close when needed.
- hydraulic failure (34%), or overtopping of a dam most commonly because of poor spillway design, debris blockage of spillways, or settlement of dam crests.

Because these failures are frequently not related to flood events, probability of failure can only be established by maintenance and evaluation. Inspection dates for county dams are included in the section on Flood Vulnerability.

Flood History

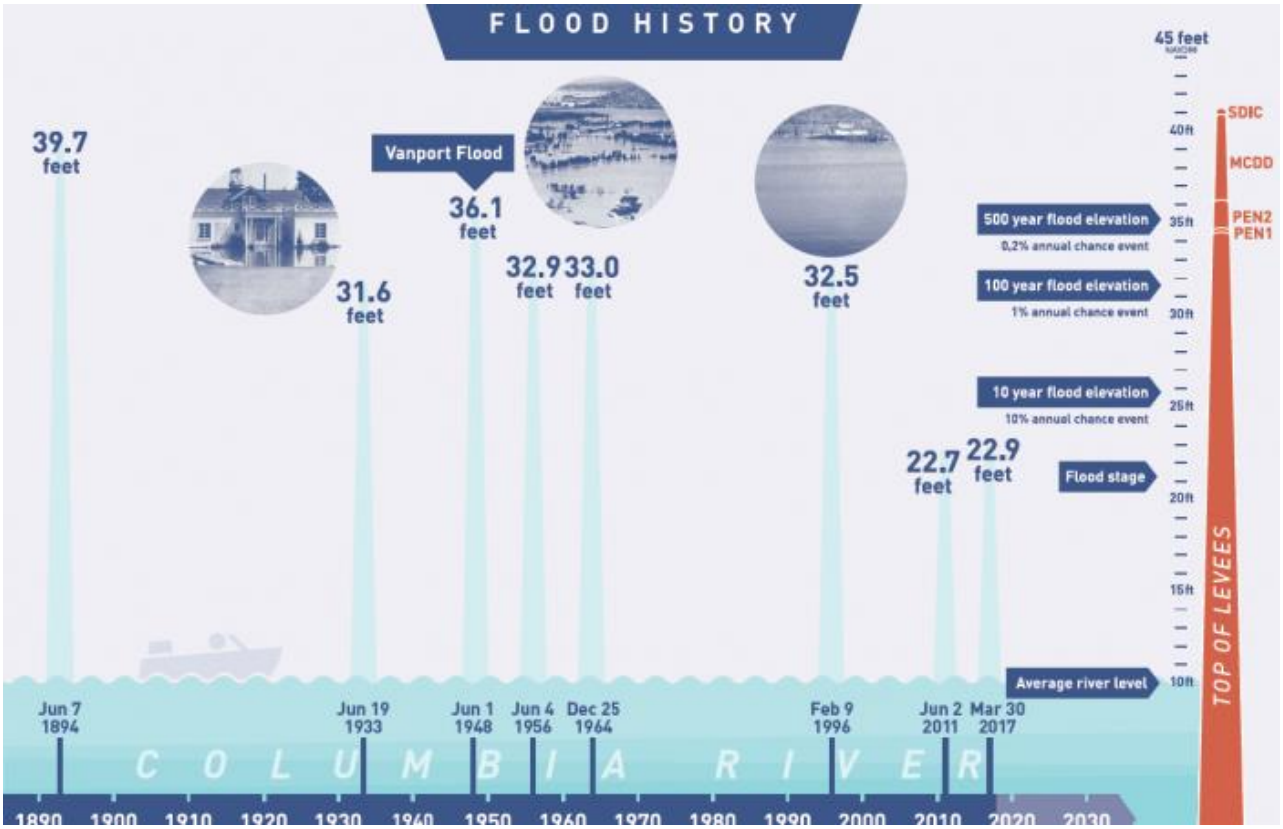

Figure 55 - Graphic showing historical high-water marks along the Columbia River. Graphic from the Multnomah County Drainage District.

Multnomah County has experiened significant floods throughout the last 125 years, including six events where the Columbia River met or exceeded the current 1% annual chance flood elevation. Although flooding on some level occurs nearly every year, the last widespread

flooding throughout the county occurred in 1996, an event with flooding throughout major river systems in Central and Northwestern Oregon that is maintained as a modern benchmark for local catastrophic flooding. The 1996 flood was the first time in over 30 years that the 1% annual chance flood level was exceeded on major rivers, and it has now been 27 years since that flood, making public risk perception of major flood an ongoing challenge. A public survey conducted for this plan update showed much lower concern from respondents about flood compared to earthquakes and more recently experienced climate-driven hazards.

The Flood of 1948 (Vanport)

Risk from levee failure was realized on May 30, 1948, with the destruction of the Vanport community in what is now Delta Park in North Portland. At least 15 people died in this disaster, making it the most catastrophic flood and largest hazard-caused population dislocation in Multnomah County in at least a century.

The Columbia and Willamette rivers were cresting at eight feet above flood stage when a breach occurred in a railroad embankment that served as a levee separating the City of Vanport from Smith Lake. Subsequent breaches occurred along the Columbia Slough, resulting in flooding in three of the four Columbia Corridor Drainage Districts.

The breach became a 500-foot gap that allowed flood waters to pour into the city within 10 minutes. Earlier in the day, residents had received flyers on their doors from the Portland Housing Authority telling them to remain calm and that warning would be given in time for them to evacuate if flooding occurred[45].

Vanport had been developed for wartime shipyard workers, peaking with a population of over 40,000 people in 1944, making it the largest public housing development in the nation and the second largest city in Oregon. The development had been designed to be temporary, but housing for non-white workers was limited in existing neighborhoods because of racially exclusionary housing policies. After the war, 18,500 people remained, of whom about a third were African-American. The city maintained commercial and cultural institutions and became the site of Vanport College and housed many returning war veterans attending the university on GI Bills.

The flood displaced the entire population and the town was not rebuilt[46]. Residents received no compensation for the total loss of their homes and belongings. Vanport College was re-formed in downtown Portland and became Portland State University, and the displacement of black residents into segregated neighborhoods in Northeast Portland began a cycle of disinvestment followed by gentrification and further displacement from those neighborhoods[47].

The Vanport Mosaic, a local non-profit organization, has collected stories from those who lived in Vanport and were affected by the Vanport Flood.

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[45] The Life and Death of Vanport, 70 years after the flood, *Street Roots*, Patricia Kullberg, April 20, 2018

[46] "Dikes are Safe at Present": The 1948 Columbia River Flood and Destruction of Vanport, Portland State University Library Digital Exhibit

[47] The Time Nature and Racism Teamed Up to Wipe Out A Whole Town, NPR Code Switch, Kenya Downs, March 2, 2015

Figure 56 - Vanport before (left) and after (right) the Flood of 1948. Photos Portland City Archives.

The US Army Corps of Engineers (USACE) and the Columbia Corridor Drainage Districts reinvested in the levee system and pump stations following the Vanport Flood, making improvements and re-establishing the levees where they had failed. Nonetheless, there remains risks of levee failure along the same railroad embankment where the Vanport Flood breach occurred. Levee Ready Columbia, the UFSWQD, and the Drainage Districts are working in partnership with the USACE on shoring up the levee system to protect against similar size floods in the future, including plans for creating a setback levee behind the railroad embankment.

Other Historic Flood Events

The historic 1996 statewide flood occurred from February 5th-9th. The cause of the flood was a wet and snowy winter that had left soils saturated and deep snowpack, followed by a freezing snap that made soils even less able to absorb water. The sudden arrival of an unusually long-lasting atmospheric river brought heavy rains and warm temperatures, combining extreme storm runoff with rapid snowmelt.

An interactive version of this map can be found at this link (Additional Regulatory Layers – Flood 1996 Inundation Zone)

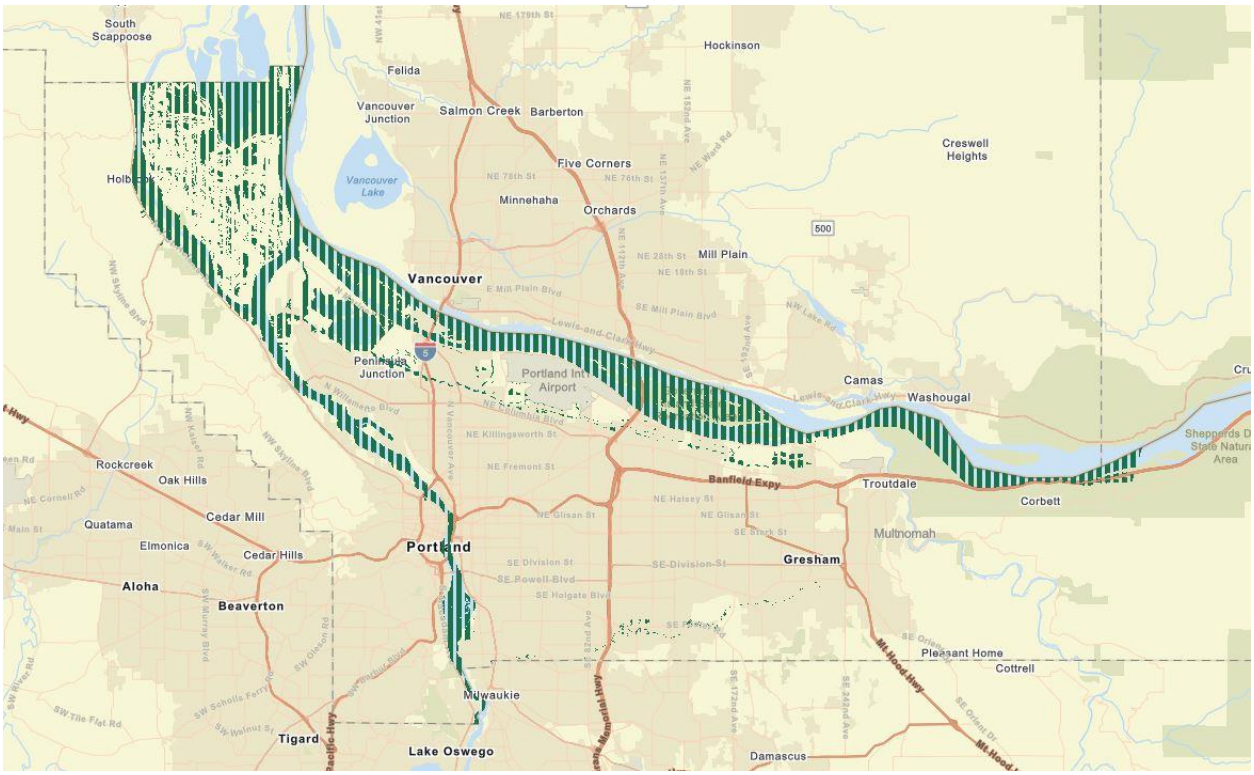

Figure 57 - Map showing Multnomah County areas flooded during the 1996 Flood event. Map from Multnomah County Land Use Planning.

The flooding closed major highways and roads, disrupted airport operations over fears of levee failure, and significantly impacted water supplies because of sedimentation. Eight deaths occurred across the state[48], including one near Troutdale, when a home was swept into the Sandy River[49]. Most Oregon deaths were people in vehicles that were carried away by floodwaters or fell into sinkholes.

The 1964 Christmas Flood was the first major non-levee related flood in Multnomah County after the creation of the extensive flood control works beginning in the 1930s. The Christmas Flood was also a rain on snow event that impacted almost the entire State of Oregon causing over $1 billion in damage.

The Flood of 1894 is considered a flood of record for Multnomah County, although larger floods have almost certainly occurred during its period of human settlement. The 1894 flood had the highest recorded flood levels on both the Willamette and Columbia Rivers. This was a spring flood, occurring in June as heavy rains and melting mountain snow combined to inundate the region. The floodwaters killed livestock, damaged railroad tracks and bridges and left central city locations covered in water for three weeks[50].

[48] Remembering Oregon's epic 1996 flood, *The Oregonian*, Joseph Rose, February 5, 2020

[49] Flood of '96: A high water mark in Oregon's weather history, KATU, February 8, 2016

[50] Willamette River flood of 1894, Oregon Encyclopedia, Oregon Historical Society

Figure 58 - Photo from downtown Portland during the Flood of 1894. Photo from City of Portland Archives.

While upriver flood-control dams and levees constructed since this event may make a flood of this magnitude less likely, it is still of note that the high water elevation on the Columbia River in 1894 was a full seven feet higher than in the catastrophic 1996 flooding event. Given the increased probability of climate-driven weather extremes, including more winter days with atmospheric rivers, analysis of current vulnerability to a repeated event of this magnitude may be warranted.

Table 20 – Flood History of Multnomah County (Federally Declared Disasters Shaded)

Date	Location	Type of Flood	Description
Dec. 1861	Willamette River	Rain on snow	Probably the most immense flood in the valley in recorded history, the “Great Flood” devastated the valley’s economy and resulted in the deaths of several people.
Dec. 1862	Willamette Basin	Rain on snow	Widespread flooding throughout western Oregon.
Feb. 1890	Willamette Basin	Rain on snow	Second largest flood of known magnitude; water levels in Portland: 22.3 ft.
June 1894	Columbia River	Snowmelt	Largest recorded flood on Columbia. Estimated to have covered everything below 36 feet along the Columbia River from the Sandy to the Willamette; only a few knolls were above water on Sauvie and Hayden islands.
Jan. 1923	Willamette & Columbia River	Rain on snow	Widespread damage to roads and railroads
Dec. 1937	Willamette Basin	Rain on snow	Considerable flooding; landslides

Date	Location	Type of Flood	Description
Dec. 1945	Willamette Basin/ NW Oregon	Rain on snow	Very warm temperatures; considerable flood damage
May–Jun. 1948	Columbia River	Rain, flooding, snowmelt	Memorial Day flood on the Columbia River. Levee breaches destroyed the City of Vanport (18,000 people); 15 fatalities recorded. Subsequent levee breaches followed, flooding Portland; flooding also occurred along Columbia River Highway and the Sandy River Delta. Snowmelt event in June and contributed impacts. Willamette River crested at 31.6 feet.
Dec. 1955	Statewide	Rain on snow	DR-49. Event occurred on December 29, 1955. Flooding and strong winds; five fatalities.
Jul. 1956	Statewide	Storms, flooding	DR-60. Event occurred on July 20, 1956. Storms and flooding.
Mar. 1957	Statewide	Flooding	DR-69. Event occurred on March 1, 1957.
Oct. 1962	Statewide	Storms	DR-136. Event occurred on October 16, 1962.
Feb. 1963	Statewide	Flooding	DR-144. Event occurred on February 25, 1963.Flooding.
Dec. 1964	Statewide	Heavy rains, flooding, rain on snow	DR-184.Event occurred on December 24, 1964. Record-breaking rainfall; damaged or destroyed about 750 homes along the Sandy River. In Multnomah County, the Columbia River Highway was washed out at the east end of the Beaver Creek Bridge. Statewide damage totaled $157 million and 17 deaths.
Jan. 1972	Willamette & Sandy Rivers	Storms, flooding, rain on snow	DR-319.Event occurred on January 21, 1972. Widespread damage; five fatalities.
1974	Western Oregon	Rain on snow, flooding	DR-413. Flooding resulted from rain-on-snow events. Willamette River at Portland crested at 25.7 feet. Nine counties declared disasters.
Jan. 1978	Willamette River	Rain on snow	Intense rain/snowmelt; widespread flooding
Feb. 1986	Statewide	Snowmelt, flooding	Intense rain, melting snow, and flooding. Some homes evacuated.
1990	Western Oregon	Rain on snow, flooding	DR-853 Ten rivers in eight counties were flooding in a rain-on-snow weather event. Many bridges were washed away.
Feb. 1996	Statewide	Storms, flooding, rain on snow	DR-1099 Winter storms with rain, snow, ice, floods and landslides. Power outages, road closures and property damage. Warm temperatures, record breaking rains; extensive flooding in Multnomah County; widespread closures of major highways and secondary roads; eight fatalities. Multnomah County was one of 27 counties covered by the disaster declaration.

Date	Location	Type of Flood	Description
Dec. 1996-Jan. 1997	Statewide	Winter storm, flooding	DR-1160. Severe snow and ice. Up to four to five inches of ice in the Columbia Gorge. Interstate 84 closed for four days. Hundreds of downed trees and power lines. Widespread power outages in the greater Portland area, including Multnomah County.
Jan.-Feb. 1999	NW Oregon	Rain, flooding, landslides, mudslides	Widespread flooding on smaller rivers and streams;. numerous landslides and mudslides. Historic Columbia River Highway east of the Sandy River Bridge covered with slides coming from the cliffs above. Mudslide pushed a house into the Sandy River, resulting in a fatality.
Winter 2001	Wood Village	Flooding	Arata Creek overflowed its banks at the point where it crosses NW 244th Avenue. One building east of that point was damaged.
Jan. 2003	Portland area	Heavy rain	Johnson Creek crested at two feet above flood stage, the highest Johnson Creek had risen in years. No damages were reported, but the rising river prompted the evacuation of approximately 25 nearby houses. Heavy rain resulted in standing water on many streets in the Portland metro area, resulting in some road closures. A small slide resulted in the temporary closure of a ramp leading to the St Johns Bridge.
Dec. 2007–Jan. 2008	NW Oregon	Winter storms, heavy rain, flooding	DR-1824. Severe winter storm, flooding, winds, record and near-record snow, landslides and mudslides. Gresham received 26 inches of snow . Many roads closed. Significant damages to public infrastructure, homes and businesses.
Jan. 2009	Portland area	Rain, flooding, rain on snow	The Portland area received 3.04 inches of rain from a warm tropical storm (“Pineapple Express”) which combined with extensive snowmelt from heavy snowfall in December. Flood elevations in Johnson Creek were the second highest recorded, and flooding also occurred on other streams in Multnomah County.
Jan. 2011	Statewide	Winter storm	DR-1956. Severe winter storm, flooding, mudslides, landslides and debris flows.
Jan. 2012	Multnomah County	Rain, rain on snow	Heavy rain combined with snowmelt runoff caused the Johnson Creek at Sycamore to overflow its banks and flood low-lying areas. Johnson Creek crested at 13.2 feet on January 19 at 4 pm PST, 2.2 feet above flood stage.
Sep. 2013	Portland Metro Area	Heavy rain, flooding	KPTV-KPDX Broadcasting reported that heavy rain resulted in flooding and damage to the Legacy Good Samaritan Medical Center and several businesses in Northwest Portland. Besides damage to the hospital's emergency and operating rooms, some elective surgeries were canceled.

Date	Location	Type of Flood	Description
Dec. 2015	Western Oregon	Winter storm, heavy rain	DR-4258. Severe winter storms, straight-line winds, flooding, landslides and mudslides. Pump failed and had to be replaced at Sandy Pump Station.
Mar. 2017	Western Oregon	Winter storm, heavy rain	High water duration lasted over one month, some minor erosion occurred at levees requiring repair.
May 2018	Multnomah County	Regional rains	15 days of elevated water on the Columbia River, requiring some repairs for minor erosion.
April 2019	Statewide	Severe storm, flooding, landslide	DR-4452; Limited impacts in Multnomah County. Columbia River elevated for 2 days, with some minor erosion and sinkholes in the levee system.
Dec. 2020-Jan. 2021	Multnomah County	Heavy rain, landslide	Heavy rains caused minor damage on Johnson Creek in Portland. Continuing rain caused a fatal landslide in a burned over area in Dodson, in Unincorporated Multnomah County.
Nov. 2021	Multnomah County	Heavy rain	Internal flood event in MCDD East caused by heavy rains and pump station inaccessibility. Impacted communities in Fairview and Interlachen community in Unincorporated Multnomah County
June 2022	Multnomah County	Heavy rain	High water levels on the Columbia River, Columbia River Slough, and Fairview Lake.

3.2.3 Flood Vulnerability

Riverine and Lake Flooding

Because of the protective levee system and limitations on development in high-hazard areas, the participating jurisdictions in this plan face mostly localized impacts from stream and lake flooding. If event intensity increases because of climate change, additional risk should be considered.

A 2016 HAZUS model estimated damages caused by a 1% annual chance flood of all mapped flooding sources in the county. This study did not contemplate a failure of the levee system–the vulnerability to that event is covered later in this chapter.

In the table below, it is shown that only twelve residences in communities participating in this plan would be substantially damaged by the mapped event, with another 203 homes suffering moderate damage. Substantial damage means that the cost of repairs is 50% or more of the structure's market value before the event, while moderate damage means less than 50% of pre-disaster value. No commercial or industrial structures were identified as being damaged. The combined losses for all locations, considering building loss, contents loss and relocation costs, were calculated at over $72 million. Johnson Creek in the City of Portland is not included in this data, but has been a recent source of flood losses in Multnomah County.

Table 21 – 2016 Estimation of Flood Damage Across Multnomah County Jurisdictions (HAZUS Model)

Community*	# of Homes Substantially Damaged (>50% of Value)	# of Homes with <50% damage	Building Loss	Contents Loss and Relocation Cost
Participating Communities Total	12	203	$44,247,000	$28,383,000
Total for Unincorporated Multnomah County	10	62	$19,462,000	$12,898,000
East of Sandy River	2	10	$4,809,000	$3,980,000
Interlachen	0	0	$109,000	$69,000
Pleasant Valley	0	1	$292,000	$182,000
Riverdale Area	3	2	$1,282,000	$723,000
Sauvie Island Area	5	47	$10,910,000	$6,631,000
West of Sandy River	0	2	$2,060,000	$1,322,000
City of Fairview	0	36	$4,882,000	$3,013,000
City of Gresham	0	78	$13,371,000	$8,482,000
City of Troutdale	2	27	$6,532,000	$3,985,000
City of Wood Village	0	0	0	0

In the Lower-Columbia Sandy Watershed where flood maps were recently revised, another vulnerability assessment was conducted shortly after the 2019 map update was published. This analysis used HAZUS as well, along with updated hydrology and improved ground mapping and building inventories. This study overlaps, and provides more detailed analysis, for the parts of Troutdale, Gresham, and Unincorporated Multnomah County located within the watershed.

Note that this study uses different criteria to explain vulnerability than the above table, including analyzing scenarios for different flood frequency events. This study indicates slightly more exposure for Troutdale, which is primarily located in this watershed, than was shown in the 2016 analysis. That increase is most likely reflective of increases in predicted flood heights or changes to the flood extent from improved ground elevation mapping. Additional development may have occurred in the area, but would have been required to be constructed to withstand the 1% annual chance flood with little damage.

It is worth noting that damage projection continue to roughly double once the study looks at a larger event than the 1% annual chance flood. Those additional areas are outside the mapped regulatory floodplain and therefore much less likely to restrict development or require higher construction standards to limit flood loss. Residents may not be aware of this flood risk and would not be subject to mandatory flood insurance purchase requirements, which could further decrease resilience.

Table 22 – 2020 Estimation of Flood Damage in the Lower-Columbia Sandy Watershed (DOGAMI O-20-06, Natural Hazard Risk Report for the Lower Columbia-Sandy Watershed)

	10% annual chance (10-year) flood – buildings damaged	10% annual chance (10-year) flood – damage costs	2% annual chance (50-year) flood – buildings damaged	2% annual chance (50-year) flood – damage costs	1% annual chance (100-year) flood – buildings damaged	1% annual chance (100-year) flood – damage costs	0.2% annual chance (500-year) flood – buildings damaged	0.2% annual chance (500-year) flood – damage costs
Watershed Total (Multnomah County portion only)	4	$54,000	20	$286,000	48	$967,000	106	$4,956,000
Gresham	1	$16,000	5	$94,000	6	$119,000	10	$380,000
Troutdale	1	$10,000	8	$87,000	33	$640,000	67	$3,262,000
Unincorporated Multnomah County	2	$28,000	7	$105,000	9	$218,000	29	$1,314,000

National Flood Insurance Program

Participation in the National Flood Insurance Program (NFIP) is a way to both evaluate vulnerability and identify resilience, as flood insurance is a key way to make communities more able to recover from flood. Participation also requires standards for new buildings in flood-prone areas to meet standards identified in local Floodplain Management Ordinances. All communities in Multnomah County participate in the plan except for the City of Maywood Park. Special districts do not join the NFIP–their eligibility is included in the city or county jurisdictions where their structures or served communities are located.

Homes built before areas were mapped under the NFIP may have grandfathered 'pre-FIRM' status and be the structures most at risk from flood. Minus-rated policies are those pre-FIRM policies where the lowest floor is at least one foot below the 1%-annual chance flood elevation.

Table 23 – NFIP Policies by Type and Coverage Amount in Participating Jurisdictions (FEMA)

Community	Policies In Force	Pre-FIRM Policies	Minus Rated Policies	Insurance Coverage ($)
Participating Communities Total	345	187	6	100,231,000
Unincorporated Multnomah County	177	112	2	49,917,000
Fairview	41	10	0	13,634,100
Gresham	83	45	1	23,214,600
Troutdale	44	20	3	13,465,300
Wood Village	0	0	0	0

Between 1978 and 2015, 105 NFIP claims were made by property owners in communities that are part of this plan. In that time period, $1.2 million in insurance payments were received to cover flood losses.

Table 24 – NFIP Flood Damage Claims in Participating Jurisdictions (FEMA)

Community	Total Losses Submitted	Losses Paid	Closed Without Payment	Total Payments ($)
Participating Communities Total	105	72	33	1,206,915.96
Unincorporated Multnomah County	86	61	25	1,148,575.44
Fairview	3	2	1	13,276.26
Gresham	6	2	4	7,862.87
Troutdale	10	7	3	37,201.39
Wood Village	0	0	0	0

Repetitive loss and severe repetitive loss properties are an indication of development in extremely high-hazard areas. These properties are considered of the highest vulnerability and best candidates for property mitigation, such as voluntary buyouts that return the properties to open space.

FEMA defines repetitive loss properties as those that have had at least two paid flood losses of more than $1,000 apiece in any 10-year period. There are four repetitive loss structures in jurisdictions included in this plan.

- Unincorporated Multnomah County
  - 2 single-family residences
  - 1 non-residential structure
- City of Troutdale
  - 1 single-family residence

Severe repetitive loss properties are those that have:

- Four or more separate paid claims, each more than $5,000; or
- Two paid claims where the total amount paid exceeds the market value of the structure before each flood loss.

There are no severe repetitive loss properties in the jurisdictions participating in this plan.

The Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, flood insurance premium rates are discounted to reflect the reduced

flood risk resulting from the community actions. CRS ratings range from 1-10, with lower scores indicating a higher level of flood reduction programs and improved flood insurance discounts.

The City of Troutdale is the only jurisdiction in this plan that participates as a CRS community. Troutdale entered the program in 2008 and has a rating of 7, meaning city residents receive a 15% discount on Federal flood insurance. The City of Portland has been a CRS participant since 2001 and has a rating of 5 (25% discount).

Vulnerability to Levee Failure

In 2018, DOGAMI published Special Paper 50, *Flood Risk Assessment for the Columbia Corridor Drainage Districts in Multnomah County, Oregon* to provide a comprehensive vulnerability assessment of the developed areas protected by the 45 miles of levee along the Columbia River.

The area was originally a series of sloughs, lakes, wetlands and side channels, before being initially leveed to dry the area enough for agricultural uses. After the establishment of the levees and other flood control infrastructure, the protected area grew and developed core parts of Multnomah County's urban development. Even after The Flood of 1948 (Vanport), thousands of new buildings have been built in these protected areas, which as of 2018 included around 8,000 residents, the Portland International Airport, the Portland Exposition Center, correctional facilities, and about 10% of the county's industrial employment base.

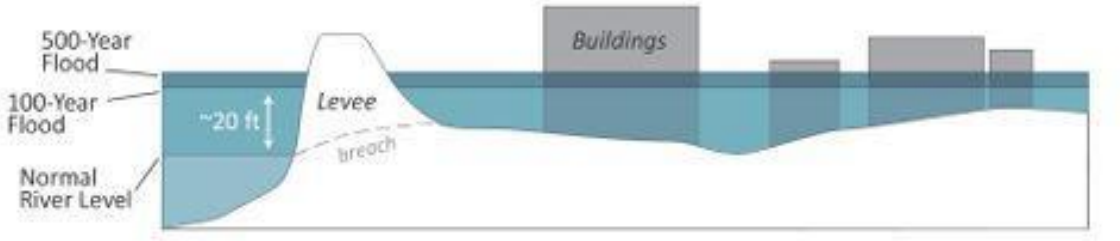

Figure 59 - Graphic showing how a levee breach impacts buildings normally protected from high water. Graphic - DOGAMI.

The study set out to quantify the loss if a breach occurred and allowed 1% annual chance (100-year) or 0.2 annual chance (500-year) flood levels to spread across the entire protected area. This analysis was conducted for each of the five current levee districts. Note that the Sauvie Island Drainage Investment Company (SIDIC) is not a participating district in this plan, but protects a large area of unincorporated Multnomah County so is included in vulnerability analyses.

Building Damage

Across the leveed areas, building exposure from 1% annual chance (100-year) flood elevations ranges from about half to nearly all of the buildings in the district, depending on the district.

Table 25 – Total Exposed Buildings and Property Damage From 100-Year Flood and 500-Year Flood without Levee Protection (DOGAMI Special Paper 50 - Flood Risk Assessment for the Columbia Corridor Drainage Districts in Multnomah County, Oregon)

District	Number of Exposed Buildings, 100-Year Flood	Number of Exposed Buildings, 500-Year Flood	Total Property Damage Assessment in 100-Year Flood after Breach (millions of dollars)	Total Property Damage Assessment in 500-Year Flood after Breach (millions of dollars)
Peninsula Drainage District #1 (PEN 1)	42	50	33.2 - 39.8	142.0 - 203.8
Peninsula Drainage District #2 (PEN 2)	1,075	1,110	672.6 - 760.2	768.7 - 826.3
Multnomah County Drainage District No. 1 (MCDD)	1,855	2,038	4,657.2 - 6,140.9	5,644.1 – 6,913
Sandy Drainage Improvement Company (SDIC)	91	131	256.4 – 345.6	383.8 – 541.2
Urban Flood Safety & Water Quality District (Total of above Districts)	3,061	3,329	5,619.4 – 7,286.5	6,938.6 – 8,484.3
Sauvie Island Drainage Improvement Company (SIDIC)	486	527	133.3 - 150	177.0 – 189.0

Displacement

Determining the extent of displacement of residents was used by applying population projections to the number of residences, adding residents of at least one established village for unhoused residents, and including those in correctional facilities.

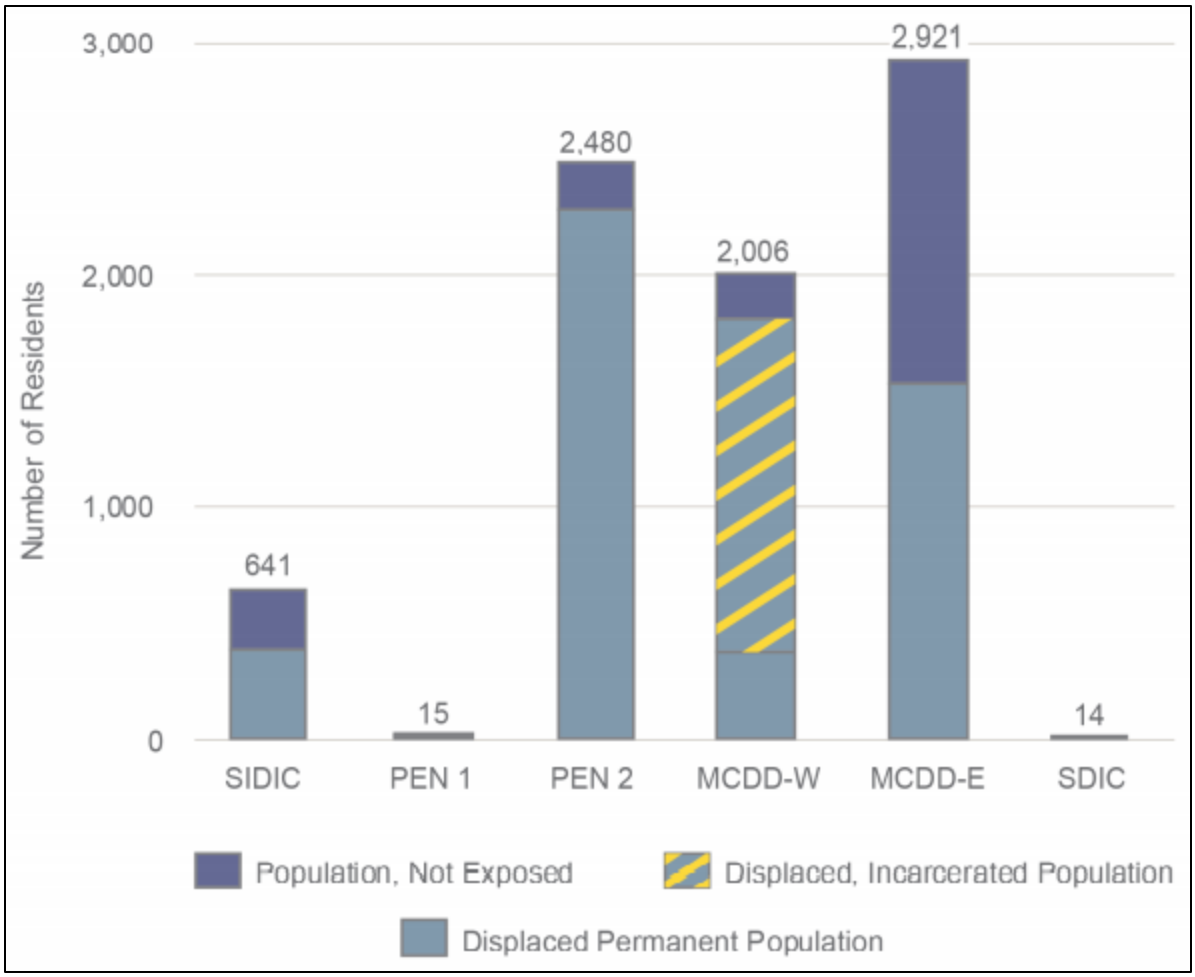

Figure 60 - Figure shows the proportion of population that would be displaced by a 1% annual chance flood without levee protection. Displacement would be especially high in the Multnomah County Drainage District and Peninsula 2 systems.

Economic Impacts

- Airport Impacts

A levee breach in a 1% annual chance (100-year) flood would expose well over $1 billion of assets at the Portland International Airport[51], damaging airport terminals and concourses, Port of Portland facilities, and long and short-term parking lots. This loss does not include damage to runways and indirect regional losses due to the interruption of regional air service.

The Troutdale Airport, a general aviation facility, would also be exposed to a 1% annual chance flood in the event of a levee breach.

- Workforce Impacts

[51] The 2018 DOGAMI study estimated the value of vulnerable PDX assets at $1 billion, but new and redeveloped facilities mean that this number is likely to be considerably higher now.

Table 26 – Impacts of Flood to Businesses and Employees in 100-Year Flood Without Levee Protection (DOGAMI Special Paper 50 - Flood Risk Assessment for the Columbia Corridor Drainage Districts in Multnomah County, Oregon)

District	Businesses Initially Closed Due to Flood, 100-Year Event	Number of Employees Initially Unable to Return to Work, 100-Year Event
Peninsula Drainage District #1	11	902
Peninsula Drainage District #2	237	4,259
Multnomah County Drainage District No. 1	1,569	42,829
Sandy Drainage Improvement Company	93	4,453
Urban Flood Safety & Water Quality District (Total of above Districts)	1,910	52,443
Sauvie Island Drainage Improvement Company	29	170

Hazardous Materials

The table below shows potential exposure of different hazardous materials in a levee breach during a 1% annual chance (100-year) or 0.2% annual chance (500-year) flood. Materials range from flammable gas, liquid, or solid; non-flammable gas; reactive and combustive materials; oxidizers; organic peroxides; poisonous materials; acute health hazards; corrosive materials; and other miscellaneous hazardous materials.

Table 27 – Hazard Materials Exposed in a 100-Year Flood without Levee Protection (DOGAMI Special Paper 50 - Flood Risk Assessment for the Columbia Corridor Drainage Districts in Multnomah County, Oregon)

District	Total Number of Buildings with Hazardous Materials Exposed in 100-Year Flood after Breach	Total Number of Hazardous Materials Exposed in 100-Year Flood after Breach
Peninsula Drainage District #1	4	40
Peninsula Drainage District #2	37	110
Multnomah County Drainage District	224	902
Sandy Drainage Improvement Company	17	65
Urban Flood Safety & Water Quality District (Total across Districts)	282	1,117
Sauvie Island Drainage Investment Company	2	2

Infrastructure Impacts

The DOGAMI study evaluated impacts to roads and four other types of critical infrastructure in their levee breach scenarios.

- *Transportation Routes*
  Assuming that road embankments hold, major road closures would likely be limited to Airport Way and Marine Drive, and one small section of Interstate 84. While limited, closures on those routes would cause substantial delays for interstate commerce and freight movement. Over three miles of light rail track and over two miles of freight/passenger rail would be inundated in a 100-year flood event.

- *Electrical Substations*
  Eight power substations are located in the inundation area, and seven would be exposed to at least six feet of flooding. Half of the substations are located in the area protected by the SDIC and were identified to suffer moderate-heavy damage, depending on full flood heights.

- *Natural Gas Facilities*
  Two natural gas facilities located in the MCDD levee area are expected to suffer extensive impacts in a 1% annual chance flood, seeing up to 10 feet of inundation.

- *Pump Stations*
  All 14 pump stations across the five levee districts would be exposed to at least seven feet of floodwater and suffer extensive impacts. All levee districts have at least one pump station, with the MCDD levee area having eight.

- *Water Facilities*
  Portions of the Columbia South Shore Well Field that provide water to parts of Fairview and Gresham would be inundated by levee breach, and would be likely to be forced to interrupt service. Two other water treatment facilities are expected to only suffer minor damage.

- *Recovery*
  Business, employment, and residential recovery would be significant. Analysis shows that many businesses would not recover or would take multiple years to reemploy staff. Debris removal post-flood totals more than 840,000 tons of debris across the Columbia Corridor Drainage Districts.

Response Plans

In addition to repairs and investments in the levee system, the Districts have a Flood Emergency Action Plan established in July 2016 and participate in flood fighting during high water events. Actions include monitoring and repairing the levee system as needed, installing flood closure structures at known low-points within the levee system, and maintaining the pump stations and internal drainage affected by rising groundwater. Additionally, the plan indicates necessary coordination between the Districts and the other overlapping jurisdictions, including traffic control.

Evacuation planning is the responsibility of the City of Portland within PEN 1, PEN 2, and most of MCDD and of Multnomah County outside of City of Portland limits. The City of Portland has an evacuation plan for the area within the levee system, current as of October 2017. MCDD, on behalf of the Districts, coordinates with the City of Portland and Multnomah County regarding on-the-ground conditions and recommendations for evacuation considerations, but does not make final decisions on evacuation orders or other protective action orders.

Dam Failure

Dams can pose risks to people living downstream, who may not be aware of the risk of dam failure. The Oregon Water Resources Department (OWRD) uses the National Inventory of Dams (NID) threat potential methodology, and maintains an inventory of known dams in Multnomah County. The inventory currently has 26 dams listed – eight are rated as high

threat[52], four as significant threat[53] and the remaining 14 as low threat[54]. The inventory tracks the last inspection date for each dam.

Five of the eight high-threat dams are located in Portland, while Bonneville, Bull Run, and Van Raden are located in unincorporated Multnomah County. No high-threat dams exist in the jurisdictional areas of any other community, but the City of Gresham has three significant-threat dams and one low-threat dam and the City of Fairview has one low-threat dam.

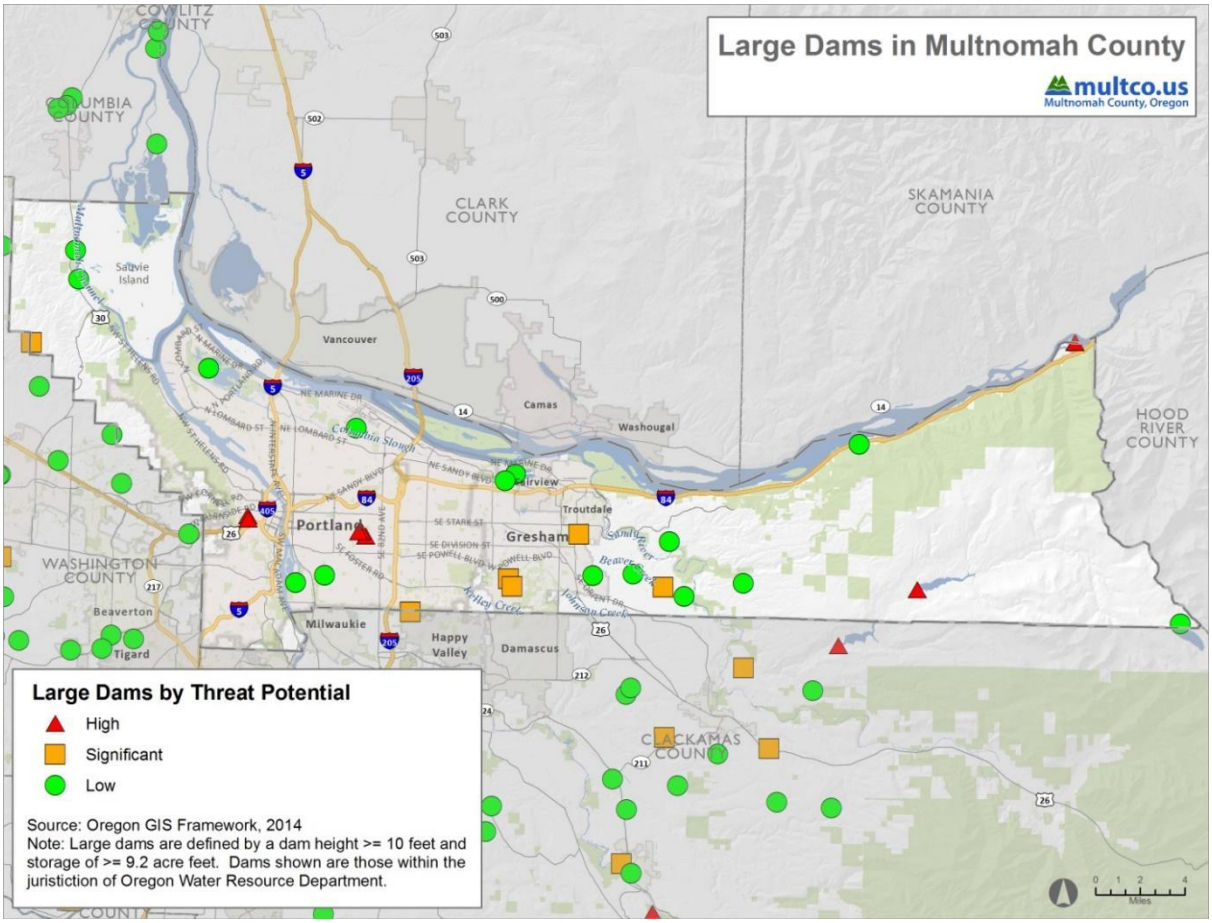

Figure 61 - Large Dams in Multnomah County, Oregon GIS Framework, 2014. Since this map was created, the Van Raden Dam has changed from significant threat to high threat. The Van Raden Dam is the farthest west orange square (on the border with Washington County) located at the Alderwood Lake Reservoir.

FEMA has a High Hazard Potential Dam (HHPD) grant program to identify and mitigate dam risks. This plan identifies all state and federally-regulated dams in Multnomah County, in accordance with 44 CFR §201 and has updated information on threat level and most recent inspection, when available.

[52] High threat means a failure is likely to cause loss of life.

[53] Significant threat means no likely loss of life in a failure, but probable economic loss and disruption of infrastructure.

[54] Low threat means no likely loss of life in a failure, and only minimal economic and environmental impact.

The *Bonneville Dam* is by far the largest dam in Multnomah County by water storage, and is a major source of regional power generation and limits Columbia River flood. The dam is operated by the US Army Corps of Engineers and power is sold by the Bonneville Power Authority – both agencies are federal, making the dam ineligible under the HHPD program. The dam is frequently inspected and has an Emergency Action Plan (EAP). Some risk exists from local earthquakes, especially a severe Mount Hood Fault Zone crustal earthquake. The dam is also at the site of a major historical landslide.

The *Bull Run Dam* is outside of the City of Portland limits, but is operated by the Portland Water Bureau, and falls under the City of Portland's vulnerability assessment. Potential inundation from this dam would be in Clackamas County, so continuing inter-jurisdictional coordination is needed. The dam was recently inspected and has an updated EAP.

The *Van Raden Dam* has moved from significant risk to high risk in the last few years. The privately-owned dam was inspected in 2020 and found to be in fair condition and an Emergency EAP was created in 2021. The Oregon Water Resources Department coordinated with Multnomah County to identify this dam as not eligible for the HHPD due to projected inundation levels and the small number of homes located below the reservoir on NW Rock Creek Road. However, it was recommended to increase coordination with the dam owner and Washington County (the dam is located right on the county line) and potentially develop an exercise for a dam failure scenario. A mitigation action is included for Multnomah County to address this risk and pursue preparation planning. The earthen dam would be subject to shaking threat from a Cascadia Subduction Zone earthquake and, especially, a major Portland Hills earthquake event.

Table 28 – Multnomah County Dam Information – (Oregon Water Resources Department and US Army Corps of Engineers)

Dam	Height (ft)	Storage (acre ft.)	Flood Source	Jurisdiction	Owner	Last Inspection	Threat Potential	Note
Bonneville	110	277,000	Columbia River	Multnomah County	US Army Corps of Engineers, Portland District	5/10/2018	High	Emer. Action Plan – 2008
Bull Run Dam 1	194	33,760	Bull Run River	City of Portland	City of Portland	9/30/20	High	Emer. Action Plan – 2021
Mount Tabor #1	30	37	Bull Run River (Offstream)	City of Portland	City of Portland	8/6/20	High	Emer. Action Plan
Washington Park #3	53	50	Bull Run River (Offstream)	City of Portland	City of Portland	8/6/20	High	Emer. Action Plan
Washington Park #4	60	54	Bull Run River (Offstream)	City of Portland	City of Portland		High	
Mount Tabor #5	55	153	Bull Run River (Offstream)	City of Portland	City of Portland	8/6/20	High	Emer. Action Plan
Mount Tabor #6	28	230	Bull Run River (Offstream)	City of Portland	City of Portland	8/6/20	High	Emer. Action Plan
Van Raden	27	115	Rock Creek	Multnomah County	Fred and Kenneth Van Raden	9/1/20	High	Fair Condition; Emer. Acton Plan 2021
Binford	25	30	Hieny Creek	City of Gresham	City of Gresham	5/1/18	Significant	

Dam	Height (ft)	Storage (acre ft.)	Flood Source	Jurisdiction	Owner	Last Inspection	Threat Potential	Note
Mt. Hood Community College	58	25	Kelly Creek	City of Gresham	Mt. Hood Community College	2/15/17	Significant	
Peyralans Reservoir	23	12	Butler Creek	City of Gresham	Marpol Ridge HOA	9/12/19	Significant	
William H. Sester	32	55	Trib. To Beaver Creek	Multnomah County	William H. Sester	10/6/16	Significant	
Belchers	28	30	Middle Fork Beaver Creek	Multnomah County	Darrold and Dan Belcher	5/24/16	Low	
Bull Run Lake	55	14,500	Bull Run River	Multnomah County	City of Portland		Low	
David Crampton	18	16		Multnomah County	David Crampton	4/7/09	Low	
Diack Reservoir	26	20	Trib. To Sandy River	Multnomah County	Samuel L. Diack	4/14/15	Low	
Fairview Lake	18	411	Columbia Slough	City of Fairview	City of Fairview	3/12/14	Low	
Kelly Creek Regional Detention Pond	20	67	Kelly Creek	City of Gresham		5/1/18	Low	
Multnomah Channel Dam #1	8.6	203	Trib. to Columbia River	Multnomah County	Metro Parks & Greenspaces		Low	
Multnomah Channel Dam #2	11.5	240	Trib. to Columbia River	Multnomah County	Metro Parks & Greenspaces	12/7/16	Low	
Oaks Bottom	9	451		City of Portland			Low	
Osburn Reservoir	34	52	Trib. to Trout Creek	Multnomah County	Tom Lehman	4/26/18	Low	
PDX De-Icing Lagoon	12	41		City of Portland	Port of Portland		Low	
Reed Lake	8	16.8	Crystal Springs Creek	City of Portland	The Reed Institute		Low	
Smith-Bybee Lakes	14	4,100	Columbia Slough	City of Portland	City of Portland	12/6/16	Low	
Wahkeena Rearing Reservoir	19	180	Wahkeena Creek	Multnomah County	Oregon Dept. of Fish and Wildlife	9/12/19	Low	

Urban Stormwater

Because urban stormwater effects are mostly local, large-scale vulnerability studies are not common. Cities included in this plan have Stormwater Management Plans to reduce impacts, and specific locations of repeated stormwater flooding are located in jurisdictional chapters.

Improvements to stormwater sewer capacity and the recovery of natural drainage systems are the primary methods for reducing vulnerability.

Channel Migration

The 2020 *Natural Hazard Risk Report for the Lower Columbia-Sandy Watershed* conducted a vulnerability assessment for channel migration risk on the Sandy River. Although channel migration undoubtedly affects other locations in Multnomah County, the Sandy River's dynamic nature and streamside location made it a clear choice for this type of study and a high-risk example of exposure.

The analysis does not include specific details for areas protected by the Sandy Drainage Improvement Company, but this movement could alter flood protection requirements or damage protective works. Totals of displaced persons and exposed buildings are for areas within the watershed boundary only.

Of the three jurisdictions in the watershed, Troutdale and Unincorporated Multnomah County are the communities with vulnerability, with a combined $55 million of potential building exposure over a 100-year view of potential erosion and new channel formation.

Table 29 – Displacement and Building Impacts from Sandy River Channel Migration Risk – (DOGAMI O-20-6 – Natural Hazard Risk Report for the Lower Columbia-Sandy Watershed)

	Number of People Potentially Displaced by Sandy River Channel Migration	Number of Buildings Exposed to Sandy River Channel Migration	Value of Buildings Exposed to Sandy River Channel Migration
Gresham	0	0	$0
Troutdale	143	66	$21,603,000
Unincorporated Multnomah County	139	114	$33,900,000

3.3 Landslide

Multnomah County has many moderate to steep slopes across its area, but especially in the far western and eastern portions of the county and upland canyons along the Sandy River. Areas with slopes are those most vulnerable to different types of land movement. Advances in LIDAR technology[55] (a laser-based ground sensing process) mapping have allowed the showing of even ancient landslides across the county, including in locations now covered by trees.

Unincorporated Multnomah County has the greatest risk from landslides among the participants of this plan, followed by the Cities of Gresham and Troutdale. The communities and districts in largely low-lying north-central portions of the county have limited exposure to landslide risk. The City of Portland, although not part of this plan, has extensive landslide risk in the Portland Hills.

Landslides can be small localized events that disrupt transportation routes or other infrastructure, or catastrophic events that threaten lives and homes. Western Oregon, because of its topography and wet climate, is much more susceptible to landslide hazards than Eastern Oregon.

As with many hazards in Multnomah County, local risk is increased by the large population and development and infrastructure in areas with high potential for future slides. Continuing growth could put additional people, structures and infrastructure in risk areas, although local jurisdictions have limited development in and around steep slopes to reduce that risk.

Figure 62 - A home in Dodson, in eastern unincorporated Multnomah County, damaged by landslide in 1996. The house later burned down during the 2017 Eagle Creek Fire.

There are different types of landslides. Most simply, a landslide is any downslope movement of rock, soil, or other debris–but it can also be a fast moving flow, spread across gentle slopes, or a fall of vertical rock or boulders. Geological factors that impact the likelihood and effect of landslides are the composition of materials in soil, such as water, rock and sand, and the steepness of slopes.

Extreme rain events are the most common cause of landslides in Multnomah County. The 1996 flood season triggered over 700 documented landslides in Portland alone, nearly half of the total number of recorded landslides in the most recent study inventory. The risk of rain-driven landslides can be further increased by wildfire, which can strip

[55] Lidar stands for light detection and ranging, and is a process that can make extremely precise ground measurements by sending out a laser light and evaluating how long it takes to reflect back to the source. American Geosciences Institute

the landscape of vegetation that holds topsoil together and alter soil chemistry, making it less able to absorb water. These effects can cause long-term landslide risk over many years.

It is also expected that a significant earthquake event will cause widespread landslides, with impacts heavily determined by whether or not soils are wet at the time of the earthquake.

Fast moving debris slides can be caused by volcanic eruptions. These dangerous events are called lahars, and information about them is in the chapter on Volcano.

Landslide Types

The Oregon Department of Geology and Mineral Industries (DOGAMI) has analyzed Multnomah County's risk and vulnerability to landslides[56], dividing risk into three types.

Deep landslides occur mostly below the roots of trees and can be hundreds of feet deep, depending on the soil and rock characteristics of the slide area. DOGAMI analysis considers any slide deeper than 15 feet below the surface to be deep. Deep landslides occur due to processes below the ground, including earthquake, rock geology and groundwater effects. Once formed, deep landslides will continue to be a risk area for resumed landslides for hundreds or even thousands of years, and can be reactivated by earthquake, extreme rainfall, or careless development practices. Deep landslides are typically much larger than shallow landslides and therefore create more risk of loss of life when they occur in populated areas. The 2014 Oso Landslide in Washington that killed 43 people was a deep landslide.

Shallow landslides occur within the zone of forest roots and are usually less than 10 feet deep. DOGAMI analysis considers any slide shallower than 15 feet below the surface to be shallow. Shallow landslides are most likely to occur because of heavy rain or sudden snowmelt. The saturation causes a loosening of soil and gravity pulls the soil, rocks and other debris downhill. Areas with shallow landslides have characteristics (soil type, slope angle) that make them susceptible to future landslides, but shallow slides themselves are not likely to be continuous or to become reactivated. Shallow landslides can vary widely in impact, depending on the size of the slope, the triggering event, and if development is in the path.

Debris flow fans are the areas where debris arrives in a flow and spreads out as it reaches the mouth of a canyon or channel. Areas with these deposits are at risk from future additional deposits of debris in further slides that would threaten development or infrastructure that has been built on top of the old deposits.

[56] DOGAMI has also produced a story map fully describing statewide landslide hazards and how they are mapped.

Other Landslide Classifications – Slides, Flows, Spreads and Topples/Falls

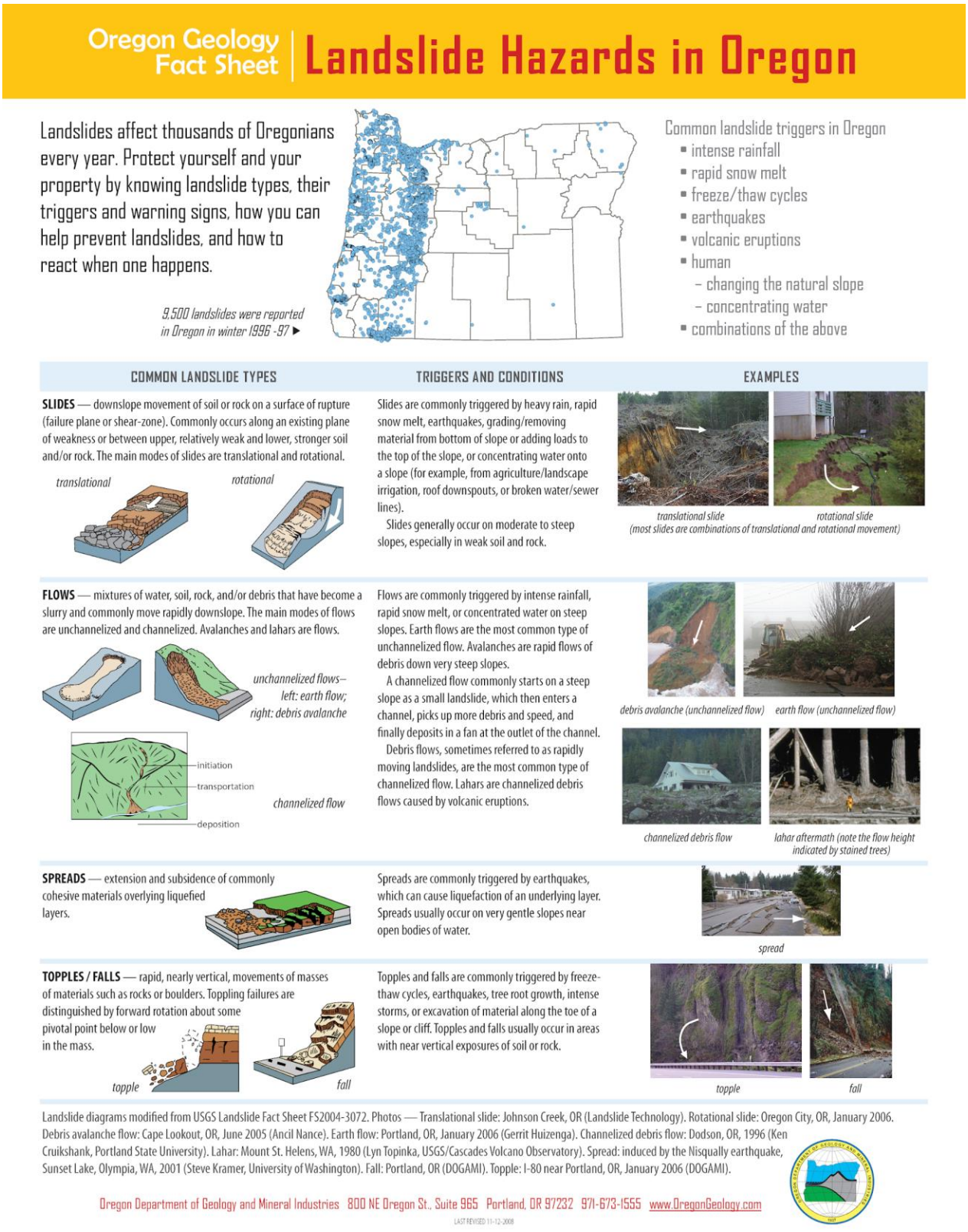

Figure 63 - DOGAMI Landslide Hazards in Oregon Fact Sheet

Five-Year Report, 2017-2022

Minor landslides were a common event during extremely rainy periods over the last five years, causing brief interruptions to transit routes. However, a major landslide occurred near the unincorporated Multnomah County community of Dodson on January 13, 2021, killing one person.

This tragedy occurred when a car was swept from the Interstate Highway 84 Frontage Road during the night of a heavy rain event. This stretch of highway runs through extremely steep portions of the Columbia River Gorge that had seen extreme landslides in the 1996 flood season and have a long geological record of slides. The slopes above the site also contained burned over areas from the 2017 Eagle Creek Fire, further increasing the probability and potential severity of a land movement event.

Figure 64 – Aftermath of the 2021 Dodson landslide. Photo Multnomah County Sheriff's Office

This event was a 15-foot high flow of mud, rocks and logs. After the slide, Dodson was evacuated for three days until it was determined by geologists that there was no imminent risk of another debris flow event. No homes were damaged by this event.

This loss of life underlined the high risk of additional landslides in areas where landslides have previously occurred, the concurrent risk of landslides during heavy rain events and the increased risk lasting years after wildfire.

The effects of smaller slides were primarily to city or county roads in areas with identified steep slopes. These smaller slides also coincided with periods of high rain.

Figure 65 - Minor 2017 winter landslide on the East Historic Columbia River Highway. Photo Multnomah County Sheriff's Office

Landslide Data

In 2017, DOGAMI released a *Landslide Hazard and Risk Study of Central and Western Multnomah County*, providing the most up-to-date information about probable locations of future landslides and vulnerability from landslide to all of the participating cities in this plan as well as the Port of Portland and most of the area served by the Columbia Corridor Drainage Districts. DOGAMI also published a *Landslide Inventory for Eastern Multnomah County* in 2017, using the same high-quality LIDAR data to identify historic slide deposits. The Eastern Multnomah inventory did not include a vulnerability analysis, but completed risk mapping for the entire county to use in planning, risk identification and communication, and response.

The updated landslide inventory data has been added to DOGAMI's Statewide Landslide Information Database for Oregon (SLIDO), which continues to be the single most comprehensive resource for statewide landslide information.

DOGAMI also received a grant in 2022 to study probabilities of post-wildfire land movement in the Portland Metropolitan region. Characteristics of post-fire land movement have been better studied in drier climates with more frequent fires, and this study will provide needed additional analysis of risks to wet climates.

Climate Change Impacts

Because landslide occurrence is so tied to extreme precipitation, climate projections for increased intensity and duration of heavy rainfall should be considered as a significant future threat to cause more frequent and extreme landslides. Projected increases in precipitation are found in the Flood chapter.

Wildfires are also a factor in increasing the risk and severity of landslides, and are another hazard significantly impacted by climate change. Wildfire burn areas impact soil cohesion and water absorption for many years. Projected increases in burned areas are found in the Wildfire and Wildfire Smoke chapter.

3.3.1 Landslide Impacts, Location and Extent

The highest density of recorded landslides in Multnomah County has been in the Portland West Hills, where slides have occurred on both sides of the ridgeline as well as in canyons within the range. That susceptibility exists with less intensity in the northwest corner of the county, along roads in unincorporated Multnomah County.

A large number of landslides in the inventory have also occurred on the north-facing slope of the Columbia River Gorge from around the Corbett community to the county's eastern boundary with Hood River County. Other areas with significant slide history in this planning area are along the Historic Columbia River Highway on the Sandy River in Troutdale and unincorporated Multnomah County, and at Highway 30 and Newberry Road in western unincorporated Multnomah County.

The historical points shown below are records from a 150-year period and are primarily shallow landslide events.

An interactive version of this map can be found here (Landslide Inventory – Historic Landslide Records (points)

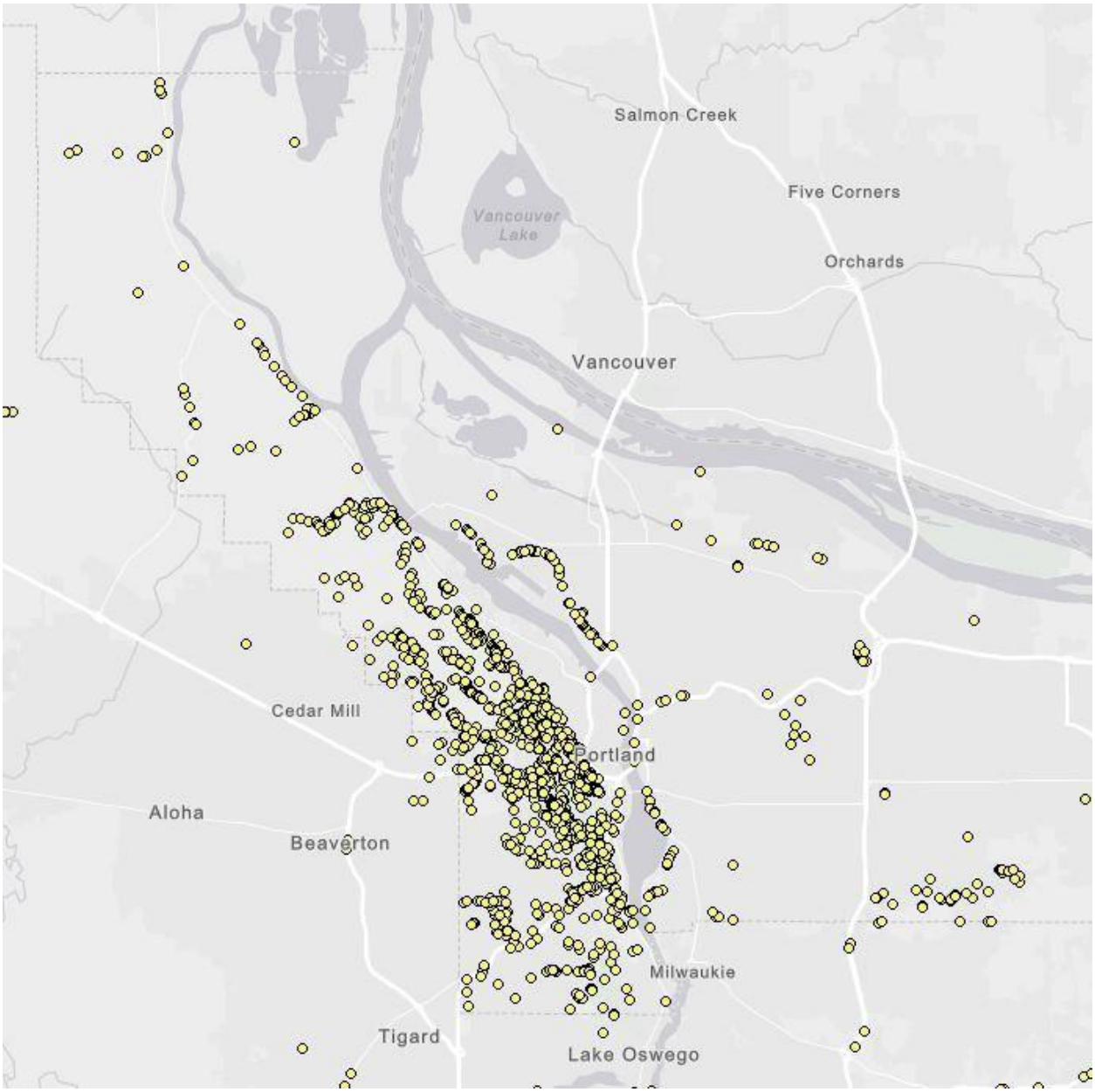

Figure 66 - Map showing locations of landslides over the last 150 years in Western and Central Multnomah County. Map from DOGAMI SLIDO site.

An interactive version of this map can be found here (Landslide Inventory – Historic Landslide Records (points)

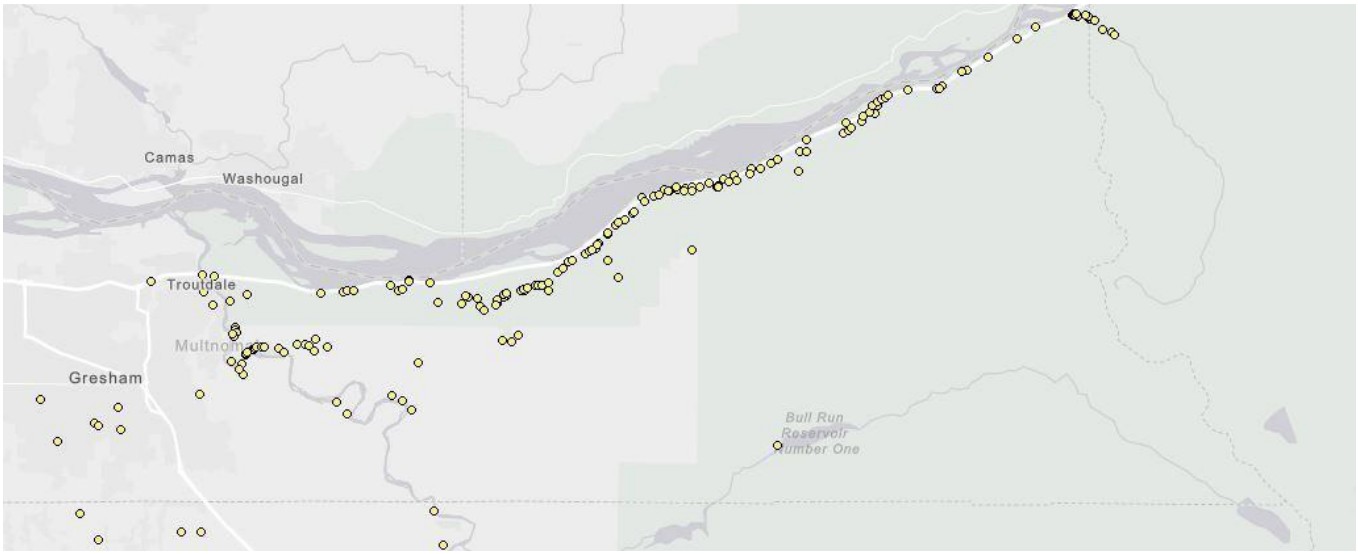

Figure 67 - Map showing locations of landslides over the last 150 years in Eastern Multnomah County. Map from DOGAMI SLIDO site.

Through the use of LIDAR, geologists can also see evidence in ground formations where deep landslides have previously occurred, even from thousands of years ago. Areas shown to have deep landslide deposits from past slides are the areas at the highest risk of future deep landslides. The largest areas of these landslide deposits are in the northwestern most corner of the county, the Columbia River Gorge, and steep slopes above the Sandy River.

[An interactive version of this map can be found here (Landslide Inventory – Deposits)]

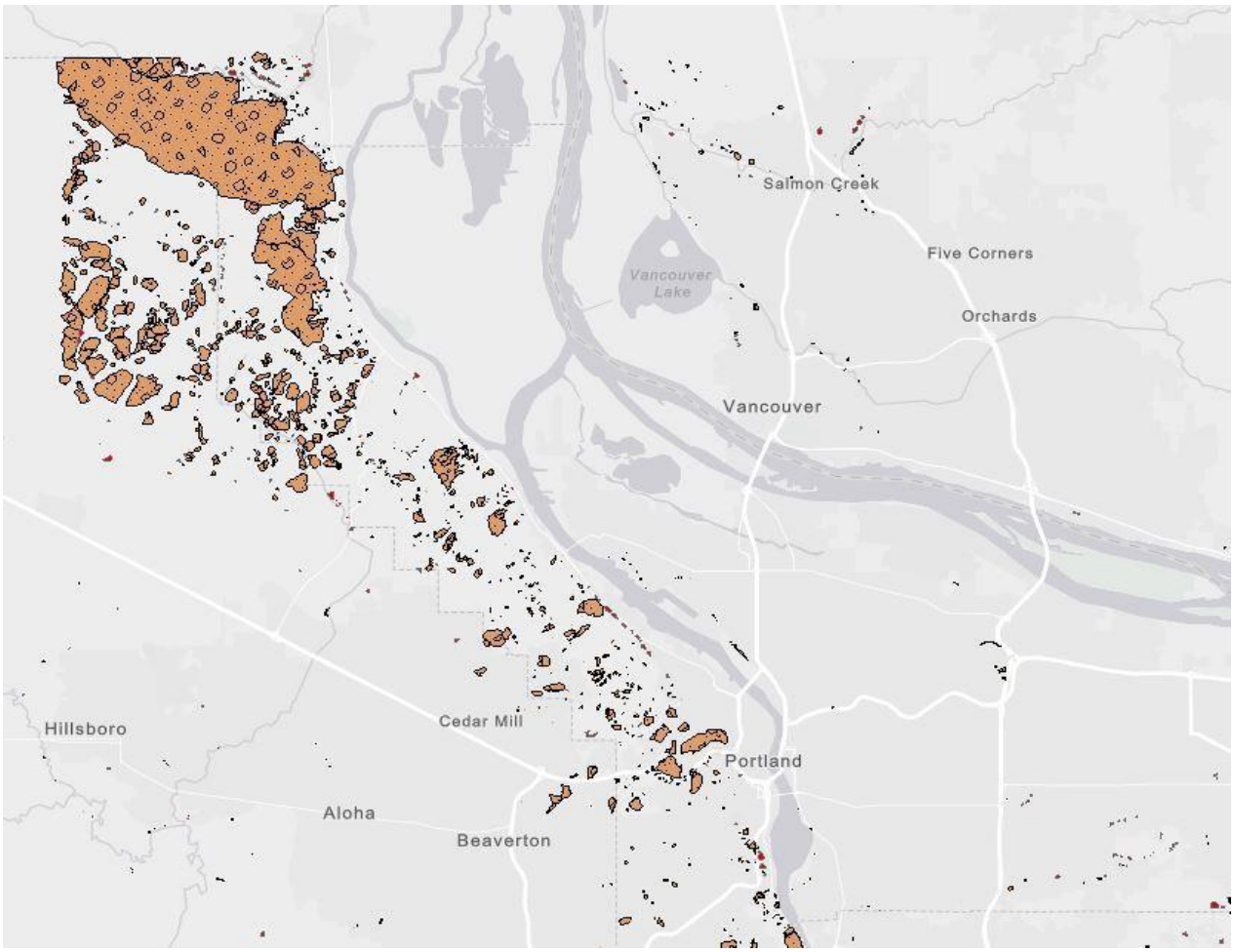

Figure 68 - Map showing locations of historic deep landslide deposits in Western and Central Multnomah County. DOGAMI SLIDO Map

[An interactive version of this map can be found here (Landslide Inventory – Deposits)]

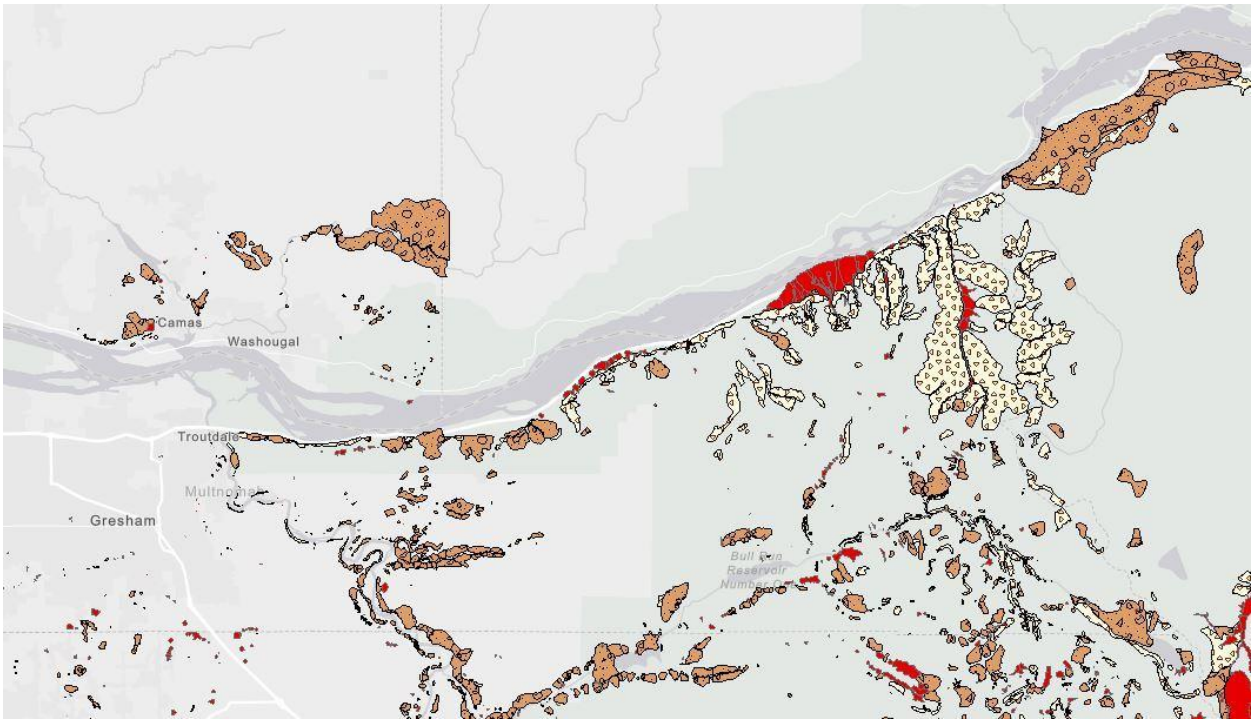

Figure 69 - Map showing historic deep landslide deposits in Eastern Multnomah County. The red areas are alluvial fans, where debris spreads out at the confluence with rivers, lakes and streams. The lightest colored areas are Talus-Colluvium deposits, which are rocky. DOGAMI SLIDO map

Combining this geological data with recent landslide records gives the most complete picture of the extent of overall landslide risk in the County. Many parts of the county have no historical record of landslides nor show evidence of historic landslide deposits. These areas may still have potential for shallow landslides, because of their soil types and slopes. Those additional areas can be seen in the overall susceptibility mapping, shown later in this section.

The following tables show the portion of susceptibility each community in this plan has across the three identified risk levels. This analysis gives an idea of which planning areas are most at risk from landslide. The total percentage includes the entirety of each area, so areas with low susceptibility are not predicted to be subject to landslide.

The area served called the Airport Neighborhood is defined as such under City of Portland Risk Reporting Areas. There is no analysis of areas within the boundaries of the Port of Portland or the Columbia Corridor Levee Districts, but the Airport neighborhood, and other low-lying areas such as the Cities of Wood Village and Fairview, can be used to estimate vulnerability.

Another limitation of this analysis is that it only includes locations in the Central and Western portion of unincorporated Multnomah County. Areas in Eastern Multnomah County have very high susceptibility to both shallow and deep landslides. Even without including that high-risk area, Unincorporated Multnomah County has, by far, the highest percentage of area in both shallow and deep high-risk zones.

In developing landslide risk studies, DOGAMI uses a classification of low, medium and high susceptibility to both shallow and deep landslides.
For shallow landslides, this risk classification is based on:

- Historical landslide inventory data points
- Measurable slope stability characteristics

The complex analysis of slope stability breaks locations into values of 'considered stable' (low), 'considered potentially unstable' (medium) and 'considered potentially unstable or considered unstable' (high)[57].

Classification of deep landslides is based on:

- Historical geological evidence of landslide (observable deposits)
- The type of rock formation or soil classification at a location
- Areas where different rock formations come in contact and a weaker layer supports a heavier layer
- The angle of the slope
- Where the direction of the potential movement matches the direction of previous landslides

Table 30 – Shallow Landslide Risk by Percentage of Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Planning Area	Percentage of Area by Risk Zone		
	Low	Moderate	High
Airport	92%	7%	2%
Fairview	74%	20%	6%
Gresham	70%	19%	11%
Troutdale	71%	20%	9%
Wood Village	77%	18%	5%
Unincorporated Multnomah County (West/Central)	56%	22%	22%

[57] Repetition of 'considered potentially unstable' is due to where breaks were made in the categorical scale. The high risk locations include areas at higher risk than medium locations, but still not with severe enough risk to be 'considered unstable'.

An interactive version of this map can be found here (Landslide Susceptibility – Susceptibility to Shallow Landslides)

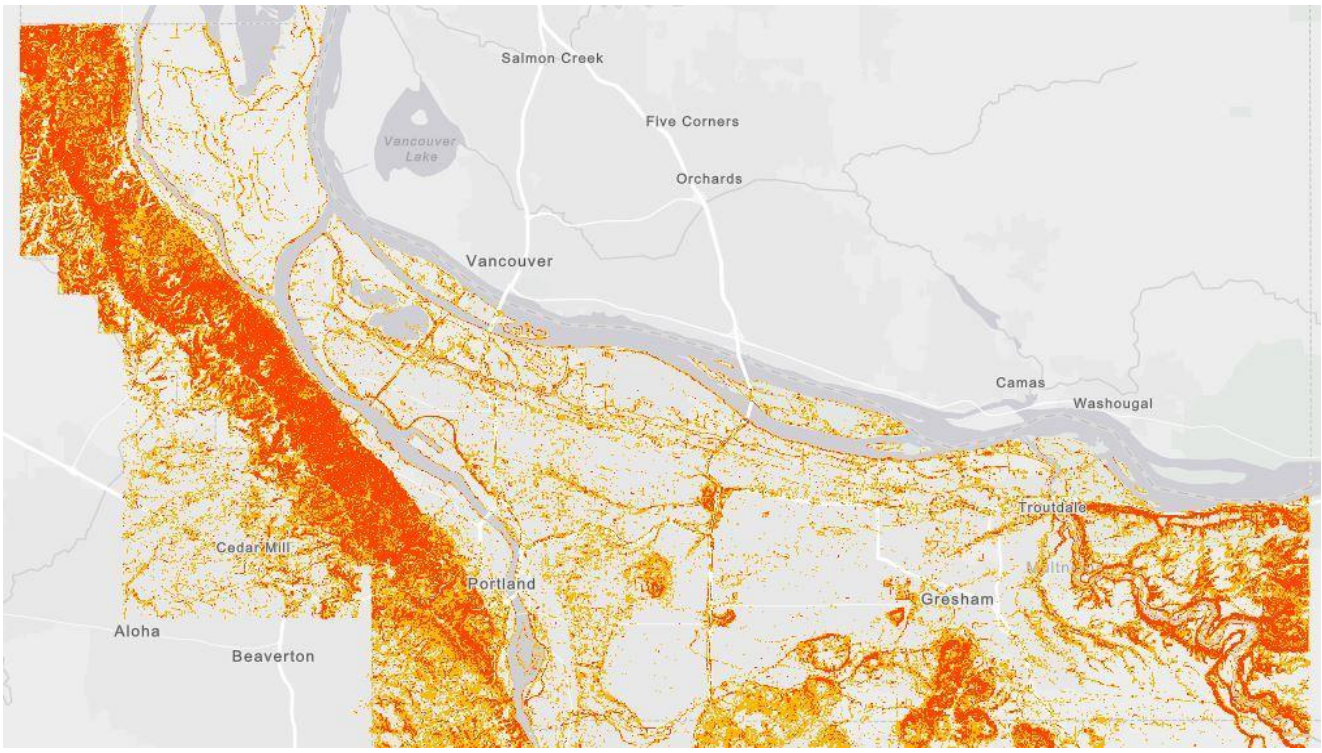

Figure 70 - Map showing location of shallow landslide risk across Western and Central Multnomah County. Dark orange indicates high susceptibility, orange is moderate susceptibility and light orange is low susceptibility. Areas with no color were determined to have no shallow landslide risk. Map DOGAMI SLIDO site.

Table 31 – Deep Landslide Risk by Percentage of Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Planning Area	Percentage by Zone		
	Low	Moderate	High
Airport	100%	0%	0%
Fairview	100%	0%	0%
Gresham	95%	4.5%	0.5%
Troutdale	96%	2.5%	1.5%
Wood Village	100%	0%	0%
Unincorporated Multnomah County (West/Central)	65%	21%	14%

An interactive version of this map can be found here (Landslide Susceptibility – Susceptibility to Deep Landslides)

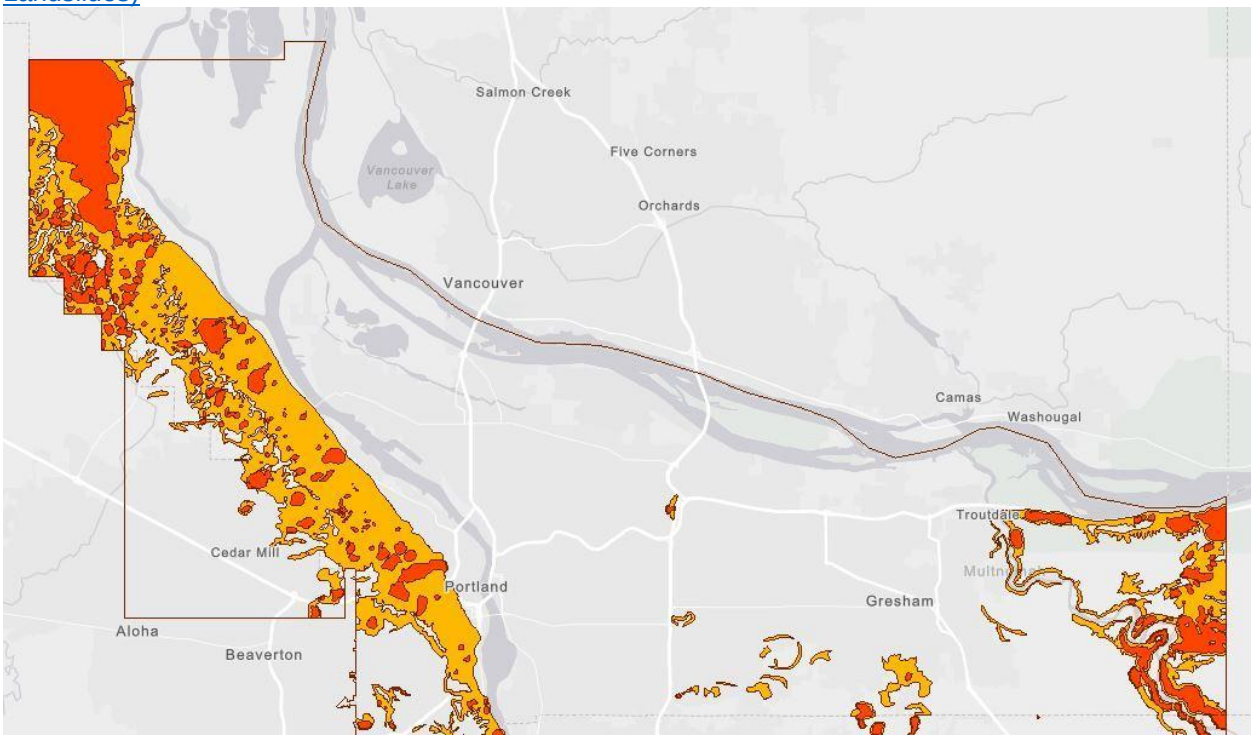

Figure 71 - - Map showing location of deep landslide risk across Western and Central Multnomah County. Red indicates high susceptibility and orange is moderate susceptibility. Areas with no color have low deep shallow landslide risk. Map DOGAMI SLIDO site.

Landslides Triggered by Earthquake

A large earthquake will also trigger landslides. These landslides will most likely occur in the same areas already identified as prone to landslides. If the earthquake is big enough, many landslides will occur at once, reducing the effectiveness of evacuation and response. Landslide susceptibility maps have been considered when identifying updated regional emergency transportation routes.

3.3.2 Landslide Probability and History

Landslides tend to occur in the same places repeatedly over time, where geological characteristics make soils fundamentally more prone to movement. Landslides are often triggered by external rain and snow or seismic events. This hazard can also be made worse by development impacts that add water to a slide area, reduce vegetation, and change slope characteristics by removing or altering soil. It is possible that many years may go by between deep or shallow landslide events in a single location, and periods of calm may suddenly end by rapid accumulations of continuing or new landslides.

DOGAMI's accumulation of historical landslide occurrences in the City of Portland over the last 150 years indicates an average of eight to nine major landslides per year. However, the real expected rate of landslides are much more clustered around storm events and, more rarely, large-scale geological events like earthquakes and volcanoes. 891 of the 1,700 (about 52%) landslide records in the inventory occurred during the winter of 1996, in a single extreme rain and flood event.

This predictability creates a method for establishing risk that can combine existing geological characteristics with historical deposits to provide an effective accounting of all locations with likelihood of landslide. Although these areas of susceptibility can be determined, it remains difficult to pinpoint exactly where or when a landslide will occur, so mitigation strategies are most likely to be effective when they limit development in high-hazard areas and prevent the changing of stormwater runoff patterns.

Areas with any evidence of previous deep slides were classified as high risk for future deep slides. The other factors were used to group areas into moderate or low risk in areas without evidence of previous deep slides.

History

Landslides have occurred for millennia in this region and are a natural part of long-term geological processes in the region. A huge landslide occurred on the Washington side of the Columbia River Gorge over 500 years ago near where the City of Cascade Locks lies now in Hood River County. The Bonneville Dam in Eastern Multnomah County sits within the location of the slide.

The Bonneville Landslide was so large, it dammed the Columbia River, forming a temporary lake, and covered an area of six square miles with slide deposits while overlapping three other previous landslide deposits. It is unknown if deaths were caused by this slide, but it profoundly altered the landscape, creating a miles-long stretch of rapids when the river flow was naturally restored and causing the formation of sandy beaches downstream[58].

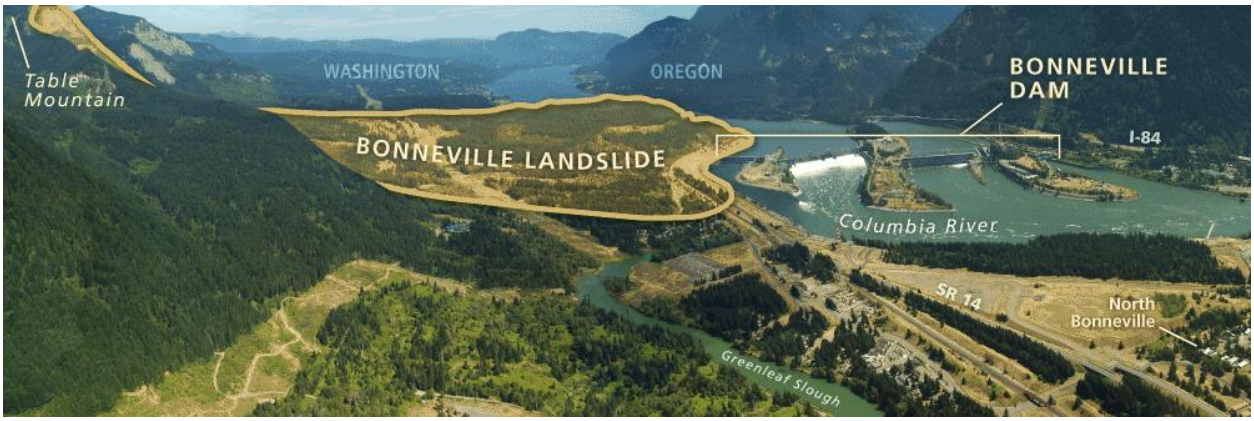

Figure 72 - Columbia River Gorge photo overlaid with an outline of the Bonneville Landslide. Image by Dan Coe, Washington Geological Survey/Washington Department of Natural Resources.

[58] Landslide blocks the Columbia River in about 1450, Washington State Department of Archaeology and Historic Preservation, David Wilma, June 2006

The March 2014 Oso Landslide in northern Washington was a catastrophic example of the threat of deep landslides when development occurs in locations below areas with landslide characteristics and evidence of previous deep slides. The slide killed 43 people, destroyed about 40 structures and buried about a mile of state highway. The slide occurred during a period of extreme rainfall (150-200 percent of normal) when the ground was already saturated. As with the Bonneville Landslide, the sheer amount of debris – about 19 million tons – dammed the local river, and created a temporary lake that flooded homes upstream. Research after the slide revealed evidence of similar past slides ranging from 500-6,000 years old[59].

Figure 73 - 2014 Oso Landslide photo. Photo Jonathan Godt, US Geological Survey

Table 32 – Landslide History of Multnomah County (Federally Declared Disasters Shaded)

Date	Location	Description
Feb. 1918	Dodson-Warrendale, Oregon	Massive debris flow that initiated in canyon east of St. Peters Dome and flowed northward; covered the highway in 10–12 feet of debris. Estimated 500,000 to 1 million cubic yards of material deposited.
Dec. 1964	Statewide	DR-184. Heavy rains and flooding, with landslides, on December 24, 1964.
Mar. 1972	Near Portland, Oregon	Mud and rockslide on I-5; three motorists injured.
1964, 1972, and 1975	Columbia Gorge, Oregon	Flooding and debris flow events described in a report as coming from a verbal source for the noted years, but no supporting documents.

[59] Oso Landslide – Five Years Later, US Geological Survey, March 20, 2019

Date	Location	Description
Oct. 1984	I-84 near Cascade Locks, Oregon	Rockslide; fatalities: two children; cost of stabilizing the slide area: $4 million.
Dec. 1987	John B. Yeon State Park	A debris flow event removed a footbridge over McCord Creek.
Sep. 1990	Near Troutdale, Oregon	Landslide injured four highway workers.
Feb. 1996	Dodson-Warrendale, Portland Metro area, Oregon	DR-1099. Heavy rains and rapidly melting snow contributed to thousands of landslides and debris flows across the state; many occurred on clear-cuts that damaged logging roads; I-84 closed at Dodson-Warrendale; 700 landslides in the Portland metro area.
Apr. 1997	I-84 at Milepost 35	A debris flow event on April 20, 1997, covered both lanes of eastbound I-84 for approximately nine hours.
Jan.- Feb. 1999	Northwest Oregon	Widespread flooding on smaller rivers and streams; numerous landslides and mudslides. Historic Columbia River Highway east of the Sandy River Bridge covered with slides coming from the cliffs above.
Nov. 2001	I-84 near Milepost 35	Multiple debris flows on November 28, 2001; they occurred in the drainage basin after five days of heavy rainfall. These flows originated in the steep cliffs south of the drainage basin. Approximately 200,000 cubic yards of debris was deposited.
Dec. 2003-Jan. 2004	Statewide	DR-1510. Winter storms with landslides. Much of the Portland area shut down.
May 2006	Statewide	DR-1632. Statewide impacts from storms, floods, landslides and mudslides.
Dec. 2007-Jan. 2008	Western Oregon	DR-1824. Severe winter storms, record and near-record snow, landslides and mudslides.
Jan. 2011	Statewide	DR-1956. Severe winter storm, flooding, mudslides, landslides and debris flows.
Jun. 2014	Historic Columbia River Highway	A landslide closed the Historic Columbia River Highway just west of the Stark Street bridge. ODOT estimated the slide to be about 1,000 cubic yards of rock.
Dec. 2015	Western Oregon	DR-4258. Severe winter storms, straight-line winds, flooding, landslides and mudslides.
Jan. 2021	Multnomah County	Long-term heavy rains caused a fatal landslide in a burned over area in Dodson, in unincorporated Multnomah County.

3.3.3 Landslide Vulnerability

Landslides can move very fast, impacting people and property in many ways and posing risk to life safety. Landslides can block and damage roadways as they dump debris on roadways or as roadways themselves slide downhill. Even ground displacements of a few inches can result in pipe failures and building or road damages.

Less common larger landslides can affect several buildings and homes, or entire neighborhoods; major roads or highways, including bridges, overpasses and viaducts; or major utility lines. Large landslides can have significant economic impact, in the range of tens of millions of dollars. Occupants of buildings or vehicles may be injured or killed by landslides of even small size.

DOGAMI's analysis showed that in the Western and Central portions of Multnomah County, 6,700 people and $1.65 billion in land and buildings are located on existing landslides. Many historical landslide points are located on public lands where there may be less infrastructure, but would threaten recreational users and natural resources.

The tables below show the exposure to high-risk shallow and deep landslide zones. The study shows the number of people, structures, critical facilities, and roads potentially impacted in each area. The study uses a 'worst-case' scenario, considering a time with maximum ground saturation, so these estimates are intended to be extreme. The study does not quantify the severity of damage in each location, only identifying the total amount of community assets in these locations.

Table 33– Vulnerability to Shallow Landslide by Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Jurisdiction	Population in High Risk Zone	Percentage of Population in High Risk Zone	Structures in High Risk Zone	Total Building Value in High Risk Zone (millions)
Fairview	171	1.94%	236	S6.75
Gresham	2,572	2.44%	4,955	$115.15
Troutdale	489	3.07%	596	$8.87
Wood Village	93	2.41%	120	$1.33
Unincorporated Multnomah County (West/Central)	1,564	10.00%	4,799	$160.71

Table 34– Critical Facility and Infrastructure Vulnerability to Shallow Landslide by Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Jurisdiction	Roads in High Risk Zone (miles)	Percentage of Roads in High Risk Zone	Critical Buildings in High Risk Zone
Fairview	0.21	0.47%	10
Gresham	1.28	0.40%	47
Troutdale	0.47	0.69%	6
Wood Village	0.12	0.01%	0
Unincorporated Multnomah County (West/Central)	11.96	74.53%	19

Table 35– Vulnerability to Deep Landslide by Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Jurisdiction	Population in High Risk Zone	Percentage of Population in High Risk Zone	Structures in High Risk Zone	Total Building Value in High Risk Zone (millions)
Fairview	0	0%	0	$0
Gresham	14	0.01%	6	$1.40
Troutdale	42	0.27%	29	$1.46
Wood Village	0	0%	0	$0
Unincorporated Multnomah County (West/Central)	1,117	28.82%	858	$1075.02

Table 36– Critical Facility and Infrastructure Vulnerability to Shallow Landslide by Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Jurisdiction	Roads in High Risk Zone (miles)	Percentage of Roads in High Risk Zone	Critical Buildings in High Risk Zone
Fairview	0	0%	0
Gresham	0.31	0.10%	0
Troutdale	1.19	1.75%	0
Wood Village	0%	0%	0
Unincorporated Multnomah County (West/Central)	25.93	7.65%	0

Infrastructure Impacts

The area not included in the vulnerability study in Eastern Multnomah County has high potential for structural damage, loss of life, and infrastructure damage. Interstate Highway 84 is a route connecting the Portland Metropolitan Area to communities in the Columbia River Gorge and Northeastern Oregon. Deep landslide deposits shown in the Eastern Multnomah County inventory would severely impact the highway and alternate routes in numerous locations. The area is also a key railroad corridor.

Impacts to US Highway 30 were included in the study, but should still be emphasized as a highly vulnerable and critical route, as a key connection from the Portland Metropolitan Area to Columbia River communities to the west.

The Bull Run Watershed lies in an area with geological evidence of previous landslides and has steep slopes that could be the sites of future slides. A landslide into the reservoir system could damage roads and equipment and introduce large amounts of sediment into the water supply that would temporarily restrict its use and harm habitat values. Aquifer wells in the northern part of the county are in locations with little susceptibility to large landslides, but surface infrastructure and pipes could be damaged by smaller slides.

Landslide damage to power poles could cause long-term localized power outages that could endanger those with medical needs

3.4 Severe Weather (Extreme Heat, Winter Storm, Windstorm, Drought)

No hazard has increased more in visibility and concern since the 2017 version of this plan than climate-based weather events. Although many participating jurisdictions in the 2017 plan already had rated Severe Weather as of their highest risk, events over the last five years have increased the public perception of risk to extreme climate, and strategies to implement and communicate mitigation and preparation strategies have become more prevalent and visible.

Extreme heat and cold events were the two natural disasters (as defined in this plan) that caused the most loss of life in Multnomah County since the 2017 plan, and climate change projections are increasing concern that these events will become even more frequent and extreme. Weather events are also significant drivers of disparate disaster outcomes to local communities, with those unable to access cool or warm spaces most at risk due to lack of shelter, living in non-climate controlled spaces, or having to work outdoors. All of the jurisdictions and districts participating in this plan have been impacted by severe weather.

The 2017 NHMP collected a number of weather hazards into a single Severe Weather chapter as a loosely defined set of eight severe weather types, including heavy rain, hail, and lightning. For this update, the chapter has been more formally separated across four hazards, with each given consideration regarding their extent, probability and vulnerabilities created. The four hazards are **extreme heat**, **winter storm**, **windstorm** and **drought**. This approach better aligns Multnomah County's NHMP with the weather hazards defined in the 2020 Oregon State Hazard Mitigation Plan[60], leaving only Coastal Hazards as those defined in the Oregon NHMP and not part of this plan. Winter rain is no longer included here, as risk elements of that hazard have been described in the flood and landslide chapters.

Some jurisdictions or districts in this plan rated their risk of severe weather as a single combined hazard, while others have broken out one or more of the weather types separately, reflecting the differing ways different mitigation partners assess risk.

All of the participating jurisdictions/districts in this plan are vulnerable to severe weather impacts. Variations of vulnerability are most based on impacts to populations with existing health risks to climate effects and to underserved communities in the highest hazard living conditions. Some climate hazard impacts are magnified by effects of built environments and natural geography or topography.

Five-Year Report, 2017-2022

- *Events*

2021 Heat Dome

While hot summers were fairly commonplace over the last five years, the Heat Dome event of June 26-28, 2021 stands alone as a historic catastrophic disaster, killing 69 people in Multnomah County from direct heat illness. This is believed to be the single largest loss of life in

[60] The Oregon State Hazard Mitigation Plan is different in that it breaks these hazards into separate chapters.

a natural disaster (as defined in this plan) in Multnomah County in over 100 years. Across Oregon, at least 107 people died from direct heat-related causes.

For three consecutive days, recorded high temperatures in Portland broke the all-time record of 107 degrees Fahrenheit. On the hottest day, June 28th, the recorded high was 116 degrees, nine degrees hotter than had ever been recorded in Multnomah County. The unprecedented heat wave was particularly dangerous because it happened early in the summer before people's bodies had fully acclimated to hotter weather. Nights were also extremely warm. The 76-degree low temperature on June 28 was higher than the average high temperature for June in Portland. These warm nights prevented living spaces from gaining relief from any overnight cooling effects before temperatures spiked again during the day.

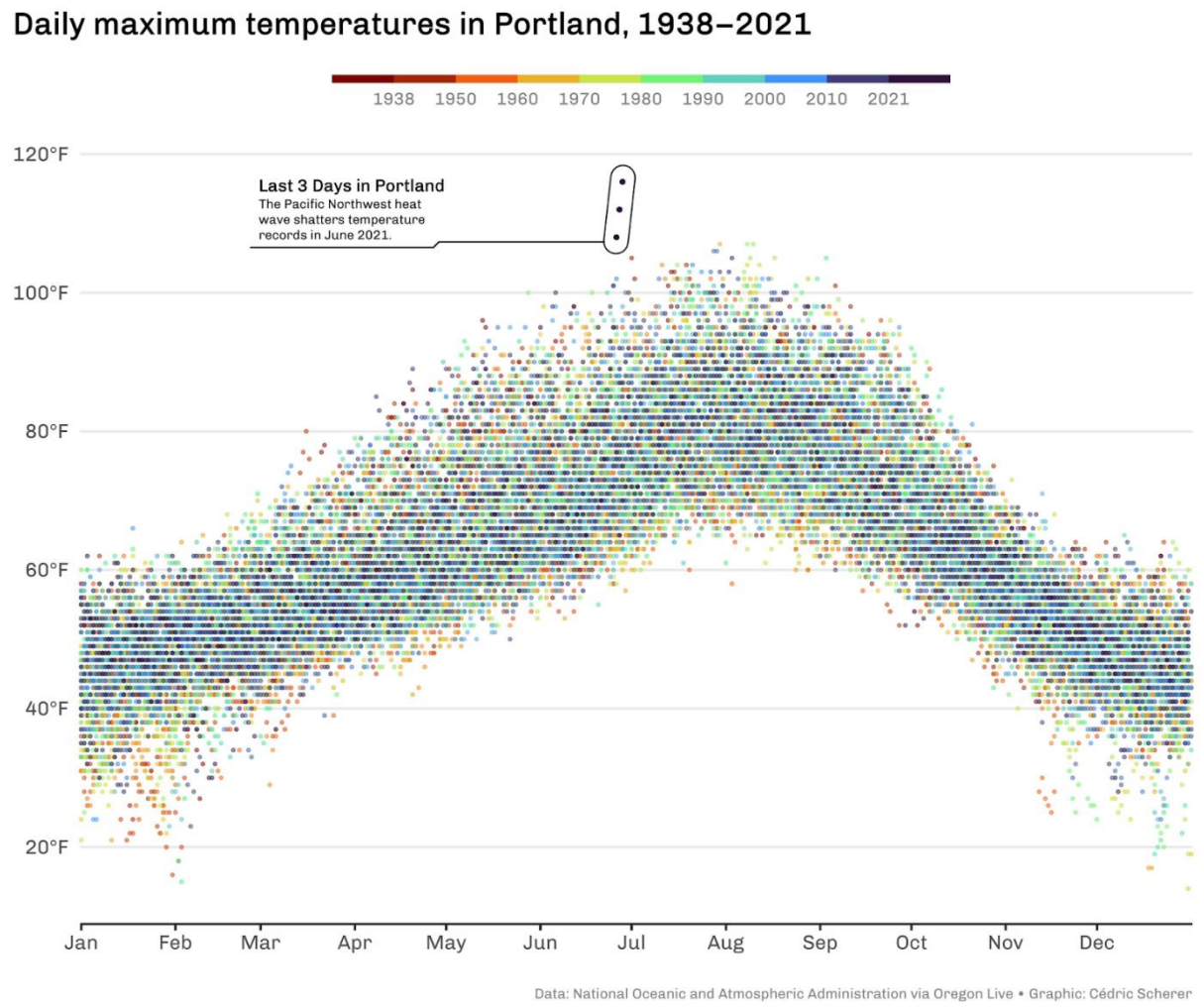

Figure 74 - Graph showing the extreme three-day event of June 2021 as compared to the previous 83 years of recorded temperature data in the City of Portland. Graphic by Cedric Scherer

The climate phenomenon that caused the Heat Dome is believed to have been an anticyclone[61], a system that rotates slowly around a center of high pressure. This process blocks other weather systems from pushing in and locks in heat by preventing it from escaping through the upper atmosphere.

This unusual event may have been made more likely because of climate-change driven weather effects. Although it has been preliminarily described as a 1,000-10,000 year event (0.1%-0.01% annual chance), it is theorized that similar events may become much more common if climate change scenarios continue on their current path[62].

Multnomah County published a Preliminary Review on Excessive Heat Deaths from the June event in July 2021 to recount the event and memorialize and tell the stories of those who died. Preliminary findings and action steps were published August 2021 and a final report of the summer of 2021 was published in June 2022.

Another heat spell in July 2022 set a new record for consecutive days over 95 degrees, and led to another five recorded hyperthermia deaths.

- *Notable Winter Storms*

Measurable snowfall occurred every year in Multnomah County between 2017 and 2022. Only the most notable events are listed here. Other hypothermia deaths occurred during this time period, but were outside of winter storms and occurred during more typical winter conditions. Impacts from the 2022-23 winter are not detailed, but included, in two separate events, the coldest low temperature since at least 2017, and the second largest calendar day snowfall in Portland's recorded history. Impacts from these events are still being gathered.

2017

The 2016-2017 winter season was the most deadly, with five deaths attributed to hypothermia during a long period of cold and snow. January 2017 was the coldest January in Portland in 32 years and the entire month averaged only 33.5 degrees. Eight to sixteen inches of snow fell in locations across Multnomah County over January 10-11[63], the local largest snowfall event in 20 years. Areas at higher elevations saw as much as two inches of snow per hour at the peak[64].

Multnomah County was hit by five separate winter storms over five weeks, from early December until mid-January and cold, wet conditions persisted into February. The long duration of the cold and wet weather was particularly harmful to those living without shelter. All five residents who died from hypothermia were unhoused.

[61] The 2021 Pacific Northwest Heat Wave and Associated Blocking: Meteorology and the Role of an Upstream Cyclone as a Diabatic Source of Wave Activity, Geophysical Research Letters (AGU), Emily Neal, Clare Huang, Noboru Nakamura, April 18, 2022

[62] Western North American extreme heat virtually impossible without human-caused climate change, World Weather Attribution, July 7, 2021

[63] National Weather Service, Portland 2017 Weather Recap

[64] KOIN 6, Portland snow storm one for the history books, January 11, 2017, Chelsea Wicks

Interstate 84 was closed multiple times between Troutdale and Hood River because of snow, ice and landslides and the Portland International Airport had a number of canceled flights in January.

2021

Freezing rain and snow fell on February 11-12, causing downed power lines and the closure of Interstate 84 between Troutdale and Hood River. This was the single largest power outage event in Oregon history, although effects in Multnomah County were not as severe as in neighboring areas. Clackamas County suffered much longer power outages and the death of four people from carbon monoxide poisoning while using heaters or cooking equipment inside recreational vehicles.

Another death in Multnomah County from hypothermia occurred during a cold, snowy snap in late December 2021. This death was of an older, housed adult.

- *High Winds and Tornadoes*

No extremely destructive windstorms occurred in this time period. However, unusually strong easterly winds fanned the explosion of wildfire on Labor Day 2020, leading to one of Oregon's worst ever fire seasons and catastrophic air quality in Multnomah County. Windstorm damage itself was limited to periodic minor events.

Tornadoes occurred in Multnomah County in 2018 and 2019 and additional tornadoes touched down in the Portland Metropolitan region outside of Multnomah County in 2020. These tornadoes were short-lived and never exceeded the level of F0, considered a 'weak' tornado with wind speeds less than 85 miles per hour. Nonetheless, these were notable events as tornadoes have been historically rare. The last tornado in Multnomah County had occurred in 2011 and the July 2019 tornado was the first July tornado in Oregon since 1937.

Increases in tornadoes may be related to climate change, and to improved weather radar, local weather reporting and modern documentation standards. Larger F3 tornadoes have happened in Oregon, including a fatal Portland-area tornado in 1972. Although tornadoes do not have a high level of local risk awareness, monitoring of scientific work should continue to refine understandings of their probability and risk.

- *Statewide Drought*

The effects of drought in Multnomah County were seen most in the creation of dangerous wildfire conditions, including the Eagle Creek Fire in 2017 and the 2020 statewide wildfire disaster which caused hazardous air quality in Multnomah County.

Statewide drought peaked in 2021, and Multnomah County was considered to have serious drought conditions. However, most of northwestern Oregon remained the only part of the state not under a Governor's disaster declaration. In the summer of 2021, the Columbia and Willamette Rivers reached their lowest levels in five years.

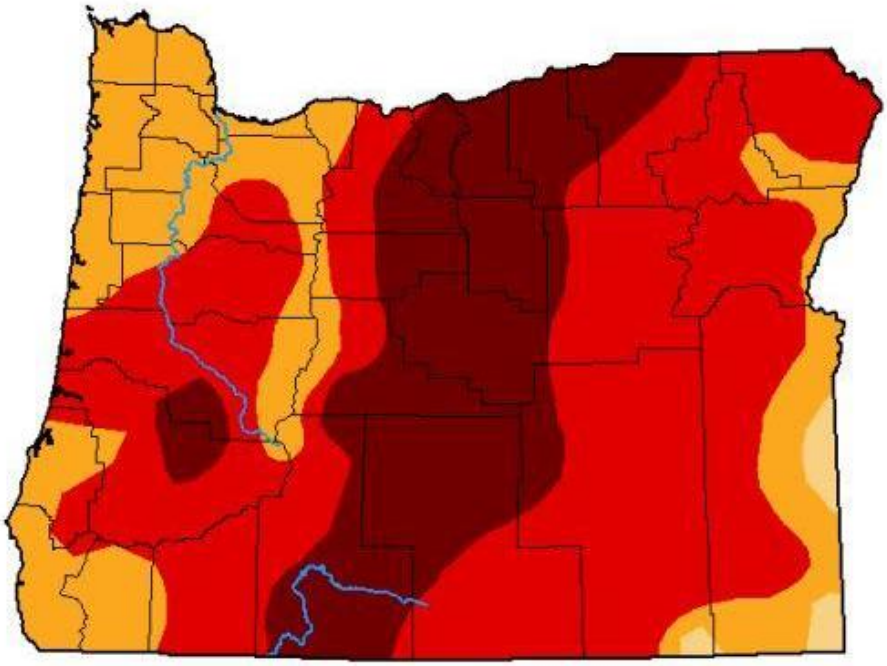

Figure 75 - Map showing drought conditions in Oregon on August 31, 2021. Colors in Western and Central Oregon range from severe to exceptional drought levels. Map from United States Drought Monitor

Because almost all water districts in Multnomah County receive their drinking water from groundwater instead of surface waters, impacts to water systems were limited. Other impacts have been to riverine ecosystems and recreational river uses.

- *Data and Risk Analysis*

The Regional Climate and Health Monitoring Report for the Tri-County Area (Multnomah, Clackamas, Washington) was released in 2019 and updated in Fall 2021. The report identifies climate and health indicators for a number of hazards, including extreme weather events, and provides strategies to address climate change impacts to public health.

A risk reduction report and workshop was jointly developed by the United States Environmental Protection Agency (EPA), Metro, and the Regional Disaster Preparedness Organization (RDPO) in April 2021. The report focused on extreme heat and wildfire smoke because of their effects on public health, inequitable impacts, and increased risk caused by climate change. The report outlined risk and vulnerability to heat, and provided a selection of potential mitigation strategies to reduce impacts from future events.

- *Climate Change Impact*

Extreme heat and drought are two of the natural hazards most likely to be worsened by climate change. Rising temperatures are the primary indicator of concern and more extreme and longer summer heat events and changing precipitation patterns are drivers of drought.

It is believed that 82% of increases in the frequency of hot summers from 2000 to 2010 can be attributed to climate change[65]. Each year in Oregon between 2000 and 2019, except 2011, was warmer than the average annual temperature between 1900 and 1999, and 2015 was the warmest year on record in Oregon between 1895 and 2019. Temperatures are projected to continue to increase in all seasons, but most of all in the summer, leading to increased frequency of dangerous heat events. Under accepted models where climate change continues without major policy intervention, Oregon is projected to have summers six degrees warmer on average by 2050 and ten degrees warmer on average by 2080.

The number of days above 90 degrees, when heat effects begin to become acute, has increased by 9 days since 1940. It is projected an additional 15 days per year will reach a heat index of 90 degrees by the middle of this century.

The atmospheric conditions related to increased heat may make the greatest increases more likely in Eastern Oregon than Western Oregon, but impacts in Northwestern Oregon will be intensified by the lower proportion of air conditioning and the effects of urban heat islands.

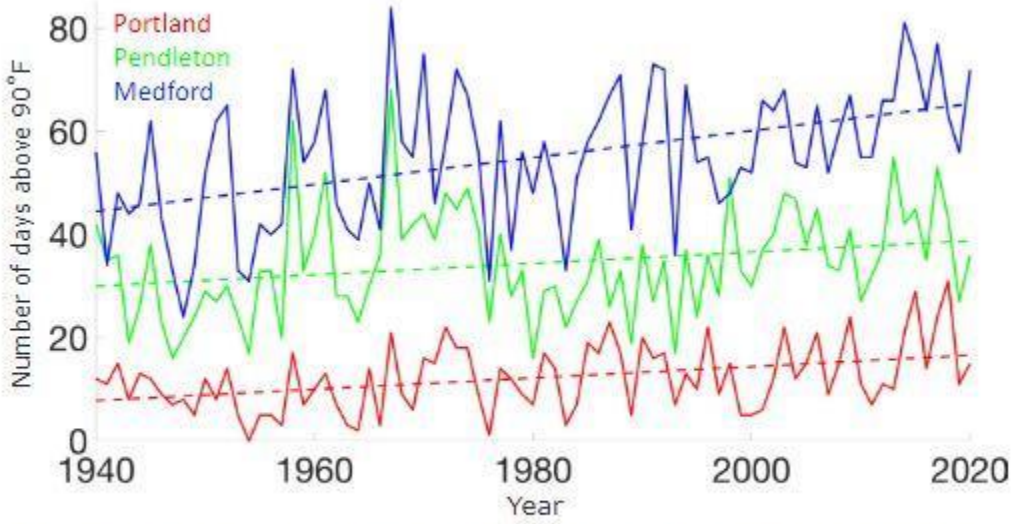

Figure 1. Number of days per year on which the daily high temperature exceeded 90°F at Medford, Pendleton, and Portland. Data source: NOAA National Centers for Environmental Information, www.ncdc.noaa.gov/ghcnd-data-access.

Figure 76 - Graph included in the Fifth Oregon Climate Assessment

Heat deaths across Oregon are projected to increase substantially, as much as 422% if current climate change trends continue. Mitigation efforts, such as increased access to cooling spaces and increasing tree canopies and pavement removal to reduce urban heat island effects, could lower this projection but excess deaths would still be expected.

Oregon has seen persistent, severe drought since 2000. Droughts in Oregon have been caused by a combination of different factors depending on the year: low snowpack, low summer and/or winter precipitation and high winter temperature.

[65] All data in this section from the Fifth Oregon Climate Assessment.

Warmer temperatures will continue to turn more winter snow into rain, and as more sunlight is absorbed by bare ground the effect becomes accelerated and further increases surface air temperatures. Multnomah County is less affected by local snow drought because of local groundwater sources and the huge drainage basins of the largest rivers. Increased risk of wildfire may be the most impactful short-term drought-related consequence for Multnomah County.

Potential impacts of climate change on winter storms are less understood, but there is the possibility that destabilization of weather patterns may maintain or even increase the probabilities of extreme cold, snow and ice events, even as winters on average become warmer and have less snow.

The effect of climate change on wind storms is similarly not well understood, but also may be impacted by increased atmospheric instability, warmer air and increases in wind shear—a phenomenon where wind speeds or wind directions are different within a small area and may contribute to storm activity. No long-term trends in the number of tornadoes have been observed in the United States, but there has been a change in where they are occurring, although there is not enough historical data yet to make conclusions whether this is a permanent effect. The recent small tornadoes that have occurred in Multnomah County do not provide enough data to understand if tornado risk has increased locally.

3.4.1 Severe Weather Impacts, Locations and Extents

Extreme Heat

Variations in high recorded air temperatures do not differ widely across Multnomah County. Temperatures at ground level, however, are highly affected by aspects of the built environment. These effects are most prevalent where there is a high proportion of impervious, reflective surfaces such as roads, roofs and parking lots that absorb and re-emit heat. This effect causes much higher temperatures at these locations and also increases the duration of heat as these surfaces continue to give off heat even as temperatures begin to drop in the evening. Shade from tree canopies lessens this effect, and vegetation absorbs heat instead of reflecting it back into the air[66].

The upward movement of re-emitted heat affects people living in the upper floors of multi-story residential buildings, where temperatures can be as much as 30 degrees hotter than on ground floors[67]. Air temperature differences have been recorded as much as 15 to 20 degrees from locations in Multnomah County with dense tree canopy compared to neighborhoods with large proportions of impervious surfaces and few trees[68].

Mapping that has been done to measure heat island effects is the best way to depict the extent of heat hazard to jurisdictions and districts, because it shows the different intensity the heat has on people in different locations across the county. These locations are often correlated with higher poverty rates, where historical neighborhood disinvestment in urban areas has resulted in fewer street trees and land-use patterns with larger roads and parking lots. Industrial

[66] About Urban Heat Islands, National Integrated Heat Health Information System
[67] Heat mapping Portland: Why do some areas get hotter than others, KGW, Megan Johnson, July 13, 2021
[68] Portland's hot spots: Urban heat islands pose threat to lower-income residents, *Street Roots*, Amanda Waldroupe, September 1, 2016

properties, and other outdoor workplaces such as parking lots, roads, bridges, runways, and roofs also have significant heat island effects.

An interactive version of this map can be found here

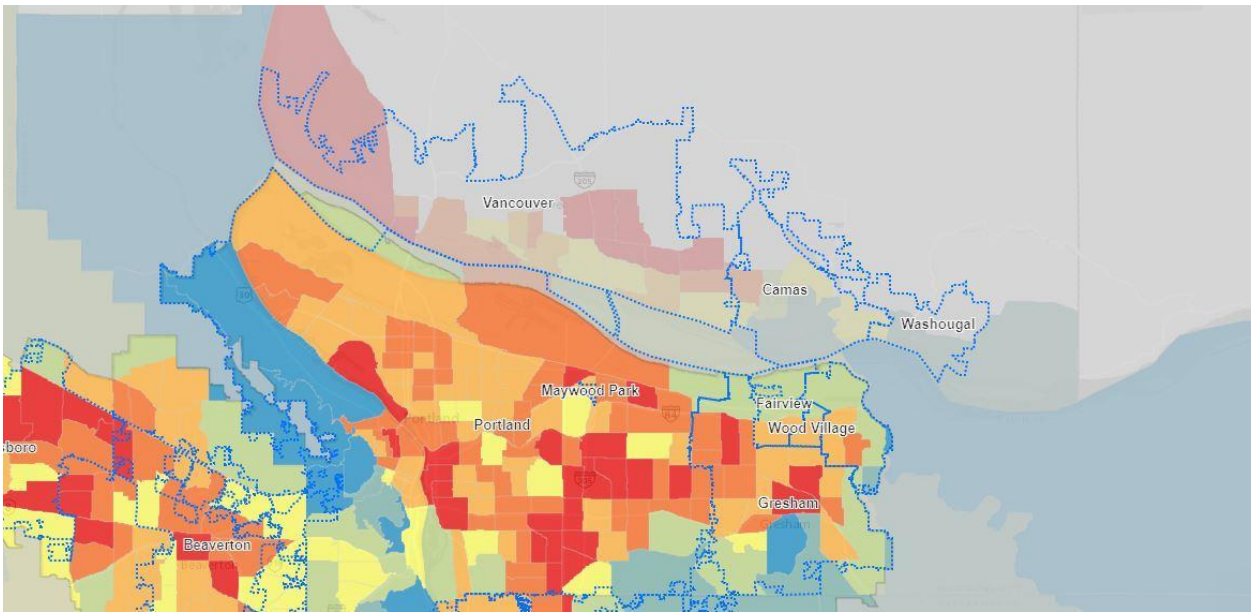

Figure 77 - Heat island effects by census tract. Tracts in red have the largest impact, generally clustered in downtown and east Portland, Gresham, and in industrial locations. More site specific heat island data can be found in jurisdictional chapters. Map - Metro

Winter Storm

Effects from winter storms are typically spread across the entire county when they occur, although higher elevations see much more snow and colder temperatures. Since most winter storm events occur when winds come into the county through the Columbia River Gorge, eastern portions of the county often experience the coldest temperatures. Snow, ice and poor visibility have frequently closed Interstate 84 between Troutdale and Hood River. Roads at higher elevations are also more prone to impact due to higher amounts of snow, or because grades make travel in winter conditions more difficult. The most serious health threats have been to unsheltered residents, wherever they are living.

Windstorm

The Columbia River Gorge is one of the windiest places in the Pacific Northwest, and sustained winds coming through the Gorge into Multnomah County cause wind damage and also strongly influence other climate hazards. The effects of gorge winds are most prominent between December and February. The elevated risks from repeated sustained winds in eastern Multnomah County are reflected in local building codes and resilient infrastructure strategies.

While the Columbia River Gorge provides the most consistent high winds, catastrophic wind events are not limited to this gorge flow. The two most damaging windstorms of the last 50 years in the region were from winds picking up speed as they moved south to north through the Willamette Valley.

Drought

Drought extents are assessed on a countywide or regional level when they occur. Impacts of drought are less based on geography and more on resilience of local water systems to low rain or snow years.

The largest river systems in Multnomah County have huge drainage basins which make them more resilient to regional drought, while other rivers and streams may rely on snow or glacial melt to maintain summer flows, and therefore may have more annual variation that will impact riverine ecosystems and recreational uses.

3.4.2 Severe Weather Probability and History

Table 37 – Severe Weather History of Multnomah County (Federally Declared Disasters Shaded)

Date	Location	Severe Weather Type	Description
Winter 1862, 1866, 1884, 1885, 1890, 1892, 1895	Portland area / Northern Willamette Valley	Snow	Severe winter conditions, especially in the Portland area. Record-breaking snowfalls (especially in 1892).
Mar. 1904	E. Portland	Tornado	"Cyclonic storm" damaged the Lewis and Clark Fairgrounds, several shacks and a large warehouse.
Dec. 1919	Portland area	Snow	Third heaviest snowfall on record. Columbia River froze, closing navigation.
Jan. 1921	Multnomah County	Ice storm	
Nov. 1921	Troutdale	Ice storm	Closed downtown Troutdale.
Winter 1927, 1936, 1937, 1943, 1949	Portland area, W. Oregon	Snow	Heavy snowfall.
Apr. 1931	W. Oregon	Winter storm	Unofficial wind speeds reported at 78 mph. Damaged fruit orchards and timber.
Jan. 1950	Statewide	Snow	Friday the 13th Storm. Heaviest snowfall since 1890. Freezing rain. Deep snow drifts closed all highways west of the Cascades and through the Columbia River Gorge. Roads and schools closed. Downed power lines. Severed communication. Hundreds of thousands of dollars in property damage.
Dec. 1951	W. Oregon	Winter storm	Statewide storm with wind speeds 60 mph in Willamette Valley. Widespread damage to transmission and utility lines. Damaged buildings.
Nov. 1958	Statewide	Winter storm	Every major highway blocked by fallen trees during windstorm. Gusts up to 71 mph.
Mar. 1960	Statewide	Snow	Snowfall amounts were 3-12 inches, depending on location.
Oct. 1962	W. Oregon	Winter storm	1962 Columbus Day Storm. Most severe windstorm for western Oregon due to sustained wind speeds and damage levels. Highest sustained winds, 88 mph, at Portland International Airport. Winds in the Willamette Valley up to 116 mph. Estimated damages $170 million. 84 homes destroyed, 5,000 severely damaged.
Jan. 1969	Statewide	Snow	Record-breaking snowfalls. $3 to $4 million in property damage.
Mar. 1971	W. Oregon	Winter storm	Great damage in the Willamette Valley; homes and power lines destroyed by falling trees.

Date	Location	Severe Weather Type	Description
Apr. 1972	Portland area	Tornado	F3 tornado, the most violent tornado in Oregon's recorded history. About $250,000 damages across the state. About $5 million damages, six deaths, 300 injuries in Vancouver, WA.
Aug. 1978	Near Gresham	Tornado	Small tornado touched ground briefly with some damage to buildings and crops.
Jan. 1980	Statewide	Winter storm	Series of storms bringing snow, ice, wind and freezing rain. Six fatalities.
Jan. 1990	Statewide	Winter storm	Heavy rain with winds greater than 75 mph; significant damage; one death.
Apr. 1991	Near Gresham	Tornado	Small weak tornado touched down. Slight damage.
Nov. 1991	Near Troutdale	Tornado	Small tornado damaged fencing, with minor damage to one building.
Jun. 1995	Gresham	Lightning	$115,000 in damages.
Dec. 1996	Statewide	Winter storm	DR-1160. Severe snow and ice. Up to four to five inches of ice in the Columbia River Gorge. Interstate 84 closed for four days. Hundreds of downed trees and power lines. Widespread power outages in the greater Portland area, including Multnomah County.
Feb. 2002	W. Oregon	Winter storm	DR-1405 Damages $6.14 million. Downed power lines and trees. Buildings damaged. Power outages caused some water supply problems.
Dec. 2003-Jan. 2004	Statewide	Snow and ice	DR-1510. Much of Portland area shut down. Twenty-six counties received assistance from the Federal Emergency Management Agency (FEMA).
Jun. 2005	Gresham	Lightning	$50,000 in damages.
Jan. 2006	Willamette Valley	Windstorm	DR-1632 Winds up to 58 mph caused total of $500,000 in damages over Clackamas, Columbia, Washington, Multnomah, Yamhill, Marion and Polk counties.
Feb. 2006	Multnomah, Clackamas, Washington, and Columbia Counties	Windstorm	Winds caused $167,000 in damages for Multnomah, Clackamas, Washington and Columbia counties; impacts also in Region 1 & 3 for a total of $575,000 in damages.
Jul. 2006	Statewide	Heatwave	Multiple days of temperatures over 100 degrees Fahrenheit.
Dec. 2007-Jan. 2008	W. Oregon	Winter storm	DR-1824. Severe winter storm, record and near-record snow, landslides and mudslides. Gresham received 26 inches of snow.
Jul. 2008	Fairview	Lightning	$2,000 in damages.
Dec. 2009	Statewide	Winter storm	Snow and freezing rain in Salem, and from Portland to Hood River. I-84 closed for 22 hours.
Nov. 2010	Statewide	Winter storm	Snow, freezing rain and ice from Portland to Hood River.
Jan. 2012	Multnomah County	Winter storm	Snow and ice east of Troutdale. I-84 closed for nine hours.
2015	Statewide	Drought	Record low snowpack across the Cascades. All of Oregon received a Federal drought declaration.
Dec 2016-Feb 2017	Statewide	Winter Storm	DR-4328 Seventh coldest January on record in Portland, coastal tornado causes damage in Manzanita, high levels of snow damage in Eastern Oregon, five hypothermia deaths in Multnomah County, major local road and school closures
Jul. 2018	Willamette Valley	Extreme Heat	July had 15 days over 90 degrees in Portland, setting a record.
Oct. 2018	Multnomah County	Tornado	Touched down in North Portland with a peak wind speed of 74 mph.

Date	Location	Severe Weather Type	Description
Jun. 2020	Near Gresham	Tornado	Damage caused in a two-mile swath in Damascus, just outside of Multnomah County
Sept. 2020	Statewide	Windstorm	45-55 mph winds from the east caused wildfire to explode and created catastrophic wildfire smoke covering Multnomah County
Feb. 2021	Statewide	Winter Storm	DR-4599 Freezing rain and snow, disaster declared in nine counties across Oregon. PGE reported 300,000 customers without power from ice damage and falling tree limbs. Interstate 84 closed.
June 2021	Statewide	Extreme Heat	Heat Dome event with Portland's all-time temperature record broken three consecutive days. Highest temperature reached 116 degrees. 69 people in Multnomah County died of hyperthermia, making it one of the worst natural disasters in Multnomah County's history. 107 deaths were reported across Oregon.
Summer 2021	Statewide	Drought	Multnomah County considered to be in severe drought. River levels on the Columbia and Willamette Rivers reached their lowest mark in five years. Fall colors of changing leaves arrived early.
April 2022	Multnomah County	Winter Storm	Two inches of snow fell on April 11-12 at PDX, the latest spring snow ever recorded.
July 2022	Multnomah County	Extreme Heat	Seven consecutive days above 95 degrees for the first time in Portland's recorded history. Five hyperthermia deaths were recorded in Multnomah County.
Dec.2022-Feb. 2023	Portland Metropolitan Area	Winter Storm	December 22 low temperatures were the lowest in five years and combined with gusting east winds to create single-digit wind chills. On February 22, Portland had 10.8 inches of snow, a calendar-day amount only exceeded by an event in 1943. The unexpected snow caused traffic gridlock across the region.

Extreme Heat

The 2021 Heat Dome event has been preliminarily described as a 1,000 year event (0.1 annual chance), but it is also theorized that the conditions that allowed this climate anomaly to form may be more likely as climate change increases ocean and air temperatures.

Weather hot enough to become dangerous is not unusual in Multnomah County, but has commonly been of short duration. Portland has historically averaged one day of 100-degree plus weather per year. 2021 had five total days over 100 degrees, tying 1941 and 1977 as the most on record. The number of days with high temperatures between 95 and 99 has increased significantly between 2010 and 2019 compared to any other decade in the last 80 years, so longer duration heat events are becoming more common and are expected to continue to increase[69]. This trend continued in July 2022, when Portland saw seven consecutive days with high temperatures above 95 degrees for the first time in recorded history. Five people in Multnomah County died from heat in that event, with similar demographic impacts as in the 2021 Heat Dome (older adults, primarily men, living in homes without air conditioning).

Winter Storm

[69] The Oregonian, Portland Temps, 1938-2023

Winter storms are a common occurrence in Multnomah County. Low elevations average about four inches of snow per season but do not have snow every year. Higher elevations get some snow annually. Predicting the frequency of extreme cold, snow or ice events is difficult, but it has been estimated that the northern Willamette Valley will experience some sort of extreme event about every four years, although these events are often short in duration. Cold-related deaths have maintained risk awareness, and emergency warming shelters have been used to respond to risks to those without access to warm spaces. Road maintenance preparation has also been expanded because of recent snowstorms.

The 2017 winter was extreme and caused loss of life, but more intense events have occurred in the last century. The largest amount of snow recorded in Portland in one day was 15.5 inches on January 21, 1943. One cold snap in 1950 recorded temperatures below zero in Portland, the only time that has occurred since records began in 1940[70]. The Columbia River froze solid for the last time in 1930[71] after high temperatures failed to break 32 degrees for 19 straight days.

Probabilities of extreme low temperatures and high snow and ice amounts may be increased by climate-change driven weather disruptions, although most models show that averages over time will result in warmer winters and less snow.

Winter storms are often linked with cold air blowing in from the Columbia River Gorge. One study has estimated that 70% of days with snowfall, 56% of total snowfall amounts, and 90% of days with freezing rain at the Portland Airport coincide with easterly Columbia River Gorge winds[72].

Windstorm

The 2020 State of Oregon Natural Hazards Mitigation Plan identifies the Northern Willamette region as having a 4% annual chance of seeing 65 mph winds (25-year event) and a 1% chance of 80 mph winds (100-year event). Wind speeds above 50-60 mph are considered to be damaging and will fell trees and power lines. Wind speeds up to 85 mph can damage shingles and siding, and wind speeds above 85 mph can knock over mobile homes and cause other building damage. There have been two events in Multnomah County in the last 60 years where wind speed has been estimated to have exceeded 100 mph.

Multnomah County can experience powerful straight-line winds or tornadoes as extreme events and also often has strong, sustained winds coming from the east through the Columbia River Gorge.

The most significant recorded windstorm in Multnomah County was a straight-line wind event—the Columbus Day storm in October, 1962, also known as the Big Blow. Winds in this event may have reached 116 mph, the equivalent of a major hurricane. Measurement equipment at the Portland Airport recorded sustained 90 mph winds before being damaged.

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[70] Joe Dorish Weather, Ten Coldest Weather Temperature Days Ever Recorded in Portland, Oregon, January 14, 2017.

[71] The building of upstream dams has also made freezing over of the Columbia River unlikely, by keeping flows high enough to prevent the river from slowing. In 1930, cars could drive across the frozen river.

[72] Columbia Gorge Gap Winds: Their Climatological Influence and Synoptic Evolution, *Weather and Forecasting*, Justin Sharp and Clifford Mass, December 1, 2004

Figure 78 - Wreckage at the Portland Airport after the 1962 Columbus Day windstorm

The Columbus Day storm was caused by the remnants of an extratropical typhoon reforming off the coast of California and maintaining its power as it traveled along the Pacific Coast. No other similar event has ever been recorded, and the large number of blown over trees that were 1,000 years or older gives an idea of just how infrequent an event this storm was[73]. However, it is also probable that warming oceans will increase the likelihood of offshore energy strengthening or revitalizing future typhoons.

Impacts from the storm reached from California to British Columbia, caused about $170 million in damages, and killed 50 people—primarily from flying debris and falling trees. At the time, it was considered to be the worst natural disaster to ever hit Oregon.

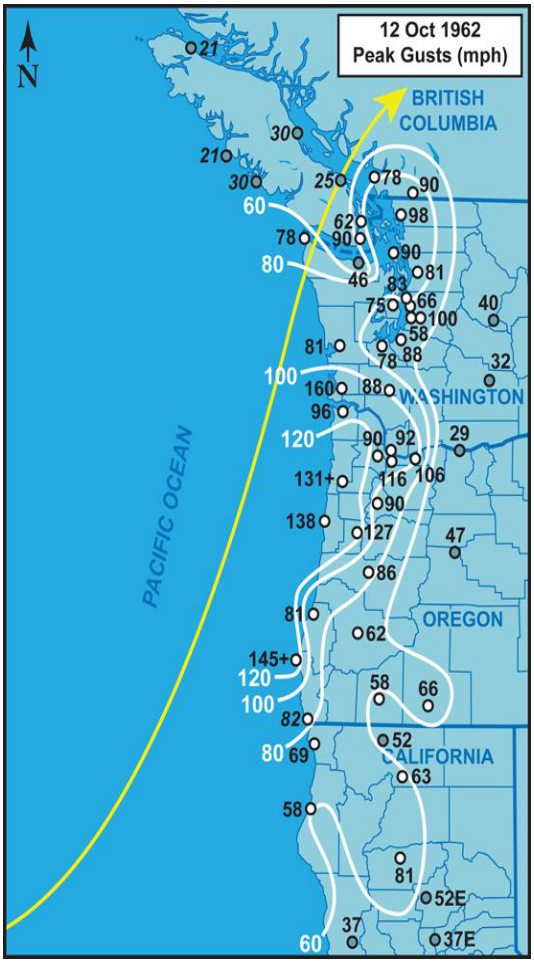


Figure 79 - A map showing the path of the 1962 Columbus Day windstorm and peak wind speeds across the Pacific Northwest. A peak gust of 116 miles per hour was recorded at the Morrison Bridge in Portland. Graphic from the Office of the Washington State Climatologist.

Tornadoes are rare in Multnomah County, but not unknown. While the most recent tornado events in 2018 and 2019 were at the lowest level of wind speed and of short duration, there have been two recorded instances of F3 (severely damaging) tornadoes in Multnomah County, in 1894 and 1972. Each of these events caused fatalities, although not necessarily in Multnomah County.

The April 5, 1972 event was the most deadly tornado in the United States that calendar year, killing six people in Clark County, Washington, and injuring 300. An elementary school was destroyed as well as businesses and homes—overall causing about $25 million in damage. The tornado touched down in Portland, at NE 33rd and Marine Drive along the Columbia River, damaging boats before it crossed the river into Washington and caused a wide swath of damage. Wind speeds were estimated to have peaked at 120 mph.

[73] The 1962 Columbus Day Storm, Office of the Washington State Climatologist, Wolf Read, Last Updated October 2015

Figure 80 - Damage in Vancouver, Washington caused by the 1972 tornado. Photo and oral recount provided by Clark History..

Overall, there have been five tornadoes in Multnomah County between 1904 and 2022, which suggests an approximate 5% annual chance, but that probability may be conservative because of climate change impacts or by more recent improvements in defining, recording and reporting of tornadoes. Similarly, an F3 tornado could be estimated to have a 1% annual chance, but the small number of events makes it an uncertain prediction. September and October have historically been the most active months for tornadoes in the Willamette Valley.

Drought

While climate change is making drought more extreme and more frequent, it is also part of a natural climatic cycle. Studies of tree rings in Central Oregon have shown that extreme drought periods occurred in the 1480s, 1630s, 1700s and 1930s[74]. The 1930s were recorded as the most sustained drought in the 545-years of available study information, and coincide with a period of extreme wildfire activity in Western Oregon.

It is extremely likely that the roughly 100-150 year historical recurrence of catastrophic drought has accelerated. The current 'mega-drought' that has been afflicting much of the entire Western United States since 2000 was considered in an article in the journal ***Nature*** to be the most wide-

[74] Physical Geography, A 545-Year Drought Reconstruction for Central Oregon, May 15, 2013, K. Pohl, K. Hadley, K. Arabas.

scale event in at least 1,200 years[75]. 42% of the drought condition has been attributed to climate change.

3.4.3 Severe Weather Vulnerability

Extreme Heat

Assessing the county's vulnerability to extreme heat requires identifying those who are most impacted because of social or environmental conditions. Consistent evidence has shown that the populations most at risk from extreme heat are:

- Older adults, especially those over age 65
- People without cooling systems in their home
- People experiencing homelessness
- People living within urban heat islands
- People with chronic medical conditions that affect the body's ability to cool itself, such as cardiovascular disease or poor blood circulation
- People with limited social connections and networks
- Children, whose vulnerability lies in their dependence on others to keep them safe
- People who are pregnant
- Outdoor workers, especially at worksites in urban heat islands
- People with mental, behavioral, or cognitive disabilities
- People who rely on medications that may decrease the body's ability to cool itself

Many of these risk factors were implicated in the 69 deaths that occurred in Multnomah County due to the 2021 Heat Dome event. None of those who died had access to central air conditioning, and very few had portable air conditioning units and most of those were not operational.

A majority of the deaths (55%) occurred in multi-family housing, and nearly half of those deaths occurred at the third floor higher in a building. Another 18% of the deaths occurred to people living in mobile homes, recreational vehicles, or automobiles. Four deaths were identified in subsidized affordable housing buildings, another four in housing for vulnerable people, and two in an independent senior living facility. Two people were identified as experiencing homelessness and were found in their vehicles. Two deaths in Oregon were to people working outdoors—one agricultural worker and one construction worker[76]. Neither death occurred in Multnomah County.

The youngest death in Multnomah County was a 48-year-old, but the average age of death was 70, including 10 people over the age of 80. 78% of deaths were people living alone. Men (64%) died at a higher rate than women, and people identified as white (92%) were overrepresented in deaths as a racial group.

Deaths occurred across the county, with the highest concentration in zip codes in downtown Portland and areas east of 42nd Avenue on the east side of the Willamette River.

[75] Associated Press, West megadrought worsens to driest in at least 1,200 years, February 14, 2022, Seth Borenstein

[76] The Oregonian, Oregon reports second workplace death from June heat wave, July 25, 2021, Jamie Goldberg

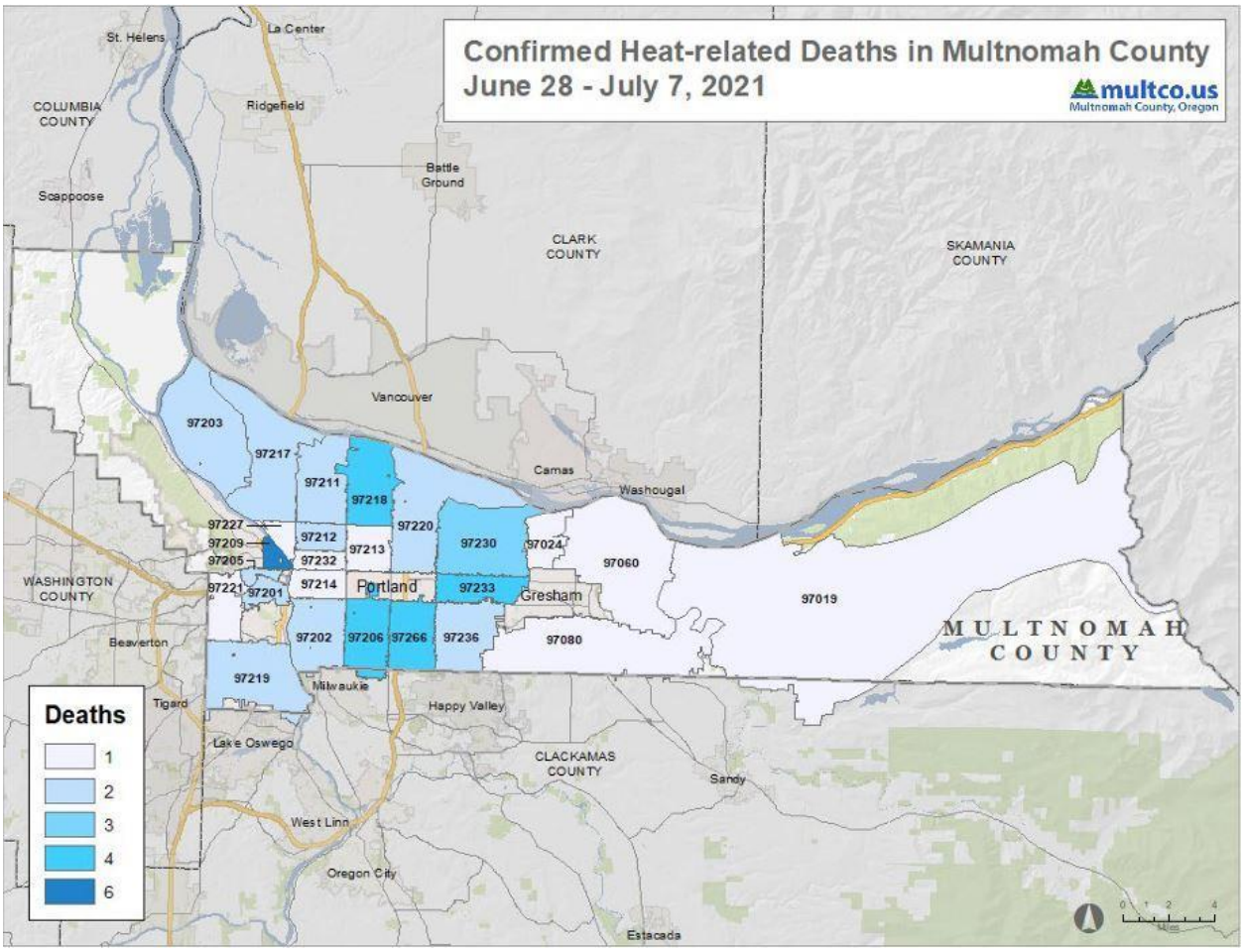


Figure 81 - Graphic of zip code locations of 2021 heat-related deaths. Map from Multnomah County.

High heat may also impact power infrastructure. Portland General Electric reported record demand for electricity during the Heat Dome—high usage combined with strain caused by high temperatures can threaten electrical equipment. Given the locations of those who died in the Heat Dome event, a widespread power loss causing a loss of home cooling would have put many more residents at risk.

When heat reaches 90 degrees, some light rail transit routes become delayed as trains reduce speed. At over 100 degrees, all lines become delayed. Some minor physical damage to road and rail infrastructure has occurred.

Winter Storm

The greatest vulnerability in recent cold events has been the risk of hypothermia to those living without shelter. Warming spaces and shelters have been used as an intervention to protect those who do not have access to safe locations. Injuries and deaths during winter storms are also caused by falling trees, downed power lines, treacherous walkways and car accidents.

Snow and ice may disrupt or damage infrastructure, including roads, sidewalks and power lines. Key transportation routes have been disrupted many times by snow or ice, which has limited the movement of emergency vehicles, prevented caregivers from reaching those in need, and

blocked important commercial transport routes. An ice storm in 2004 shut down major highways, public transportation and the Portland International Airport for three days[77].

Windstorm

Downed trees and power lines are a common risk from high wind events. Flying debris has also been a major cause of death in regional wind events, meaning that those unable to access safe spaces during extreme wind events may again be most at risk.

Structural damage can occur from falling trees and blown off shingles or siding. Mobile homes are particularly vulnerable to both straight-line winds and tornadoes, and may be pushed off foundations during extreme events. Because of the rarity of extreme wind events in this region, safe rooms purpose built for extreme winds are uncommon.

High winds often disrupt travel through the Columbia River Gorge because of blowing snow, limiting visibility or creating the risk of tall vehicles being blown over. Airport operations may also be disrupted by extreme wind events.

Power Loss

Long term loss of power is a threat from all severe weather types in this plan except for drought. Power loss may be most likely to occur during windstorm or winter storm because of damage to power lines. Winter storms may also see an increase in automobile collisions with power poles.

Long-term power loss is particularly dangerous to those who use powered medical devices or require refrigerated medicine. During heat or smoke events, power loss will prevent the use of air conditioning and air filtration equipment.

During extreme heat events, equipment may become overheated and power grids may become unstable because of excessive demand from widespread air conditioning use. Power loss was not an issue in the Heat Dome event, in part because the heat event did not impact the entire West Coast and create overwhelming regional demand. Because of the clear link between deaths in the event and a lack of access to air conditioning, a concurrent long-term power outage would have likely resulted in many more deaths and continues to loom as a risk factor in future extreme weather events.

Expanding the availability of backup power systems that can be accessed by those with urgent medical needs can limit risk during future outages. Outages during heat and smoke events will also impact those with existing health risk factors, expanding the need for backup power and accessible clean air or cooling spaces.

Drought

Multnomah County has particular resilience to drought compared to other locations in Oregon because most water users in the county get their water from the Bull Run Reservoir or from aquifer wells near the Columbia River. In both cases, these supplies are recharged by rains year-round and do not rely on melting snowpack to maintain surface water levels during the

[77] Notable Winter Storms in Oregon, *The Oregonian*, November 13, 2014, Lynne Palombo

summer. This resilience should also help manage effects from climate change, when more winter precipitation is expected to fall as rain instead of snow.

Low snowpack has particular impacts on the flow of the Sandy River, which is fed by snowmelt and glaciers on Mount Hood. During the historic low snowpack of 2015 where early spring snow levels were only 6% of normal, low flows impacted salmon recovery and recreational river use.

A more significant drought in Multnomah County could have impacts to the county's agriculture and forestry sectors. Water use restrictions have not been in place in recent years, but water conservation is regularly promoted

3.5 Volcano

The peaks surrounding Multnomah County are famous landmarks of the region, but also serve as reminders of a volcanic story that is still being written. Mount Hood has erupted in the last 300 years and remains geologically active. Multnomah County residents were able to watch the 1980 eruption of Mount St. Helens from their homes, considered the most destructive volcanic eruption in the modern history of the United States. Many severe eruptions are also known to have occurred before Oregon statehood. Those earlier eruptions profoundly changed Oregon's current geology and impacted the lives of indigenous residents.

The Pacific Northwest has a number of volcanoes (Mt. Hood, Mt. Saint Helens, Mt. Baker, Mt. Rainier) considered to be among the most dangerous in the United States because of their activity and proximity to populated areas. Fortunately, volcanic eruptions are rare events, with often extremely long periods between severe eruptions. But another Mount Hood eruption could be an extremely dangerous event, especially along the Sandy River, where a dangerous, fast-moving mudflow called a *lahar* could damage portions of east county communities. Falling ash from the eruptions across the region exists as the other significant threat to public health and infrastructure.

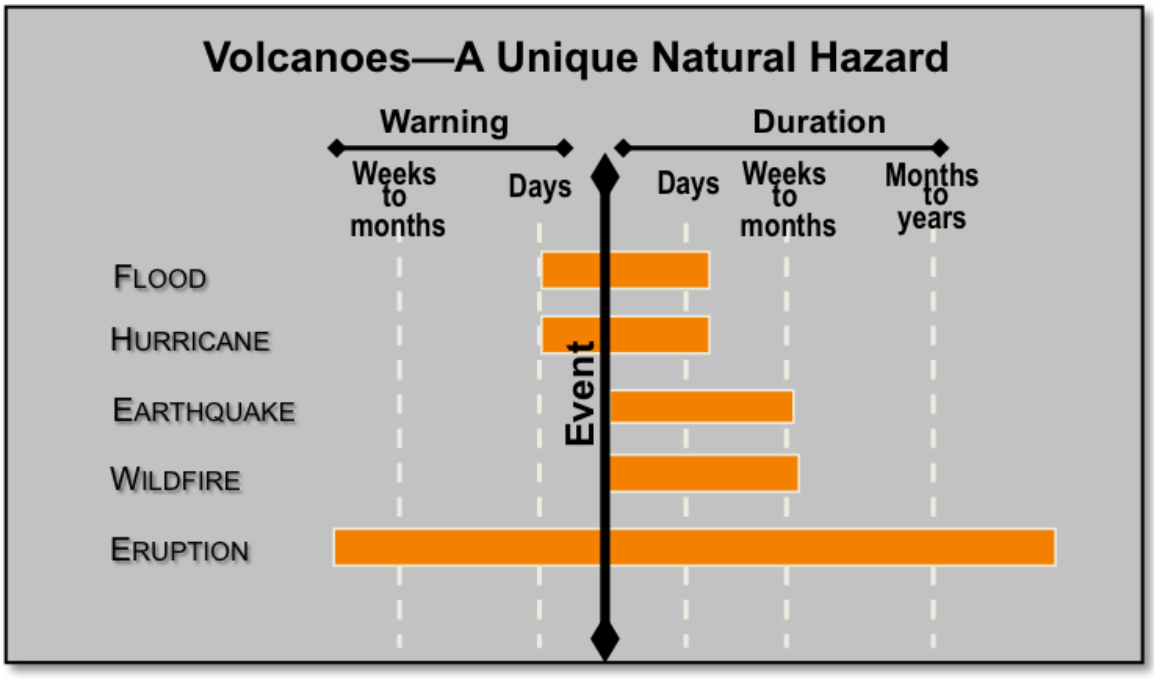


Figure 82 - Graphic shows how volcanoes differ from other hazards, by giving much more warning but also having a long duration of occurrence.

Overall, the risk from volcanoes is serious but not considered a high priority for any of the participants of this plan. The Cities of Fairview and Troutdale and levee districts with operations in and around the mouth of the Sandy River have identified the highest levels of concern. A severe event would be extremely damaging, but advances in eruption forecasting mean there is likely to be more warning of an event, the geographic scope of lahar damage is more limited than other hazards, and ash impacts are difficult to estimate in probability and impact. An extreme Mount Hood eruption event would be impactful for a very long period of time, so

attention continues to be required to maintain risk awareness and to support continuing work in volcano monitoring technology.

Five-Year Report, 2017-2022

- *Events*

No significant volcanic events have affected Multnomah County since the 2017 edition of this plan was published. Minor earthquake swarms have continued, including a magnitude 3.9 earthquake below Mt. Hood on June 5, 2021. These small earthquakes indicate the continuing geologic activity of the mountain, but this earthquake swarm was not considered to be indicative of magma movement that would foreshadow an eruption.

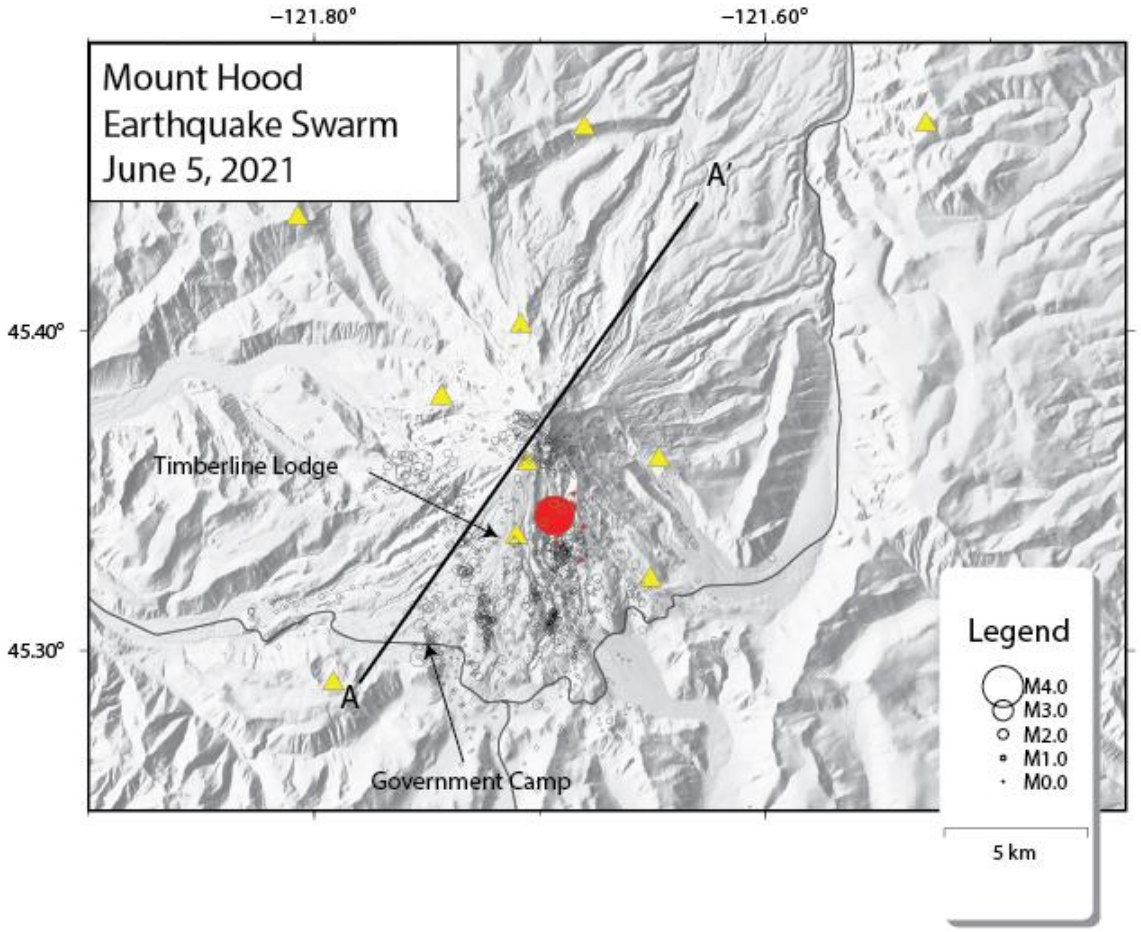


Figure 83 - Location and size of volcanic earthquakes at Mount Hood in June 2021. These earthquakes were not considered to be a precursor of heightened volcanic activity. Graphic from the US Geological Survey

As of 2014, Mount Saint Helens has also remained active, with small ground movements and earthquakes indicating activity below the surface. However, there is no current sign of impending eruption according to the United States Geological Survey.

- *Data and Risk Analysis*

Advancements in the last five years have continued in eruption forecasting, primarily through seismic monitors and other sensors to measure ground changes, pressure, and changes in gas emissions. The United States Geological Survey is currently attempting to place additional early detection and monitoring sensors at Mount Hood.

The best risk and vulnerability data continues to be based on work published before 2017. The National Volcano Threat Index was updated in 2018, and maintained threat levels for all regional volcanoes.

DOGAMI published a *Natural Hazard Risk Report for the Lower Columbia-Sandy Watershed* in 2020, which collected lahar damage study information to create a more detailed vulnerability analysis for this single watershed, which is the only portion of Multnomah County with lahar vulnerability.

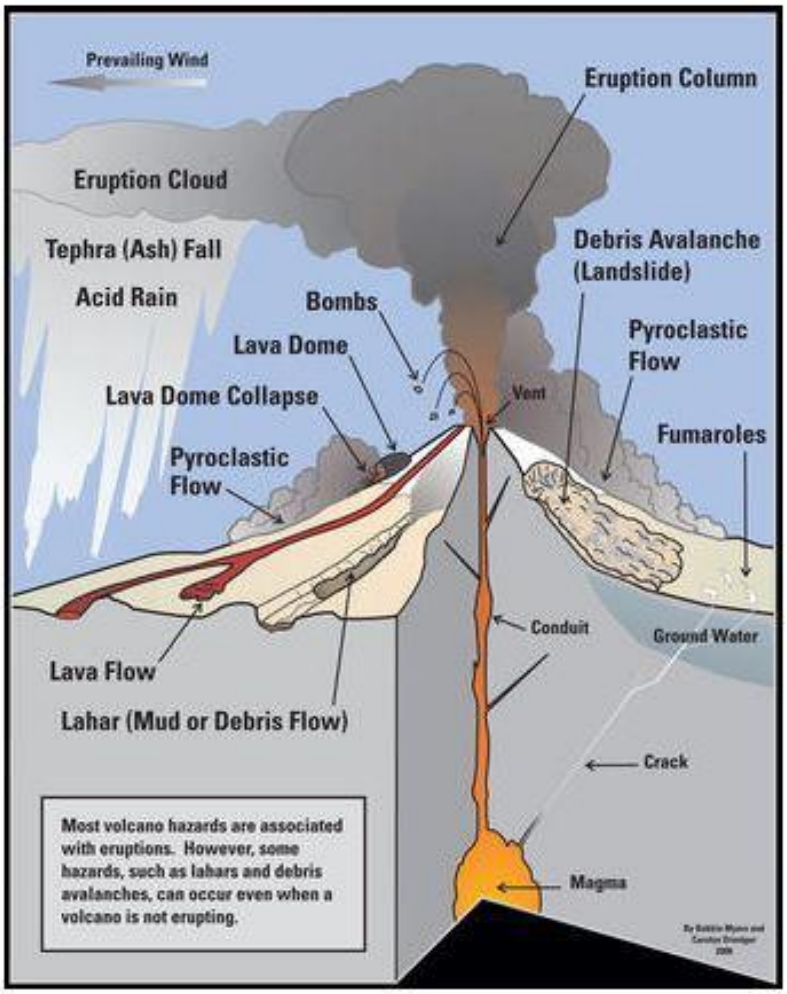


Figure 84 - Graphic showing types of volcanic impacts. Graphic from the US Geological Survey.

3.5.1 Volcano Impacts, Locations, and Extents

Volcanic hazards are varied and have different impacts depending on distance from the eruption. The hazards are categorized as either *distal hazards* (farther away) or *proximal hazards* (closer in). Although Mount Hood and Mount St. Helens loom large in the Multnomah County skyline, they are far enough away that they would only impact the county with distal hazards.

The direction of projected distal and proximal hazards at Mount Hood are based on the past two eruptions occurring at Crater Rock[78], which is also considered to be the most likely location of the next eruption. If a different vent is the eruption source, debris flows may be carried to the north or east and threaten other counties.

[78] Crater Rock on the south-facing side of the mountain, is the location of a lava dome formed during the last eruptive period.

Lahars

Lahars are mixtures of water, debris, ice, and sediment that form huge mudflows after an eruption. These dangerous flows are often made more dangerous when volcanoes are covered in snow which rapidly melts due to the heat of the eruption. Lahars can travel 20-40 miles an hour and extend as much as 50 miles, as they pick up additional debris and water along the way and consolidate in large river channels before slowing down and spreading out at major river confluences. Lahars are one of the primary volcanic threats faced by Multnomah County, as flows are expected to travel down the Sandy River and inundate land where the Sandy River meets the Columbia River.

Figure 85 - The Saint Helens Bridge on Highway 504 in Washington was carried over a quarter mile downstream by a lahar from the 1980 Mount St. Helens eruption. Photo by R.L. Schuster for the United States Geological Survey.

Tephra (Volcanic Ash)

Tephra, or volcanic ash, is tiny rock and glass fragments that is ejected during an eruption. While larger particles have different names (bombs, blocks, or others) and stay fairly close to the eruption site, tephra rises into the atmosphere and can be carried hundreds or even thousands of miles by winds. After the 1980 Mount St. Helens eruption, tephra was carried by eastern winds across the Midwest. Tephra carries significant respiratory health impacts and can also damage buildings and infrastructure and affect transportation.

Figure 86 - Tephra from the 1980 Mount St. Helens eruption at a farm in Connell, Washington, 180 miles east of the eruption. Photo Lyn Topinka, Public Domain

Proximal Hazards

Lava flows destroy everything in their path and completely change the landscape as they cool into new rock formations. Lava flows move slowly and would only threaten those very close to the eruption.

Pyroclastic flows are avalanches of rock, gas and ash that travel down the slopes of volcanoes at tremendous speeds. These flows are extremely dangerous to anyone in their path, and were the primary cause of death in the 1980 Mount St. Helens eruption. Pyroclastic flows are believed to travel up to nine miles from an eruption, but this is not far enough to create risk to Multnomah County.

Volcanic landslides are the same type of movement of rock and earth as other landslides, but may be huge as volcanic cones collapse during an eruption. Mount St. Helens dropped 1,300 feet in elevation after the 1980 eruption, leaving the horseshoe-shaped crater seen now. Landslides may also start because of shaking and sudden snowmelt—if enough water is mixed in with debris, volcanic landslides may become lahars. Volcanic shaking is not expected to cause significant landslides in Multnomah County.

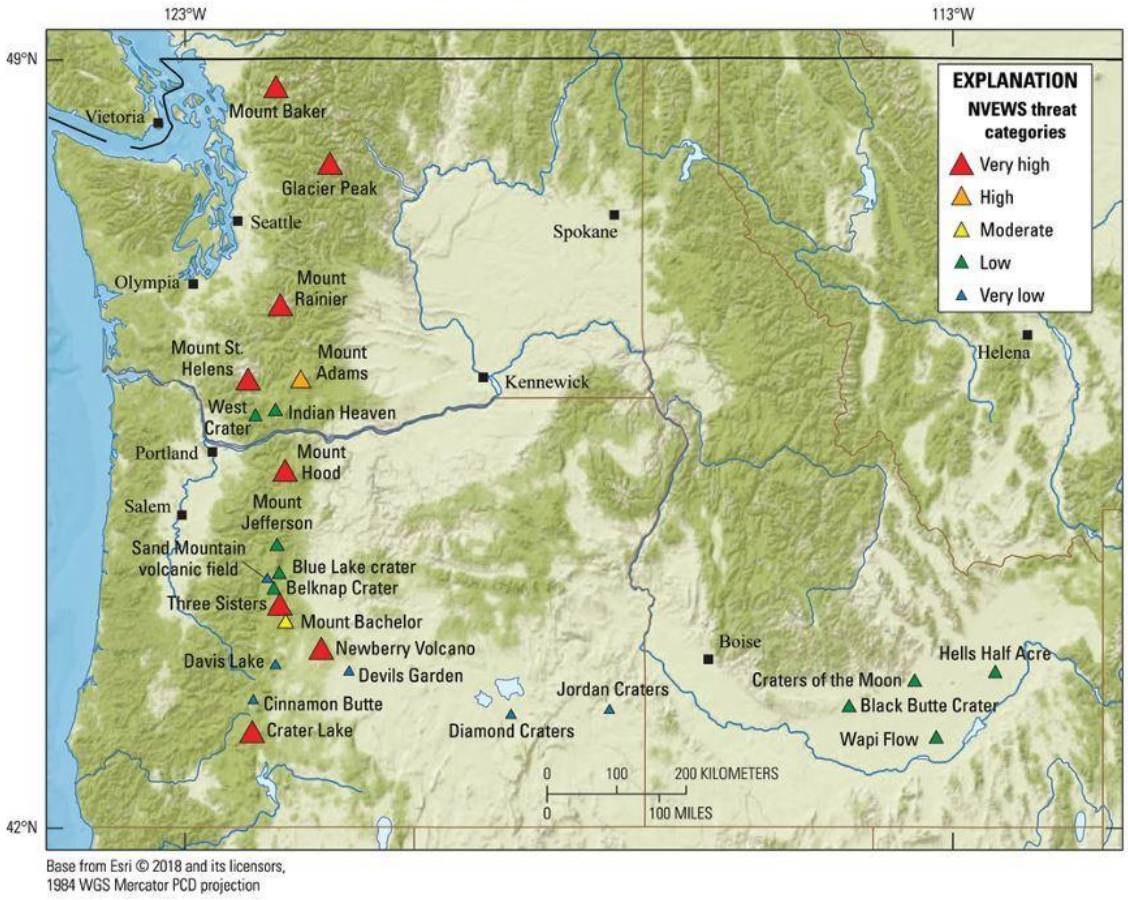


Figure 87 - Map showing volcanoes and their threat categories across the Pacific Northwest. Map from the 2018 National Volcano Threat Index.

The most recent National Volcano Threat Index was published in 2005 and revised in 2018. In the 2018 revision, there were no changes to the threat ratings of the volcanoes most likely to impact Multnomah County.

Eighteen volcanoes in the United States are rated as being of very high risk—three of those are in close enough proximity to threaten Multnomah County with severe distal hazards. The overall risk rating shown below uses a product of hazard probability and vulnerability factors to assign a numerical overall score. The risk rating is not designed to indicate relative risk to Multnomah County.

The aviation threat score is a measurement of potential impacts to aviation from airborne tephra and ashfall onto airports. Mount St. Helens has the highest threat to aviation of any volcano in the United States. The score is reflective of the higher probability and size of future eruptions, as well as the large amount of air traffic and airport operations that could be impacted.

Table 38 – Local Volcanoes and their Risk and Threat Ratings – (2018 National Volcano Threat Index)

Volcano	Overall Risk	Aviation Threat Score
Mount Saint Helens (WA)	Very High (263, 2nd highest in US)	59 (Highest in United States)
Mount Rainier (WA)	Very High (203, 3rd highest in US)	37
Mount Hood (OR)	Very High (178, 6th highest in US)	30
Mount Adams (WA)	High (92, 34th highest in US)	15

Low-threat volcanoes (overall risk score below 30) are located at Mount Jefferson, Indian Heaven and West Crater. These volcano sources are considered low threat because of limited volcanic activity, small size and/or their distance from populated areas. Other very high risk volcanoes in Central and Southern Oregon such as Three Sisters and the Newberry Volcano could also impact Multnomah County with falling tephra, depending on wind patterns at the time of eruptions.

Mount Hood

As noted above, the most likely eruption scenario at Mount Hood is another eruption at Crater Rock, shown on the Hazards Zonation Map below. An eruption at this location would create a lahar event on the Sandy River. The less likely locations of lahar hazard would come from an eruption on a vent to the north or east, which could threaten Hood River all the way to its confluence with the Columbia River, or move east on the White River through southern Wasco County.

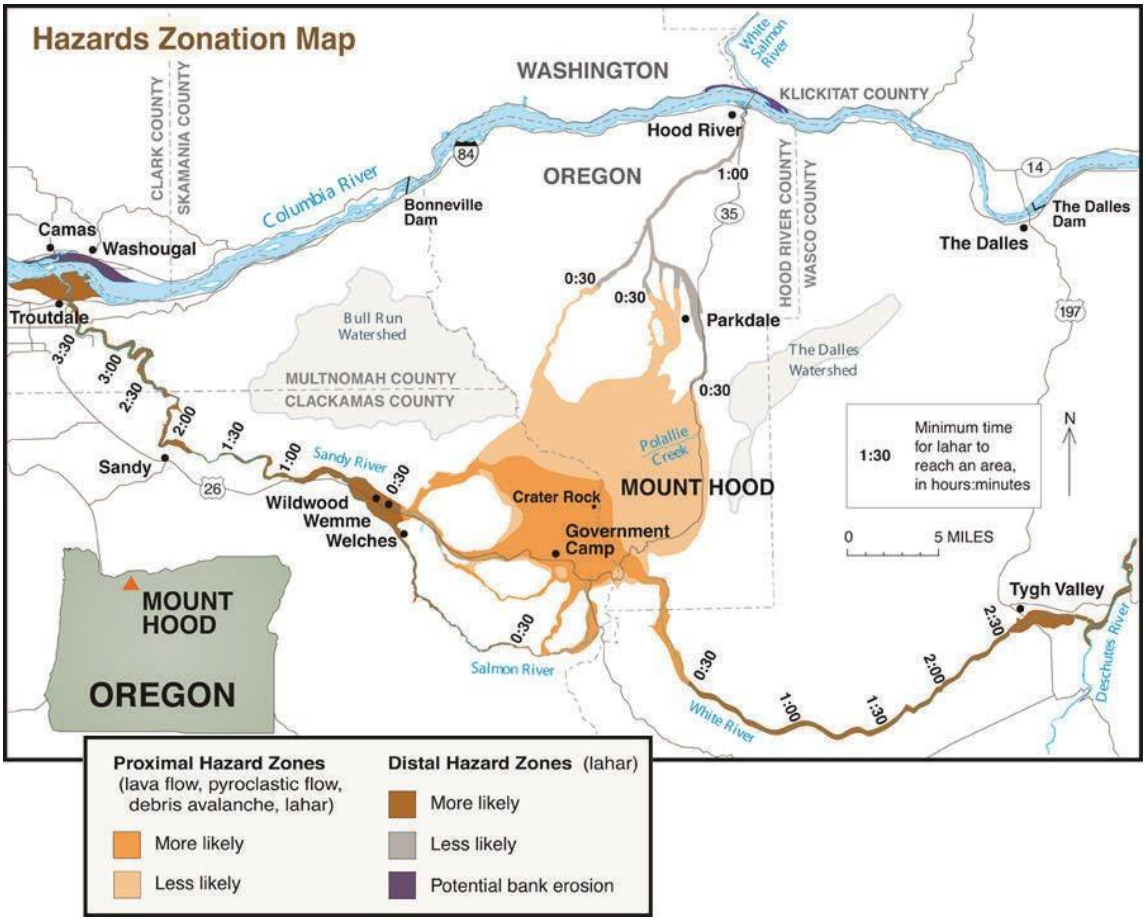


Figure 88 - Hazards Zonation Map shows potential lahar paths and the time it would take the debris flows to reach different areas in the region. Map from U.S. Geological Survey

Falling ash would likely be a significant hazard across Multnomah County, but locations of impacts would be dependent on wind direction and speed.

Mount St. Helens

Lahars from Mount St. Helens are most likely to travel west on river channels and potentially reach the Columbia River at Kalama, across from Columbia County in Oregon. There is no theorized event where lahars from Mount St. Helens would impact Multnomah County.

Falling ash from Mount St. Helens could be a significant hazard to Multnomah County, and given its activity and size of eruptions, this remains one of the major volcanic threats.

The eruption in 1980 had very favorable wind patterns for Multnomah County. Tephra was carried immediately to the north and east of the eruption and settled in highest amounts in central and eastern Washington. The only place in Oregon to receive more than trace amounts was in the northeastern corner of the state.

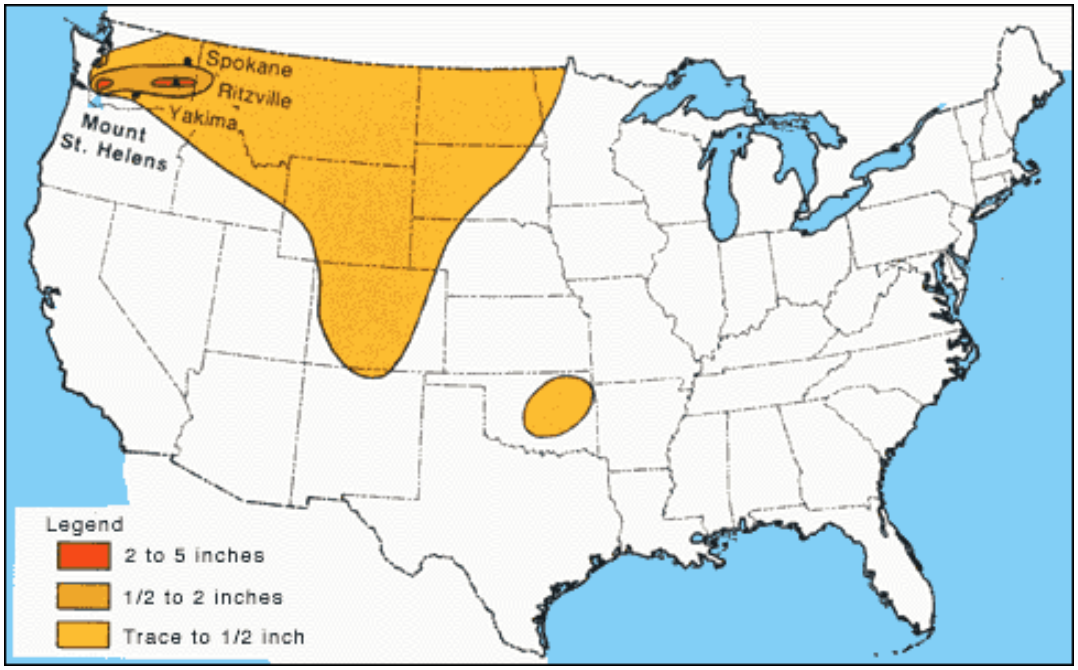


Figure 89 - Map showing location and amount of ashfall after the 1980 Mount St. Helens eruptions. Map from the United States Geological Survey.

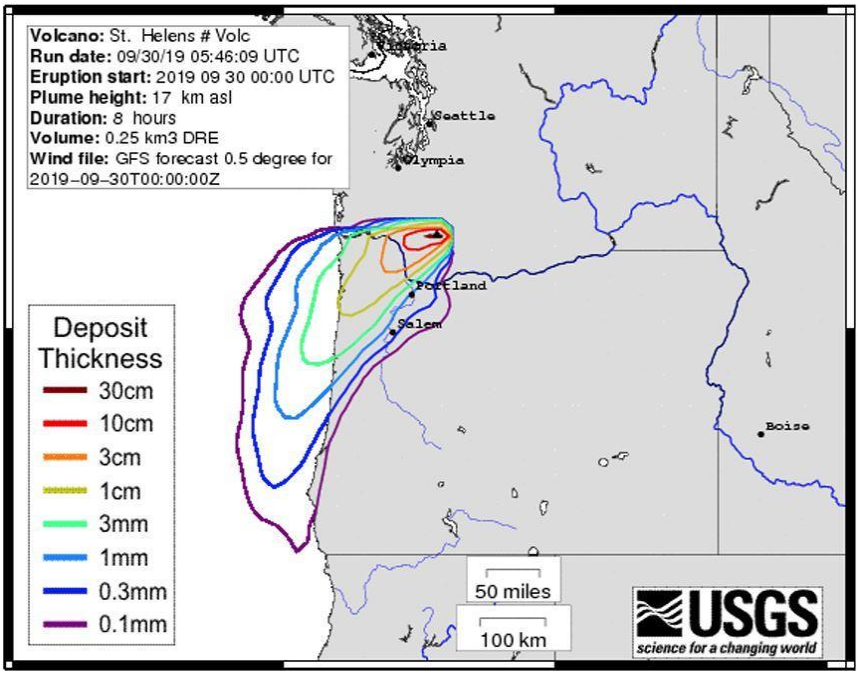


Figure 90 - Model of ashfall if Mount St. Helens had erupted on September 30, 2019, based on wind and weather conditions from that day. The US Geological Survey maintains a dynamic map showing potential movement of tephra every day based on weather conditions.

The westerly winds that carried tephra away from Multnomah County are the prevailing winds at the mountain, making it the most likely direction for the ash to travel in future events. However, non-prevailing winds are possible, and alternate weather scenarios have been modeled. The example to the left is one possible scenario, presented here to better convey the possible extent of tephra hazard.

Other regional volcanoes also only threaten Multnomah County with ash hazards. Risk is roughly equivalent across the county, if wind directions are unfavorable.

3.5.2 Volcano Probability and History

Probabilities for volcano risk are difficult to determine broadly, because they are controlled by movements of magma below the surface that are difficult to study. Eruptive histories provide a snapshot of future potential, but it is not unusual for an active volcano to go dormant for long periods of time, or for long-dormant volcanoes to suddenly reactivate. Mount Hood is not considered 'overdue' for an eruption because volcanoes do not have a set regularity of eruption probability in the same way that earthquake faults build pressure and can have anticipated periods of time between ruptures.

Current activity levels can be measured at volcanoes, based on earthquakes, ground movement and release of gasses. Improved forecasting can indicate when these processes signify the formation of eruptive potential that might occur in a matter of months or weeks. However, long-term projections of future activity remain elusive. Before Mount Hood erupted in the 1790s, it had been dormant for over 1,000 years. After that eruption, it continued to have eruptive periods through the mid 1800's, but has not had significant activity since 1866.

This unpredictability makes planning challenging. An extra-large Mount Hood eruption would be a catastrophic level event in east Multnomah County. If winds were to blow ash towards Multnomah County, impacts to public health and risk of building and infrastructure damage would also be catastrophic. However, an extra-large eruption is one of the least probable events contained in this plan, so participating entities mostly have this classified as a low-risk hazard and most do not have mitigation strategies directly for volcano risk.

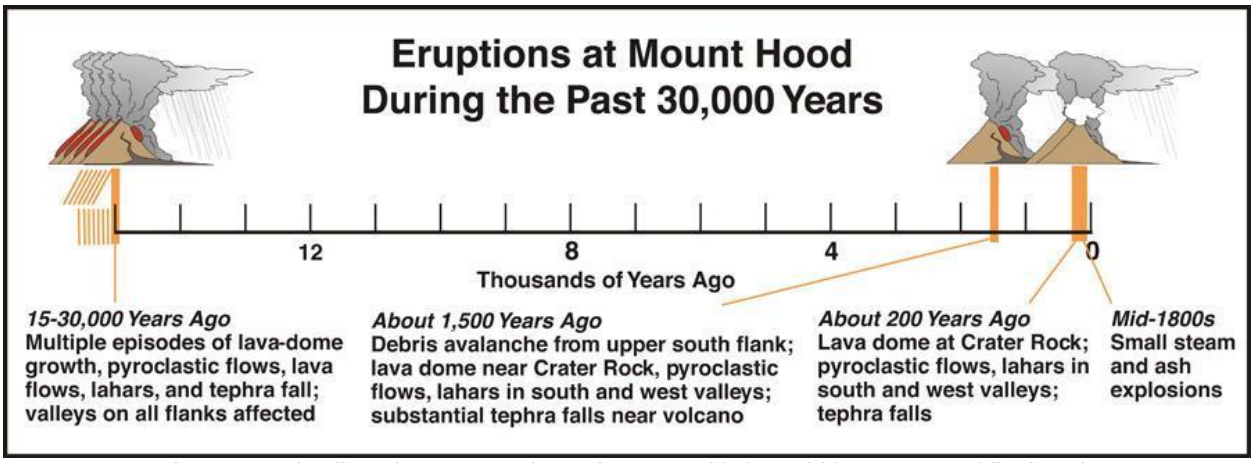


Figure 91 - Timeline of Mount Hood eruptions. Graphic by Bobbie Meyers, public domain

Geological records indicate that the eruptive period of the late 1700s deposited debris along the Sandy River, but was much smaller than eruptions 1,500 years ago that moved massive boulders and so much debris that it altered the flow of the Columbia River. However, even that eruption was only about 10% as large as eruptions 100,000 years ago that buried the area where the City of Hood River is now in 400 feet of debris. A future eruption is not likely to be that size, but can be considered to be the worst possible scenario.

Mount Hood eruption probabilities used for analyzing volcanic impacts in the Lower Columbia-Sandy Watershed Risk Report are shown below. Only a 'large' or 'extra-large' event would cause structural lahar damage in Multnomah County. Greater impacts would be present farther upstream in Clackamas County.

- 'Small' – 10-year event (10% annual chance)
- 'Medium' – 100-year event (1% annual chance)
- 'Large' – 500-1,000 year event (0.1-0.2% annual chance)
- 'Extra Large' – 100,000 year event (0.001% annual chance)

Table 39 – Volcano History of Multnomah County

	Volcano	Eruptions
Oregon		
	Mount Hood	1859 and 1865; Small events without known lahar deposits
	Mount Hood	1781; Old Maid Eruptive Period; lahar deposits widespread in Sandy River
	Mount Hood	~500 (1,500 years ago); Timberline Eruptive Period; Major lava dome formation and lahar deposits; Eruptive events lasting decades
	Mount Hood	15,000-30,000 years ago; Polallie Eruptive Period
Washington		
	Mount St Helens	2004-2008; Renewed Activity; Small eruptions in January and March 2005, including dusting of ash over 90 miles to the east; New lava domes refill 7% of crater
	Mount St Helens	1989-1991; Six small ash-producing explosions, including avalanches and minor debris flows.
	Mount St Helens	1980-1986; Smaller episodic eruptions that rebuilt lava domes in the new crater; Ash impacts ocurred in parts of Oregon in 1980 from these eruptions, in locations that were not impacted by the May 1980 eruption.
	Mount St Helens	May 18, 1980; Most destructive volcanic eruption in the history of the United States, 57 killed, widespread damage from blast effects, lahars, and ash.
	Mount St Helens	1800-1857; Goat Rocks Eruptive Period; Small series of eruptions creating the Goat Rocks Dome
	Mount St Helens	1479-1720; Kalama Eruptive Period; Large explosive eruptions in 1479 and 1482
	Mount Rainier	1825 (?)
	Mount Adams	950 (?)
	Mount St. Helens	1980 - 2008
	West Crater	5760 BCE (?)
	Indian Heaven	6250 $\pm$ 100 BCE

3.5.3 Volcano Vulnerability

Lahars

Lahars generated in an eruption of Mount Hood are the most significant threat to Multnomah County, especially the Cities of Troutdale and Fairview and Drainage Districts at the mouth of the Sandy River. Lahar vulnerability to buildings and critical facilities was included in the *Lower Columbia-Sandy Watershed Risk Report* performed by DOGAMI in 2020.

An interactive version of this map can be found here (Volcanic Hazard – Moderate Hazard)

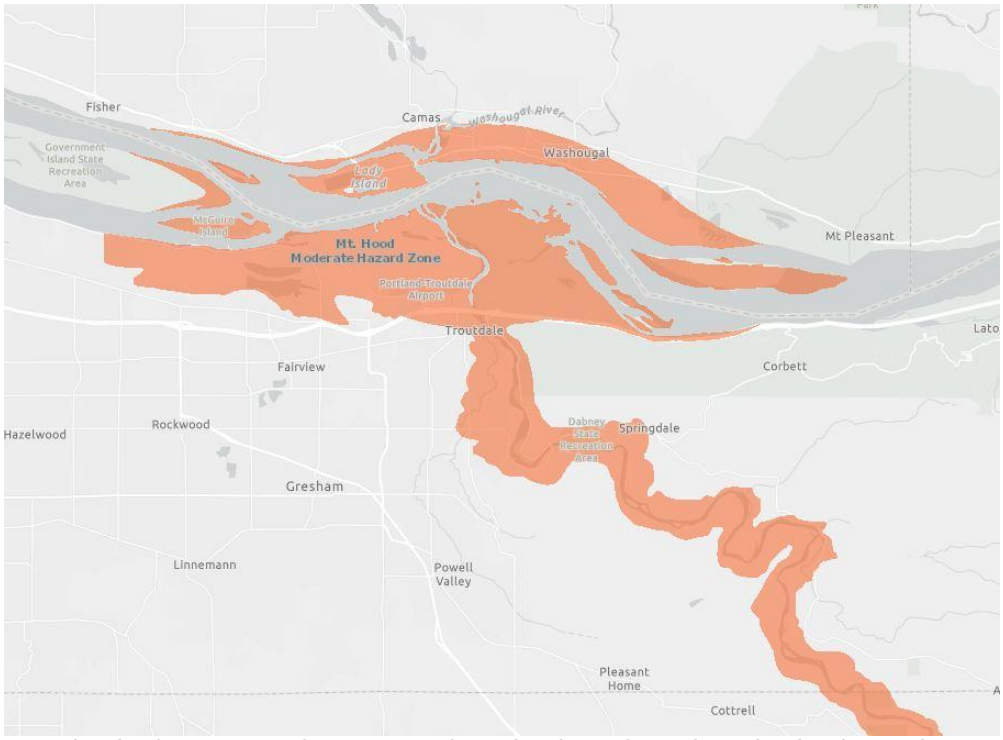


Figure 92 - Map showing impact areas from an extra-large (moderate hazard zone) volcanic eruption at Mount Hood. Map from DOGAMI HazVu.

This study provides extremely useful vulnerability data since the Sandy River is the lone Multnomah County location with lahar threat. This analysis ends at the watershed boundary—yet it is also known that an extra-large event described below would also cause significant debris effects to lakes, sloughs and low-lying shoreline areas in Fairview, Wood Village, Portland and across the Columbia River into Washington.

Most of the Multnomah County residents of the watershed are not threatened by even a large event. If a large to extra-large event occurs (predicted to occur every 100,000 years, or having a .001% annual chance of occurrence), buildings in lower-lying areas would be damaged and destroyed, including 37% of Troutdale's structures located within the watershed. Such a lahar is predicted to cause half a billion dollars in structural damage in Troutdale and another $75 million dollars in damage in unincorporated Multnomah County. Damage to flood-control structures for the SDIC (located entirely in the lahar zone), MCDD, and UFSWQD (partially located) are included in the city or county jurisdictions where they reside, but loss estimates do not include the cost of levee damage and non-structural levee infrastructure.

Table 39 – Buildings Impacted and Loss Estimate from Large and Extra-Large Mount Hood Eruption – Lower Columbia-Sandy Watershed Only – (DOGAMI O-20-06, Natural Hazard Risk Report for the Lower Columbia-Sandy Watershed)

	'Large' lahar event		'Extra-Large' lahar event	
Community (Watershed Portion Only)	**Number of Buildings Impacted**	**Loss Estimate**	**Number of Buildings Impacted**	**Loss Estimate**
City of Gresham	0	$0	1	$319,000
City of Troutdale	0	$0	1,588	$522,890,000
Unincorporated Multnomah County	0	$0	228	$75,738,000

The analysis showed that lesser lahar events from less violent eruptions would not damage buildings in Gresham, Troutdale, or Unincorporated Multnomah County, but would cause damage at higher elevations along rivers in Clackamas County. Even in cases where buildings are not damaged by a smaller lahar event (1% annual chance), there could be impacts to recreational areas and natural resources, levee operations and river transportation activity. Large amounts of sediment could be carried by rivers and discharged into the Columbia River. This sediment could narrow the Columbia's channel, forcing it to the north and potentially causing bank erosion along the river's north bank. The effects of lahars may take months or even years for recovery and restoration.

Lahars move swiftly and an extra-large event would require quick notice and evacuation, even given the distance from Multnomah County to Mount Hood. It is estimated that a lahar coming down the Sandy River could reach Multnomah County in about two-and-a-half hours, and reach Troutdale an hour after that.

Tephra (Ashfall)

Falling tephra from a local or regional eruption could significantly impact Multnomah County, depending on wind directions during the eruption.

Volcanic ash is abrasive and corrosive and does not dissolve in water. It will irritate eyes and respiratory systems, and will require the use of masks to prevent inhalation, especially among those with pre-existing health conditions. Health risks will be similar to those from severe wildfire smoke. Populations living or working outside or in spaces without effective air filtration and with limited access to preventative equipment will face the most health risks.

Ash also is disruptive to buildings and other infrastructure, including damaging roofs and HVAC systems. Damage can range from minor cosmetic damage to catastrophic structural damage. In rare cases, thick ashfall has fully collapsed roofs and it becomes especially heavy when

combined with precipitation with long, low-pitched roofs being most vulnerable. Wet ash can weigh 10-15 pounds per square foot and 5-10 pounds per square foot when dry.

Summary of Potential Building Impacts from Volcanic Ash[79]

- Damage to interior equipment and flooring
- Abrasion to roofing and cladding
- Obstructed HVAC filters, condensers and air intakes
- Blockage of gutters and downpipes, including internal gutters
- Paint damage

Transportation Impacts

Ash can cause shutdowns of airports because of its impact on airplane engines, instruments, and other surfaces. In 2010, there was a major disruption at over 300 airports for a week across Europe due to the eruption of Eyjafjallajökull in Iceland in 2010. Over 100,000 flights were canceled, and work has since been done to better understand low tephra concentration impacts on planes.

Airports themselves have also been impacted across the world by ashfall. Accumulations of just a few millimeters of ash on runways has caused temporary airport closures, as well as impacts to buildings as noted above.

Figure 93 - Ash at the Quito International Airport in Ecuador after the 2002 eruption of Reventador, about 60 miles away. The airport closed for eight days. Photo - Ecuador Geophysical Institute

Roads may also be closed during ash events due to loss of visibility and increased danger caused by reduction of traction, obscuring of road signs, and clogging ditches and culverts. Ash may clog air filters and water intakes, restricting marine and rail activities.

Utility System Impacts

[79] Summary of Ash Impacts to Buildings and Building Support Systems, Volcanic Ashfall Impacts Working Group

Ashfall can cause power systems to shut down because of insulator damage, line breakage, equipment corrosion, power generation disruption and controlled outages to clean and repair damage. Sustained power loss creates significant vulnerabilities to those with acute medical needs, as noted throughout this plan.

Ash will degrade water quality for uncovered water system reservoirs and increase maintenance at utility pumping stations. As ash is swept into stormwater and sewer networks, it can cause damage to water treatment equipment

3.6 Wildfire and Wildfire Smoke

In the 2017 version of this plan, it was noted that Multnomah County had escaped from having the types of large fires that had become commonplace across Oregon during summer fire seasons. The plan further explained that changing climate conditions, large amounts of vegetative wildfire fuel and continued development in rural and urban edge areas of the county, had created conditions conducive to a large fire event.

Even as that plan was being reviewed and adopted around September 2017, just such an event occurred in eastern Multnomah County. The Eagle Creek Fire set a new modern standard for wildfire impact to Multnomah County, and may be a precursor for similar or even larger events in the future.

The public health impacts of wildfire smoke were noted as a hazard needing more consideration in the Wildfire chapter of the 2017 plan. This too predicted a catastrophic event in 2020, as smoke from regional fires caused local air quality to reach unprecedented levels of health hazard across the county. This update to the NHMP has elevated Wildfire Smoke as a hazard. While it is still combined into a chapter with wildfire, it now has an expanded description and more detailed connection to local mitigation strategies.

Wildfire and wildfire smoke are significant to all participating entities in this plan, but wildfire smoke has a more universal impact. Like the climate hazards described in the chapter for Severe Weather, the impacts of wildfire smoke have been felt across the entire county, and are especially harmful to those already most at risk from disparate impacts in disasters, such as those unable to access clean air spaces and those with existing health conditions. Wildfire smoke is also a hazard that does not require being originated in the county, meaning the probability of annual health impact due to smoke is vastly increased because of threat from fires from other parts of Oregon, across the Western United States and even Western Canada.

The largest risk of wildfire is to unincorporated Multnomah County, because of large forested or vegetated areas in the eastern and western reaches of the county. However, the possibility exists for large fires to impact communities in Wildland Urban Interface (WUI) areas at or within city boundaries, and for wildfires to happen on a smaller, but still dangerous, scale in urban locations when conditions are severe.

Climate change is a major driver of wildfire risk, and therefore of wildfire smoke risk as well. Oregon has continued to see a consistent elevation in the number of fires and acres burned over the last 20 years. A continuation of the warming climate will further reduce snowpack and dry out vegetation over longer, hotter summers, making fire and smoke a hazard that is expected to only grow in risk over coming years.

Five-Year Report, 2017-2022

- *Eagle Creek Fire 2017*

The Eagle Creek fire began on September 2, 2017 when a recreational park user threw fireworks into a steep canyon from the Eagle Creek Trail in the Mount Hood National Forest, right on the county line between Multnomah County and Hood River County.

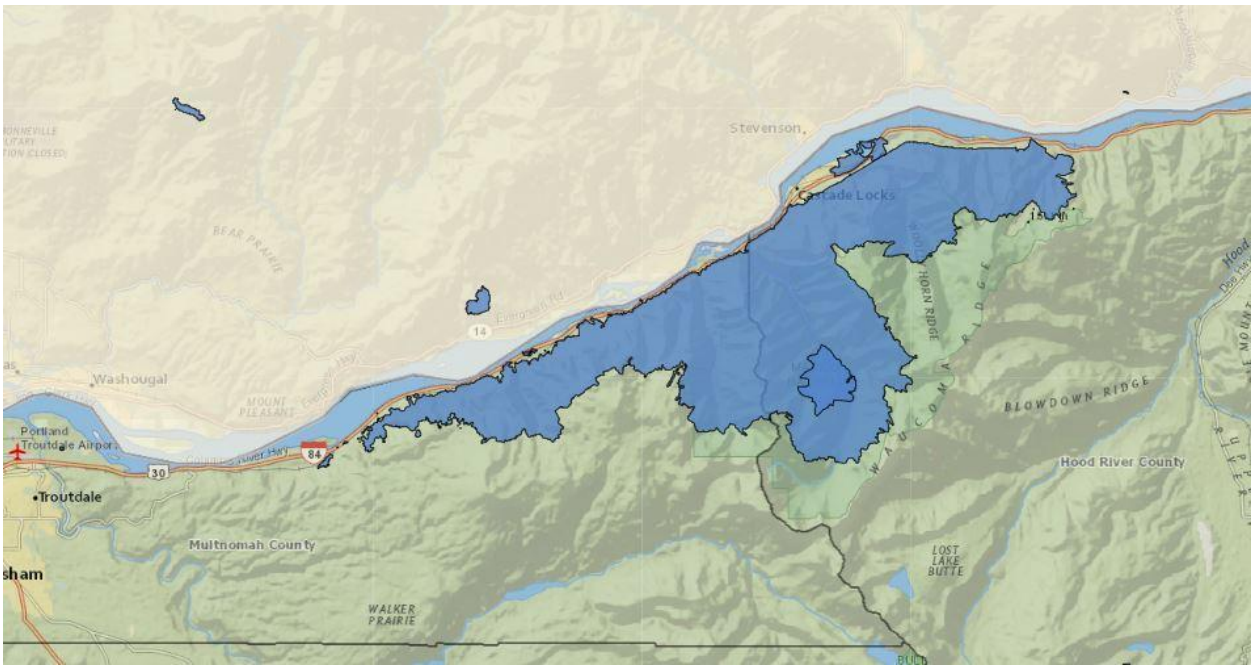


Figure 94 - Map showing full extent of the 2017 Eagle Creek Fire in Multnomah and Hood River Counties.

By the time the fire was contained on November 30, it had burned nearly 49,000 acres in the two counties, as well as a few spot fires that started across the Columbia River in Washington. Impacts to life and property were limited thanks to favorably shifting weather conditions and highly coordinated firefighting response. No one was killed and there were only four minor injuries and four burned structures. One-hundred seventy six hikers had to be rescued after being trapped by the fire. The Eagle Creek Fire was named a federally declared disaster, FM-5203.

The fire burned in primarily hemlock and fir forests, almost entirely on federal lands[80]. Although less than half of the area in the fire perimeter burned with moderate (30%) or high (15%) intensity, this was enough to cause severe and long-lasting impacts to the area. The fire did not reach incorporated areas or cause significant damage to unincorporated communities in the Columbia River Gorge. The blaze did require broad evacuations, including evacuation warning alert levels as far as the City of Troutdale.

[80] Eagle Creek Fire Story & Data, US Forest Service

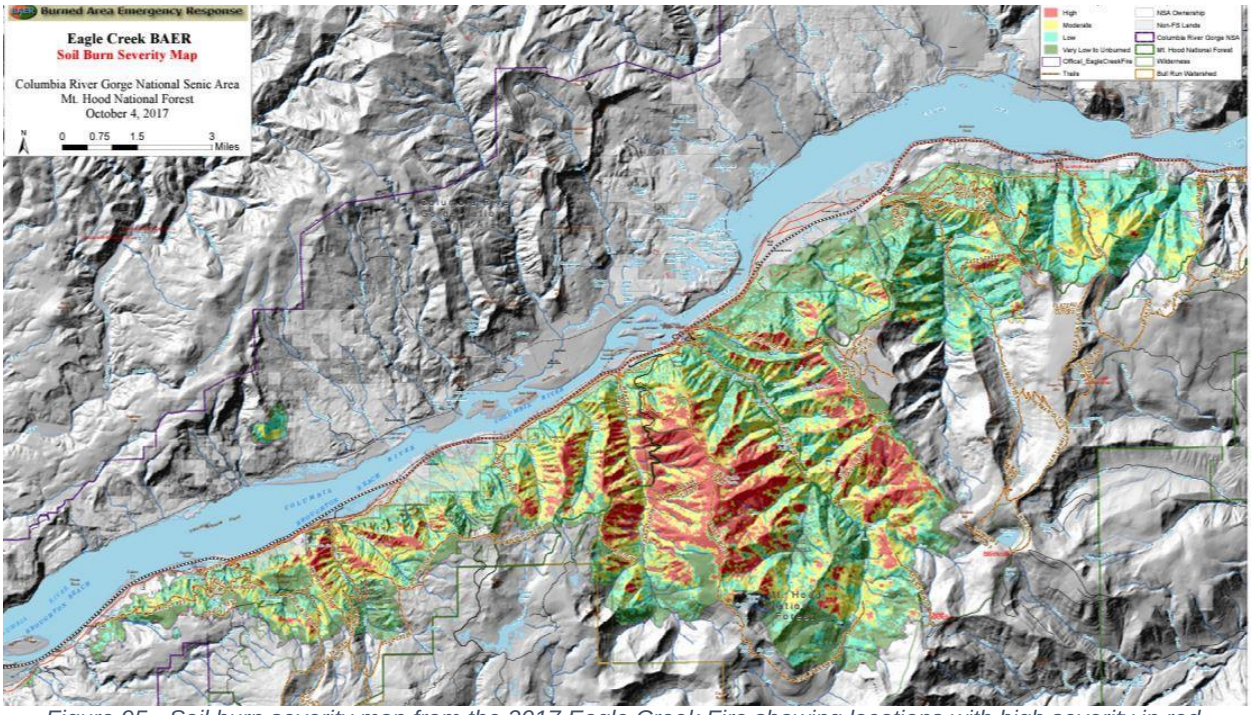


Figure 95 - Soil burn severity map from the 2017 Eagle Creek Fire showing locations with high severity in red, moderate severity in yellow, low severity in light green and very low to no impact in dark green. In low severity areas, ground cover is reduced but intact and the soil structure is unchanged, showing the normal mosaic of impacts in a large wildfire. Map from US Forest Service Eagle Creek Fire Story and Data page.

The fire was a traumatic event that caused sudden evacuation for those living in the Columbia River Gorge, threatened historic buildings and important infrastructure, and damaged recreational areas, closing some heavily used trails for multiple years. The fire produced smoke and ash throughout Multnomah County, and created dangerous conditions for rockfall, debris flows, and flash floods below burned slopes. The burn scar area was likely a contributing factor to a fatal 2020 landslide in Dodson.

Figure 96 - Landscape after the 2017 Eagle Creek Fire from Angel's Rest looking west in the Columbia River Gorge.

The fire closed Interstate Highway 84, a critical route, for 11 days going westbound and 19 days going eastbound. Rail transport through the Columbia River Gorge was closed for three days and river traffic on the Columbia River for two days.

The fire significantly raised the awareness of risk to wildfire in Multnomah County, as the largest fire in the county since at least 1902. Mitigation for wildfire was prioritized by communities across the county after the fire, including initiating a revision to the county's Community Wildfire Protection Plan.

- *Urban Wildfire, Portland August 2019*

A wildfire in Portland on August 26, 2019 was notable in that it was started on a small vegetated area within a highly urbanized area, and damaged five homes, two businesses and a number of vehicles. The total damage of the four-acre fire was around $2 million[81]. The fire occurred during a red-flag warning, a time when fire danger was considered to be critical because of dry vegetation, low humidity and high winds.

Figure 97 - Aerial photo of damage from the 2019 fire in Portland. Photo Portland Fire

The fire started in a brushy lot that had previously been a golf driving range, and was caused by arson. It is difficult to establish a probability of wildfire at this scale, yet many of the participating entities in this plan have vegetated lots large enough to create a fire that could spread to developed areas and become an urban fire, or vice versa. These smaller fires may also threaten unhoused residents living in or near open areas. The wildfire probability data used in this chapter defines an area with wildfire risk as being a potential source of a fire of 250 acres or more. A fire of that size may not be a significant risk for many of the entities in this plan. But as this fire showed, much smaller wildfires can still have dangerous potential in urban areas.

- *Wildfire Smoke 2020*

[81] Arrested for Northeast Portland Arson, *The Portland Observer*, November 26, 2019

The 2020 Oregon wildfire season was one of the worst in recent memory, burning over one million acres and destroying more than 4,000 homes statewide. Local fire districts were able to suppress wildfires that started in Multnomah County, sparing local communities from the devastation that occurred in other parts of the state. However, smoke from wildfires elsewhere caused the unhealthiest air ever recorded in Multnomah County.

Acute health impacts during this event were observed by a 75% spike of asthma-like symptoms seen in emergency rooms and urgent care clinics. Chronic health impacts from this event may take time to fully understand, but research indicates that exposure to wildfire smoke has tremendously negative health effects and leads to significant additional deaths over time.

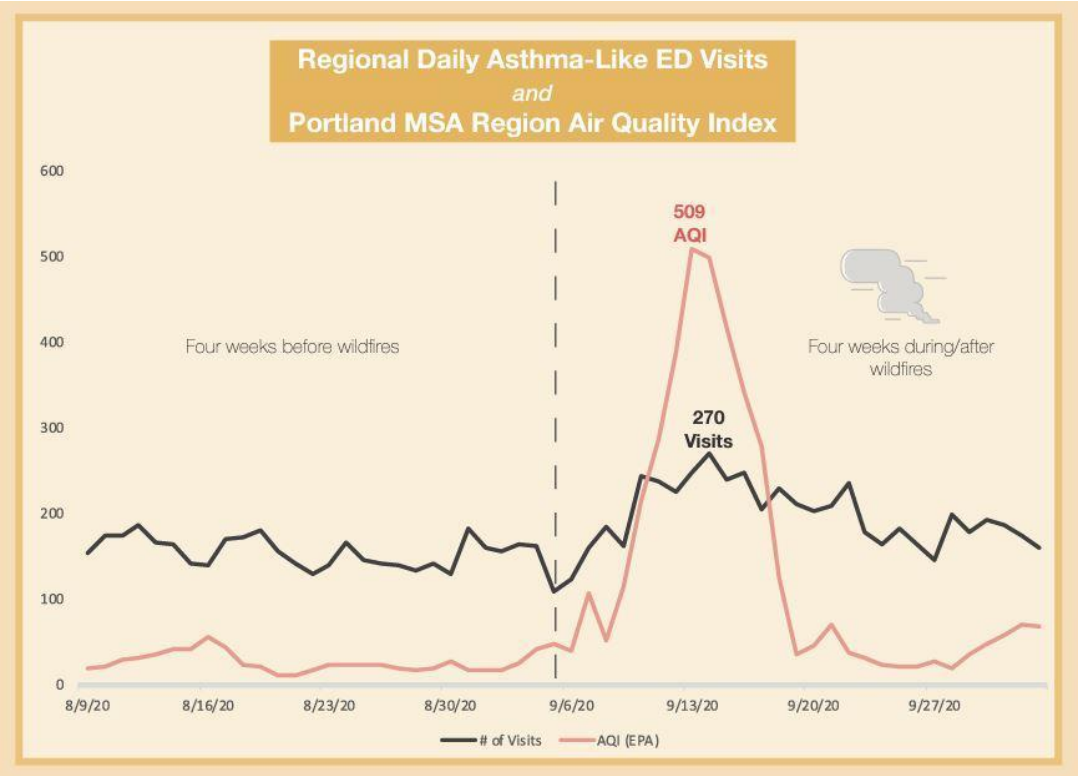


Figure 98 - Regional emergency visits for asthma-like symptoms before and after the 2020 Wildfire Smoke event. Graph by the US Environmental Protection Agency and used in the 2010-20 Regional Climate and Health Monitoring Report

The arrival of extreme winds on September 7, 2020 caused an explosion of new fires across Oregon and fanned existing fires into massive blazes. The largest fires burned in many different counties, primarily on the west slopes of the Cascades, and the smoke from these huge regional fires blanketed Multnomah County.

For a few days after the fires began, air quality in Multnomah County ranged from good to moderate, but on September 10, changes in wind direction caused fine particulate matter readings (PM2.5) to spike and kick off a week of record concentrations of these harmful particles. Concentrations peaked on September 13, with the highest Air Quality Index (AQI) reading in Multnomah County at 509, beyond the highest category on the measurement scale and considered to be immediately hazardous to health.

This was the first time that an AQI for PM2.5 had been recorded above 300[82] in Multnomah County. That record was exceeded for five consecutive days. Wind conditions eventually changed again and blew the lingering smoke out of the county fairly suddenly on September 16 and healthy air quality readings returned.

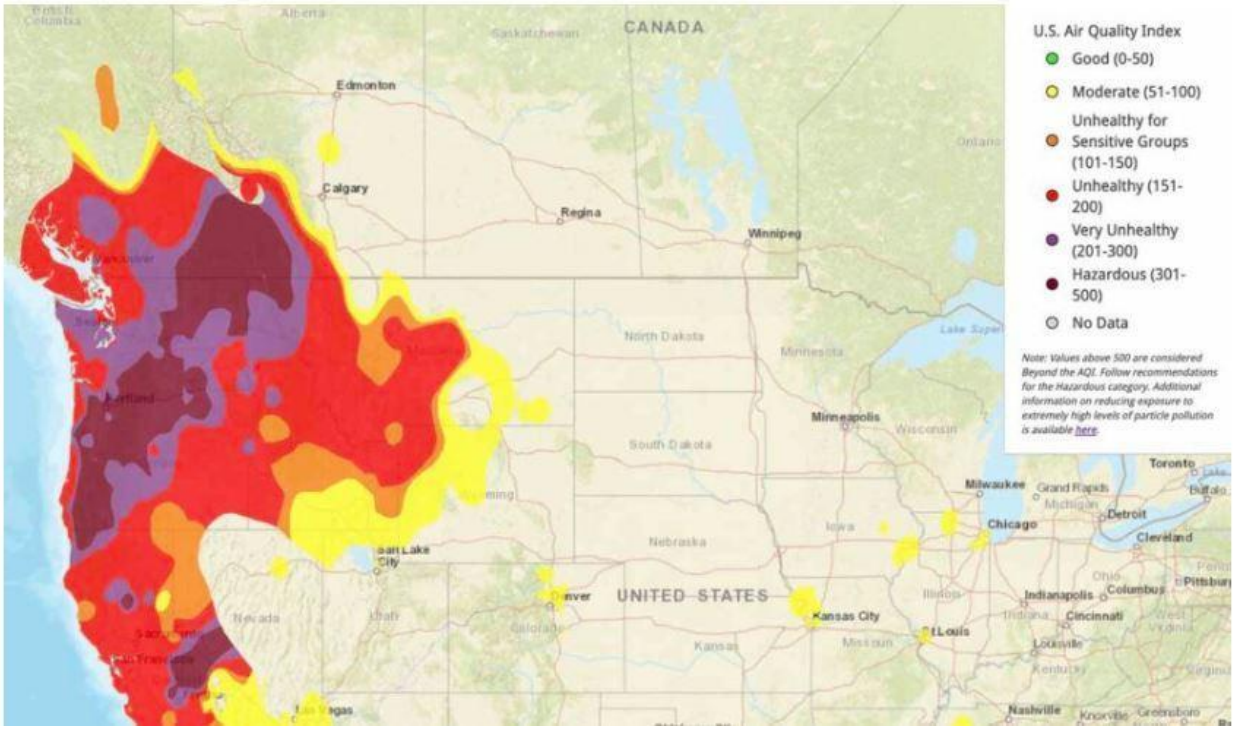


Figure 99 – Archived AirNow map showing concentrations of PM2.5 during the 2020 Wildfire Smoke event. Current real-time air quality information is available at AirNow.

No other recent wildfire smoke events have approached the 2020 event in severity, but unhealthy air levels have been reached several other times, most recently in October 2022.

Wildfire and Wildfire Smoke New Data, Analysis and Policy

- A revision to the 2011 Multnomah County Community Wildfire Protection Plan (CWPP) was initiated in late 2019, through post-wildfire grant funding available from FEMA after the Eagle Creek Fire. That process is ongoing and will be completed in early 2023. The revised plan will reflect the increased risk from climate change and heightened public concern over wildfire risk, incorporate updated risk assessment information, revise mitigation strategies, and include a new section on Wildfire Smoke mitigation. The section on Wildfire Smoke will create coordinated mitigation strategies for that hazard for the first time. That work has informed this portion of the NHMP and will be used in further updates after the completion of the CWPP.

- Risk, probability and vulnerability data for this chapter comes primarily from the Pacific Northwest Quantitative Wildfire Risk Assessment (QWRA), published by Pyrologix for the U.S. Forest Service in 2018. This project served to create a new foundational source

[82] 301-500 is the threshold for highest hazard.

of data for Oregon and Washington to use in wildfire disaster planning. The assessment considered multiple factors in creating its assessment of all locations in the two states:

  - the likelihood of a fire burning
  - the intensity of a fire if one should occur
  - the exposure of assets and resources based on their locations
  - the susceptibility of those assets and resources to wildfire.

The assets and resources considered include people, property, infrastructure and natural resources. The 2017 NHMP used an aggregated risk model with best available inputs at that time from the 2011 Multnomah County CWPP. Although that CWPP is still effective, the QWRA has superseded the risk analysis from that plan. Risk assessment inputs and QWRA outputs are hosted by the Oregon Wildfire Risk Explorer, a data product provided by the Oregon Department of Forestry.

- Senate Bill 762 was passed by the Oregon Legislature in 2021. This bill implemented policy recommendations made by the Oregon Governor's Wildfire Council, initiated in January 2019.

  Senate Bill 762 addressed mitigation strategies for both wildfire and wildfire smoke on a statewide level. The legislation is expected to provide mapping that will supersede some of the QWRA data, and be used to classify risk areas in Oregon for assessing newly funded mitigation programs. Programs will fund clean air shelters, air filtration systems and land restoration and management projects. The bill will also mandate higher building code standards for wildfire resistant structures in high-risk locations. Implementation is occurring as this plan is being reviewed, with the first mapping efforts published in summer of 2022. However the initial map release was pulled back and the QWRA maps are still considered to be the best available data for the time being. The Senate Bill 762 maps are expected to be released again in 2023.

- The Regional Climate and Health Monitoring Report for the Tri-County Region (Clackamas, Multnomah, Washington) was updated in 2021 to include data from climate change impacted events between 2018 and 2020. This update included specific health related impact information from the 2020 smoke event.

- A risk reduction report and workshop was jointly developed by the U.S. Environmental Protection Agency (EPA), Metro, and the Regional Disaster Preparedness Organization (RDPO) in April 2021. The report focused on extreme heat and wildfire smoke because of their effects on public health, inequitable impacts, and increased risk caused by climate change. The report outlined risk and vulnerability to wildfire smoke, and provided a selection of potential mitigation strategies to reduce impacts from future events.

Climate Change Impacts

The rate of wildfire across the western United States has steadily increased and is linked to climate change.

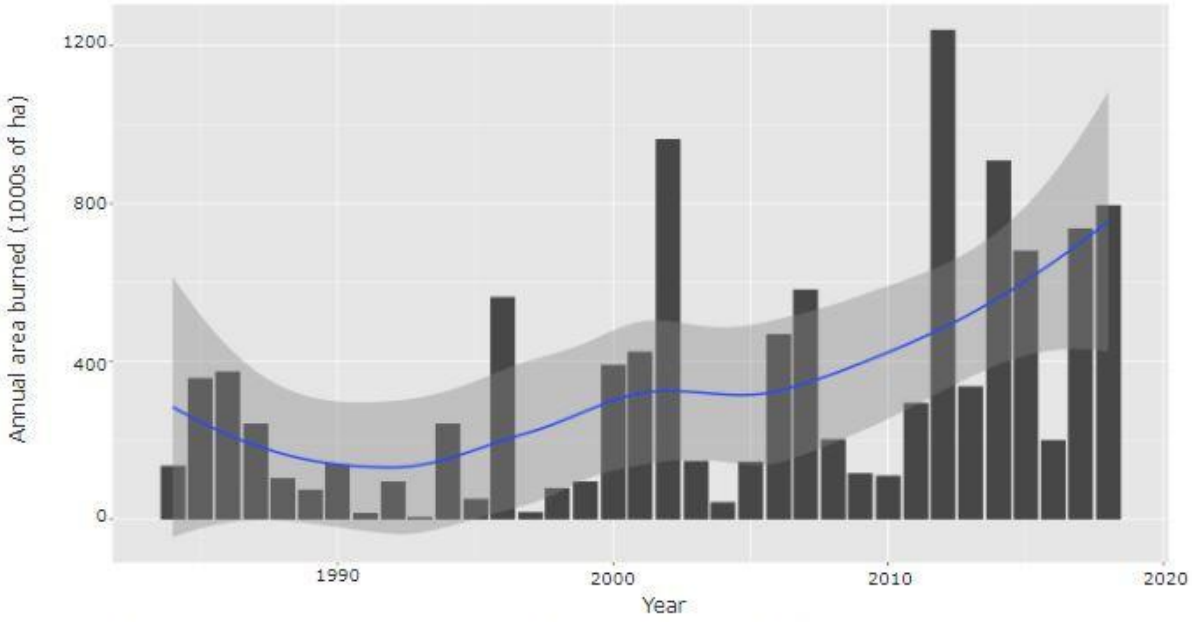


Figure 2. Annual area burned in Oregon from 1984–2018. Fires smaller than 988 acres (400 ha) were omitted. Data source: Monitoring Trends in Burn Severity (Eidenshink et al. 2007).

Figure 100 - Graph used in the Fifth Oregon Climate Assessment..

The effects of climate change that are most likely to lead to increased high-severity wildfire in Multnomah County are extreme heat and drought conditions, especially when they intersect with late summer/early fall dry easterly winds. Additional impacts are being seen from the change of tree species due to the warmer climate, additional tree mortality from drought or disease, and the advance of invasive plant species that may be more fire-prone or alter local fire ecologies.

Fire frequency and area burned are both expected to increase in Multnomah County, but the recent levels of fire and area burned had been small before Eagle Creek. Evidence exists that fire was periodically widespread in the area during previous major drought periods, before colonial settlement and widespread wildfire suppression.

The past fire history of Multnomah County has been of infrequent but very large fires, which makes it difficult to project exactly when and where those fires will become more likely. The complexity of how changes to forest species are changing risk is also challenging to predict. However, it is expected that the impacts of climate change locally are the exact same drivers that increase the probability of another catastrophic wildfire in Multnomah County.

3.6.1 Wildfire and Wildfire Smoke Location and Extent

Wildfire Location and Extent

Wildfire can happen in almost any vegetated area of even small size when conditions become hazardous enough. Forests have the most fuel to support the largest fires, but grass and brush fires and agricultural fires can also be origination points of damaging wildfires.

Areas of the highest risk were identified in the 2011 Community Wildfire Protection Plan. The Oregon Department of Forestry maintains these locally-identified areas statewide as 'Communities at Risk'.

Table 40 – Wildfire Communities at Risk in Multnomah County

Portland Fire & Rescue Bureau	• Skyline Ridge • Mount Tabor • Kelly Butte • Powell Butte • Johnson Creek Watershed • Oaks Bottom • Springwater & Flavel • Sullivan's Gulch • Willamette Bluffs Escarpment • Forest Heights	• Smith/Bybee Lake • Forest Park • Linnton • NW Portland (Pittock Mansion area) • Tryon Creek • Terwilliger Curves • Oregon Zoo & Hoyt Arboretum • Riverdale • Bull Run Watershed
Port of Portland Fire	• Elrod Road	• Government Island (Unprotected)
Gresham Fire Department	• Walters Hill/Gresham Butte • Ritchie Road • Oxbow Park • Lower Sandy River Bend	• 1000 Acres (a.k.a. Sandy River Delta) • Blue Lake • Wisteria Lane • Wistful Vista
Scappoose Fire District	• Holbrook Road • Logie Trail Road	• Gilkenson Road
Corbett Fire	• Trout Creek Road • Tout Creek Camp • Aims Road • Mannthay Road • Deverell Road • Gordon Creek • North Oxbow • Camp Angeles • Corbett Watershed • Brower/Palmer Mill	• Ricker/O Regan Roads • Howard Road • Alder Meadows • Maffet Road • Red Elder • Haines/Thompson Mill • Columbia Historic Hwy • Latourell/Alex Barr • Bridal Veil Lakes
Tualatin Valley Fire & Rescue	• Skyline Ridge • Cornelius Pass	
Structurally Unprotected Areas	• Warrendale-Dodson • Bonneville • Ainsworth	• Government Island • Eagle Creek
Sauvie Island	• Entire Island	

Locations of future fires are most likely to come where human activity intersects with wildfire risk caused by dry fuels and high winds. Nearly all fires in Multnomah County are human caused—with outdoor debris burning, cigarettes, campfires, equipment/vehicles and arson being the most common causes. In order to limit fire ignition, limitations have been placed on camping, outdoor burning and fireworks in some communities during high hazard periods.

Locations of wildfire events are also determined by where fires are most likely to escape control after ignition. Wildfire spotting and alerting can affect the probability of this outcome as well as the ability of fire services to access specific locations, the distance from a fire start to firefighting resources, and water availability. Ninety-eight percent of new wildfires are knocked down before

they become uncontrolled[83], making the location of catastrophic fires very dependent on conditions.

The locations of past fires give an idea of where risk of ignition may continue to be highest, because of continuing vegetation growth and intersection with human uses. The map below shows locations of fires between 1992 and 2019. Nearly every fire recorded was human-caused (red) rather than caused by lightning (yellow). The lack of fires in the old-growth forest of the Bull Run Watershed, which is not publicly accessible because of its critical importance as a drinking water source, further underlines how linked human uses are with wildfire ignition in Multnomah County. Lightning is a significant cause of fire in Southern Oregon and East of the Cascade Mountains.

An interactive version of this map can be found here (Fire History and Active Fires – Fire Locations 1992-2019)

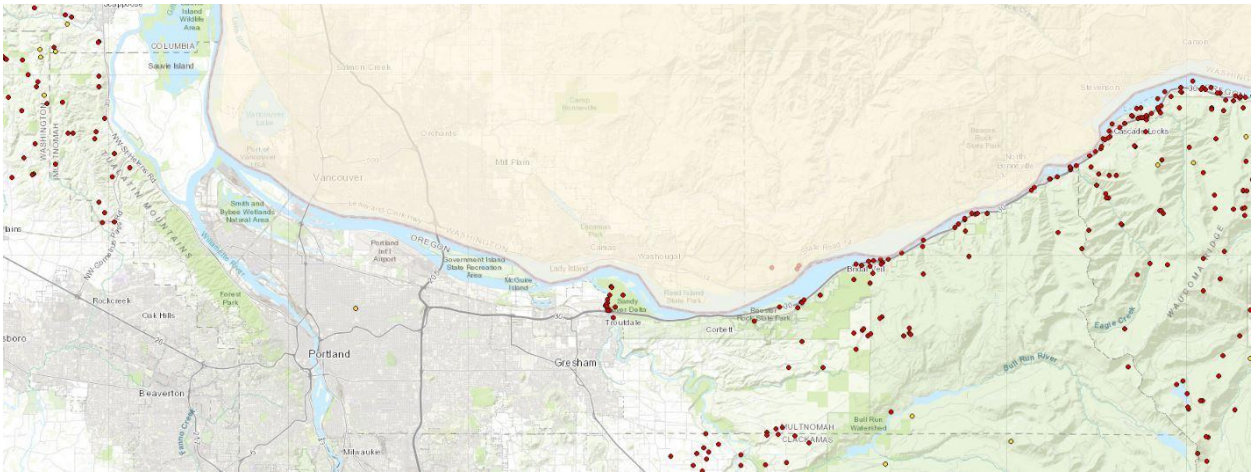


Figure 101- Map from Oregon Wildfire Explorer using data from a variety of sources.

This data set is limited by it including all fires of a tenth of an acre or more, and only including fires recorded in Oregon Department of Forestry service areas. Therefore, factors more likely to lead to catastrophic large fires (such as time of year or ignition location) are not captured and wildfires in urban locations are not included.

Wildfire Smoke

No local climate or geographical effects have been shown that significantly impact the smoke risk to different locations in Multnomah County. Wind direction and other atmospheric effects have been more important in determining when a smoke intrusion event occurs, and even smoke from distant wildfires can be extremely hazardous to health[84]. The majority of US mortality and asthma morbidity from wildfire smoke fine particulate matter occurs outside of the West.
The Air Quality Index for fine particulate matter readings (PM2.5) in Multnomah County during the Eagle Creek fire in 2017 peaked at 157—much lower than levels reached during the Labor

[83] The 98% Suppression Rate: Analyzing Extreme Wildfire Behavior, US Forest Service, Andrew Avitt, September 2022
[84] Estimated Mortality and Morbidity Attributable to Smoke Plumes in the United States: Not Just a Western US Problem, *GeoHealth*, August 21, 2021, K. O'Dell, K. Bilsback, B. Ford, S. Martenies, S. Magzamen, E. Fischer, J. Pierce.

Day smoke event in 2020, even though the smoke in 2020 came from outside of Multnomah County. Consequently, mitigation planning for wildfire smoke has treated the entire county as roughly equally subject to the hazard, and mitigation strategy has focused on protecting those most at risk from disparate health impacts.

3.6.2 Wildfire and Wildfire Smoke Probability and History

Wildfire

Historically, the wet forests of western Oregon have burned infrequently, but have periodically experienced catastrophic stand replacement fires where much of the forest is burned to the ground and eventually regenerates itself. The reason for this history is the wet climate, which promotes productive vegetation growth over long periods of time until severe enough drought combined with high winds creates conditions for huge fires. Some of the largest recorded fires in state history, such as the Silverton Fire in 1865 and the Tillamook Burn between 1933 and 1951, occurred in northwest Oregon.

Different parts of Oregon have extremely different natural rates of wildfire, and different ecosystems within those regions also have different rates. Dry forests in eastern Oregon may have natural return rates of fire of around a decade, as low-intensity fires frequently cleared underbrush and small trees while not killing large trees. The return rate of wildfire in wet Oregon forests, on the other hand, has been estimated as occurring every 100 to 400 years, creating similarities in frequency and scope with other infrequent but extremely catastrophic hazards like earthquakes. Areas dominated by grasslands, shrubs, and oak savannas have return wildfire rates closer to 35-100 years, even in a wet climate.

This vastly different fire probability carries a risk of creating an oversimplified understanding of vulnerability in statewide mapping, as most of the northwestern Oregon region is shown to have low risk of fire compared to other parts of the state. That probability does not necessarily reflect the large amount of people, structures and infrastructure at risk in wildland-urban interface areas, nor the potential risk to life safety created by infrequent wind-driven catastrophic fires. Therefore, vulnerability maps are used to define risk at the jurisdiction/district level in this plan rather than probability maps.

Currently probability maps hosted by the Oregon Department of Forestry show the highest risk of annual fire in Multnomah County occurring in the eastern portion of the county. These maps only consider fuel and topography characteristics and do not include future climate change impacts to probability.

An interactive version of this map can be found here (Burn Probability – Burn Probability)

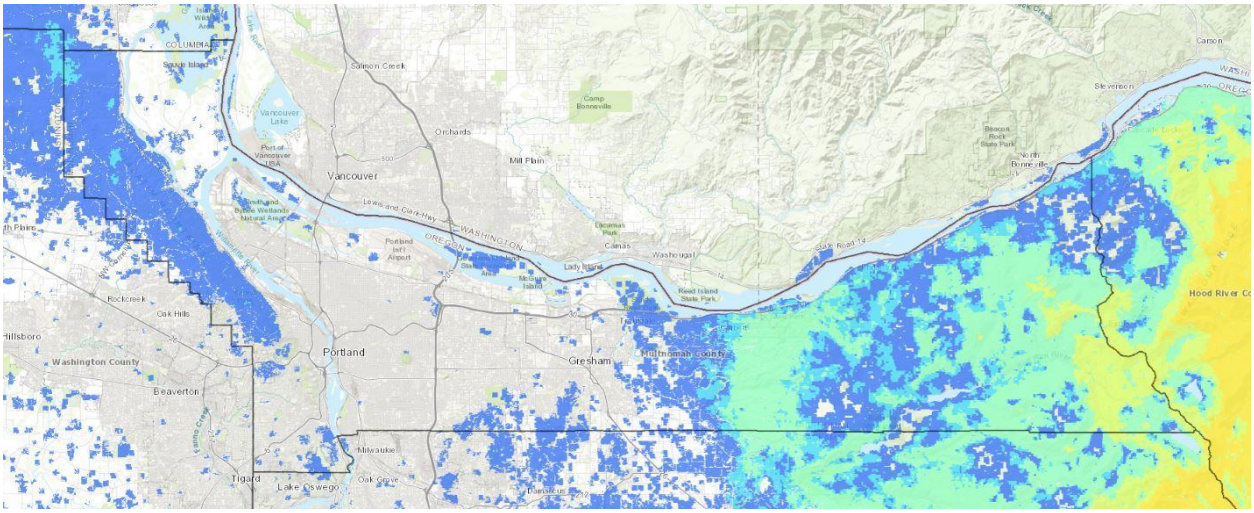


Figure 102 - Map showing burn probability at locations across Multnomah County. Map from the Oregon Wildfire Explorer using data collected in the PNW-QWRA. Most of western Multnomah County is considered to have low to moderate burn probability in this analysis with parts of western Multnomah County having moderate to high burn probability.

Wildfire Smoke

Probability of a wildfire smoke event is much higher than that of wildfire, as the county is susceptible to smoke coming from locations across the region. During drought periods with active fire seasons across the west coast, there is a likelihood that Multnomah County will experience at least some wildfire smoke impacts every summer. Acute disasters on the level of the 2020 event are clearly much rarer and were driven by fires nearer to Multnomah County. However, health impacts even from distant fires can still be extremely significant.

3.6.3 Wildfire and Wildfire Smoke Vulnerability

Wildfire

Wildfire vulnerability has not been quantified in the same way as hazards like earthquake or landslide. The overall fire risk in different locations has been classified, but the exact ignition location and intensity of future fires is highly variable and impacts are extremely dependent on circumstances. In the 2020 Oregon fire season, the Almeda Drive Fire in Jackson County in Southern Oregon started as a brush fire and burned only 3,200 acres—less than 10% the size of the Eagle Creek Fire. But because the fire traveled alongside a highway through populated areas it destroyed nearly 3,000 structures, far more than any other Oregon fire that year.

Mapping indicates which parts of Multnomah County face vulnerability from a major wildfire event. The Wildland Urban Interface (WUI) is the transition zone between developed land and major wildfire fuels. The WUI provides a high-level view of risk and includes highly developed locations that are not in vegetated areas, but could be impacted by embers from a large wildfire. In a 2010 analysis by the U.S. Forest Service, it was determined that 3.8% of Oregon is located in a WUI. The amount of WUI in Multnomah County is significantly higher because of the large county population located near Urban Growth Boundaries or large urban parks.

An interactive version of this map can be found here (Planning and Cadastral – Oregon WUI Hazard Rating)

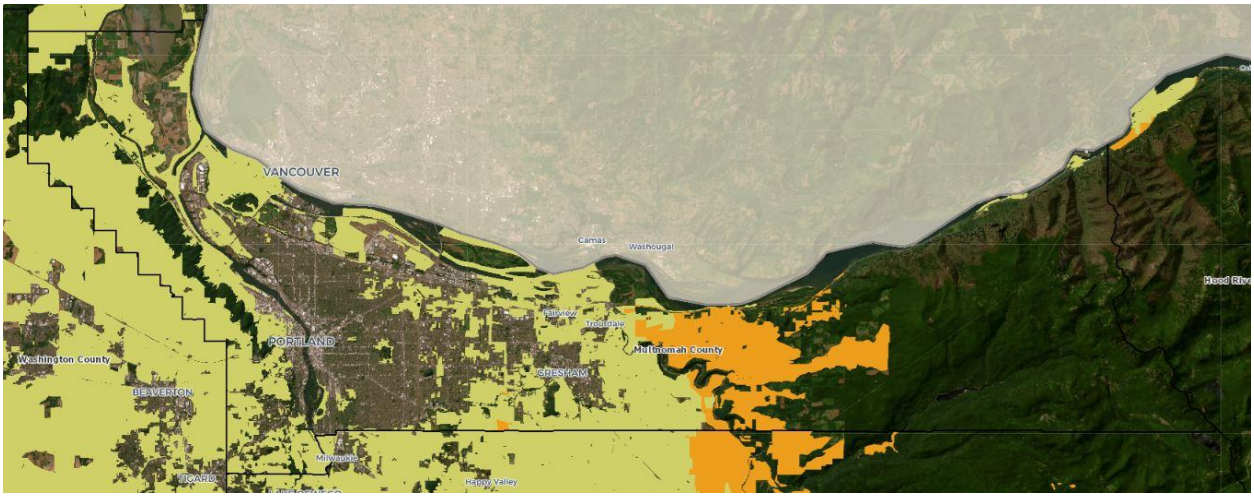


Figure 103 - A map showing identified WUI areas in Multnomah County as of 2017, using data from the 2011 CWPP. The orange areas are of higher risk than the yellow. Core urban areas are not considered WUI because they are not adjacent to wildfire fuels. Areas in eastern Multnomah County and the center of Forest Park in Portland are not consider WUI because of the lack of adjacent urban development. Map from the Oregon Wildfire Explorer with data from the Oregon Department of Forestry

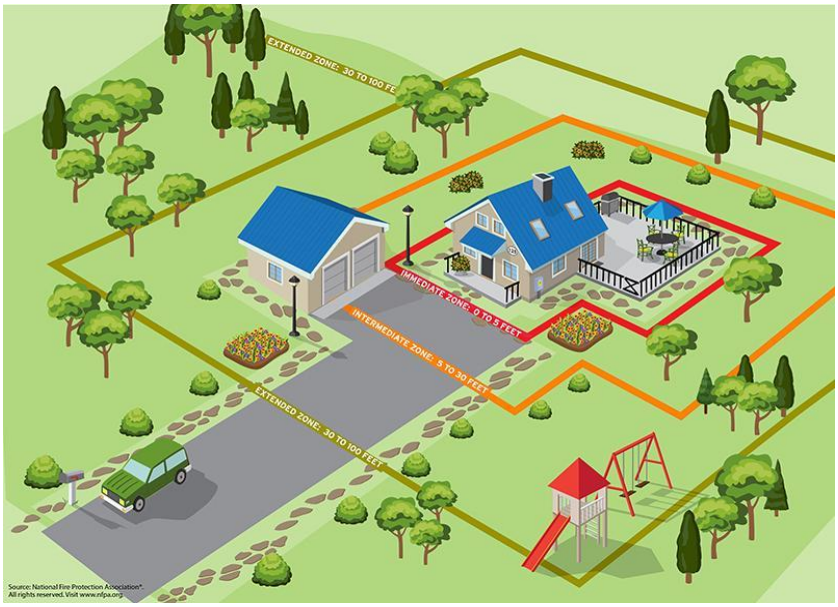


Figure 104 - A diagram of the home ignition zone, where work can be done to make it less likely a structure will ignite in a wildfire. Each zone has specific recommendations. Graphic from the National Fire Protection Association

A large wildfire can send embers up to a mile ahead of the main fire, creating spot fires and setting structures ablaze. Mitigation activities are recommended in WUI areas to increase the resilience of structures by clearing gutters and roofs of flammable material and the immediate areas around the structure of woodpiles and brush. Once structures catch on fire, they can spread the fire to adjacent structures and further spread embers into new neighborhoods or adjacent forests or brush.

WUI areas have been collected by ODF based on local determination. Senate Bill 762 is expected to standardize the definition and location of WUI areas statewide, but local areas will still be able to define their own risk based on local conditions.

Another way to consider wildfire vulnerability is to look at the PNW-QWRA's analysis of potential wildfire impacts, including risk to people, structures, infrastructure and natural resources. While statewide analysis of fire vulnerability often indicates low relative risk of wildfire in Multnomah County, this map indicates the high level of potential impact to the county's resources. This map only considers vulnerability in areas with wildfire potential, so it works well in coordination with

the WUI map – it classifies vulnerability in areas that are not included in the WUI map because they do not have structures but have infrastructure and natural resource values. Areas of vulnerability expand to include roads, high-tension power lines, and the Bull Run Reservoir, which could see significant erosion impacts on water quality after a major fire.

An interactive version of this map can be found here (Wildfire Potential Impact – Overall Potential Impact)

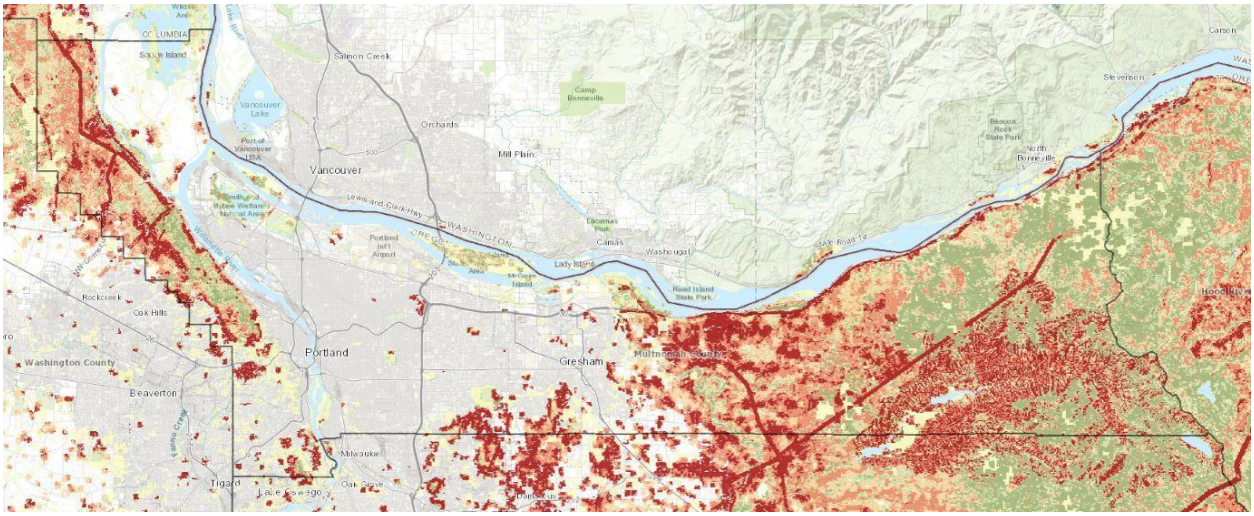


Figure 105 - Map showing risk to people and infrastructure from wildfire in Multnomah County. Darker red indicates highest risk. Map from the Oregon Wildfire Explorer, with data from the PNW-QWRA

Public Safety Power Shutoffs

Beginning in the summer of 2021, Portland General Electric (PGE) announced that they would implement a program of preventative power shutoffs in extreme wildfire conditions. This program had already been used in other parts of Oregon, and was extended to Multnomah County.

The other electricity providers in Multnomah County—Pacific Power, Columbia River PUD, and Cascade Locks City Electric—have not initiated this program in this county. Each of these providers has much smaller or more urban service areas compared to PGE.

The purpose of the shutoffs is to limit the possibility of wildfire ignition coming from power equipment, such as transmission lines and transformers. Factors that determine when this preventative shutoff might occur are extremely dry conditions and high winds. The first shutoff occurred in September 2022, when all four Public Safety Power Shutoff (PSPS) zones in Multnomah County were subject to late summer dry conditions and a high wind event similar in timing to the fire weather that led to the September 2020 Oregon wildfire event.

The lowering of ignition risk from electricity infrastructure is an important mitigation strategy to limit wildfire impact during the highest hazard periods. However, the potential shutoff of power for multiple days until conditions change and lines and other equipment can be inspected, does create vulnerability for those most reliant on powered medical devices, refrigerated medicines, air conditioning and air filtration. Multnomah County provided power and other supplies at two resource centers during the 2022 shutoff.

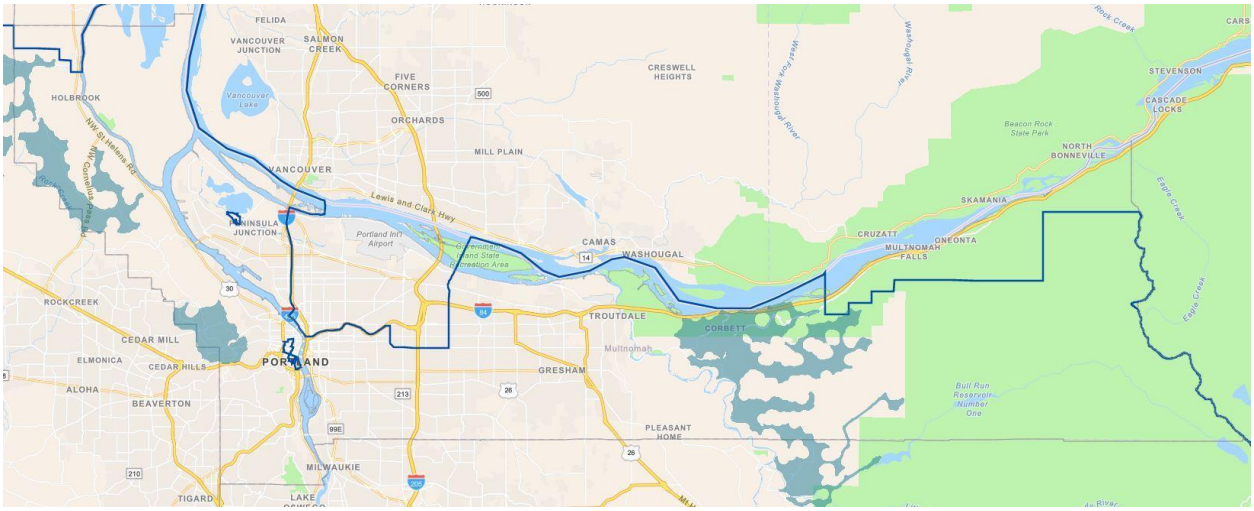


Figure 106 - Map showing PGE service area and PSPS zones during Summer 2022. This map should not be used to confirm PGE's planned power shutoff areas – instead check PGE's live map.

The current map of potential shutoff areas impacts only unincorporated Multnomah County and the City of Portland, with the most county residents affected in the Corbett area in east Multnomah County and in Portland's West Hills. However, these areas are re-evaluated every year, and are subject to change.

Wildfire Smoke

Vulnerability to wildfire smoke is centered on those most likely to suffer impacts. The fine particulate matter in wildfire smoke is harmful to people during an event, as evidenced by the sharp increase in emergency room visits during the 2020 September Smoke Event. But wildfire smoke also causes long-term chronic health impacts.

Those identified by the EPA as having the highest risk from wildfire smoke are:

- People with asthma and other respiratory diseases
- People with cardiovascular disease
- Children under the age of 18
- Those pregnant, and their fetuses
- Older adults
- Those without resources to avoid exposure to hazardous air, either through access to spaces with air filtration or the ability to leave the area
- Those required to work outside

Wildfire smoke is made up of a number of substances, many of which exist as solid or liquid particles suspended in the air. The smallest of these particles, known as PM2.5 (less than 2.5 microns in diameter) are particularly harmful to health and are commonly used as the measurement for hazardous air quality. Because of their size, these particles can easily make their way into homes and other buildings. Once breathed in they are small enough to enter the lungs and cause serious effects to the lungs and heart.

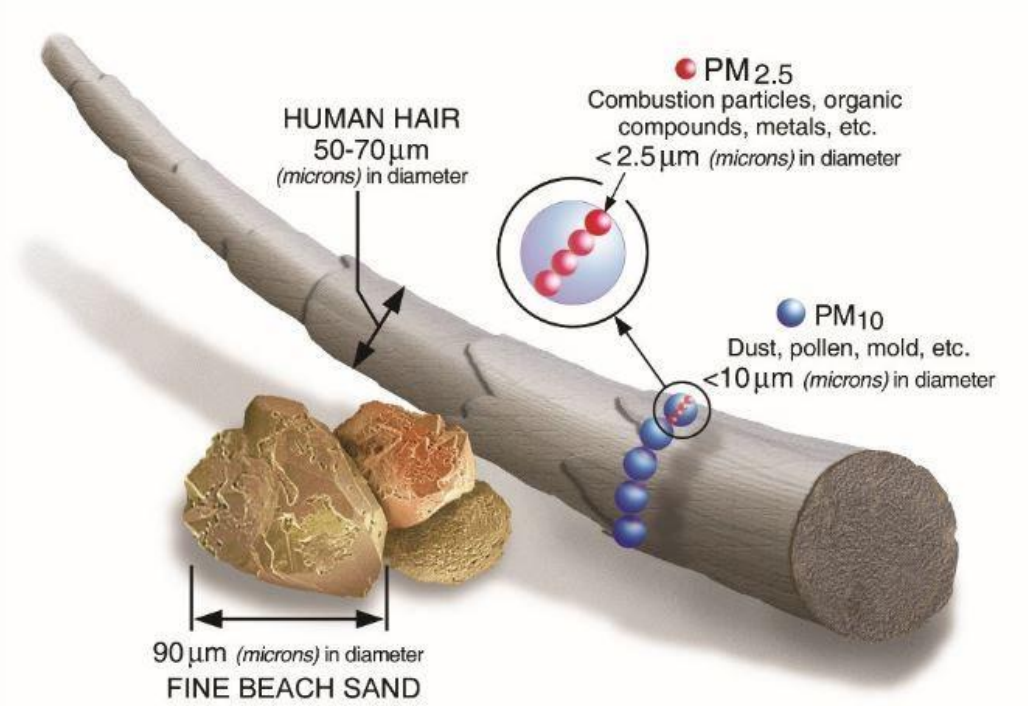


Figure 107 - Diagram showing the small size of wildfire smoke particles. Graphic from the US Environmental Protection Agency.

High concentrations of PM2.5 are the most likely to require immediate emergency medical care. But there is evidence that as smoke oxidizes over time, it may become more carcinogenic, meaning that even smoke from faraway fires can have long-term health impacts. Studies have indicated that thousands of deaths in the United States occur each year because of chronic exposure to PM2.5, and that the majority of those deaths occur east of the Rocky Mountains, showing the continuing danger of smoke even as it drifts far away from fires.

Rates of asthma, respiratory disease and cardiovascular disease are often higher in communities already facing disparate impacts from poor air quality. Impacts of smoke are also magnified in county locations that lack tree canopy to filter the air and prevent urban heat islands which simultaneously stress human systems. As noted in the Severe Weather chapter, areas with low rates of tree canopy are often linked with higher poverty rates, further establishing wildfire smoke as a hazard with a high potential for disparate impacts to underserved communities.

Interventions to prevent these disparate impacts have included the establishment of public clean air spaces and emergency shelters, distribution of home filters, and home weatherization programs

Chapter 4 – Public Comment and Planning Process

4.1 Public Comment

Gaining public input into mitigation plans is an important step in understanding the needs and priorities of the communities served, and how natural hazards can impact people disproportionately. This section is purposefully placed before the mitigation actions in order to emphasize the importance of this step in recognizing priorities.

Public participation is not a process limited to the period of time when the plan is being updated. The participating communities and districts in this plan have been gathering input continuously from constituents since 2017 through public meetings, community organization collaboration, outreach efforts, community communication and focus groups. Public input also does not end when the plan is published, as the needs of communities continue to evolve.

The Port of Portland and the Columbia Corridor Drainage Districts have each performed significant focus group efforts in the last few years to develop their priorities as part of the development of their first Natural Hazard Mitigation Plans.

All of the participating entities also distributed a short survey through social media and newsletters to gather community priorities and mitigation project ideas. For the 2017 plan, public input was primarily collected at live community events, with a table that allowed visitors to identify the hazards that they were the most concerned about. Because of the impacts of the COVID-19 pandemic on community gatherings, public input for this process was primarily gained through the website survey. The survey asked the same question of respondents as in 2017 so that answers could be compared for changes in attitudes about hazards over the last five years.

Internet surveys can be more inclusive for those who cannot attend or do not wish to attend community events. The internet survey was also published in multiple languages, while community event tabling did not have translators. The internet survey also asked additional questions that were not part of previous NHMP tabling, as people could take longer with a survey than they might wish to while stopping by a table at a community event. The survey was also able to collect responses over a fairly long period of time, allowing those interested to pick a time of their choosing to respond.

However, internet surveys are less accessible for those who do not use the internet or who have technology accessibility barriers. The survey is not considered to be a complete method of soliciting input from the public, and additional and ongoing engagement methods are part of the action strategies in this plan.

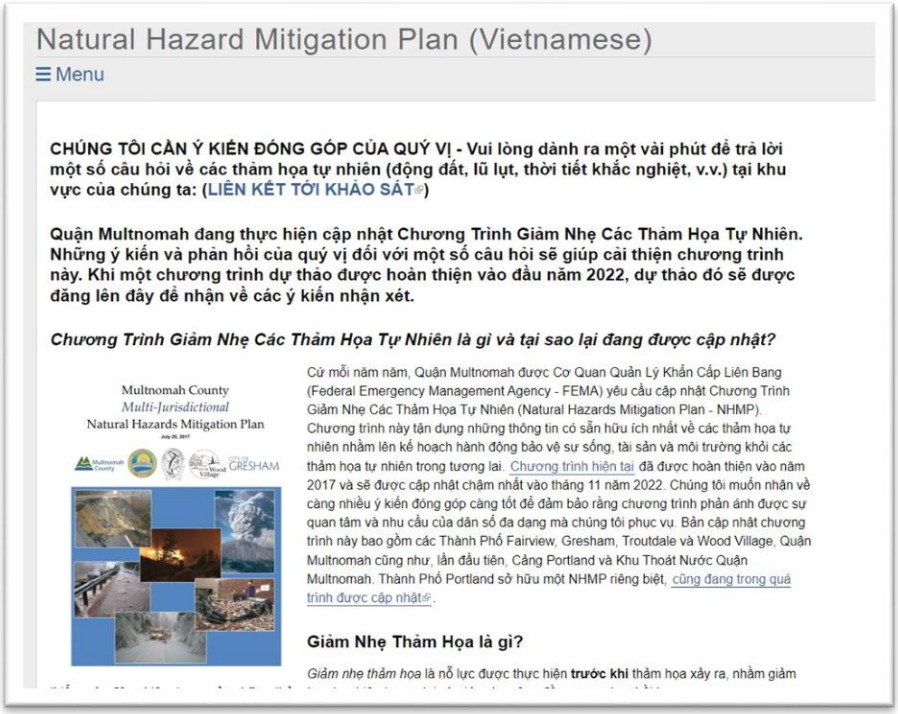


Figure 108 - NHMP update page in Vietnamese, one of six language pages with natural hazard info and a link to the survey detailed below. The pages are still available for reference.

The 2022 survey was distributed in English and in the five next most widely spoken languages—Chinese, Russian, Somali, Spanish, and Vietnamese. The survey was also publicized by the Multnomah County Office of Community Involvement to improve response rates in languages other than English.

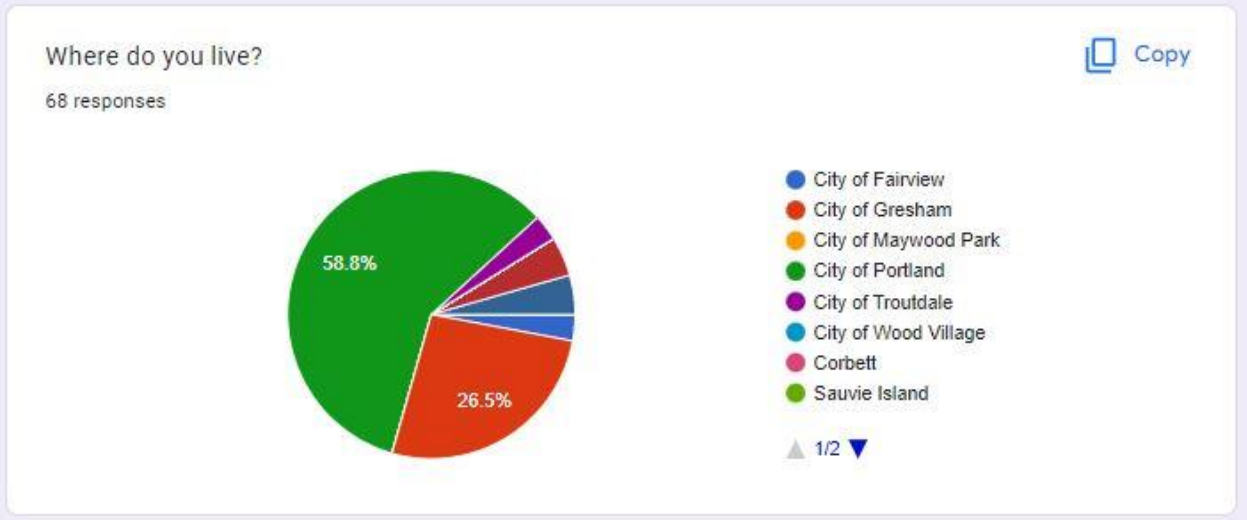


Figure 109 - English-language results from the NHMP survey.

The majority of English-language respondents identified as living in Portland (40), with a significant number also responding from Gresham (18). Other respondents selected being from unincorporated Multnomah County (3), outside of Multnomah County (3), the City of Fairview (2) and the City of Troutdale (2). Respondents from Portland may also include residents from parts of unincorporated Multnomah County with Portland addresses and constituents of the Columbia Corridor Drainage Districts and the Port of Portland.

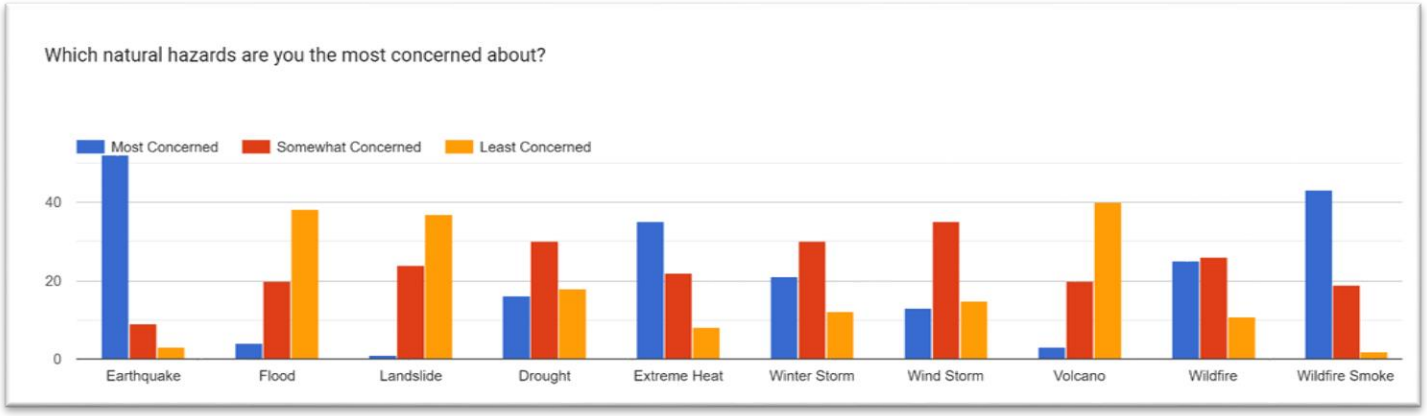


Figure 110 - English-language results from the NHMP survey.

English-language responses to the survey indicated continuing highest concern about earthquakes, with wildfire smoke and extreme heat rated as the next highest hazards of concern. The data collected in the 2017 plan had severe weather as one of the lowest hazards of concern, indicating that the extreme climate events of the last five years have significantly heightened public risk perception. This increased risk perception was also reflected in the suggested mitigation priorities provided by respondents.

Other hazards that impact Multnomah County on a more regional scale—drought, winter storm, windstorm and wildfire—were the next most concerning hazards. Flood, landslide, and volcano were of lowest concern, which perhaps reflects that these hazards are the most localized by geography and topography. Flood can happen regionally, but has not occurred at that scale since 1996, so these results may indicate that awareness of flood risk has become undervalued, especially considering that climate impacts are expected to increase the intensity of future floods.

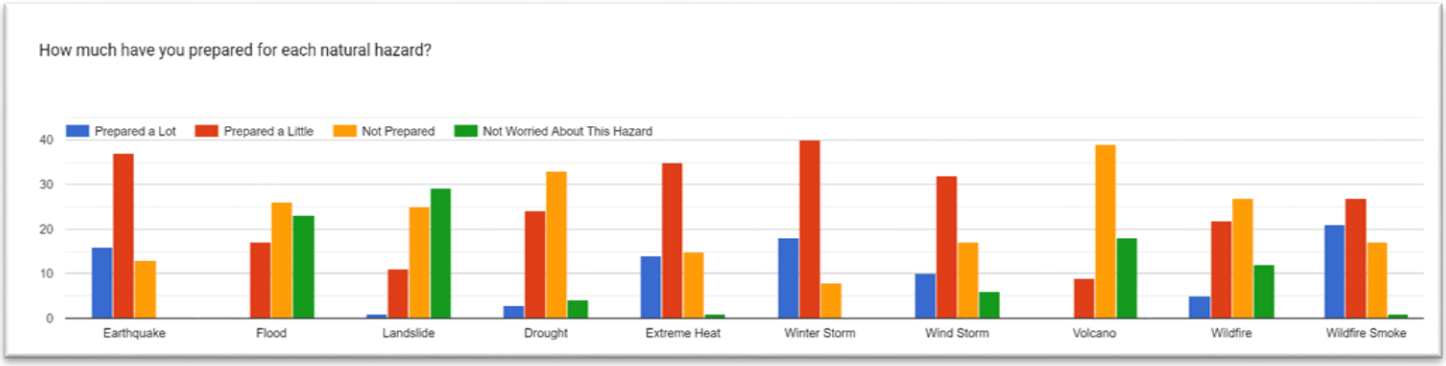


Figure 111 - English-language results from the NHMP survey.

The survey also asked how much people had prepared for each hazard, to get a further sense of risk perception and to cross-analyze which hazards are hardest for residents to feel prepared for.

Climate hazards were high on the list for preparation, showing the awareness of risk and that the preparation efforts for these hazards may be less costly and difficult to take on, such as adding air conditioning units, preparing homemade air filters, and low-barrier home weatherization. Preparation for earthquakes is not as complete compared to the high level of concern. This likely indicates a greater difficulty in preparing enough to feel safe—actions such as retrofitting homes and being able to provide long-term water and sanitation. The extreme and long-term impacts of a large earthquake may fundamentally make it difficult for residents to feel prepared.

Responses in languages other than English were provided in Russian (8) and Spanish (1).

Figure 112 - Russian-language results from the NHMP survey.

Responses in Russian were evenly split between Portland (dark green) and Gresham (red), with one response from outside Multnomah County. Russian language respondents identified extreme heat and wildfire and wildfire smoke as of the most concern, and indicated less concern than English-language respondents around earthquake.

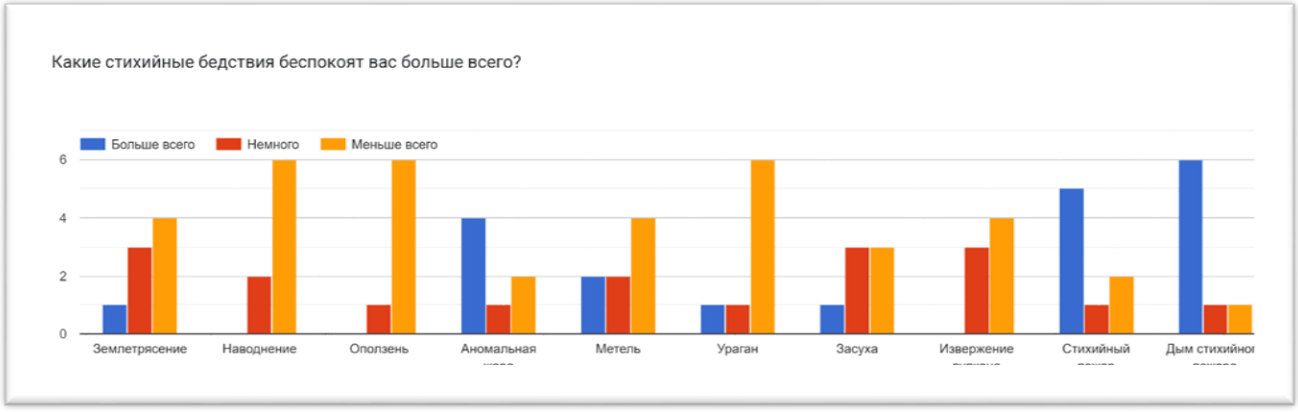


Figure 114 - Chart showing Russian language responses to the question of which hazards are you the most concerned about. Categories are in the same order as in the English-language version shown on the previous page.

The survey also asked respondents how money and resources could best be used to keep the community safe from natural disasters. Answers are printed in full in Annex E, but have been roughly grouped into categories here.

- The most commonly promoted strategy was to **provide personal disaster safety gear to residents**, especially those with less financial resources. Mentioned items included air conditioning units, portable air filters, evacuation go kits, earthquake post-disaster supplies, and informational resource booklets.
- A number of respondents asked for increased efforts to **financially support home retrofits** for earthquakes and weatherization. Providing subsidies for those homeowners who have faced historic housing discrimination was mentioned.
- **Increasing the resilience of infrastructure and critical facilities** was also a high priority, with bridges and reservoirs especially mentioned. Mitigating risk from earthquake to the Critical Energy Infrastructure Hub was also a top priority. Concern over water supplies after a major earthquake was frequently noted.
- Other suggestions focused on pre- and post-disaster actions for catastrophic disaster were the development of **supply cache locations, expanded and more accessible evacuation plans and evacuation exercises/events**.
- **Reducing the risk of wildfire through more intensive forest management**, including the use of controlled burning, was mentioned by multiple respondents.
- **Community building** was cited by multiple respondents as a strategy for increasing neighborhood resilience, including more use of local resources such as the City of Portland's Neighborhood Emergency Teams (NETs).
- **Continuing and increased emergency sheltering** those most at risk from extreme weather events was supported.
- Other suggestions related to climate disasters were to **increase tree planting and preserve more large trees**.

Port of Portland Focused Engagement

The Port of Portland undertook focused engagement related to earthquake mitigation and preparedness, in collaboration with a research team from the Portland State University School of Social Work. This engagement was to complete an analysis of community concerns and interests with respect to the role the Portland International Airport plays in emergency earthquake response and recovery. Specifically, the engagement sought to learn about the needs of individuals and groups most likely to be directly affected by a prolonged closure of the airport, based on demographic information about those working in major employment sectors in the region.

The research findings were that:

- A fast earthquake recovery is more important than other factors, particularly for people of color.
- Resuming airport service, even when solely emergency services, is symbolically important because it provides a sense of hope.

These findings indicate that using mitigation to reduce vulnerability to earthquakes in a way that maintains the ability to run operations at PDX is essential.

The Port also hosted a discussion about natural hazard risks at the public PDX Community Advisory Committee meeting on January 26, 2022. Priorities raised included:

- Mitigating harm to natural resources
- Having a coordinated plan across facilities to ensure the greatest benefit from investment
- Having continuous and independent power provision
- Using a climate-action lens in decision making
- Determining how the Port will serve the surrounding community and those at the airport, including understanding communication and preparedness limitations and barriers for some served communities.

Multnomah County Drainage District Focused Engagement

During Fall 2021, Multnomah County Drainage District staff created an online and mail survey to assess natural hazard concerns and priorities of people who work, live, or own property within all four of the existing drainage districts included in this plan. The survey was promoted in the district's newsletter and at District Board and landowner meetings.

The survey received 231 responses with the following key themes emerging:

- Participants recommended activities related to levee improvements, monitoring and maintenance as approaches to flood mitigation.
- Participants shared concerns about the impacts that camps of unsheltered residents have on the integrity and maintenance ability of flood infrastructure.
- Participants recommended that the drainage district engage in better education and outreach related to flood risk and general emergency preparedness.

Mitigation actions aligned with these engagement priorities are noted as such in the CCDD chapter.

Multnomah County Community Involvement Committee

The Community Involvement Committee (CIC) is Multnomah County government's advisory body for community engagement and involvement. The CIC makes direct recommendations to the Multnomah County Office of Community Involvement and County Leadership on topics relating to the removal of barriers to civic participation.

Multnomah County Emergency Management staff were invited to a committee meeting in January 2022 to discuss mitigation and response efforts for severe weather hazards. The committee also met with representatives from Multnomah County Sustainability, Health, Human Services, and Communications and the Joint Office of Homeless Services, and created a set of recommendations for actions to lessen the harm from extreme weather events.

The recommendations made are to:

- Resource the most vulnerable members of our community around severe weather events.
- Continue expanding and strengthening relationships with the community, including mutual aid organizations and school districts.
- Continue to assess the efficacy and accessibility of warming and cooling shelters for our most vulnerable community members.
- Increase collaboration with other jurisdictions to support long term solutions for community resilience.
- Increase collaboration with other jurisdictions to resource community members to shelter in place during an extreme weather event.

Each topic includes specific approaches and further implementation recommendations. The recommendations are available online.

4.2 Steering Committee and Stakeholders

The development of this plan was guided by stakeholders representing all of the participating entities, with multiple members from larger communities and an advisory and coordinating member from the City of Portland. In some cases, there was change of stakeholders during the plan process—those no longer with jurisdictions or districts are included to note their contributions to this effort.

Steering committee members provided specific information and mitigation strategies for their jurisdictions, through internal processes. Steering committee meetings were held with all participating members to develop shared plan content and collaborate on jurisdictional mitigation approaches.

City of Fairview

- Nolan Young, City Manager
- Allan Berry, Public Works Director

City of Gresham

- Kelle Landavazo, Emergency Manager
- Shannon Martin, Solid Waste and Recycling Manager
- Tina Núñez-Osterink, Natural Resources and Parks Planner
- Robin Pederson, Utility Resilience Coordinator
- Michael Whiteley, Water Division Manager

City of Portland

- Jonna Papaefthimiou, Chief Resilience Officer

City of Troutdale

- Arini Farrell, Assistant Planner
- Ryan Kruger, Assistant Planner
- Alex Lopez, Assistant Planner

City of Wood Village

- John Niiyama, Public Works Director

Columbia Corridor Drainage Districts

- Matt Burlin, Emergency Manager and Project Planner (Multnomah County Drainage District)
- Brian Eberhardt, Emergency Manager and Project Planner (Multnomah County Drainage District)
- Colin Rowan, Deputy Director (Multnomah County Drainage District)

Port of Portland

- Alex Howard, Senior Policy Development Manager

Multnomah County

- Jenny Carver, Human Services Emergency Manager
- Kevin Cook, Senior Land Use Planner
- Lisa Corbly, Emergency Management Planning Division Chief
- Mark Dorin, Facilities Specialist
- Tina Lefebvre, Transportation Division
- David Lentzner, Emergency Management Planner

Additional support and content were provided by:

- Beth Britell, Multnomah County Bridges
- Ashley Carroll, Multnomah County Disability Resource Specialist
- Celeste Duvall, Emergency Manager, Joint Office of Homeless Services
- Arini Farrell, Multnomah County Emergency Management Planner

- Ryan Linskey, Project Manager, Multnomah County Health Department
- Megan Neill, Engineering Services Manager, Multnomah County Transportation
- Mike Pullen, Multnomah County Communications Office

Content for the chapter on wildfire and wildfire smoke was provided by the many stakeholders of the ongoing update to the Community Wildfire Protection Plan (CWPP).

4.2.1 Steering Committee Meetings

All meetings listed were intended for all participating jurisdictions. This list does not include internal content meetings held stakeholders or individual content development meetings. When members were not able to attend a meeting, individual discussions were arranged to share meeting information.

2020

- **December 14 – Final 2017 NHMP Maintenance Meeting**

2021

- **February 5 – Plan Update Kickoff**
    - **Introduction/News**
    - **Project Timeline**
    - **Review of Mission, Goals, Objectives**
        - What has been successful about the current plan?
        - What would make the plan more useful for your jurisdiction/organization?
        - What are the key outcomes for this revision?
        - What new data/information is needed to make the plan more relevant?
        - How do we make the plan more equitable?
    - **Plan Revision Organization**
        - Decision Making Rules
        - Including Special Districts
        - Public Comment Strategy
            - 44 CFR § 201.6 (b) (1)
            - Additional Stakeholders
        - CWPP Integration
        - Plan Structure
        - Meeting Scheduling
        - Contingency Planning
        - Adoption
    - **Next Steps**
        - Next Meeting
        - Collecting information
            - Critical Facilities Review
            - Hazard Mapping
            - Event Histories
            - Development Trend Data
            - GIS Mapping
            - Photos (disasters, mitigation projects)
            - Other Plans, Studies, Technical Reports

- **May 25 – Equity Goals Discussion**
  - **Introduction**
    - Applying equity goals to NHMP planning process and completed plan
  - **Meeting Goal**
    - How can the plan be maintained/improved to meet your jurisdiction/district equity goals?
    - What in the plan should be defined collectively and what should be defined individually?
    - What are the next steps?
  - **Current Plan Elements (2017)**
  - **Vision, Goals and Objectives**
  - **Community Profile**
  - **Hazard Identification and Risk Assessment**
  - **Public Engagement**
  - **Mitigation Actions**
  - **Round Table Discussion**
  - **Next Steps**

- **June 23 – Hazard Identification and Risk Assessment Review**
  - **Plan Overview**
    - Introductions
    - Project Timeline
    - Plan Structure
  - **Equitable Hazard Planning**
    - Equity Strategy
    - Mapping and Data
    - Public Engagement
  - **Hazard Assessments**
    - Risk Rankings Exercise
    - Hazard Characterization Update
  - **Next Steps**
    - Future Meetings
    - Parking Lot Items
    - Conclusion

- **November 2 – External/Regional Stakeholder Input Workshop**
  - **Introductions**
  - **NHMP Update Process and Mitigation Action Development Process**
  - **NHMP Stakeholders Report**

    What are your current priorities for reducing risk from future natural hazards events? What has happened in your community/district in the last five years that is determining those priorities?

    - City of Gresham

- City of Fairview
- City of Troutdale
- City of Wood Village
- Port of Portland
- Multnomah County Drainage District
- Multnomah County

- **Regional/External Stakeholders Report**

  What do you see as the biggest concerns from natural hazards for your communities/constituents?

  - City of Portland
  - Tri-Met
  - Home Forward
  - NAACP Environmental Justice Committee
  - Portland Harbor Community Coalition
  - Metro
  - Multnomah County Sheriff's Office

- **Shared Mitigation Action Brainstorm Exercise**

- **Brainstorm Review and Discussion**

2022

- **<u>May 3 – Mitigation Action Workshop</u>**

  - **Welcome, Introductions**
  - **Project Status**
  - **Mitigation Strategy Overview**
  - **Group Discussion – Mitigation Strategies**
    - All-Hazard Strategies
    - Earthquake
    - Severe Weather
    - Flood
    - Wildfire and Wildfire Smoke
    - Landslide
    - Volcano
    - Adjourn

- **August 24 – Mitigation Action and Plan Adoption Discussion**
    - **Introductions and Meeting Goal**
    - **Revised Plan Update Timeline**
    - **Plan Adoption Discussion**
    - **Open Questions**
    - **Finalize Maintenance Plan**
    - **Mitigation Action Discussion**
        - Breakout Discussions
        - Large Group Discussion
    - **Next Steps and Close**

4.2.2 External Stakeholder Input

Input from external stakeholders was received through multiple methods. Most significantly, the Steering Committee included a representative from the City of Portland. Portland maintains their own plan, but is an essential partner for the Special Districts in this plan, works closely on initiatives with Multnomah County, and has additional services or infrastructure (such as the Bull Run Reservoir) with importance to residents outside Portland itself.

A meeting was held on November 2, 2021 to share information and mitigation planning with other partners, including those representing organizations supporting affordable housing, regional transit, emergency services and environmental justice.

Regional coordination was maintained by the participation of Multnomah County Emergency Management in a regional mitigation/recovery sub-committee to the REMTEC (Emergency Managers Work Group) committee of the Regional Disaster Preparedness Organization (RDPO). RDPO supports work over five Portland-area counties. The Mitigation/Recovery Subcommittee provides a venue for county or city planners to convene and share information about mitigation planning work, including NHMP updates.

The inclusion of the Columbia Corridor Drainage Districts and Port of Portland as partners in this update has created an important enhancement of priority and coordination with key lifelines. These districts represent some of the most important infrastructure in Multnomah County for natural hazard mitigation or recovery.

4.3 Continuing Plan Comment and Further Plan Updates

After this plan is formally adopted it enters a period of maintenance, the timespan before the next required update in five years.

As part of a transition of the NHMP to become a more living document and because of some limitations of soliciting input during the plan revision process due to COVID-19 - public and additional stakeholder comment will continue to be sought during the maintenance period.

Revisions will be considered annually, or comments will be maintained throughout the maintenance period to be used in the next update. Ideally, public comment will be prioritized outside of the update process itself, so that it is not bound by update timelines.

Steering committee meetings will be held twice per year during the plan maintenance period. Along with the incorporation of new public or external stakeholder input, these meetings will discuss:

- Funding opportunities
- New risk or vulnerability data
- Mitigation action progress and mitigation successes
- Ongoing public engagement outcomes
- Elected official priorities
- Lessons learned
- Plan update priorities
- Shared project work and new mitigation action identification

Chapter 5 - Jurisdictional/District Profiles

This chapter is divided into seven sections, each with specific information for the participants in this multi-jurisdictional plan. All of the entities that make up the Columbia Corridor Drainage Districts are combined into a single volume.

Each section begins with the mitigation strategies identified for the jurisdiction or district(s). Mitigation strategies are organized by hazard (multi-hazard first, then alphabetically), and the listed by priority score order within each hazard. The format for all actions is the table shown here:

Hazard	Action ID	Mitigation Actions – City or District							
Multi-Hazard	1	**Mitigation Action**							
		Plan Goals –		Hazards Addressed –					
		Lifelines – Community Resilience		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
				-	-	-	-	-	-
		Potential Funding –							
		Potential Implementation Methods –							
		Notes -							

Each mitigation action has a unique number for that section (numbers are repeated between jurisdictions/districts). Actions which address two or more hazards are indicated as multi-hazard, with the specific hazards mitigated shown in the table under 'hazards addressed'.

The Plan Goals box shows which of the shared NHMP goals each action addresses. Those goals are located in Chapter 1.

- Goal 1 – Strengthen the capacity of the whole community to reduce risk by increasing hazard awareness.
- Goal 2 - Create partnerships to fully leverage funding, and other implementation and policy opportunities.
- Goal 3 – Develop mitigation actions that leverage strengths and reduce vulnerabilities to community systems and lifelines.
- Goal 4 – Prioritize mitigation strategies that reduce disparities in risk to historically underserved and underrepresented communities.

- Goal 5 – Prioritize mitigation strategies with high benefit-to-cost ratios, those that reduce risk from multiple or cascading hazards, those that address problems identified in other plans, and those made more feasible by having public support.

The Lifelines box shows which Lifeline or Community System is addressed by the action. Lifelines and community systems are defined earlier in the plan and are intended to be relatable to FEMA's National Response Framework, although the exact same classifications are not used in this plan.

The prioritization criteria is unchanged from the 2017 NHMP. Each jurisdiction/district evaluated their mitigation actions using the criteria described below. A total priority number (up to 15 points) was created by adding the five criteria. The Capacity criteria serves as a measure of whether or not actions are short-, medium-, or long-term goals.

Criteria	High (3 points)	Medium (2 point)	Low (1 point)
Equity	Social benefits are highly likely, especially for people in areas with high hazard exposure and for people who have been disproportionately impacted by natural disasters.	Social impacts are likely to be neutral to positive, especially for people in areas with high hazard exposure and for people who have been disproportionately impacted by natural disasters.	Social impacts are likely to be neutral, especially for people in areas with high hazard exposure and for people who have been disproportionately impacted by natural disasters.
Benefits	Supports compliance with a legal mandate or will have an immediate impact on the reduction of risk exposure to life and property.	Will have a long-term impact on the reduction of risk exposure to life and property.	Long-term benefits of the action are difficult to quantify in the short term.
Costs	Possible to fund under existing budget. Project is or can be part of an existing ongoing program or would not require substantial effort to initiate or appropriate funds.	Possible to budget for under existing work-plan, but would require a reapportionment of the budget or a budget amendment.	Existing work plan and funding levels are not adequate to cover the costs of the proposed project.
Risk	Addresses a high-risk issue as described in the local risk assessment.	Addresses a moderate-risk issue as described in the local risk assessment.	Addresses a low-risk issue or has not been assessed for the level of risk.
Capacity	Capacity is highly feasible within 1 to 3 years.	Capacity is feasible within 5 years, but may need to be further explored.	Capacity is uncertain to unlikely within 5 years.

Within each section, there is an overview of the community or district and a summary of natural hazard impacts, mitigation successes and data improvements since the last version of the plan. Although the Columbia Corridor Drainage Districts and Port of Portland were not part of that

plan, they have the same format – but their chapters do have differences in organization that represent their specific missions.

The hazards have been classified for a level of risk to that jurisdiction or district, with a symbol applied to represent high, medium or low risk.

High Risk

Moderate Risk

Low Risk

A table is included at the back of each section with the scoring that was used by the community to determine these risk categories. Note that each community did their own analysis so the risk categories can be used for comparison across jurisdictions, but the risk scores should not.

5.1 City of Fairview

5.1.1 Mitigation Actions

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Fairview</th></tr>
<tr><td rowspan="8">Multi-Hazard</td><td rowspan="8">1</td><td colspan="8">Regularly share hazard materials and risk information, including in languages other than English, at City of Fairview events such as Fairview on the Green and National Night Out.</td></tr>
<tr><td colspan="3">Plan Goals – 1,4,5</td><td colspan="5">Hazards Addressed – All Hazards</td></tr>
<tr><td colspan="3">Lifelines – Community Resilience</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Public Works</td><td>Multnomah County Emergency Management</td><td>3</td><td>2</td><td>3</td><td>2</td><td>3</td><td>13</td></tr>
<tr><td colspan="8">Potential Funding – Existing Public Outreach Budget</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Existing City Staff Capacity</td></tr>
<tr><td colspan="8">Notes –</td></tr>
</table>

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Fairview</th></tr>
<tr><td rowspan="7">Multi-Hazard</td><td rowspan="7">2</td><td colspan="8">Identify water and wastewater system resilience opportunities, including well houses and wastewater pump stations housed in unreinforced block buildings and increasing resilience of newly constructed infrastructure.</td></tr>
<tr><td colspan="3">Plan Goals – 2,3,5</td><td colspan="5">Hazards Addressed – Earthquake, Flood, Landslide</td></tr>
<tr><td colspan="3">Lifelines – Water and Wastewater Infrastructure</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Public Works</td><td>Finance Director</td><td>1</td><td>3</td><td>3</td><td>3</td><td>3</td><td>13</td></tr>
<tr><td colspan="8">Potential Funding – Internal Funding, FEMA HMA Grants</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Water and Wastewater Master Plan</td></tr>
<tr><td colspan="8">Notes –</td></tr>
<tr><td rowspan="7">Multi-Hazard</td><td rowspan="7">3</td><td colspan="8">Publicize severe weather and wildfire smoke risks by providing accessible preparation, warning and alert information on the city website.</td></tr>
<tr><td colspan="3">Plan Goals – 1,4,5</td><td colspan="5">Hazards Addressed – Severe Weather, Wildfire and Wildfire Smoke</td></tr>
<tr><td colspan="3">Lifelines – Community Resilience</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Public Works</td><td>Finance Director, Information Technology</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td><td>10</td></tr>
<tr><td colspan="8">Potential Funding – Existing Budget</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Existing City Staff Capacity</td></tr>
<tr><td colspan="8">Notes –</td></tr>
</table>

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Fairview</th></tr>
<tr><td rowspan="7">Earthquake</td><td rowspan="7">4</td><td colspan="8">Assess the feasibility of seismic retrofits at City Hall and the Crestwood Shop, which stores Public Works' outdoor equipment.</td></tr>
<tr><td colspan="4">Plan Goals - 3,5</td><td colspan="4">Hazards Addressed - Earthquake</td></tr>
<tr><td colspan="4">Lifelines – Public Facilities</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>City Manager</td><td>Finance Director</td><td>1</td><td>2</td><td>1</td><td>2</td><td>1</td><td>7</td></tr>
<tr><td colspan="8">Potential Funding – FEMA HMA grants or other external funding</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Emergency Operations Plan</td></tr>
<tr><td colspan="8">Notes -</td></tr>
<tr><td rowspan="7">Flood</td><td rowspan="7">5</td><td colspan="8">Maintain participation in Levee Ready Columbia and support continuing accreditation of Columbia Corridor Drainage District levees.</td></tr>
<tr><td colspan="4">Plan Goals – 2,3</td><td colspan="4">Hazards Addressed - Flood</td></tr>
<tr><td colspan="4">Lifelines – Levee and Drainage System</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>City Manager's Office</td><td>Levee Ready Columbia, Public Works Director, Citizen Representation</td><td>1</td><td>3</td><td>1</td><td>3</td><td>2</td><td>10</td></tr>
<tr><td colspan="8">Potential Funding – Budgeted - unknown costs to reach accreditation depending on requirements</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Levee Ready Columbia</td></tr>
<tr><td colspan="8">Notes -</td></tr>
</table>

5.1.2 City Overview

The City of Fairview was incorporated in 1908 and covers about 3.5 square miles of land in the eastern half of Multnomah County. Fairview is completely surrounded by the municipalities of Gresham (west, south), Wood Village (east) and Troutdale (east), apart from the northern boundary, which reaches the south bank of the Columbia River. Within the perimeter of the city, only one Multnomah County unincorporated area remains—the Interlachen Lane neighborhood between Blue Lake and Fairview Lake.

Fairview has historically been a residential and agricultural community. The city grew substantially with suburban residential development in the 1960s, after levees, flood channels, holding ponds, and other flood-control measures stemmed repeated flooding in the Columbia River and adjacent wetlands. Despite that significant growth, wetlands have been maintained in the city, and are expected to remain 22% of the jurisdiction at full buildout. Major recreation areas are located at Blue Lake Regional Park (operated by Metro) and Salish Ponds Wetlands Park (City).

Figure 113 - City of Fairview boundaries outlined by red line.

Due to its small size and location near the Columbia River, the topography of Fairview is fairly flat without many steep slopes. Thanks to successful flood protection infrastructure, flooding is not considered to be a primary hazard to the city. Severe weather and wildfire smoke that impact everyone in the community have become of the highest concerns, and Fairview also has significant vulnerability from a major earthquake.

Population growth has slowed over the last 20 years, with new annexations ending in the 1990s. Increases in population have been the result of infill and increased housing density, with the population increasing at about 150 residents per year since 2000. Below is the summary of Fairview's population growth.

Table 40 – Fairview Population by Census Year (For population details, see Community Profile chapter)

Census or Estimate Year	Total Population – City of Fairview	Percentage Change
2000	7,561	216.2% (1990)
2010	8,920	18.0% (2000)
2015 (est)	8,940	
2020	10,424	14.4% (2010)
2021 (est)[85]	10,446	

Fairview has a population that is older than average within Multnomah County, and has seen significant increase in the percentage of residents over the age of 65 since the 2017 NHMP was published. Fairview's Hispanic population of any race is also much higher than the county average, with over 20% of residents identifying as Hispanic or Latino in the 2020 Census.

The city is divided into four neighborhoods for planning purposes. Commercial development is along primary east-west routes while residential areas are located on both sides of I-84. Industrial development is centered in the eastern part of the city, and the preserved wetland parks sit at the northern and southern ends of the city.

[85] 2021 population estimates from the Portland State University Population Center. All other totals or estimates come from the US Census Bureau

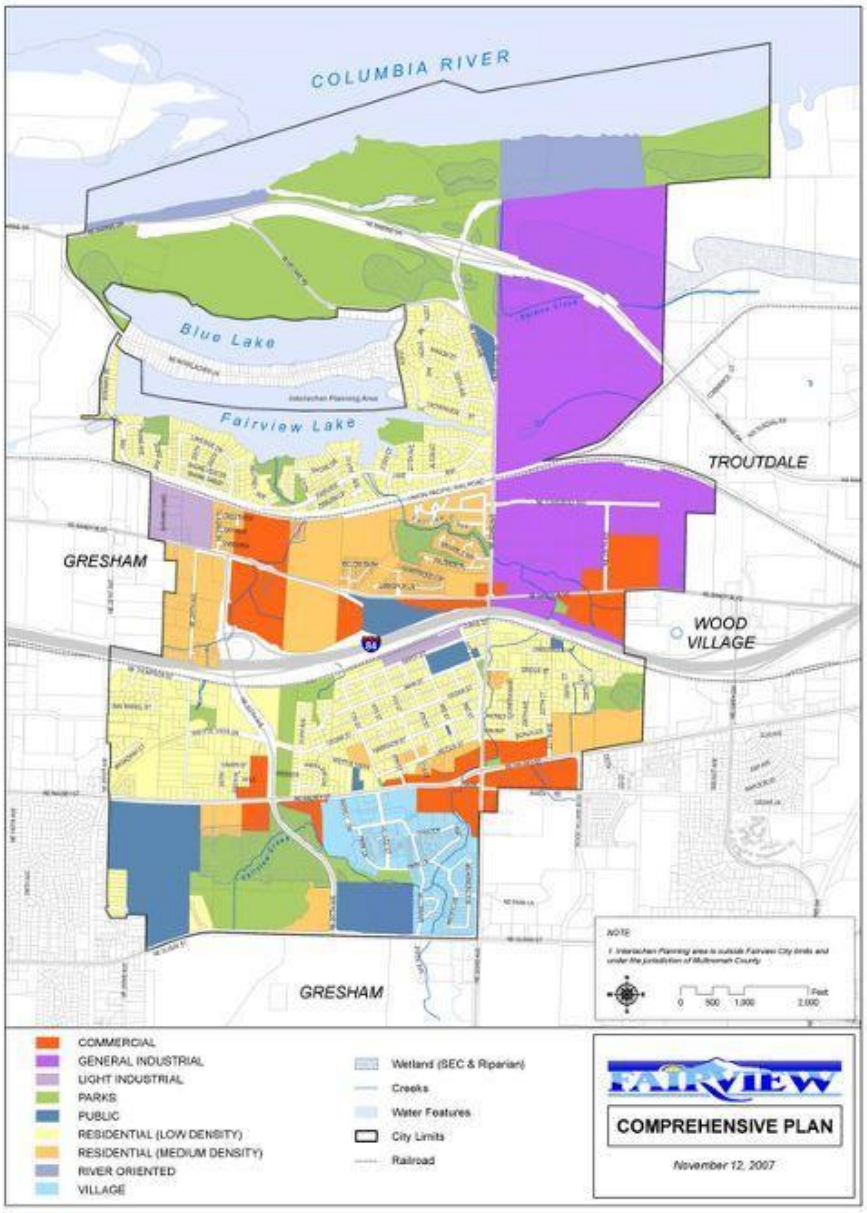


Figure 114- Land use designations in the City of Fairview. From 2017 City of Fairview Comprehensive Plan.

Transportation

Interstate 84 runs east/west through the center of Fairview, including a major interchange at Fairview Parkway. Other key east-west routes are Glisan Street, Halsey Street, Sandy Boulevard, Marine Drive and Fairview Lake Road. Key north-south routes are 223rd Avenue and Fairview Parkway (also known as 207th Avenue).

Public transportation is provided through TriMet bus service.

Utilities

The City of Fairview provides about 750,000 gallons of drinking water to residents daily. Water comes from wells within the city limits tapping into aquifers. Three reservoirs provide storage and water is delivered through 23 miles of mains. A small portion of the city is served by the Rockwood Water People's Utility District, which primarily purchases water from the Bull Run Watershed but is expanding use of local aquifer wells. The city also provides wastewater and stormwater services.

Electricity is provided by Portland General Electric and natural gas by NW Natural.

Critical Facilities

Critical facilities, as defined in this plan, existing in Fairview are:

- Childcare Facilities
- City Hall
- Community Center
- County Assets
- Fire Station
- Law Enforcement Facility
- Library
- Schools

Figure 115 - Blue Lake Regional Park in Fairview. Photo from Metro.

5.1.3 Five Year Update, 2017-2022

Natural Hazard Events

In 2020, minor flooding occurred along Fairview Lake, when high water was unable to be pumped because of an encampment blocking access to Multnomah County Drainage District pumping facilities.

Fairview was impacted by the number of heat, winter storm and wildfire smoke events that afflicted Multnomah County in the last five years. No deaths from the 2021 Heat Dome were recorded in Fairview's zip code. Longer-term health impacts from these incidents have not been measured at this scale.

Local and regional transportation routes were frequently disrupted by snow and ice events during this time period.

Mitigation Activities

- The City of Fairview replaced its Public Works Building in 2021. The previous building was of cinder block construction, making it a high risk of failure in an earthquake. Because the city's water system controls were located in the building, as well as equipment needed to respond to disaster, Fairview's resilience to different hazards was reduced and put employees at risk.

  The new building, along with meeting current seismic construction standards, provides better accessibility to those with disabilities and has improved controls for structural fire. The new building was paid for through city utility fees.

Figure 116 - New Fairview Public Works building. Photo from P&C Construction.

- A Letter of Map Revision[86] (LOMR) was completed on October 6, 2022, which revised modeled flood velocities, elevations and extents on about 470 feet of Fairview Creek

[86] LOMR 22-10-0253P can be found on FEMA's Map Service Center.

and 160 feet on the Barr Bypass of Fairview Creek. The basis of the revision was a review of study data at the SE Matney Street bridge.

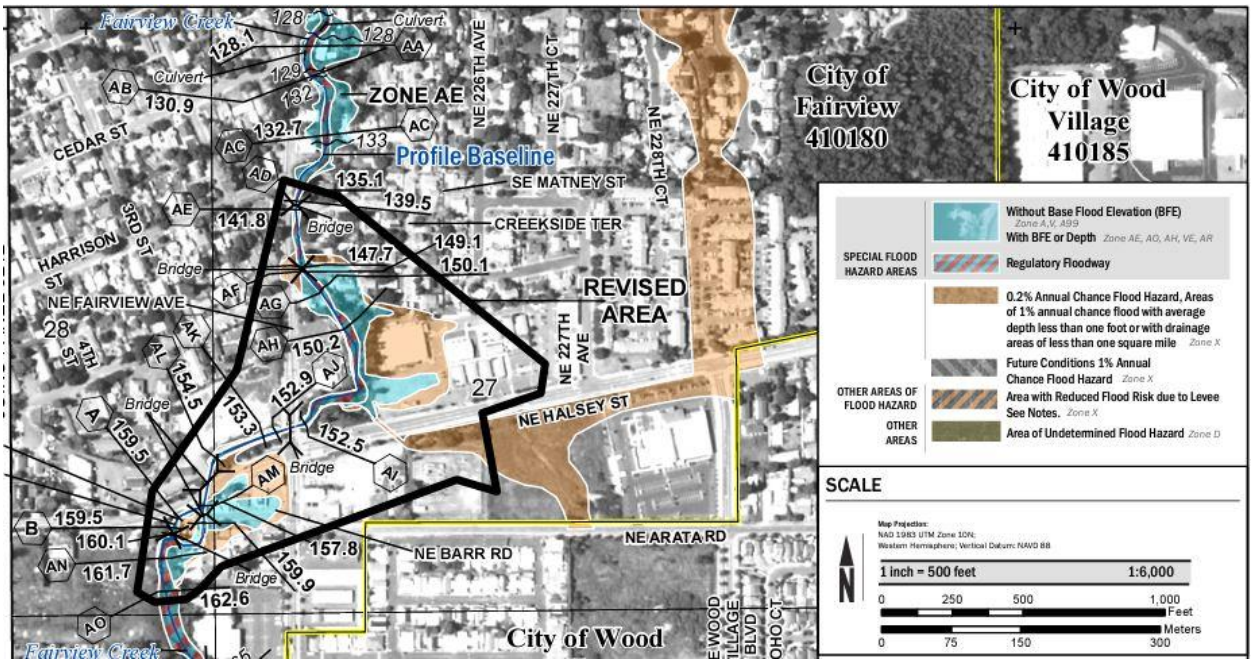


Figure 117 - Area revised by 2022 Fairview LOMR. Map available on FEMA's Map Service Center.

New Data

No new natural hazard data was created specifically for Fairview since 2017, but the city is included in countywide improvements to risk and vulnerability analyses for wildfire, earthquakes and landslides, as well as updated data for social vulnerability and climate-related risk.

Development Impacts

Growth trends have not changed significantly in the last five years. Fairview has continued to grow without an increase in its city limits, so new development continues to increase density via infill and additional multi-unit properties.

As of 2019, Fairview already had the highest rate of multi-family residences among participating communities and the second highest rate of mobile homes. Fairview Oaks Woods is the largest multi-family development in the city with 328 units. Mobile homes and RV parks are located north of Highway 84.

5.1.4 Local Hazard Analysis

Earthquake – Risk Rating Moderate

See Earthquake Section for more detailed risk and vulnerability information.

Fairview faces risks similar to neighboring cities from earthquakes. The northernmost part of the city is located in a historic floodplain with loose soils prone to liquefaction from a Cascadia Subduction Zone event or Portland Hills crustal earthquake. Ground shaking would be very strong and fairly uniform across the city. In these scenarios modeled by DOGAMI, Fairview would suffer casualties and significant structural and infrastructure damage.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard

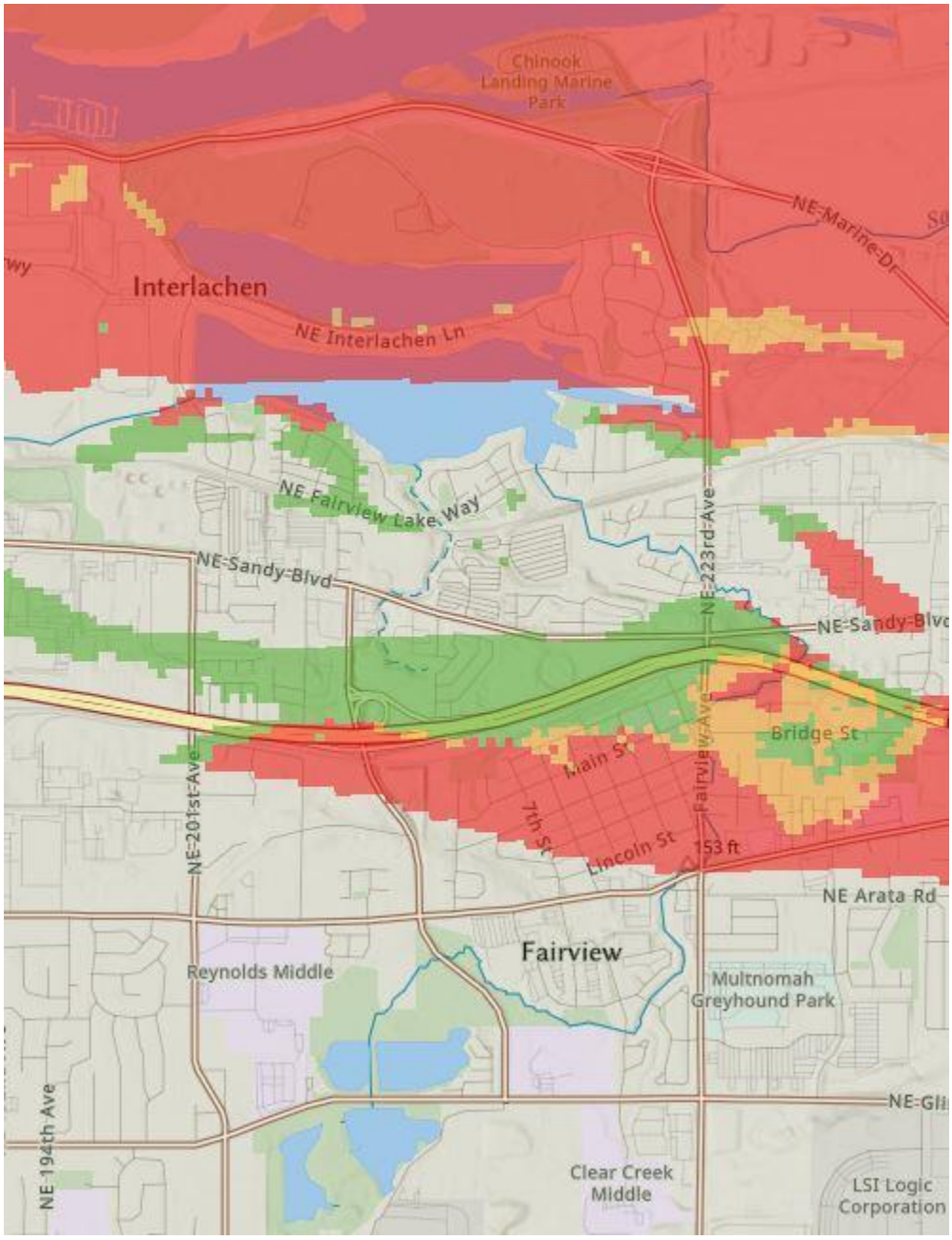


Figure 118 - Map showing soil liquefaction risk areas in the City of Fairview, with red being highest risk, yellow being moderate risk and green being lower risk. Map from DOGAMI HazVu site.

The loss of structural soil stability from liquefaction will be a threat to residential neighborhoods in the Blue Lake and Fairview Lake areas. Another area of poorly draining soils at severe risk to liquefaction extends through the center of the city, risking additional residential areas and critical facilities.

Overall, vulnerability to earthquakes is slightly lower in Fairview than in western parts of the county. Additionally, Fairview's largely residential nature is expected to make it more resilient to earthquakes, as wood framed homes are less at risk from collapse than larger masonry buildings. However, Fairview would still be expected to suffer tens of millions of dollars in damage and potential long-term loss of utility services.

Flood – Risk Rating Low

See Flood Section for more detailed risk and vulnerability information.

Fairview's largest flood risk would come from a failure of protective levees currently operated by the Multnomah County Drainage District (and to be operated in the future by the Urban Flood Safety & Water Quality District). The large area of levee protection in the northern section of Fairview has maintained the relatively low risk of flood despite having been a flood-prone area early in its history.

Areas of river and lake flood are mapped along Fairview Creek and around Fairview Lake and Blue Lake, but there is very little development that has occurred in mapped regulatory hazard areas. Fairview Creek is fairly constrained as it travels through the center of the city, but based on FEMA Flood Insurance mapping, areas near the creek and Fairview Avenue have some risk of flood from a 1% annual chance (100-year) event.

The city has much larger areas of mapped potential hazard in a catastrophic 0.2% annual chance (500-year event) flood, especially in the area where Fairview Creek drains into Fairview Lake. These areas are not regulated through the National Flood Insurance Program because of their lower probability of flood.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

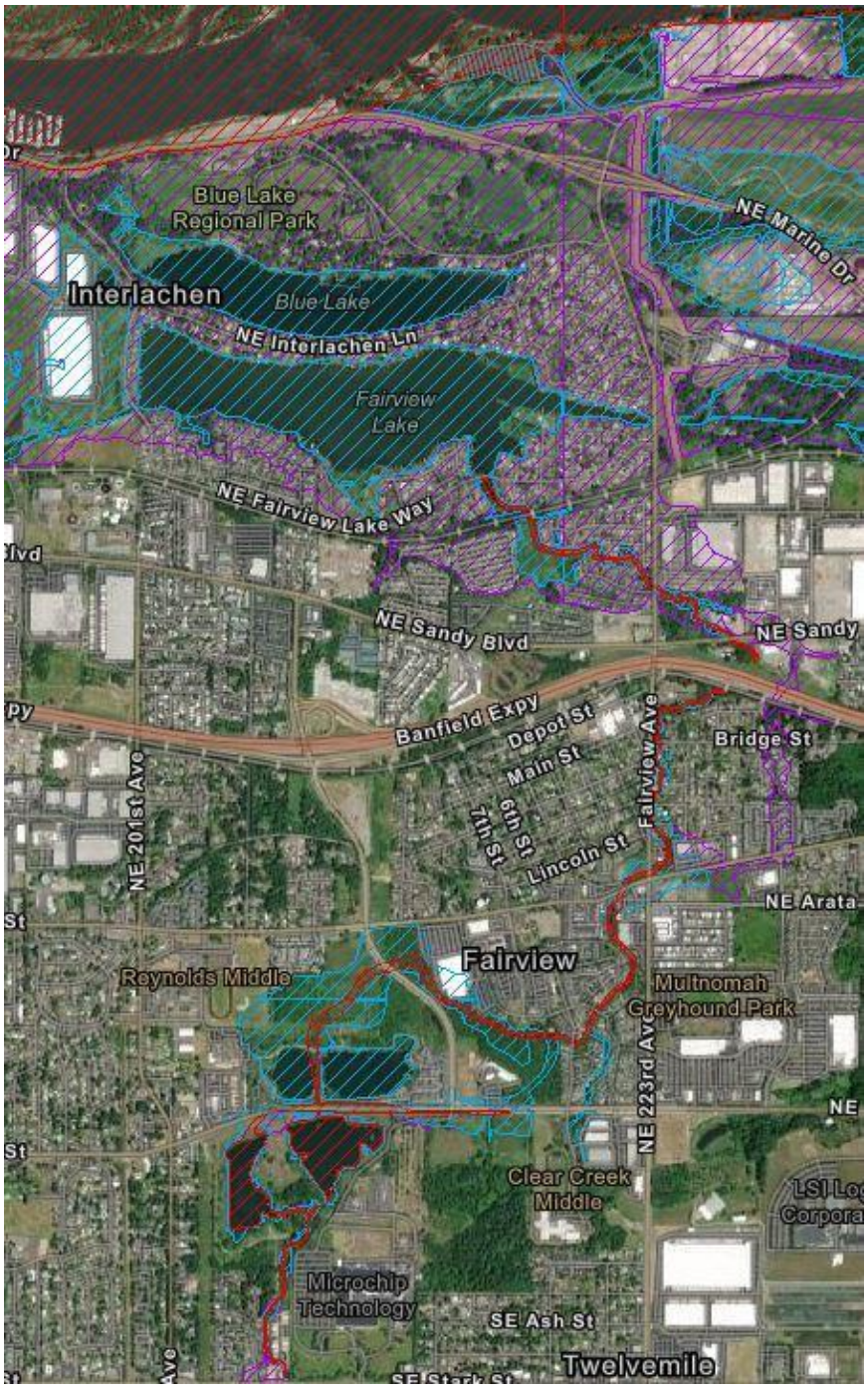


Figure 119 - Map showing flood hazard zones shown as part of FEMA's Flood Insurance Rate Maps. The areas shown in blue are the 1%-annual chance flood zone (100 year flood) and those in purple are the .2%-annual chance flood zone (500 year flood). Red areas are the floodway. Map from DOGAMI's HazVu site. The most up to date interactive flood risk mapping can be found at FEMA's National Flood Hazard Layer (NFHL).

Fairview has participated in the National Flood Insurance Program since 1987. Program participation allows city residents to purchase federal flood insurance and requires the city to maintain a flood protection ordinance to make new and rebuilt construction more resilient to

flood. As of 2016, there were 41 active policies with over $13 million in insurance coverage. Since Fairview residents became eligible for Federal flood insurance, two claims had been paid as of 2016, totaling about $13,000 in payments. Fairview has no structures considered repetitive loss or severe repetitive loss properties.

Fairview's Floodplain Management Ordinance is located in the city's Development Code, and is administered by the Public Works Department.

Local areas considered of concern for urban stormwater flooding are:

- NE Glisan Street at Fairview Creek
- NE Halsey Street between 201st and 205th Streets
- 223rd north of Halsey Street and south of Bridge Street
- Sandy Boulevard at Fairview Creek

Landslide – Risk Rating Low

See Landslide Section for more detailed risk and vulnerability information.

DOGAMI landslide inventories show no recorded historic landslides and no deep landslide deposits within the City of Fairview, leading to a low risk rating. There is no area in the city limits considered susceptible to deep landslides.

However, there are a number of small slopes that meet thresholds for potential of shallow landslides. These areas are primarily stream and lake banks and road berms.

An interactive version of this map can be found here (Landslide Susceptibility – Susceptibility to Shallow Landslides)

Figure 120 - Map showing shallow landslide risk in Fairview.

The area with the most notable vulnerability to landslide in Fairview is in the area where Sandy Boulevard lies below steep berms supporting Interstate 84.

Severe Weather

- *Extreme Heat, Winter Storm, Windstorm – Risk Rating High*
- *Drought – Risk Rating Moderate*

See Severe Weather Chapter for mode detailed risk and vulnerability information.

Fairview classified risk ratings for severe weather into two separate ratings, breaking out drought and combining extreme heat, winter storm, and windstorm. Drought is considered to be less of a risk to the city compared to weather events, due to the city's groundwater supply being resilient to low snow years and dry summers.

The remaining hazards are of concern across the jurisdiction, with extreme heat creating risks for those in urban heat islands with increased risk, including older residents, or unable to go to cooling spaces. Winter storms have caused repeated road and utility disruptions.

Fairview has retained a high level of tree canopy and other vegetation and has limited areas subject to the worst urban heat island effects. The most affected areas are primarily in large surface parking lots in the industrial eastern portion of the City.

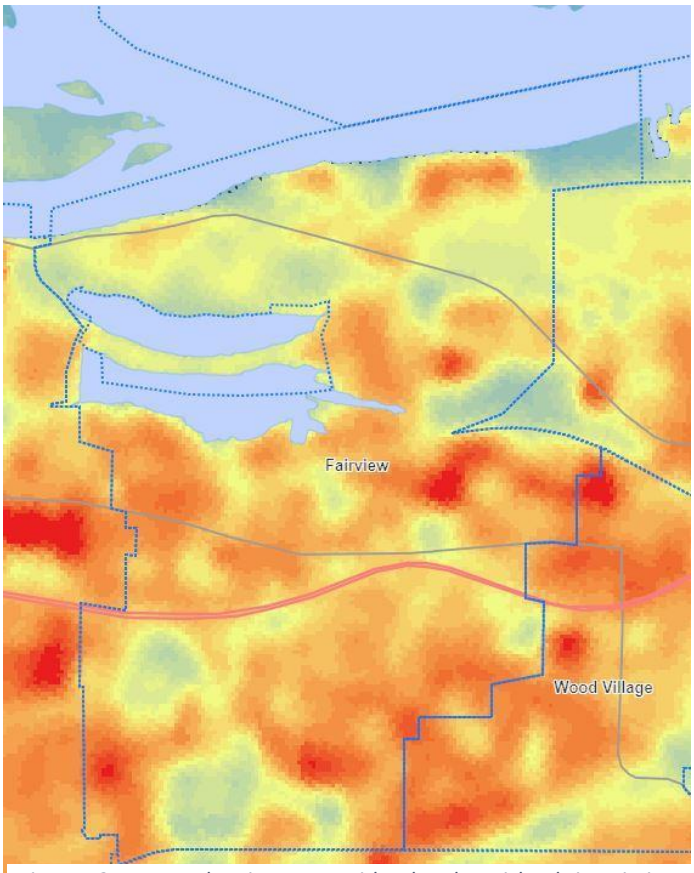


Figure 121 - Map showing areas with urban heat islands in Fairview. Areas in red are those most prone to urban heat island effects. Map – Metro.

An interactive version of this map can be found here

Effects from windstorms could be particularly severe in mobile home and RV parks within the city. Long-term power outages caused by ice, wind or other factors would threaten residents with powered medical devices or refrigerated medicines, and disruptions to travel routes could risk the ability of caregivers to reach residents with critical support needs.

Volcano – Risk Rating Low

See Volcano Chapter for mode detailed risk and vulnerability information

Fairview faces some vulnerability from volcanic lahars originating from Mount Hood. Yet because of the low probability and often very long duration between eruptions, this hazard is considered to be of low risk relative to other hazards in Fairview.

A moderately sized lahar (predicted 450-900 year event) could impact the Blue Lake Park area north of Interlachen Lane. In the worst-case event (an extremely unlikely scenario considered to be the largest possible eruption of Mount Hood), severe damage from debris would impact most of the city north of Sandy Boulevard.

An interactive version of this map can be found here (Volcano Hazard – Moderate Hazard Zone)

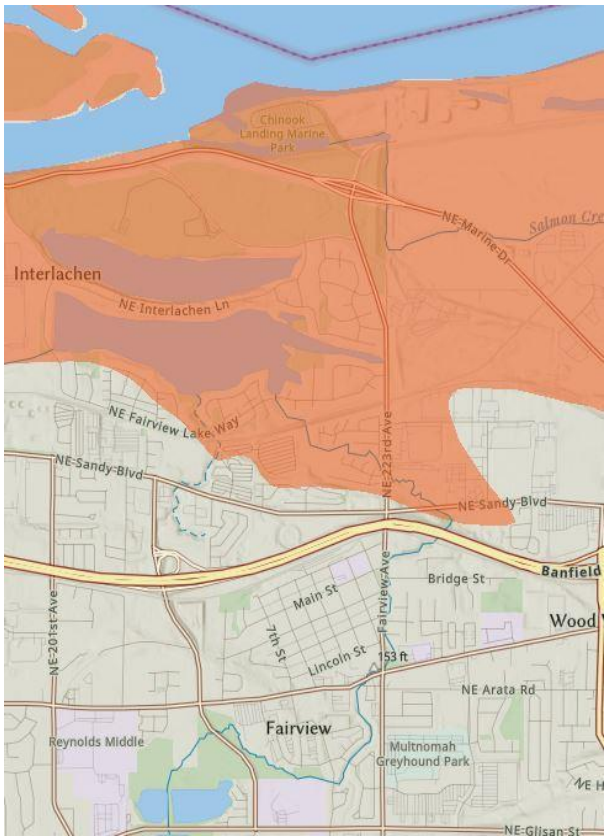


Figure 122 - Map showing potential lahar impacts in Fairview from an extreme (10,000-100,000 year event) Mount Hood eruption. Map - DOGAMI HazVu site.

A full vulnerability analysis of potential lahar damage in Fairview has not yet been performed.

Ashfall would impact Fairview similarly to other jurisdictions in the county, causing respiratory health impacts, disrupting transportation routes and potentially impacting structural stability and operations.

Wildfire and Wildfire Smoke

- *Wildfire – Risk Rating Low*
- *Wildfire Smoke – Risk Rating High*

See Wildfire and Wildfire Smoke Chapter for mode detailed risk and vulnerability information.

Wildfire smoke is considered a high risk for the City of Fairview. As with severe climate events, all of Fairview's population face impacts from wildfire smoke, but especially those with existing risk factors and those unable to access clean air spaces.

Wildfire smoke is likely to come from regional fires, not wildfires within the city limits. Risk of wildfire in Fairview is considered to be low, as the city limits are urbanized and surrounded by other cities buffering Fairview from wildfires coming from forests and farmland to the east.

An interactive version of this map can be found here (Wildfire Potenial Impacts – Overall Potential Impacts)

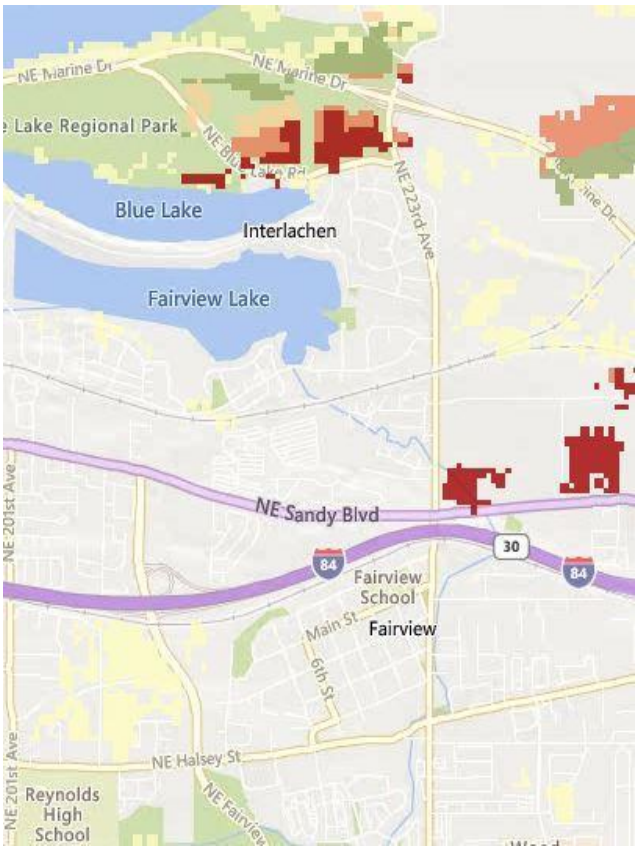


Figure 123 - Map showing wildfire vulnerability risk in Fairview, with areas in red having the most vulnerability from a wildfire. Map - Oregon Wildfire Explorer with data from PNW-QWRA.

The Oregon Wildfire Risk Explorer shows a handful of small, scattered vegetated areas within the city where sufficient fuel exists to create a risk of wildfire to neighboring development and infrastructure. This fire risk would be most prevalent during periods of extremely dry vegetation and high winds. The risk mapping for wildfire identifies locations where a wildfire greater than 250 acres could start—smaller scale fires could also start on vegetated lots and be dangerous to nearby structures.

Blue Lake Regional Park has the largest mapped area of potential fire in the city limits. However, much of the park is separated from development by its size and fuel breaks made up of wetlands, grassy fields, and roads.

5.1.5 Hazard Risk Scoring

The identified levels of risk from each hazard were determined by the City of Fairview, using a scoring methodology designed by Oregon Emergency Management, and applied across the state to contextualize local risk perception.

Fairview Hazard Risk Analysis

Hazard	History (Weight Factor = 2)		Vulnerability				Probability (Weight Factor = 7)		Risk Score	Initial Risk Ranking
			Average (WF = 5)		Max (WF = 10)					
Earthquake	2 x	**1**	5 x	**8**	10 x	**10**	7 x	**2**	**166**	**Moderate**
Flood	2 x	**1**	5 x	**5**	10 x	**7**	7 x	**3**	**118**	**Low**
Landslide	2 x	**1**	5 x	**3**	10 x	**7**	7 x	**3**	**108**	**Low**
Severe Weather – Extreme Heat, Winter Storm, Wind Storm	2 x	**8**	5 x	**8**	10 x	**10**	7 x	**10**	**226**	**High**
Severe Weather – Drought	2 x	**3**	5 x	**4**	10 x	**10**	7 x	**3**	**147**	**Low**
Volcano	2 x	**1**	5 x	**8**	10 x	**10**	7 x	**1**	**149**	**Low**
Wildfire	2 x	**1**	5 x	**3**	10 x	**7**	7 x	**3**	**108**	**Low**
Wildfire Smoke	2 x	**10**	5 x	**10**	10 x	**10**	7 x	**10**	**240**	**High**

5.1.6 Fairview Aligned Plans and Other Implementation Processes

Overview

Fairview shares similar implementation strengths and challenges with the other East County cities. Fairview manages its own utility system infrastructure for streets, drinking water pumping and storage, stormwater management, and wastewater collection. These lifelines provide the greatest opportunity for addressing local infrastructure resilience. Wastewater is treated by the

City of Gresham, traveling through a main conveyance line that adds to regional city level partnership. Fairview has limitations in funding and staff to take on grants management and new initiatives – the focus in this plan update has been to identify areas where existing processes can build in greater resilience, participation in regional resilience building bodies, and to use existing budget for community engagement.

- City Council Work Plan
  - Council work plans are adopted at the beginning of each new fiscal year, on July 1.
  - Hazard mitigation priorities can be set through the work plan process. Fairview's NHMP proposed mitigation actions should be aligned into the work plan to enhance implementation and focus.
- City Budget
  - Budgets are adopted at the beginning of each new fiscal year, on July 1.
  - The annual budget allocates funding that could be used for natural hazards mitigation. Proposed mitigation strategies that require additional local funding will need to go through this process to gain needed financial support.
- Emergency Operations Plan
  - Most recently adopted in 2012
  - The EOP describes the city's plans in the event of a natural hazard event. The Situation and Planning Assumptions sections in the EOP can be updated to reflect the revised NHMP Risk Assessment.
- Comprehensive Plan
  - Most recently revised in September 2022. In 2017, the Fairview Transportation System Plan was adopted into the Comprehensive Plan.
  - Chapter 7 addresses the extent and severity of natural hazards present in the City of Fairview. References to the NHMP in the Comprehensive Plan should be updated, including goals, objectives and actions.
- Consolidated Stormwater Master Plan (CSMP)
  - Most recently updated in 2015, and amended in 2018 with the Fairview Creek Addendum.
  - The CSMP identifies needed capital improvement projects that are needed to reduce flooding. Relevant revised flooding data and mitigation strategies from the NHMP should be updated in the CSMP.
- Development Code
  - Most recently updated in August 2022.
  - The development code regulates new development and use of land. Fairview has a floodplain overlay which applies the development regulations required by participation in the National Flood Insurance Program. New hazard maps in the NHMP update should be referred to in the code where needed, and used in the development of future code updates that intersect with natural hazard risk.
- Water Management and Conservation Plan (WMCP)
  - Updated most recently in February 2017
  - The WMCP guides development and implementation of water use in the city. Water shortage emergencies that could be caused by drought or by damage or contamination during a natural hazard event are addressed, and those system interfaces should be reviewed in consideration of new hazard information in the revised NHMP. Strategies to increase resilience of water systems can be developed through the intersection of these plans.
- Parks and Open Space Master Plan

  - Most recently updated in 2017.
  - Parks and natural areas play an important role in natural hazard risk and mitigation. Updating the plan in light of revised natural hazard risk information is important, especially considering the heightened awareness of extreme heat risk, which could impact the design and amenities of parks and open spaces.
- Transportation System Plan (TSP)
  - Current plan adopted in 2017 and most recently amended in 2022.
  - The TSP addresses key lifelines that allow the safe and efficient movement of people across the city. Natural hazards are not currently considered in the plan, and could be an opportunity for future updates to identify ways to maintain the resilience of the system.

5.2 City of Gresham

5.2.1 Mitigation Actions

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Gresham</th></tr>
<tr><td rowspan="8">Multi-Hazard</td><td rowspan="8">1</td><td colspan="8">Develop a Disaster Debris Management Plan to support community recovery and maximize FEMA reimbursement.</td></tr>
<tr><td colspan="4">Plan Goals – 2,3,5</td><td colspan="4">Hazards Addressed – All Hazards</td></tr>
<tr><td colspan="4">Lifelines – Debris Management</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Solid Waste, Recycling and Sustainability (SWR&S)</td><td>Environmental Services, Transportation Operations</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>15</td></tr>
<tr><td colspan="8">Potential Funding – Solid Waste operating budget, Environmental Services budget</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Gresham Debris Management Plan</td></tr>
<tr><td colspan="8">Notes –</td></tr>
</table>

Hazard	Action ID	Mitigation Actions – City of Gresham							
Multi-Hazard	2	**Engage with community-based organizations (CBO's) to ensure touchpoints with frontline communities vulnerable in disasters.**							
		Plan Goals – 1,2,4,5		Hazards Addressed – All Hazards					
		Lifelines – Community Resilience		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Community Engagement	Emergency Management	**3**	**2**	**3**	**3**	**3**	**14**
		Potential Funding –							
		Potential Implementation Methods –							
		Notes –							
Multi-Hazard	3	**Support the City's adopted Climate Action Plan actions that relate to climate change resiliency and preparedness.**							
		Plan Goals – 1,2,3,4,5		Hazards Addressed – Flood, Landslide, Severe Weather, Wildfire & Wildfire Smoke					
		Lifelines – Climate Resilience		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Solid Waste, Recycling and Sustainability (SWR&S)		**3**	**2**	**3**	**3**	**2**	**13**
		Potential Funding – Solid Waste operating budget, Grants							
		Potential Implementation Methods – Climate Action Plan, Green Business Program, Needs amendments to Comprehensive Plan							
		Notes -							

Hazard	Action ID	Mitigation Actions – City of Gresham								
Multi-Hazard	4	**Support local businesses in preparing for disasters and promote local business continuity planning.**								
		Plan Goals – 1,2		Hazards Addressed – All Hazards						
		Lifelines – Local Economy		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Solid Waste, Recycling and Sustainability (SWR&S)	Economic Development, Emergency Management	**2**	**2**	**3**	**1**	**3**	**11**	
		Potential Funding –								
		Potential Implementation Methods –								
		Notes –								
Earthquake	5	**Implement improvements to the wastewater treatment plant to resist seismic events, including earthquake caused landslides**								
		Plan Goals – 3,5		Hazards Addressed – Earthquake						
		Lifelines – Wastewater Infrastructure		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Wastewater Division		**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – CIP, Grants								
		Potential Implementation Methods – Master Plan, Seismic Plan								
		Notes –								

Hazard	Action ID	Mitigation Actions – City of Gresham								
Earthquake	6	**Harden the city's sewer backbone system to resist seismic events, including earthquake caused landslides.**								
		Plan Goals – 3,5		Hazards Addressed – Earthquake						
		Lifelines – Wastewater Infrastructure		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Wastewater Division		**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – CIP, Grants								
		Potential Implementation Methods – Master Plan/Seismic Plan								
		Notes –								
Earthquake	7	**Continue to implement seismic structural retrofits at water reservoirs and pump stations.**								
		Plan Goals – 3,5		Hazards Addressed – Earthquake						
		Lifelines – Wastewater Infrastructure		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Water Division		**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – CIP, Grants								
		Potential Implementation Methods – Master Plan, Seismic Plan. AWIA Requirements								
		Notes –								

Hazard	Action ID	Mitigation Actions – City of Gresham							
Earthquake	8	**Improve seismic resilience of water pipeline infrastructure.**							
		Plan Goals – 3,5		Hazards Addressed – Earthquake					
		Lifelines – Water Infrastructure		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Water Division		**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – CIP, Grants							
		Potential Implementation Methods – Master Plan, Seismic Plan, AWIA Requirements							
		Notes –							
Earthquake	9	**Seismically retrofit existing public wastewater facilities and infrastructure to withstand and continue service after a catastrophic earthquake, allowing the city to meet the Oregon Resilience Plan Target States of Recovery.**							
		Plan Goals – 3,5		Hazards Addressed – Earthquake					
		Lifelines – Wastewater Infrastructure		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Wastewater Division		**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – CIP, Grants							
		Potential Implementation Methods – Master Plan, Seismic Plan							
		Notes –							

Hazard	Action ID	Mitigation Actions – City of Gresham							
Earthquake	10	**Build resiliency and mitigation education into public events. Partner with NGOs to ensure culturally appropriate and engaging material.**							
		Plan Goals – 1,2,4		Hazards Addressed – Earthquake					
		Lifelines – Community Resilience		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Community Engagement	Emergency Management	**3**	**2**	**3**	**1**	**3**	**12**
		Potential Funding –							
		Potential Implementation Methods –							
		Notes -							
Earthquake	11	**Develop a seismic overlay.**							
		Plan Goals -		Hazards Addressed – Earthquake					
		Lifelines – Land Use, Zoning, Building		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Urban Design and Planning		**2**	**2**	**2**	**3**	**2**	**11**
		Potential Funding – General Fund							
		Potential Implementation Methods – Needs amendments to Comp Plan Volumes 1-3, could be stand-alone or combined with Wildfire Overlay Project.							
		Notes –							

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Gresham</th></tr>
<tr><td rowspan="7">Flood</td><td rowspan="7">12</td><td colspan="8">Develop and implement strategies to restore and enhance the natural functions of floodplains.</td></tr>
<tr><td colspan="4">Plan Goals – 3,5</td><td colspan="4">Hazards Addressed – Flood</td></tr>
<tr><td colspan="4">Lifelines – Floodplain Management</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Watershed Division</td><td></td><td>3</td><td>3</td><td>2</td><td>2</td><td>3</td><td>13</td></tr>
<tr><td colspan="8">Potential Funding – Watershed CIP</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Natural Resources Master Plan</td></tr>
<tr><td colspan="8">Notes - These projects are found within the Natural Resources Master Plan, Stormwater Master Plan, and are associated with Transportation projects involving major stream crossings. Projects should be reviewed for potential to provide additional flood attenuation to reduce flooding</td></tr>
<tr><td rowspan="7">Flood</td><td rowspan="7">13</td><td colspan="8">Implement flood attenuation strategies as identified and prioritized in the Stormwater Master Plan.</td></tr>
<tr><td colspan="4">Plan Goals – 3,5</td><td colspan="4">Hazards Addressed – Flood</td></tr>
<tr><td colspan="4">Lifelines – Stormwater Infrastructure</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Wastewater Division</td><td></td><td>3</td><td>3</td><td>2</td><td>2</td><td>3</td><td>13</td></tr>
<tr><td colspan="8">Potential Funding – Watershed CIP</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Stormwater Master Plan</td></tr>
<tr><td colspan="8">Notes -</td></tr>
</table>

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Gresham</th></tr>
<tr><td rowspan="7">Flood</td><td rowspan="7">14</td><td colspan="8">Maintain eligibility in the National Flood Insurance Program (NFIP) and initiate participation in the Community Rating System (CRS).</td></tr>
<tr><td colspan="3">Plan Goals – 1,2,3</td><td colspan="5">Hazards Addressed – Flood</td></tr>
<tr><td colspan="3">Lifelines – Floodplain Management</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Urban Design and Planning</td><td>Watershed Division</td><td>2</td><td>2</td><td>2</td><td>2</td><td>3</td><td>11</td></tr>
<tr><td colspan="8">Potential Funding – Existing Resources/General Fund</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Endangered Species Act BiOp Compliance</td></tr>
<tr><td colspan="8">Notes –</td></tr>
<tr><td rowspan="7">Landslide</td><td rowspan="7">15</td><td colspan="8">Protect slopes and associated infrastructure by identifying and prioritizing at-risk slopes with high consequences of failure.</td></tr>
<tr><td colspan="3">Plan Goals – 3,5</td><td colspan="5">Hazards Addressed – All Hazards</td></tr>
<tr><td colspan="3">Lifelines – All Infrastructure</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Natural Resources</td><td>Wastewater, Environmental Services</td><td>2</td><td>2</td><td>2</td><td>2</td><td>3</td><td>11</td></tr>
<tr><td colspan="8">Potential Funding – Watershed and other Environmental Services CIPs</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Natural Resources Master Plan</td></tr>
<tr><td colspan="8">Notes - Weight loading of dead vegetation and debris; Alteration of vegetation to more stabilizing species; identify City program staff and budget for landslide risk mitigation and landslide response; Programmatic retrofits needed for developments prior to 1994; Modeling of highest risk areas with infrastructure conflicts.</td></tr>
</table>

Hazard	Action ID	Mitigation Actions – City of Gresham							
Landslide	16	**Integrate landslide prevention into outreach/enforcement programs to find and resolve encroachments at the public/private interface where dumping contributes to landslide risk.**							
		Plan Goals – 1,3,5		Hazards Addressed – Landslide					
		Lifelines – Community Resilience		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Natural Resources	Code Compliance, City Attorney's Office	**2**	**2**	**1**	**2**	**2**	**9**
		Potential Funding – Watershed CIP, Settlement Agreements							
		Potential Implementation Methods –							
		Notes -							
Severe Weather	17	**Revisit where and what kind of generators need to be available for water and wastewater infrastructure due to significant power outages.**							
		Plan Goals – 3,4,5		Hazards Addressed – Severe Weather					
		Lifelines – Water and Wastewater Infrastructure		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Water/Wastewater Divisions		**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – CIP, Grants							
		Potential Implementation Methods – Master Plan, AWIA Requirements							
		Notes -							

Hazard	Action ID	Mitigation Actions – City of Gresham							
Severe Weather	18	**Coordinate with Multnomah County to mitigate the effects of severe weather on vulnerable populations.**							
		Plan Goals – 1,2,4,5		Hazards Addressed – Severe Weather					
		Lifelines – Community Resilience, Medical Systems		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Emergency Manager	Multnomah County Health Department, Multnomah County Human Services, Multnomah County Emergency Management	**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding –							
		Potential Implementation Methods –							
		Notes -							
Severe Weather	19	**Conduct a shade audit in all city parks.**							
		Plan Goals – 3,4,5		Hazards Addressed – Severe Weather					
		Lifelines – Community Resilience, Parks		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Parks and Recreation Division		**2**	**2**	**3**	**2**	**3**	**12**
		Potential Funding – Parks and Recreation General Fund							
		Potential Implementation Methods – Parks and Recreation Trails and Natural Areas Master Plan Update (2024)							
		Notes -							

Hazard	Action ID	Mitigation Actions – City of Gresham							
Severe Weather	20	**Install trees in tree-deficient neighborhoods that experience urban heat island effect impacts to enhance shade equity in underserved areas.**							
		Plan Goals – 1,2,4,5		Hazards Addressed – Severe Weather					
		Lifelines – Community Resilience, Parks		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Parks and Recreation Division	Watershed Division	**2**	**2**	**3**	**2**	**3**	**12**
		Potential Funding – Special Designated Tree Fund/EMSWCD PIC Grant through 2023, General Fund (Parks & Recreation and UDP), Stormwater CIP or Operating Funds							
		Potential Implementation Methods – Urban Forestry Management Plan, Tree Code, Stormwater Retrofit Strategy							
		Notes - Potential grant funding from FEMA/EPA and USDA inflation reduction act 2023 - 2026							
Severe Weather	21	**Develop an emergency service plan for solid waste removal in multifamily properties after a disaster event.**							
		Plan Goals – 2,4,5		Hazards Addressed – Severe Weather					
		Lifelines – Solid Waste Removal		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Solid Waste, Recycling and Sustainability (SWR&S)		**2**	**2**	**2**	**2**	**2**	**10**
		Potential Funding –							
		Potential Implementation Methods –							
		Notes -							

Hazard	Action ID	Mitigation Actions – City of Gresham								
Wildfire & Wildfire Smoke	22	**Expand permanent backyard burning ban.**								
		Plan Goals – 1,5		Hazards Addressed – Wildfire & Wildfire Smoke						
		Lifelines – Fire Prevention		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Fire	Urban Design and Planning, Watershed Division	**3**	**2**	**3**	**2**	**3**	**13**	
		Potential Funding – None needed								
		Potential Implementation Methods – Post-levy vote								
		Notes -								
Wildfire & Wildfire Smoke	23	**Include content on wildfire defensible space in outreach to properties within or adjacent to protected resource areas.**								
		Plan Goals – 1,2		Hazards Addressed – Wildfire & Wildfire Smoke						
		Lifelines – Fire Prevention		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Natural Resources	Fire, Urban Design and Planning	**2**	**3**	**2**	**2**	**3**	**12**	
		Potential Funding – Natural Resources Operating Funds								
		Potential Implementation Methods – Distribution to begin with completion of EOP Phase 2 (est. FY 24-25)								
		Notes -								

Hazard	Action ID	Mitigation Actions – City of Gresham							
Wildfire & Wildfire Smoke	24	**Develop emergency ingress/egress mapping tool for older developments and assess options for alternative access where no secondary ingress/egress exists.**							
		Plan Goals – 1,2,5		Hazards Addressed – Wildfire & Wildfire Smoke					
		Lifelines – Fire Operations, Evacuation Planning		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Fire	GIS, Transportation, Natural Resources	**2**	**2**	**3**	**2**	**2**	**11**
		Potential Funding – Existing resources							
		Potential Implementation Methods – Existing plans and workloads							
		Notes -							
Wildfire & Wildfire Smoke	25	**Strengthen code language to ensure secondary access for future subdivisions.**							
		Plan Goals – 2,5		Hazards Addressed – Wildfire & Wildfire Smoke					
		Lifelines – Fire Operations, Evacuation Planning, Land Use		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Urban Design and Planning	Transportation	**2**	**2**	**3**	**2**	**2**	**11**
		Potential Funding – General Fund							
		Potential Implementation Methods – Combined with other transportation or housing updates to Comp Plan Volume 3							
		Notes -							

Hazard	Action ID	Mitigation Actions – City of Gresham							
Wildfire & Wildfire Smoke	26	**Address riparian forest die off and implement measures to transition to more drought tolerant/climate resilient plant communities.**							
		Plan Goals – 1,2,5		Hazards Addressed – Wildfire & Wildfire Smoke					
		Lifelines – Parks, Fire Prevention		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Natural Resources		**3**	**2**	**1**	**2**	**2**	**10**
		Potential Funding – Natural Resources Operating Funds							
		Potential Implementation Methods – Implemented by means of City's Temperature TMDL regulatory response							
		Notes -							
Wildfire & Wildfire Smoke	27	**Develop a wildfire overlay.**							
		Plan Goals – 1,2,5		Hazards Addressed – Wildfire & Wildfire Smoke					
		Lifelines – Parks, Fire Prevention		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Urban Design and Planning		**2**	**1**	**2**	**2**	**2**	**9**
		Potential Funding – General Fund							
		Potential Implementation Methods – Needs amendments to Comp Plan Volumes 1-3, could be stand-alone or combined with Seismic Overlay Project							
		Notes -							

5.2.2 City Overview

The City of Gresham was incorporated in 1905 and occupies about 23.4 square miles of land on the eastern side of Multnomah County. Gresham spans from the northern boundary of the

county at the Columbia River all the way to the southern boundary with Clackamas County. Gresham is primarily bordered by the City of Portland to the West. Fairview and Wood Village are north of Gresham and Troutdale borders Gresham to the northeast. The city is otherwise bounded by unincorporated Multnomah County.

Gresham is the second largest city in Multnomah County and the fourth largest city in the State of Oregon by population. Only Portland and Vancouver, Washington are larger cities within the Portland Metropolitan Area.

Figure 124- Public art at the Rockwood light rail station in Gresham. Photo - Metro

Gresham spans across a number of landscapes, from the flat floodplains of the Columbia Slough watershed, the deep, well-drained rocky soils of the Rockwood area, the Downtown area with its high surface water, and the mostly forested southern butte complex.

Gresham has grown out from its early urban core with three urban centers; Historic Downtown, Rockwood and the Civic Neighborhood, each with commercial corridors. Low-density residential development and slowly urbanizing farmland characterize the southern areas (bordering Clackamas County) of the urban services boundary and the eastern edges of the city. Johnson Creek, Fairview Creek and Kelly Creek and their tributaries form vegetated corridors through the city. The Rockwood area in northwest Gresham, was first developed in the 1970s when it was unincorporated and became denser in the late 80s and early 90s due to significant multifamily development. Mount Hood dominates the viewsheds and Mount St. Helens is visible on clear days.

Because of its diversity of landscapes and development patterns, Gresham has significant vulnerability to specific natural hazards. There are numerous hazard risks that overlay against the large population and resultant critical infrastructure located across the City.

Gresham remains the fastest growing city included in this plan, based on total population increase. Although geographic and population growth has slowed compared to the rapid city expansion of the 1980s and 1990s, Gresham continues to annex areas of unincorporated Multnomah County and has also added residents through residential infill and redevelopment.

Table 41 – Gresham Population by Census Year (For population details, see Community Profile chapter)

Census or Estimate Year	Total Population – City of Gresham	Percentage Change
2000	90,205	32.2% (1990)
2010	105,594	17.1% (2000)
2015 (est)	107,065	
2020	114,247	8.3% (2010)
2021 (est)[87]	114,361	

Gresham is notably racially, linguistically and socio-economically diverse, compared to Oregon and Multnomah County as a whole. Gresham's demographics add another layer of risk to residents, requiring multi-faceted approaches to maintain risk communication and understand the complex needs of diverse populations in developing hazard resilience as well as hazard preparation, response and recovery.

Gresham's population is younger than the county average, with 23% of residents being children under the age of 18, compared to about 18% countywide. However, the city has grown significantly faster with those over 65 compared to children over the last five years. Because of its large size, Gresham has, by far, the largest total number of children (26,359) and those over the age of 65 (15,572) of cities included in this plan.

Gresham has the highest number of those identifying as having a disability (16,778) and the highest proportion of residents with a disability (14.7%) of communities participating in this plan.

Gresham also has the highest poverty rate of any community in Multnomah County, with about 16% of the population (17,568) being below federally-designated poverty levels. While poverty has historically been concentrated in the Rockwood area, development patterns, intraregional migration, and the ongoing housing crisis has led to growing dispersal of this population.

Though the other cities in this plan are characterized as "East County" for the purposes of the Point in Time counts of homeless residents, Gresham is enumerated separately. In the 2019 PIT count, 103 residents of Gresham were identified as unsheltered – a sharp increase from the 2017 count, even as the total countywide population remained flat. The number of people identified as chronically homeless also grew at a more rapid rate for Gresham. A new 2022 count is currently being finalized.

[87] 2021 population estimates from the Portland State University Population Center. All other totals or estimates come from the US Census Bureau.

Gresham has ten manufactured home parks within city limits. Within these parks, there are a total of 636 spaces making up approximately 1.5% of the city's housing units.

Gresham is second only to Wood Village in its proportion of residents who speak a language other than English at home and speak English less than 'very well'. Again, because of the city's large size, it serves by far the most people in this plan with limited English proficiency (11,445).

Transportation

Gresham is bisected by Interstate 84 in the north and by United States Route 26 (Powell Boulevard) in the south. Other key primary transportation routes are:

- 181st/182nd Avenue
- Division Street
- Burnside Street
- Hogan Road
- Kane Road (257th Avenue)
- Eastman Parkway (223rd Avenue)
- Stark Street
- Glisan Street
- Halsey Street
- Pleasant View Drive (190th Avenue)

Public transportation is provided by TriMet, with extensive light rail and bus service, including a transit center at NE Kelly and 8th Streets. North-south transit is weak with relative underserved populations south of Powell and east of Hogan.

Utilities

The City of Gresham and the Rockwood Water People's Utility District provide water to city residents. Water has primarily come from the City of Portland's sources (mostly the Bull Run Reservoir) and has been supplemented in dry periods and emergencies by the Columbia South Shore Well Field. Gresham and Rockwood Water PUD have also maintained their own wells in the Sand and Gravel Aquifer to supplement Portland supply. In 2021 they formed the Cascade Groundwater Alliance to develop more wells which will be the primary source of Gresham's drinking water by 2026.

The City of Gresham also provides wastewater and stormwater services to its citizens.

Electricity is provided by Portland General Electric (PGE) and natural gas by NW Natural.

Critical Facilities

A full list of critical facilities can be found in the Human-Caused and Technological Hazard Identification and Risk Assessment, included as an annex to this plan. Communities define critical facilities through their own definition.

Critical facilities in Gresham include:

- Bridges
- Childcare Facilities

- City Hall
- Community Center
- County Assets
- Fire Stations
- Hospital
- Law Enforcement Facilities
- Libraries
- Licensed Medical Facilities
- Residential Care Facilities
- Schools
- Urgent Care Centers

5.2.3 Five-Year Update, 2017-2022

Hazard Events

Natural impacts over the past five years were most prominently climate events, as Gresham residents suffered from extreme heat and cold and from wildfire smoke.
One death from hyperthermia in the 2021 Heat Dome event was recorded in a Gresham zip code. Residents living in neighborhoods with severe urban heat island effects and without the ability to access cooling spaces were most at risk.

Unsheltered residents were especially impacted by a long cold period in the winter of 2017, and by shorter events in following years. Transportation routes and other infrastructure were repeatedly impacted by snow and ice over this timespan.

The September 2020 Wildfire Smoke event impacted all city residents, with those closest to Clackamas County experiencing the heaviest smoke, and those in neighborhoods with limited tree canopies dealing with high heat and less filtered air. Long term health impacts from the smoke have not yet been quantified.

Periods of heavy rain caused localized ponding and small landslides, but no significant damage.

Mitigation Activities

Seismic Resilience

- Gresham's 2016 Water System Seismic Resilience Plan identified key resources that would be at risk from the effects of a large earthquake. The Grant Butte Reservoir and associated pipes were determined to be a priority vulnerability to earthquake impacts, including co-seismic landslide. Gresham received a $2.2 million hazard mitigation grant from FEMA to improve underground pipes and structurally improve the reservoir structure as well as operational equipment. Final repaving work was completed in the summer of 2022.

Figure 125 - The Grant Butte Reservoir in Gresham. Photo - City of Gresham

- Gresham received a FEMA Hazard Mitigation grant to strengthen a sewer/water conveyance flyover at Johnson Creek near Cedarville Park. The project will replace the span, strengthen the base with piles and harden manholes. This type of project was specifically noted as a prioritized mitigation strategy in Gresham's 2017 NHMP. Construction is planned for Summer 2023.

Tree Planting

- As part of Gresham's efforts to cool elevated stream temperatures and to improve stream bank stability, Gresham's Natural Resources Program continues to plant over 15,000 riparian trees and shrubs annually.

- Urban heat islands have been identified with Rockwood (the area with the highest concentration of poverty and limited English proficiency) showing extreme heat. Tree planting is being prioritized in Gresham for these areas given the extreme heat risk and poor air quality in neighborhoods with high proportions of impervious surfaces and populations with less ability to avoid these risks. Increasing the tree canopy also assists in infiltrating stormwater in these highly urbanized areas.

- To support the goal of increasing tree canopy, the City of Gresham partnered with the Multnomah County Office of Sustainability, Friends of Trees and the East Multnomah Soil and Water Conservation District (EMSWCD) in 2018 to create the Green Gresham, Healthy Gresham program to plant additional street trees in the Rockwood, Wilkes East and North Gresham neighborhoods. Since the initiation of this program, hundreds of trees have been planted and Gresham is also seeking funding for a larger-scale project in Rockwood to add trees to a highly urbanized commercial area that would include permanent pavement replacement.

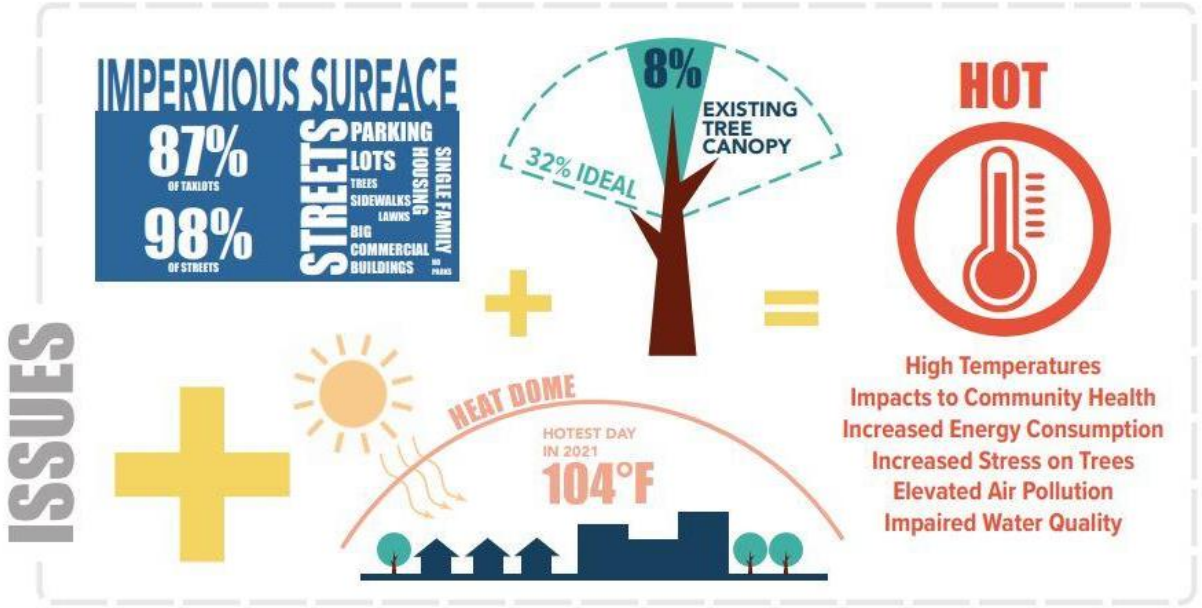


Figure 126– Graphic from Juncus Studio landscape analysis for City of Gresham, 2021

Flood Resilience

- In 2019 Gresham updated its floodplain code to bring the city into compliance with updated FEMA standards and adopted new FIRM maps within the Lower Columbia-Sandy Watershed. Riparian code updates went into effect in 2021 were targeted to maintain current levels of code protection but increase understanding and enforceability.

- The culvert under Palmquist Road was upsized to prevent historic backups and flooding of the area including Palmquist Estates, an 86-space manufactured home park.

Landslide Resilience

- In 2020 updated code and overlay maps regarding development in areas with steep slopes and landslide risk. Hillside mapping was updated to utilize LIDAR and DOGAMI landslide risk data. The code was updated to require a geotechnical professional review development in these areas and to further protect trees from removal.

Sustainable Infrastructure

- The City of Gresham partnered with the University of Oregon's Institute for Policy Research and Engagement (IPRE) and the Center for Sustainable Infrastructure to review the city's natural hazard policies and consider how critical infrastructure is impacted. The collaboration focused on the development of a more resilient water supply and how that project could be reimagined in ways that strengthen the resilience of critical infrastructure systems and the interconnection of systems—with an eye to maximizing economic, public health and environmental value, and reducing risks posed by natural and human-induced disasters. A report and workshop series were created to evaluate the project on those terms.

- The resilient water supply project was undertaken by Gresham's two water providers because of rising costs of buying water from Portland and to increase redundancy in the system. In 2021, a new well was completed in Gresham, a new reservoir is under construction at Rockwood Water People's Utility District facilities, and Gresham is planning for new earthquake-resilient transmission mains.

5.2.4 Local Hazard Analysis

Earthquake – Risk Rating High

See Earthquake Section for more detailed risk and vulnerability information.

Gresham faces considerable risk from a Cascadia Subduction Zone event or local crustal fault event. In the two earthquake events modeled by DOGAMI in the countywide Multnomah County Earthquake Impact Study (Cascadia Subduction Zone earthquake and Portland Hills crustal earthquake), Gresham faces primarily very strong shaking fairly evenly across the city. Severe shaking effects are predicted in floodplains in the farthest north of the city along the Columbia River and Columbia Slough and along creeks in the south of the city, especially Johnson Creek. These areas with heightened earthquake impacts make up about 20% of the city.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)

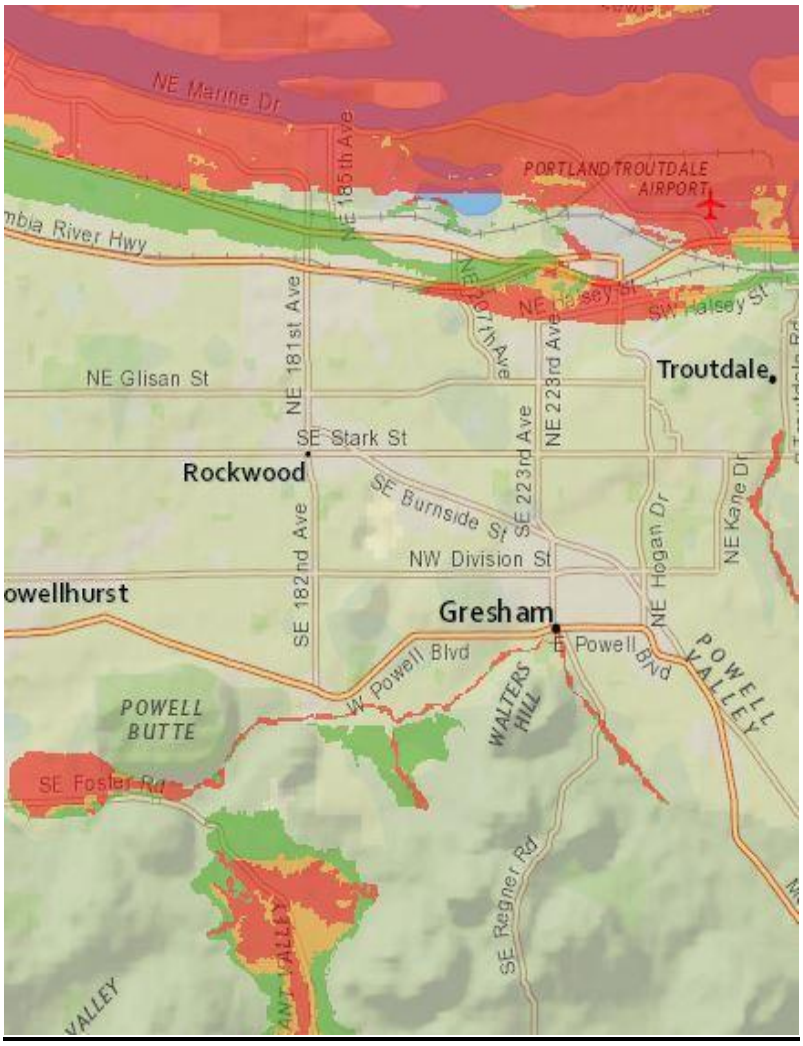


Figure 127- Map showing liquefaction risk zones in Gresham. High risk is shown in red, medium risk in yellow and lower risk in green. All areas of Gresham would be subject to ground shaking. Map from DOGAMI HazVu website.

Gresham has highly urbanized areas including older multifamily residential buildings which would be more susceptible to shake damage. Much of the population in these areas are at increased risk and have significant barriers to resilience/mitigation planning. There is significant infrastructure in the Columbia Slough watershed and along Johnson Creek. These factors lead to a high relative risk for Gresham.

Gresham is also the only city in this plan which has identified crustal faults within its jurisdiction. These faults are the Grant Butte Fault Zone and Damascus-Tickle Creek Fault Zone located around Gresham Butte and in Powell Valley respectively. While these faults are a concern, they have not been evaluated for vulnerability to earthquake scenarios and there is little record of past seismic activity.

An interactive version of this map can be found here (Earthquake Hazard – Active Faults)

Figure 128 - Map showing location of crustal faults in Gresham. Map from DOGAMI HazVu..

The buttes in the south of the city are also at high risk from earthquake-induced landslides. Those areas are expected to be the same as the mapped risk areas for any landslide, but a large earthquake would be expected to trigger a large number at once and complicate response and evacuation efforts and put infrastructure at risk.

Flood – Risk Rating Moderate

***See Flood Section for more detailed risk and vulnerability information*.**

While much of Gresham's industrial land lies in the Columbia River floodplain, the area is largely protected by the Multnomah County Drainage District levee system and upstream dams. In other portions of the City, mapped flood hazard area is limited closely to stream channels. These extents, most prominently along the Columbia Slough, Johnson Creek, Fairview Creek, and Kelly Creek are sufficient to consider the relative risk of flood in Gresham to be moderate. There is also documented risk of flooding along Burlingame Creek which is not reflected on FEMA floodplain maps, and protections have been implemented with the recent floodplain updates.

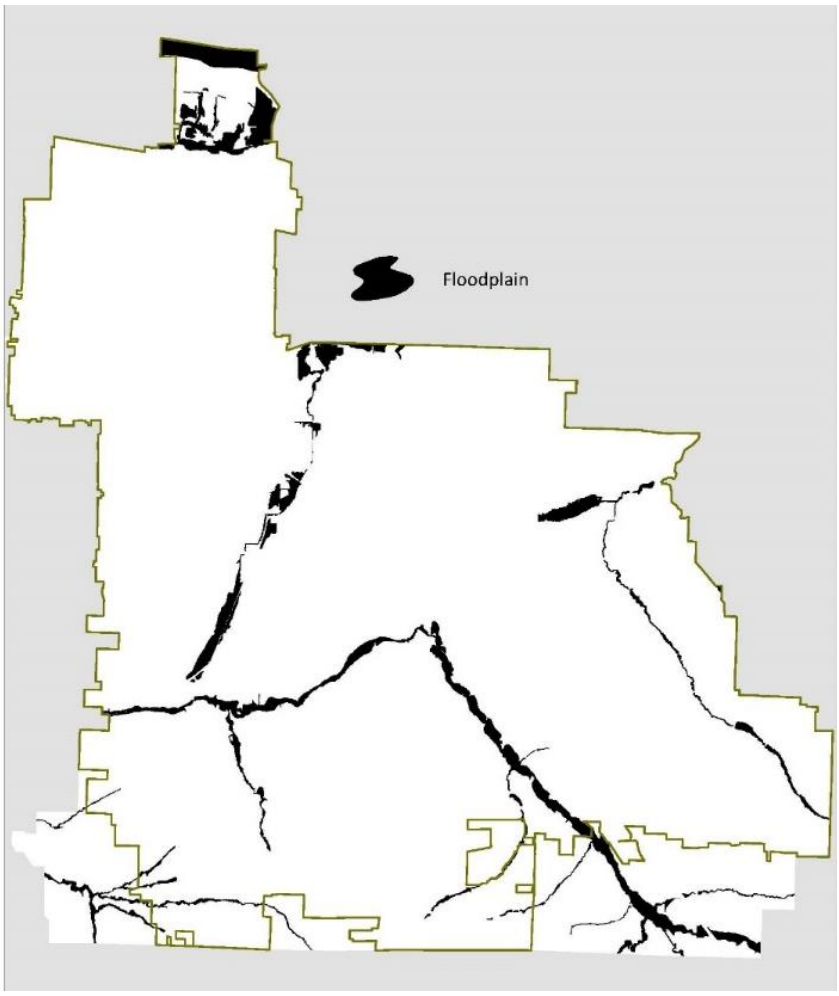


Figure 129 - Floodplain overlay for the City of Gresham indicated in black. Map from the Gresham Community Development Plan, Volume 2, Section 10.232

Gresham has participated in the National Flood Insurance Program (NFIP) since 1979, and adopted its Floodplain Overlay Zone to its Development Code in 1988. NFIP Program participation allows city residents to purchase federal flood insurance and requires the city to maintain a flood protection ordinance to make new and rebuilt construction more resilient to flood. As of 2016, there were 83 active policies with over $23 million in insurance coverage. Since Gresham residents became eligible for Federal flood insurance, two claims had been paid as of 2016, totaling about $8,000 in payments. Gresham has no structures considered repetitive loss or severe repetitive loss.

Gresham's floodplain management program is overseen by the Urban Design and Planning Department, which that implements the Floodplain Overlay Zone. The city updated its Floodplain Overlay in 2019 to adopt revised Flood Insurance Rate Maps developed for the Lower Columbia-Sandy watershed.

Gresham seeks to reduce flooding impacts of existing and new development by constructing regional stormwater detention facilities, requiring new development to provide on-site stormwater detention, protecting undeveloped riparian and floodplain areas and, where possible, utilizing green practices. Areas identified as of risk for urban stormwater flooding are:

- Areas along Burlingame Creek, particularly those near Hogan Road where Burlingame enters the Gresham Golf Course
- Properties along Johnson Creek off Park Avenue

Landslide – Risk Rating Moderate

See Landslide Section for more detailed risk and vulnerability information.

Gresham's risk of landslide is primarily in the butte areas in the south of the city, while the northern portion shares the flatter topography of the other cities in this plan. Apart from unincorporated Multnomah County, Gresham has the highest proportion of its area with high-risk shallow and deep landslide areas of entities in this plan. Gresham has been fairly successful in reducing development on the buttes in recent years, but legacy development exists at toes of slope of all the buttes and along the eastern slope of Gresham Butte and Hogan Butte. Increased die off of forest canopy throughout the buttes is associated with the increase in warmer, drier summers, resulting in a decline in tree cover as well as a decline in the slope stabilization provided by healthy tree roots. Because of these factors, the risk level for landslides was determined as moderate.

DOGAMI landslide inventories show a small number of recorded landslides around Gresham Butte. Deep landslide deposits were identified in several areas around the city buttes, with the largest found on a steep slope near Kelly Creek and SW Rodlun Road at the boundary between Gresham and Unincorporated Multnomah County.

Notable landslide risk areas identified by the City of Gresham are the Springwater and Pleasant Valley communities, the north and east face of Gresham Butte and at Walter's Road, the east face of Hogan Butte, and along Miller Avenue, Lovar Street and 14th Street.

An interactive version of this map can be found here (Landslide Susceptibility – Susceptability to Deep Landslides)

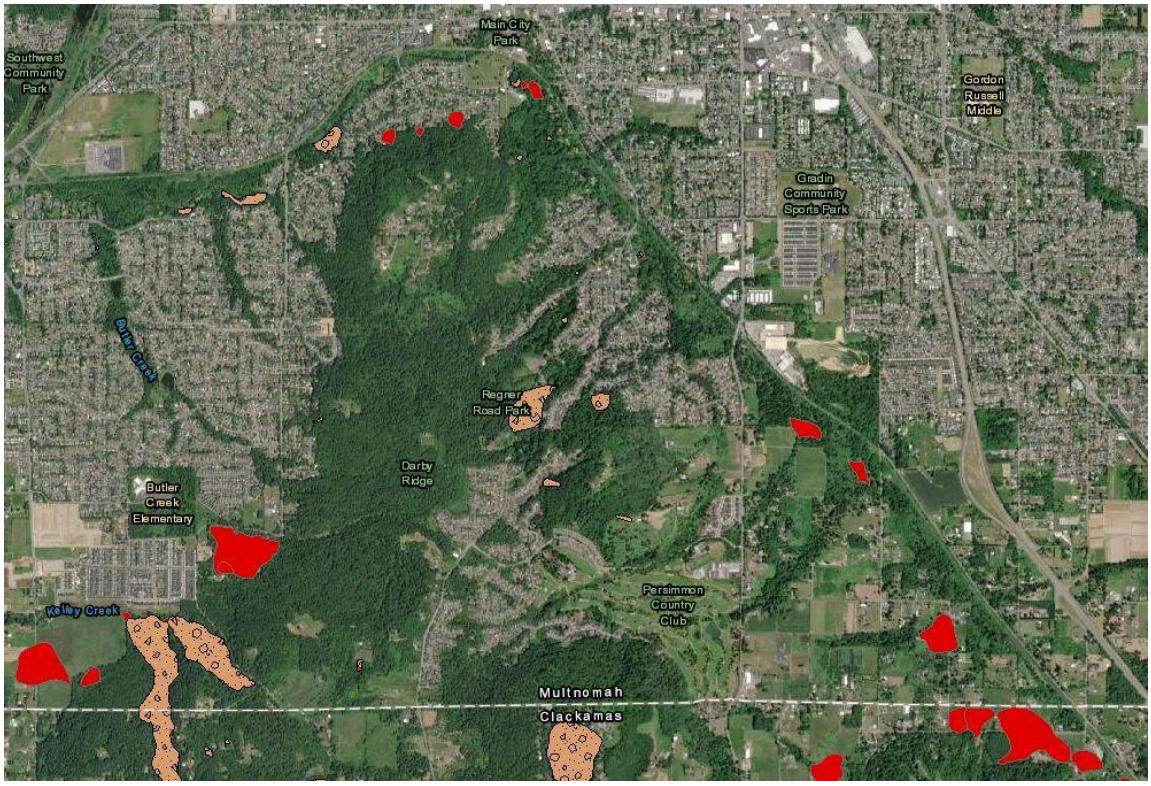


Figure 130- Map showing historic landslide deposits in the Gresham Buttes area. Areas indicated in orange are historic slide deposits and red areas are historic alluvial fans. Map from DOGAMI SLIDO site.

The southern buttes are also highly susceptible to shallow landslides because of their steep slopes and soil makeups.

[An interactive version of this map can be found here (Landslide Susceptibility – Susceptability to Shallow Landslides)]

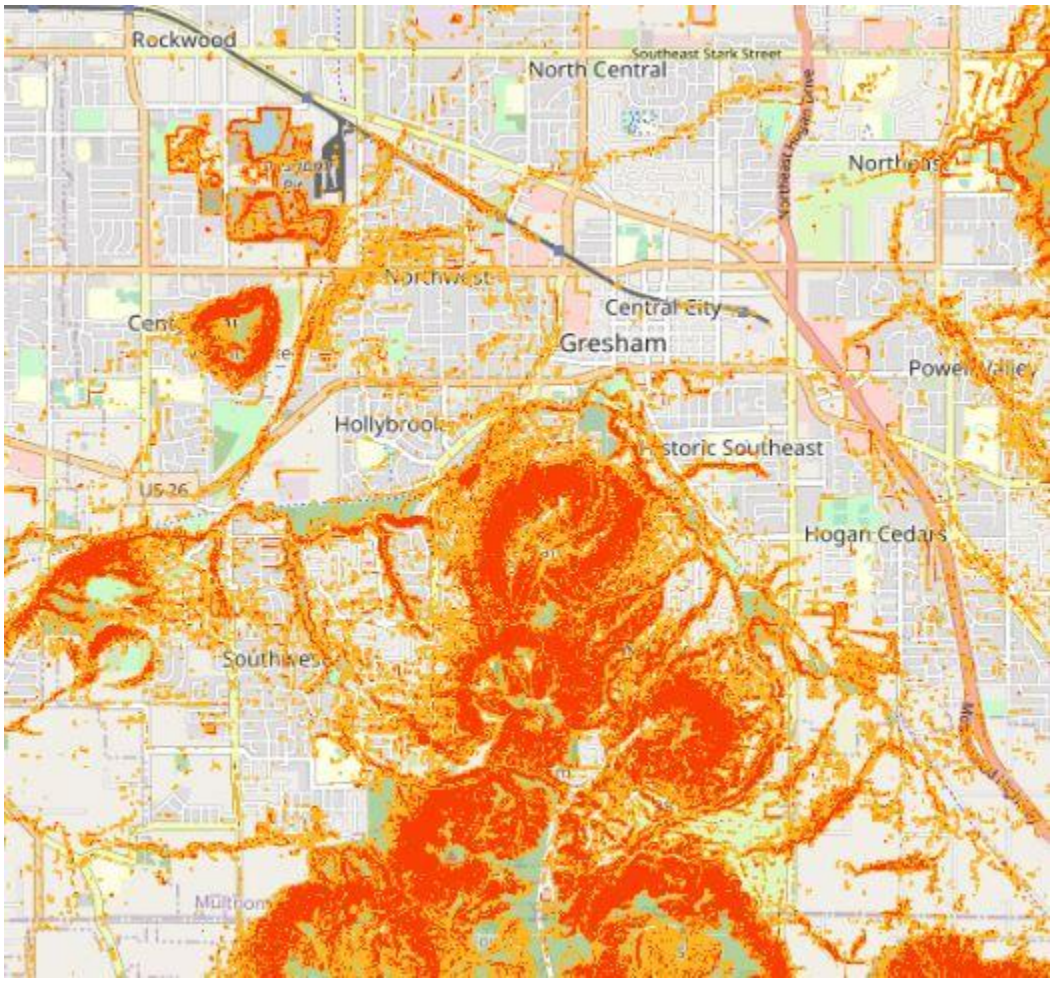


Figure 131 - Map showing shallow landslide susceptibility in South Gresham. Red are the highest risk areas, orange are medium risk, and yellow are lower risk. Map from DOGAMI SLIDO site.

Gresham referenced SLIDO and DOGAMI's landslide and hazard risk study to identify areas of landslide risk and used that and community risk assessments to create a Hillside and Geologic Risk Overlay which regulates work, including tree removal, on hillsides and steeply sloped areas. Ground disturbance is limited in such mapped areas and on slopes greater than 35% development is severely limited. Almost all development in these areas requires a geotechnical engineer to have reviewed plans. Trees are protected and replacement is required if dangerous trees are removed to mitigate the loss of slope stability.

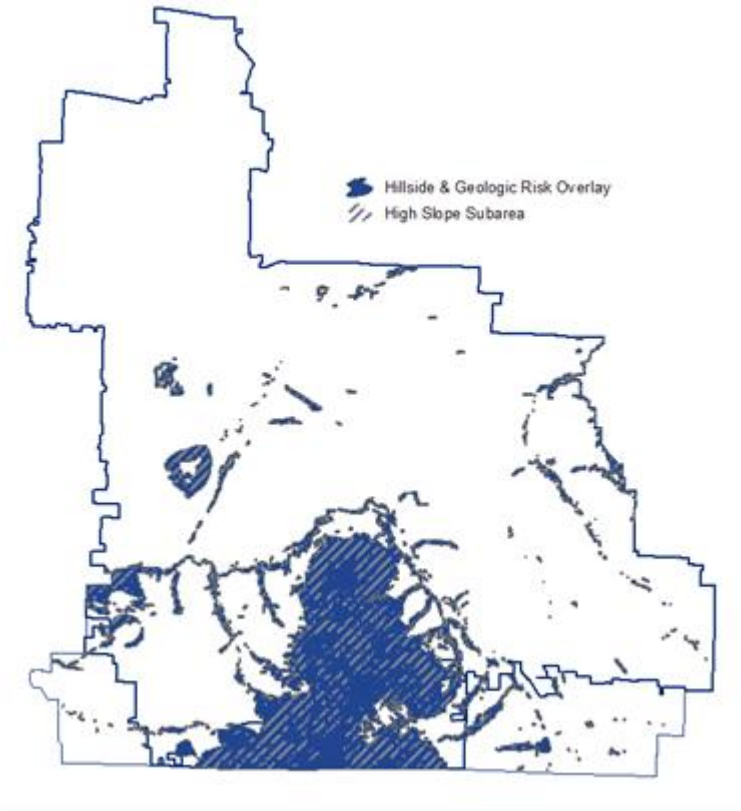


Figure 132 - Map showing City of Gresham Hillside & Geologic Risk Overlays, from the Gresham Community Development Plan, Volume 2, Section 10.211

Severe Weather – Risk Rating High

See Severe Weather Section for more detailed risk and vulnerability information.

Due to the density of Gresham's urban centers the impacts of extreme weather events may be particularly severe in Gresham. Due to the limited tree canopy in these areas (particularly Rockwood) the impacts of heat in particular is likely to be much greater while the aging multifamily housing stock in those same areas may create more susceptibility to extreme cold. Due to this intersection of risk and elevated harm, Gresham provided a single risk rating of high for severe weather as a whole.

Extreme Heat

Extreme heat is a high priority risk for Gresham. One hyperthermia death in the 2021 Heat Dome Event was identified in the city, while other deaths occurred in directly neighboring zip codes in East Portland. Measurements of urban heat islands in East Portland during that event showed ambient temperatures as much as 50 degrees hotter than green spaces, an effect likely repeated in Gresham neighborhoods like Rockwood and East Gresham with similarly developed streetscapes. Increasing tree canopy in the most affected neighborhoods is a key mitigation strategy.

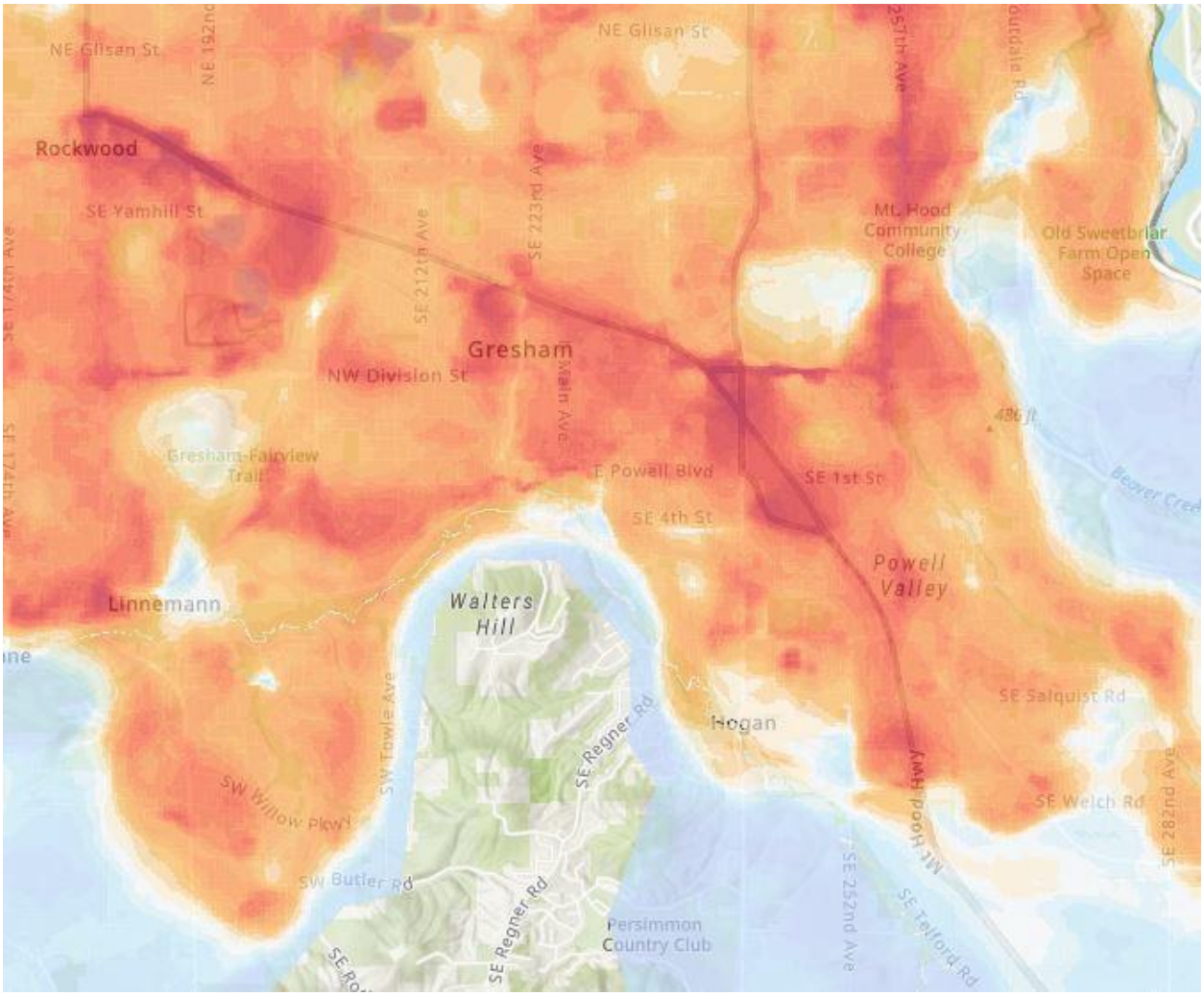


Figure 133 - Figure 134 - Map showing heat risk during severe heat events, with areas in the darkest red having the most significant urban heat island effects. Map from CAPA Strategies East Multnomah County Heat Watch Report.

Winter Storms

Winter storms are particularly dangerous to Gresham's unsheltered population. Snow and ice have also caused disruptions to transportation, utilities, and other infrastructure. Long-term power loss creates risks for Gresham's disabled and medically fragile population that use powered medical devices or need refrigerated medications. Transportation and power disruptions may also prevent caregivers from being able to reach those who need daily support.

Windstorms

Gresham's risk of windstorm is similar to other east county cities. Vulnerabilities include mobile homes, transportation corridors and power lines that can be impacted by the wind and or from downed trees.

Drought

As with other communities, the risk to Gresham's drinking water from drought is lessened by Gresham's water supply resources. The Bull Run Reservoir and aquifer wells used by local

water providers are recharged through year-round rainfall and are not reliant on surface waters fed by snowpack during hot summer months. The implementation of the Cascade Groundwater Alliance and increasing use of groundwater will not impact this resilience to weather. Gresham's forest resources are at high risk from drought, and an increase in forest die off contributes to increased risks for wildfire and landslides.

Volcano – Risk Rating Low

See Volcano Section for more detailed risk and vulnerability information.

Portions of Gresham along the Columbia River could be impacted by a volcanic lahar, a massive debris flow caused by an eruption of Mount Hood. The area of Gresham at risk is an industrial area between the railroad tracks and NE Marine Drive, but this risk would likely only be realized in a rare, 'worst-case' event. A full vulnerability analysis of potential lahar damage in Gresham has not yet been performed.

An interactive version of this map can be found here (Volcano Hazard – Moderate Hazard Zone)

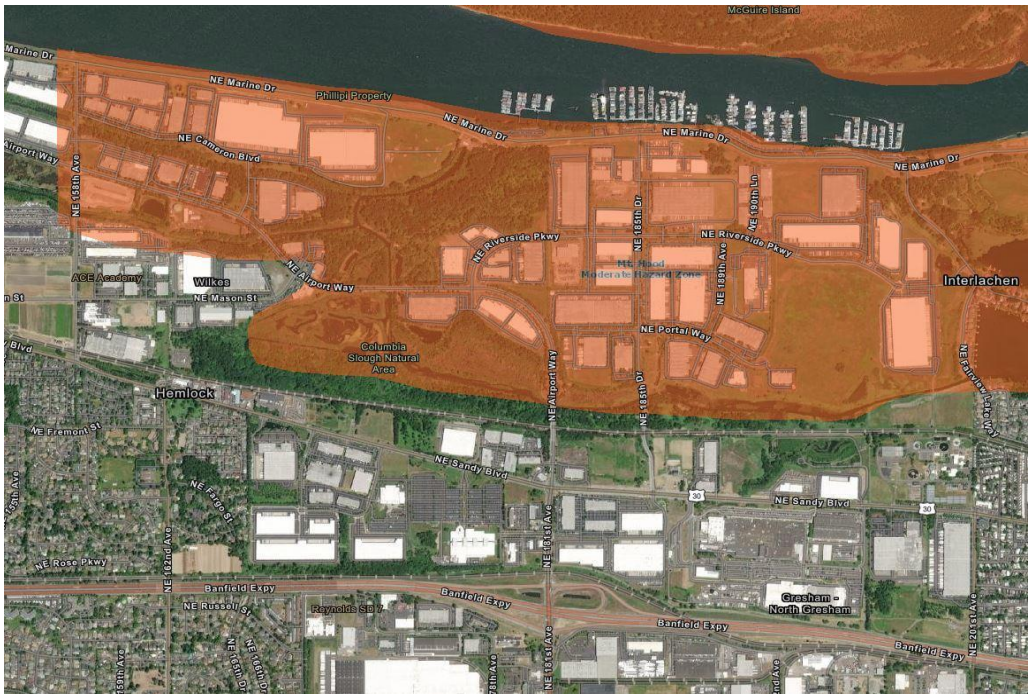


Figure 135- Map showing potential lahar impacts in Gresham from an extra-large Mount Hood eruption (10,000-100,000 year event). Map from DOGAMI HazVu site.

Falling ash from eruptions of Mount Hood would be expected to impact Gresham, though weather conditions would determine how severely. Falling ash could have severe impacts to the health of vulnerable community members, and damage buildings and infrastructure. But these events are of extremely low probability and therefore Gresham has rated volcanic risk overall as low.

Wildfire and Wildfire Smoke – Risk Rating Moderate

See Wildfire and Wildfire Smoke Section for more detailed risk and vulnerability information.

Wildfire and wildfire smoke is considered to be of moderate risk for the City of Gresham. As with all other cities in this plan, all of Gresham's population, especially those with existing health risk factors and/or unable to move to clean air spaces, face the greatest impacts from wildfire smoke events. Tree canopies can also help filter particulates, so areas subject to impacts from heat island effects may also suffer additional impacts during smoke events.

Wildfire risk is most prominent in the city's southern buttes. There is a large connected area of forest from Gresham Butte to the Clackamas County line where a wildfire of over 250 acres could originate and threaten a fairly large population in local neighborhoods at the foots of buttes, as well as important infrastructure.

Other risk areas are scattered across the city, in locations where smaller vegetated areas could become fire transmission locations to urban development in extreme fire weather conditions. Significant risk areas have also been identified just outside of the city limits to Gresham's southeast, creating risk to Wildland Urban Interface areas within the urban boundary.

An interactive version of this map can be found here (Wildfire Potenial Impacts – Overall Potential Impacts)

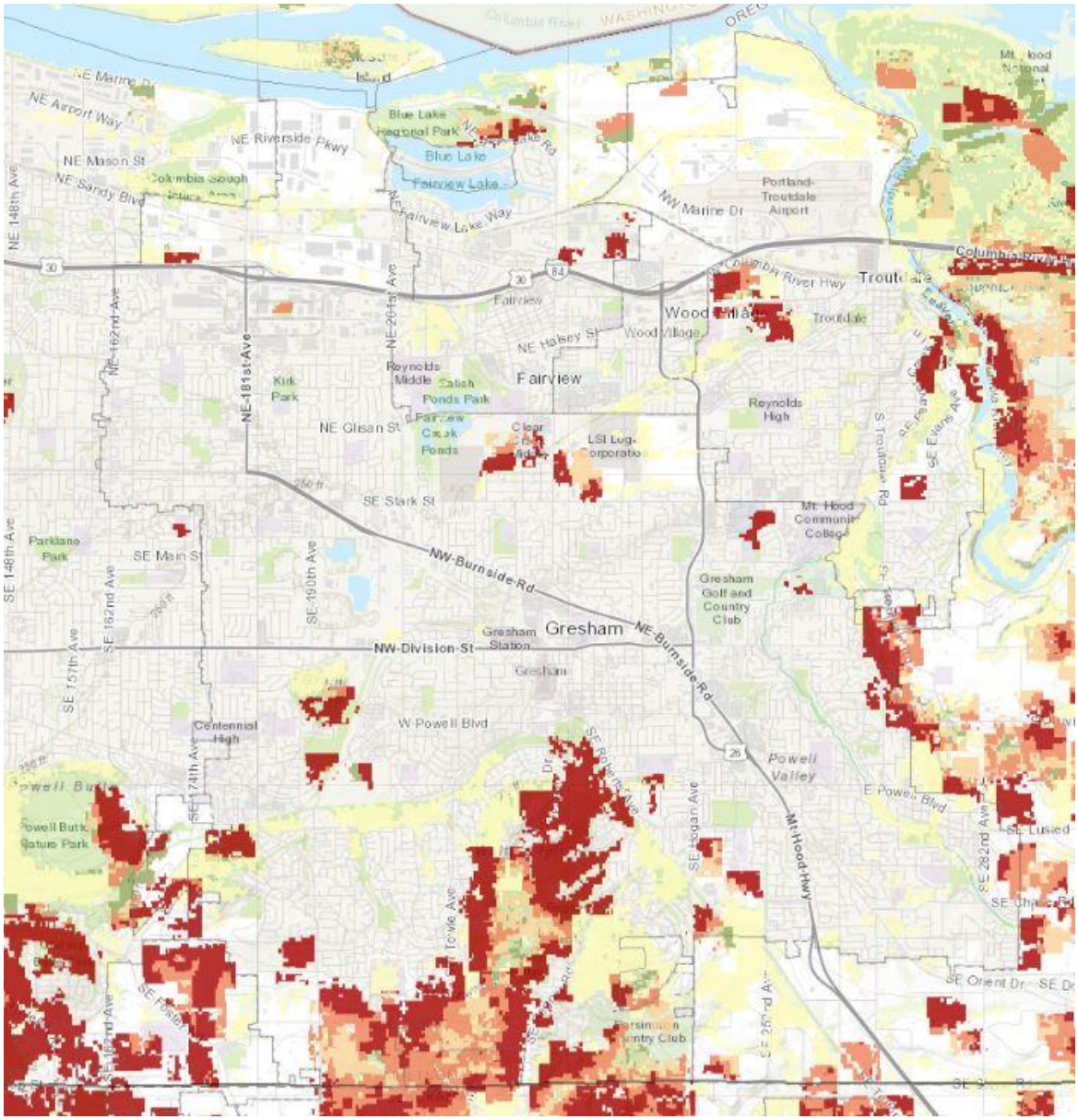


Figure 136 – Map showing overall impact of wildfire to locations in Gresham. Impact includes risk to structures, infrastructure and natural resources. Since catastrophic fire is linked to extreme wildfire risk conditions, this serves as a measure of where fire ignition would be the most dangerous. Map from Oregon Wildfire Risk Explorer with data from PNW-QWRA.

5.2.5 Hazard Risk Scoring

The identified levels of risk from each hazard were determined by the City of Gresham, using a scoring methodology designed by Oregon Emergency Management, and applied across the state to contextualize local risk perception.

Gresham Hazard Risk Analysis										
Hazard	History (Weight Factor = 2)		Vulnerability				Probability (Weight Factor = 7)		Risk Score	Initial Risk Ranking
			Average (WF = 5)		Max (WF = 10)					
Earthquake	2 x	**10**	5 x	**10**	10 x	**10**	7 x	**8**	**226**	**High**
Flood	2 x	**7**	5 x	**4**	10 x	**7**	7 x	**8**	**160**	**Moderate**
Landslide	2 x	**3**	5 x	**7**	10 x	**7**	7 x	**10**	**181**	**Moderate**
Severe Weather – Extreme Heat, Winter Storm, Wind Storm, Drought	2 x	**10**	5 x	**10**	10 x	**10**	7 x	**10**	**240**	**High**
Volcano	2 x	**1**	5 x	**8**	10 x	**8**	7 x	**2**	**136**	**Low**
Wildfire and Wildfire Smoke	2 x	**8**	5 x	**8**	10 x	**8**	7 x	**10**	**206**	**Moderate**

5.2.6 Aligned Plans and Other Implementation Processes

Overview

Gresham has similar plans and processes to other cities in this plan, under the State Building Code and Land Use Program. Because Gresham is larger than the other cities, it has some resilience-focused staff, which has helped the city take advantage of grant opportunities, build out development codes with additional hazard overlays, drive natural resource programs, and begin work on a Climate Resilience Plan. Integration of hazard mitigation resilience into infrastructure system planning and general plan alignment has been ongoing and effective, as Gresham manages all of its own local lifeline systems. Coordination with partners in water delivery, wastewater treatment, and fire service has built multi-jurisdictional resilience in east Multnomah County. Gresham does not have the resources of larger cities like Portland, so still must make targeted priority decisions when implementing mitigation, and ongoing and increasing coordination with Multnomah County government around climate risk remediation is an important strategy noted in this update.

- Capital Improvement Program (CIP)
  - A five-year estimate, most recently adopted in June 2022
  - The CIP funds major infrastructure projects in the city that can reduce risk by being lifelines in disaster. The CIP can work in concert with the NHMP by aligning infrastructure priorities with new risk and vulnerability hazards data.

- City Budget
  - Adopted each new fiscal year, beginning on July 1.
  - The annual budget can provide funding used for natural hazard mitigation. Action items from the NHMP that require local funding should be aligned with the budget process for funding.
- City of Gresham Emergency Operations Plan (EOP)
  - Most recently updated in 2015
  - The mission and goals of the NHMP support the mission of the EOP to coordinate disaster response. When the EOP is updated next it should include updated risk assessment information and mapping to prioritize response priorities.
- City Strategic Plan
  - Developed in 2021-22 to provide a shared vision for the city from 2022-25
  - The Strategic Plan is the result of a community effort called Imagine Gresham that occurred in 2021-2022. The mission of the plan is to foster a safe, thriving and welcoming community over the three-year planning horizon. The Community Safety goal has the objective of strengthening the city's ability to withstand natural disasters and deal with climate change. The strategic plan offers another vehicle to prioritize natural hazards mitigation planning and implement identified actions from the NHMP update.
- City-wide Stormwater Master Plan (SWMP)
  - Adopted June 2022
  - The set of stormwater management codes and plans reduce risk to people and property from flooding. Updated risk assessment information in the NHMP can be used to inform updates to the SWMP, and stormwater management gaps identified in the SWMP have informed NHMP action priorities.
- Climate Action Plan (In Progress)
  - When adopted, the Climate Action Plan will be a community-driven roadmap for addressing causes of and outcomes from climate change. The climate preparedness goal will address strategies for reducing risk from climate hazards – fire and smoke, extreme heat and cold, winter weather, and precipitation – and align and continue to inform NHMP action strategies for these hazards.
- Comprehensive Plan
  - Includes housing capacity analysis and community plans for downtown, Civic neighborhood, Central Rockwood, Gresham Butte, Pleasant Valley, and Springwater
  - The plan addresses the extent of natural hazards to meet statewide Land Use Goal 7. References in the plan to the NHMP should be updated, and the risk assessment and mapping used should be aligned with new information in the NHMP update.
- Debris Management Plan (In Draft)
  - The plan, when adopted, will identify opportunities to managing post-disaster debris and can identify risk-reduction processes that may be suitable to become future NHMP actions.
- Development Code
  - Revised in 2009, and amended more recently.
  - The Development Code provides regulation for development and land use in the city. Gresham's code includes overlay districts for Flood Plans and Hillside and Geologic Risk, with specific code requirements for those locations. Alignment with NHMP updates is needed, and the city may consider additional overlay districts in the future for other natural hazards of concern.

- Gresham Water Infrastructure Resilience Planning
  - The outcome of a planning workshop to look at long-term resilience in Gresham's water system. The planning effort included a link to the NHMP update process and noted the overlap between the plans in identifying priorities.
- Gresham Redevelopment Commission Community Investment Framework
  - 2029 Community Investment Framework in process
  - This framework has an opportunity to center climate resilience and other natural hazard risk in their investment priorities – building off work already occurring in Gresham.
- Parks Master Plan
  - Last adopted in 2009, with a 20-year planning horizon
  - Parks are a part of a natural hazard mitigation strategy and also can be an element of risk. Updates to the parks plan could include updated risk assessment and mapping from the NHMP, and could determine design and amenities of new or redeveloped parks or open space.
- Rockwood-West Gresham Renewal Plan
  - Approved November 2003
  - The Rockwood-West Gresham area is subject to natural hazards and the renewal plan is a tool that guides development and can be used to increase the resilience of the community to natural hazards. Because the plan was approved in 2003, it does not have discussion of the significant urban heat islands in this part of Gresham and any future update of the plan would likely consider the climate impacts to less resourced and historically underserved residents.
- Wastewater Collection System Master Plan (WCSMP)
  - Adopted June 2020
  - The Wastewater System Master Plan provides a long-term framework for wastewater system requirements, of which resilience is an important element. The plan includes a section on system-wide seismic resilience. The plan should be aligned with the NHMP update, and a priority action in this plan is to implement projects identified in the WCSMP.
- Wastewater Plant Master Plan
  - Adopted October 2017
  - The Wastewater Plant Master Plan details system needs for this critical infrastructure lifeline. Seismic risk is described in the plan, and revised earthquake and flood risk assessments should continue to be integrated into future updates.
- Water Master Plan (WSMP)
  - Most recently updated in March 2022
  - The Water System Master Plan provides a long-term framework for water system requirements, of which resilience is an important element. The recently updated plan includes a section on seismic resilience, and this plan and the NHMP have been used in tandem to identify retrofits to water system infrastructure. The plan should be aligned with the NHMP update, and continue to inform resilience project needs to be listed in future iterations of this NHMP.
- Transportation System Plan (TSP)
  - Being updated with policies and projects identified in the 2018 Active Transportation Plan.

- The hazard resilience of transportation systems is essential to meeting the goals of the plan. The TSP should reflect the revised risk assessment in this plan to help prioritize transportation system improvements that will increase resilience.

5.3 City of Troutdale

5.3.1 Mitigation Actions

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Troutdale</th></tr>
<tr><td rowspan="8">Multi-Hazard</td><td rowspan="8">1</td><td colspan="8">Continue to integrate natural hazard risk information into plan and development code updates.</td></tr>
<tr><td colspan="3">Plan Goals – 1,2,3,5</td><td colspan="5">Hazards Addressed – All Hazards</td></tr>
<tr><td colspan="3">Lifelines – Planning and Building</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Land Use Planning</td><td></td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>15</td></tr>
<tr><td colspan="8">Potential Funding – General fund, Grants</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Comprehensive Land Use Plan, Development Code</td></tr>
<tr><td colspan="8">Notes – Modified action from 2017 plan.</td></tr>
</table>

Hazard	Action ID	Mitigation Actions – City of Troutdale							
Multi-Hazard	2	**Continue to use natural hazard risk information to identify and pursue mitigation projects through continuity of operations and resilience plans.**							
		Plan Goals – 2,3,5		Hazards Addressed – All Hazards					
		Lifelines – All Infrastructure		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Public Works		**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – Utility Funds, Grants							
		Potential Implementation Methods – Continuity of Operations Plan, Infrastructure Resilience Plans							
		Notes – Modified action from 2017 plan.							
Multi-Hazard	3	**Consider adopting a development standard requiring consideration of natural hazard risk when designing public improvements.**							
		Plan Goals – 2,3,5		Hazards Addressed – All Hazards					
		Lifelines – Public Facilities		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Public Works		**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – Utility Funds							
		Potential Implementation Methods – Capital Improvement Plan, Development Pre-Planning							
		Notes –							

Hazard	Action ID	Mitigation Actions – City of Troutdale							
Earthquake	4	**Continue to pursue seismic upgrades to suspended wastewater conveyance pipelines identified in Public Works' Resiliency Plan.**							
		Plan Goals – 3,5		Hazards Addressed – Earthquake					
		Lifelines – Wastewater Infrastructure		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Public Works		**3**	**3**	**2**	**3**	**3**	**14**
		Potential Funding – Utility Funds							
		Potential Implementation Methods – Wastewater Capital Improvement Plan							
		Notes – Modified and continuing action from 2017 plan.							
Flood	5	**Maintain engagement with levee recertification efforts to provide local considerations and information and identify capital improvements that will help maintain levee accreditation.**							
		Plan Goals – 1,2,3		Hazards Addressed – Flood					
		Lifelines – Flood Protection Infrastructure		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		City Manager	Levee Ready Columbia, Sandy Drainage Improvement Company, Multnomah County Drainage District	**3**	**3**	**1**	**3**	**3**	**13**
		Potential Funding – General Fund							
		Potential Implementation Methods – Levee Ready Columbia							
		Notes – Continuing action from 2017 plan.							

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Troutdale</th></tr>
<tr><td rowspan="8">Flood</td><td rowspan="8">6</td><td colspan="8">Conduct an inventory of wastewater manholes within the 1% annual chance floodplain and determine the feasibility of replacing manhole covers with watertight lids.</td></tr>
<tr><td colspan="3">Plan Goals – 3,5</td><td colspan="5">Hazards Addressed – Flood</td></tr>
<tr><td colspan="3">Lifelines – Wastewater Infrastructure</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Public Works</td><td></td><td>1</td><td>2</td><td>3</td><td>1</td><td>3</td><td>10</td></tr>
<tr><td colspan="8">Potential Funding – Utility Funds, Grants</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Wastewater Capital Improvement Plan</td></tr>
<tr><td colspan="8">Notes – Modified action from 2017 plan.</td></tr>
<tr><td rowspan="8">Landslide</td><td rowspan="8">7</td><td colspan="8">Incorporate landslide risk mapping into the next update of the Comprehensive Plan.</td></tr>
<tr><td colspan="3">Plan Goals – 1,2,5</td><td colspan="5">Hazards Addressed – Landslide</td></tr>
<tr><td colspan="3">Lifelines – Planning and Building</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Land Use Planning</td><td>DOGAMI</td><td>3</td><td>3</td><td>3</td><td>2</td><td>3</td><td>14</td></tr>
<tr><td colspan="8">Potential Funding – General Fund</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Comprehensive Plan</td></tr>
<tr><td colspan="8">Notes –</td></tr>
</table>

Hazard	Action ID	Mitigation Actions – City of Troutdale								
Landslide	8	**Develop coordination between Public Works and the Building Department for improving stormwater management standards on private property.**								
		Plan Goals – 1,5		Hazards Addressed – Landslide						
		Lifelines – Community Resilience, Planning and Building		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Land Use Planning	Public Works	**2**	**2**	**3**	**3**	**3**	**13**	
		Potential Funding – General Fund								
		Potential Implementation Methods – Capital Improvement Plan, Comprehensive Plan								
		Notes –								
Severe Weather	9	**Create a handout for residents living in mobile homes about wind and snow load impacts on roofs.**								
		Plan Goals – 1,4		Hazards Addressed – Severe Weather						
		Lifelines – Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Building Department	Communications	**3**	**2**	**3**	**3**	**3**	**14**	
		Potential Funding – Code Specialties								
		Potential Implementation Methods – Administration								
		Notes –								

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Troutdale</th></tr>
<tr><td rowspan="7">Volcano</td><td rowspan="7">10</td><td colspan="8">Perform outreach with homebuilders professional organizations to determine how volcano risk disclosure might be included in home sale documentation.</td></tr>
<tr><td colspan="3">Plan Goals – 1,2</td><td colspan="5">Hazards Addressed – Volcano</td></tr>
<tr><td colspan="3">Lifelines – Community Resilience</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Building Department</td><td>Homebuilders Organizations</td><td>3</td><td>1</td><td>2</td><td>3</td><td>2</td><td>11</td></tr>
<tr><td colspan="8">Potential Funding – General Funds</td></tr>
<tr><td colspan="8">Potential Implementation Methods –</td></tr>
<tr><td colspan="8">Notes –</td></tr>
<tr><td rowspan="7">Wildfire & Wildfire Smoke</td><td rowspan="7">11</td><td colspan="8">Consider adoption of additional wildfire safety standards in the Troutdale Development Code focusing on siting, defensible space, construction standards, access standards, mitigation planning, and subdivision proposals - using policy work developed through Senate Bill 762 as a guide.</td></tr>
<tr><td colspan="3">Plan Goals – 1,2,5</td><td colspan="5">Hazards Addressed – Wildfire & Wildfire Smoke</td></tr>
<tr><td colspan="3">Lifelines – Wildfire Protection, Community Resilience</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Land Use Planning</td><td>Gresham Fire</td><td>2</td><td>3</td><td>3</td><td>3</td><td>3</td><td>14</td></tr>
<tr><td colspan="8">Potential Funding – General Fund</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Community Wildfire Protection Plan, Development Code</td></tr>
<tr><td colspan="8">Notes –</td></tr>
</table>

Hazard	Action ID	Mitigation Actions – City of Troutdale								
Wildfire & Wildfire Smoke	12	**Implement wildfire mitigation strategies identified in the revision to the Multnomah County Community Wildfire Protection Plan, including pursuing grants for fuel management projects in and near residential neighborhoods in identified Wildfire Urban Interface areas.**								
		Plan Goals – 1,2,5		Hazards Addressed – Wildfire & Wildfire Smoke						
		Lifelines – Wildfire Protection, Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Land Use Planning	Gresham Fire, Multnomah County Emergency Management	**1**	**2**	**3**	**3**	**3**	**12**	
		Potential Funding – Community Wildfire Defense Grant, Other Grants								
		Potential Implementation Methods – Community Wildfire Protection Plan								
		Notes –								
Wildfire & Wildfire Smoke	13	**Continue development of culturally competent wildfire risk education materials for residents.**								
		Plan Goals – 1,4		Hazards Addressed – Wildfire & Wildfire Smoke						
		Lifelines – Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Land Use Planning	Outreach Programs, Multnomah County Emergency Management, Gresham Fire	**3**	**2**	**2**	**2**	**2**	**11**	
		Potential Funding – General Fund								
		Potential Implementation Methods – Outreach Programs, Community Wildfire Protection Plan								
		Notes –								

5.3.2 City Overview

The City of Troutdale was incorporated in 1907, and is the third largest city in Multnomah County. Troutdale is the most northeasterly of the county's municipalities, serving as a gateway to the Columbia River Gorge Scenic Area and Sandy River Canyon. Troutdale is bordered to the west by the Cities of Fairview and Wood Village, to the south by the City of Gresham, and to the east by Unincorporated Multnomah County.

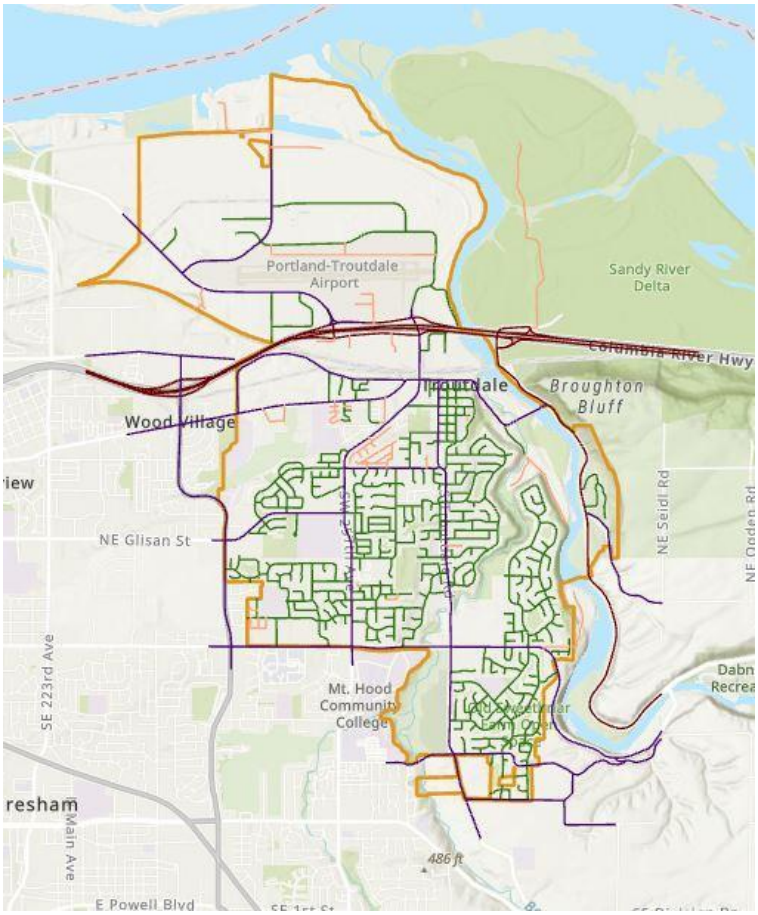


Figure 137 - Map showing municipal limits, outlined in yellow, of the City of Troutdale

Troutdale's location on the edge of the Urban Growth Boundary creates particular vulnerability to natural hazards. The Columbia River Gorge strongly influences its climate, making it often windier and colder than other cities in the county, and making the city more subject to disruptions from ice and snow.

Figure 138 - Welcome sign to Troutdale Town Center - Photo City of Troutdale

The geologically active Sandy River serves as an eastern border to most of the city, creating some susceptibility to flood and landslide. The Sandy River's volcanic deposits create hazards from both earthquake liquefaction and channel migration, and it is predicted that a future eruption of Mount Hood would send new debris flows down the Sandy River.

Troutdale also faces risk from wildfire as the first city to be threatened from a wildfire moving west from the vast forest tracts and steep slopes of the Columbia River Gorge.

Troutdale grew extremely rapidly as a residential suburb between the 1970s and the 1990s. Growth has slowed considerably in the last 20 years as the city is limited in future growth of its boundaries by topography and adjacent cities. Population growth is currently occurring primarily through infill and increased density within the existing city limits.

Table 42 – Troutdale Population by Census Year (For population details, see Community Profile chapter)

Census Year	Total Population – City of Troutdale	Percentage Change
2000	13,777	75.5% (1990)
2010	15,962	15.9% (2000)
2015 (est)	16,020	
2020	16,300	1.7% (2015)
2021 (est)[88]	16,319	

Troutdale's population is younger than the county as a whole, with over 29% of its population under the age of 18, compared to about 18% countywide. Growth over the last ten years has diversified the city, which now has a larger proportion of Hispanic residents than the county as a

[88] 2021 population estimates from the Portland State University Population Center. All other totals or estimates come from the US Census Bureau.

whole, and the proportion of older residents has also increased. New development applications have increased through 2022, with additional multi-family residential projects continuing to increase the city population, despite there having been no expansion of the municipal limits.

Land use in the city is divided by Interstate 84. There is no residential zoning north of the highway—that area is the site of the Troutdale Airport and has had a continuing buildout of industrial properties making it a major employment center for the region. Areas closest to the Columbia River are mostly reserved as open space.

Transportation

Troutdale is bisected by Interstate Highway 84, including a major interchange at NE 238th Drive. Other key identified transportation routes are Marine Drive, the Columbia River Highway, 257th Avenue, Stark Street, Cherry Park Road, Buxton Road and Troutdale Road.

Utilities

The City of Troutdale's Water Division provides about 1.6 million gallons of water to city residents daily. Troutdale's water comes from groundwater wells in the Sand and Gravel Aquifer and Troutdale Sandstone Aquifer, and is piped to reservoirs before being distributed to customers through 63 miles of water mains. The city also provides sanitary sewer services, parks management, stormwater management, street maintenance and recycling programs.

Electricity to the city is provided by Portland General Electric (PGE) and natural gas by NW Natural.

Critical Facilities

Critical facilities, as defined in this plan, existing in Troutdale are:

- Airport
- Bridge
- Childcare Facilities
- City Halls
- County Assets
- Fire Station
- Law Enforcement Facility
- Library
- Residential Care Facilities
- Schools

5.3.3 Five-Year Update, 2017-2022

Natural Hazard Events

Troutdale was primarily impacted in the last five years by weather-related events—heat, winter storms and wildfire smoke. The 2021 Heat Dome recorded no deaths in Troutdale zip codes. Long-term health impacts from that event and the 2020 Wildfire Smoke event are not yet known.

Disruptions to transportation routes, including local roads, were common due to snow and ice and landslides. Blizzards and landslides in January 2017 closed Interstate 84 from Troutdale to Hood River, a 45-mile closure blocking eastern travel from the city.

Mitigation Activities

- A shallow landslide in June 2019 blocked the recreational Robin's Way Trail in an area between SE Sandy Boulevard and the East Historic Columbia River Highway. As the area was being restored and mitigated, the slide continued in September 2020. Improved stormwater drainage and risk awareness signage were part of the project, and the trail reopened for use in June 2021.

Figure 139 - Map showing location on landslides on Robin's Way Trail in 2019 and 2020. Graphic - City of Troutdale

- Sanitary Sewer Pump Station #2, located near businesses on NW South Frontage Road, will be upgraded beginning in 2022. These resilience improvements will help ensure the continued operation of pumps in an emergency, by adding bypass pipes and backup power systems.

- In Spring 2021, the Sustainable Cities Institute at the University of Oregon created a report titled *Assessing Hazard Vulnerability in Troutdale*, providing mapping and analysis of natural hazard risk in the city. The report included recommendations for increasing citizen resources and infrastructure resilience.

New Data

A new FEMA flood study for the Lower Columbia-Sandy Watershed was published in 2019, providing improved flood risk mapping for most of the city.

The study coincided with a vulnerability analysis of almost all of the hazards in this plan for the entire watershed. This analysis was published by the Oregon Department of Geology and Mineral Industries (DOGAMI) in 2020. Troutdale is not completely located in the watershed, but

the majority of the city is, making the study a vital new data source of hazard exposure for the city.

Troutdale was also included in new countywide risk and impact data for wildfire, landslide, and earthquake.

Growth and Development Impacts

Troutdale's population growth has been fairly slow since 2010, but the City has seen extensive growth in industrial development and in redevelopment of commercial areas. Continuing future population growth is expected to primarily occur as a result of infill.

The largest planned major development is called The Confluence with the goal of creating a dense development center between Downtown Troutdale and Interstate 84. The 16-acre development site is outside mapped regulatory floodplain and the project would also include the establishment of a riverside greenway.

5.3.4 Local Hazard Analysis

Earthquake – Risk Rating Moderate

See Earthquake Section for more detailed risk and vulnerability information.

Earthquake risk to Troutdale is primarily affected by soil types within the city. Its location in eastern Multnomah County has less overall risk to the western part of the county in scenarios modeled by DOGAMI for a Cascadia Subduction Zone or Portland Hills Crustal Quake. Even so, Troutdale is still expected to suffer casualties, and significant structural and infrastructure damage in the analyzed scenarios. Very strong ground shaking would be fairly uniform across the city, with areas of soft, wet soils along rivers and streams having slightly more susceptibility.

Liquefaction threat in the low-lying northern part of the city is Troutdale's largest concern. As with neighboring cities, the floodplain along the Columbia River is the most likely developed area to lose structural support integrity, which could severely impact the city's major industrial sector, including the Troutdale Airport. This vulnerability has maintained Troutdale's 2017 risk rating as moderate.

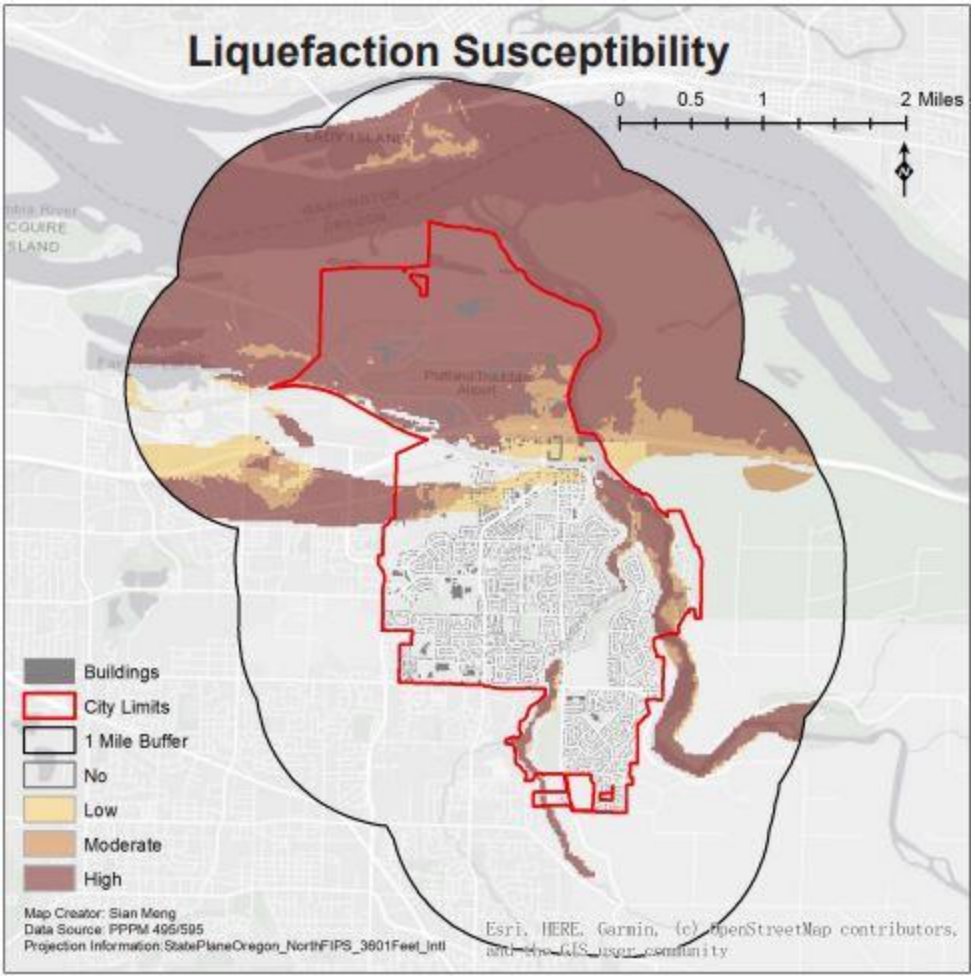


Figure 140 - Map showing Troutdale's vulnerability to soil liquefaction. Map – Sustainable Cities Institute Report - Assessing Hazard Vulnerability in Troutdale.

No crustal faults have been identified within Troutdale. An additional vulnerability study was conducted for the Lower Columbia-Sandy watershed, and used the Mount Hood fault zone as a threat, which had not been used in the Multnomah County earthquake risk report. This analysis showed that a magnitude 6.9 event on that fault would be nearly as damaging in Troutdale as a Cascadia Subduction Zone event, although less likely to occur.

Flood – Risk Ranking Low

See Flood Section for more detailed risk and vulnerability information.

Flood risk in Troutdale comes most from spring rain-on-snow flood events, which are particularly hazardous to properties along the Sandy River and Beaver Creek. Some additional low-lying areas with mapped flood risk are in industrial properties north of Interstate 84 and areas in the west of the city near Edgefield. The industrial northern portion, including the Troutdale Airport, has ponding areas reserved from development and a large developed area mapped in the 0.2% annual chance (500-year) flood risk zone, which is not part of the regulatory floodplain but indicates vulnerability to a catastrophic flood event.

Overall, about 3% of the city is mapped in FEMA's Special Flood Hazard Area—the area with a 1% annual chance of flood. The overall small exposure to flood risk, as well as local planning and regulatory measures taken to reduce flood risk, have lowered the relative risk rating for flood in Troutdale from moderate in 2017 to low in 2022.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

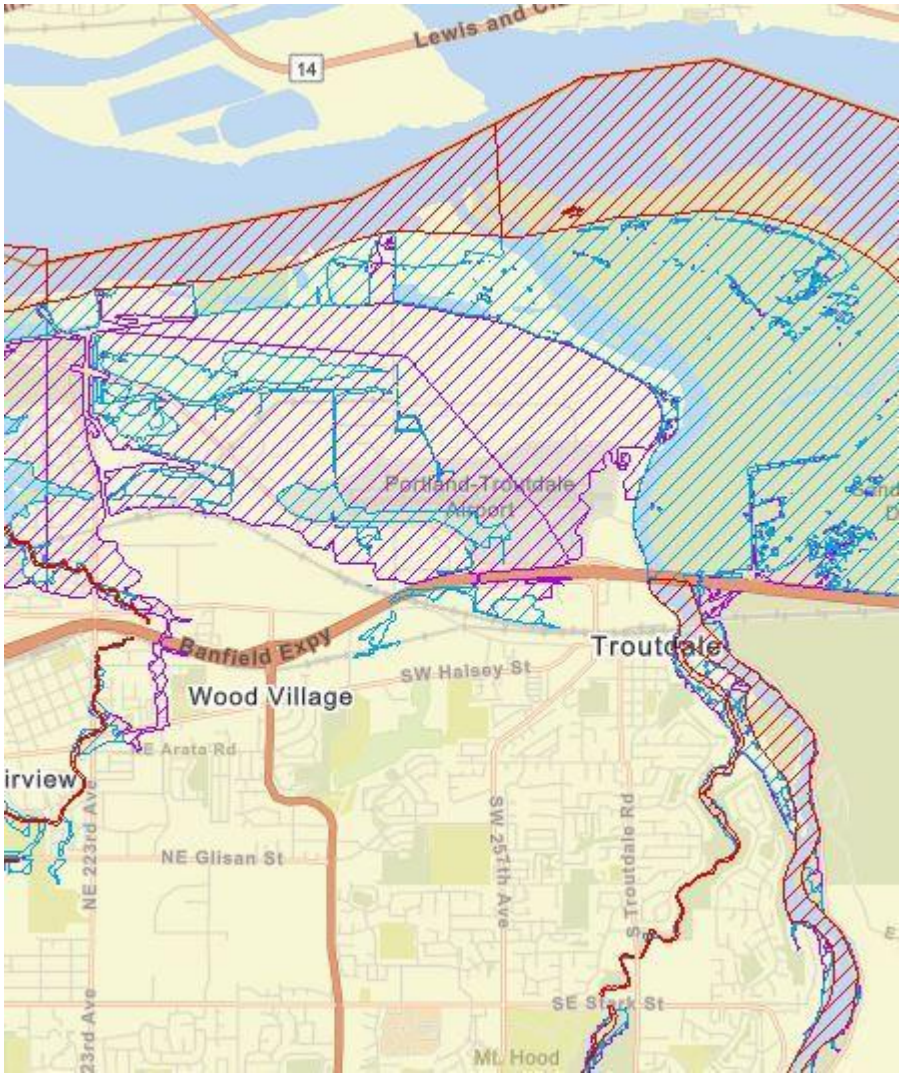


Figure 141 - Map showing areas of mapped flood hazard risk in Troutdale. Areas in blue are the 1% annual chance (100-year) floodplain and the purple areas are the 0.2% annual chance (500-year) floodplain. Map from DOGAMI's HazVu site.

Troutdale has been a participating community in the National Flood Insurance Program (NFIP) since 1988. Program participation allows city residents to purchase federal flood insurance and requires the city to maintain a flood protection ordinance to make new and rebuilt construction more resilient to flood. Troutdale's flood ordinance is administered by the Planning Division.

Troutdale has also been part of the Community Rating System (CRS) program since 2008. This program reduces flood insurance rates for residents based on the number of higher standards taken by a community to increase local flood protection. Troutdale has a program rating of 7,

which reduces flood insurance rates across the jurisdiction by 15%. So far, only Troutdale and the City of Portland have qualified for a CRS discount in Multnomah County.

Local areas considered to have particular risk for urban stormwater flooding are:

- Areas along the Sandy River
- Areas along the lower reaches of Beaver Creek

Channel migration of the Sandy River creates a risk to some structures in Troutdale, in areas that may be outside mapped flood risk zones. This migration can occur as slow bank erosion and eventual undercutting of buildings, or by the creation of new or secondary channels in the Sandy River Delta.

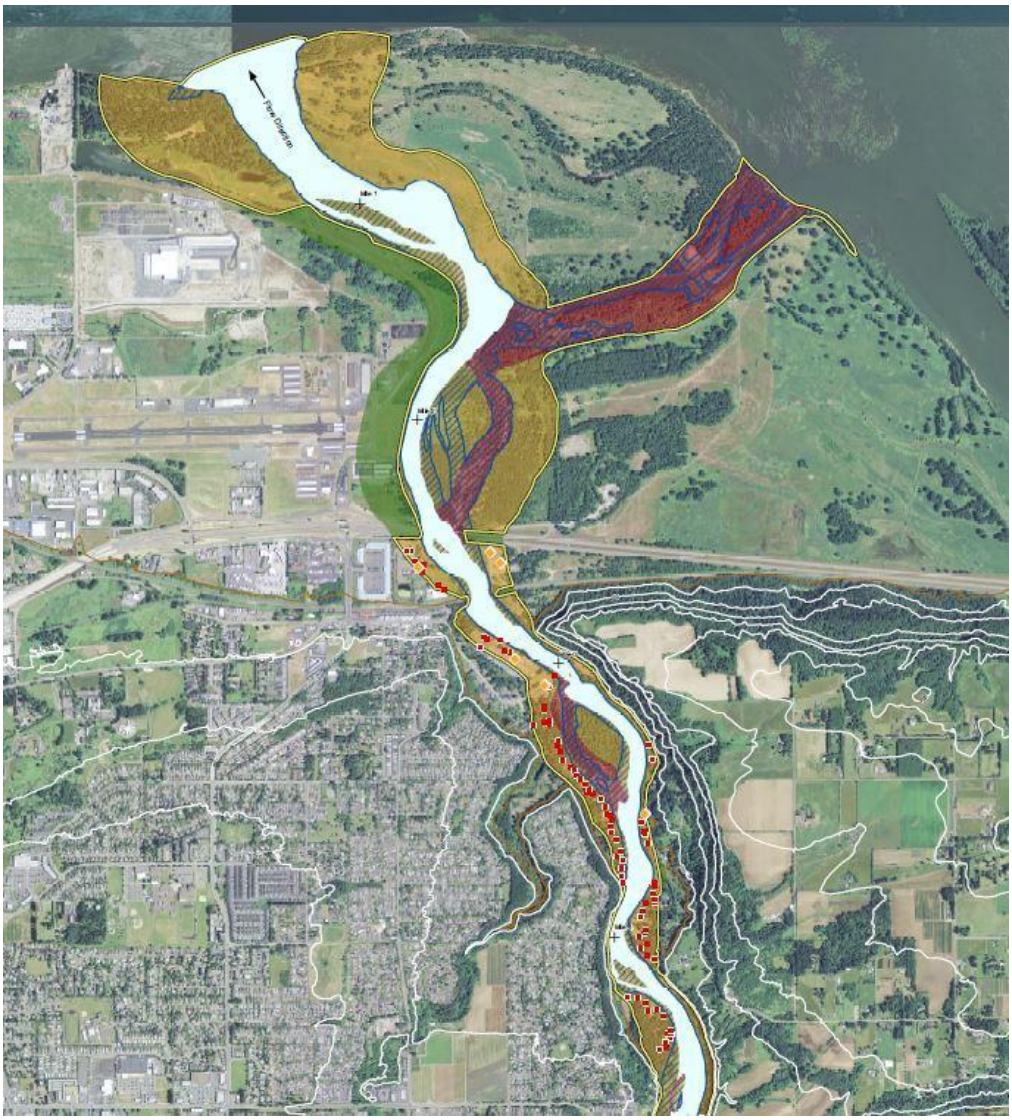


Figure 142 -- Map showing channel migration potential on the lower portion of the Sandy River in Troutdale. The yellow areas have risk from bank erosion in the next 100 years, the red areas have risk from the formation of a new river channel, the blue shaded areas are previous locations of the river channel at some point between 1955-2019, and the green areas are where built structures have eliminated risk of channel migration. The small red squares are the location of structures with some risk from the hazard. Map from DOGAMI report O-13-10.

The highest risk area for channel migration is the potential for an old channel to be reformed along SE Jackson Park Road south of Glenn Otto Park, which would put a number of homes at risk for future flooding and foundation undercutting. Steady erosion in that area within the existing Sandy River channel creates some threat to structures on both sides of the river from erosion damage. New meanders in the Sandy River delta would not cause much damage because of the limited development in that location.

Landslide – Risk Ranking Low

See Landslide Section for more detailed risk and vulnerability information.

Although Troutdale has a number of steep slopes along the Sandy River and other creeks and streams, development has been restricted on slopes over 15% and prohibited on slopes over 30%. This has reduced the likelihood that landslides will cause serious risks to residents and structures. The low-lying areas in the northern part of the city have a very low likelihood of landslide. The low risk ranking is unchanged for Troutdale from the 2017 NHMP.

An interactive version of this map can be found here (Landslide Susceptibility – Regional Landslide Susceptability)

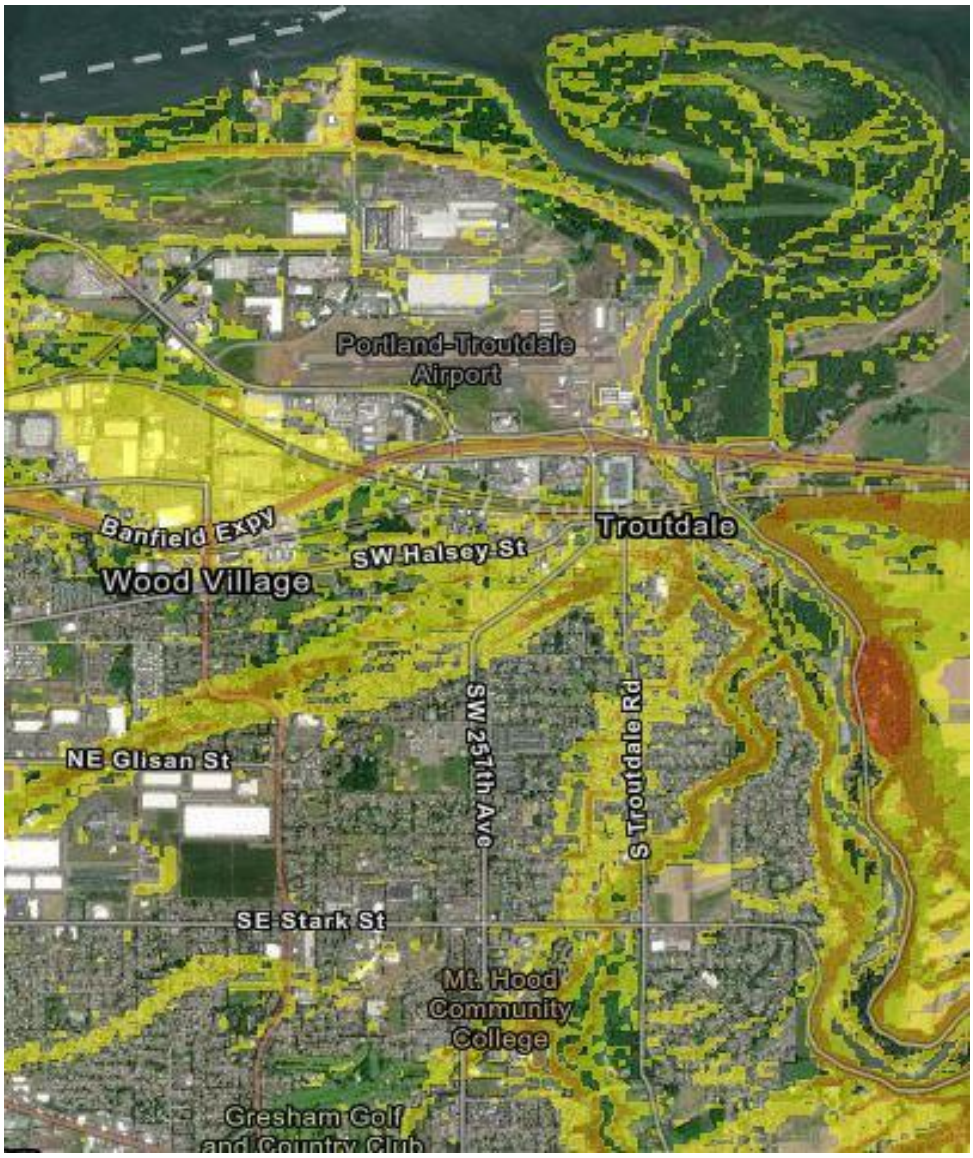


Figure 143 - Map showing overall landslide risk in Troutdale, with red being area of highest risk, orange of moderate risk, and yellow lowest risk. Map from DOGAMI SLIDO site.

The areas of highest concern for landslide are the canyons along Beaver Creek, canyons along the Sandy River, and the steep slopes along the Historic Columbia River Highway east of the Sandy River and north of the former Tad's Restaurant. The major scarp area along the Historic Columbia River Highway shows historic landslide deposits, making it the single risk area for deep landslide in Troutdale.

An interactive version of this map can be found here (Landslide Hazard – Deposits)

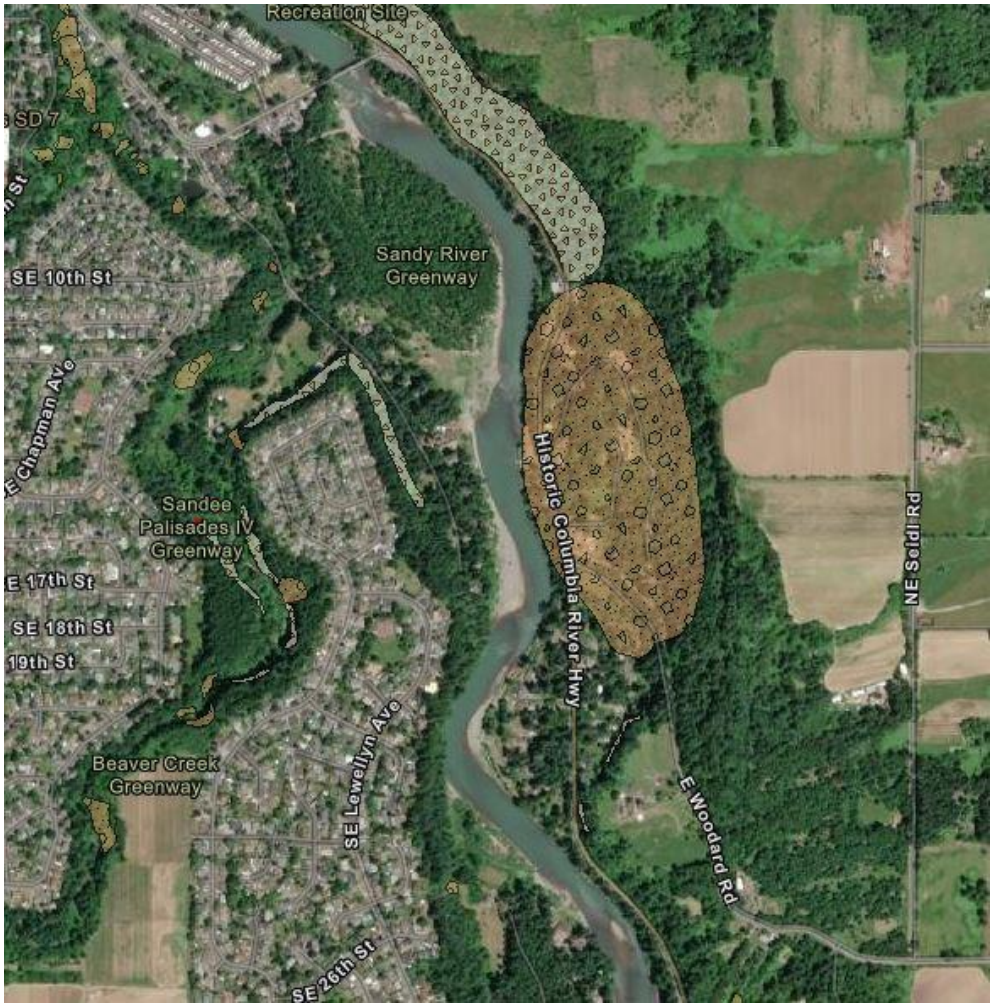


Figure 144- Map showing location of historic deep landslide deposits. The brown area is landslide depost and the lighter color are rocky Talus-Colluvium deposits. Map from DOGAMI's HazVu site.

Severe Weather

- *Extreme Heat – Risk Ranking High*
- *Wind Storm – Risk Ranking High*
- *Drought – Risk Ranking High*

- *Winter Storm – Risk Ranking Moderate*

See Severe Weather Section for more detailed risk and vulnerability information.

In the 2017 NHMP, all of these hazards were collected as a single event type, rated as high risk. Within Multnomah County, Troutdale is particularly threatened by strong winter winds coming

from the Columbia River Gorge, and was granted a local building code exception by the State of Oregon to increase wind loading requirements in new residential, commercial and industrial development.

Residential areas of Troutdale have relatively high levels of tree canopy and fewer urban heat island hotspots than some neighboring communities. The industrial/airport area has a large amount of impervious surface and is prone to heat island effects that could be harmful to outdoor workers. Overall, Troutdale residents face heat impacts from hotter summers, especially when they work outside or are unable to access cooling spaces. A severe weather shelter was established at Reynolds High School in Troutdale during countywide winter weather responses over the past few years.

An interactive version of this map can be found here

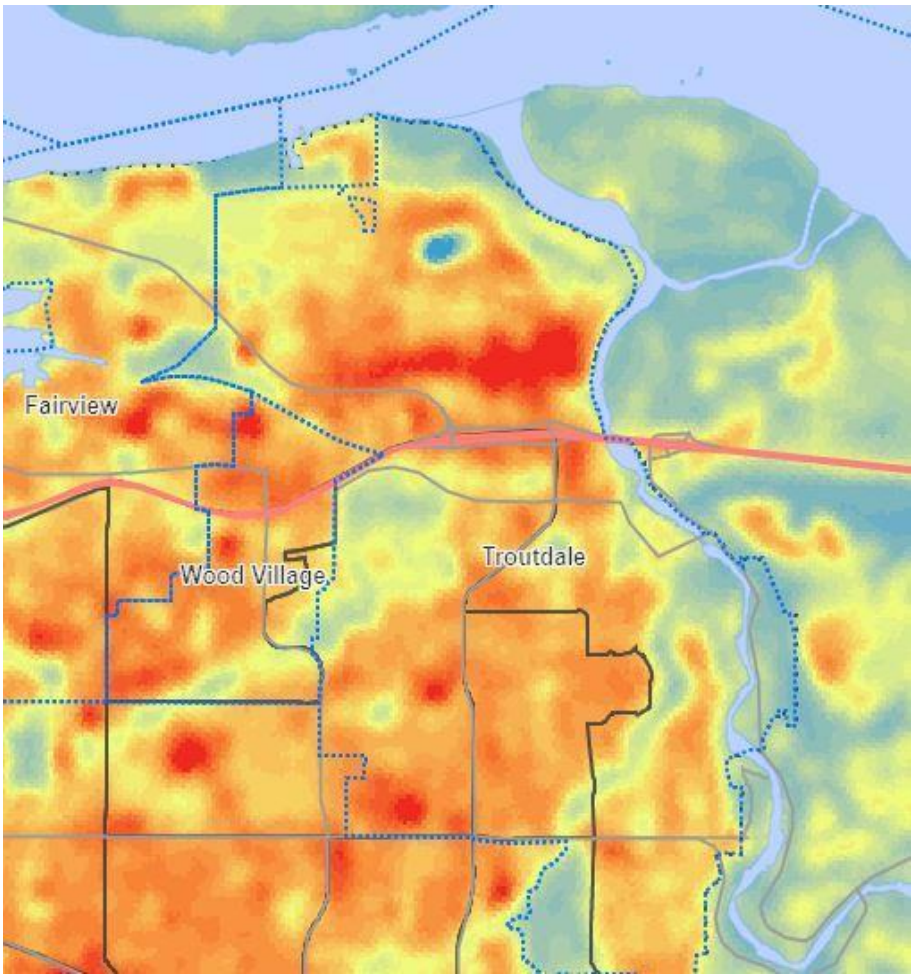


Figure 145 - Map showing locations of urban heat islands in Troutdale. Areas in darkest red have the highest intensity of urban heat island effects – in Troutdale the industrial area north of Interstate 84 has the most significant hazard.. Map from Metro.

Winter storms can be especially disruptive to Troutdale because of its location at the mouth of the Gorge and subsequent higher winds and colder temperatures. Road closures and downed trees and power lines have been a consistent result of recent winter storms.

Troutdale's aquifer-fed water source is less susceptible to drought than Oregon communities that use surface waters. However, the Sandy River has seen low summer flows, which has impacted local recreation and natural resources.

Volcano – Risk Ranking Moderate

See Volcano Section for more detailed risk and vulnerability information.

Troutdale would face considerable risk from a major volcanic eruption of Mount Hood, although, fortunately, it is an event that rarely occurs. Troutdale's development along the Sandy River and northern industrial areas would likely be severely damaged by debris after an 'extra large' Mount Hood eruption (likely to occur only every 10,000-100,000 years). This continuing, but low-probability, risk has maintained Troutdale's 2017 risk rating for volcano as moderate. A smaller volcanic eruption would still impact Troutdale more than any other city in the county with increased erosion and silt deposits along the Sandy River to its confluence with the Columbia River.

An interactive version of this map can be found here (Volcano Hazard – Moderate Hazard Zone)

Figure 146 - Map showing location of volcanic lahar impacts in Troutdale from an extra-large eruption (10,000-100,000 year event). Map from DOGAMI HazVu site.

Volcanic ash could also be a significant hazard for Troutdale from regional volcanos. A major ash event would be harmful to respiratory health and could threaten structural stability, building machinery, and outdoor operations. Depending on winds at the time of future eruptions of regional volcanoes, Troutdale Airport would likely be disrupted by an ash event, and industrial sites could face risk to employees and buildings.

Wildfire and Wildfire Smoke

- *Wildfire - Risk Ranking Moderate*

- *Wildfire Smoke – Risk Ranking High*

See Wildfire and Wildfire Smoke Section for more detailed risk and vulnerability information.

In the 2017 NHMP, these hazards were combined in a single Wildfire category, which was rated as moderate risk. That rating has been maintained for wildfire, but Wildfire Smoke has been broken out and assigned a high risk rating.

As with all other cities in this plan, all of Troutdale's population, especially those with existing health risk factors and those unable to access clean air spaces, will face impacts from wildfire smoke events. Troutdale's location close to the Columbia River Gorge may increase particulate matter from east county fires, although potential increased risk has not been quantified and smoke events are heavily driven by wind patterns and will often come from greater distances.

Wildfire smoke is much more likely to be a hazard from regional fires, not wildfires within the city limits. Troutdale is considered to have moderate risk for wildfire because of fire risk areas along the forested banks of the Sandy River and Beaver Creek. Large risk areas also exist just across the Sandy River in unincorporated Multnomah County. Troutdale is the closest incorporated city to the Columbia River Gorge, where a catastrophic fire could occur and move west, creating spot fires ahead of the main fire line and risking communities in the Wildland Urban Interface.

Wooded areas along Beaver Creek and the Sandy River are surrounded by residential development and have been mapped as having the highest impact from wildfire to people and other assets within city limits. Smaller unmapped vegetative lots could threaten structures on a smaller scale when dry and windy conditions become extreme.

[An interactive version of this map can be found here (Wildfire Potenial Impacts – Overall Potential Impacts)]

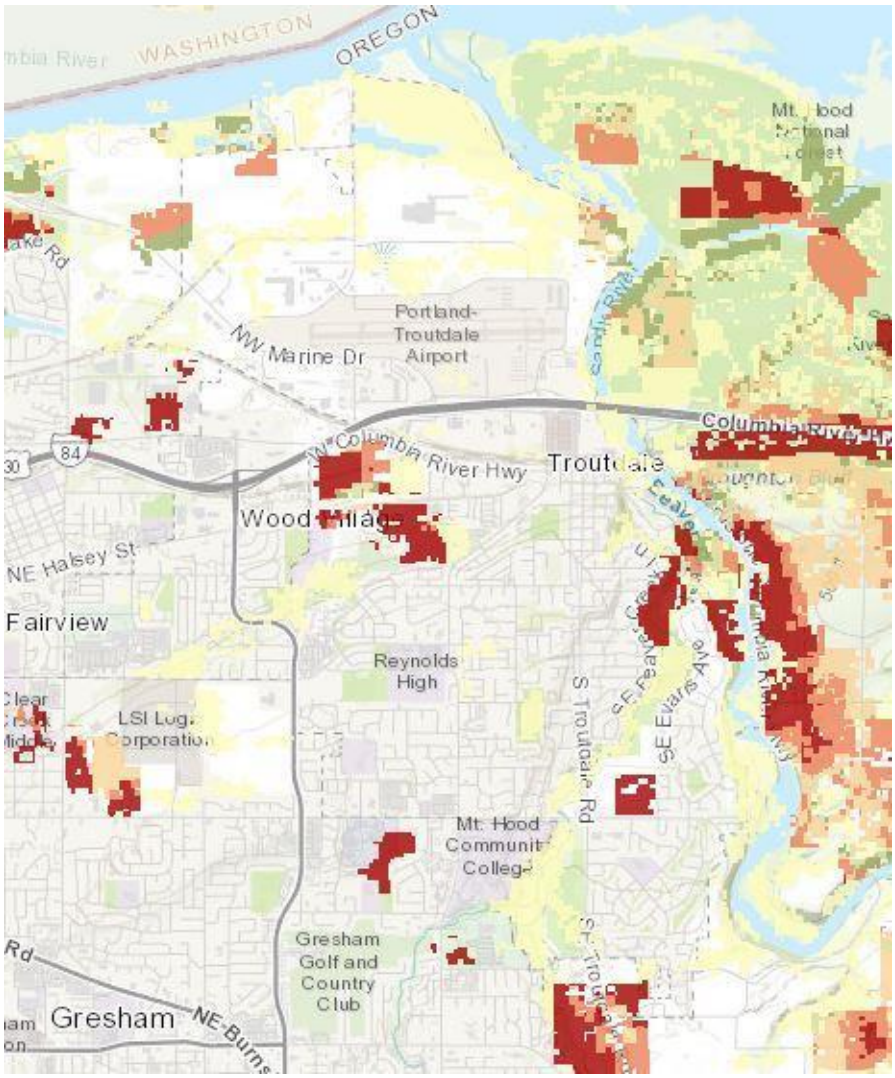


Figure 147 - Map showing locations where structures, infrastructure and natural resources are most threatened by potential wildfires. Map from the Oregon Wildfire Risk Explorer with data from PNW-QWRA.

5.3.5 Hazard Risk Scoring

The identified levels of risk from each hazard were determined by the City of Troutdale, using a scoring methodology designed by Oregon Emergency Management, and applied across the state to contextualize local risk perception.

Hazard	History (Weight Factor = 2)		Vulnerability				Probability (Weight Factor = 7)		Risk Score	Initial Risk Ranking
			Average (WF = 5)		Max (WF = 10)					
Earthquake	2 x	**1**	5 x	**7**	10 x	**10**	7 x	**1**	**144**	**Moderate**
Flood	2 x	**5**	5 x	**6**	10 x	**3**	7 x	**2**	**84**	**Low**
Landslide	2 x	**4**	5 x	**4**	10 x	**3**	7 x	**1**	**65**	**Low**
Severe Weather – Extreme Heat	2 x	**5**	5 x	**6**	10 x	**7**	7 x	**7**	**159**	**High**
Severe Weather – Winter Storm	2 x	**4**	5 x	**4**	10 x	**5**	7 x	**5**	**113**	**Moderate**
Severe Weather – Wind Storm	2 x	**4**	5 x	**6**	10 x	**5**	7 x	**10**	**158**	**High**
Severe Weather – Drought	2 x	**8**	5 x	**5**	10 x	**8**	7 x	**8**	**177**	**High**
Volcano	2 x	**1**	5 x	**5**	10 x	**7**	7 x	**1**	**104**	**Moderate**
Wildfire	2 x	**3**	5 x	**4**	10 x	**7**	7 x	**6**	**138**	**Moderate**
Wildfire Smoke	2 x	**8**	5 x	**9**	10 x	**9**	7 x	**10**	**221**	**High**

5.3.6 City of Troutdale Aligned Plans and Other Implementation Processes

Overview

Troutdale manages its own infrastructure, providing wastewater collection and treatment services, drinking water, stormwater management, local roads, and parks. This creates opportunities to develop synergies benefitting resilience between master planning and capital improvement planning and the NHMP. Troutdale has advanced initiatives to address its elevated risk to natural hazards, including membership in the Community Rating System to acknowledge advanced flood risk reduction, a commissioned report to study water system infrastructure, and additional overlays and building code amendments compared to smaller neighboring cities. As with the other cities in this plan, Troutdale's limitations in implementing additional hazard mitigation come from limits in funding and resources.

- Capital Improvement Plan (CIP)
  - Most recently adopted in 2016, and amended in 2017 and 2022
  - The CIP funds major infrastructure that can built to create or increase resilience of critical lifelines. CIP updates can be aligned with NHMP risk assessment and

actions to support implementation of major projects with a nexus to hazard mitigation.

- City Budget
  - Adopted each fiscal year, beginning July 1
  - The annual budget allocation can provide funding for natural hazard mitigation. NHMP actions can be integrated in budget development processes to prioritize strategies that require city funding to be implemented.
- Comprehensive Land Use Plan
  - Periodic review most recently in 2014 – the plan is being updated to adopt the new Parks Master Plan and an ongoing Housing Needs Analysis.
  - Chapter 7 of the Troutdale Comprehensive Plan address natural hazards in the city. The plan includes restrictions on development in high-hazard areas such as steep slopes and flood prone areas. The plan will need updates in the future to align with the new risk assessment information included in this revised plan.
- Emergency Operations Plan (EOP)
  - Most recently updated in 2010
  - The EOP describes the city's plans in the event of a natural hazard disaster. The EOP can be updated in the future to align with the local natural hazards priorities and revised risk assessment information established in this update.
- Parks Master Plan
  - Most recently adopted in 2006, with an update expected in 2023
  - Parks are a city amenity that can reduce or be the source of hazards. Future parks planning can use revised risk assessment information to identify acquisitions and inform how parks can be developed to also reduce risk from certain hazards.
- Public Facilities Plan
  - Adopted in 2014.
  - The infrastructure lifeline facilities addressed in the plan are susceptible to damage from natural hazards events. Resilience improvements to these systems can be aligned with priorities addressed in the NHMP.
- Sanitary Sewer Master Plan
  - Adopted and most recently amended in 2013
  - Wastewater systems are a key lifeline that the city provides, and subject to damage from natural hazard events. System resilience can be addressed further in future updates, using up-to-date risk assessment information, and identify projects that can become future mitigation action items.
- SDIC and North Troutdale Drainage Master Plan
  - Adopted in 2020 and last updated in January 2021. The plan addresses stormwater and other flooding, and provides a formal planning process with the Sandy Drainage Improvement Company, another partner in this plan. Future planning updates can integrate continuing developments in flood risk mapping, and the coordination with SDIC makes it an ideal continuing platform for developing multi-agency mitigation strategies.
- South Troutdale Storm Drainage Master Plan
  - Adopted in 2012
  - Stormwater management is a key part of flood risk reduction in the city, and this master plan outlines future capital improvement projects needed. When the plan is next updated, it can incorporate updated risk information from the NHMP and

work in alignment to identify mitigation plans and projects that can be supported through the NHMP.

- Town Center Plan
  - The plan was adopted most recently in 2021, with a planning horizon through 2040.
  - The plan addresses long-term planning of the physical, social, and economic growth of the city's historic downtown. Future planning can be aligned with risks identified in this plan, to make downtown development more resilient to natural hazards.
- Transportation System Plan (TSP)
  - Adopted in 2014 and most recently amended in 2022
  - The TSP has the goal of providing a safe transportation system, which is a key lifeline to community resilience. Prioritization of future tranposrtation system improvements can use the NHMP risk assessment to identify system vulnerabilities and integrate planning with emergency transportation route needs.
- Troutdale Development Code (TDC)
  - Current version was adopted in 2019, and the most recent amendment was made in 2022
  - The TDC provides regulations for construction and land use, which are impacted by natural hazards in a number of ways. The code has overlays in Chapter 4 that include specific development requirements in vegetated corridors and steep slopes and flood management areas. The city's floodplain development ordinance is included as Chapter 14. The TDC will continue to be informed by updated risk assessment data and mapping in the NHMP and can be used to implement risk reduction measures through future overlays or other code amendments.
- Urban Renewal Budgets, Audits and Financial Impacts
  - Riverfront Renewal Plan now being developed as The Confluence at Troutdale
  - Urban renewal projects can foster development and redevelopment in selected areas, which may be subject to risks from natural hazards. Opportunities arise to build resilience into future urban renewal planning, as with The Confluence, where mapped flood risk areas are being reserved for parks or natural areas.

5.4 City of Wood Village

5.4.1 Mitigation Actions

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Wood Village</th></tr>
<tr><td rowspan="8">Multi-Hazard</td><td rowspan="8">1</td><td colspan="8">Work with local partners, including churches, to identify locations in the city that could be used for weather or smoke sheltering and develop strategies for operating sites.</td></tr>
<tr><td colspan="3">Plan Goals – 1,2,4,5</td><td colspan="5">Hazards Addressed – Severe Weather, Wildfire and Wildfire Smoke</td></tr>
<tr><td colspan="3">Lifelines – Disaster Sheltering, Community Resilience</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>City Manager’s Office</td><td>Multnomah County Emergency Management, Department of County Human Services</td><td>3</td><td>3</td><td>3</td><td>3</td><td>2</td><td>14</td></tr>
<tr><td colspan="8">Potential Funding –</td></tr>
<tr><td colspan="8">Potential Implementation Methods –</td></tr>
<tr><td colspan="8">Notes – Addresses lack of weather and smoke shelter sites in East County cities.</td></tr>
</table>

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Wood Village</th></tr>
<tr><td rowspan="7">Multi-Hazard</td><td rowspan="7">2</td><td colspan="8">Continue to integrate hazard mitigation goals into early design processes for public facilities and infrastructure projects.</td></tr>
<tr><td colspan="4">Plan Goals – 1,2,3</td><td colspan="4">Hazards Addressed – All Hazards</td></tr>
<tr><td colspan="4">Lifelines – All City Infrastructure</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td colspan="2">Implementation Lead</td><td colspan="2">Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>1</td><td>3</td><td>2</td><td>3</td><td>2</td><td>11</td></tr>
<tr><td colspan="8">Potential Funding – Existing funding capacity</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Five-year budgets, City Council, Finance, Public Work</td></tr>
<tr><td colspan="8">Notes – Continuing action from 2017 NHMP</td></tr>
<tr><td rowspan="7">Multi-Hazard</td><td rowspan="7">3</td><td colspan="8">Continue to identify retrofit programs to strengthen mobile homes from high winds and earthquakes.</td></tr>
<tr><td colspan="4">Plan Goals – 1,3,4</td><td colspan="4">Hazards Addressed – Earthquake, Severe Weather</td></tr>
<tr><td colspan="4">Lifelines – Housing</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td colspan="2">Implementation Lead</td><td colspan="2">Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>3</td><td>2</td><td>1</td><td>2</td><td>2</td><td>10</td></tr>
<tr><td colspan="8">Potential Funding – External grant funding required, no internal budget to subsidize private complexes</td></tr>
<tr><td colspan="8">Potential Implementation Methods – City Council, Public Works Capacity</td></tr>
<tr><td colspan="8">Notes – Addresses Wood Village's high proportion of manufactured homes as a total of housing supply. Continuing action from 2017 NHMP</td></tr>
</table>

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – City of Wood Village</th></tr>
<tr><td rowspan="6">Multi-Hazard</td><td rowspan="6">4</td><td colspan="8">Implement natural hazard resilience actions identified in the upcoming update to the city's water and wastewater master plans.</td></tr>
<tr><td colspan="4">Plan Goals – 2,3,5</td><td colspan="4">Hazards Addressed – Earthquake, Flood</td></tr>
<tr><td colspan="4">Lifelines – Water and Wastewater Systems</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td></td><td></td><td>1</td><td>2</td><td>1</td><td>3</td><td>2</td><td>9</td></tr>
<tr><td colspan="8">Potential Funding – Federal grants - BRIC, EPA; state grants - OHA, DEQ</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Master Plan, Capital Outlays, Public Works Internal Procurement</td></tr>
<tr><td colspan="8">Notes -</td></tr>
<tr><td rowspan="6">Severe Weather</td><td rowspan="6">5</td><td colspan="8">Collaborate with Multnomah County to identify potential in-home cooling interventions for the most at-risk residents living in mobile home parks within the city.</td></tr>
<tr><td colspan="4">Plan Goals – 1,2,4,5</td><td colspan="4">Hazards Addressed – Severe Weather (Extreme Heat)</td></tr>
<tr><td colspan="4">Lifelines – Housing, Community Resilience</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>City Manager’s Office</td><td>Multnomah County Emergency Management, Department of County Human Services</td><td>3</td><td>3</td><td>3</td><td>3</td><td>2</td><td>14</td></tr>
<tr><td colspan="8">Potential Funding – Existing County, State, Federal Programs</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Emergency Operations Plan</td></tr>
<tr><td colspan="8">Notes - Addresses Wood Village’s high proportion of manufactured homes as a total of housing supply.</td></tr>
</table>

5.4.2 City Overview

The City of Wood Village was incorporated in 1949 and has continued as a primarily residential suburb since its origins as a wartime housing project for employees of an aluminum plant in 1942. Of the cities included in this plan, Wood Village is the most recently incorporated, and the smallest in size and population.

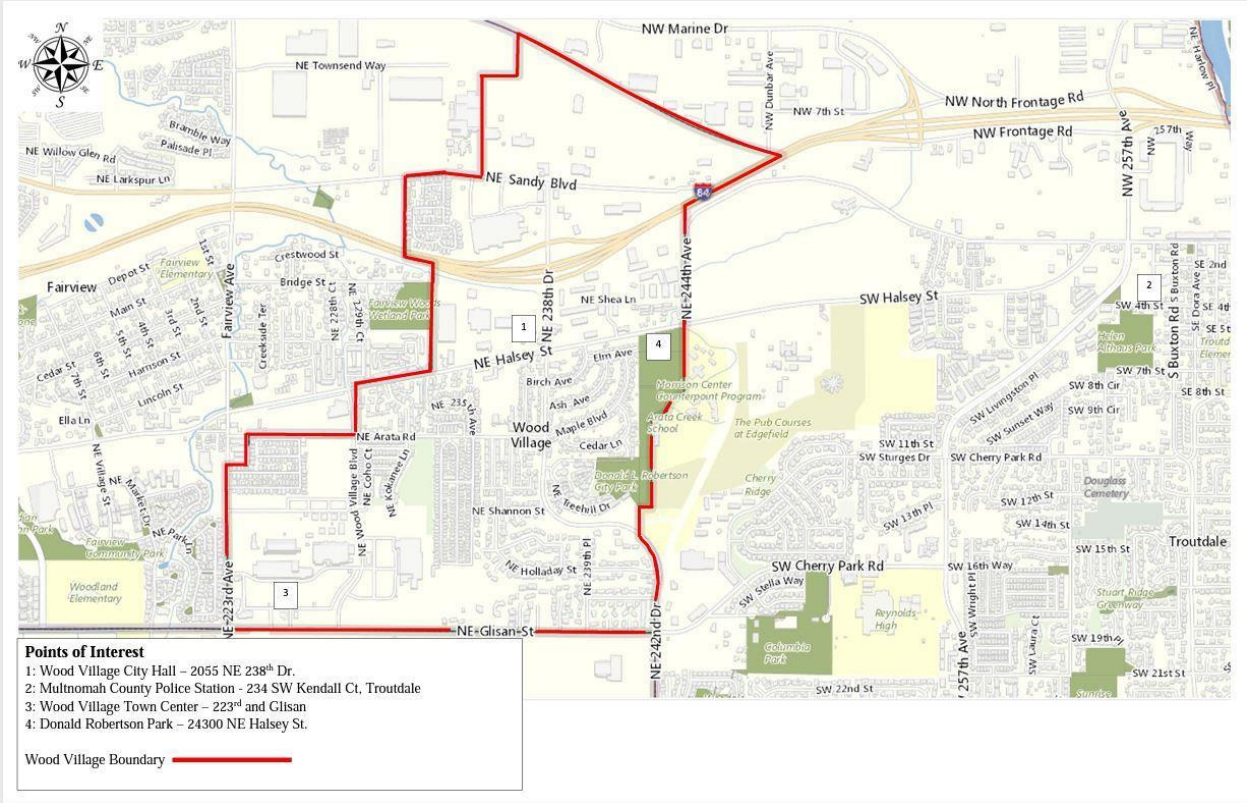


Figure 148 - Map of Wood Village city limits, outlined in red.

Wood Village is completely surrounded by other municipalities, and unlike its neighbors Gresham, Fairview and Troutdale, does not extend north all the way to the Columbia River. Because of these characteristics, Wood Village has less wetlands and floodplains, and less risk from hazards associated with those landscapes. Wood Village is still largely low-lying, so landslide risks are also low. Acute location-specific hazards, apart from earthquake, are not prevalent. Wood Village does face the same risk as all other entities from regional level climate events and air quality hazards.

Wood Village has seen consistent population growth over the last 20 years, which has taken place as infill and increased density since the city limits cannot expand. Despite that growth limitation, Wood Village remains one of the fastest growing cities in the county as of 2021.

Table 43 – Wood Village Population by Census Year (For population details, see Community Profile chapter)

Census Year	Total Population – City of Wood Village	Percentage Change
2000	2,860	1.6% (1990)
2010	3,878	35.6% (2000)
2015 (est)	3,910	
2020	4,387	10.9% (2015)
2021 (est)[89]	4,478	

Wood Village has exceptional population characteristics that may make it less resilient to hazards and require specific action planning for communicating natural hazard risk.

Of the participating entities in this plan, Wood Village has:

- The highest proportion of children;
- The highest proportion of people with limited proficiency in English;
- The highest proportion of Hispanic population;
- The highest proportion of mobile homes as a housing type.

Transportation

Interstate 84 runs east/west through the northern portion of Wood Village, including a major interchange and overpass at NE 238th Drive. Other key east-west routes are NE Glisan Street, NE Halsey Street, NE Sandy Boulevard, and NE Arata Road. NE 238th Drive is the key north/south route.

Public transportation is provided through TriMet bus service.

Utilities

Wood Village provides water to its residents via 12 miles of pipelines from four wells and three reservoirs within the city limits. The wells draw water from the Troutdale Aquifer. Wood Village also provides wastewater services, stormwater management, and residential street maintenance.

[89] 2021 population estimates from the Portland State University Population Center. All other totals or estimates come from the US Census Bureau.

Electricity is provided by Portland General Electric (PGE) and natural gas by NW Natural.

Critical Facilities

A full list of critical facilities can be found in the Human-Caused and Technological Hazard Identification and Risk Assessment, included as an annex to this plan. Communities define critical facilities through their own definition.

Figure 149 - Photo of the Wood Village City Hall, opened in 2021. Photo - LRS Architects

For this update, the City of Wood Village added the overpass bridge at Interstate 84 and NE 238th Drive as critical infrastructure. The critical facilities existing in Wood Village, as defined in this plan:

- Bridge
- Childcare Facilities
- City Hall
- Residential Care Facilities

5.4.3 Five Year Update, 2017-2022

Event History

Wood Village was subject to impacts from extreme climate events that impacted all of Multnomah County, including disruptions to roads from winter storms and severe rainfall, and health effects from heat and smoke.

No deaths from the 2021 Heat Dome event were recorded in Wood Village's zip code. Long-term health impacts from heat or smoke across Multnomah County are yet to be determined.

Mitigation Activities

Within the last five years, Wood Village has significantly expanded communications in Spanish and Russian, recognizing the main non-English languages used in the city. City newsletters are released monthly and always include an item related to hazards, and the city has added bilingual staff to better support residents' needs.

A new Municipal Building was opened in 2021, providing central community space built to modern building code. A new splash pad at the site has seen extensive use, providing an additional cooling space for residents during heatwaves.

New Data

No new natural hazard risk or vulnerability data was created specifically for Wood Village, but the city is included in new studies that have provided up-to-date analyses for earthquake and landslide exposure, wildfire risk, and improved climate risk and social vulnerability data.

Updated flood risk maps were printed for the city in February 2019 as part of a remapping project that covered a portion of eastern Multnomah County.

Development Impacts

Growth occurring in Wood Village has increased the density of the city and increased the proportion of multi-family housing. Because of the significant liquefaction risk across much of the planning area, this increases the number of people at risk and has increased requirements for hazard communication and response planning. New construction is required to meet Oregon Residential and Structural Specialty Codes.

As noted above, Wood Village does not face acute hazard risk from flood, landslide, wildfire or volcano, so the location of new and denser development has not significantly increased risk from those hazards. The increase in population will increase the number of people at health risk from heat, cold, power loss, and wildfire smoke.

5.4.4 Local Hazard Analysis

Earthquake – Risk Rating High

See Earthquake Section for more detailed risk and vulnerability information.

In scenarios of a Columbia Subduction Zone event and a Portland Hills crustal earthquake, Wood Village would expect to have strong, fairly uniform shaking across the entire city.

However, the threat of liquefaction is high in a band of loose soils tracking roughly along NE Halsey Street, including residential areas, the Municipal Building and an important commercial center near Interstate 84.

This soil characteristic gives Wood Village significant susceptibility to earthquake. Although overall impacts, particularly injury and loss of life, are not predicted to be as severe as in neighboring communities with critical community assets located in wet soils along the Columbia River, Wood Village is still expected to see significant building damage. The city's diverse population may also face resource or language barriers to pre-disaster preparation and post-disaster response and recovery actions. Wood Village's three major mobile home parks could also face higher risk of damage from ground shaking but are fortunately almost entirely located outside of the high risk liquefaction area.

Resilience of reservoirs is an area of concern and is being addressed as part of new water system master planning. The overpass at NE 238th and Interstate 84 has been added to this plan as critical infrastructure, because of its importance for local travel.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)

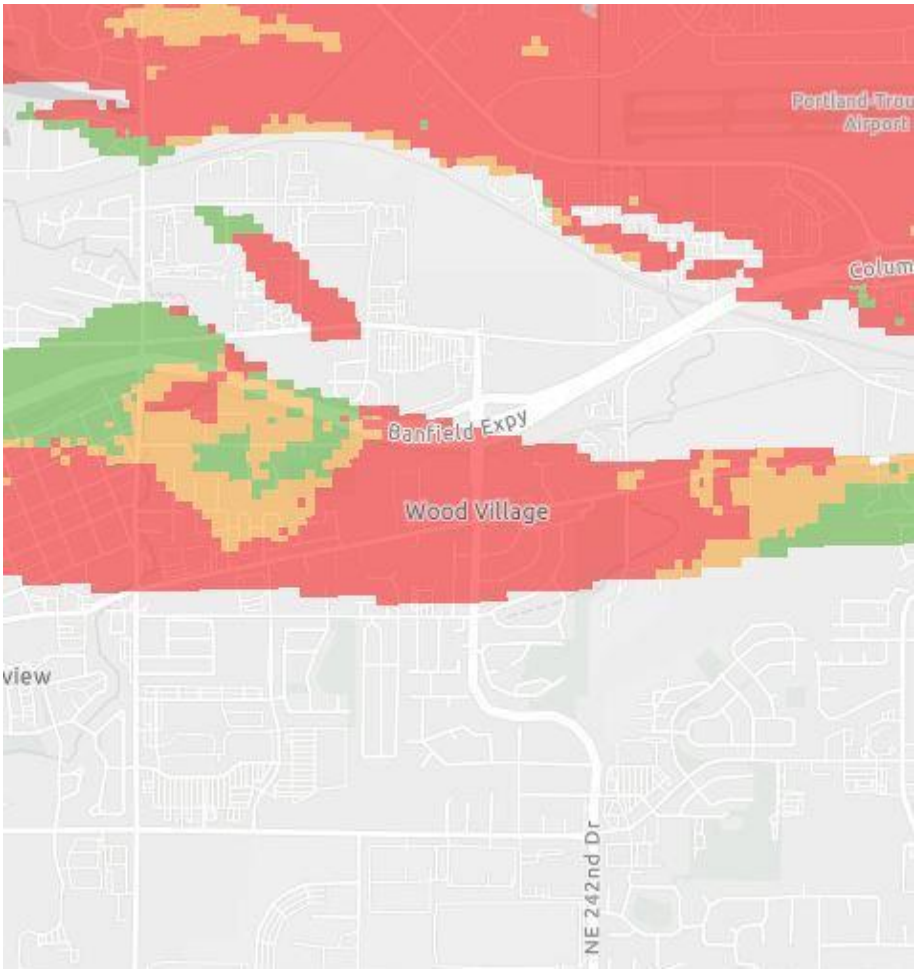


Figure 150- Map showing soil liquefaction risk areas in Wood Village, red is high risk, yellow is moderate risk and green is lower risk.. Map from DOGAMI HazVu site.

Flood – Risk Rating Low

See Flood Section for more detailed risk and vulnerability information.

Wood Village is the least flood-threatened city in Multnomah County, with only a tiny area of mapped FEMA regulatory floodplain. This single flood risk zone is a ponding area from a backup of Salmon Creek that would reach the point where Interstate 84 passes under a rail overpass on the far northeastern corner of the city limits. No structures are threatened by this risk. Wood Village is also located southerly enough to be largely unaffected even by a significant levee breach along the Multnomah County Drainage District levee system.

Wood Village is the only jurisdiction in Multnomah County without any structures within the NFIP regulatory flood hazard. There are locations where a larger, 500-year flood event could impact the city, but those areas are also extremely limited.

Stormwater management will continue to be the primary flood concern as the city continues to develop within its fixed boundaries. The relative risk of flooding remains low however. It should be noted that flooding can occur anywhere and a quarter of flood claims are made outside of FEMA mapped risk areas.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

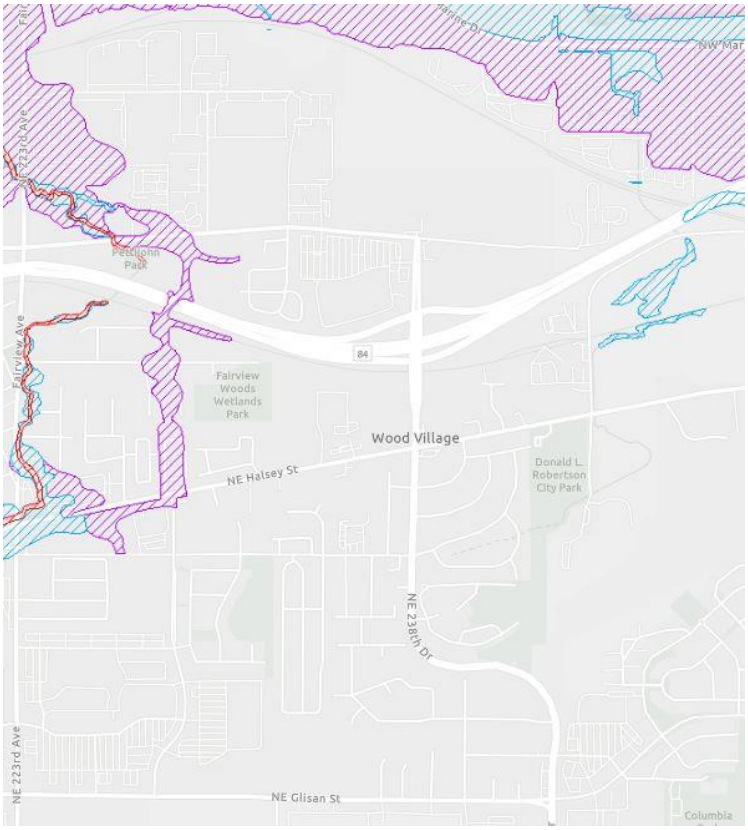


Figure 151 - Map showing FEMA mapped flood hazard area in and around the City of Wood Village. The regulatory 1% annual chance flood (100-year flood) area is shown in blue and the .2% annual chance flood (500-year flood) is shown in purple. Map - DOGAMI HazVu site.

Wood Village has participated in the National Flood Insurance Program since 1985, despite not having any mapped regulatory flood risk areas until 2019. Program participation allows city residents to purchase federal flood insurance and requires the city to maintain a flood protection ordinance that would regulate floodplain development if maps change in the future and new flood risk areas are identified. As of 2016, there were no active policies in the city and no record of any claims. As there are no historical claims, Wood Village has no repetitive loss or severe repetitive loss structures. Local administration of the NFIP is the responsibility of the Public Works department, under Section 425 (Floodplain Hazard Areas) of the city's Development Code.

Urban stormwater is managed by the city, through its Storm Water System Facility Plan. Stormwater drainage is managed on Arata Creek, No Name Creek and Fairview Creek within the city limits.

Landslide – Risk Rating Low

See Landslide Section for more detailed risk and vulnerability information.

DOGAMI landslide inventories show no historic landslide records and no deep landslide deposits within the City of Wood Village (there are two small areas with evidence of historic alluvial fans), leading to the relative risk being determined as low. There is no identified area subject to deep landslides in the jurisdiction.

An interactive version of this map can be found here (Landslide Susceptibility – Susceptability to Shallow Landslides)

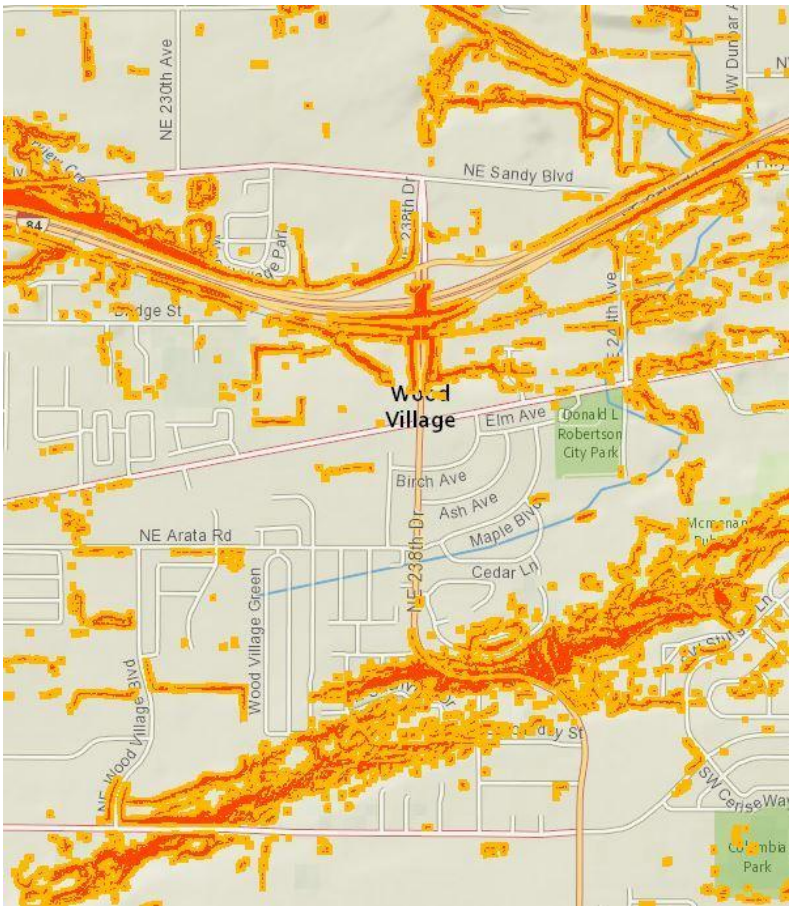


Figure 152 - Map showing shallow landslide risk in the City of Wood Village. The darker color of orange represents areas with higher risk. Map - DOGAMI SLIDO map.

There are a number of small slopes that meet thresholds for potential of shallow landslides. Areas with particular vulnerability to landslide in Wood Village are the hilly ridge shown in the southern portion of the City, especially where it crosses NE 238th Drive. However, these slides

would be expected to be minor and the highest risk areas do not have any structures at risk. Road berms around the Interstate 84 interchange are also highlighted in the mapping as potential locations of small landslides.

Severe Weather

- ***Extreme Heat*** *– Risk Rating High*
- ***Winter Storm*** *– Risk Rating High*
- ***Wind Storm*** *– Risk Rating Moderate*

- ***Drought*** *– Risk Rating Low*

See Severe Weather Section for more detailed risk and vulnerability information.

Wood Village identified severe weather as its highest risk hazard in the 2017 version of this plan. In this update, Wood Village has broken out risk scoring for each of the four severe weather hazards, maintaining Extreme Heat and Winter Storm as the highest risk hazards to the city.

Extreme heat is a threat to all city residents, especially to those with existing health conditions, older residents, and those living in uncooled spaces. Wood Village's high proportion of residents living in mobile homes are more likely to lack central cooling and be at risk during extreme events. Overall, Wood Village does not have an extremely high rate of urban heat islands because of its lower density development patterns, but there are some residential areas with hotspots and industrial areas in the northern part of the city may have risk for those working outdoors.

No emergency sheltering for heat, cold or smoke has been formally established yet within Wood Village.

An interactive version of this map can be found here

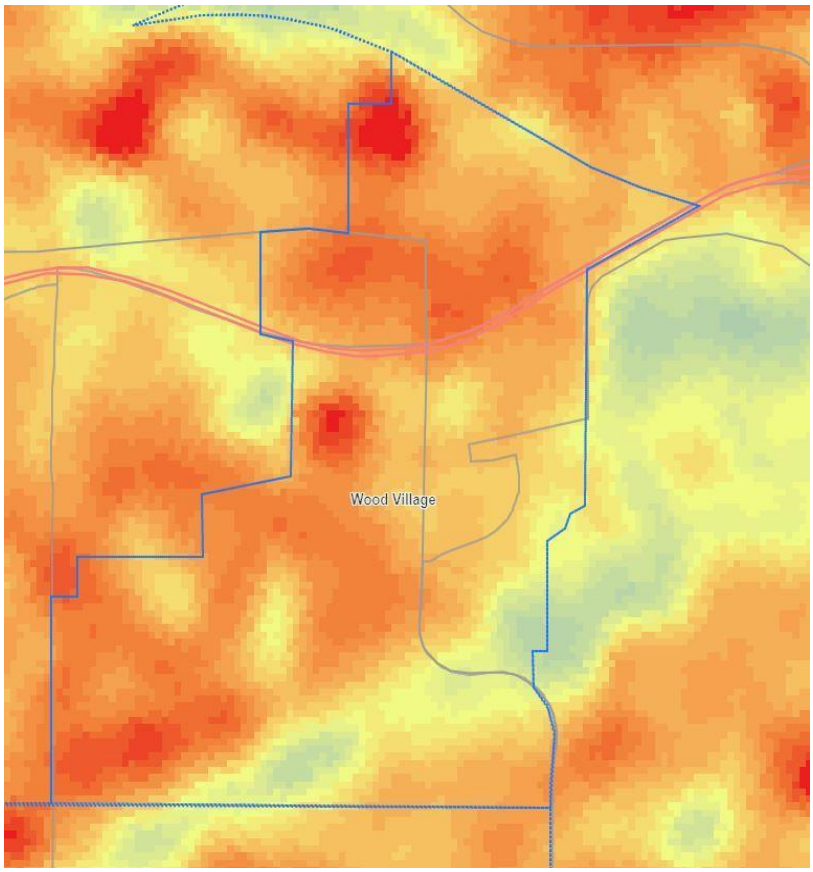


Figure 153 - Map showing urban heat island areas in the City of Wood Village. Areas with the strongest effect are shown in red. Map - Metro

Winter storms are also a high hazard across Wood Village because of threat to health and safety and risk to infrastructure. The limited amount of public transportation available makes travel during winter events difficult, but the city has been able to manage support of residents because of its small size.

Wood Village has continued a mitigation action for windstorm risk from the 2017 plan. Wood Village has three large mobile home parks, where residences could be blown off of foundations by extreme straight-line winds or tornadoes.

Drought is rated as a low risk because Wood Village's municipal water comes from local underground aquifers that are able to recharge year-round from rain.

Volcano – Risk Rating Low

See Volcano Section for more detailed risk and vulnerability information.

A major eruption of Mount Hood could send a massive debris flow down the Sandy River to the Columbia River. This inundation would be expected to spread along low-lying areas along the river for miles. Wood Village could see small amounts of this impact in the worst case eruption scenario, but the probability of this level of event is extremely low and impacts would be much less than in neighboring communities.

An interactive version of this map can be found here (Volcano Hazard – Moderate Hazard Zone)

Figure 154 - Map showing potential lahar impacts from an extreme (10,000-100,000 year event) Mount Hood eruption. Map from DOGAMI HazVu site.

A full vulnerability analysis of potential lahar damage in Wood Village has not yet been performed. Mapping indicates that even in a 'worst-case' scenario, impact would be limited to industrial properties in the far northern part of the city.

An ashfall event would impact Wood Village similarly to other jurisdictions in the county, causing respiratory health impacts, disrupting transportation routes and potentially impacting structural stability and systems.

Wildfire and Wildfire Smoke

Wildfire – Risk Rating Low

Wildfire Smoke – Risk Rating High

See Wildfire and Wildfire Smoke Section for more detailed risk and vulnerability information.

Wildfire smoke is considered a high risk for the City of Wood Village. As with all other cities in this plan, all of Wood Village's population, especially those with existing health risk factors, face impacts from wildfire smoke events coming from wildfires across the region. Because of the city's small size, formal emergency clean air spaces as part of a countywide response have not been provided in Wood Village in previous events.

Wildfire smoke is not likely to come from wildfires within the city limits, because of limited areas with sufficient vegetation to cause a large fire. Wood Village is considered to have low risk for wildfire, although potential of small fires not mapped by the Oregon Wildfire Risk Explorer still have potential to spread to structures and parts of the city are considered to be Wildland Urban Interface areas because of their proximity to large potential fire sites east of Troutdale and Gresham.

[An interactive version of this map can be found here (Wildfire Potenial Impacts – Overall Potential Impacts)]

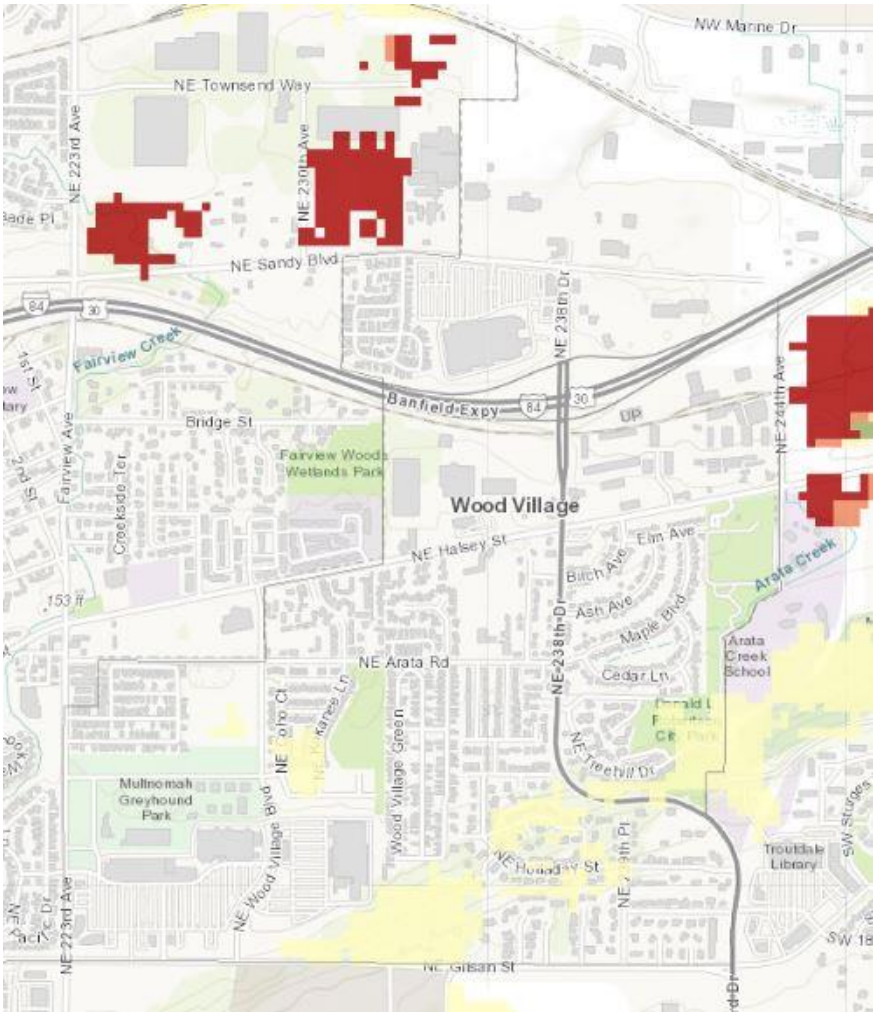


Figure 155 - Map showing potential impact from wildfire to structures, infrastructure and natural resources in the City of Wood Village. Sites in red have the highest potential impact, but are located outside of the city. Yellow areas inside the City have lower predicted impact. Map from Oregon Wildfire Explorer with data from PNW-QWRA.

The Oregon Wildfire Risk Explorer indicates the location of fire starts growing to 250 acres or larger. Probabilities at this scale are less reliable and it is possible that an urban fire could be caused by a fire beginning outside of the city boundaries and spreading into the city. However, increased industrial development north of Interstate 84 is reducing the number of vegetated lots that could be an ignition point of an urban wildfire.

5.4.5 Hazard Risk Scoring

The identified levels of risk from each hazard were determined by the City of Wood Village, using a scoring methodology designed by Oregon Emergency Management, and applied across the state to contextualize local risk perception.

Wood Village Hazard Risk Analysis										
Hazard	History (Weight Factor = 2)		Vulnerability				Probability (Weight Factor = 7)		Risk Score	Initial Risk Ranking
			Average (WF = 5)		Max (WF = 10)					
Earthquake	2 x	**1**	5 x	**10**	10 x	**9**	7 x	**1**	**149**	**High**
Flood	2 x	**3**	5 x	**3**	10 x	**3**	7 x	**3**	**72**	**Low**
Landslide	2 x	**2**	5 x	**3**	10 x	**3**	7 x	**2**	**63**	**Low**
Severe Weather – Extreme Heat	2 x	**4**	5 x	**6**	10 x	**6**	7 x	**8**	**154**	**High**
Severe Weather – Winter Storm	2 x	**8**	5 x	**7**	10 x	**8**	7 x	**8**	**187**	**High**
Severe Weather – Wind Storm	2 x	**5**	5 x	**4**	10 x	**5**	7 x	**7**	**129**	**Moderate**
Severe Weather – Drought	2 x	**2**	5 x	**2**	10 x	**2**	7 x	**5**	**69**	**Low**
Volcano	2 x	**1**	5 x	**1**	10 x	**1**	7 x	**2**	**31**	**Low**
Wildfire	2 x	**3**	5 x	**2**	10 x	**3**	7 x	**3**	**67**	**Low**
Wildfire Smoke	2 x	**6**	5 x	**7**	10 x	**7**	7 x	**6**	**159**	**High**

5.4.6 Wood Village Aligned Plans and Other Implementation Processes

Overview

Wood Village has a similar set of plans and processes as other communities in Oregon, under the statewide Building Code and Land Use Programs. Wood Village is the smallest city included in this plan, but still manages its own stormwater, wastewater collection, drinking water and local streets. Wood Village is reliant on managing some day-to-day operations through contracts and outsourcing and does not have resources to significantly expand in-house resilience programs through grants management or plan and code expansion. Mitigation strategies in this update rely on integrating mitigation into existing infrastructure system planning or using existing city resources and budgets. Lifeline resilience is enhanced by Intergovernmental Agreements (IGAs) with neighboring cities to support each other in emergencies to maintain critical services.

- Comprehensive Plan
  - Most recently amended in 2017

  - Chapter 7 of the plan addresses the extent of and severity of natural hazards to Wood Village. References to the NHMP should updated in the next revision, and risk assessment information from this plan update should be incorporated where relevant.
- City Budget
  - Updated for each fiscal year, beginning July 1
  - The annual budget provides funding that can be used to improve the resilience of Wood Village. The risk assessment and identified mitigation strategies in this plan can be brought to future budget processes to identify opportunities where funding can increase city resilience.
- Emergency Operations Plan (EOP)
  - Most recently updated in 2012
  - The NHMP mission and goals work together with the EOP to coordinate response to natural disasters. The next update to the EOP should be revised to match the risk assessment in the NHMP.
- Transportation System Plan (TSP)
  - Most recently updated in 2017
  - The TSP guides the implementation of transportation programs in the city, and impact from natural hazards can damage or limit systems. The plan has room for additional description of natural hazard threats that would impact transportation infrastructure and operations.
- Water Master Plan
  - Current plan adopted in 2023
  - The Water Master Plan outlines the existing water service infrastructure and opportunities for improvement. The updated master plan will be used to identify future water system resilience projects, as noted in this plan update.
- Sanitary Sewer Master Plan
  - Current plan adopted in 2023, an update is in process as of 2023
  - The Sanitary Sewer Master Plan identifies improvements and long-term planning for the system. The plan can be used to identify mitigation opportunities by incorporated information from the NHMP risk assessment, and this opportunity is part of an action in this plan update.
- Parks Master Plan
  - Adopted in 2015, and most recently updated in October 2018
  - Parks can serve as amenities to mitigate hazards or be subject to hazards themselves. Parks planning can be used in coordination with this plan to identify locations of future parks that support hazard mitigation goals.
- Stormwater Management Plan
  - Updated for 2022-23 fiscal year.
  - The Stormwater Management plan builds off of the 2012 Stormwater System Master Plan by identifying a number of specific strategies to meet program goals. Many actions support water quality, but stormwater flood prevention is also mentioned and can continue to align with NHMP goals relating to stormwater risks.
- Stormwater System Master Plan
  - Adopted March 2012
  - The Stormwater System Master Plan is the overview of existing and planned stormwater facilities. Updates that can inform the NHMP may come from updated

risk assessments based on higher discharge rates that could result from climate related rainstorms. Historic stormwater flood events are listed in the plan.

- Urban Renewal District Plan
  - Plan approved in 2010
  - The Urban Renewal Plan provides a long-term framework for community improvements in area eligible for Tax Increment Financing. Future updates to the plan could align renewal projects with risk reduction efforts identified in this plan's risk assessment.
- Zoning and Development Code
  - Most recently amended in May 2022
  - The code creates land use and building code requirements in the city, some of which are directly related to natural hazards. Future development regulations can use the revised risk assessment in this plan to inform strategies and develop future hazard mitigation planning.

5.5 Multnomah County

5.5.1 Mitigation Actions

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – Multnomah County</th></tr>
<tr><td rowspan="8">Multi-Hazard</td><td rowspan="8">1</td><td colspan="8">Build coordination with disability advocacy groups and disabled residents to analyze varied community risks and identify actions to enhance the safety of disabled residents in all types of hazards.</td></tr>
<tr><td colspan="4">Plan Goals – 1,2,4</td><td colspan="4">Hazards Addressed – All Hazards</td></tr>
<tr><td colspan="4">Lifelines – Community Resilience</td><td colspan="4">Prioritization Criteria</td></tr>
<tr><td colspan="2">Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td colspan="2">Multnomah County Emergency Management Planning Division</td><td>MCEM Operations, Community Based Organizations, RDPO, Regional Partners</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>15</td></tr>
<tr><td colspan="8">Potential Funding – Emergency Management staff time, UASI partnerships and grants.</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Emergency Operations Plan and Standard Operating Procedures</td></tr>
<tr><td colspan="8">Notes – Addresses potential disparate natural hazard community risk.</td></tr>
</table>

Hazard	Action ID	Mitigation Actions – Multnomah County								
Multi-Hazard	2	**Develop countywide recovery plan to enhance short-term disaster resilience and focus long-term social and economic equity in recovery processes.**								
		Plan Goals – 1,2,4,5						Hazards Addressed – All Hazards		
		Lifelines – Community Recovery, All Lifelines						**Prioritization Criteria**		
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management Planning Division	MCEM Operations, Multnomah County Cities, RDPO, All Recovery Support Function Leads	**3**	**2**	**3**	**2**	**3**	**13**	
		Potential Funding – Emergency Management staff time, FEMA Planning Grants, UASI partnerships								
		Potential Implementation Methods – Existing Recovery Frameworks								
		Notes –								
Multi-Hazard	3	**Continue to integrate hazard mitigation goals in the early design processes for County public facility and infrastructure projects, co-benefitting sustainability and resilience goals.**								
		Plan Goals – 2,3,5						Hazards Addressed – All Hazards		
		Lifelines – Public Facilities						**Prioritization Criteria**		
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Facilities	Multnomah County Sustainability, Multnomah County Emergency Management	**2**	**2**	**3**	**3**	**3**	**13**	
		Potential Funding – Existing staff capacity								
		Potential Implementation Methods – Capital Improvement Plan								
		Notes – Continuing action from 2017 NHMP.								

Hazard	Action ID	Mitigation Actions – Multnomah County								
Multi-Hazard	4	**Enhance equitable community capacity building by applying for and managing resilience grants that can be administered by community-based organizations that represent underserved communities.**								
		Plan Goals – 1,2,4		Hazards Addressed – All Hazards						
		Lifelines – Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	Community-Based Organizations, Office of Community Involvement, RDPO	**3**	**3**	**2**	**3**	**2**	**13**	
		Potential Funding – Existing staff capacity, FEMA HMA, UASI, other grants								
		Potential Implementation Methods – Hazard Mitigation Plan, Emergency Operations Plan and Standard Operating Procedures, Sustainability and Climate Action Planning								
		Notes –								
Multi-Hazard	5	**Continue participation in state, regional, and local Critical Energy Infrastructure Hub all-hazard mitigation planning; supporting studies to identify mitigation strategies to reduce environmental impact and threat to life.**								
		Plan Goals – 1,2,3		Hazards Addressed – Earthquake, Flood Landslide, Wildfire and Wildfire Smoke						
		Lifelines – Fuel, Hazardous Materials		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	Multnomah County Sustainability, City of Portland, OEM	**2**	**3**	**3**	**3**	**2**	**13**	
		Potential Funding – Existing staff capacity								
		Potential Implementation Methods – State Legislation, City and County mitigation and evacuation planning								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County								
Multi-Hazard	6	**Continue process of evaluating the resilience of all county facilities to all natural hazards, and recommend mitigation opportunities resulting from the evaluation.**								
		Plan Goals - 3		Hazards Addressed – All Hazards						
		Lifelines – Public Facilities		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Facilities	Multnomah County Emergency Management	**2**	**2**	**3**	**3**	**2**	**12**	
		Potential Funding – Existing staff capacity								
		Potential Implementation Methods – Capital Investment Plan, Facility Plans								
		Notes –								
Multi-Hazard	7	**Evaluate small residential care and child-care facilities licensed by Multnomah County for resilience to natural hazards and power loss and develop implementable mitigation strategies.**								
		Plan Goals – 1,2,3,4,5		Hazards Addressed – Earthquake, Flood, Landslide, Severe Weather, Wildfire and Wildfire Smoke						
		Lifelines – Care Facilities, Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Department of County Human Services	Multnomah County Emergency Management, Health Department	**3**	**2**	**1**	**3**	**3**	**12**	
		Potential Funding – HMA grants, other external funding								
		Potential Implementation Methods – County Care Facility Licensing Regulations, Emergency Operations Plan and Standard Operating Procedures								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County								
Multi-Hazard	8	**Develop power backup and air quality resilience capabilities at critical county facilities, especially those that protect residents with heightened risk to climate and wildfire smoke impacts. Capabilities may include backup power generators, transfer switches, and portable or permanent air filtration or air conditioning systems.**								
		Plan Goals – 3,4,5		Hazards Addressed – All Hazards						
		Lifelines – Public Facilities, Disaster Sheltering		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	Multnomah County Facilities, Environmental Health, Joint Office of Homeless Services	**3**	**3**	**1**	**3**	**2**	**12**	
		Potential Funding – Internal Facility Budgets, HMA grants, other external funding								
		Potential Implementation Methods – Emergency Operations Plan and Standard Operating Procedures, JOHS Strategic Planning								
		Notes –								
Multi-Hazard	9	**Convene an update to the Critical Facilities Inventories of the participating entities in this plan and analyze with updated natural hazard risk mapping.**								
		Plan Goals – 3,5		Hazards Addressed – All Hazards						
		Lifelines – Critical Facilities		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	Multi-Jurisdictional NHMP Participants	**2**	**3**	**3**	**2**	**2**	**12**	
		Potential Funding – Existing staff time								
		Potential Implementation Methods – Hazard Mitigation Planning, Regional THIRA-SPR								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County								
Multi-Hazard	10	**Support the development of resilience hubs to create sites for community pre-disaster engagement and response capacity in county locations with barriers to resilience and recovery.**								
		Plan Goals –		Hazards Addressed – All Hazards						
		Lifelines – Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Sustainability	Multnomah County Emergency Management, Multnomah County Commissioners' Offices	**3**	**2**	**2**	**3**	**2**	**12**	
		Potential Funding – Existing staff time, HMA grants, other external funding								
		Potential Implementation Methods – Climate Justice Planning								
		Notes –								
Multi-Hazard	11	**Develop a prioritization of county transportation emergency routes based on trip studies.**								
		Plan Goals – 1,2,3		Hazards Addressed – All Hazards						
		Lifelines – Roads		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Roads	RDPO, Multnomah County Emergency Management	**2**	**2**	**1**	**3**	**1**	**9**	
		Potential Funding – Existing staff time, regional funding								
		Potential Implementation Methods – Regional Emergency Transportation Routes, Emergency Operations Plan								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County								
Multi-Hazard	12	**Develop accessible Story Maps and other GIS Mapping Tools to enhance risk communication and the visibility of natural hazard mitigation opportunities.**								
		Plan Goals – 1,2,4		Hazards Addressed – All Hazards						
		Lifelines – Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	Multnomah County GIS, Multnomah County Office of Community Involvement	**3**	**1**	**1**	**2**	**2**	**9**	
		Potential Funding – External grants								
		Potential Implementation Methods – Emergency Operations Plan, Community Wildfire Protection Plan								
		Notes –								
Earthquake	13	**Continue pursuit of funding for seismic home retrofit programs for historically underserved residents.**								
		Plan Goals – 1,4		Hazards Addressed – Earthquake						
		Lifelines – Housing		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	Multnomah County Cities, Affordable Housing Providers	**3**	**3**	**1**	**3**	**2**	**12**	
		Potential Funding – External grants								
		Potential Implementation Methods – Affordable Housing Strategic Planning, Poverty Report								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County								
Earthquake	14	**Reassess existing seismic assessments of County facilities, and develop new project prioritization based on results.**								
		Plan Goals – 3		Hazards Addressed – Earthquake						
		Lifelines – Public Facilities		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Facilities	Multnomah County Emergency Management	**2**	**3**	**2**	**3**	**1**	**11**	
		Potential Funding – Existing county capacity								
		Potential Implementation Methods – Capital Improvement Plan								
		Notes –								
Earthquake	15	**Continue to develop the Earthquake Ready Burnside Bridge project and consider project and funding pathways for seismic retrofits of the Hawthorne, Broadway, and Morrison Bridges, as identified in the 2015 Willamette River Critical Infrastructure Plan (CIP).**								
		Plan Goals – 2,3,5		Hazards Addressed – Earthquake						
		Lifelines – Bridges		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Bridges (DCS)		**1**	**3**	**1**	**3**	**2**	**10**	
		Potential Funding – BRIC, other external grants								
		Potential Implementation Methods – Critical Infrastructure Plan								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County								
Earthquake	16	**Identify and develop applications for ShakeAlert in public safety preparation and seismic resilience of critical county facilities.**								
		Plan Goals – 2,3,5		Hazards Addressed – Earthquake						
		Lifelines – Public Facilities		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	Multnomah County Facilities, Oregon Emergency Management, RDPO	**2**	**2**	**1**	**3**	**2**	**10**	
		Potential Funding – HMA, other external grants, internal construction budgets								
		Potential Implementation Methods – Capital Improvement Plan, Statewide ShakeAlert planning								
		Notes –								
Earthquake	17	**Identify post-earthquake debris storage sites and fully implement the current Multnomah County Debris Management Plan.**								
		Plan Goals – 2,3,5		Hazards Addressed – Earthquake						
		Lifelines – Debris Management		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Department of County Services	Multnomah County Emergency Management, Metro, RDPO, City of Gresham	**1**	**2**	**3**	**2**	**2**	**10**	
		Potential Funding – Existing staff capacity								
		Potential Implementation Methods – Debris Management Plan								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County								
Flood	18	**Assess Emergency Action Plan for the Van Raden Dam and develop preparation and response planning for any potential dam failure.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Dam		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	Washington County Emergency Management, Oregon Water Resources Department, Dam Owner	**1**	**2**	**3**	**1**	**2**	**9**	
		Potential Funding – Existing staff capacity								
		Potential Implementation Methods – Emergency Operations Plan and Standard Operating Procedures								
		Notes –								
Flood	19	**Develop policy recommendations for channel migration zone impacts on the Sandy River to existing and future development.**								
		Plan Goals – 1,3		Hazards Addressed – Flood						
		Lifelines – Housing, Land Use, Zoning and Building		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Land Use	Multnomah County Emergency Management	**1**	**2**	**1**	**2**	**2**	**8**	
		Potential Funding – Existing staff capacity								
		Potential Implementation Methods – Land Use and Zoning Codes, Development Permit Processes								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County

Landslide — Action 20

Update the County's geological hazards overlay, building off the existing steep slope overlay and addressing stormwater management and slope stabilization for landslide prevention.

Plan Goals – 1,2,5

Hazards Addressed – Landslide

Lifelines – Land Use, Zoning and Building

Implementation Lead	Coordinating Partnerships	Prioritization Criteria: Equity	Benefit	Cost	Risk	Capacity	Priority Score
Multnomah County Land Use		1	2	2	2	2	9

Potential Funding – Existing staff capacity

Potential Implementation Methods – Land Use and Zoning Codes, Development Permit Processes, Comprehensive Plan

Notes –

Landslide — Action 21

Work with residents with homes in high landslide risk areas to identify mitigation opportunities, including potential property buyout grants when residents have interest.

Plan Goals – 1,2

Hazards Addressed – Landslide

Lifelines – Housing, Community Resilience

Implementation Lead	Coordinating Partnerships	Prioritization Criteria: Equity	Benefit	Cost	Risk	Capacity	Priority Score
Multnomah County Emergency Management	DOGAMI, Oregon Emergency Management	1	2	1	2	2	8

Potential Funding – Existing staff capacity, HMA grants

Potential Implementation Methods – Emergency Operations Plan, DOGAMI Landslide Risk Reduction Recommendations

Notes –

Hazard	Action ID	Mitigation Actions – Multnomah County								
Severe Weather	22	**Continue to fund and develop programs to support in-home mitigation for residents in high-risk housing and with limited resources, through weatherization programs and the delivery and installation of portable air conditioners and air filters.**								
		Plan Goals – 1,2,4,5		Hazards Addressed – Severe Weather						
		Lifelines – Housing, Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Department of County Human Services	Multnomah County Health Department, Emergency Management	**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – Existing staff capacity, state and federal grants								
		Potential Implementation Methods – Emergency Operations Plan and Standard Operating Procedures								
		Notes –								
Severe Weather	23	**Coordinate with cities on tree-planting, concrete removal, and other heat island mitigation projects across the county in neighborhoods with high proportions of historically underserved residents, with those living in vulnerable housing, and with those with high proportions of residents with pre-existing health conditions.**								
		Plan Goals – 1,2,3,4,5		Hazards Addressed – Severe Weather						
		Lifelines – Housing, Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Sustainability	Multnomah County Emergency Management, Multi-Jurisdictional NHMP Entities, Metro, RDPO, EPA	**3**	**2**	**2**	**3**	**2**	**12**	
		Potential Funding – EPA, FEMA HMA grants, internal funds								
		Potential Implementation Methods – Emergency Operations Plan and Standard Operating Procedures								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County								
Wildfire & Wildfire Smoke	24	**Support grants for home ignition zone assessment and mitigation, including vegetation management and structure maintenance, especially for residents in high-hazard areas or with physical or resource limitations.**								
		Plan Goals – 1,2,4,5		Hazards Addressed – Wildfire & Wildfire Smoke						
		Lifelines – Housing, Community Resilience		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	County Fire Districts (Unincorporated Areas), ODF, OSFM	**2**	**3**	**3**	**3**	**3**	**14**	
		Potential Funding – CWDG grants, other Senate Bill 762 programs, Firewise Community opportunities								
		Potential Implementation Methods – Community Wildfire Protection Plan, Fire District Strategic Planning								
		Notes –								
Wildfire & Wildfire Smoke	25	**Implement mitigation strategies for wildfire and wildfire smoke identified in the current and upcoming revision of the Multnomah County Community Wildfire Protection Plan.**								
		Plan Goals – 1,2,5		Hazards Addressed – Wildfire & Wildfire Smoke						
		Lifelines –Community Resilience, Infrastructure		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Multnomah County Emergency Management	County Fire Districts (Unincorporated Areas), ODF, OSFM	**2**	**3**	**2**	**3**	**2**	**12**	
		Potential Funding – CWDG grants, other Senate Bill 762 programs, FEMA HMA grants, internal funding								
		Potential Implementation Methods – Community Wildfire Protection Plan, Fire District Strategic Planning								
		Notes –								

Hazard	Action ID	Mitigation Actions – Multnomah County							
Wildfire & Wildfire Smoke	26	**Identify strategies for supporting defensible space for structures in high-risk wildfire areas in zoning regulations, using Senate Bill 762 processes including new state land-use requirements, new risk mapping, and building code revision opportunities.**							
		Plan Goals – 1,2,5		Hazards Addressed – Wildfire & Wildfire Smoke					
		Lifelines – Land Use, Construction		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Multnomah County Land Use	Multnomah County Emergency Management	**1**	**2**	**2**	**3**	**2**	**10**
		Potential Funding – CWDG grants, other Senate Bill 762 programs, FEMA HMA grants, internal funding							
		Potential Implementation Methods – Community Wildfire Protection Plan, Fire District Strategic Planning							
		Notes –							

5.5.2 County Overview

Multnomah County was founded in 1854 as a new county created from portions of Washington County and Clackamas County. The county is bordered on the west by Columbia County and Washington County, on the south and east by Clackamas County and to the northeast by Hood River County. The entire northern border of the county is the Columbia River looking across to the Washington state line. The entire county is 466 square miles, making it the smallest county by area in Oregon.

Portions of this Hazard Mitigation Plan chapter for Multnomah County focus predominantly on the risks and vulnerabilities of unincorporated areas. However, many key Multnomah County government services are also provided in incorporated areas, where Multnomah County is the primary governmental service provider and owns and operates critical facilities. Hazards most impactful to these countywide services receive a countywide lens. Some specific roles that Multnomah County has in the county that are especially reflected in natural hazard mitigation are listed here:

- The primary public provider for health and human services, including public health, environmental health, behavioral health, clinical services, and services for older adults, veterans, those with intellectual and developmental disabilities, residential care facilities, child care facilities and universal preschool.
- Shares administration of the Joint Office of Homeless Services with the City of Portland.
- Operates a number of bridges within incorporated areas, including several spans of the Willamette River in central Portland.
- Operates libraries and other critical facilities throughout the county.
- Provides contracted police services to Fairview, Troutdale, and Wood Village through the Multnomah County Sheriff's Office.
- Operates county jails in the City of Portland and in areas protected by the Columbia Corridor Drainage Districts.
- Provides animal services across the county.

Extreme heat, severe cold, wildfire smoke, and disaster-related long-term power loss are among the most likely hazards to be mitigated and responded to on a countywide level by Multnomah County. Earthquakes are also a hazard where countywide risk is important to document because of the county operation of important bridges.

Multnomah County's road and land use planning services are primarily focused in unincorporated areas. Multnomah County government has no fire services or water agency, but coordinates with multiple districts in unincorporated areas to assist in the management of natural hazard risks.

Some mitigation strategies prioritized in this plan would be implemented in both incorporated and unincorporated areas. Multnomah County may also share goals and strategies with cities or special districts, including the City of Portland, where coordination between governments is essential to successful mitigation.

The unincorporated portions of Multnomah County are primarily located in the eastern and western reaches of the county, and a few unincorporated enclaves remain within the county's Urban Growth Boundary. The Community Profile of this plan has demographic and infrastructure information for the county as a whole, including elements of vulnerability to different demographic populations.

The large unincorporated areas to the east and west hold some of the largest areas in the county with forests, farmland, and steep slopes, making them the highest risk areas for wildfire and landslide in the county. There are also unincorporated areas with particular risk from floods and volcanic impacts.

Unincorporated Multnomah County has seen a significant decline in population since the last version of the plan, due to annexations – especially by the City of Portland in the West Hills – not population loss.

The demographic characteristics of unincorporated Multnomah County differ between locations, but as a whole those outside of incorporated cities are older, less likely to meet definitions of living in poverty and less likely to be non-white or speak a language other than English. Rural unincorporated areas have fewer transportation routes, limited public transit options, and are farther from goods and services, making post-disaster evacuation and resource support more challenging and requiring the development of neighborhood-scale resilience and local planning.

Unincorporated Western Multnomah County

Sauvie Island is located between the Columbia River and the Multnomah Channel, and is only accessible from the rest of the county across the Sauvie Island Bridge. The island is about 15 miles long and four miles wide, with about half of the island managed as the Sauvie Island Wildlife Area and much of that half in Columbia County. Nearly all of the approximately 2,000 residents live in Multnomah County. The southern portion is well-known for small-scale agriculture, and is an important food-growing resource to the Portland Metro area, as well as a popular recreational area. Sauvie Island maintains its own Fire District.

Figure 156 - The Warrior Rock Lighthouse guides ships on the Columbia River from an eastern point on Sauvie Island. It is the smallest lighthouse in Oregon. Photo from the Sauvie Island Community Association.

The West Hills including Forest Park and Tualatin Mountains make up two census tracts have been used to estimate demographics. This area is located north of the City of Portland and reaches to the boundaries with Washington and Columbia Counties. Highway 30 runs through this area near the Multnomah Channel, but most of the terrain is mountainous and includes a portion of Forest Park. The City of Portland has annexed significant portions of this area since

the publication of the 2017 NHMP, leading to a large decline in population. There are several small unincorporated communities, including Burlington and Holbrook.

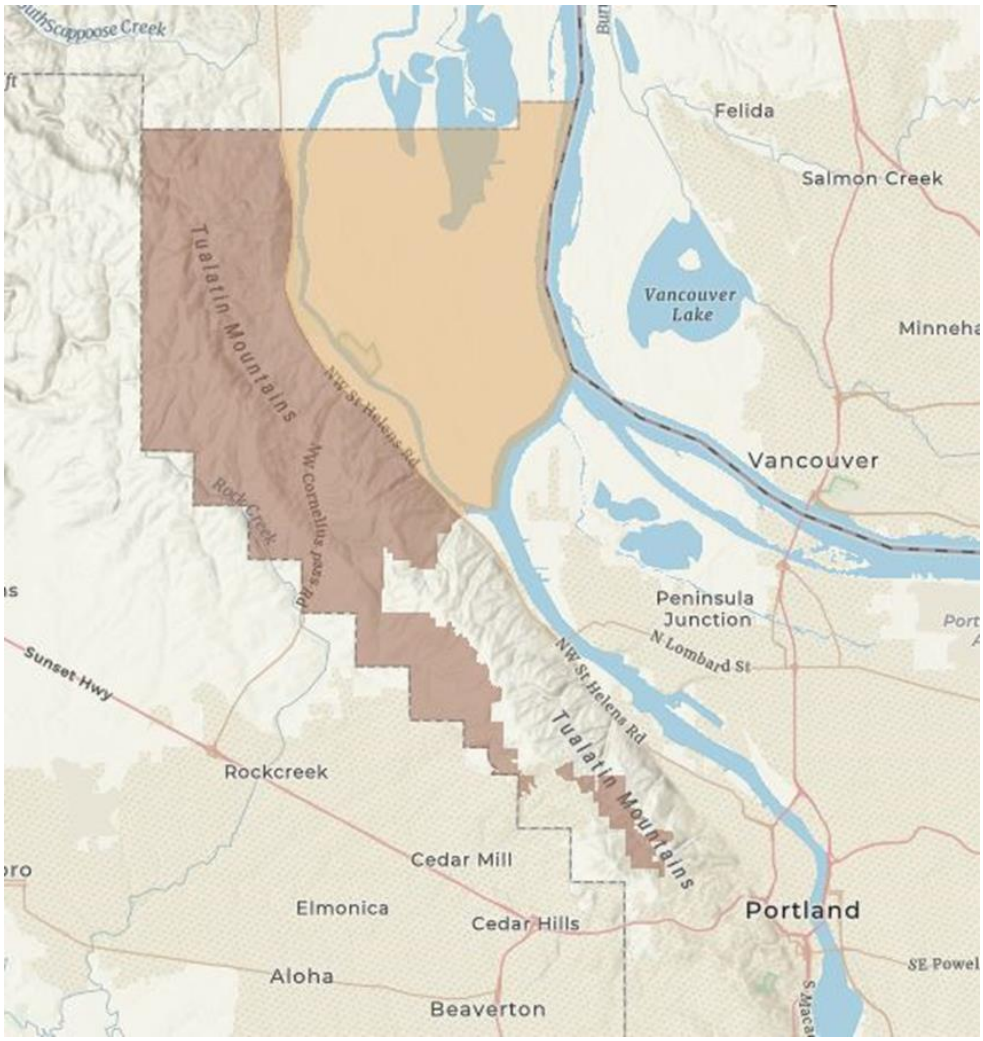


Figure 157 - Map showing the county planning areas for Sauvie Island (tan) and West Hills (brown). Map from Multnomah County Land Use Planning Reference Map.

Unincorporated Eastern Multnomah County

Two census tracts are used to measure demographics of unincorporated areas located to the east of Troutdale and Gresham and south of Gresham, all the way to the boundaries with Hood River County and Clackamas County.

West of the Sandy River makes up the unincorporated areas west of the Sandy River border the City of Gresham to the west and the City of Troutdale to the north. The area is primarily agricultural, and includes a high school. Some annexations have occurred here since the 2017 NHMP. The area approximately west of SE 282nd Avenue is within the Urban Growth Boundary

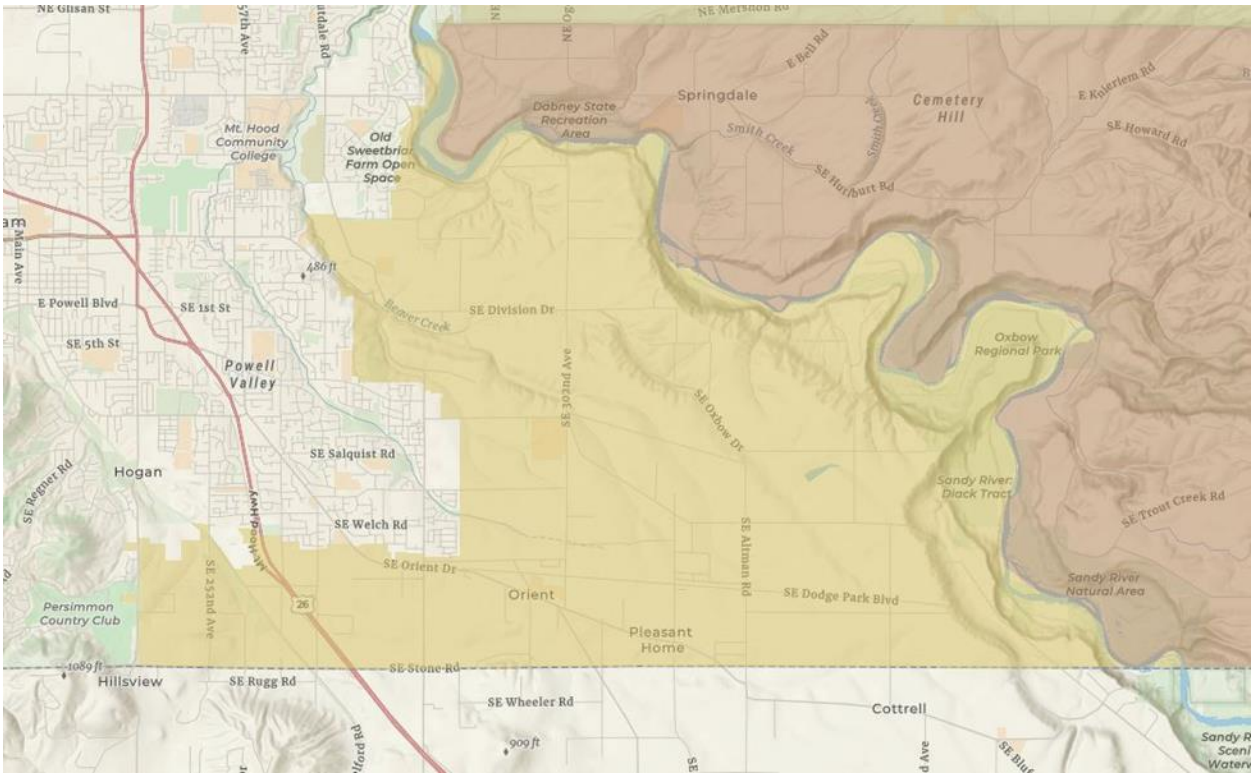


Figure 158 - Map showing county planning areas in East Multnomah County. The lighter area is 'West of the Sandy River' and the darker brown color is 'East of the Sandy River'. Map from [Multnomah County Land Use Planning Reference Map](#).

East of the Sandy River includes communities in the Columbia River Gorge. Corbett is the largest unincorporated community in Multnomah County, with around 2,300 people, and has local school, fire, and water districts. Springdale is located west of Corbett and three miles east of Troutdale, and has another approximately 1,000 people. Farther east in the gorge are the small communities of Latourell, Bridal Veil, Warrendale and Dodson, the Bonneville Dam, and highly valued recreational and cultural sites, including Multnomah Falls. Interstate Highway 84 is the primary transportation route through the gorge. Areas south of the gorge communities include the Aims community but are primarily part of the Mount Hood National Forest or the protected Bull Run Watershed.

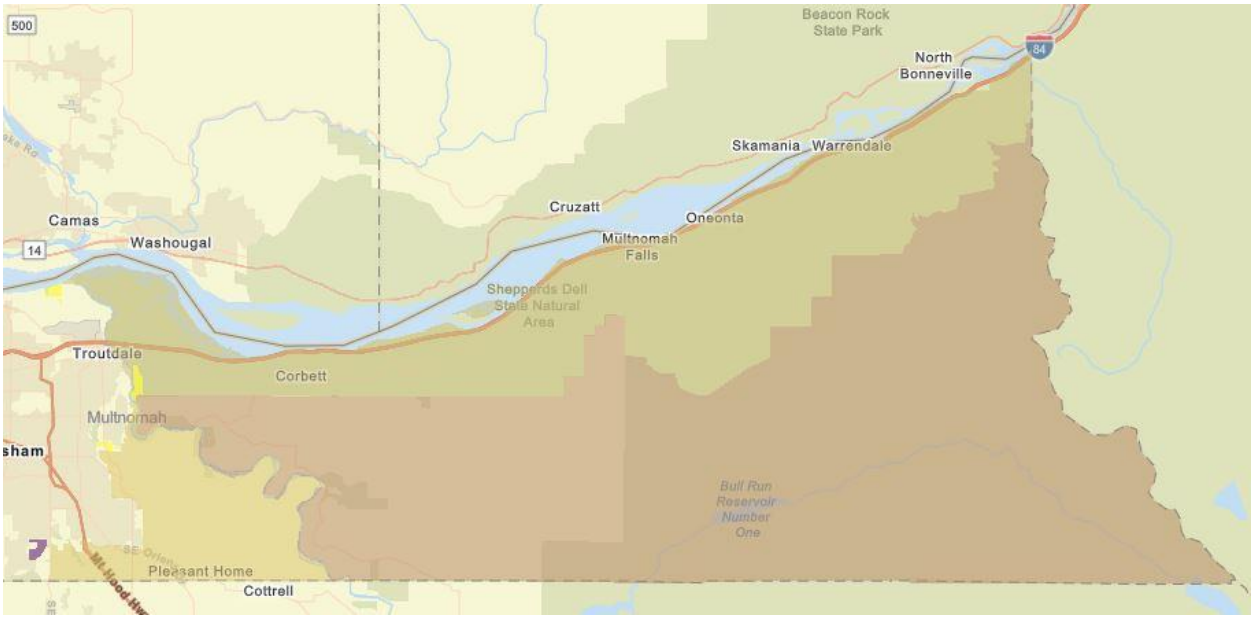


Figure 159 - Map showing Multnomah County Planning Areas. All three colors east of the Sandy River are considered to be the area 'East of the Sandy River' for the purpose of this plan. Map from Multnomah County Land Use Planning Reference Map

Unincorporated Urban Pockets

There are a number of additional enclaves surrounded by cities that have not been annexed and remain unincorporated. These areas are too small to be differentiated through census data tracts and so are not broken out in the Community Profile chapter. Many of these areas are also administered by neighboring cities through Intergovernmental Agreements (IGAs), so are not included as part of this plan, and risk is captured within planning for the administering municipality. The two largest enclaves still administered by Multnomah County are detailed in this chapter:

- The Interlachen neighborhood is located on a ridge between Blue Lake and Fairview Lake, with the City of Fairview to the east, south and north and the City of Gresham to the west. The area has about 150 homes.

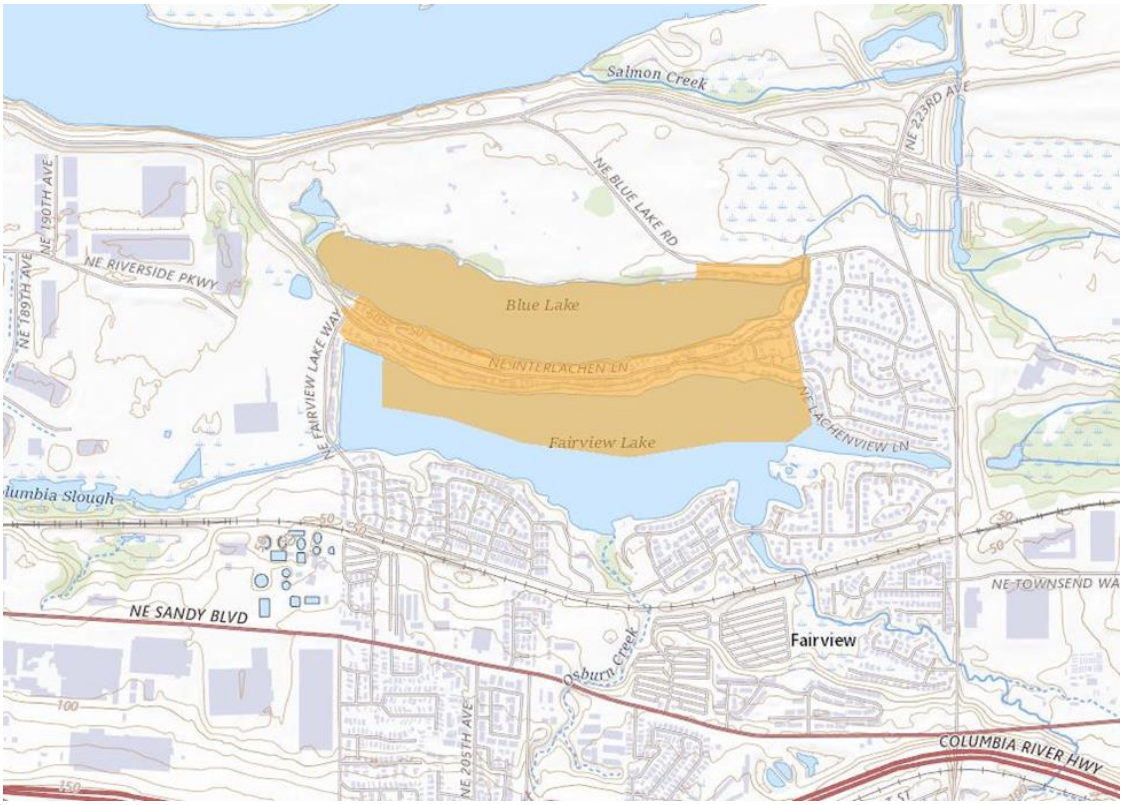


Figure 160 - Map showing the location of the Interlachen neighborhood. Map from [Multnomah County Land Use Planning Reference Map]

- Pleasant Valley is located between the Cities of Portland and Gresham, and borders Clackamas County to the south. The area is bisected by SE Foster Road and is primarily agricultural, but includes an elementary school. This area is also located within the Urban Growth Boundary.

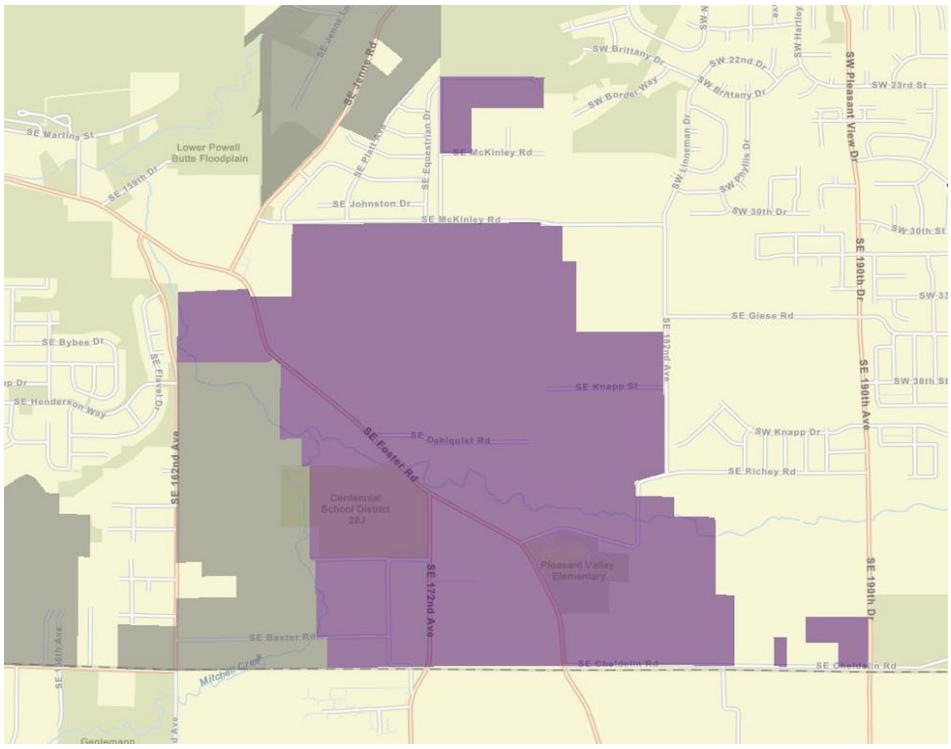


Figure 161 - Map showing the unincorporated Pleasant Valley neghborhood in purple. Gray areas are also unincorporated, but at are administered by the City of Portland. Unshaded areas are part of the City of Portland or the City of Gresham. Map from [Multnomah County Land Use Planning Reference Map]

Transportation

The center of Multnomah County is bisected by Interstate Highways 5 and 405 running through the City of Portland. The western and eastern sides of Multnomah County have just a few important routes that carry most of the through traffic in areas with terrain susceptible to natural hazards.

Western Multnomah County

- State Highway 30, connecting to Columbia County
- State Highway 26, on the west side, connects Portland to Washington County over the West Hills.
- NW Cornelius Pass Road, the primary crossing in northern Multnomah County over the West Hills to Washington County

Eastern Multnomah County

- Interstate Highway 84, connecting to Hood River County through the Columbia River Gorge
- State Highway 26, on the east side connects to Clackamas County through the Mount Hood National Forest
- East Historic Columbia River Highway, connecting unincorporated communities and recreational travelers through the Columbia River Gorge

Public transit options are generally not available in rural unincorporated parts of the county, while the urban enclaves are in the vicinity of TriMet bus routes.

Utilities

A number of water utilities service residents in unincorporated Multnomah County. The majority of residents in the county as a whole are served by the Portland Water Bureau via water from the Bull Run Reservoir and supplemented by the Columbia South Shore Well Field. The Corbett Water District serves about 1,100 customers with surface water from Gordon Creek. Wells and septic systems are also used in rural areas.

Electricity in unincorporated areas is primarily provided by Portland General Electric (PGE) and natural gas by NW Natural. Three other electric utilities operate in small portions of the farthest east and west reaches of the County.

Critical Facilities

A full list of critical facilities can be found in the Human-Caused and Technological Hazard Identification and Risk Assessment, included as an annex to this plan. Communities define their own critical facilities by type. The Critical Facilities identified in unincorporated areas of Multnomah County are:

- Bridges
- Childcare Facilities
- Community Centers
- County Assets
- Fire Stations
- Licensed Medical Facilities
- Law Enforcement Facility
- Private and Public Schools

When considering county-identified Critical Facilities in incorporated cities, the following types of facilities are added:

- Ambulance Services
- Homeless Shelters
- Hospitals
- Jails
- Law Enforcement Facilities
- Libraries
- Residential Care Facilities
- Urgent Care Centers

5.5.3 Five-Year Update, 2017-2022

Hazard Events

Multnomah County suffered a number of significant natural disasters since the adoption of the 2017 NHMP, which have guided a reconsideration of mitigation priorities. The most significant localized events occurred in unincorporated areas, while countywide climate events particularly impacted Multnomah County service providers because of their disparate impacts to residents served by Multnomah County Health, Human Services, and the Joint Office of Homeless Services.

- *2021 Heat Dome*

The 2021 Heat Dome was a transformative event for Multnomah County as a health disaster responsible for at least 69 deaths from heat illness. Deaths were concentrated among older adults living in spaces without climate control and in areas identified as urban heat islands. Response to the disaster included emergency notification and the operation of cooling shelters. As a result of this disaster, heat interventions were developed or expanded, including pre-event preparedness messaging, distribution of air conditioners, and delivery of cooling kits to housed and unhoused people with the most vulnerability.

- *2017 Eagle Creek Fire*

All direct fire impacts from the Eagle Creek Fire occurred in unincorporated Multnomah County, in a location mapped as having high wildfire risk. The fire threatened Columbia River Gorge communities, required significant evacuation, and caused long-term damage to recreation and forestry. The impact of the fire also created increased risk of flood and landslide in burned areas, and was implicated as a factor in the fatal 2021 Dodson landslide. The magnitude of the Eagle Creek Fire increased awareness of wildfire risk throughout the county.

- *2021 Dodson Landslide*

The most significant landslide in the last five years was a fatal event that occurred in 2021 near the unincorporated community of Dodson, in the northeasternmost portion of the county. The landslide was caused by heavy rain and was likely influenced by post-fire effects from the Eagle Creek Fire. The Dodson-Warrenton area has a long geological history of major landslides.

- *2020 September Wildfire Smoke Event*

The wildfire smoke event in September 2020 blanketed the entire county in thick smoke for nearly a week. This disaster led to elevated emergency room visits and was of particular concern for those with existing respiratory illness. Shelter space was provided for unsheltered residents, as well as for those evacuating from fire in Clackamas County. Personal protective equipment was distributed and communication was provided on the risk of wildfire smoke and how to make homes safer from unhealthy air.

- *Other Heat and Cold Events*

Deaths occurred in a number of other heat and cold events over the past five years, including the death of five unhoused residents in the severe winter of 2016-2017, and five hyperthermia deaths from a weeklong heatwave in 2022.

Mitigation Successes

- After the Heat Dome event in 2021, Multnomah County began purchasing portable air conditioner units to distribute to County Human Services clients determined to be particularly at risk from heat. This intervention is part of a number of climate-based mitigation programs, including home weatherization programs, emergency sheltering, and coordination with affordable housing providers with residents particularly at risk from heat. Residents in the City of Portland have also received air conditioners through the Portland Clean Energy Fund and as of 2022, The State of Oregon also has a distribution program through the Oregon Health Authority.

- A major project to replace the Burnside Bridge began in earnest around the time the previous plan was adopted. The county-owned bridge is a central lifeline route in Portland connecting the east and west sides of the county. Feasibility studies were completed between 2016 and 2018 and four alternatives were moved forward to environmental review in 2019.

  The preferred alternative, a full replacement span, was approved in October 2020. Refinements to the plan developed through additional public input and environmental review were occurring through 2022. Construction is hoped to begin in 2025 and be completed in 2029.

- The Sauvie Island Drainage Improvement Company (SIDIC) received accreditation of its levees from the United States Army Corps of Engineers (USACE) in 2019. This accreditation certifies the protective quality of the levees for 10 years, and the report recommended that FEMA maintain levee protection status on Flood Insurance Rate Maps.

- A new Central County Courthouse opened in 2020, replacing a 106-year-old building located along the Willamette River in Portland in an area with high soil liquefaction risk. The new $34 million building was built with an elastic concrete frame to lessen the risk of collapse and fluid viscous dampers to dissipate shaking energy.

- The Multnomah County Office of Sustainability has worked with the City of Gresham to increase tree planting in urban heat island neighborhoods. The office released a final progress report on the 2015 Climate Action Plan in 2021, which included strategies linked to hazard mitigation planning work. Climate planning is continuing with a focus on climate justice and the centering of front-line communities to address disparities in

climate impacts caused by non-weatherized homes, lack of tree canopy, and inequitable health outcomes.

Growth and Development Impacts

As noted above, the population of unincorporated Multnomah County has declined in the last five years, as areas with new development inside the Urban Growth Boundary have been mostly annexed by neighboring cities.

Development managed by Multnomah County continues to be low-density and rural, requiring management of natural hazard threats most prominent in those locations–landslide, wildfire, and flood. Planning and building codes continue to evolve to make future development more resistant to these hazards.

The county's population growth continues to increase the number of people at risk from climate hazards. The population has grown older in the last five years, increasing the number of older adults more at risk from these hazards. The number of unhoused residents has also sharply increased, increasing a population group with often the most difficulty moving to climate-controlled spaces and with high rates of pre-existing health conditions and disability.

5.5.4 Local Hazard Analysis

Earthquake – Risk Rating High

See Earthquake Section for more detailed risk and vulnerability information.

The most severe impacts to Multnomah County from earthquakes will likely be caused in densely populated areas. This risk will place a large burden on Multnomah County to support mass sheltering, health services, and support to human services clients, including older adults, children, and those with disabilities. Damage to county bridges could be extensive, and many other county facilities will likely also be damaged.

Unincorporated areas have fewer structures and infrastructure to be at risk than in cities, but face vulnerability because of the lack of redundant systems that could leave at-risk residents without evacuation routes and the ability to reach critical resources and health services. Earthquake-triggered landslides are also a major concern on both sides of the county, as are potential post-disaster fires.

Areas located in the western part of the county and areas located in wet soils in the historical Columbia River floodplain face the highest risk from a Cascadia Subduction event or a Portland Hills crustal quake. Liquefaction may occur throughout the western portion of the county, even in higher elevation areas along creeks. The entirety of Sauvie Island is considered to have high liquefaction potential, which will threaten residences and the protective levee system.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)

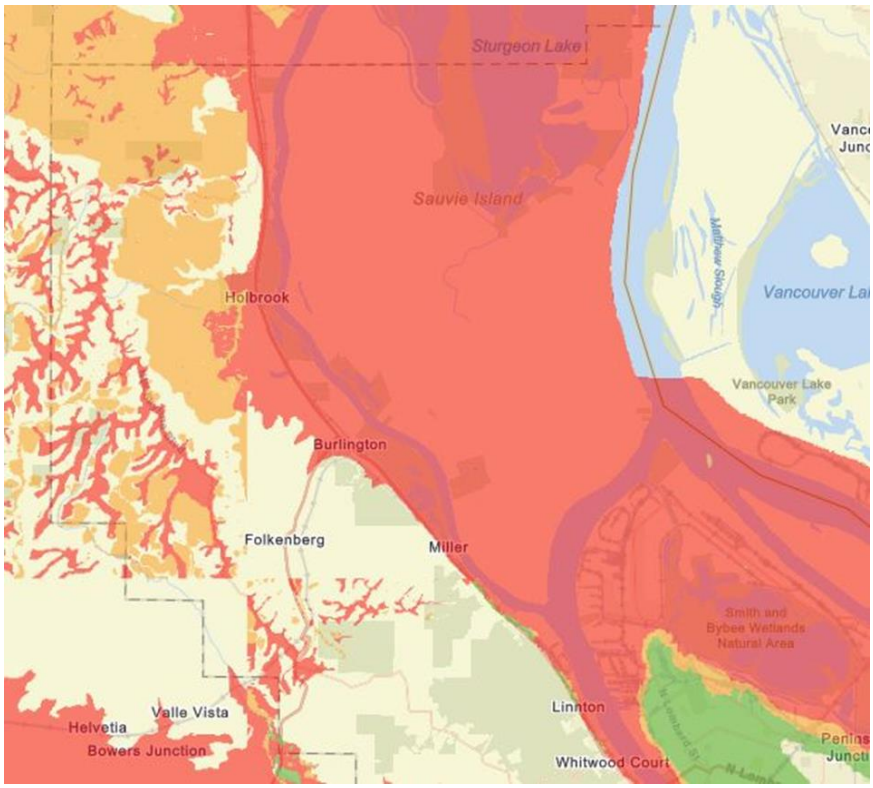


Figure 162 - Map showing soil liquefaction risk in the Western portion of Multnomah County. Red is the highest risk area, orange is moderate, and green has a lower risk. Map from DOGAMI's HazVu site.

The Critical Energy Infrastructure (CEI) Hub in Northwest Portland near Linnton is also a major concern, as major damage to the facility would likely send a huge amount of liquid fuel downriver, create a toxic plume, and render Highway 30 impassable. The entirety of the facility is also located in a high-risk soil liquefaction area.

Much of the eastern side of the county has less risk from Cascadia Subduction or Portland Fault events. Generally, the eastern portion of the county has much less soil prone to liquefaction but areas with wet soils along the Columbia and Sandy Rivers would still see elevated shaking and liquefaction potential. The Sandy River Delta is the most earthquake-prone area and has been a frequent camping site for unsheltered residents and is a popular recreation area.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)

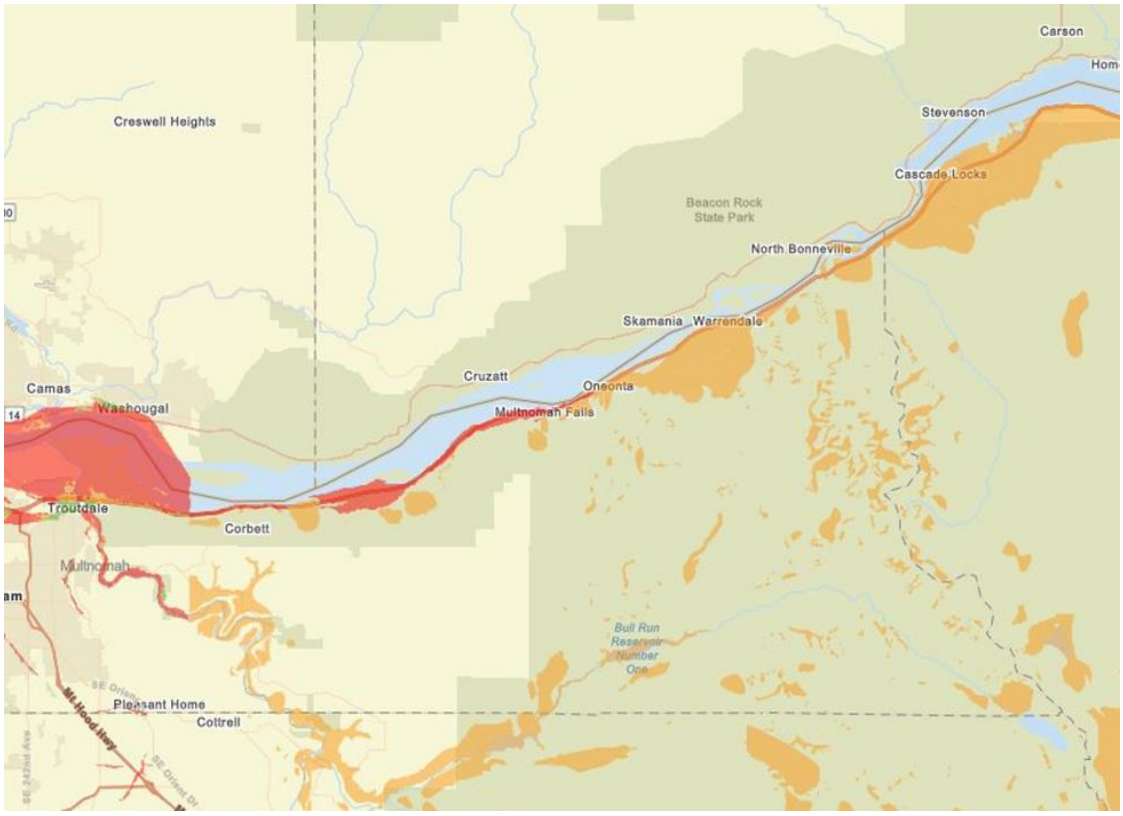


Figure 163 - Map showing soil liquefaction risk in the Eastern portion of Multnomah County. Red is the highest risk area, orange is moderate, and green has a lower risk. Map from DOGAMI's HazVu site.

More damage may occur in eastern Multnomah County from a large earthquake on the Mount Hood fault. An earthquake at that location would have stronger shaking and could trigger additional landslides that could threaten communities and block emergency routes, including Interstate Highway 84. A Mount Hood earthquake is considered to be less likely than a Cascadia Subduction Zone event.

There are additional small faults identified in eastern Multnomah County, but these faults are not part of the National Seismic Hazard Model and are not currently considered to be of significant risk.

An interactive version of this map can be found here (Earthquake Hazard – Active Faults)

Figure 164 - Map showing mapped crustal faults in Eastern Multnomah County. Map from DOGAMI HazVu site.

The urban pocket areas also face significant risk from soil liquefaction. The Interlachen neighborhood is located on wet soils between lakes, and is subject to heavy shaking as well as road and foundation damage from lateral spreading.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)

Figure 165 - Map showing soil liquefaction potential in the Interlachen neighborhood. Red areas have the highest soil liquefaction potential, orange areas have moderate risk, and green areas have lower risk. Map from DOGAMI HazVu site.

The Pleasant Valley area has less potential for shaking during a Cascadia event, but also lies on wet soils in one of the largest liquefaction areas in the southern portion of the county.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)

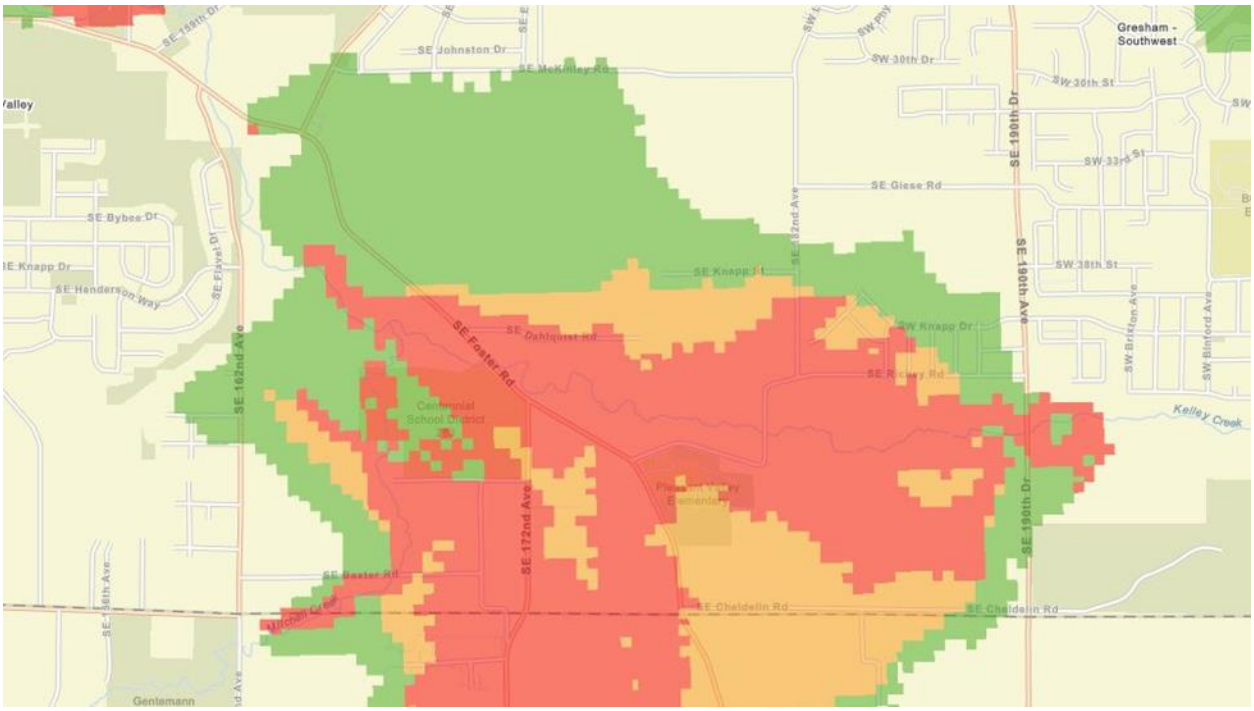


Figure 166 - Map showing soil liquefaction potential in the Pleasant Valley neighborhood. Red areas have the highest soil liquefaction potential, orange areas have moderate risk, and green areas have lower risk. Map from DOGAMI HazVu site.

Bridges

Multnomah County operated bridges are highly vulnerable to earthquake damage. The banks along both sides of the Willamette River are highly subject to heavy shaking and liquefaction, and remaining unreinforced bridges are likely to see damage to both approaches and spans.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)

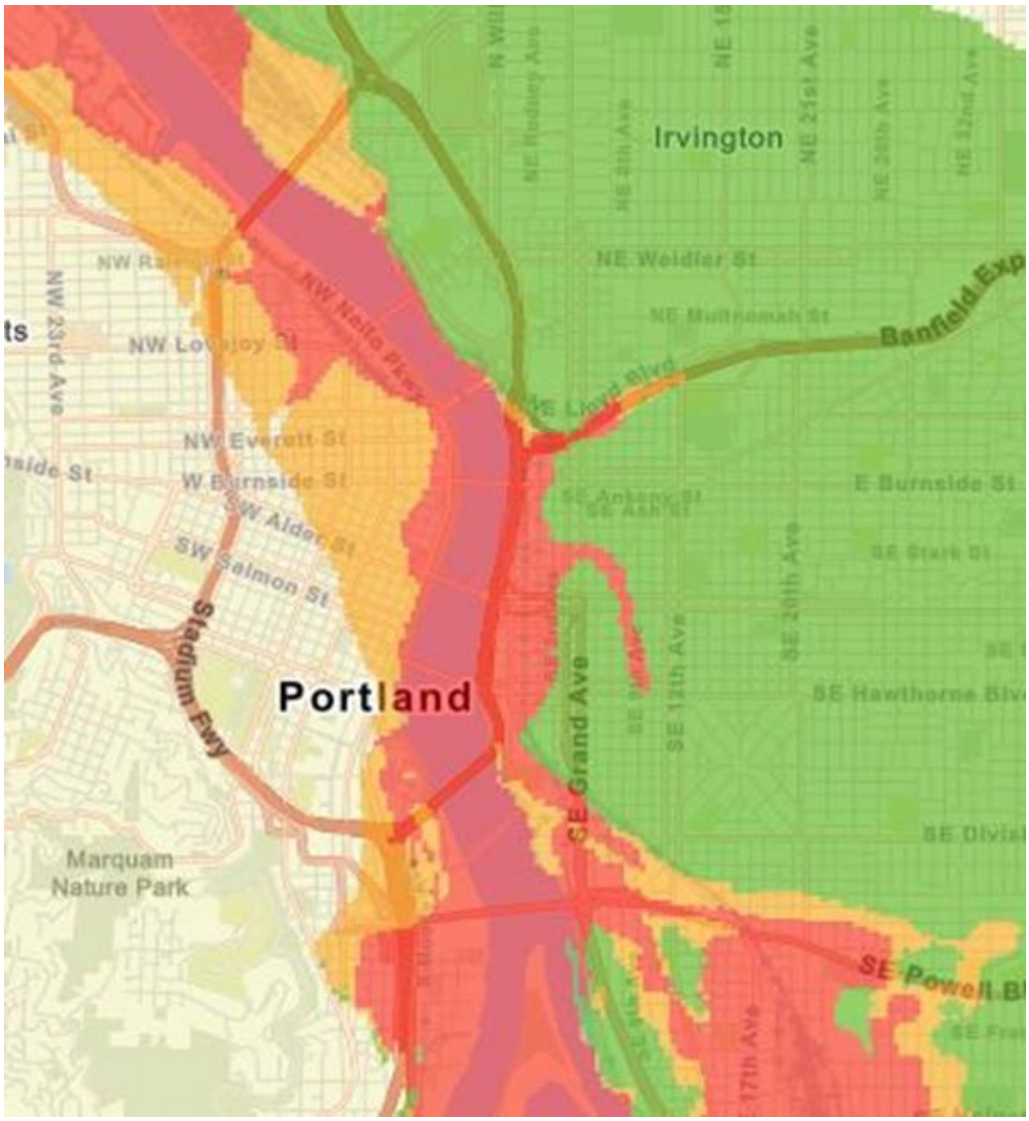


Figure 167 - Map showing soil liquefaction threat at bridge sites across the Willamette River operated by Multnomah County. Red are areas with the highest risk, yellow is moderate risk, and green is lower risk. Map from DOGAMI HazVu site.

Bridges across the Sandy River are also threatened by soil liquefaction and shaking from earthquakes. The Stark Street Bridge is operated by Multnomah County and has high soil liquefaction threat on both sides of the span.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)

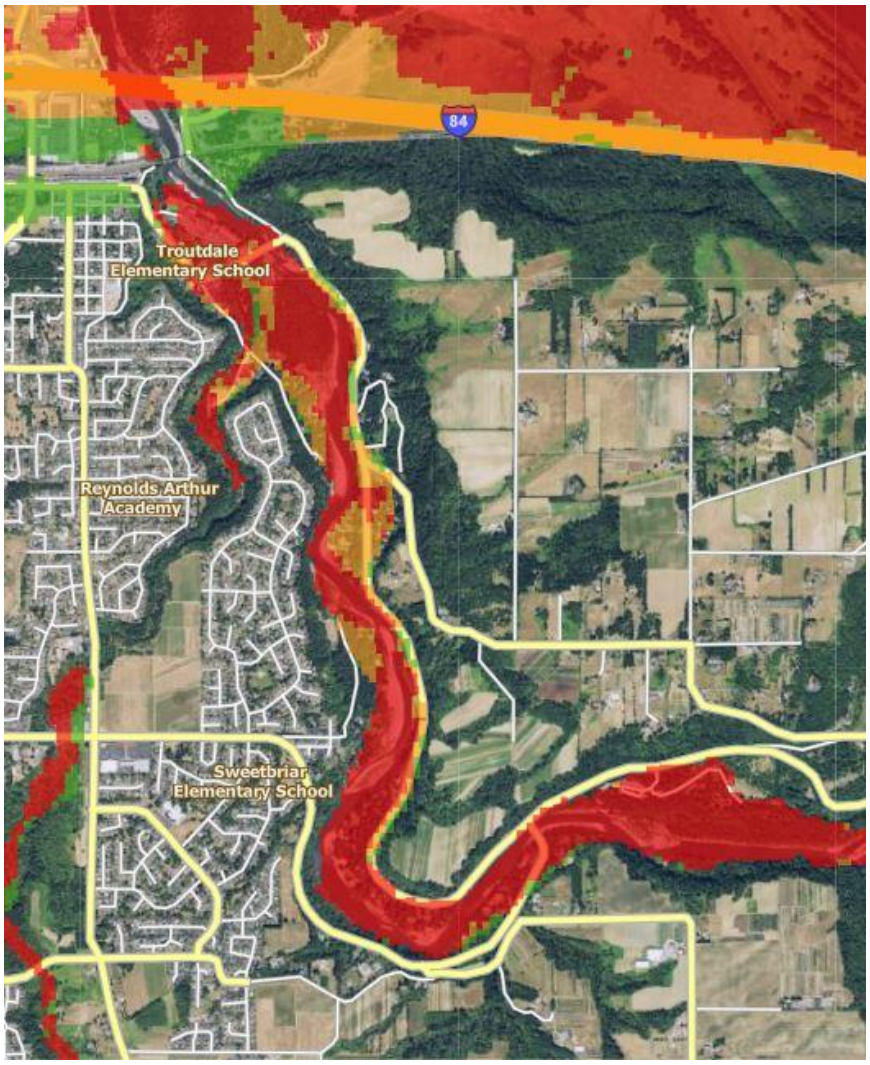


Figure 168 - Map showing soil liquefaction risks around Sandy River bridges. Red indicates high soil iquefaction risk, orange is moderate risk, and green are lower risk. Map from DOGAMI HazVu site.

Flood – Risk Rating Moderate

See Flood Section for more detailed risk and vulnerability information.

Flood is considered a moderate risk for Multnomah County. As with other hazards, a major countywide flooding event would require significant resources for evacuation, sheltering, and care for the most at-risk residents of the county who might be cut off from power, services, and caregiver support. However, flood risk to people and structures in unincorporated portions of the county is somewhat limited, in part due to the low population density, levee protection, and flood sources being channelized because of steep topography.

The largest area of risk is Sauvie Island, due to its flat topography and location between channels of the Columbia River. The levee system provides protection to a 0.2% annual chance (500-year) flood to most of the populated lower portion of the island. There are a few locations with 1% annual chance (100-year) mapped regulatory floodplain at Bell View Point and around Virginia Lake. The recent recertification of the levees is expected to maintain the current status for the most part, but revised mapping with improved ground-elevation data will slightly alter flood risk zones and will provide more detail of interior ponding areas inside the levees. The new maps are expected to be completed in 2023.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

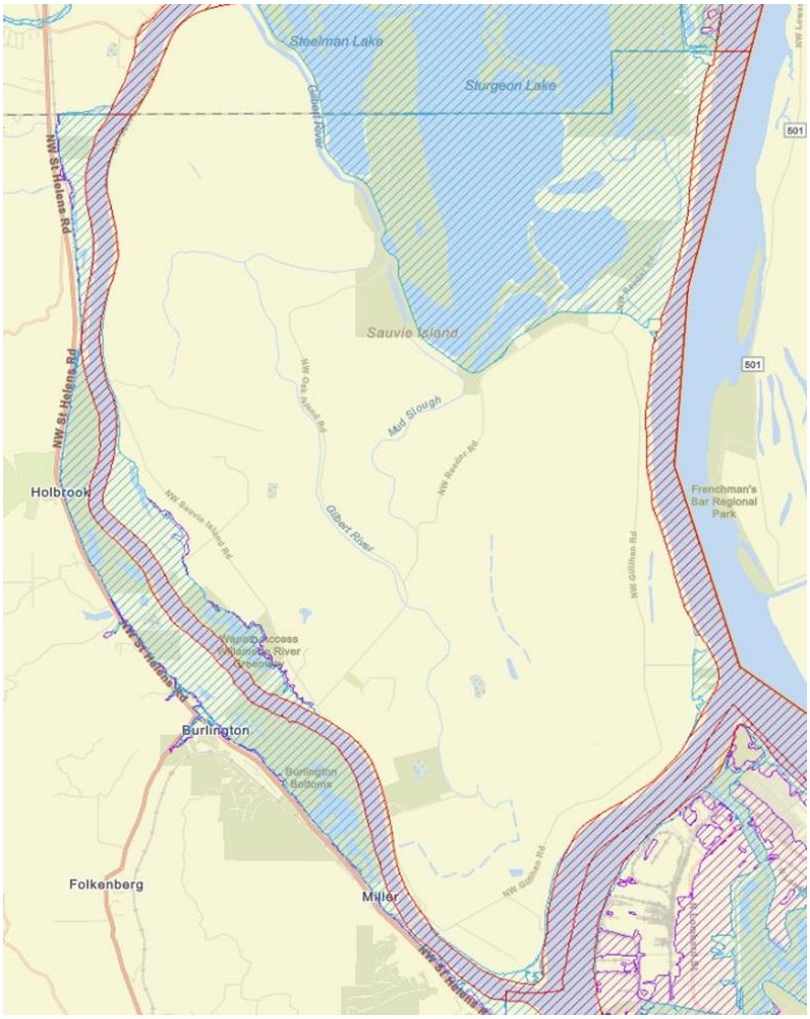


Figure 169 - Map showing mapped flood risk areas in and around Sauvie Island. Areas in blue are in the 1% annual chance (100-year) and those in purple are in the 0.2% annual chance (500-year) floodplain. Map from DOGAMI's HazVu site.

Areas between Highway 30 and the Multnomah Channel from Burlington north to the county boundary have flood risk, but development in these areas is limited to marina parking and facilities, with the majority of the area reserved as open space.

There are no currently mapped floodplains in the unincorporated portions of the West Hills/Tualatin Mountains, although fast-moving stormwater in creeks can exceed banks during heavy rain events. However, there is little development in these areas. Land movement and debris flows during flooding rains are a concern.

Flood risk zones in the eastern unincorporated portion of the county are most significant along Beaver Creek, Johnson Creek, and the Sandy River. These areas are primarily approximate studies, meaning they lack the detail of mapping in more urbanized areas, reflecting low mapping priority because of low population density.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

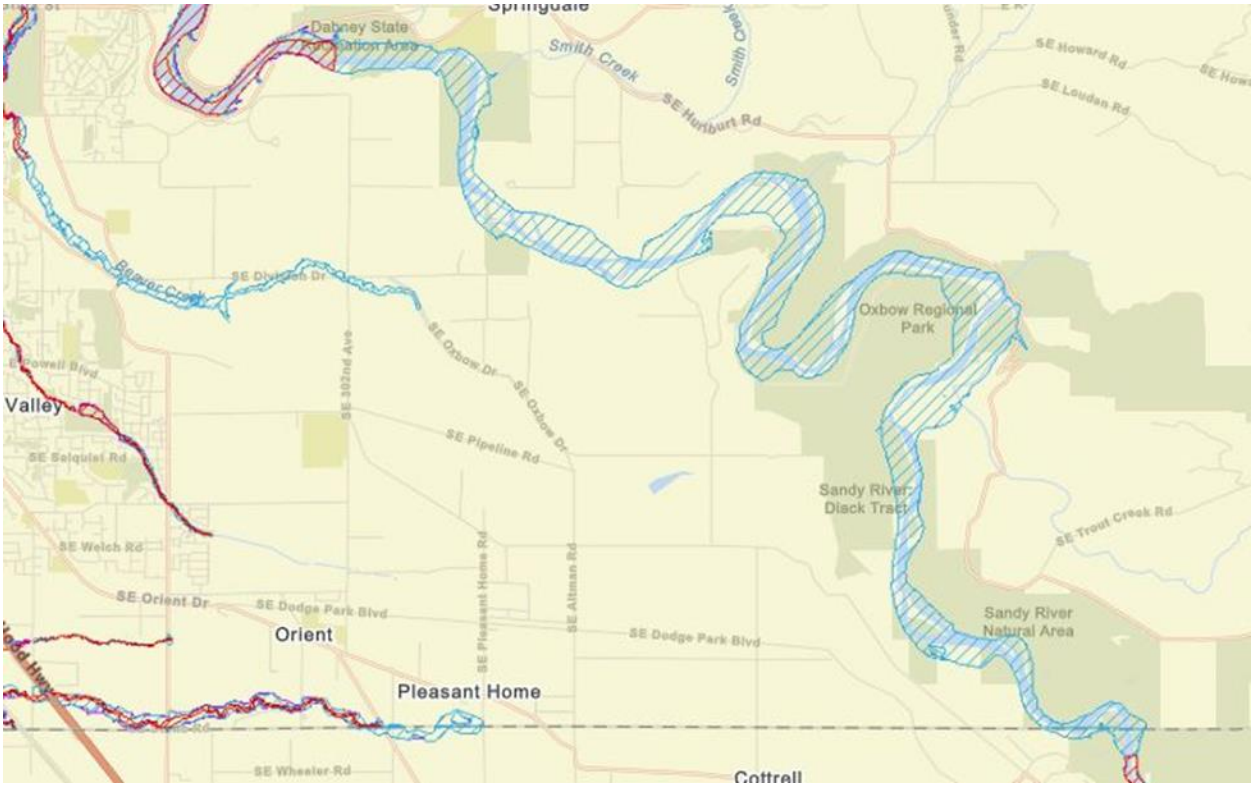


Figure 170 - Map showing flood risk areas along the Sandy River in Unincorporated Multnomah County. Areas in blue are part of the 1% annual chance (100-year) floodplain and areas in purple are part of the 0.2% (500-year) floodplain. Floodways are shown in red. Map from DOGAMI HazVu site.

The Columbia River through the Gorge has mapped regulatory floodplain, but at elevations below developed areas. Interstate Highway 84 has only one location, at Bridal Veil Creek, where it would be expected to be inundated by the regulatory level of flood. Land movement and debris flows during heavy rain events are the most significant risk in this part of the county.

[An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)]

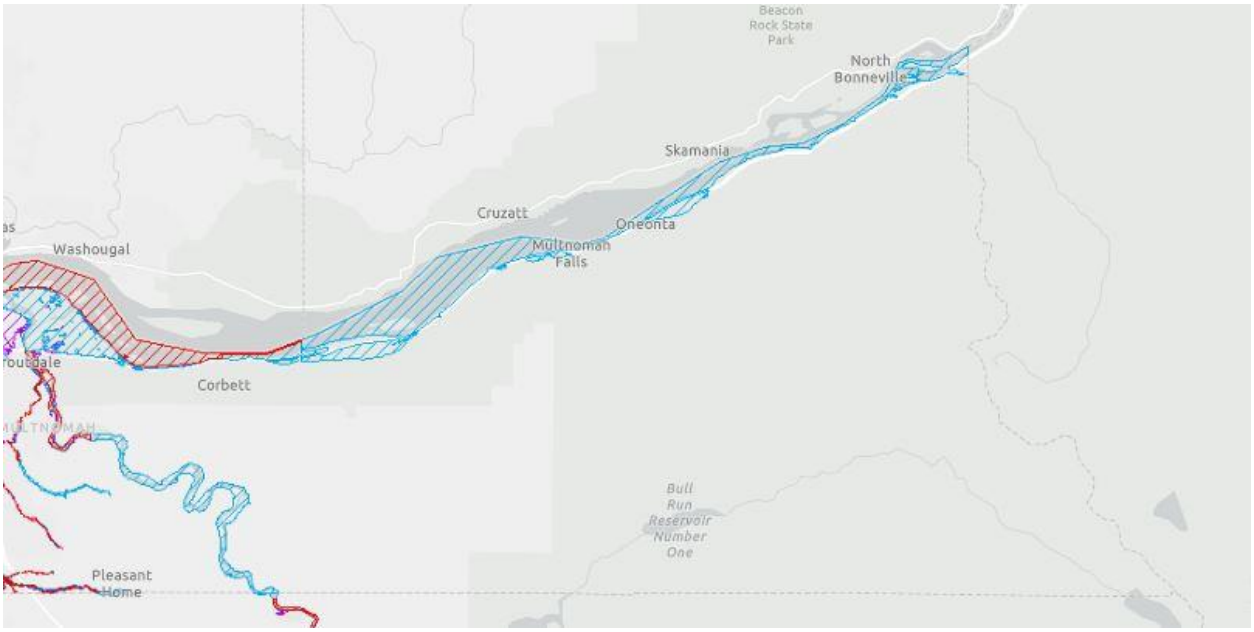


Figure 171 - Map showing flood risk areas in eastern Unincorporated Multnomah County. Areas in blue are part of the 1% annual chance (100-year) floodplain and areas in purple are part of the 0.2% (500-year) floodplain. Floodways are shown in red. Map from DOGAMI HazVu site.

Pleasant Valley has some flood risk from a confluence of creeks and tributaries, with a small number of structures potentially threatened by a major event.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

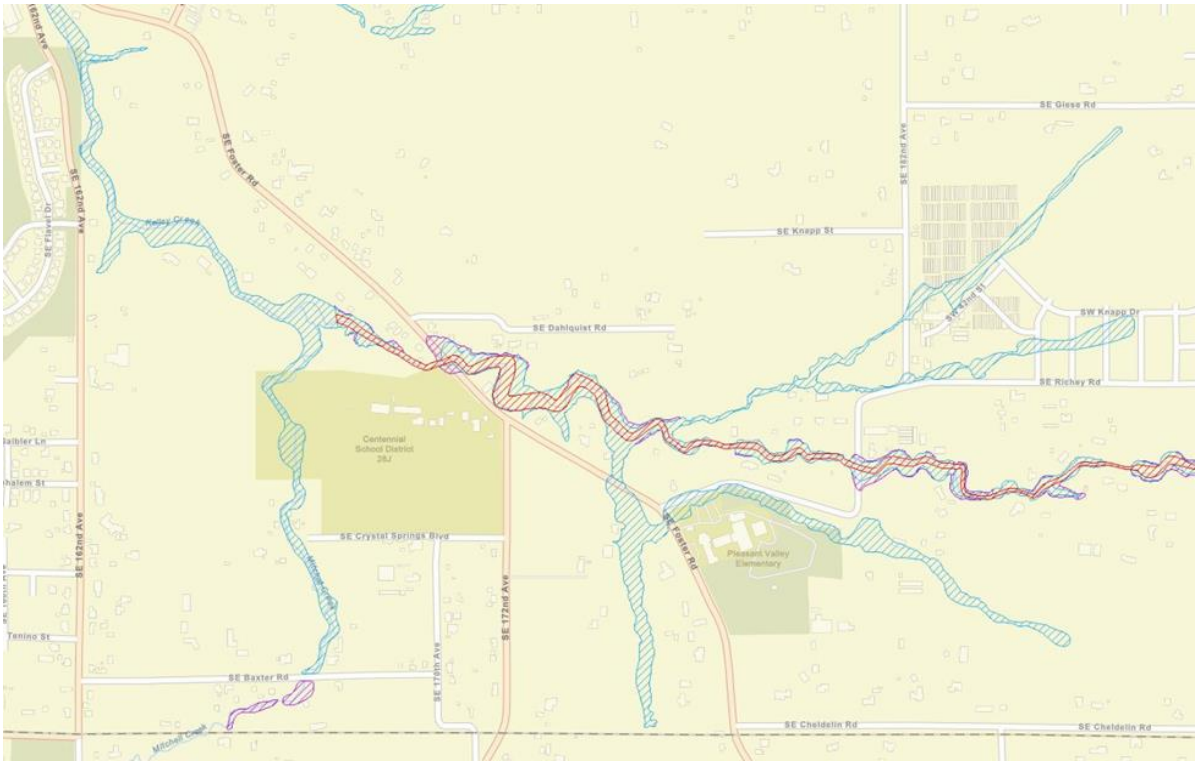


Figure 172 - Map showing flood risk areas along in the Pleasant Valley area of Unincorporated Multnomah County. Areas in blue are part of the 1% annual chance (100-year) floodplain and areas in purple are part of the 0.2% (500-year) floodplain. Map from DOGAMI HazVu site.

The Interlachen community is on a ridge above the adjacent lakes and is not part of the regulatory floodplain. The purple hatching represents risk from a larger event, the 0.2% annual chance (500-year) flood. A catastrophic flood of this size is shown to completely inundate the community as well as all transportation routes in and out of the neighborhood. Because the risk from the 0.2% chance event is not regulated under the NFIP, residents may be less likely to have flood insurance.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

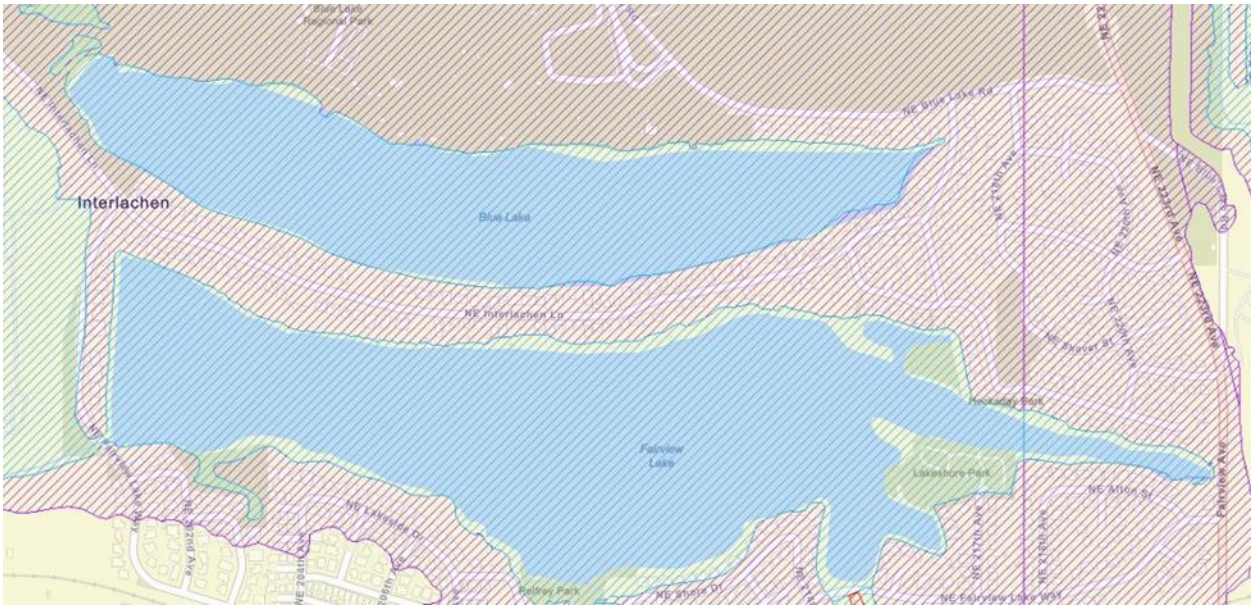


Figure 173 - Map showing flood risk areas along in the Pleasant Valley area of Unincorporated Multnomah County. Areas in blue are part of the 1% annual chance (100-year) floodplain and areas in purple are part of the 0.2% (500-year) floodplain. Map from DOGAMI HazVu site.

Stormwater management undertaken by the county is more limited than in cities, because of the lower density of development in unincorporated areas. Areas around county-owned roads and bridges are primary areas of concern, to prevent stormwater from washing out roads or culverts and impacting water quality to nearby surface waters. The unincorporated urban pocket areas are also subject to county stormwater permitting

NFIP Data

Multnomah County participates in the National Flood Insurance Program (NFIP), which allows residents in unincorporated areas to purchase flood insurance. The county maintains a Flood Hazard Overlay in its Zoning Code, to apply development requirements as part of its NFIP participation. NFIP program requirements are currently administered by Multnomah County Land Use, including the application of regulating substantially damaged or substantially improved structures, as defined in Section §39.5005 of the Flood Hazard Overlay. Substantial damage and substantial improvement determinations are made in coordination with the County's Department of Assessment, Recording and Taxation (DART).

As of April 27, 2022, there are 110 Federal flood insurance policies held in the unincorporated county. Since Multnomah County joined the program in 1982, there have been 78 NFIP claims, totaling $1,086,652.16 in losses paid.

Most Flood Insurance Rate Maps in unincorporated Multnomah County were published in 2009, except those in the Lower Columbia-Sandy Watershed along the Sandy River, which were updated in 2019.

There is one repetitive loss structure in Unincorporated Multnomah County, in the Dunthorpe neighborhood in the southwest portion of the county near the Clackamas County line. There are no severe repetitive loss structures.

Channel Migration

The movement of streams due to bank cutting and new channel formation during flood events is specifically mentioned as a flood concern in the Multnomah County Comprehensive Plan that could be addressed in the future through development overlay.

Channel migration creates a risk to existing development from foundation undercutting as the bank erodes and moves a river closer and closer to homes or other structures. The altered channels can also create new flooding risk in areas and put structures at risk that were not built under flood mitigation building standards.

The Sandy River is extremely prone to channel migration because of the soft volcanic silt of the banks. The upland areas of the river in unincorporated Multnomah County have wide areas that could be cut. Although development is fairly limited, there are a number of homes near Oxbow Park that could be at risk, depending on how the river moves in the future.

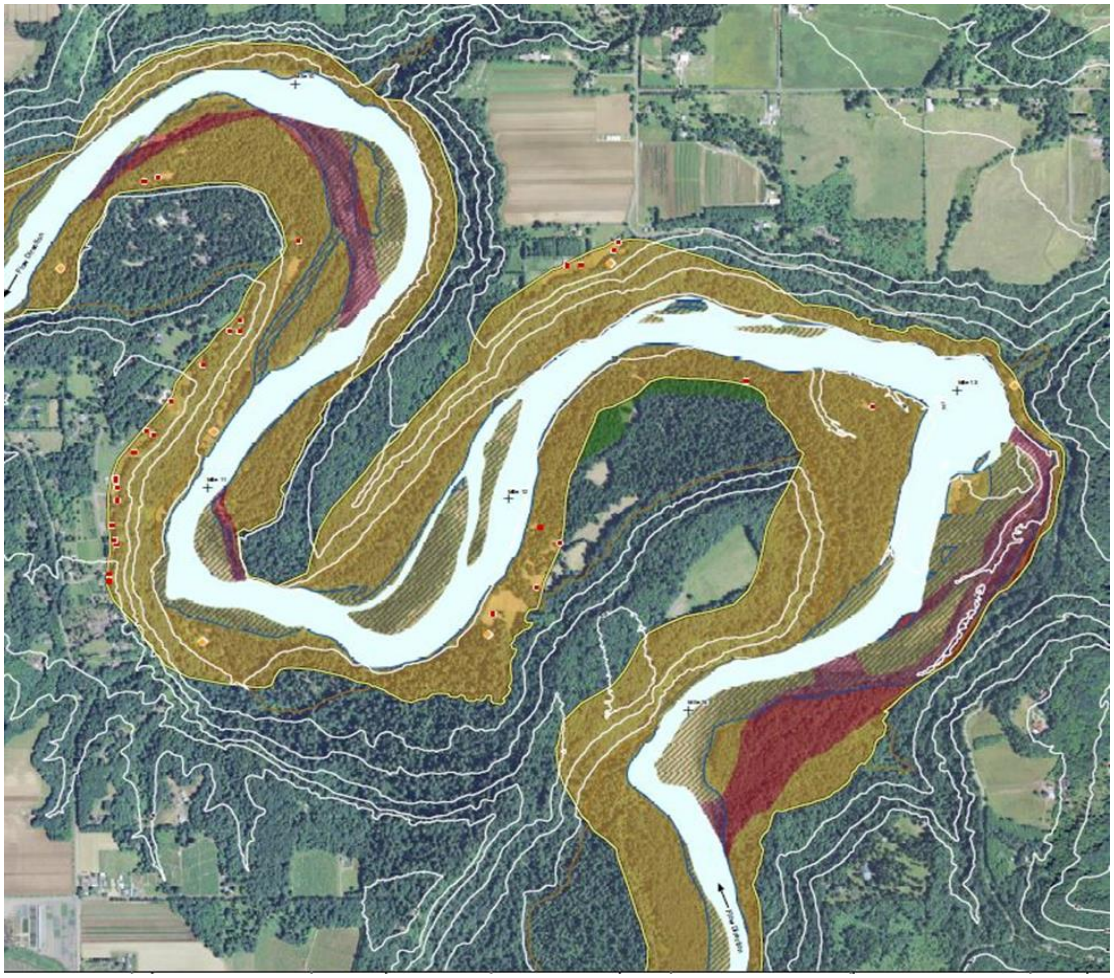


Figure 174 - Map showing channel migration potential on the upper portion of the Sandy River in Unincorporated Multnomah County. The yellow areas have risk from bank erosion in the next 100 years, the red areas have risk from the formation of a new river channel, the blue shaded areas are previous locations of the river channel at some point between 1955-2019, and the green areas are where built structures have eliminated risk of channel migration. The small red squares are the location of structures. Map from DOGAMI report O-13-10

Landslide – Risk Rating

See Flood Section for more detailed risk and vulnerability information.

Landslide has been elevated from low risk to moderate risk in this update for Multnomah County. This change is in part due to observed events, the increased likelihood of future landslides caused by climate-driven winter precipitation events, and improved landslide mapping showing the scope of historical deep landslides in the western and eastern reaches of the county.

The Columbia River Gorge is a particularly dangerous area for landslides and debris flows and was the site of significant land movement during the 1996 flood and a fatal landslide in 2021.

DOGAMI published an inventory of historical events using LIDAR data to visualize ground composition that shows past landslide deposits. This data shows the scale of the risk in the

Gorge. The Warrendale/Dodson area has massive areas of soil and rock deposits and alluvial fans (areas where landslide material has spread out at the confluence of a river). Landslide deposits are also widespread in the Gorge, especially to the east of Corbett and areas just east of the Sandy River. Previous landslides have covered numerous areas through which Highway 84 now passes, showing the vulnerability of the highway as an evacuation route during earthquake or flooding events. The Bull Run Watershed also has a number of deep landslide risk areas that could threaten reservoirs with sedimentation.

An interactive version of this map can be found here (Landslide Hazard – Deposits)

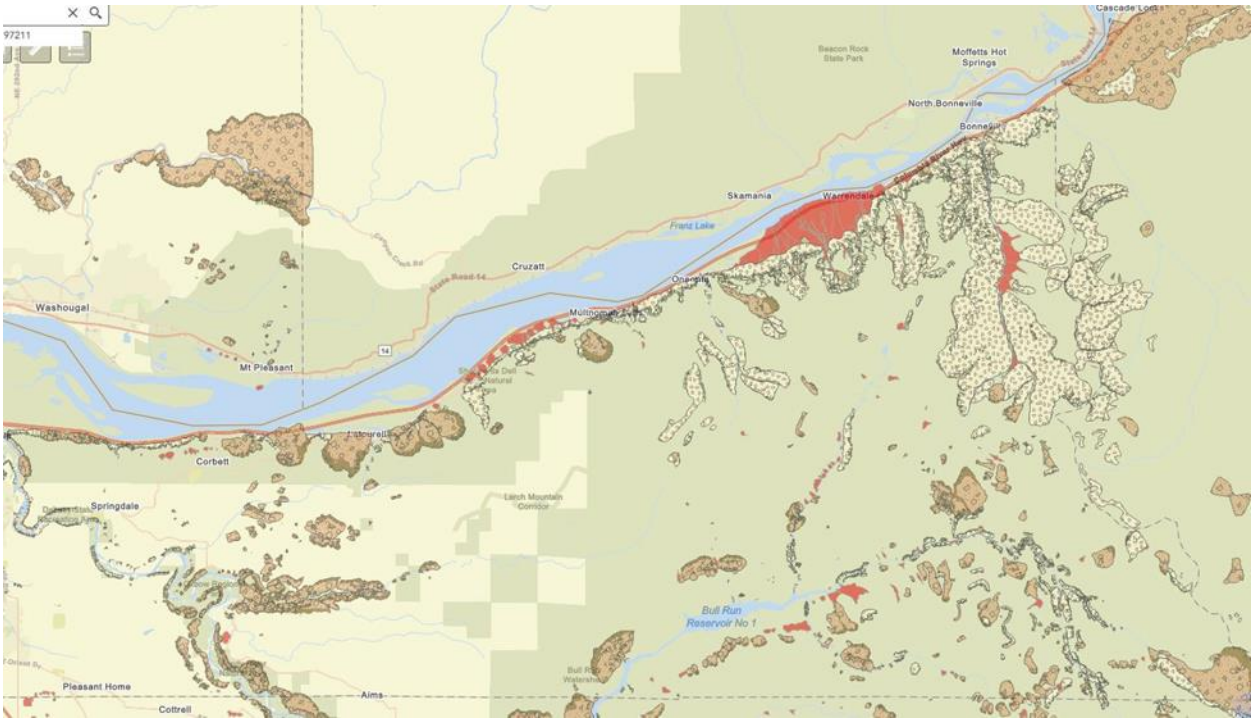


Figure 175 - Map showing historic landslide deposits in eastern Multnomah County. These areas have greater risk of future deep landslides. Brown areas are landslide deposits, light colored areas are locations of historic rock deposits, and red are historic alluvial fans. Map from DOGAMI SLIDO site.

A vulnerability analysis that shows the percentage of structures in landslide risk areas and the amount of expected damage from landslides has not been performed for locations east of the Sandy River. Most of the historic deposits are in unpopulated areas, but some developed areas in Corbett are at risk as are the small eastern gorge communities of Latourell, Warrendale and Dodson.

The west side of the county is also highly susceptible to landslides and has very large areas with historical slide deposits, especially in the northwesternmost part of the county. Residential and commercial development is sparse in many of these areas, but population and infrastructure are at risk. Extensive landslides during a flood or earthquake event could block Highway 30 and important roads connecting through the West Hills such as NW Skyline Boulevard, NW Cornelius Pass Road, NW Logie Trail Road and NW Rocky Point Road.

An interactive version of this map can be found here (Landslide Hazard – Deposits)

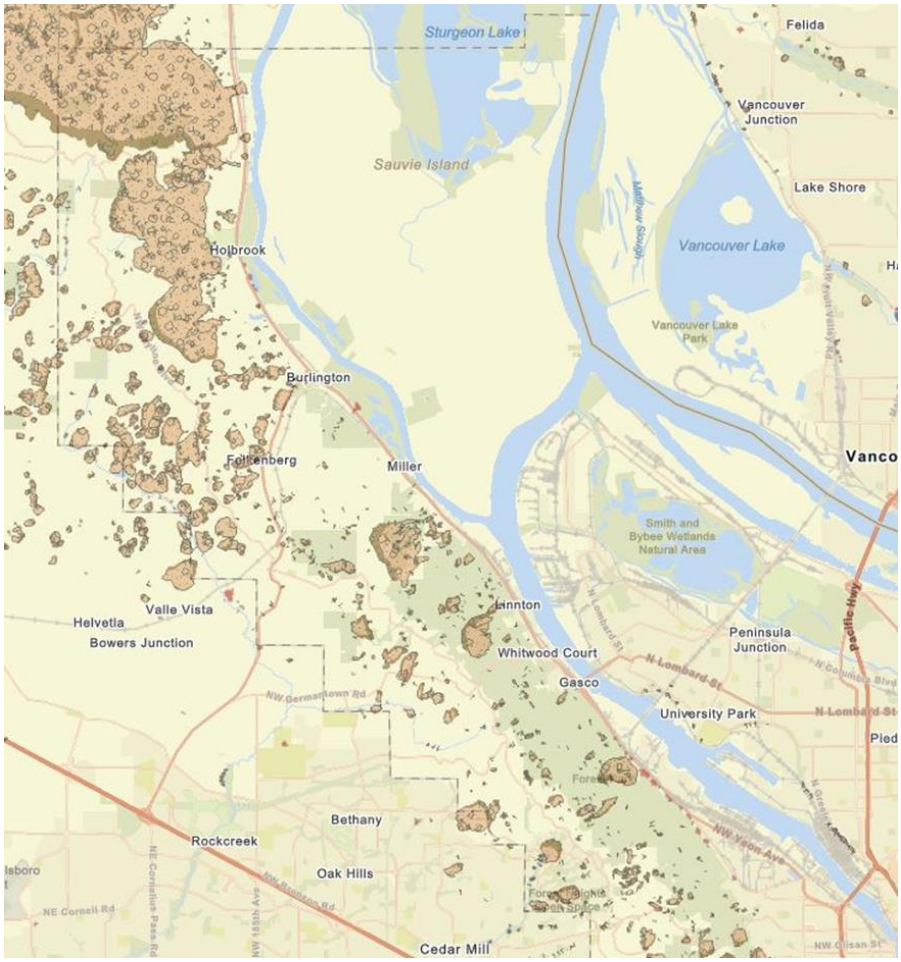


Figure 176 - Map showing historic landslide deposits in eastern Multnomah County. These areas have greater risk of future deep landslides. Map from DOGAMI SLIDO site.

These risks are only for the more dangerous deep landslides. More frequent, shallow landslides are a risk through the entire west and east county areas at high elevation. Shallow landslides are seen nearly every year during winter rains, creating short and medium term impacts to roads and infrastructure. The areas of highest risk shown in the below map match those with deep landslide susceptibility, but the areas in orange show additional risk areas without historical landslide deposits but with particularly steep slopes and loose soils.

An interactive version of this map can be found here (Landslide Susceptibility – Susceptability to Shallow Landslides)

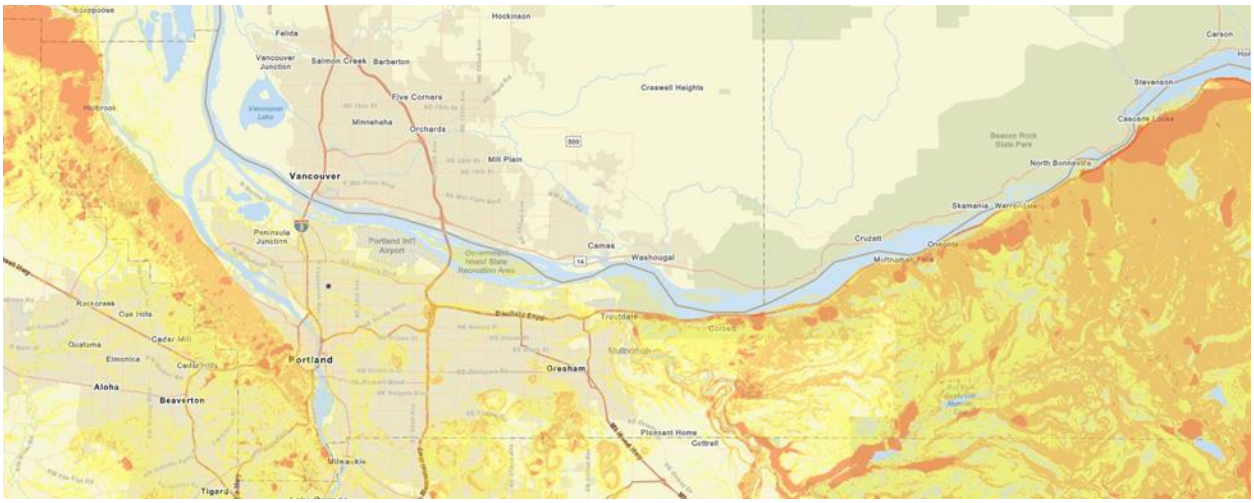


Figure 177 - Map showing landslide risk across Multnomah County. Red has the highest risk, orange is moderate risk and yellow areas have lower risk. Map from DOGAMI SLIDO site.

Sauvie Island, Interlachen, and unincorporated Pleasant Valley are all largely flat and low-lying and have only minor, shallow landslide risk.

Multnomah County has a Hillside Development overlay zone creating requirements for assessing risk on slopes with a greater than 25% grade. Development on slopes with grades between 10%-25% are reviewed via Grading and Erosion Control code to determine if more study is needed. The Hillside Development overlay is being considered for update with the release of the updated DOGAMI risk maps in 2017.

Severe Weather – Risk Rating High

See Severe Weather Section for more detailed risk and vulnerability information.

The four types of Severe Weather described in this plan have been kept together into a single risk rating to emphasize that all climate-based hazards being affected by climate change are a high priority for county mitigation work. Risks described below focus on unincorporated areas, but mitigating public health risks for all county residents is a key function of Multnomah County government. Extreme heat and winter storms have made up the majority of Multnomah County responses and the largest loss of life among natural hazard events over the last five years.

Locations within cities are the most likely to have urban heat island effects and residents living on upper floors of buildings without air conditioning. Both of these factors were implicated in the location of deaths during the 2021 Heat Dome event, and the in-home distribution of air conditioners to those most at risk is a priority for pre-event mitigation. Building the resilience of emergency shelters, residential care facilities, and child care facilities to extreme weather, smoke, and power loss events is also a priority.

Urban heat island effects are shown below. Apart from large industrial sites, the areas most susceptible to heat island effects are on Portland's west side, East Portland and Gresham, all with lower levels of tree canopy and high proportions of pavement. These areas coincide with higher poverty rates, increased health risks, and barriers to accessing governmental services.

Because most unincorporated areas are low density, they are generally not subject to urban heat island effects. However older adults, children, and disabled populations still face elevated risks from extreme heat, as do those working outdoors in farming, forestry, construction, and other jobs.

An interactive version of this map can be found here

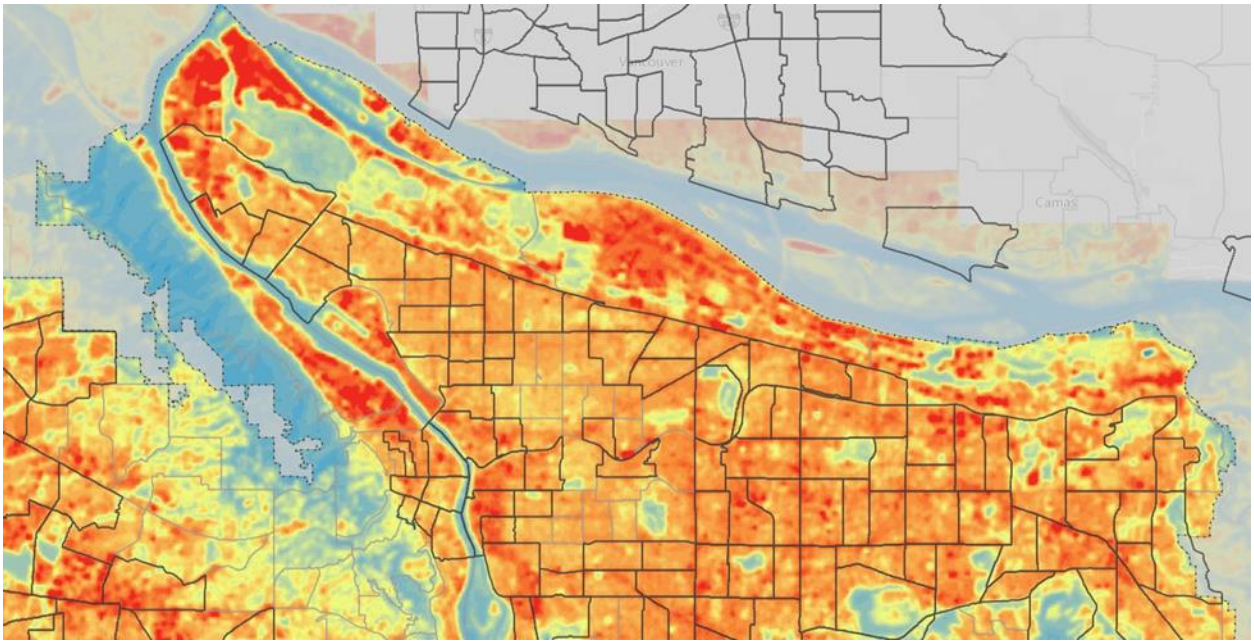


Figure 178 - Map showing urban heat island effects in locations inside Metro planning boundaries. Areas in red have the most intense heat island effects, with orange areas having moderate effects, yellow having lower effects, and blue areas having no effects.

Winter storms have been especially deadly for unhoused residents living without shelter. Although unsheltered residents are located throughout the county, the majority of those identified in the 2019 Point-In-Time count were located in the City of Portland, with the highest proportions in Southeast Portland (22.1%) and Downtown Portland (21%). Warming spaces and shelters and the distribution of winter gear and safety kits have been prioritized as life-saving interventions.

Unincorporated areas of the county face differing risks from severe weather hazards. High elevation areas on both sides of the county see much more snow, ice, and colder temperatures than at low elevations, and are therefore more likely to have disruptions to power and roads. Winter storms are especially precarious in the Columbia River Gorge, where gorge wind effects can lower temperatures and blow snow, making visibility difficult. Highway 84 was closed numerous times in the last five years because of winter conditions, most significantly in 2017.

Power loss from severe weather events or for fire prevention create risk for many of the same populations as the weather itself. Lengthy outages can be harmful to those who use powered medical devices or need refrigerated medicine. Multnomah County Health and Human Services has worked to identify clients at highest risk from outages to develop pre-event communication and response interventions.

Drought has not been a significant problem in Multnomah County, even during a historic statewide dry period. Most water comes from providers or wells that use groundwater that can recharge during rains and do not require snowpack to maintain flows in the summer. However, Corbett Water District does use surface water for their customers, and may have higher sensitivity to winter precipitation changes. Drought is a primary driver of Multnomah County's wildfire risk, and has causing impacts to local ecosystems and natural resources.

Volcano – Risk Rating Low

See Volcano Section for more detailed risk and vulnerability information.

Unincorporated areas along the Sandy River will see lahar impacts if Mount Hood erupts again in the future. Residential upriver areas are most at risk, although much of this area are undeveloped locations at Indian John Island, Oxbow Park, and Dabney State Park. Parts of the Parkdale community are at moderate risk from lahar damage, as are some homes at SE Hosner Terrace near Oxbow Park. These upriver areas would see lahars arrive sooner than any other populated area in Multnomah County, but an eruption large enough to threaten these areas is very unlikely. Because of the very low probability of this event, risk continues to be considered low.

An interactive version of this map can be found here (Volcano Hazard – Moderate Hazard Zone)

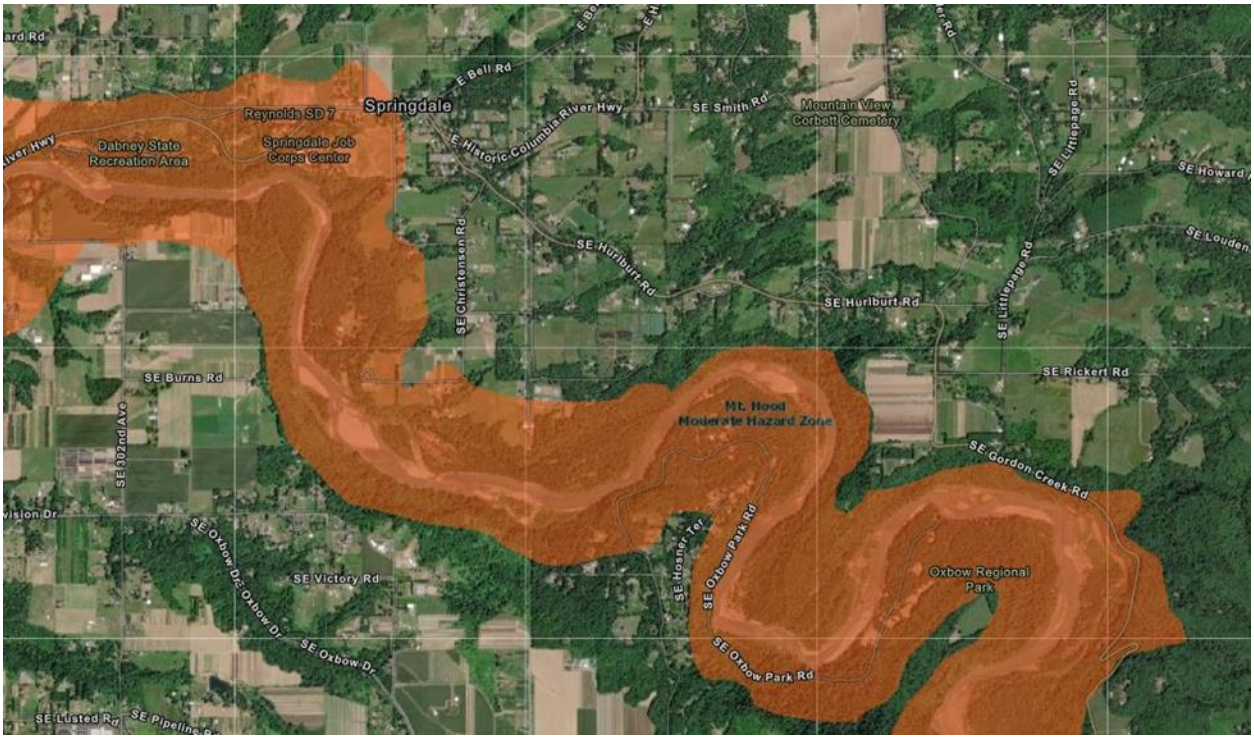


Figure 179 - Map showing potential lahar impacts from an extra-large eruption of Mount Hood. The orange areas would be inundated by debris in this volcano scenario. Map from DOGAMI HazVu site.

A major eruption at Mount Hood, Mount Saint Helens, or other regional volcanoes could bring significant ash into Multnomah County, depending on winds. An ash event would require a public health response to respond to risk to those with respiratory illnesses or other existing risk factors similar to wildfire smoke risk.

Wildfire and Wildfire Smoke – Risk Rating High

See Wildfire and Wildfire Smoke Section for more detailed risk and vulnerability information.

The impacts from wildfire and wildfire smoke events over the last five years have highlighted the risk to Multnomah County from both types of event. Risk has been combined into a single high rating.

The 2020 Wildfire Smoke event was unprecedented and impacted the entire county, requiring a public health response with similarities to those for extreme heat and winter storms. Clean air spaces, the distribution of protective equipment, and safety messaging were used to respond to the disaster. Impacts may be particularly severe for residents of the county living in areas that already have poor air quality, and where health effects may become compounded.

An interactive version of this map can be found here (Wildfire Potenial Impacts – Overall Potential Impacts)

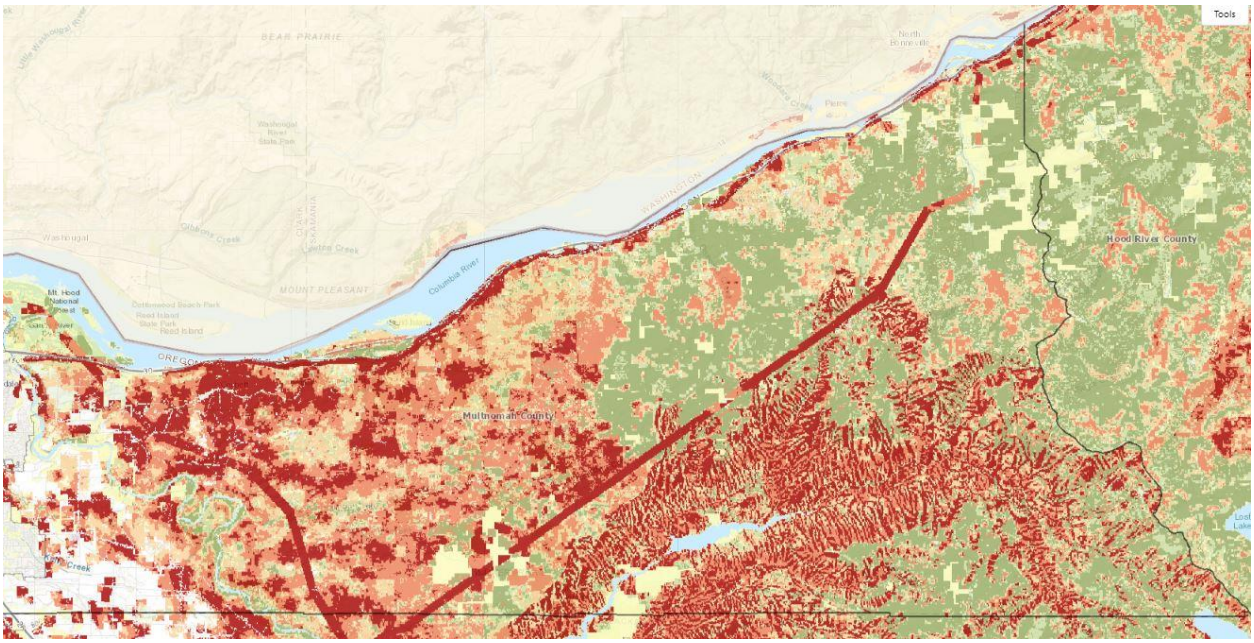


Figure 180 – Potential wildfire impact across eastern Multnomah County. Areas in red would see very high impacts to structures, infrastructure, or natural resources. Areas in orange would see moderate impacts and yellow and would have low impacts. Areas of green would have limited impacts and could see ecosystem benefits from fire. Map from the Oregon Wildfire Explorer with data from the PNW-QWRA.

Risk of large wildfires is much higher in unincorporated areas in Multnomah County than in the cities participating in this plan. The eastern side of the county has the highest annual risk of fire, especially in the southeastern corner. This area is part of the Mount Hood National Forest, so immediate threat to life, property, and infrastructure is reduced by the lack of development, but concern of a fire starting there and spreading to populated areas or the Bull Run Watershed is high. Throughout the gorge and all the way to the Sandy River, communities face some of the highest county risk of annual wildfire.

The west side of the county has a lower likelihood of seeing fire each year, but is more developed and has more people and structures at risk. Risk is spread fairly evenly across the West Hills/Tualatin Mountains, and could also be a danger for spreading fire into more populated areas along the edge of the park. Sauvie Island has more limited risk of an agricultural or forest fire, but the high number of day visitors during high-hazard periods is a concern for notification and evacuation.

An interactive version of this map can be found here (Wildfire Potential Impacts – Overall Potential Impacts)

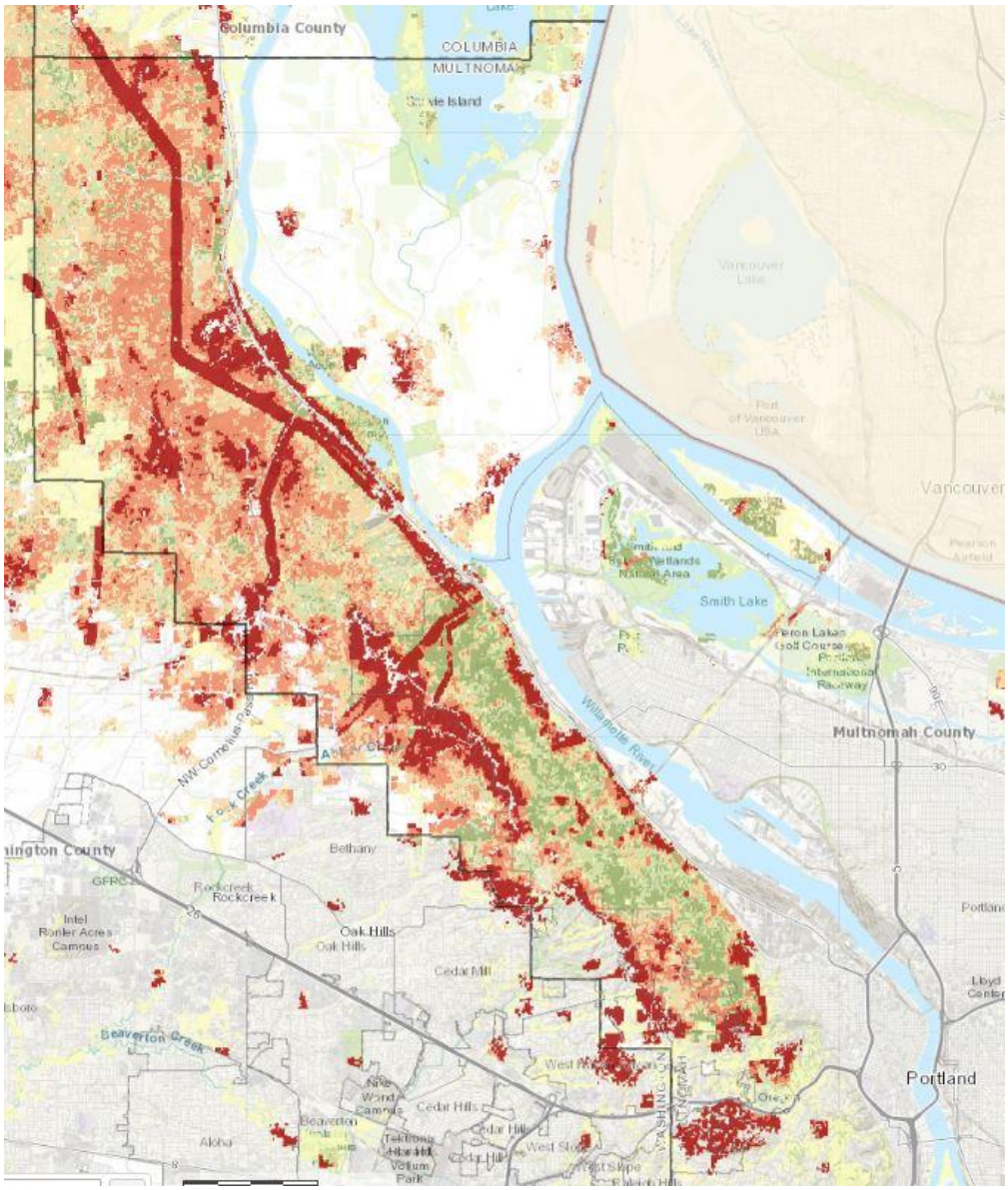


Figure 181 - Potential wildfire impact across western Multnomah County. Areas in red would see very high impacts to structures, infrastructure, or natural resources. Areas in orange would see moderate impacts and yellow and would have low impacts. Areas of green would have limited impacts and could see ecosystem benefits from fire. Map from the Oregon Wildfire Explorer with data from the PNW-QWRA.

Risk from wildfire on both sides of the county is heightened when taking into account the limited number of evacuation routes, difficulty evacuating residents with mobility barriers, pets and livestock, as well as the greater difficulty in emergency alerting because of the mountainous topography. Both sides of the unincorporated county also have unsheltered residents and temporary recreational users who may be difficult to find and assist during a fire.

Statewide mapping shows that wildfire is not as likely in Multnomah County compared to many other parts of Oregon, but when conditions do become severe enough for a major fire, damage

and loss may be severe. When major fire occurs it will likely be at the same time as extreme drought and high winds, making future fires difficult to control, and expanding risk to a large number of Wildfire Urban Interface areas. The long return interval between fires, the wet growing environment, and climate-driven changes to forest ecology mean that wildfire fuels will continue to expand and change–making fuel mitigation a long-term and complex effort.
To manage wildfire risk for future catastrophic fires, mitigation strategies have included improving emergency alerting systems and evacuation planning. Implementing neighborhood-level mitigation and coordination is important, through creating defensible space around homes and building local capacity through localized community organizations. Revising development codes in coordination with Oregon Senate Bill 762 provisions is in process.

5.5.5 Hazard Risk Scoring

The identified levels of risk from each hazard were determined by the Multnomah County, using a scoring methodology designed by Oregon Emergency Management, and applied across the state to contextualize local risk perception.

Multnomah County Hazard Risk Analysis

Hazard	History (Weight Factor = 2)		Vulnerability				Probability (Weight Factor = 7)		Risk Score	Initial Risk Ranking
			Average (WF = 5)		Max (WF = 10)					
Earthquake	2 x	**10**	5 x	**10**	10 x	**10**	7 x	**8**	**226**	**High**
Flood	2 x	**7**	5 x	**6**	10 x	**6**	7 x	**8**	**160**	**Moderate**
Landslide	2 x	**3**	5 x	**7**	10 x	**7**	7 x	**10**	**181**	**Moderate**
Severe Weather – Extreme Heat, Winter Storm, Wind Storm, Drought	2 x	**10**	5 x	**10**	10 x	**10**	7 x	**10**	**240**	**High**
Volcano	2 x	**1**	5 x	**8**	10 x	**8**	7 x	**2**	**136**	**Low**
Wildfire and Wildfire Smoke	2 x	**8**	5 x	**8**	10 x	**8**	7 x	**10**	**206**	**High**

5.5.6 Multnomah County Aligned Plans and Other Implementation Processes

Overview

Multnomah County's plans and processes have some differences to the cities included in this plan, due to the types of services that specifically are provided or not provided by county government. The county does not have water or wastewater services, but does have roads and land-use responsibilities in unincorporated areas and the county's bridge operations are unique among this plan's partners. The county provides health and human services across the county, so planning and processes to limit health impacts from disasters are able to be leveraged for hazard mitigation coordination, especially for climate-related hazards. Multnomah County also plays a central role in the project management of countywide plans, such as the Recovery Plan and the Community Wildfire Protection Plan, and provides Emergency Management support for small cities – creating additional coordination points for developing broader scale, multi-jurisdictional mitigation actions.

- Climate Action Planning
  - Climate Action Plan released in 2015, Climate Justice Plan in development
  - The Climate Action Plan provided a roadmap for climate related programs and projects, including direct coordination with the NHMP for wildfire and heat risks. The Climate Justice Plan will bring together leaders of frontline communities, community-based organizations, government partner's and the county's Advsory Committee on Sustainability & Innovation. The plan will again coordinate action to reduce risks from climate change to those most at risk.
- Climate Change and Health Planning
  - The county recognized
- Community Wildfire Protection Plan (CWPP)
  - Most recently adopted in 2011, being updated in 2023
  - The CWPP includes all jurisdictions and fire districts in the county, addressing wildfire risk in coordination with state and federal partners. The 2023 update is including wildfire smoke in risk reduction consideration, and is a key addition to mitigating these hazards by bringing in additional stakeholders that can address them in more detail. The NHMP links actions to strategies identified in the CWPP.
- Comprehensive Plan
  - Most recently adopted in September 2016
  - The plan provides long-term planning for development and land use in unincorporated areas of the county. Chapter 7 focuses on natural hazards, and includes maps and risk data for all hazards with specific locational impacts. The Comprehensive Plan can be updated in the future to incorporate updated risk mapping and integrate long-term planning with mitigation goals identified in the NHMP.
- County Budget
  - Adopted for each fiscal year, beginning on July 1
  - The county budget provides funding for county programs, which can include resilience and mitigation programs and projects that require funding beyond

existing budgets. Continuing awareness of natural hazard vulnerability by county leadership can assist with integrating budget funding with future initiatives.

- Emergency Operations Plan (EOP)
  - Most recently updated in 2017 – update planned for late 2023
  - The EOP describes the county's plans for response in the event of a natural hazard disaster. The upcoming update to the EOP will integrate updated risk assessment information from this volume, and revised county hazard prioritization can inform EOP annex development.
- Facilities Maintenance Plan
  - The Facilities Maintenance Plan sets out a process for keeping county facilities safe, accessible and effective. Actions may be for short-term disruptions or long-term facility maintenance, and larger projects may be managed through the Facilities Capital Improvement Program. The NHMP can inform the potential of facilities vulnerability to natural hazards that can be accounted for in maintenance planning.
- NPDES Stormwater Management Plan
  - Most recently adopted in November 2022
  - This plan provides best management practices for stormwater discharge permitting in unincorporated urban pockets and county and bridge right-of-ways. Along with maintaining water quality, stormwater management can prevent urban flooding. Future updates can continue to integrate with the NHMP in identifying stormwater flood risk areas and sharing strategies for reducing risk.
- Regional Recovery Framework
  - Developed in 2019
  - The regional framework will guide the county's future recovery plan and will focus on how to restore all functions of the county in a way that enhances future resilience. The future recovery plan priorities can be informed by the risk assessment in this plan, and provide concents for future mitigation strategies that can enhance resilience during recovery.
- Roads Capital Improvement Plan
  - Adopted January 2020 for the time period of 2020-2024
  - The Roads Capital Improvement Plan identifies priorities for major road and bridge infrastructure spending. Roads and bridges are critical disaster lifelines and resilience to hazards that threaten this infrastructure are included in project prioritization.
- Transportation System Plan (TSP)
  - Most recently adopted in September 2016
  - The TSP is a master plan for county roads outside of incorporated cities. The primary focus is to enhance the safety of rural roads, and these roads are threatened by different hazards. Rural roads are also a critically important lifeline, and the TSP can further integrate with the NHMP risk assessment to identify projects that will make roads safer and more resilient.
- Willamette River Bridges Capital Improvement Plan
  - Most recently revised in August 2015, for the time period of 2015-2034
  - This plan focuses on capital expenditures for bridges, including for seismic resilience. This plan is already being used in this plan to prioritize future bridge

retrofit projects that will considerably strengthen the county resilience in a future earthquake.

- Zoning and Development Codes
  - Most recently amended on May 2022
  - The Zoning and Development Codes address building and land use regulations in unincorporated portions of Multnomah County. The current zoning code has overlays for Flood Hazard and Geologic Hazards (5A and 5B), with the Flood Hazard Overlay making up the county's floodplain management ordinance. Overlays can be added or amended based on risk priorities established in this plan and building codes are monitored when state codes are strengthened, or when local opportunities for more resilient building code standards are offered.

5.6 Columbia Corridor Drainage Districts (CCDD)

5.6.1 Mitigation Actions

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – Columbia Corridor Drainage Districts</th></tr>
<tr><td rowspan="8">Multi-Hazard</td><td rowspan="8">1</td><td colspan="8">Prepare for and reduce impacts from power outages by installing backup portable generator connections at pump stations, backup power at facilities, purchasing back-up pumping equipment, and/or having rental contracts for back-up power and equipment.</td></tr>
<tr><td colspan="3"><u>Plan Goals</u> – 3,5</td><td colspan="5"><u>Hazards Addressed</u> – Flood, Severe Weather</td></tr>
<tr><td colspan="3"><u>Lifelines</u> – Levee and Drainage System</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td colspan="2">Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>MCDD</td><td colspan="2">PEN 1, PEN 2, SDIC</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>15</td></tr>
<tr><td colspan="8">Potential Funding – Capital Loans, Bonds, FEMA, SPIRE</td></tr>
<tr><td colspan="8">Potential Implementation Methods – CIP, PMLS, Standard Operations, District Budget Authorization</td></tr>
<tr><td colspan="8">Notes – Includes Pump Station 2, Broadmoor, Air Trans, Pump Station 4, Schmeer Rd, and 181st Pump Station.</td></tr>
</table>

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts							
Multi-Hazard	2	**Build relationships with community groups and culturally specific community-based organizations and learn how we can best serve those communities for emergency preparedness and response.**							
		Plan Goals – 1,4,5		Hazards Addressed – All Hazards					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD		**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – UFSWQD Revenue (once established), Communications budget							
		Potential Implementation Methods – District Budget Authorization, Emergency Operations Plan, Communications and Public Affairs Plan							
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.							
Multi-Hazard	3	**Develop a Continuity of Operations Plan (COOP) to maintain general District operations during emergencies.**							
		Plan Goals – 3,5		Hazards Addressed – All Hazards					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – Grants, District Assessments							
		Potential Implementation Methods – District Budget Authorization							
		Notes –							

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Multi-Hazard	4	**Customize and integrate flood-risk, earthquake-risk, and emergency preparedness curriculum and outreach/communications for the public and partners.**								
		Plan Goals – 1,4		Hazards Addressed – All Hazards						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**3**	**2**	**3**	**3**	**3**	**14**	
		Potential Funding – PMLS (Non-Structural), District Assessments, Grants								
		Potential Implementation Methods – PMLS, District Budget Authorization								
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.								
Multi-Hazard	5	**Adapt and expand ICS training, exercises, and job shadowing opportunities for MCDD staff.**								
		Plan Goals – 3,5		Hazards Addressed – All Hazards						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD		**3**	**2**	**3**	**3**	**3**	**14**	
		Potential Funding – District Assessments, Grants								
		Potential Implementation Methods – Emergency Operations Plan								
		Notes –								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Multi-Hazard	6	**Develop and implement asset management program to track asset condition, performance and risk and set priorities for maintenance and repairs in advance of natural hazards.**								
		Plan Goals – 3,5		Hazards Addressed – All Hazards						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD		**2**	**2**	**3**	**3**	**3**	**13**	
		Potential Funding – District Assessments, Grants								
		Potential Implementation Methods – Strategic Asset Management Plan								
		Notes –								
Multi-Hazard	7	**Build GIS capacity to improve preparedness and enhance responsiveness and recovery from natural hazards within the Districts.**								
		Plan Goals – 3,5		Hazards Addressed – All Hazards						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD		**2**	**2**	**1**	**2**	**3**	**10**	
		Potential Funding – Grants								
		Potential Implementation Methods – Emergency Operations Plan								
		Notes –								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts							
Earthquake	8	**Improve seismic resilience of hard infrastructure (e.g. pump stations) to reduce downtime by assessing seismic retrofit options to determine feasibility and benefit-cost ratio; planning mitigation investments where practical and cost-effective; and incorporating design criteria for new infrastructure to be seismically resilient.**							
		Plan Goals – 2,3,5		Hazards Addressed – Earthquake					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD	Port of Portland, PEN 1, PEN 2, SDIC	**3**	**3**	**1**	**3**	**1**	**14**
		Potential Funding – Grants, Port of Portland Cost-Share, District Assessments							
		Potential Implementation Methods – CIP, District Drainage Master Plans							
		Notes –							
Earthquake	9	**Implement seismic upgrades for MCDD administrative and operations buildings.**							
		Plan Goals - 3		Hazards Addressed – Earthquake					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD		**1**	**2**	**2**	**3**	**3**	**11**
		Potential Funding – District Assessments, Grants, Capital Loans							
		Potential Implementation Methods – District Drainage Master Plans, Emergency Operations Plan							
		Notes –							

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	10	**Levee Ready Columbia partners, the Columbia Corridor Drainage Districts, and the Urban Flood Safety & Water Quality District will seek funding to support re-certification and maintaining accreditation of the Columbia River levee systems, including support of federal investments in the system.**								
		Plan Goals – 1,2,3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		USFWQD	MCDD, PEN 1, PEN 2, SDIC, Portland, Multnomah County, Gresham, Fairview, Troutdale, Wood Village	**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – General Fund, Local Resources								
		Potential Implementation Methods – Levee Ready Columbia								
		Notes – Maintained action from 2017 NHMP								
Flood	11	**Continue coordination across all jurisdictions for development reviews to prevent unplanned impacts on levee and drainage system.**								
		Plan Goals – 1,3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – Development Review Fees								
		Potential Implementation Methods – District Budget Authorization								
		Notes – Expansion from prior plan to include all Districts								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	12	**Increase capacity, dependability and redundancy for all District pump stations.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – District Assessments, FEMA HMA, Other Grants								
		Potential Implementation Methods – CIP, PMLS								
		Notes –								
Flood	13	**Conduct training, planning, and modeling exercises that integrate new district mandates: water quality, fish and wildlife habitat, climate change, landscape resilience, equity and social justice, and cultural history.**								
		Plan Goals – 1.3.4		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		UFSWQD	MCDD, PEN 1, PEN 2, SDIC	**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – UFSWQD (once established), District Assessments								
		Potential Implementation Methods – District Budget Authorization								
		Notes –								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts							
Flood	14	**Update and maintain Flood Emergency Action Plan to prepare for riverine and internal drainage flooding due to natural hazard emergencies.**							
		Plan Goals – 1,3,5		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – Direct Assessments, Grant Funding							
		Potential Implementation Methods – District Budget Authorization, Emergency Operations Plan, Flood Emergency Action Plan							
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.							
Flood	15	**Complete SCADA upgrades at all pump stations to improve data collection and storage, communications, monitoring and surveillance.**							
		Plan Goals – 2,3		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – Assessments, Capital Loans, Grants							
		Potential Implementation Methods – CIP, District Drainage Master Plans							
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.							

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	16	**Develop and implement preventative maintenance strategies to monitor performance and increase redundancy at all District pump stations.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – District Assessments, Grants								
		Potential Implementation Methods – District Drainage Master Plans, Emergency Operations Plan								
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.								
Flood	17	**Enhance security and surveillance at District pump stations to improve resiliency and increase redundancy in response to a natural hazard emergency.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – District Assessments, Grants								
		Potential Implementation Methods – CIP, Districts Budget Authorization								
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts							
Flood	18	**Rehabilitate gravity flow system (drainage pipes, slide gates, and inlet/outlet screens) as redundancy to Pump Station 1.**							
		Plan Goals – 3,5		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD		**3**	**3**	**3**	**3**	**3**	**15**
		Potential Funding – District Assessments, Capital Loans, Bonds, Grants							
		Potential Implementation Methods – MCDD Drainage Master Plan							
		Notes –							
Flood	19	**Conduct 2-D flood inundation modeling, graphic design, and map products to improve flood risk analysis and communication with the partners and the public.**							
		Plan Goals – 1,3		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**2**	**3**	**3**	**14**
		Potential Funding – District Assessments, FEMA HMA, Other Grants							
		Potential Implementation Methods – District Budget Authorization, Emergency Operations Plan, Internal Drainage, Emergency Operations Plan							
		Notes –							

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts							
Flood	20	**Design, purchase, and install signage in the floodplain for flood evacuation rates and demarcation of the managed floodplain/protected area.**							
		Plan Goals – 1,4,5		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**2**	**3**	**3**	**14**
		Potential Funding – PMLS (Non-Structural Measures, Grants, District Budget							
		Potential Implementation Methods – Emergency Operations Plan, District Budget Authorization							
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.							
Flood	21	**Improve pump station reliability by installing flow monitors at all district pump stations.**							
		Plan Goals – 3,5		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD	PEN 1, PEN 2, SDIC	**3**	**2**	**3**	**3**	**3**	**14**
		Potential Funding – District Assessments, Grants							
		Potential Implementation Methods – CIP, District Drainage Master Plans							
		Notes –							

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts							
Flood	22	**Rehabilitate or replace drainage pipes and slide gates at 142nd cross levee.**							
		Plan Goals – 3,5		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD		**3**	**2**	**3**	**3**	**3**	**14**
		Potential Funding – District Assessments, Grants							
		Potential Implementation Methods – CIP, District Budget Authorization, District Drainage Master Plans							
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.							
Flood	23	**Convert recent USACE PMLS Study modeling and lessons learned to inform drainage master planning in Districts.**							
		Plan Goals – 3		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD	PEN 1, PEN 2, SDIC	**3**	**2**	**2**	**3**	**3**	**13**
		Potential Funding – District Assessments							
		Potential Implementation Methods – District Budget Authorization, District Drainage Master Plans, Emergency Operations Plan, Internal Drainage Emergency Action Plan							
		Notes –							

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	24	**Protect levee toe from hydraulic scouring caused by anticipated increased frequency loading in the wet season under current climate models.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD		**3**	**3**	**2**	**3**	**2**	**13**	
		Potential Funding – PMLS, Grants, Bonds								
		Potential Implementation Methods – District Budget Authorization, PMLS, Levee Ready Columbia								
		Notes – This action includes conventional and nature-based solutions								
Flood	25	**Evaluate temporary flood control structure needs, determine the best options for each closure (including automated systems where beneficial), invest in needed closure structures, and create clear job sheets for each closure for emergency response.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**3**	**3**	**2**	**3**	**2**	**13**	
		Potential Funding – District Assessments, Planning Grants, Capital Loans, Bonds or Grants								
		Potential Implementation Methods – District Budget Authorization, Emergency Operations Plan, Flood Emergency Action Plan								
		Notes –								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	26	**Coordinate with partners in floodplain resilience planning, environmental zoning, and development standards within floodplains to increase / maintain green infrastructure and to increase flood resilience within building standards.**								
		Plan Goals – 1,2,3						Hazards Addressed – Flood		
		Lifelines – Levee and Drainage System						**Prioritization Criteria**		
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	City of Portland, PEN 1, PEN 2, SDIC	**3**	**2**	**2**	**3**	**3**	**13**	
		Potential Funding – District Assessments, Grants								
		Potential Implementation Methods – District Budget Authorization								
		Notes –								
Flood	27	**Raise levee near I-5 cloverleaf & Marine Drive interchange.**								
		Plan Goals – 3,5						Hazards Addressed – Flood		
		Lifelines – Levee and Drainage System						**Prioritization Criteria**		
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2	**2**	**3**	**3**	**3**	**2**	**13**	
		Potential Funding – PMLS, Levee Ready Columbia, Grants, District Assessments, Bonds								
		Potential Implementation Methods – PMLS, CIP, Levee Ready Columbia, District Budget								
		Notes –								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	28	**Decommission or install valve replacements for Gate Tower & associated drainage pipes between MCDD and SDIC to address hydrologic connection vulnerabilities between drainage basins.**								
		Plan Goals – 3		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	SDIC	**1**	**3**	**3**	**3**	**3**	**13**	
		Potential Funding – Levee Ready Columbia, CIP, District Assessments, Bonds, Grants								
		Potential Implementation Methods – PMLS, CIP, Levee Ready Columbia, District Budget								
		Notes –								
Flood	29	**Analyze and address houseless community's impacts on flood management system and access.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**3**	**2**	**2**	**3**	**3**	**13**	
		Potential Funding – District Assessments, Grants								
		Potential Implementation Methods – District Budget Authorizations, Public Affairs Program								
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	30	**Relocate and replace PIR and Vanport Pump Stations with upgrades for backup power connection, seismic resilience, wind event resilience, pumps and discharge lines, and addition of automatic trash rake system.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1	**1**	**3**	**3**	**3**	**3**	**13**	
		Potential Funding – City of Portland Cost-Share, FEMA HMA								
		Potential Implementation Methods – CIP, District Budget Authorization								
		Notes –								
Flood	31	**Address oversteepened toe of levee for Columbia Slough southwest levee enhancement.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**2**	**2**	**3**	**3**	**3**	**13**	
		Potential Funding – Levee Ready Columbia, Bonds, Grants								
		Potential Implementation Methods – Levee Ready Columbia Budget, District Budget Authorization, CIP								
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts							
Flood	32	**Address vulnerabilities from animal burrows on Columbia River MCDD Levee of NE Corner Rehab.**							
		Plan Goals – 3,5		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD		**2**	**2**	**3**	**3**	**3**	**13**
		Potential Funding – Levee Ready Columbia, Bonds, Grants							
		Potential Implementation Methods – Levee Ready Columbia Budget, District Budget Authorization, CIP							
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.							
Flood	33	**Replace, and potentially increase capacity of, the primary stormwater pumping station for the Sandy Pump Station.**							
		Plan Goals – 3,5		Hazards Addressed – Flood					
		Lifelines – Levee and Drainage System		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		MCDD	SDIC	**3**	**3**	**1**	**3**	**3**	**13**
		Potential Funding – Local Resources, US Economic Development Administration grants, FEMA HMA, US EPA Grants, Oregon Infrastructure Finance Authority Loans							
		Potential Implementation Methods – SDIC Capital Improvement Plan							
		Notes –							

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	34	**Incorporate climate and equity into flood modeling/planning, factoring in updated precipitation and hydrologic forecasts and anticipated impacts on communities.**								
		Plan Goals – 1,2,3,4		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		UFSWQD	MCDD, PEN 1, PEN 2, SDIC	**3**	**2**	**2**	**3**	**2**	**12**	
		Potential Funding – Grants, District Assessments, USFWQD Revenue								
		Potential Implementation Methods – District Budget Authorization								
		Notes –								
Flood	35	**Regrade and bench oversteepened levee banks on the Columbia River.**								
		Plan Goals – 3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**2**	**2**	**2**	**3**	**3**	**12**	
		Potential Funding – District Assessments, FEMA HMA, Other Grants								
		Potential Implementation Methods – CIP, District Budget Authorization								
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	36	**Improve drainage pathways through pipe improvements or daylight open channels in areas such as Meadow Drive and Middlefield Road.**								
		Plan Goals – 3		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**2**	**2**	**3**	**3**	**3**	**12**	
		Potential Funding – District Assessments, Grants								
		Potential Implementation Methods – CIP, District Drainage Master Plans								
		Notes –								
Flood	37	**Identify and create redundant channels and pipes to allow for additional flood storage and flow paths.**								
		Plan Goals – 3		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**2**	**2**	**1**	**3**	**3**	**11**	
		Potential Funding – Grants, District Assessments								
		Potential Implementation Methods – CIP, PMLS, Drainage Master Plans								
		Notes –								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	38	**Plan for landscape resilience, including identifying open spaces within the managed floodplain (or brownfield sites that could be converted to open space), developing solutions for flood storage (or other objectives), and creating a worklist for future study/modeling to quantify services that provided by those sites.**								
		Plan Goals – 2,3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		UFSWQD	MCDD, PEN 1, PEN 2, SDIC	**3**	**2**	**1**	**3**	**2**	**11**	
		Potential Funding – UFSWQD Revenue Steam								
		Potential Implementation Methods – UFSWQD Budget Authorization								
		Notes –								
Flood	39	**Upgrade levee management practices by implementing measures that increase early-warning times prior to failures.**								
		Plan Goals – 2,3,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**2**	**2**	**2**	**3**	**2**	**11**	
		Potential Funding – District Assessments, Grants								
		Potential Implementation Methods – Emergency Operations Plan, District Drainage Master Plans								
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.								

Hazard	Action ID	Mitigation Actions – Columbia Corridor Drainage Districts								
Flood	40	**Plan designated safe zones for people who cannot safely evacuate in the event of a levee breach and flood.**								
		Plan Goals – 1,3,4,5		Hazards Addressed – Flood						
		Lifelines – Levee and Drainage System		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	PEN 1, PEN 2, SDIC	**3**	**2**	**1**	**3**	**2**	**11**	
		Potential Funding – District Assessments, Grants								
		Potential Implementation Methods – Emergency Operations Plans								
		Notes – This strategy reflects a top theme from the Fall 2021 public survey on natural hazard mitigation priorities.								
Flood	41	**Support agency partners to improve joint stormwater assets that are essential to the existing internal drainage system.**								
		Plan Goals – 2,3,5		Hazards Addressed – Flood						
		Lifelines – Disaster Sheltering		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		MCDD	City of Portland, Port of Portland, PEN 1, PEN 2, SDIC	**2**	**2**	**1**	**3**	**1**	**9**	
		Potential Funding – District Assessments, Interagency Cost-Share, Grants								
		Potential Implementation Methods – District Drainage Master Plans, Emergency Operations Plan, Internal Drainage Emergency Action Plan								
		Notes –								

5.6.2 Districts Overview

As noted in the plan introduction, six separate drainage and levee management bodies are collected in this volume as Columbia Corridor Drainage Districts. Of the six, four drainage districts – Multnomah County Drainage District (MCDD), Peninsula Drainage District #1 (PEN 1), Peninsula Drainage District #2 (PEN 2), and the Sandy Drainage Improvement Company (SDIC) – are current drainage and levee management districts. While the risk of flood is central to this chapter, the risk of other natural hazards varies by District. Within the hazard assessment and mitigation strategy sections of this chapter, each District is examined independently to reflect the current needs and vulnerabilities within their respective boundaries.

The Columbia Corridor Drainage Districts Joint Contracting Authority (CCDDJCA) is an intergovernmental entity that combines the four drainage districts into a single funding and contract administration body. Eventually, the four districts will fully consolidate into the Urban Flood Safety and Water Quality District (UFSWQD), created by the Oregon State Legislature in 2019 to modernize the work of the multiple drainage districts covering the 27 miles of levees and water conveyance infrastructure under these four districts. Once in place, the UFSWQD will continue the flood safety work of the independent districts while adding additional services.

Because the CCDDJCA and UFSWQD cover the same territory as the four independent drainage districts combined, they are included with averaged risk ratings and combined mitigation strategies. When the districts are consolidated, CCDDJCA and UFSWQD will already have NHMP requirements in place and can seamlessly maintain eligibility for Federal hazard mitigation grants.

As special districts of Oregon, the Columbia Corridor Drainage Districts are limited purpose units of government, and the hazard mitigation strategies identified herein are subject to their flood safety statutory authorities. The term Columbia Corridor Drainage Districts (Districts) will be used for the remainder of the chapter and will refer to all six entities.

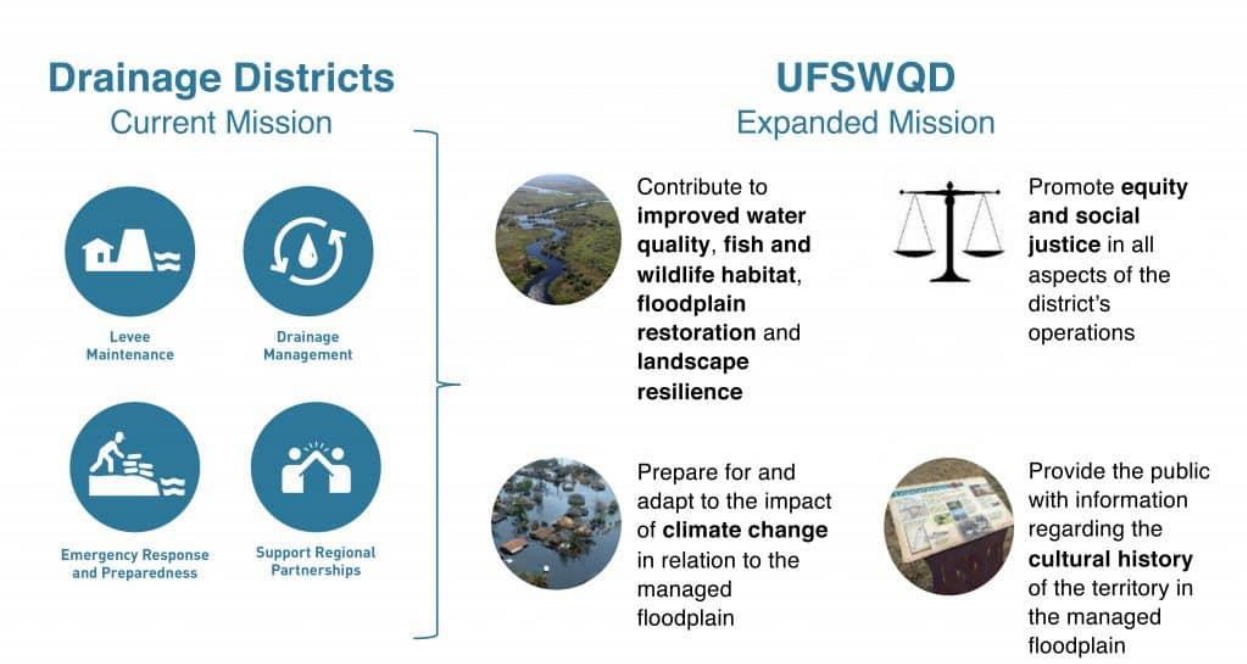


Figure 182 - Drainage Districts' current and expanded mission

With new requirements for Special Districts to have their own NHMPs to manage FEMA Hazard Mitigation grants, the Districts elected to join this multi-jurisdictional plan. As a first-time plan participant, the Districts are not updating actions and priorities from prior plans but making comprehensive assessment of risks from natural hazards and vulnerabilities that can mitigate that risk.

- *About the Districts*

The Districts operate and maintain drainageways and levees that were first built between 1917 and 1920 to support year-round farming and industry. At that time there were only 500 homes behind the levees, and most of the land was either unimproved or agricultural. Now, the system protects the Portland International Airport, a regional Exposition Center, the backup water supply for the City of Portland, thousands of homes, and three major interstates. The area is also home to hundreds of businesses and approximately 10% of Multnomah County's employment base. The drainageways and levee system are essential to the protection of the daily life of 7,500 residents and the nearly 13,000 acres of land amounting to $7.3 billion in assessed property value.

Since 2013, Levee Ready Columbia (LRC, previously Levee Improvement Project) has been working toward recertification of the levee system with FEMA, as well as maintaining active status in USACE's Rehabilitation and Inspection Program. To do so, and maintain accreditation by FEMA of the levee system, LRC has been working to understand the vulnerabilities and deficiencies that exist within the levee system, as well as to define the assets (structural, historical, community, environmental, and cultural) that the Districts protect. This has involved extensive engineering investigations (primarily geotechnical, civil, and structural) of the pump stations and levee prism.

- *Geography*

The four independent drainage districts are located in the northern portion of Multnomah County along the South shore of the Columbia River. They are bounded to the west by North Portland Rd (Near Smith and Bybee Lakes) and to the east by the Sandy River. The southern border of the Districts generally coincides with Columbia Boulevard apart from the Sandy Drainage Improvement Company (SDIC), which shares a southern border with a railroad line.

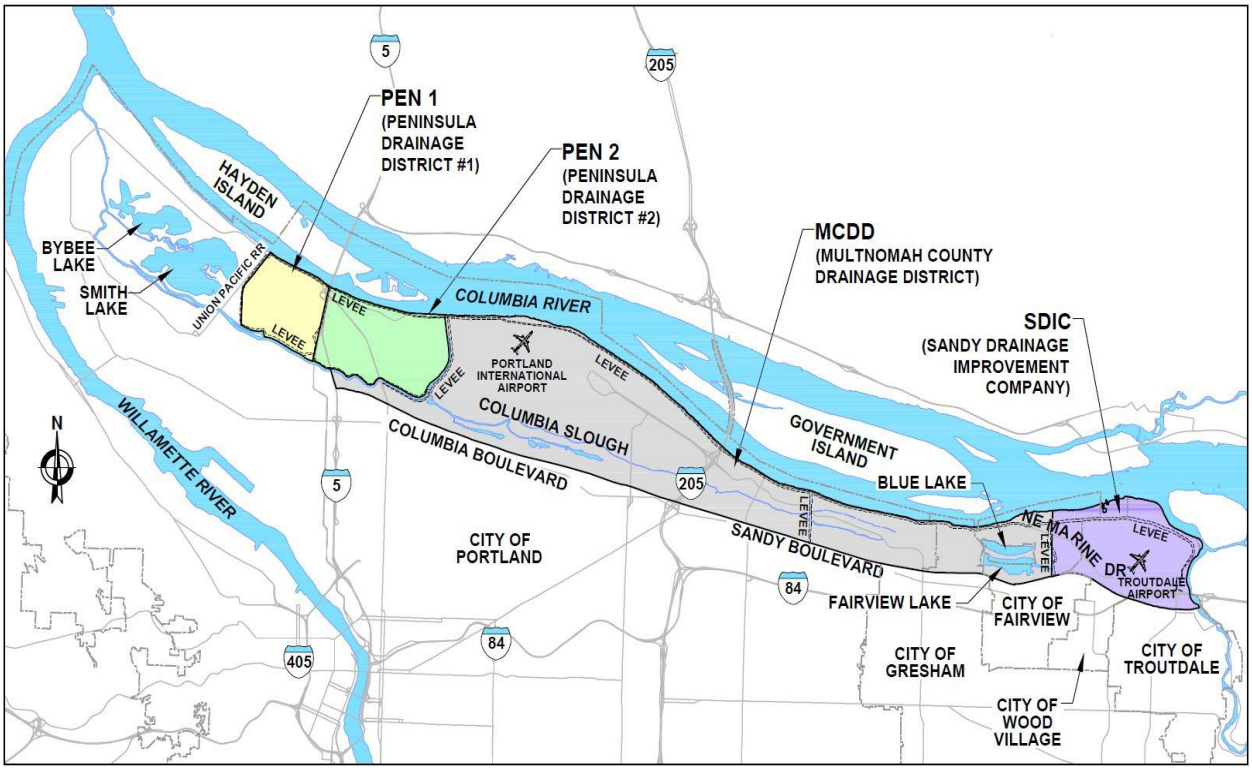


Figure 183 – Map showing the location of the independent Drainage Districts

- Peninsula Drainage District No. 1, established in 1917, 1.6 square miles
- Peninsula Drainage District No. 2, established in 1917, 2.5 square miles
- Multnomah County Drainage District No. 1, established in 1917, 13.4 square miles
- Sandy Drainage Improvement Company, established in 1917, 2.4 square miles

The entire four-district levee system is maintained by the MCDD on behalf of all districts. SDIC is set alongside the Sandy River on its eastern border and has a setback levee at its confluence with the Columbia River.

Taken as a whole, the Districts share area within the cities of Portland, Gresham, Troutdale, and Fairview, as well as portions of unincorporated Multnomah County. As special purpose units of government, they are authorized to provide flood safety services within their jurisdictional boundaries.

- *Topography*

Being in the natural floodplain of the Columbia River, the topography of the Districts is generally flat and low-lying. As such, the Districts contain several lakes, wetlands, sloughs, side channels, and other areas prone to ponding during rain events. In addition to these features, man-made levees and embankments are present throughout the Districts. These areas act primarily as hydraulic barriers and create drier upland zones.

- *Population*

Although the territory of the Districts overlays that of city and county jurisdictions, information about the population of those living in levee-protected areas have been included in this plan when available.

Table 44 – Population in levee-protected areas by Drainage District (For population details, see Community Profile chapter). Data from DOGAMI estimate.

District	Estimated Population
Peninsula Drainage District #1 (PEN 1)	15
Peninsula Drainage District #2 (PEN 2)	2,480
Multnomah County Drainage District (MCDD)	4,927
Sandy Drainage Improvement Company (SDIC)	14
Total:	**7,436**

Unsheltered residents also reside in the served areas, although individual counts or estimates are not available at the District level. Many of these individuals are often located along roadways, including on the levee, and near waterways or low-lying areas that are highly susceptible to flooding under even minor flooding scenarios.

The Districts serve to protect a large workforce for industrial and manufacturing facilities, hotels and correctional facilities, and protect the Portland International Airport (PDX), a primary source of incoming travelers to the area.

Table 45 – Workforce in levee-protected areas by Drainage District (For population details, see Community Profile chapter). Data from DOGAMI estimate.

District	Estimated Workforce
Peninsula Drainage District #1 (PEN 1)	1,167
Peninsula Drainage District #2 (PEN 2)	4,506
Multnomah County Drainage District (MCDD)	47,119
Sandy Drainage Improvement Company (SDIC)	6,062
Total:	**58,854**

- *Land Use and Zoning*

Most of the land in the Districts is classified as industrial zoning, land uses consist of residential, commercial, and parks and open space. The Districts have several protected green spaces, including Blue Lake Regional Park and Big Four Corners (MCDD), Children's Arboretum Park (PEN 2), Vanport Wetlands (PEN 1), and TRIP Wetlands (SDIC).

While not subject to the same land use requirements as cities and counties, and without the authority to regulate land use decisions, the Districts are aware of increased in-fill and impervious areas within their borders. Recent examples include the conversion of Portland Meadows (park zoning) to industrial/commercial property in PEN 2; conversion of open farmland at Cereghino Farms (MCDD-East) to industrial/commercial property; and conversion of open industrial land on Port of Portland property to warehouses (including Amazon) in SDIC.

Expanding impervious area in the Districts increases flows that can affect the capacity of pumping systems and increase the risk of flooding. The Districts have completed drainage master plans to address growth within the system, including upsizing pumping capacity, evaluating green infrastructure solutions, and assessing the condition of culverts to mitigate surface flooding risk. Several mitigation strategies included in this chapter reflect the priorities identified in the drainage master plans.

- *Transportation*

The major interstates of the Districts include I-5 and I-205, which both include major bridges that cross the Columbia River into Washington State. Many residents, workers, and travelers use these bridges to gain access to or from the resources within the Districts. The major roads in the Districts include:

  - NE Columbia Boulevard – an east-west traversing road along the southern border of the Districts
  - NE Marine Drive – an east-west traversing road adjacent to the Columbia River in the Districts
  - Martin Luther King Jr Dr. – a north-south traversing road in Pen 2
  - NE Airport Way – an east-west traversing road in MCDD, providing access to PDX Airport

The MAX light-rail provides mass public transportation connecting downtown Portland with both the Expo Center (PEN 1) and the PDX Airport (MCDD), as well as Tri-Met bus services. Transportation systems within the Districts also serve as terminals and throughways for freight movement through trucking and rail.

- *Utilities*

Electric utilities in the Districts are provided by either PacifiCorp (Pacific Power) or Portland General Electric (PGE). Pacific Power services the Districts west of NE 122nd and PGE services the area east of NE 122nd. PGE's Troutdale Substation in SDIC is the lone energy facility within the Districts.

The City of Portland provides drinking water, sewer and stormwater services to the residents and workers in the western Districts (PEN 1, PEN 2, and portions of MCDD), with services in the eastern Districts (portions of MCDD and SDIC) being provided by the Cities of Fairview, Wood Village, Gresham, and Troutdale. The Districts also contain and protect important natural areas owned by the City of Portland as well as the Columbia South Shore Well Fields, the second largest source of drinking water in Oregon.

- *Critical Facilities*

The critical facilities identified for the operation of the Districts are pump stations and MCDD's main campus, which includes administrative and operational offices. Pump stations and gravity outfalls are critical facilities to District operations as the primary methods for moving water through and out of the District's internal drainageways. Other critical facilities that exist in the protected levee areas are listed below.

- Airports
- Bridge
- Childcare Facilities
- Community Center
- County Assets
- Fire Stations
- Homeless Shelters
- Jails
- Law Enforcement Facilities
- Licensed Medical Facilities
- Residential Care Facility
- Schools
- Urgent Care Centers

Additional assets that the levees and drainage system protect include:

- The Columbia South Shore Well Fields (MCDD)
- The Oregon Air National Guard (MCDD)
- Portland Expo Center (PEN 1)
- Portland International Raceway (PEN 1)
- Historic Vanport (PEN 1)
- Cascade Station (MCDD)
- Troutdale Reynolds Industrial Park (SDIC)

5.6.3 Local Hazard Analysis

Earthquake – Risk Rating Moderate (All Districts)

See Earthquake Section for more detailed risk and vulnerability information.

The Districts' levee system, pump stations, and drainage channels are primarily located on historic floodplain and are very susceptible to ground liquefaction and severe ground-shaking. The built environments vary from district to district, but PEN 2 and MCDD have larger residential populations, as well as large commercial-industrial areas that would likely be affected by liquefaction and shaking damage. All District entities assessed the risk as moderate due to the long return period between earthquakes in this region.

In a magnitude 9.0 Cascadia Subduction Zone earthquake, ground-shaking would be consistently moderately strong across the Districts. Permanent ground deformation caused by liquefaction would be moderate to high throughout the Districts, with greater impacts to the western Districts.

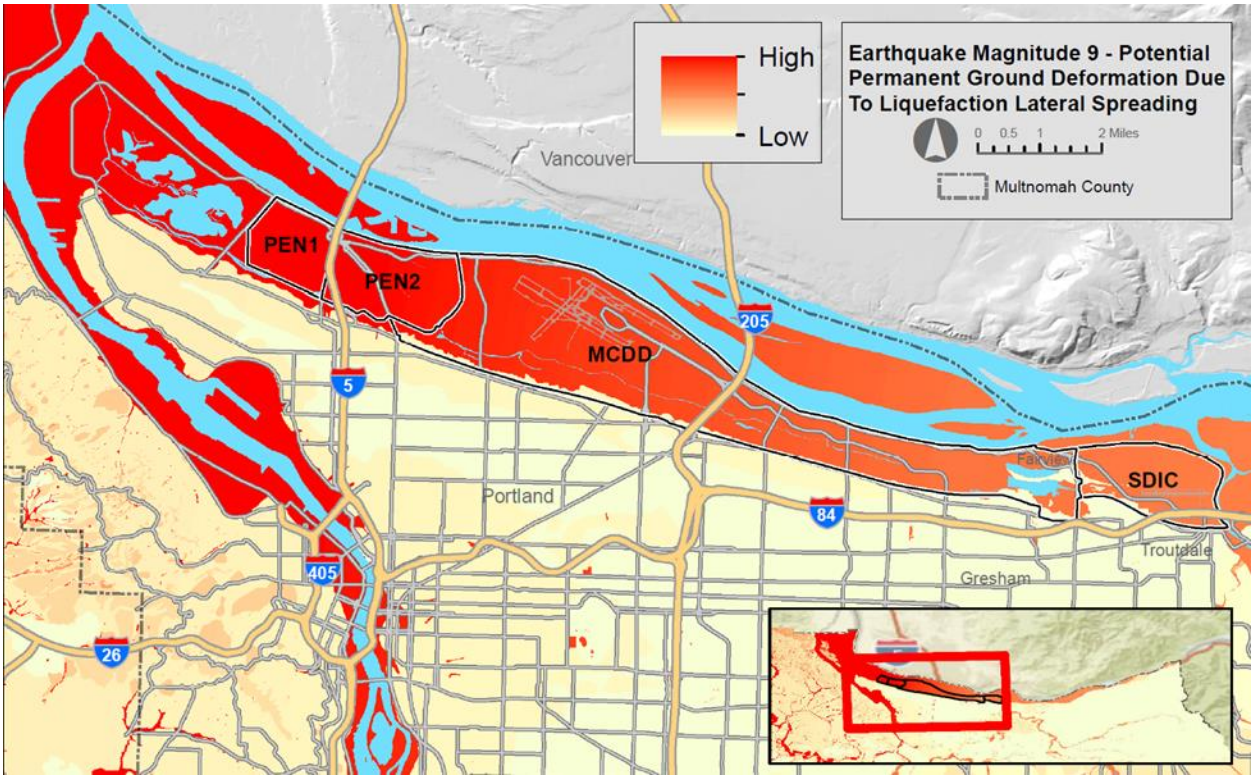


Figure 184 - Map of potential impacts in the Districts from a magnitude 9.0 Cascadia Subduction Zone earthquake.

A magnitude 6.8 Portland Hills Fault crustal earthquake is expected to impact the Districts more substantially than a Cascadia Subduction Event. This increased effect would be seen in both ground shaking and liquefaction. The damage potential is “heavy” in the western Districts to “moderate/heavy” in the eastern Districts. The shaking is “violent” in the western Districts and “severe” in the eastern Districts.

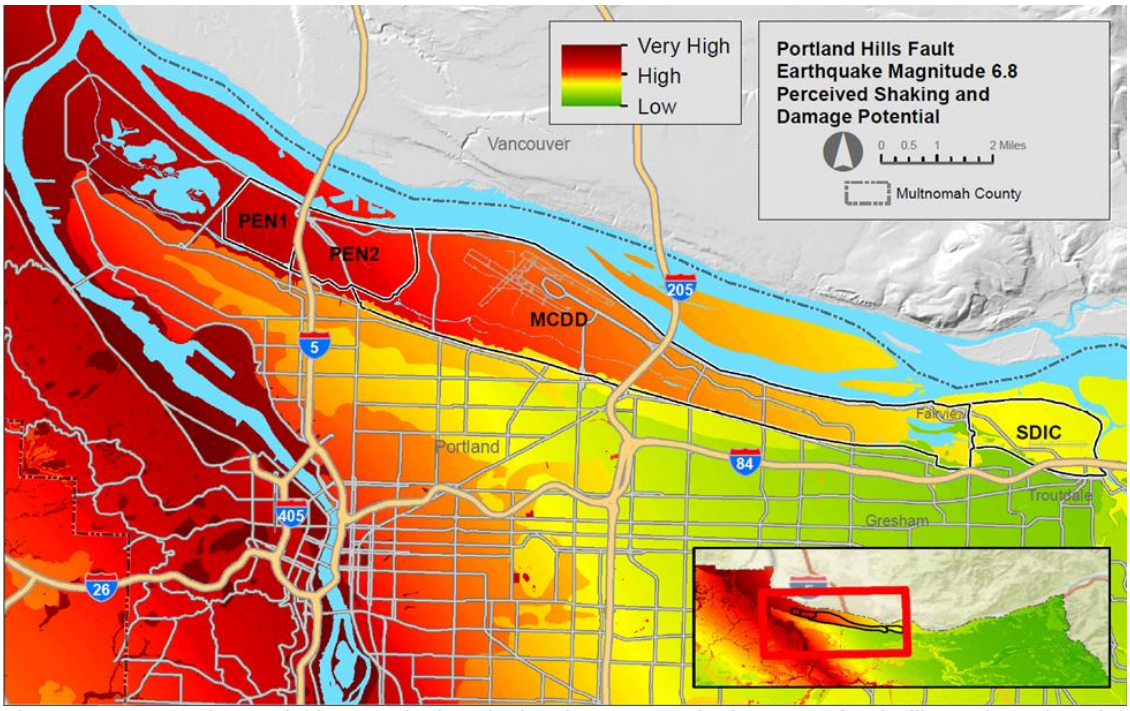


Figure 185 - Map of potential impacts in the Districts from a magnitude 6.8 Portland Hills Fault earthquake.

Flood – Risk Rating High (All Districts)

See Flood Section for more detailed risk and vulnerability information.

Flood is considered a high risk hazard across the entire levee system. The Districts' levee system, pump stations, and drainage channels all exist for the purpose of mitigating flood hazards. Levee systems protect low-lying areas along the Columbia River, including thousands of residents and billions of dollars in assessed property and annual economic activity. Though the probability of levee failure within the Districts is low, the direct impacts would be significant for the participating jurisdictions of this plan.

Many areas of the Districts are mapped under FEMA's Flood Insurance Rate Map (FIRM) system as having a reduced risk of flooding due to levees. Other areas are mapped as being at risk for a 0.2% annual chance flood hazard (the eastern Planning Area) or a 1% annual chance flood hazard, where interior flooding within the levee system can occur or undeveloped areas where levee protection may not be complete.

An interactive version of this map shaking is "violent" in the western Districts and "severe" in the eastern Districts.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

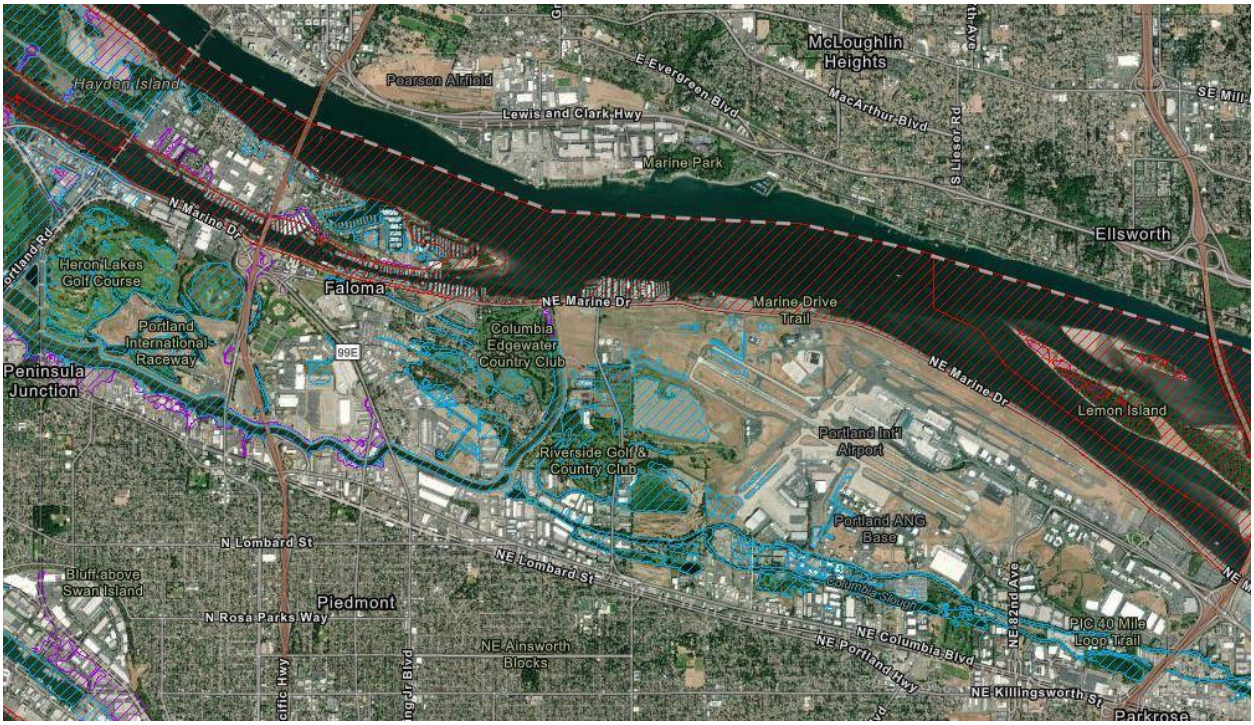


Figure 186 - FEMA National Flood Insurance Rate Maps in western districts showing 1% annual chance flood probability (100-year) in blue and the .2% annual chance flood area (500-year) in purple. The floodway is shown in red. Map from DOGAMI HazVu Site.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

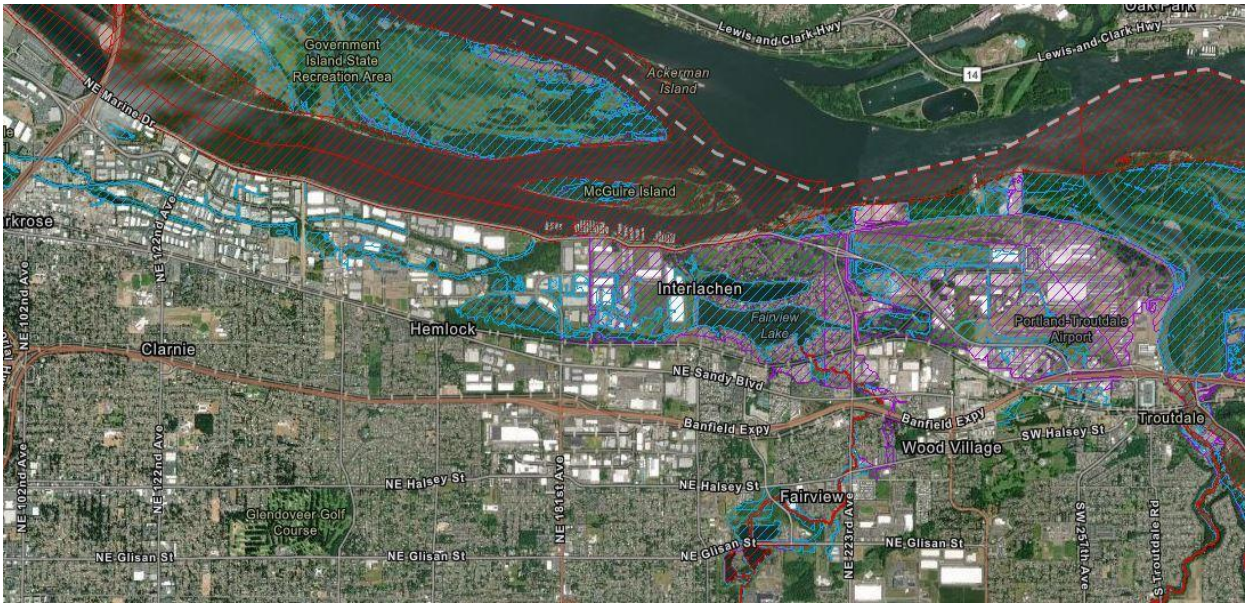


Figure 187 - FEMA National Flood Insurance Rate Maps in eastern districts showing 1% annual chance flood probability (100-year) in blue and the .2% annual chance flood area (500-year) in purple. The floodway is shown in red. Map from DOGAMI's HazVu site.

The Districts recently completed a 3-year New Start Feasibility Study with USACE as a part of the Portland Metropolitan Levee System (PMLS) Project. In the PMLS' Final Report & Environmental Assessment[90], the US Army Corps of Engineers determined there would be substantial benefit from federal investment in levee system improvements including: creating a new setback levee, raising and widening sections of the levee, and providing backup power connections to pump stations. If approved, construction could start as early as 2025.

In addition, flooding may exacerbate channel migration and potentially impact MCDD and SDIC, depending on erosion patterns at the Sandy River Delta and the potential for the creation of new channels or reoccupation of historical channels.

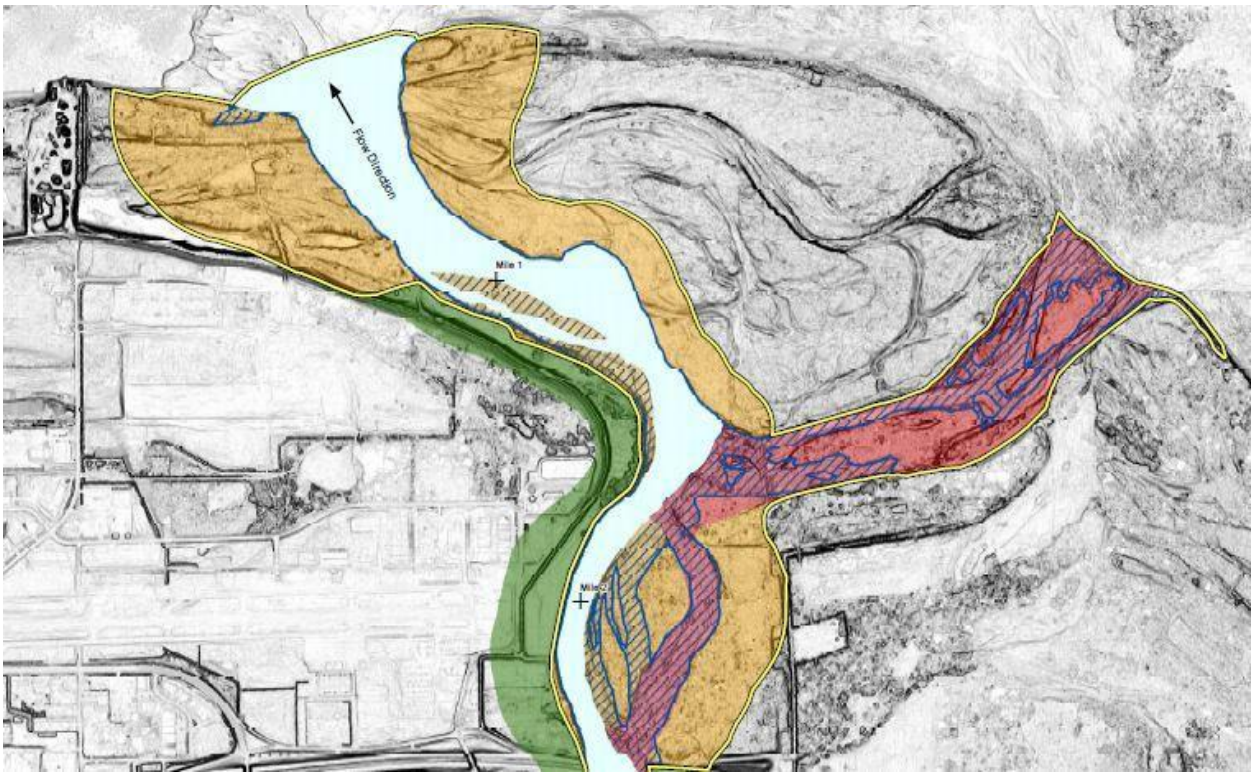


Figure 188 - Potential channel migration on the Sandy River. The yellow areas have risk from bank erosion in the next 100 years, the red areas have risk from the formation of a new river channel, the blue shaded areas are previous locations of the river channel at some point between 1955-2019, and the green areas are where built structures have eliminated risk of channel migration. Map from DOGAMI.

Landslide – Risk Rating Low (All Districts)

See Landslide Section for more detailed risk and vulnerability information.

Landslide risk in the Districts is low due to predominantly low-lying land with minimal slopes. All four districts and combined entities rated landslide as being of relative low risk. There is no identified probability for deep landslides within the levee-protected areas. While the overall risk of shallow landslides is low, the 27 miles of levee may experience some erosion, landslides and

[90] Published in coordination with the US Army Corps of Engineers in 2021. https://usace.contentdm.oclc.org/digital/collection/p16021coll7/id/18451

settling during heavy rains or high water events. Shallow landslide susceptibility is expected in berm areas along roads and the levee system itself, with the most susceptible areas along NE Cornfoot Road between NE 47th and Alderwood Road in Portland.

An interactive version of this map can be found here (Landslide Susceptibility – Susceptability to Shallow Landslides)

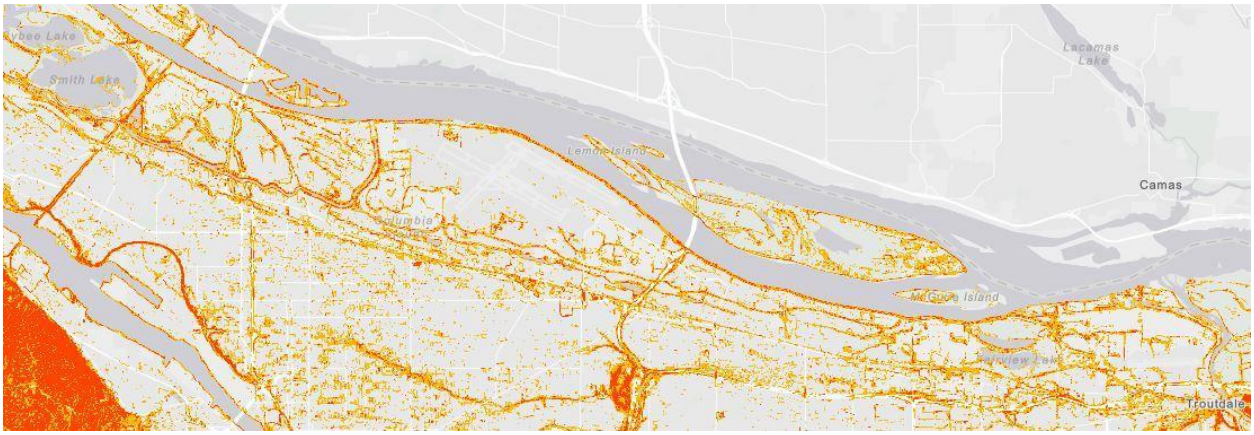


Figure 189 - Shallow landslide susceptibility in the Columbia Corridor Drainage Districts. Map from DOGAMI SLIDO site.

Severe Weather – Risk Rating High (All Districts)

See Severe Weather Section for more detailed risk and vulnerability information.

All Districts rated Severe Weather as a high risk. Weather events due to climate change are expected to increase vulnerability and will continue to be a significant concern for District operations as well as those living in the protected areas.

Over the last five years, winter storms have significantly disrupted transportation routes and utilities. Snow events are a key driver for flooding, and strong winter storms have increased incidences of landslides in the region. Severe windstorms threaten damage to District equipment and cause power outages. These outages may be significant when windstorms coincide with high precipitation events, requiring resilient backup power for pumps. Windstorms may also create extreme risk for wildfire in grassy levee areas when they coincide with dry summer conditions.

Locations with severe urban heat island effects are throughout District areas, coinciding primarily with areas of dense industrial development, especially airport infrastructure.

An interactive version of this map can be found here

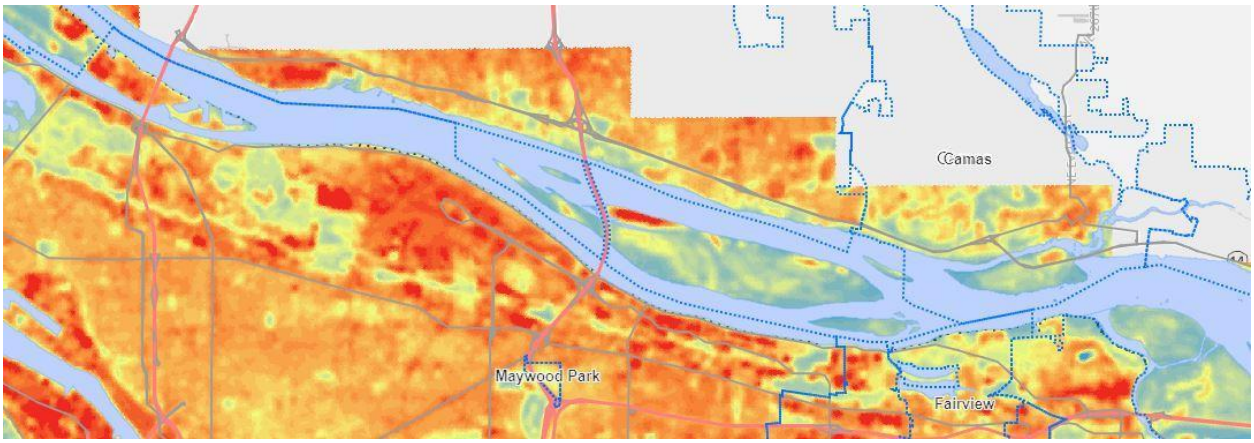


Figure 190 - Urban heat island potential in the Districts. Map from Metro.

Drought is not a significant issue for the Districts, and residents and businesses in the District areas receive water from Bull Run or aquifer well fields, which are recharged year round and are less impacted by seasonal drought. Droughts pose a risk of drying out vegetation and creating wildfire conditions.

Volcano

- *MCDD, SDIC – Risk Rating Moderate*
- *PEN 1, PEN 2, UFSWQD, CCDDJCA – Risk Rating Low*

See Volcano Section for more detailed risk and vulnerability information.

Volcanic effects to levee systems are greatly affected by their proximity to the Sandy River lahar zone. MCDD and SDIC have system operations on each side of the mouth of the Sandy River, which is the primary area of concern for these fast moving debris flows. This risk area could be very large and impacts extremely severe in a 'worst-case' Mount Hood eruption or more limited in extent and scope in a less violent event.

An interactive version of this map can be found here (Volcano Hazard – Moderate Hazard Zone)

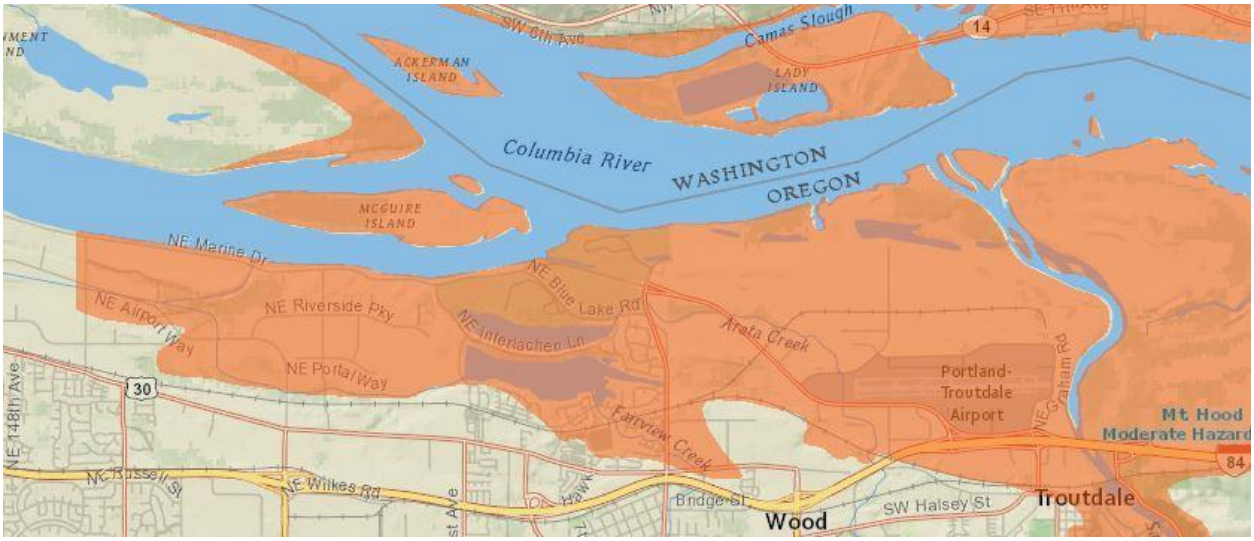


Figure 191 - Map showing risk from a volcanic lahar in an extra-large eruption (10,000-100,000 year event) of Mount Hood. Map from DOGAMI HazVu site. The study used for this image was limited to a fixed geographical boundary – effects from such a major lahar would extend further downriver beyond the western boundary indicated by the DOGAMI map.

Due to its overlapping geography along the western bank of the Sandy River Delta, SDIC has a very comparable risk level to Troutdale of both major and moderate lahars. The lahar would certainly affect drainage in the low-lying area by changing the hydrology and potentially damaging the Sandy Pump Station, which drains the basin to the Columbia River. It would also likely damage areas protected by the levee, including the Troutdale Airport, commercial areas, manufacturing/warehouse buildings, and other industrial business structures. It is unclear how it might affect the levees, which are built of sand and silt, but it's reasonable to expect impacts that may require repairs to maintain their levels of protection from flooding.

Due to its overlapping geography with Fairview near the western bank of the Sandy River Delta, eastern portions of MCDD (risk mapping ends at about NE 158th in Portland but effects would continue farther west) have a very comparable risk level to Fairview in case of a major lahar. The lahar would certainly affect drainage in the low-lying area by changing the hydrology and potentially damaging Pump Station 4 (and another smaller pump station) draining the upper basin to the Columbia River. It would also likely damage areas protected by the levee, including commercial areas, manufacturing/warehouse buildings, and other industrial business structures. It is also unclear how it might affect the levees, which are built of sand and silt, but is reasonable to imagine they would be impacted in some way and may need repairs to maintain their levels of protection from flooding.

The remaining drainage districts, as well as the western portions of MCDD, are outside of the zone and are not expected to suffer lahar impacts. As such, the hazard risk rating reflects this different level of risk between the districts.

Falling ash could impact surface waters and potentially damage utility pumping stations and other structures. Ash would also pose a significant health risk to those living or working in levee-protected areas.

Wildfire and Wildfire Smoke

- ***MCDD, PEN 2, UFSWQD, CCDDJCA – Risk Rating Moderate***
- ***PEN 1, SDIC – Risk Rating Low***

See Wildfire Smoke Section for more detailed risk and vulnerability information.

Wildfire and Wildfire Smoke risk is moderate in MCDD and PEN 2 due to the prevalence of large, drought-prone grassy areas and houseless resident camps with limited access to emergency communications and evacuation notices. PEN 1 and SDIC have slightly lower vulnerability. The average risk for the UFSWQD is closer to moderate than low.

Areas identified as having the highest risk of large fire impact by the Oregon Wildfire Explorer are along North Portland Road at the western edge of PEN1, residential areas around the Columbia Edgewater Country Club, the Blue Lake Regional Park area, and the Sandy River Delta. Most industrialized areas and open wetlands in the levee districts are considered low risk for wildfires starting or spreading into a large urban fire.

Wildfire smoke could impact levee operations due to unhealthy outdoor working conditions and is a significant health risk to those living in levee-protected areas, as with the other participating jurisdictions.

An interactive version of this map can be found here (Wildfire Potential Impacts – Overall Potential Impacts)

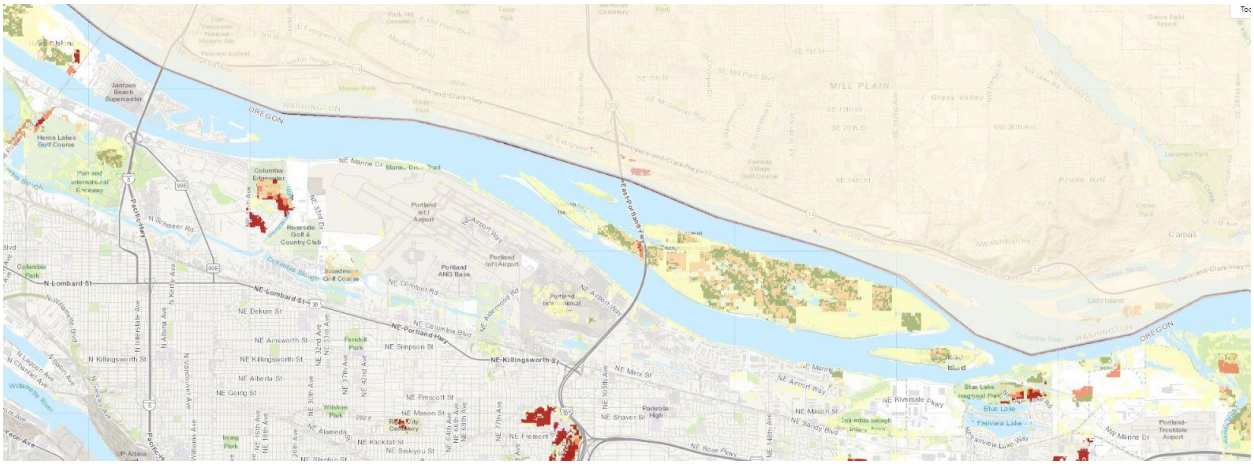


Figure 192 - Potential wildfire impact across the Columbia Corridor Drainage Districts. Areas in red would see very high impacts to structures, infrastructure, or natural resources. Areas in orange would see moderate impacts and areas in yellow would have lower impacts. Map from Oregon Wildfire Explorer with data from PNW-QWRA.

5.6.4 Hazard Risk Scores

The identified levels of risk from each hazard were determined by the Columbia Corridor Drainage Districts, using a scoring methodology designed by Oregon Emergency Management, and applied across the state to contextualize local risk perception.

Columbia Corridor Drainage Districts Natural Hazard Risk Analysis										
Hazard	History (Weight Factor = 2)		Vulnerability				Probability (Weight Factor = 7)		Risk Score	Risk Ranking
			Average (WF = 5)		Max (WF = 10)					
Earthquake (all)	2 x	**1**	5 x	**10**	10 x	**10**	7 x	**2**	**166**	**Moderate**
Flood (all)	2 x	**10**	5 x	**5**	10 x	**10**	7 x	**9**	**208**	**High**
Landslide (all)	2 x	**1**	5 x	**1**	10 x	**2**	7 x	**2**	**41**	**Low**
Severe Weather (SDIC)	2 x	**10**	5 x	**10**	10 x	**10**	7 x	**10**	**240**	**High**
Severe Weather (P1/P2/MC)	2 x	**9**	5 x	**10**	10 x	**10**	7 x	**10**	**238**	**High**
Severe Weather (CCDDJCA/UFSWQD)	2 x	**9**	5 x	**10**	10 x	**10**	7 x	**10**	**238**	**High**
Volcano (SDIC/MCDD)	2 x	**1**	5 x	**1**	10 x	**10**	7 x	**1**	**114**	**Moderate**
Volcano (P1/P2)	2 x	**1**	5 x	**1**	10 x	**5**	7 x	**1**	**64**	**Low**
Volcano (CCDDJCA/UFSWQD)	2 x	**1**	5 x	**1**	10 x	**6**	7 x	**1**	**74**	**Low**
Wildfire (MCDD)	2 x	**4**	5 x	**5**	10 x	**6**	7 x	**6**	**135**	**Moderate**
Wildfire (P1/SDIC)	2 x	**4**	5 x	**4**	10 x	**4**	7 x	**6**	**110**	**Low**
Wildfire (P2/CCDDJCA/UFSWQD)	2 x	**4**	5 x	**4**	10 x	**5**	7 x	**6**	**120**	**Moderate**

5.6.5 CCDD Aligned Plans and Other Implementation Mechanisms

Overview

The Columbia Corridor Drainage Districts have a different mitigation position compared to other participants in this plan, as a special district with authority focused on flood mitigation. All current planning and processes are focused on that goal, and are reflected in the number of mitigation actions in this plan directly tied to master planning and the Capital Improvement Program. The Districts manage an essential flood mitigation lifeline for the entire county, with 100 years of experience and expertise in infrastructure-based flood risk reduction. That long history of work is being broadened by a need for incorporating adaptive flood management strategies, and future climate change projections are becoming an essential component for ongoing and future implementation mechanisms. The Districts, as they approach consolidation,

are also working on building a community-driven all-hazards approach to resilience, even while only having authority to regulate flood.

- District Drainage Master Plans
  - Drainage Master Plans for each of the Columbia Corridor Drainage Districts were completed from 2018-2022. Each Plan provides a clear understanding of the existing drainage system within the levee systems and an outline of improvements to address both existing and future needs. To help MCDD mitigate risk, each Plan identifies capital investments to address internal drainage issues and present conceptual project solutions to be considered in the District's Capital Improvement Plan process.
    - MCDD – June 2019
    - PEN 1 – September 2022
    - PEN 2 – June 2019
    - SDIC – January 2021
- Emergency Operations Plan (under development, expected Summer 2023)
  - The Emergency Operations Plan (EOP) describes the Districts' approach to preparing for and responding to emergencies.
  - The EOP defines the roles, responsibilities and legal authorities of the Districts to mitigate flood risk within an all hazards approach and helps fulfill Federal Emergency Management Agency (FEMA) and US Army Corps of Engineers (USACE) requirements stipulating that levee operators have emergency response plans for their flood management systems.
- Flood Emergency Action Plan - Adopted July 2016
  - The purpose of the Flood Emergency Action Plan (FEAP) is to establish protocols and responsibilities for MCDD in the event of a Columbia River flood emergency within the Columbia Corridor.
  - As an annex of the EOP, the FEAP will provide a consistent framework to help residents, landowners, and partner agencies have higher awareness regarding MCDD's emergency response during rain events.
- Internal Drainage Emergency Action Plan (under development, expected Summer 2023)
  - The purpose of the Drainage Emergency Action Plan (DEAP) is to establish protocols and responsibilities for Multnomah County Drainage District #1 (MCDD) as first responders in the event of a drainage flood emergency within the levee system in the Columbia Corridor.
  - As an annex of the EOP, the DEAP will provide a consistent framework to help residents, landowners, and partner agencies have higher awareness regarding MCDD's emergency response during rain events.
- Levee Ready Columbia
  - Levee Ready Columbia is a partnership of over twenty public, private, nonprofit, and community-based organizations committed to reducing the risk of flooding within the Columbia Corridor Drainage Districts.
  - After several years of research and discussion, the LRC partners worked with local state legislators to introduce legislation to reform and modernize the way the local levee system is managed and to make a more robust set of financial tools available to support the system going forward. The State Legislature almost unanimously passed the legislation, and it was signed into law by the Governor in late July 2019. The new structure management will be permanent in 2024 and has been designed to:

        - Meet long-term flood safety needs and shifting federal standards;
        - Create a less fragmented framework for management and decision-making
        - Provide for a more equitable distribution of costs based on services and benefits received;
        - Allow for improved environmental stewardship along the levees and drainageways, which is currently prohibited under the drainage district structure; and
        - Create a more democratic and transparent selection process for board members in which significantly more people have a voice.
- MCDD Capital Improvement Plan
    - MCDD recognizes that strategic investment of its assessment dollars includes improvements to assets it owns or maintains. MCDD's Capital Improvement Plan (CIP) represents a list of projects prioritized to maximize the benefits to the internal drainage and levee systems managed by the district.
- MCDD Strategic Asset Management Plan
    - MCDD is committed to ongoing maintenance and investment in its infrastructure to ensure a modern system that will fulfill the district's mission.
    - MCDD's Strategic Asset Management Plan (SAMP) outlines the strategies and tactics required to modernize the agency's asset management approach by institutionalizing appropriate industry best practices.
- Portland Metro Levee Study
    - US Army Corps of Engineers, report completed in June 2021
    - The Portland Metro Levee System (PMLS) Feasibility Study (study) is a flood risk management general investigations feasibility study being conducted by the Portland District U.S. Army Corps of Engineers (Corps) in partnership with the Columbia Corridor Drainage Districts Joint Contracting Authority (CCDD).
    - The purpose of the study is to analyze current flood risks in the system, develop projections of future without-project conditions and identify flood risk management options that could meet current and future needs within the policies and regulations of the Corps. Implementation of this study could lead to a federally supported construction component if a solution is found to be in the federal interest.

5.7 Port of Portland

5.7.1 Mitigation Actions

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – Port of Portland</th></tr>
<tr><td rowspan="8">Multi-Hazard</td><td rowspan="8">1</td><td colspan="8">Develop internal and external programming to inform and educate employees, tenants and business partners about hazards and potential ways to mitigate them.</td></tr>
<tr><td colspan="3">Plan Goals – 1,3</td><td colspan="5">Hazards Addressed – All Hazards</td></tr>
<tr><td colspan="3">Lifelines – Airport, Marine Port</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Port of Portland Emergency Management</td><td>Port of Portland Operations</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>15</td></tr>
<tr><td colspan="8">Potential Funding – Port of Portland funding and federal grant programs</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Emergency Management activities</td></tr>
<tr><td colspan="8">Notes - This action will help communities, particularly workers and nearby residents, improve their ability to mitigate risk and exposure through education.</td></tr>
</table>

Hazard	Action ID	Mitigation Actions – Port of Portland

Multi-Hazard | **2**

Establish and maintain agreements with federal and state partners to support the use of Port facilities in response and recovery operations and identify collaborative opportunities with federal and state agencies to implement supporting on-site mitigation measures.

Plan Goals – 1,2,3,5

Hazards Addressed – All Hazards

Lifelines – Airport, Marine Port

Prioritization Criteria

Implementation Lead	Coordinating Partnerships	Equity	Benefit	Cost	Risk	Capacity	Priority Score
Port of Portland Operations	Portland of Portland Government Affairs, FEMA, OEM	**3**	**3**	**3**	**3**	**3**	**15**

Potential Funding – Port of Portland funding

Potential Implementation Methods – Emergency Management activities, Government Affairs

Notes - This low-cost, high benefit action will provide a direct benefit to those most impacted by a disaster by providing clear and pre-negotiated expectations; this will speed aid delivery and assistance.

Multi-Hazard | **3**

Document facility, infrastructure and equipment vulnerabilities to high heat and wildfire smoke; evaluate mitigation actions; and implement actions as appropriate.

Plan Goals – 3,4,5

Hazards Addressed – Severe Weather, Wildfire & Wildfire Smoke

Lifelines – Airport, Marine Port

Prioritization Criteria

Implementation Lead	Coordinating Partnerships	Equity	Benefit	Cost	Risk	Capacity	Priority Score
Port of Portland Planning and Development	Port of Portland Operations	**3**	**3**	**2**	**2**	**2**	**12**

Potential Funding – Port of Portland funding

Potential Implementation Methods – Facility Planning activities, Operational work plans, Asset Management plans, Port CIP

Notes - High heat and wildfire smoke directly impacts outdoor workers at Port facilities. Mitigating risks will provide direct benefit to workers with direct exposure to high heat and smoke.

Hazard	Action ID	Mitigation Actions – Port of Portland								
Multi-Hazard	4	**Develop and implement communications plans and systems, including automated and robotic communications and notification systems at Port facilities to mitigate risks related to communication system loss in the event of an earthquake or flood.**								
		Plan Goals - 3		Hazards Addressed – Earthquake, Flood						
		Lifelines – Airport, Marine Port		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Portland of Portland Emergency Management	Port of Portland IT	**2**	**3**	**2**	**3**	**2**	**12**	
		Potential Funding – Port of Portland funds, UASI, BRIC, other Federal grant programs								
		Potential Implementation Methods – Facility Planning activities, PDX Capital Improvement Plan, General Fund Capital Improvement Plan								
		Notes - This action will enable the Port to provide community response, providing broad social benefit by enabling support services at PDX facilities, which will increase aid distribution benefitting those impacted by disasters.								
Multi-Hazard	5	**Harden security systems and upgrade communications to address seismic and flood risks.**								
		Plan Goals – 2,3		Hazards Addressed – Earthquake, Flood						
		Lifelines – Airport, Marine Port		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Port of Portland Engineering	Port of Portland Operations, IT	**1**	**3**	**2**	**2**	**2**	**10**	
		Potential Funding – UASI and other federal grant programs								
		Potential Implementation Methods – General Fund Capital Improvement Plan								
		Notes - This action will help enable to use of Terminal 6 in maritime-based response. It provides community-wide benefit.								

Hazard	Action ID	Mitigation Actions – Port of Portland								
Multi-Hazard	6	**Assess expected climate impacts on T6 and identify and implement needed mitigation investment to ensure continued performance and longevity given heat and flood risks.**								
		Plan Goals – 1,3,4,5		Hazards Addressed – Flood, Severe Weather						
		Lifelines – Airport, Marine Port		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Port of Portland Planning and Development	Port of Portland Operations, Engineering	**3**	**3**	**3**	**3**	**3**	**15**	
		Potential Funding – Port of Portland funding								
		Potential Implementation Methods – Facility Planning Activities, General Fund Capital Improvement Plan								
		Notes - T6 is expected to provide a critical community lifeline connection for maritime aid and fuel supplies. Ensuring the facilities is adapted to new conditions is critical to providing critical lifeline services.								
Earthquake	7	**Complete the engineering and design for and construct the resilient runway seismic mitigation, construct the resilient airfield regulator building with back-up power, and related improvements needed to ensure a resilient airfield.**								
		Plan Goals – 2,3,5		Hazards Addressed – Earthquake						
		Lifelines – Airport		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Port of Portland Engineering	Port of Portland Planning and Development, Operations	**3**	**3**	**1**	**3**	**3**	**13**	
		Potential Funding – Port of Portland funding, BRIC and other federal and state programs								
		Potential Implementation Methods – PDX Capital Improvement Plan								
		Notes - A seismically resilient airport is a community lifeline that will significant speed local and regional recovery. It will provide benefits to all communities, particularly communities with fewer household resources. A resilient runway, in particular, will speed up recovery times by weeks. Portland State equity impacts analysis identified that a resilience runway will have a high level of community benefit.								

Hazard	Action ID	Mitigation Actions – Port of Portland								
Earthquake	8	**Set performance goals, update or expand seismic risk assessments and feasibility studies, identify and prioritize mitigation strategies and make investments for the airfield, concourses, terminal, maintenance facilities, parking and transportation infrastructure, passenger processing and critical utility systems, and other PDX systems and facilities as appropriate.**								
		Plan Goals – 3,5		Hazards Addressed – Earthquake						
		Lifelines – Airport		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Port of Portland Planning and Development	Port of Portland Operations	**2**	**2**	**2**	**3**	**3**	**12**	
		Potential Funding – Port of Portland funding, BRIC and other federal grant programs								
		Potential Implementation Methods – PDX Master Plan, Facility Planning Activities, PDX Capital Improvement Plan								
		Notes - A seismically resilient airport is a community lifeline that will significant speed local and regional recovery. It will provide benefits to all communities, particularly communities with fewer household resources.								
Earthquake	9	**Identify system failure points and mitigate harm to people, the environment, and infrastructure systems by implementing Earthquake Early Warning systems.**								
		Plan Goals – 1,2,3		Hazards Addressed – Earthquake						
		Lifelines – Airport, Marine Port		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Port of Portland Planning and Development	Port of Portland Engineering, Operations	**1**	**3**	**2**	**3**	**3**	**12**	
		Potential Funding – Port of Portland funding, BRIC and other federal and state programs								
		Potential Implementation Methods – PDX Capital Improvement Plan, General Fund Improvement Plan								
		Notes - This project will mitigate harm within the airport for airport workers and passengers; benefits are generally limited to those on site at the time of the event.								

Hazard	Action ID	Mitigation Actions – Port of Portland							
Earthquake	10	**Review and update the T6 seismic plan to address completed projects and identify new needs.**							
		Plan Goals – 3,5		Hazards Addressed – Earthquake					
		Lifelines – Marine Port		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Port of Portland Planning and Development	Port of Portland Operations, Engineering	**2**	**3**	**3**	**2**	**2**	**12**
		Potential Funding – Port of Portland funding, BRIC and other federal programs							
		Potential Implementation Methods – Facility Planning Activities, General Fund Capital Improvement Plan							
		Notes - This action will help enable to use of Terminal 6 in maritime-based response. It provides community-wide benefit.							
Earthquake	11	**Support investments in fueling facilities to mitigate harm resulting from an earthquake.**							
		Plan Goals – 1,2,3,4,5		Hazards Addressed – Earthquake					
		Lifelines – Airport		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Port of Portland Planning and Development	PDX Fuel Company	**3**	**3**	**1**	**3**	**1**	**11**
		Potential Funding –							
		Potential Implementation Methods – Facility Planning Activities, PDX Capital Improvement Plan							
		Notes - This action will significantly improve health and safety outcomes and protect Columbia River water quality; the Columbia River runs along numerous communities and provides a secondary water supply for the City of Portland.							

Hazard	Action ID	Mitigation Actions – Port of Portland								
Earthquake	12	**Assess seismic vulnerabilities of flood and stormwater management infrastructure that serves PDX and implement appropriate mitigation measures and risk mitigation plans; plan for and invest to improve seismic resilience and power reliability for pump stations that serve or support PDX, and mitigate flood exposure risk for critical airport facilities.**								
		Plan Goals – 2,3,5		Hazards Addressed – Earthquake						
		Lifelines – Airport		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Port of Portland Planning and Development	MCDD, UFSWQD (when created), Port of Portland Engineering	**3**	**3**	**1**	**3**	**1**	**11**	
		Potential Funding – Port of Portland funding, UFSWQD funding, federal and state grants								
		Potential Implementation Methods – Facility Planning Activities, PDX Capital Improvement Plan								
		Notes - PDX relies on the consistent functioning of levee and pump system to keep the airfield dry. Mitigating flood risk following an earthquake will allow PDX to provide a critical lifeline connection and support essential aid distribution to impacted communities.								
Earthquake	13	**Complete the construction of seismic resilience improvements at Berth 603 to enable T6 to mitigate seismic risk.**								
		Plan Goals – 3,5		Hazards Addressed – Earthquake						
		Lifelines – Marine Port		**Prioritization Criteria**						
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**	
		Port of Portland Engineering	Port of Portland Operations	**2**	**3**	**1**	**3**	**1**	**10**	
		Potential Funding – BRIC, PIDP, RAISE and other federal grant programs								
		Potential Implementation Methods – General Fund Capital Improvement Plan								
		Notes - This action will help enable to use of Terminal 6 in maritime-based response. It provides community-wide benefit.								

Hazard	Action ID	Mitigation Actions – Port of Portland							
Earthquake	14	**Mitigate seismic risk by developing a Disaster Recovery Site for technology infrastructure.**							
		Plan Goals – 3		Hazards Addressed – Earthquake					
		Lifelines – Airport		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Port of Portland IT	Port of Portland Operations	**2**	**2**	**2**	**3**	**1**	**10**
		Potential Funding – Port of Portland funding							
		Potential Implementation Methods – Business Continuity Planning, Technical Services Program							
		Notes - This action will enable the Port to provide community response, providing broad social benefit by enabling support services at PDX facilities, which will increase aid distribution benefitting those impacted by disasters							
Earthquake	15	**Plan for and invest in seismically resilient on-site emergency power and district energy systems to mitigate earthquake risk.**							
		Plan Goals – 2,3		Hazards Addressed – Earthquake					
		Lifelines – Airport		**Prioritization Criteria**					
		Implementation Lead	**Coordinating Partnerships**	**Equity**	**Benefit**	**Cost**	**Risk**	**Capacity**	**Priority Score**
		Port of Portland Planning and Development	Port of Portland Operations, Engineering	**2**	**2**	**1**	**1**	**1**	**7**
		Potential Funding – Port of Portland funding, federal and state grant programs							
		Potential Implementation Methods – Utility Resilience Planning, PDX and General Fund Capital Improvement Plan							
		Notes - This action will enable the Port to provide community response, providing broad social benefit by enabling support services at PDX facilities, which will increase aid distribution benefitting those impacted by disasters.							

<table>
<tr><th>Hazard</th><th>Action ID</th><th colspan="8">Mitigation Actions – Port of Portland</th></tr>
<tr><td rowspan="8">Volcano</td><td rowspan="8">16</td><td colspan="8">Develop a mitigation plan to protect against damage from volcanic ash.</td></tr>
<tr><td colspan="3">Plan Goals - 3</td><td colspan="5">Hazards Addressed – Earthquake</td></tr>
<tr><td colspan="3">Lifelines – Airport</td><td colspan="5">Prioritization Criteria</td></tr>
<tr><td>Implementation Lead</td><td>Coordinating Partnerships</td><td>Equity</td><td>Benefit</td><td>Cost</td><td>Risk</td><td>Capacity</td><td>Priority Score</td></tr>
<tr><td>Port of Portland Planning and Development</td><td>Port of Portland Operations</td><td>1</td><td>1</td><td>2</td><td>1</td><td>1</td><td>6</td></tr>
<tr><td colspan="8">Potential Funding – Port of Portland funding, grants</td></tr>
<tr><td colspan="8">Potential Implementation Methods – Facility Planning Activities</td></tr>
<tr><td colspan="8">Notes - This action will help protect airport operations, providing general community-wide benefit and lifeline connection.</td></tr>
</table>

5.7.2 District Overview

The 2022 Multnomah County Multi-Jurisdictional Hazard Mitigation Plan includes the Port of Portland's first NHMP, and collects years of work the Port has already done to evaluate and mitigate risk to visitors, facilities and employees from natural hazards.

Originally created by the Oregon Legislature in 1891 to dredge a shipping channel from Portland 100 miles to the sea, the Port is today charged with promoting aviation, maritime, commercial, and industrial interests within Clackamas, Multnomah, and Washington Counties. The mission of the Port of Portland is to build shared prosperity for the region through travel, trade, and economic development. The Port's vision is to contribute to a prosperous region, where quality jobs, multigenerational wealth and access to markets are equitably shared.

The Port is directed by a nine-member commission, whose members are appointed by the Governor of the State of Oregon and confirmed by the Oregon Senate.

The Port manages marine and airport facilities throughout the region that link intermodal transportation systems connecting people and local markets with each other, the nation, and beyond, and supports river navigation. In Multnomah County, the Port's facilities include Portland International Airport (Oregon's only major commercial airport) and three active marine

terminals—two on the Willamette and Terminal 6, a major container terminal on the Columbia River. The Port also owns Troutdale Airport (a general aviation airport) in the City of Troutdale and Hillsboro Airport (a general aviation airport) located in the City of Hillsboro in Washington County and not part of this plan. The Port also has a portfolio of industrial land holdings across the region.

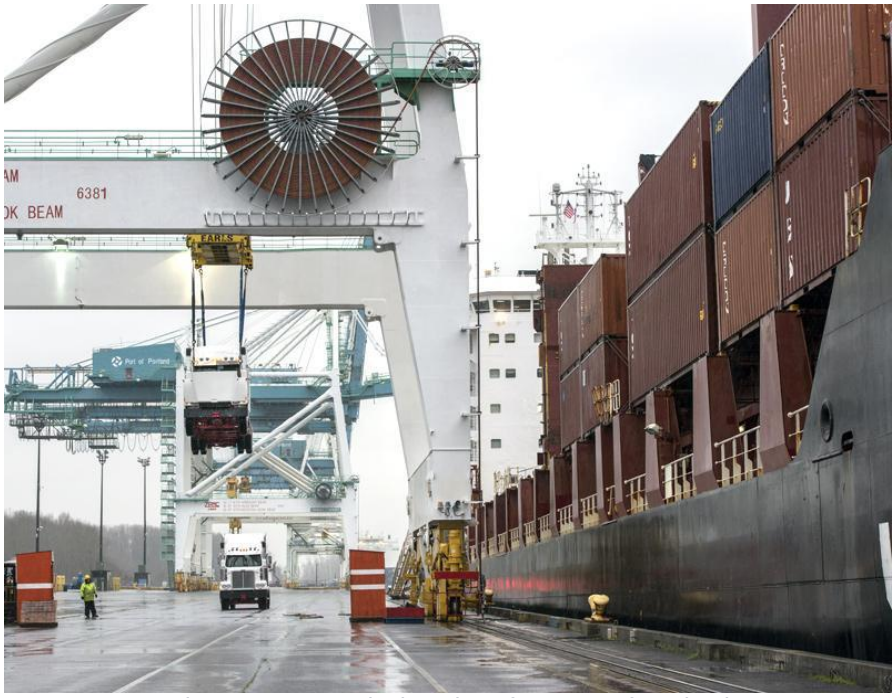


Figure 193 – Terminal 6. Photo from Port of Portland

Following the development of the first Oregon Resilience Plan, the Port's awareness of seismic risk increased, as did the Port's understanding of the essential roles it could play in supporting response and recovery. The release of the plan prompted the Port to complete a corporate seismic risk assessment, adopt a seismic resilience policy, and to develop a resilience program, initially focusing on mitigating seismic risks to Port infrastructure and facilities, but also addressing other relevant natural hazard risks. The Port has also evaluated climate and public health vulnerabilities.

As a public infrastructure and development agency, it is critical the Port provides air and marine access at all times, but especially in response to natural hazard occurrences. This critical function is amplified when considering the needs to bring in aid and supplies.

Within Multnomah County, the Port identified two critical community assets to be the focus of this plan and the Port's mitigation strategy: Portland International Airport (PDX) and Marine Terminal 6 (T6). These are the Port's largest facilities and the facilities with the greatest capacity to support large scale response and to significantly drive recovery if hazard risks are mitigated.

Mitigation Core Capabilities

As a public agency the Port has a role in helping to improve regional health, safety, and resilience. Mitigation requires capabilities necessary to reduce loss of life and property by lessening the impacts of disasters. Provided below is a summary of the Port's core mitigation capabilities:

- Planning and Long-Term Vulnerability Reduction: The Port of Portland's Planning and Development Department coordinates and implements long range airport planning, consistent with FAA requirements, as well as facility planning for the marine terminals. The Port also manages comprehensive capital improvement and asset management programs for marine terminals and three airports: PDX and two general aviation airports, one in Multnomah County (Troutdale Airport) and one in Washington County (Hillsboro Airport). The Port's Emergency Management Department manages emergency response and multiple services described under the *Operational Coordination, Administration, and Technical* category below. These functions enable planning, design, and development of infrastructure mitigation plans and projects.

- Operational Coordination, Administration and Technical: The Port has a variety of organizational, administration, and technical capabilities that enable the Port to plan for and implement mitigation projects across an array of action types and to coordinate and manage emergency response following a destructive event. The Port's Airport Communication Center (ACC) includes three call centers: Emergency Communication Center (ECC), Maintenance Operations Center and Customer Service call center. The ECC is staffed at all times and serves as the 911 center for PDX and the surrounding community. The ECC dispatches police, fire, and emergency medical services, in addition to issuing emergency notifications and fire alarm monitoring and dispatching. The majority of the communication services for PDX are provided through the ACC. The ACC also handles airport paging, customer service issues, access control system, CCTV monitoring, real time security violation tracking, as well as construction and exclusions logs. The Port also operates secure international marine facilities, which are staffed 24/7.

- Education: The Port's Emergency Management department has done outreach within the PDX Airport and Port of Portland communities, offering resiliency and preparedness presentations, participation incentives, and educational opportunities to the more than 10,000 PDX employees and hundreds of Port of Portland staff. Through this outreach, we've better prepared PDX and Port of Portland employees for seismic and other natural hazard events.

- Financial: The Port of Portland has resources and funds to complete mitigation projects, and projects would be reviewed for funding options through the Port's capital improvement and asset management programs. Non-capital projects—such as plan development and education—can be supported through the same mechanisms the Port uses for activities for other purposes. The Port's bonding and tax authorities and parameters are defined in Oregon Revised Statute 778.

Critical Community Assets

Within the Multnomah County Multi-Jurisdictional Natural Hazard Mitigation Plan, the Port of Portland focuses on mitigating natural hazard risks to two community assets of regional and statewide importance: Portland International Airport (PDX) and Marine Terminal 6 (T6).

Risks at these facilities need to be mitigated to ensure the Port can provide essential services and support during emergency response and disaster recovery. Port goals and actions within this plan are intended to mitigate risks at those two facilities to improve Oregon's disaster resilience and to provide key lifeline connections in the event of a natural disaster. These facilities can support the work of Federal, State, and regional and local response and are essential to facilitating recovery.

Portland International Airport (PDX) – PDX is located in the north-central portion of Multnomah County behind the Columbia River levee system. Access to PDX is from NE Airport Way which connects to I-205 and 82nd Avenue. Marine Drive runs along the north side of the airport and separates the airport from the Columbia River. NE 33rd Avenue is the westernmost border of the airport. PDX is located within the protection area of the Multnomah County Drainage District.

PDX provides access to commercial, freight, and private air service. In 2019, PDX served nearly 20 million passengers, and was a major air freight gateway, essential to meet the needs of key Oregon industries. In 2022, passenger volumes are starting to return to pre-pandemic levels. Air freight remains strong.

Figure 194 - Location of the Portland International Airport

PDX facilities include the main Terminal area, which is currently under expansion, and the B, C, D, and E concourses. There are three large parking structures; a Rental Car Center, which includes the Port's Emergency Operations Center; a separate Maintenance Campus in the southeast portion of the Port's properties; FAA structures; emergency response facilities; private aviation and air cargo operations, among other operations.

Mitigating natural hazard risks at PDX increases near-term regional and statewide access to emergency supplies and response aid, which supports emergency response and enables longer-term recovery.

Following the development of the first Oregon Resilience Plan, the Port's awareness of seismic risk increased, as did the Port's understanding of the essential roles it could play in supporting response and recovery. The release of the plan prompted the Port to complete a corporate seismic risk assessment, adopt a seismic resilience policy, and to develop a resilience program, initially focusing on mitigating seismic risks to Port infrastructure and facilities, but also addressing other relevant natural hazard risks. The Port has also evaluated climate and public health vulnerabilities.

Marine Terminal 6 **–** Terminal 6 (T6) is a 419-acre multi-purpose marine terminal along the Columbia River in Portland. It is in the northwestern corner of Portland in an area dominated by industrial uses and open space areas at the confluence of the Columbia and Willamette Rivers and bordered to the south by Smith and Bybee Lakes. T6 features five active vessel berths capable of handling oversized, breakbulk cargo, automobiles, renewable energy cargo, and containers. Along with access to major east-west and north-south highways, it has direct multimodal connectivity and on-dock rail access to the transcontinental rail network, supported by a 52.5-acre intermodal rail terminal. As one of a limited number of Pacific coast deep-water ports, the Port of Portland is crucial to the regional and national economy, facilitating $15.4 billion worth of trade throughout the Pacific Northwest and Midwest. T6 is the major container shipping port on the south side of the Columbia River. Mitigating risks at T6 provides an opportunity to support emergency supply and fuel distribution via ship to Oregon and supports longer-term recovery.

Figure 195 - Location of Marine Terminal 6 (T6)

Recent Hazard Mitigation Activities

The Port has invested in research and analysis to better understand hazard risks and has completed or is completing significant investments that mitigate natural hazard risks to PDX and T6. Provided below are summaries of the Port's recent successes.

Corporate Seismic Risk Assessment – In 2015, the Port completed an assessment of seismic risk and vulnerabilities of multiple structures at PDX and identified approaches for mitigating seismic vulnerability and/or additional studies needed to better understand mitigation options. Multiple projects in the Port's current expansion of PDX are the result of the 2015 Corporate Seismic Risk Assessment.

Resilient Runway Analyses – The Port completed numerous analyses to understand the seismic vulnerabilities of the PDX runways, to develop concepts for how to mitigate risks to runways, the benefits and costs of seismically mitigating one runway, and the community equity benefits of having a functional runway at PDX following a major Cascadia Subduction Zone earthquake.

- *Applied technical research with Oregon State University (OSU) and private consultants* – OSU researchers completed in situ testing of soils at PDX to understand how the soil column performs at different depths. The OSU study provided critical additional background information for Port consultants, GRI, Inc., to complete a conceptual design for mitigating vertical settlement due to liquefaction at PDX's South Runway.

- *National Institute of Building Sciences Resilient Runway Benefit Cost Assessment* – A National Institute of Building Sciences study indicated that investing in a resilient runway would provide a 50:1 benefit to cost ratio for each dollar spent on runway resilience. The benefit to cost ratio was based on preventing runway damage, enhancing response logistics including allowing the arrival of medical and structural engineering support, and avoiding business interruption. The study did not assess qualitative community benefits, or the financial benefit of preserving airfield access for the Oregon Air National Guard, which is located adjacent to PDX's South Runway.

- *Portland State University Runway Equity Study* – Researchers at Portland State University completed qualitative and quantitative analyses aimed at understanding the community-level benefits of having a resilient runway. The analyses indicated that a fast recovery is a top priority for people of color, and that the presence of functional facilities, like PDX—even if not directly accessed—will help provide a feeling of hope and progress, along with providing quantitative benefits in terms of response and recovery capacity.

In 2021 and 2022, the Port of Portland secured significant support from the State of Oregon and a federal congressional allocation to complete the engineering and construction documents for mitigating seismic risk on PDX's South Runway.

PDX Next Seismic Improvements – As part of the Port's major expansion of PDX, numerous seismic mitigation projects have been completed or are underway. Specifically, through PDXNext, the Port constructed a concourse extension on a resilient structural slab that is designed to be repairable after a major Cascadia Subduction Zone earthquake. Significant improvements are being made in the Terminal core area which will dramatically increase seismic performance and health and safety for travelers and workers. The Port also constructed the new Emergency Operations and Communications Center on a base isolated floor; this location is built to be immediately operational following a major earthquake.

Seismic Resilience Plan: Marine Facilities – In 2019, the Port completed a marine facility resilience plan to identify projects needed to mitigate seismic risk at Port marine facilities and identify where to focus the Port's resilience investments. This plan includes a comprehensive list of needed seismic improvements and identifies the Port's focus on mitigating risks at T6.

PDX Climate Vulnerabilities Assessment – In 2022, the Port completed a high-level scan of major climate vulnerabilities at PDX. The analysis found that high heat, smoke, and higher intensity rain events related to climate change pose the greatest risks to PDX.

Terminal 6 Resilience Assessment – In 2022, the Department of Homeland Security Cybersecurity and Infrastructure Security Agency finalized its Resilience Guide. It identified T6

as a critical facility to assist in mitigating for Cascadia Subduction Zone seismic events and assessed the degree to which investments in infrastructure can mitigate impacts from seismic events.

Recent Hazard Events

Port of Portland facilities were most recently impacted by the severe Wildfire Smoke event in September 2020. Regional fires caused air quality to reach severely unhealthy levels, with smoke infiltrating Port properties and affecting outdoor workers and passengers. Operational impacts included canceled flights due to low visibility, temporary closure of some businesses inside the airport, suspension of outdoor construction projects, and moving employees indoors when able. Extreme high heat also impacted construction projects, employees working outside, and taxed systems necessary to mitigate heat and smoke impacts.

Operational impacts and actions on the marine side were similar in that terminal managers provided critical employees, like security officers, with N95 masks and other health and safety services to enable continuation of outside work activities.

Winter storms impacted operations in both 2017 and 2021—in both cases causing runway closures and stranding passengers, as well as impacting transportation access to and from Port facilities.

5.7.3 Port of Portland Local Hazard Analysis

Earthquake – Risk Rating High

See Earthquake Section for more detailed risk and vulnerability information.

The risk of a subduction zone, crustal, or intraplate earthquake is the most significant risk faced by the Port of Portland's critical facilities. Both PDX and T6 are located in floodplains with loose, sandy soils that are extremely susceptible to soil liquefaction and resultant loss of load bearing strength. Most critical Port buildings at PDX are supported on piles, which provide better performance in earthquakes, but with varying levels of structural resilience. As noted under Recent Mitigation Successes, seismic performance has been or is being upgraded in PDX structures including the Terminal Core, the Rental Car Center which includes the Port's Emergency Operations Center, and in the Concourse E extension. Older buildings would face considerable risk in a moderate earthquake, and floor slabs in all buildings could be damaged.

Airfield pavement, roadways and buried utilities are also at considerable risk, and areas near the Columbia River are subject to lateral spreading as well as settlement due to liquefaction.

Marine terminals would suffer similar impacts, with shipping berths and other structures being located on the water and having inherent structural vulnerability to severe lateral spreading. Upgrades in the last ten years have made some marine facilities more resistant to earthquakes, but a larger event could disrupt some areas from four months to nearly two years.

An interactive version of this map can be found here (Earthquake Hazard – Earthquake Liquefaction (Soft Soil) Hazard)

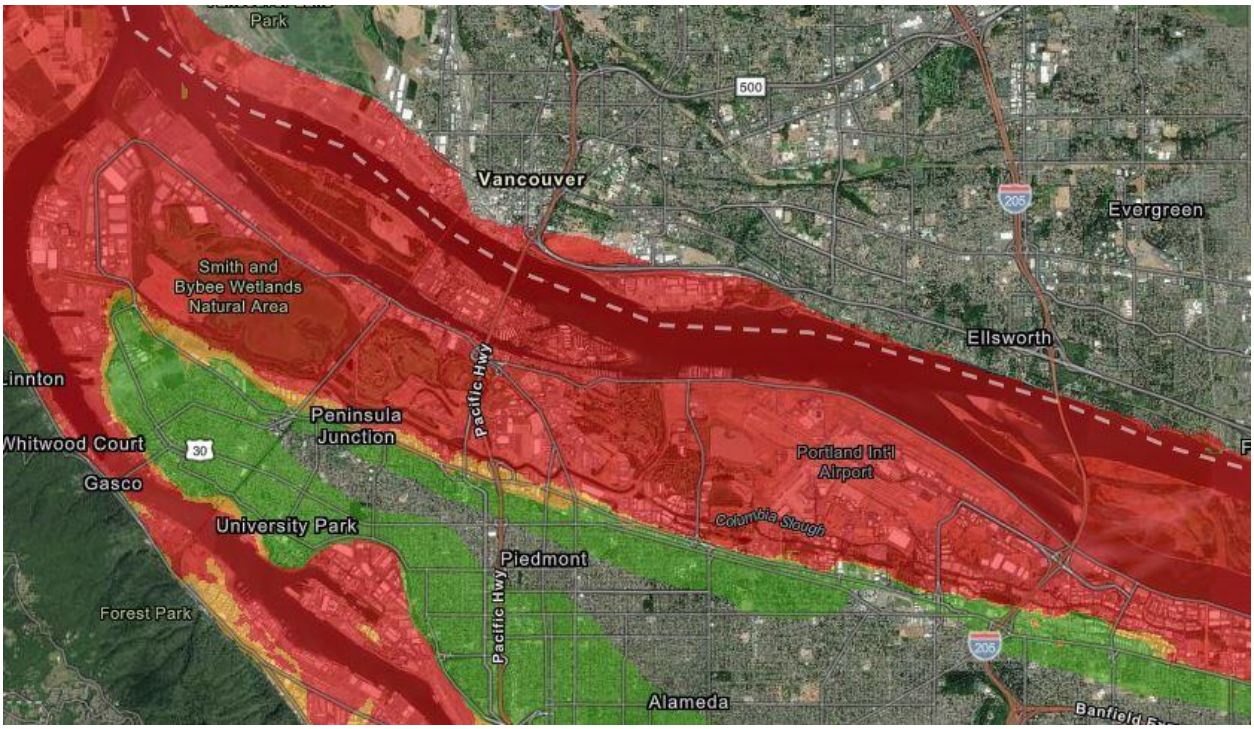


Figure 196 - Map showing soil liquefaction risk at the Port of Portland's critical community assets. Areas in red, which include the Portland International Airport and Terminal 6, have high risk of soil liquefaction. Map from DOGAMI HazVu site.

Flood – Risk Rating Moderate

See Flood Section for more detailed risk and vulnerability information.

Flood is considered a moderate threat in the Port of Portland's risk rankings. Because of flood protection infrastructure, PDX remains dry from river flooding and generally only is required to react to stormwater management issues in the interior of the levee system. T6 could be subject to Willamette and Columbia River flooding, but only catastrophic events are currently shown to cause widespread site flooding. A levee failure during a flood stage would likely be the worst-case scenario for the Port of Portland and could cause catastrophic damage.

The entirety of PDX is located in an area protected from flood by the Multnomah County Drainage District. Some small interior drainage channels and ponding areas are mapped on FEMA maps as risk zones, but they are contained or small in size and do not indicate flooding risk to structures or other infrastructure, even in a larger 500-year event.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

Figure 197 - Map showing mapped flood risk at and near the Portland International Airport. Areas in blue are the 1% annual chance (100-year) floodplain and purple is the 0.2% annual chance (500-year) floodplain. The floodway is shown in red. Levee protection has removed most of PDX from having mapped floodplain on FEMA's Flood Insurance Rate Maps. Map from DOGAMI HazVu site.

A failure of flood control systems could be very damaging to PDX facilities, causing major disruption to the community, significant building damage and creating risk of hazardous material discharge. Maintaining on-site pump systems is a priority for the Port, as are large-scale levee maintenance activities. The DOGAMI risk assessment for a breach or overtopping of the levee system recommended a detailed economic impact study that would include an assessment of direct business income loss as well as long-term, regional indirect impacts of the closure and restoration of the Portland International Airport due to flooding.

T6 is not protected by a levee system and does have some risk to flooding of facilities directly adjacent to the Columbia River. A larger 500-year event could see flooding across lots and facilities from both the Columbia River and backflow from the Willamette River on the Columbia Slough.

An interactive version of this map can be found here (Flood Hazard – Effective FEMA Flood Data)

Figure 198 - Map showing mapped flood risk at Terminal 6. Areas in blue are the 1% annual chance (100-year) floodplain and purple is the 0.2% annual chance (500-year) floodplain. The floodway is shown in red. Map from DOGAMI HazVu site.

Landslide – Risk Rating Low

See Landslide Section for more detailed risk and vulnerability information.

Landslide is considered a low-risk hazard at PDX and Terminal 6, which are located in flat floodplains. There is no identified susceptibility to deep landslides anywhere on Port property and shallow landslide potential is primarily limited to road berms, levees and other small-scale engineered slopes.

An interactive version of this map can be found here (Landslide Susceptibility – Susceptability to Shallow Landslides)

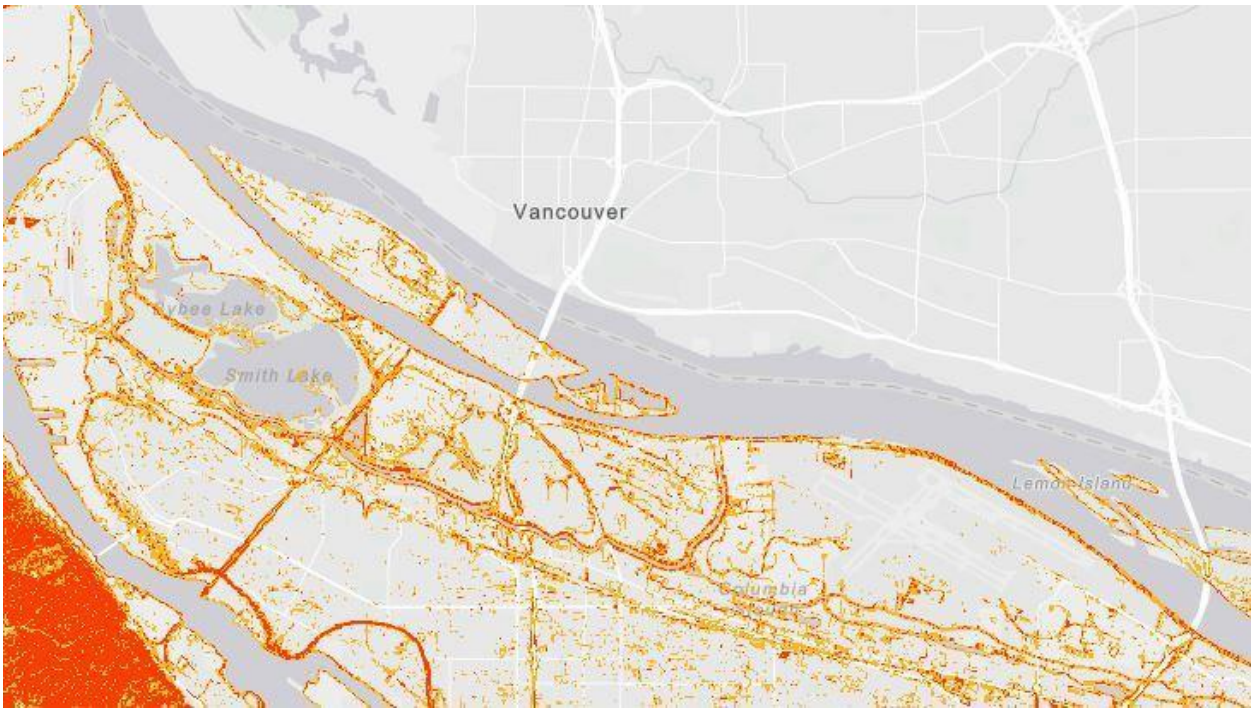


Figure 199 - Map showing shallow landslide risk at the Port of Portland's critical community assets. Red areas have the higher risk, with orange having more moderate risk and yellow areas with lower risk. Areas with no color have no landslide risk. Map from DOGAMI's SLIDO site.

Severe Weather – Risk Rating Moderate

See Severe Weather Section for more detailed risk and vulnerability information.

Climate events impact the Port by interrupting operations at air or marine terminals because of unsafe conditions. Those conditions may cause health and safety impacts to the portion of the Port's workforce that is required to work outdoors, or prevent access to facilities. Disruptions from these events have been short-term in recent years, even when events have been extreme, leading to a moderate risk classification.

The Port's built environment is reflective of needs and requirements for the types of facilities. At both PDX and T6, vast paved areas on the airfield and in parking areas, and vast paved areas to support cargo movement mean that tree canopy is limited, and urban heat island effects are quite severe. Since there are no residential areas affected by these heat islands, their impact is primarily to employees at risk working in these areas during high heat events. There were no heat-related deaths at Port facilities during the 2021 Heat Dome event.

An interactive version of this map can be found here

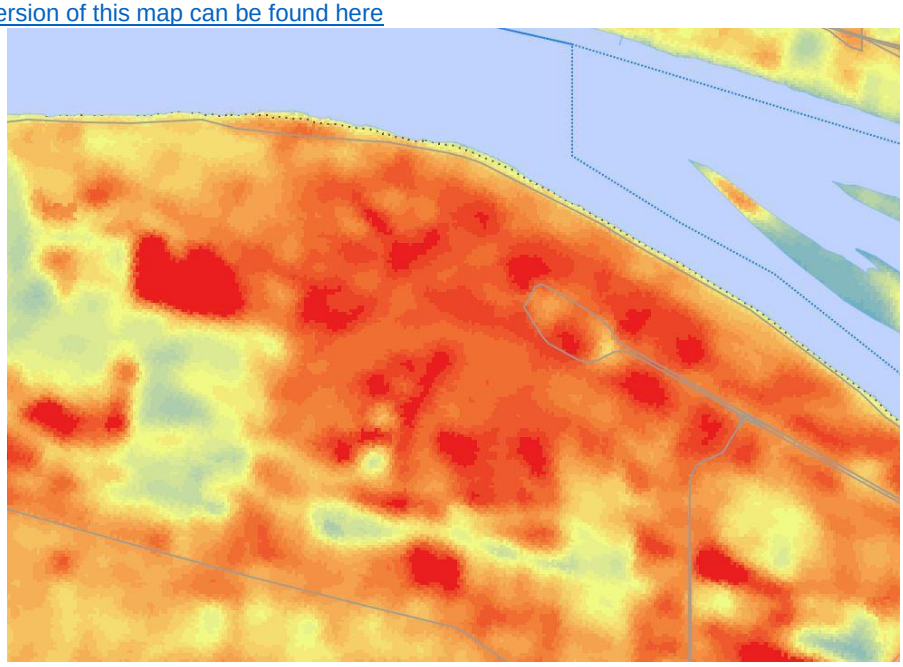


Figure 200 - Map showing heat island effects at PDX, with areas in red having the most intense effects. Map from Metro.

An interactive version of this map can be found here

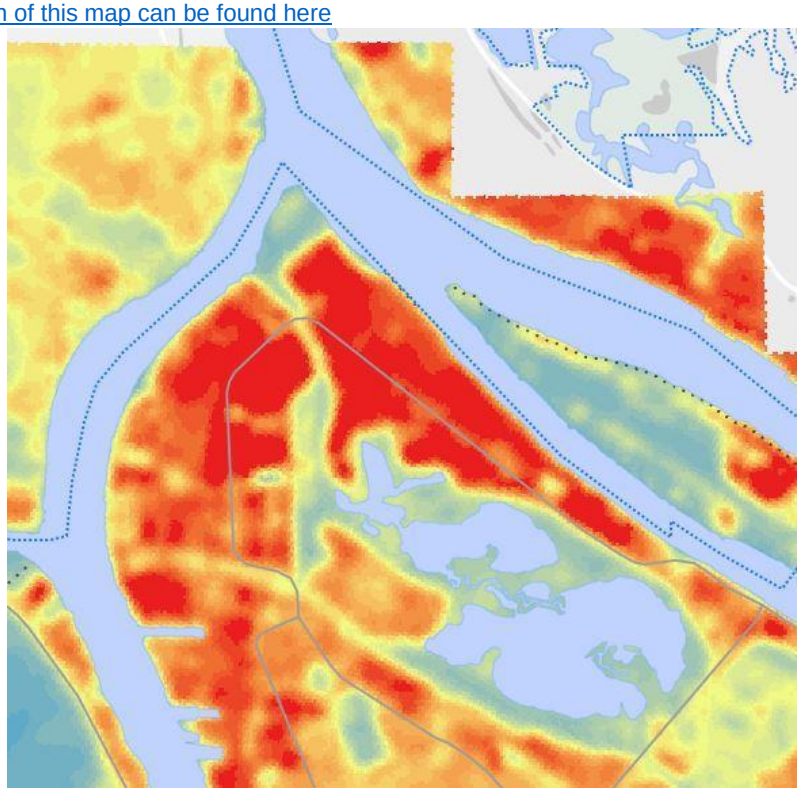


Figure 201 - Map showing heat island effects at T6 with areas in red having the most intense effects. Map from Metro.

Winter storms have created disruptions in recent years by closing operations or creating risk for employees or those attempting to travel to Port facilities.
Significant windstorms have not been as prevalent in the last several years, but another event similar to the Columbus Day Storm in 1962 could be enormously disruptive. In that event, hurricane force winds flipped over small airplanes and a repeated incident would test the resilience of structures at both facilities.

Drought is not a significant issue for port operations. Water supply comes from the City of Portland sources at the Bull Run Reservoir and backup wells in the Columbia River Wellfield. Both sources are recharged through rain and are not reliant on snowpack to maintain surface water levels in the summer. The Port also has water rights for non-potable use at PDX.

Volcano – Risk Rating Low

See Volcano Section for more detailed risk and vulnerability information.

The primary risk to Port operations from a volcanic eruption comes from impacts to air operations and HVAC systems from falling ash in a regional eruption. Volcanic ash is disruptive to operations of airplanes, by damaging surfaces, machinery and instruments. Significant ash events have completely shut down air travel when wind patterns have carried it over urban areas, even when volcanoes are some distance away. Ash can also disrupt airport operations when ground accumulations are sufficient to make runways unusable, and in large enough events accumulating ash could be a threat to the operation and stability of some Port buildings.

The threat of a lahar, a fast-moving debris flow that could flow down the Sandy River after an eruption of Mount Hood, has been the main focus of volcano risk in this plan. A lahar from a worst-case eruption of Mount Hood, could cause catastrophic damage at the Troutdale Airport, but PDX is located too far west to likely see any significant impacts.

Wildfire and Wildfire Smoke – Risk Rating Moderate

See Wildfire and Wildfire Smoke Section for more detailed risk and vulnerability information.

The risk classification of moderate is primarily due to vulnerability to wildfire smoke. As with severe heat events, outdoor workers would be at risk from respiratory hazard and potential combined effects from heat. Jet traffic was able to continue during the worst of the 2020 September Wildfire Smoke event, but continued operations meant employees were required to continue working in unhealthy air, requiring personal safety measures. Terminal 6 continued operations in 2020, unimpeded by the wildfire smoke event although employees were similarly affected as at PDX.

Port facilities themselves are at low risk from wildfire. The intense development and lack of tree canopy at both facilities make anything more than small grass fires unlikely. There is some risk of larger wildfire in open spaces near PDX, but significant transmission is not anticipated. Fire risk maps from the Oregon Wildfire Risk Explorer only include fire probability for wildfires of 250 acres or more, so events that could threaten structures on a small scale may not be captured.

[An interactive version of this map can be found here (Wildfire Potenial Impacts – Overall Potential Impacts)]

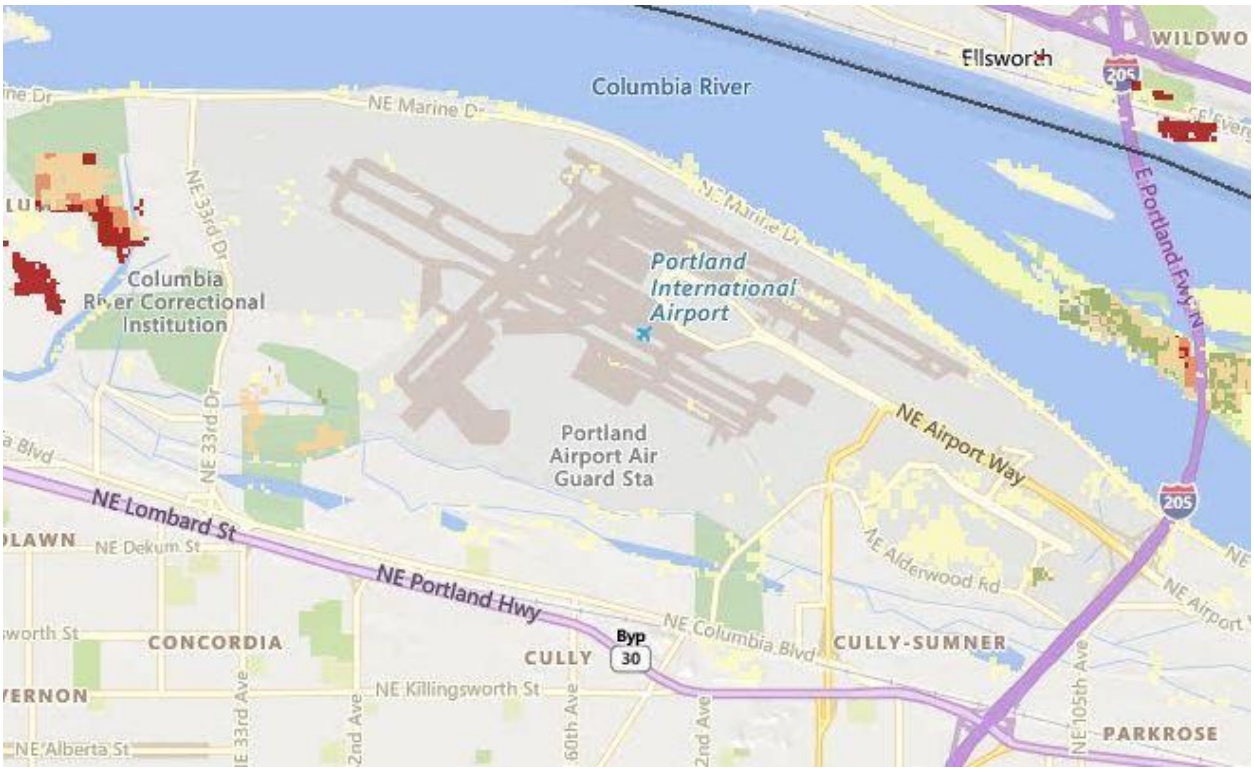


Figure 202 - Map showing areas with risk of ignition of a wildfire of 250 acres or more near PDX. Areas in red would have the highest wildfire impacts to people or infrastructure. Map from Oregon Wildfire Explorer with data from PNW-QWRA.

5.7.4 Hazard Risk Scoring

The identified levels of risk from each hazard were determined by the Port of Portland, using a scoring methodology designed by Oregon Emergency Management, and applied across the state to contextualize local risk perception.

Port of Portland Hazard Risk Analysis						
Hazard	History (Weight Factor = 2)	Vulnerability		Probability (Weight Factor = 7)	Risk Score	Initial Risk Ranking
		Average (WF = 5)	Max (WF = 10)			
Earthquake	2 x 1	5 x 10	10 x 10	7 x 5	187	**High**
Flood	2 x 1	5 x 10	10 x 10	7 x 2	166	**Moderate**
Landslide	2 x 1	5 x 3	10 x 3	7 x 1	54	**Low**
Severe Weather – Extreme Heat, Winter Storm, Windstorm, Drought	2 x 4	5 x 6	10 x 7	7 x 8	164	**Moderate**
Extreme Heat	2 x 5	5 x 7	10 x 8	7 x 8	181	
Winter Storm	2 X 5	5 x 7	10 x 8	7 x 8	181	
Windstorm	2 x 4	5 x 7	10 x 8	7 x 8	179	
Drought	2 x 1	5 x 1	10 x 4	7 x 8	103	
Volcano	2 x 1	5 x 7	10 x 8	7 x 1	124	**Low**
Wildfire and Wildfire Smoke					157	**Moderate**
Wildfire	2 x 2	5 x 5	10 x 5	7 x 3	100	
Wildfire Smoke	2 x 4	5 x 8	10 x 8	7 x 10	198	

5.7.5 Port of Portland Plans and Other Implementation Processes

Overview

The Port of Portland's hazard mitigation implementation strategy is driven by its values and principles and the need to maintain key air service and maritime community lifelines in the wake of a natural hazard event and to improve the resilience of facilities under changing conditions. Resilience is advanced internally through the Port's Resilience Program, through cross-departmental teams aimed at improving energy efficiency, and through the Port's Stormwater Master Plan. As a result, mitigation projects are competitive when determining investment priorities. Close coordination with the Columbia Corridor Drainage District enhances flood resilience for facilities in levee-protected areas.

- Port of Portland Capital Improvement Plan
  - The Capital Improvement Plan (CIP) allocates funding from all Port funding sources (Airline, Port, and General Fund cost centers) that could be used for natural hazards mitigation.
- PDX Stormwater Master Plan, 2015
  - The PDX Stormwater Master Plan identifies specific projects and performance standards that mitigate risks related to stormwater, and support the development of specific mitigation projects.
- PDX Master Plan, currently under update
  - The PDX Master Plan will consider and integrate needs to improve hazard resilience – building on the Port's many seismic risk studies and the climate vulnerabilities assessment. The content of the master plan provides policy guidance for many Port projects included in the Port CIP.
- 2015 Port Seismic Risk Assessment
  - The Port Seismic Risk Assessment identifies seismic vulnerabilities at numerous Port facilities; and it provides recommendations for specific actions the Port can implement to mitigate seismic risk.
- 2021 Portland Resilient Runway Benefit-Cost Analysis, National Institute of Building Sciences
  - The NIBS's cost benefit-assessment assesses risks from a Cascadia Subduction Zone earthquake in the region, and provides detailed information on the benefits of constructing a resilient runway at PDX. This report will be used to educate communities about risk, and to provide information on the quantitative benefits of investing in mitigation. It can also be used by others to develop additional risk mitigation actions.
- Portland Resilient Runway Equity Study, Portland State University
  - The Resilient Runway Equity Study provides a quantitative and qualitative portrait of which workers would be most negatively impacted by a long-term airport shut down as the result of a catastrophic earthquake and documents the community benefit of investing in PDX resilience, providing important background information on how seismic investments benefit the community, particularly communities with fewer resources.
- Dynamic In Situ Nonlinear Inelastic Response of a Deep Medium Dense Sand Deposit; Amalesh Jana and Armin Studlein

- This technical analysis provided important information on the specific soil conditions along the Columbia River in the PDX area, which greatly improves the specificity of the design of mitigation projects. This information can also be used by regional partners to inform their project designs.

Chapter 6 – Plan Maintenance and Implementation

The Steering Committee retains responsibility for coordinating maintenance of this plan and tracking mitigation action implementation. Each participating entity will continue to maintain a presence on the Steering Committee through the kickoff of the next update process.

6.1 Continuing Mitigation Planning

Natural Hazard Mitigation Plans are required to be updated every five years to maintain compliance for FEMA Mitigation Grants. Much work is required in between the adoption of required updates to ensure that hazard mitigation strategies have accountability but also can be adjusted as needed in response to new data, changed local priorities, and hazard events.

The Multi-Jurisdictional Steering Committee will continue to meet twice per year in this 'maintenance phase'. Minor updates to the plan will be considered during this period, if needed.

6.2 Continuing Public Participation

Public comment was important for the development and direction of this plan. Public participation is not limited to the timeline required during the update process. Some continuing community engagement strategies are included as mitigation actions, but each participating entity will also continue public input processes and the recordation of public comment to direct future plan changes and become input in the next version of this plan.

6.3 Implementation Mechanisms

6.3.1 Integration into Other Plans

Each participating entity in this plan has their own set of planning and funding processes and strategic initiatives that relate to hazard mitigation. Leveraging those existing processes is an important way to build broad support for identified mitigation priorities. Aligned plans and other strategic processes are listed at the end of each jurisdictional/district chapter for that entity.

6.3.2 Funding

Lack of local resources are a common barrier to mitigation implementation. Most actions are expected to be funded through existing funds - often via general budgets for capital improvement, outreach, and other purposes. However, not all actions will be able to be supported through local budgets and will require external funding to be completed.

Grants are an essential resource for successful mitigation, making up that local resource limitation. Most grants will still require a cost-share, as well as support for grant management, cost-benefit analyses, and other administrative tasks. Entities in this plan can work together to support multi-jurisdictional grants, or simply provide peer support for identifying and managing opportunities.

Some grants are identified in this section, although this should not be considered an exhaustive list of current or future opportunities. Grants mentioned as potential funding sources in the mitigation actions are included for reference. Some grants listed in this section have been long-

term annual opportunities, while others are new and may not have funding for permanent support or may have already expired by the time of plan adoption.

Grants

- **Local and Regional Funding Programs**

  Partners in Conservation (PIC) – PIC grants are funded by the East Multnomah Soil and Water Conservation District (EMSWCD) to support water quality, soil health, habitat restoration, and sustainable agriculture. Local governments are eligible recipients are eligible projects can include the increasing of tree canopies and reduction of disparities to people and communities in access to environmental health and natural amenities. EMSWCD serves all of Multnomah County east of the Willamette River, covering all of the entities included in this plan.

  Urban Area Security Initiative (UASI) – UASI grants are a Federal program funded by the Department of Homeland Security. However, the grants are locally managed by the Regional Disaster Preparedness Organization (RDPO), which evaluates project applications with a regional perspective. Grants have a nexus to catastrophic event risk reduction.

- **State Funding Programs**

  Seismic Rehabilitation Grant Program – Administered by Business Oregon, this annual statewide competitive grant provides funding for the seismic resilience of critical public facilities, especially schools and emergency services buildings.

  Senate Bill 762 Programs – Grant programs identified through the Wildfire and Wildfire Smoke legislation are being administered by the Oregon Department of Forestry (past grants have included Landscape Resiliency Program and Small Forestland Grant Program), Office of the State Fire Marshal (Wildland Urban Interface Assistance Grant),

and the Oregon Department of Environmental Quality (Smoke Management-Community Response Plans).

Oregon Water Enhancement Board (OWEB) – OWEB provides a number of different grant programs for the purpose of watershed protection, many of which have connections to hazard mitigation goals. Programs have included programs for post-wildfire restoration, forest restoration, drought relief, and wetland conservation.

- **Federal Funding Programs**

FEMA Hazard Mitigation Assistance (HMA) – HMA is a group of pre- and post-disaster hazard mitigation grants that are designed to reduce risks identified in local Natural Hazards Mitigation Plans. These annual grants are the most significant source of external mitigation funding for local governments and special districts

Building Resilient Infrastructure and Communities (BRIC) – BRIC is a relatively new pre-disaster program created to prioritize large mitigation projects that reduce risk at an infrastructure or community schedule. As with all HMA grants, mitigation projects must be identified in the NHMP.

Flood Mitigation Assistance (FMA) – An annual pre-disaster grant focused on reducing flood losses – especially in locations with repeated losses.

Hazard Mitigation Grant Program (HMGP) – Post-disaster funding available after a presidentially-declared disaster in a state. While funds are normally prioritized for the type and location of the disaster, funds often become available statewide.

Hazard Mitigation Grant Program Post Fire (HMGP-Post Fire) – Another post-disaster mitigation grant specifically for wildfire risk reduction activities.

Pre-Disaster Mitigation Grant Program (PDM) – This annual program for pre-disaster mitigation was replace after 2019 with BRIC, but returned in 2022 to provide an additional source of pre-disaster funds.

FEMA Public Assistance (PA) – A major source of post-disaster recovery funding. PA provides reimbursement for actions such as debris removal and the restoration of key infrastructure.

Community Wildfire Defense Grant (CWDG) – The most significant grant program currently provided by the US Forest Service, and administered by the Oregon Department of Forestry. CWDG grants require that local Community Wildfire Protection Plans be less than ten years old and identify wildfire risk reduction projects that can be taken on by fire districts, local jurisdictions and certain community groups.

Environmental Protection Agency (EPA) – The EPA provides support for activities to reduce risk from extreme heat and wildfire smoke, and other elements of climate adaptation. The Wildfire Smoke Preparedness in Community Buildings Grant Program supports the upgrading of community facilities into clean air spaces and other grants support environmental justice projects and the development of green infrastructure.

Small Business Administration (SBA) – SBA provides low-interest loans to help businesses, non-profit organizations and homeowners recover from presidentially-declared disasters. Funding is available for losses that are not covered by insurance of FEMA post-disaster funding.

US Army Corps of Engineers (USACE) – USACE primary serves local mitigation as a contractor, providing engineering capacity and expertise, as with the Portland Metropolitan Levee Feasibility Study (PMLS). USACE does have some grants, including the Corps Water Infrastructure Financing Program (CWIFP), with a current appropriation for upgrading, repairing or maintaining dams.

US Department of Housing and Urban Development – Community Development Block Grants (CDBG) – The CDBG-MIT (Mitigation) program is specifically for pre-disaster mitigation activities that reduce disaster risk to HUD-identified impacted and distressed communities. The CDBG-DR (Disaster Recovery) program serves the same communities with post-disaster recovery funding.

US Department of Transportation (USDOT) – Grants from USDOT are most significant to the Port of Portland, as a major provider of air transportation and port infrastructure.

Port Infrastructure Development Program (PIDP) – A grant from the Maritime Division of USDOT that provides funding for planning and capital projects to improve the safety and reliability of port services.

Rebuilding American Infrastructure with Sustainability and Equity (RAISE) – An annual program to provide funds to complete critical freight and passenger transportation infrastructure projects, especially those that are not able to be completed through other USDOT grants.

ANNEX A – Federal Requirements Crosswalk and Plan Assessment

Local Mitigation Plan Review Tool

Cover Page

The Local Mitigation Plan Review Tool (PRT) demonstrates how the local mitigation plan meets the regulation in 44 CFR § 201.6 and offers states and FEMA Mitigation Planners an opportunity to provide feedback to the local governments, including special districts.

1. The Multi-Jurisdictional Summary Sheet is a worksheet that is used to document how each jurisdiction met the requirements of the plan elements (Planning Process; Risk Assessment; Mitigation Strategy; Plan Maintenance; Plan Update; and Plan Adoption).
2. The Plan Review Checklist summarizes FEMA's evaluation of whether the plan has addressed all requirements.

For greater clarification of the elements in the Plan Review Checklist, please see Section 4 of this guide. Definitions of the terms and phrases used in the PRT can be found in Appendix E of this guide.

Plan Information	
Jurisdiction(s)	Multnomah County, City of Fairview, City of Gresham, City of Troutdale, City of Wood Village, Multnomah County Drainage District, PEN 1 Drainage District, PEN 2 Drainage District, Sandy Drainage Investment Company, Columbia Corridor Drainage Districts Joint Contracting Authority, Urban Flood Safety and Water Quality District, Port of Portland
Title of Plan	Multnomah County Multi-Jurisdictional Natural Hazards Mitigation Plan
New Plan or Update	Update
Single- or Multi-Jurisdiction	Multi-jurisdiction

Date of Plan	7/15/2023
Local Point of Contact	
Title	David Lentzner, Planner
Agency	Multnomah County Emergency Management
Address	501 SE Hawthorne Blvd, Suite 400, Portland, OR 97214
Phone Number	503-679-3275
Email	David.lentzner@multco.us

Review Information	
State Review	
State Reviewer(s) and Title	Jason Gately, Mitigation Planner & Program Representative
State Review Date	7/26/2023
FEMA Review	
FEMA Reviewer(s) and Title	Ellie Schwartz, CERC Planner
Date Received in FEMA Region	Click or tap to enter a date.
Plan Not Approved	Click or tap to enter a date.
Plan Approvable Pending Adoption	Click or tap to enter a date.
Plan Approved	Click or tap to enter a date.

Multi-Jurisdictional Summary Sheet

In the boxes for each element, mark if the element is met (Y) or not met (N).

#	Jurisdiction Name	A. Planning Process	B. Risk Assessment	C. Mitigation Strategy	D. Plan Maintenance	E. Plan Update	F. Plan Adoption	G. HMPD Requirements	H. State Requirements
1	Multnomah County	Y	Y	Y	Y	Y			
2	City of Fairview	Y	Y	Y	Y	Y			
3	City of Gresham	Y	Y	Y	Y	Y			
4	City of Troutdale	Y	Y	Y	Y	Y			
5	City of Wood Village	Y	Y	Y	Y	Y			
6	Multnomah County Drainage District	Y	Y	Y	Y	N/A			
7	PEN 1 Drainage District	Y	Y	Y	Y	N/A			
8	PEN 2 Drainage District	Y	Y	Y	Y	N/A			
9	Sandy Drainage Investment Company	Y	Y	Y	Y	N/A			
10	Columbia Corridor Drainage Districts Joint Contracting Authority	Y	Y	Y	Y	N/A			
11	Urban Flood Safety and Water Quality District	Y	Y	Y	Y	N/A			
12	Port of Portland	Y	Y	Y	Y	N/A			

Plan Review Checklist

The Plan Review Checklist is completed by FEMA. States and local governments are encouraged, but not required, to use the PRT as a checklist to ensure all requirements have been met prior to submitting the plan for review and approval. The purpose of the checklist is to identify the location of relevant or applicable content in the plan by element/sub-element and to determine if each requirement has been "met" or "not met." FEMA completes the "required revisions" summary at the bottom of each element to clearly explain the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is "not met." Sub-elements in each summary should be referenced using

the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each element and sub-element are described in detail in Section 4: Local Plan Requirements of this guide.

Plan updates must include information from the current planning process.

If some elements of the plan do not require an update, due to minimal or no changes between updates, the plan must document the reasons for that.

Multi-jurisdictional elements must cover information unique to all participating jurisdictions.

Element A: Planning Process

Element A Requirements	Location in Plan (section and/or page number)	Met / Not Met
A1. Does the plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement 44 CFR § 201.6(c)(1))		
A1-a. Does the plan document how the plan was prepared, including the schedule or time frame and activities that made up the plan's development, as well as who was involved?	Sec. 1.3 (pp. 3–4), Sec. 1.5 (pp. 6–7), Sec. 4.2 (pp. 202– 207)	Met
A1-b. Does the plan list the jurisdiction(s) participating in the plan that seek approval, and describe how they participated in the planning process?	Sec. 1.3 (pp. 3–4), Sec. 4.2 (pp. 202– 207)	Met
Element A Requirements	Location in Plan (section and/or page number)	Met / Not Met
A2. Does the plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development as well as businesses, academia, and other private and non-profit interests to be involved in the planning process? (Requirement 44 CFR § 201.6(b)(2))		

A2-a. Does the plan identify all stakeholders involved or given an opportunity to be involved in the planning process, and how each stakeholder was presented with this opportunity?	Sec. 4.1 (pp. 196– 202), Sec. 4.2 (pp. 202–207)	Met
A3. Does the plan document how the public was involved in the planning process during the drafting stage and prior to plan approval? (Requirement 44 CFR § 201.6(b)(1))		
A3-a. Does the plan document how the public was given the opportunity to be involved in the planning process and how their feedback was included in the plan?	Sec. 4.1 (pp. 196– 202), Annex D (pp. 471–478)	Met
A4. Does the plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement 44 CFR § 201.6(b)(3))		
A4-a. Does the plan document what existing plans, studies, reports and technical information were reviewed for the development of the plan, as well as how they were incorporated into the document?	Sec. 1.7.5 (pp. 11–13)	Met

ELEMENT A REQUIRED REVISIONS
Required Revision: Click or tap here to enter text.

Element B: Risk Assessment

Element B Requirements	*Location in Plan (section and/or page number)*	*Met / Not Met*
B1. Does the plan include a description of the type, location, and extent of all natural hazards that can affect the jurisdiction? Does the plan also include information on previous occurrences of hazard events and on the probability of future hazard events? (Requirement 44 CFR § 201.6(c)(2)(i))		

B1-a. Does the plan describe all natural hazards that can affect the jurisdiction(s) in the planning area, and does it provide the rationale if omitting any natural hazards that are commonly recognized to affect the jurisdiction(s) in the planning area?	Sec. 1.4 (p. 5), Sec. 3.1 (p. 63), Sec. 3.2 (p. 92), Sec. 3.3 (p. 129), Sec. 3.4 (p. 147), Sec. 3.5 (p. 165), Sec. 3.6 (p. 180)	Met
B1-b. Does the plan include information on the location of each identified hazard?	Sec. 3.1.1. (p. 68), Sec. 3.2.1 (p. 97), Sec. 3.3.1 (p. 134), Sec. 3.4.1 (p. 153), Sec. 3.5.1 (p. 167), Sec. 3.6.1 (p. 187)	Met
B1-c. Does the plan describe the extent for each identified hazard?	Sec. 3.1.1. (p. 68), Sec. 3.2.1 (pp. 97– 100), Sec. 3.3.1 (pp. 134–141), Sec. 3.4.1 (pp. 153–155), Sec. 3.5.1 (pp. 167–173), Sec. 3.6.1 (pp. 187–190)	Met

Element B Requirements	*Location in Plan (section and/or page number)*	*Met / Not Met*
B1-d. Does the plan include the history of previous hazard events for each identified hazard?	Sec. 3.1 (p. 66), Sec. 3.2 (pp. 93–97, 106–115), Sec. 3.3 (pp. 132–134), Sec. 3.4 (pp. 147–153, 155– 157), Sec. 3.5 (p. 166), Sec. 3.6 (pp. 180–187)	Met

B1-e. Does the plan include the probability of future events for each identified hazard? Does the plan describe the effects of future conditions, including climate change (e.g., long-term weather patterns, average temperature and sea levels), on the type, location and range of anticipated intensities of identified hazards?	Sec. 2.2.2 (p. 23), Sec. 3.1.2 (p. 74), Sec. 3.2.2 (p. 106), Sec. 3.3.2 (p. 141), Sec. 3.4.2 (p. 155), Sec. 3.5.2 (p. 174), Sec. 3.6.2 (p. 190)	Met
B1-f. For participating jurisdictions in a multi-jurisdictional plan, does the plan describe any hazards that are unique to and/or vary from those affecting the overall planning area?	Annex C (p. 459), Sec. 5.1.4 (p. 220), Sec. 5.2.4 (p. 252), Sec. 5.3.4 (p. 279), Sec. 5.4.4 (p. 299), Sec. 5.5.4 (p. 335), Sec. 5.6.3 (p. 387), Sec. 5.7.3 (p. 414)	Met
Element B Requirements	*Location in Plan (section and/or page number)*	*Met / Not Met*
B2. Does the plan include a summary of the jurisdiction's vulnerability and the impacts on the community from the identified hazards? Does this summary also address NFIPinsured structures that have been repetitively damaged by floods? (Requirement 44 CFR § 201.6(c)(2)(ii))		
B2-a. Does the plan provide an overall summary of each jurisdiction's vulnerability to the identified hazards?	Sec. 3.1.3 (p. 78), Sec. 3.2.3 (p. 115), Sec. 3.3.3 (p. 144), Sec. 3.4.3 (p. 161), Sec. 3.5.3 (p. 176), Sec. 3.6.3 (p. 191) Sec. 5.1.5 (p. 229), Sec. 5.2.5 (p. 264), Sec. 5.3.5 (p. 290), Sec. 5.4.5 (p. 308), Sec. 5.5.5 (p. 357), Sec. 5.6.4 (p. 396), Sec. 5.7.4 (p. 422)	Met

B2-b. For each participating jurisdiction, does the plan describe the potential impacts of each of the identified hazards on each participating jurisdiction?	Annex F (pp. 584– 687), Sec. 3.1.1. (p. 68), Sec. 3.2.1 (p. 97), Sec. 3.3.1 (p. 134), Sec. 3.4.1 (p. 153), Sec. 3.5.1 (p. 167), Sec. 3.6.1 (p. 187)	Met
B2-c. Does the plan address NFIP-insured structures within each jurisdiction that have been repetitively damaged by floods?	Sec. 3.2.3 (p. 118), Sec. 5.1.4 (p. 224), Sec. 5.2.4 (p. 255), Sec. 5.3.4 (p. 281), Sec. 5.4.4 (p. 301), Sec. 5.5.4 (p. 347)	Met

ELEMENT B REQUIRED REVISIONS
Required Revision: Click or tap here to enter text.

Element C: Mitigation Strategy

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met

C1. Does the plan document each participant's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement 44 CFR § 201.6(c)(3))		
C1-a. Does the plan describe how the existing capabilities of each participant are available to support the mitigation strategy? Does this include a discussion of the existing building codes and land use and development ordinances or regulations?	Sec. 5.1.6 (p. 229230), Sec. 5.2.6 (pp. 264-267), Sec. 5.3.6 (pp. 290-292), Sec. 5.4.3 (p. 298), Sec. 5.4.6 (pp. 308–310), Sec. 5.5.2 (p. 325), Sec. 5.5.2 (p. 330), Sec. 5.5.6 (p. 358360)	Met
C1-b. Does the plan describe each participant's ability to expand and improve the identified capabilities to achieve mitigation?	Sec. 5.1.2 (p. 215), Sec. 5.1.3 (p. 218), Sec. 5.2.2 (p. 245), Sec. 5.2.3 (p. 249), Sec. 5.3.2 (p. 275), Sec. 5.3.3 (p. 277), Sec. 5.4.2 (p. 296), Sec. 5.4.3 (p. 298), Sec. 5.5.2 (p. 324), Sec. 5.5.3 (p. 333), Sec. 5.6.2 (p. 382), Sec. 5.7.2 (p. 407)	Met
C2. Does the plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C2-a. Does the plan contain a narrative description or a table/list of their participation activities?	Sec. 2.6.1 (p. 47), Sec. 5.1.4 (pp. 219– 220, 222–224), Sec. 5.2.4 (pp. 254–256), Sec. 5.3.4 (pp. 280–283), Sec. 5.4.4 (pp. 300–302), Sec. 5.5.4 (pp. 341–348)	Met

Element C Requirements	Location in Plan (section and/or page number)	Met / Not Met
C3. Does the plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement 44 CFR § 201.6(c)(3)(i))		
C3-a. Does the plan include goals to reduce the risk from the hazards identified in the plan?	Sec. 1.9 (pp. 13–14), Ch. 5 (pp. 209–210), Sec. 5.1.1 (pp. 212–214), Sec. 5.2.1 (pp. 232–244), Sec. 5.3.1 (pp. 268–274), Sec. 5.4.1 (pp. 293–295), Sec. 5.5.1 (pp. 311–323), Sec. 5.6.1 (pp. 361–381), Sec. 5.7.1 (pp. 399–406)	Met
C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement 44 CFR § 201.6(c)(3)(ii))		
C4-a. Does the plan include an analysis of a comprehensive range of actions/projects that each jurisdiction considered to reduce the impacts of hazards identified in the risk assessment?	Annex C (pp. 459–470); Mitigation Actions, start on the following pages: Sec. 5.1.1 (p. 212), Sec. 5.2.1 (p. 232), Sec. 5.3.1 (p. 268), Sec. 5.4.1 (p. 293), Sec. 5.5.1 (p. 311), Sec. 5.6.1 (p. 361), Sec. 5.7.1 (p. 399)	Met

C4-b. Does the plan include one or more action(s) per jurisdiction for each of the hazards as identified within the plan's risk assessment?	Annex C (pp. 459–470); Mitigation Actions, start on the following pages: Sec. 5.1.1 (p. 212), Sec. 5.2.1 (p. 232), Sec. 5.3.1 (p. 268), Sec. 5.4.1 (p. 293), Sec. 5.5.1 (p. 311), Sec. 5.6.1 (p. 361), Sec. 5.7.1 (p. 399)	Met
Element C Requirements	*Location in Plan (section and/or page number)*	*Met / Not Met*
C5. Does the plan contain an action plan that describes how the actions identified will be prioritized (including a costbenefit review), implemented, and administered by each jurisdiction? (Requirement 44 CFR § 201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))		
C5-a. Does the plan describe the criteria used for prioritizing actions?	Chapter 5 (pp. 209–211)	Met
C5-b. Does the plan provide the position, office, department or agency responsible for implementing/administrating the identified mitigation actions, as well as potential funding sources and expected time frame?	Annex C (pp. 459–470); Mitigation Actions, start on the following pages: Sec. 5.1.1 (p. 212), Sec. 5.2.1 (p. 232), Sec. 5.3.1 (p. 268), Sec. 5.4.1 (p. 293), Sec. 5.5.1 (p. 311), Sec. 5.6.1 (p. 361), Sec. 5.7.1 (p. 399)	Met

ELEMENT C REQUIRED REVISIONS

Required Revision:

Click or tap here to enter text.

Element D: Plan Maintenance

Element D Requirements	Location in Plan (section and/or page number)	Met / Not Met
D1. Is there discussion of how each community will continue public participation in the plan maintenance process? (Requirement 44 CFR § 201.6(c)(4)(iii))		
D1-a. Does the plan describe how communities will continue to seek future public participation after the plan has been approved?	Sec. 4.3 (pp. 207– 208), Sec. 6.2 (p. 425) Sec. 1.8 (p. 13), Sec. 4.3 (pp. 207–208), Sec. 6.3 (p. 425) Sec. 4.3 (pp. 207–208) Sec. 6.2 (p. 425) Sec. 1.8 (p. 13), Sec. 4.3 (pp. 207–208), Sec. 6.2 (p. 425)	Met
D2. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a five-year cycle)? (Requirement 44 CFR § 201.6(c)(4)(i))		
D2-a. Does the plan describe the process that will be followed to track the progress/status of the mitigation actions identified within the Mitigation Strategy, along with when this process will occur and who will be responsible for the process?	Sec. 1.8 (p. 13), Sec. 4.3 (pp. 207–208), Sec. 6.1 (p. 425)	Met
D2-b. Does the plan describe the process that will be followed to evaluate the plan for effectiveness? This process must identify the criteria that will be used to evaluate the information in the plan, along with when this process will occur and who will be responsible.	Sec. 4.3 (pp. 207– 208), Sec. 6.1 (p. 425)	Met

D2-c. Does the plan describe the process that will be followed to update the plan, along with when this process will occur and who will be responsible for the process?	Sec. 1.8 (p. 13), Sec. 4.3 (pp. 207–208), Sec. 6.1 (p. 425)	Met
Element D Requirements	*Location in Plan (section and/or page number)*	*Met / Not Met*
D3. Does the plan describe a process by which each community will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement 44 CFR § 201.6(c)(4)(ii))		
D3-a. Does the plan describe the process the community will follow to integrate the ideas, information and strategy of the mitigation plan into other planning mechanisms?	Sec. 1.8 (p. 13), Sec. 6.3 (pp. 425–429), Aligned Plans and Other Implementation Processes, start on the following pages: Sec. 5.1.6 (p. 229), Sec. 5.2.6 (p. 264), Sec. 5.3.6 (p. 290), Sec. 5.4.6 (p. 308), Sec. 5.5.6 (p. 358), Sec. 5.6.5 (p. 396), Sec. 5.7.5 (p. 423)	Met
D3-b. Does the plan identify the planning mechanisms for each plan participant into which the ideas, information and strategy from the mitigation plan may be integrated?	Aligned Plans and Other Implementation Processes, start on the following pages: Sec. 5.1.6 (p. 229), Sec. 5.2.6 (p. 264), Sec. 5.3.6 (p. 290), Sec. 5.4.6 (p. 308), Sec. 5.5.6 (p. 358), Sec. 5.6.5 (p. 396), Sec. 5.7.5 (p. 423)	Met

D3-c. For multi-jurisdictional plans, does the plan describe each participant's individual process for integrating information from the mitigation strategy into their identified planning mechanisms?	Sec. 5.1.6 (p. 229), Sec. 5.2.6 (p. 264), Sec. 5.3.6 (p. 290), Sec. 5.4.6 (p. 308), Sec. 5.5.6 (p. 358), Sec. 5.6.5 (p. 396), Sec. 5.7.5 (p. 423)	Met

ELEMENT D REQUIRED REVISIONS
Required Revision: Click or tap here to enter text.

Element E: Plan Update

Element E Requirements	*Location in Plan (section and/or page number)*	*Met / Not Met*
E1. Was the plan revised to reflect changes in development? (Requirement 44 CFR § 201.6(d)(3))		
E1-a. Does the plan describe the changes in development that have occurred in hazard-prone areas that have increased or decreased each community's vulnerability since the previous plan was approved?	Sec. 1.7.3 (p. 10), Sec. 2.6 (pp. 45–48), and Development Impacts subsections (e.g., Sec. 5.1.3 p. 220)	Met
E2. Was the plan revised to reflect changes in priorities and progress in local mitigation efforts? (Requirement 44 CFR § 201.6(d)(3))		

E2-a. Does the plan describe how it was revised due to changes in community priorities?	Sec. 1.5 (pp. 6–7), Sec. 1.7 (pp. 9–13), Sec. 5.1.3 (p. 218), Sec. 5.2.3 (p. 249), Sec. 5.3.3 (p. 277), Sec. 5.4.3 (p. 298), Sec. 5.5.3 (p. 333), Sec. 5.6.2 (p. 382), Sec. 5.7.2 (p. 407)	Met
E2-b. Does the plan include a status update for all mitigation actions identified in the previous mitigation plan?	Annex C (pp. 459– 470), Annex E (pp. 478–489	Met
Element E Requirements	*Location in Plan (section and/or page number)*	*Met / Not Met*
E2-c. Does the plan describe how jurisdictions integrated the mitigation plan, when appropriate, into other planning mechanisms?	Sec. 1.7.5 (pp. 11– 13), Select mitigation actions in Annex E (p. 478, 483), Sec. 6.3.1 (p. 425), Sec. 5.1.6 (p. 229), Sec. 5.2.6 (p. 263), Sec. 5.3.6 (p. 287), Sec. 5.4.6 (p. 304), Sec. 5.5.6 (p. 352), Sec. 5.6.5 (p. 388), Sec. 5.7.5 (p. 415)	Met

ELEMENT E REQUIRED REVISIONS
Required Revision: Click or tap here to enter text.

Element F: Plan Adoption

Element F Requirements	Location in Plan (section and/or page number)	Met / Not Met
F1: For single-jurisdictional plans, has the governing body of the jurisdiction formally adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F1-a. Does the participant include documentation of adoption?	To be included when adopted.	Choose an item.
F2: For multi-jurisdictional plans, has the governing body of each jurisdiction officially adopted the plan to be eligible for certain FEMA assistance? (Requirement 44 CFR § 201.6(c)(5))		
F2-a. Did each participant adopt the plan and provide documentation of that adoption?	Appendix B (p. 458)	Choose an item.

ELEMENT F REQUIRED REVISIONS		
Required Revision: Click or tap here to enter text.		

Element G: High Hazard Potential Dams (Optional)

HHPD Requirements	Location in Plan (section and/or page number)	Met / Not Met
HHPD1: Did the plan describe the incorporation of existing plans, studies, reports and technical information for HHPDs?		
HHPD1-a. Does the plan describe how the local government worked with local dam owners and/or the state dam safety agency?	Click or tap here to enter text.	Choose an item.

HHPD1-b. Does the plan incorporate information shared by the state and/or local dam owners?	Click or tap here to enter text.	Choose an item.
HHPD2. Did the plan address HHPDs in the risk assessment?		
HHPD2-a. Does the plan describe the risks and vulnerabilities to and from HHPDs?	Click or tap here to enter text.	Choose an item.
HHPD2-b. Does the plan document the limitations and describe how to address deficiencies?	Click or tap here to enter text.	Choose an item.
HHPD3. Did the plan include mitigation goals to reduce longterm vulnerabilities from HHPDs?		
HHPD3-a. Does the plan address how to reduce vulnerabilities to and from HHPDs as part of its own goals or with other longterm strategies?	Click or tap here to enter text.	Choose an item.
HHPD3-b. Does the plan link proposed actions to reducing longterm vulnerabilities that are consistent with its goals?	Click or tap here to enter text.	Choose an item.
HHPD4-a. Did the plan include actions that address HHPDs and prioritize mitigation actions to reduce vulnerabilities from HHPDs?		
HHPD4-a. Does the plan describe specific actions to address HHPDs?	Click or tap here to enter text.	Choose an item.
HHPD Requirements	*Location in Plan (section and/or page number)*	*Met / Not Met*
HHPD4-b. Does the plan describe the criteria used to prioritize actions related to HHPDs?	Click or tap here to enter text.	Choose an item.
HHPD4-c. Does the plan identify the position, office, department or agency responsible for implementing and administering the action to mitigate hazards to or from HHPDs?	Click or tap here to enter text.	Choose an item.

HHPD Required Revisions
Required Revision: Click or tap here to enter text.

Element H: Additional State Requirements (Optional)

Element H Requirements	Location in Plan (section and/or page number)	Met / Not Met
This space is for the State to include additional requirements.		
Click or tap here to enter text.	Click or tap here to enter text.	Choose an item.

Plan Assessment

These comments can be used to help guide your annual/regularly scheduled updates and the next plan update.

Element A: Planning Process

Strengths

- The plan shows strong examples of public outreach. While surveys were a good idea, the plan noted their limits for people without internet or with "technology accessibility barriers" (p. 196). It was helpful to collect public input at live community events. It is notable that the Natural Hazard Mitigation Plan (NHMP) Steering Committee offered its survey in multiple languages. Annex D includes untranslated comments. This process centers racial and ethnic diversity in Multnomah County, as given in Section 2.3.9 (pp. 33–36).
- The plan includes a range of studies. It was helpful to see Section 1.7.5 broken down by hazard or theme (e.g., climate and health) (pp. 11–13).

Opportunities for Improvement

- The plan includes NHMP Steering Committee members and their meeting agendas. However, it would help to include how much each member participated. For instance: Did all members attend every meeting? Which stakeholders were most active?
- The plan shows extensive outreach. In the future, it could detail how nonprofit organizations joined in (p. 206). The planning process may also consider more outreach to private companies.
  For example, Section 2.9.1 made the connection between freight rail and the Transportation Community Lifeline. "Rail networks . . . are also vulnerable to impact from earthquakes, landslides, wildfires and floods" (p. 53).
- Future outreach may consider underserved communities and socially vulnerable groups in the Demographics section (pp. 28–48). These may include migrant workers, older adults, unhoused people, etc.

Element B: Risk Assessment

Strengths

- The maps in the Risk Assessment are strong. There are also illustrative maps in the jurisdiction/district chapters. These layer the natural hazard risk with critical facilities.
- The plan provides a strong analysis on hazard probability and calculation of vulnerability.
- The plan is clear on how it breaks down hazard risk by area.
- The vulnerability sections are clear and relatable. There are specific details and stories throughout the profiles.

Opportunities for Improvement

- The plan outlines vulnerability for each participant. In the future, it could provide a summary for the whole area.

Element C: Mitigation Strategy

Strengths

- Overall, the participant chapters are easy-to-follow and detailed.
- Maps added to the mitigation narratives. To illustrate, the City of Fairview included an area map to show its Letter of Map Revision (p. 220).
- The plan follows relevant, broad goals. These can trickle down to communities. They may apply to a wide range of mitigation action (pp. 209–210).
- The plan gives a mix of mitigation actions. These cover local planning, infrastructure protection, education and awareness, and nature-based solutions. In particular, the Columbia Corridor Drainage Districts show a wide range of flood actions.

- Scoring criteria for the mitigation strategy are well-rounded. Including equity aligns with FEMA's Local Planning Policy Guide and the FEMA Strategic Plan (p. 210).

Opportunities for Improvement

- The plan could improve its analysis on mitigation action tools. Each city or county lists policy documents. The plan could describe how these resources help or hold back mitigation.
- The plan has unique mitigation actions for high-risk hazards in most areas. There are three communities where this was not the case: Fairview (no unique action on severe weather), Wood Village (no unique action on wildfire/smoke) and the Columbia Corridor Drainage Districts (no unique action on severe weather).

Element D: Plan Maintenance

Strengths

- The list of plans and implementation processes are diverse for each participant.

Opportunities for Improvement

- The plan could be stronger at evaluating effectiveness. What are criteria for this to happen during the update period?
- The plan could improve how it describes plan integration and processes for each community. The NHMP Steering Committee could do this by comparing the entities or highlighting their strengths

Element E: Plan Update

Strengths

- The plan summarizes changes in development in different ways. This lets the reader see the changes at various scales.
- The 5-Year Update sections cover a lot of information. Listing mitigation activities shares best practices across the communities and with the public.

Opportunities for Improvement

- While there are many sections on development, some are stronger than others. The plan could be clearer in linking development and hazard vulnerability.
- Like the comment on development, the sections on plan integration could be stronger. It would help to be more explicit in connecting changes in the last plan to the updated plan.

Element G: HHPD Requirements (Optional)

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

Element H: Additional State Requirements (Optional)

Strengths

- [insert comments]

Opportunities for Improvement

- [insert comments]

State Review Comments (Oregon Emergency Management)

Reviewer: Jason Gately, Mitigation Program Representative

05/04/2023

Pg. 1

General Comments:

1. Overall, great job! I did not read every page in its entirety, but I read most of them and reviewed every page.

2. The plan is well written, organized and researched!

3. It is dense reading, but that is fine as it is very comprehensive.

4. There are MANY great links that I will be checking these out in the future for my own education.

5. Love the depth of links to relevant data and websites. I realize these may get broken over

time, but at least the reader will know the title of the document/information it is trying to link to. You may want to review and update these links as needed during the 5-year maintenance process.

6. I did not find many typos and I probably didn't catch all of them, but I did point out the ones I noticed.

7. Excellent graphics and relevant photos in the plan with nice descriptions.

Title Page/Table of Contents/Acknowledgements

1. There is not a TOC for figures and tables. I see this occasionally in other NHMP's. I personally think it's a nice thing to include, but it's up to you.

Introduction

1. Pg. 4, 3rd paragraph – typo – should be met, instead of meet.

2. Very nice Introduction chapter.

Community Profile

1. Pg. 37, last sentence has a 1.6 at the end that I think should be deleted.

2. Pg. 51 – first sentence has a typo – he should be the. Also, the 2nd paragraph needs a period at the end.

Hazard Identification and Risk Assessment

1. Pg. 62, typo in the last bullet.

2. Pg. 71, link on Figure 32 is broken. As mentioned above, this will happen and not sure you need to check and fix all of the links. I spot check as I read the plan.

Public Comment and Planning Process

1. Pg. 207, 2nd paragraph says a meeting with planning was help in 2011 – is that the correct date?

2. Pg. 207, 4.2.2 line 5 has a typo (outsider should be outside)

3. Same page, 5th paragraph – Columbia is misspelled.

Jurisdictional Chapters

1. Pg. 400, typo in the 2nd bullet (the word “Center”)

2. No mention of Terminal 4 in the plan – is that not owned by the Port of Portland anymore?

Plan Implementation and Maintenance

1. Very nice discussion of potential funding opportunities with links.

Annex A

1. Pg. 423 – the met/not met summary sheet is completed by FEMA. Leave the names of the jurisdictions, however, leave blank the y/n.

2. Excellent job on Elements A-H.

Annex B

1. No comments.

Annex C

1. No comments.

Annex D

1. No comments.

Annex E

1. No comments.

Annex F

1. No comments

End.

ANNEX B – Local Adopting Resolutions

to be added

ANNEX C – Combined Multi-Jurisdictional Risk Ratings and Mitigation Actions

Risk ratings, as determined by each participating jurisdiction/district. Scoring used to determine these ratings is located in each jurisdiction/district chapter.

Jurisdiction/District	Earthquake	Flood	Landslide	Severe Weather	Volcano	Wildfire & Wildfire Smoke
Fairview	**Moderate**	**Low**	**Low**	**High**[91]	**Low**	**High**[92]
Gresham	**High**	**Moderate**	**Moderate**	**High**	**Low**	**Moderate**
Troutdale	**Moderate**	**Low**	**Low**	**High**[93]	**Moderate**	**High**[94]
Wood Village	**High**	**Low**	**Low**	**High**[95]	Low	**High**[96]
Multnomah County	**High**	**Moderate**	**Moderate**	**High**	Low	**High**
Multnomah County Drainage District	**Moderate**	**High**	**Low**	**High**	**Moderate**	**Moderate**
Peninsula 1 Drainage District	**Moderate**	**High**	**Low**	**High**	Low	**Low**
Peninsula 2 Drainage District	**Moderate**	**High**	**Low**	**High**	Low	**Moderate**
Sandy Drainage Improvement Company	**Moderate**	**High**	**Low**	**High**	**Moderate**	**Low**
CCDDDJCA/UFSWQD	**Moderate**	**High**	**Low**	**High**	**Low**	**Moderate**
Port of Portland	**High**	**Moderate**	**Low**	**Moderate**	**Low**	**Moderate**

[91] All elements of Severe Weather were rated high risk, except for Drought which was rated low.

[92] Wildfire Smoke rated as high risk, Wildfire was rated as low risk.

[93] All Severe Weather elements rated as high risk, except for Winter Storms.

[94] High Rating for Wildfire Smoke, moderate risk for WIldfire

[95] High Rating for Extreme Heat and Winter Storms. Windstorm was rated moderate and Drought low.

[96] High Rating for Wildfire Smoke, low rating for wildfire

Collected mitigation actions are in order as they appear in the jurisdiction/district chapters and are presented here to be more easily compared.

Hazards	Jurisdiction/District	No.	Mitigation Action
Multi-Hazard	Fairview	1	**Regularly share hazard materials and risk information, including in languages other than English, at City of Fairview events such as Fairview on the Green and National Night Out.**
Multi-Hazard	Fairview	2	**Identify water and wastewater system resilience opportunities, including well houses and wastewater pump stations housed in unreinforced block buildings and increasing resilience of newly constructed infrastructure.**
Multi-Hazard	Fairview	3	**Publicize severe weather and wildfire smoke risks by providing accessible preparation, warning and alert information on the city website.**
Earthquake	Fairview	4	**Assess the feasibility of seismic retrofits at City Hall and the Crestwood Shop, which stores Public Works' outdoor equipment.**
Flood	Fairview	5	**Maintain participation in Levee Ready Columbia and support continuing accreditation of Columbia Corridor Drainage District levees.**
Multi-Hazard	Gresham	1	**Develop a Disaster Debris Management Plan to support community recovery and maximize FEMA reimbursement.**
Multi-Hazard	Gresham	2	**Engage with community-based organizations (CBO's) to ensure touchpoints with frontline communities vulnerable in disasters.**
Multi-Hazard	Gresham	3	**Support the City's adopted Climate Action Plan actions that relate to climate change resiliency and preparedness.**
Multi-Hazard	Gresham	4	**Support local businesses in preparing for disasters and promote local business continuity planning.**
Earthquake	Gresham	5	**Implement improvements to the wastewater treatment plant to resist seismic events.**
Earthquake	Gresham	6	**Harden the city's sewer backbone system to resist seismic events.**
Earthquake	Gresham	7	**Continue to implement seismic structural retrofits at water reservoirs and pump stations.**
Earthquake	Gresham	8	**Improve seismic resilience of water pipeline infrastructure.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Earthquake	Gresham	9	**Seismically retrofit existing public wastewater facilities and infrastructure to withstand and continue service after a catastrophic earthquake, allowing the city to meet the Oregon Resilience Plan Target States of Recovery.**
Earthquake	Gresham	10	**Build resiliency and mitigation education into public events. Partner with NGOs to ensure culturally appropriate and engaging material.**
Earthquake	Gresham	11	**Develop a seismic overlay.**
Flood	Gresham	12	**Develop and implement strategies to restore and enhance the natural functions of floodplains.**
Flood	Gresham	13	**Implement flood attenuation strategies as identified and prioritized in the Stormwater Master Plan.**
Flood	Gresham	14	**Maintain eligibility in the National Flood Insurance Program (NFIP) and initiate participation in the Community Rating System (CRS).**
Landslide	Gresham	15	**Protect slopes and associated infrastructure by identifying and prioritizing at-risk slopes with high consequences of failure.**
Landslide	Gresham	16	**Integrate landslide prevention into outreach/enforcement programs to find and resolve encroachments at the public/private interface where dumping contributes to landslide risk.**
Severe Weather	Gresham	17	**Revisit where and what kind of generators need to be available for water and wastewater infrastructure due to significant power outages.**
Severe Weather	Gresham	18	**Coordinate with Multnomah County to identify at-risk population from long-term power outages.**
Severe Weather	Gresham	19	**Conduct a shade audit in all city parks.**
Severe Weather	Gresham	20	**Install trees in tree-deficient neighborhoods that experience urban heat island effect impacts to enhance shade equity in underserved areas.**
Severe Weather	Gresham	21	**Develop an emergency service plan for solid waste removal in multifamily properties after a disaster event.**
Wildfire & Wildfire Smoke	Gresham	22	**Expand permanent backyard burning ban.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Wildfire & Wildfire Smoke	Gresham	23	**Include content on wildfire defensible space in outreach to properties within or adjacent to protected resource areas.**
Wildfire & Wildfire Smoke	Gresham	24	**Develop emergency ingress/egress mapping tool for older developments and assess options for alternative access where no secondary ingress/egress exists.**
Wildfire & Wildfire Smoke	Gresham	25	**Strengthen code language to ensure secondary access for future subdivisions.**
Wildfire & Wildfire Smoke	Gresham	26	**Address forest die off and implement measures to transition to more drought tolerant/climate resilient plan communities through open spaces and the urban canopy, and through transition to more fire-resistant plant communities at the wildland urban interface.**
Wildfire & Wildfire Smoke	Gresham	27	**Develop a wildfire overlay.**
Multi-Hazard	Troutdale	1	**Continue to integrate natural hazard risk information into plan and development code updates.**
Multi-Hazard	Troutdale	2	**Continue to use natural hazard risk information to identify and pursue mitigation projects through continuity of operations and resilience plans.**
Multi-Hazard	Troutdale	3	**Consider adopting a development standard requiring consideration of natural hazard risk when designing public improvements.**
Earthquake	Troutdale	4	**Continue to pursue seismic upgrades to suspended wastewater conveyance pipelines identified in Public Works' Resiliency Plan.**
Flood	Troutdale	5	**Maintain engagement with levee recertification efforts to provide local considerations and information and identify capital improvements that will help maintain levee accreditation.**
Flood	Troutdale	6	**Conduct an inventory of wastewater manholes within the 1% annual chance floodplain and determine the feasibility of replacing manhole covers with watertight lids.**
Landslide	Troutdale	7	**Incorporate landslide risk mapping into the next update of the Comprehensive Plan.**
Landslide	Troutdale	8	**Develop coordination between Public Works and the Building Department for improving stormwater management standards on private property.**
Severe Weather	Troutdale	9	**Create a handout for residents living in mobile homes about wind and snow load impacts on roofs.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Volcano	Troutdale	10	**Perform outreach with homebuilders professional organizations to determine how volcano risk disclosure might be included in home sale documentation.**
Wildfire & Wildfire Smoke	Troutdale	11	**Consider adoption of additional wildfire safety standards in the Troutdale Development Code focusing on siting, defensible space, construction standards, access standards, mitigation planning, and subdivision proposals - using policy work developed through Senate Bill 762 as a guide.**
Wildfire & Wildfire Smoke	Troutdale	12	**Implement wildfire mitigation strategies identified in the revision to the Multnomah County Community Wildfire Protection Plan, including pursuing grants for fuel management projects in and near residential neighborhoods in identified Wildfire Urban Interface areas.**
Wildfire & Wildfire Smoke	Troutdale	13	**Continue development of culturally competent wildfire risk education materials for residents.**
Multi-Hazard	Wood Village	1	**Work with local partners, including churches, to identify locations in the city that could be used for weather or smoke sheltering and develop strategies for operating sites.**
Multi-Hazard	Wood Village	2	**Continue to integrate hazard mitigation goals into early design processes for public facilities and infrastructure projects.**
Multi-Hazard	Wood Village	3	**Continue to identify retrofit programs to strengthen mobile homes from high winds and earthquakes.**
Multi-Hazard	Wood Village	4	**Implement natural hazard resilience actions identified in the upcoming update to the city's water and wastewater master plans.**
Severe Weather	Wood Village	5	**Collaborate with Multnomah County to identify potential in-home cooling interventions for the most at-risk residents living in mobile home parks within the city.**
Multi-Hazard	Multnomah County	1	**Build coordination with disability advocacy groups and disabled residents to analyze varied community risks and identify actions to enhance the safety of disabled residents in all types of hazards.**
Multi-Hazard	Multnomah County	2	**Develop countywide recovery plan to enhance short-term disaster resilience and focus long-term social and economic equity in recovery processes.**
Multi-Hazard	Multnomah County	3	**Continue to integrate hazard mitigation goals in the early design processes for County public facility and infrastructure projects, co-benefitting sustainability and resilience goals.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Multi-Hazard	Multnomah County	4	**Enhance equitable community capacity building by applying for and managing resilience grants that can be administered by community-based organizations that represent underserved communities.**
Multi-Hazard	Multnomah County	5	**Continue participation in state, regional, and local Critical Energy Infrastructure Hub all-hazard mitigation planning; supporting studies to identify mitigation strategies to reduce environmental impact and threat to life.**
Multi-Hazard	Multnomah County	6	**Continue process of evaluating the resilience of all county facilities to all natural hazards, and recommend mitigation opportunities resulting from the evaluation.**
Multi-Hazard	Multnomah County	7	**Evaluate small residential care and child-care facilities licensed by Multnomah County for resilience to natural hazards and power loss and develop implementable mitigation strategies.**
Multi-Hazard	Multnomah County	8	**Develop power backup and air quality resilience capabilities at critical county facilities, especially those that protect residents with heightened risk to climate and wildfire smoke impacts. Capabilities may include backup power generators, transfer switches, and portable or permanent air filtration or air conditioning systems.**
Multi-Hazard	Multnomah County	9	**Convene an update to the Critical Facilities Inventories of the participating entities in this plan and analyze with updated natural hazard risk mapping.**
Multi-Hazard	Multnomah County	10	**Support the development of resilience hubs to create sites for community pre-disaster engagement and response capacity in county locations with barriers to resilience and recovery.**
Multi-Hazard	Multnomah County	11	**Develop a prioritization of county transportation emergency routes based on trip studies.**
Multi-Hazard	Multnomah County	12	**Develop accessible Story Maps and other GIS Mapping Tools to enhance risk communication and the visibility of natural hazard mitigation opportunities.**
Earthquake	Multnomah County	13	**Continue pursuit of funding for seismic home retrofit programs for historically underserved residents.**
Earthquake	Multnomah County	14	**Reassess existing seismic assessments of County facilities, and develop new project prioritization based on results.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Earthquake	Multnomah County	15	**Continue to develop the Earthquake Ready Burnside Bridge project and consider project and funding pathways for seismic retrofits of the Hawthorne, Broadway, and Morrison Bridges, as identified in the 2015 Willamette River Critical Infrastructure Plan (CIP).**
Earthquake	Multnomah County	16	**Identify and develop applications for ShakeAlert in public safety preparation and seismic resilience of critical county facilities.**
Earthquake	Multnomah County	17	**Identify post-earthquake debris storage sites and fully implement the current Multnomah County Debris Management Plan.**
Flood	Multnomah County	18	**Assess Emergency Action Plan for the Van Raden Dam and develop preparation and response planning for any potential dam failure.**
Flood	Multnomah County	19	**Develop policy recommendations for channel migration zone impacts on the Sandy River to existing and future development.**
Landslide	Multnomah County	20	**Update the County's geological hazards overlay, building off the existing steep slope overlay and addressing stormwater management and slope stabilization for landslide prevention.**
Landslide	Multnomah County	21	**Work with residents with homes in high landslide risk areas to identify mitigation opportunities, including potential property buyout grants when residents have interest.**
Severe Weather	Multnomah County	22	**Continue to fund and develop programs to support in-home mitigation for residents in high-risk housing and with limited resources, through weatherization programs and the delivery and installation of portable air conditioners and air filters.**
Severe Weather	Multnomah County	23	**Coordinate with cities on tree-planting, concrete removal, and other heat island mitigation projects across the county in neighborhoods with high proportions of historically underserved residents, with those living in vulnerable housing, and with those with high proportions of residents with pre-existing health conditions.**
Wildfire & Wildfire Smoke	Multnomah County	24	**Support grants for home ignition zone assessment and mitigation, including vegetation management and structure maintenance, especially for residents in high-hazard areas or with physical or resource limitations.**
Wildfire & Wildfire Smoke	Multnomah County	25	**Implement mitigation strategies for wildfire and wildfire smoke identified in the current and upcoming revision of the Multnomah County Community Wildfire Protection Plan.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Wildfire & Wildfire Smoke	Multnomah County	26	**Identify strategies for supporting defensible space for structures in high-risk wildfire areas in zoning regulations, using Senate Bill 762 processes including new state land-use requirements, new risk mapping, and building code revision opportunities.**
Multi-Hazard	Columbia Corridor Drainage Districts	1	**Prepare for and reduce impacts from power outages by installing backup portable generator connections at pump stations, backup power at facilities, purchasing back-up pumping equipment, and/or having rental contracts for back-up power and equipment.**
Multi-Hazard	Columbia Corridor Drainage Districts	2	**Build relationships with community groups and culturally specific community-based organizations and learn how we can best serve those communities for emergency preparedness and response.**
Multi-Hazard	Columbia Corridor Drainage Districts	3	**Develop a Continuity of Operations Plan (COOP) to maintain general District operations during emergencies.**
Multi-Hazard	Columbia Corridor Drainage Districts	4	**Customize and integrate flood-risk, earthquake-risk, and emergency preparedness curriculum and outreach/communications for the public and partners.**
Multi-Hazard	Columbia Corridor Drainage Districts	5	**Adapt and expand ICS training, exercises, and job shadowing opportunities for MCDD staff.**
Multi-Hazard	Columbia Corridor Drainage Districts	6	**Develop and implement asset management program to track asset condition, performance and risk and set priorities for maintenance and repairs in advance of natural hazards.**
Multi-Hazard	Columbia Corridor Drainage Districts	7	**Build GIS capacity to improve preparedness and enhance responsiveness and recovery from natural hazards within the Districts.**
Earthquake	Columbia Corridor Drainage Districts	8	**Improve seismic resilience of hard infrastructure (e.g. pump stations) to reduce downtime by assessing seismic retrofit options to determine feasibility and benefit-cost ratio; planning mitigation investments where practical and cost-effective; and incorporating design criteria for new infrastructure to be seismically resilient.**
Earthquake	Columbia Corridor Drainage Districts	9	**Implement seismic upgrades for MCDD administrative and operations buildings.**
Flood	Columbia Corridor Drainage Districts	10	**Levee Ready Columbia partners, the Columbia Corridor Drainage Districts, and the Urban Flood Safety & Water Quality District will seek funding to support re-certification and maintaining accreditation of the Columbia River levee systems, including support of federal investments in the system.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Flood	Columbia Corridor Drainage Districts	11	**Continue coordination across all jurisdictions for development reviews to prevent unplanned impacts on levee and drainage system.**
Flood	Columbia Corridor Drainage Districts	12	**Increase capacity, dependability and redundancy for all District pump stations.**
Flood	Columbia Corridor Drainage Districts	13	**Conduct training, planning, and modeling exercises that integrate new district mandates: water quality, fish and wildlife habitat, climate change, landscape resilience, equity and social justice, and cultural history.**
Flood	Columbia Corridor Drainage Districts	14	**Update and maintain Flood Emergency Action Plan to prepare for riverine and internal drainage flooding due to natural hazard emergencies.**
Flood	Columbia Corridor Drainage Districts	15	**Complete SCADA Upgrades at all pump stations to improve data collection and storage, communications, monitoring and surveillance.**
Flood	Columbia Corridor Drainage Districts	16	**Develop and implement preventative maintenance strategies to monitor performance and increase redundancy at all District pump stations.**
Flood	Columbia Corridor Drainage Districts	17	**Enhance security and surveillance at District pump stations to improve resiliency and increase redundancy in response to a natural hazard emergency.**
Flood	Columbia Corridor Drainage Districts	18	**Rehabilitate gravity flow system (drainage pipes, slide gates, and inlet/outlet screens) as redundancy to Pump Station 1.**
Flood	Columbia Corridor Drainage Districts	19	**Conduct 2-D flood inundation modeling, graphic design, and map products to improve flood risk analysis and communication with the partners and the public.**
Flood	Columbia Corridor Drainage Districts	20	**Design, purchase, and install signage in the floodplain for flood evacuation rates and demarcation of the managed floodplain/protected area.**
Flood	Columbia Corridor Drainage Districts	21	**Improve pump station reliability by installing flow monitors at all district pump stations.**
Flood	Columbia Corridor Drainage Districts	22	**Rehabilitate or replace drainage pipes and slide gates at 142nd cross levee.**
Flood	Columbia Corridor Drainage Districts	23	**Convert recent USACE PMLS Study modeling and lessons learned to inform drainage master planning in Districts.**
Flood	Columbia Corridor Drainage Districts	24	**Protect levee toe from hydraulic scouring caused by anticipated increased frequency loading in the wet season under current climate models.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Flood	Columbia Corridor Drainage Districts	25	**Evaluate temporary flood control structure needs, determine the best options for each closure (including automated systems where beneficial), invest in needed closure structures, and create clear job sheets for each closure for emergency response.**
Flood	Columbia Corridor Drainage Districts	26	**Coordinate with partners in floodplain resilience planning, environmental zoning, and development standards within floodplains to increase / maintain green infrastructure and to increase flood resilience within building standards.**
Flood	Columbia Corridor Drainage Districts	27	**Raise levee near I-5 cloverleaf & Marine Drive interchange.**
Flood	Columbia Corridor Drainage Districts	28	**Decommission or install valve replacements for Gate Tower & associated drainage pipes between MCDD and SDIC to address hydrologic connection vulnerabilities between drainage basins.**
Flood	Columbia Corridor Drainage Districts	29	**Analyze and address houseless community's impacts on flood management system and access.**
Flood	Columbia Corridor Drainage Districts	30	**Relocate and replace PIR and Vanport Pump Stations with upgrades for backup power connection, seismic resilience, wind event resilience, pumps and discharge lines, and addition of automatic trash rake system.**
Flood	Columbia Corridor Drainage Districts	31	**Address oversteepened toe of levee for Columbia Slough southwest levee enhancement.**
Flood	Columbia Corridor Drainage Districts	32	**Address vulnerabilities from animal burrows on Columbia River MCDD Levee of NE Corner Rehab.**
Flood	Columbia Corridor Drainage Districts	33	**Replace, and potentially increase capacity of, the primary stormwater pumping station for the Sandy Pump Station.**
Flood	Columbia Corridor Drainage Districts	34	**Incorporate climate and equity into flood modeling/planning, factoring in updated precipitation and hydrologic forecasts and anticipated impacts on communities.**
Flood	Columbia Corridor Drainage Districts	35	**Regrade and bench oversteepened levee banks on the Columbia River.**
Flood	Columbia Corridor Drainage Districts	36	**Improve drainage pathways through pipe improvements or daylight open channels in areas such as Meadow Drive and Middlefield Road.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Flood	Columbia Corridor Drainage Districts	37	**Identify and create redundant channels and pipes to allow for additional flood storage and flow paths.**
Flood	Columbia Corridor Drainage Districts	38	**Plan for landscape resilience, including identifying open spaces within the managed floodplain (or brownfield sites that could be converted to open space), developing solutions for flood storage (or other objectives), and creating a worklist for future study/modeling to quantify services that provided by those sites.**
Flood	Columbia Corridor Drainage Districts	39	**Upgrade levee management practices by implementing measures that increase early-warning times prior to failures.**
Flood	Columbia Corridor Drainage Districts	40	**Plan designated safe zones for people who cannot safely evacuate in the event of a levee breach and flood.**
Flood	Columbia Corridor Drainage Districts	41	**Support agency partners to improve joint stormwater assets that are essential to the existing internal drainage system.**
Multi-Hazard	Port of Portland	1	**Develop internal and external programming to inform and educate employees, tenants and business partners about hazards and potential ways to mitigate them.**
Multi-Hazard	Port of Portland	2	**Establish and maintain agreements with federal and state partners to support the use of Port facilities in response and recovery operations and identify collaborative opportunities with federal and state agencies to implement supporting on-site mitigation measures.**
Multi-Hazard	Port of Portland	3	**Document facility, infrastructure and equipment vulnerabilities to high heat and wildfire smoke; evaluate mitigation actions; and implement actions as appropriate.**
Multi-Hazard	Port of Portland	4	**Develop and implement communications plans and systems, including automated and robotic communications and notification systems at Port facilities to mitigate risks related to communication system loss in the event of an earthquake or flood.**
Multi-Hazard	Port of Portland	5	**Harden security systems and upgrade communications to address seismic and flood risks.**
Multi-Hazard	Port of Portland	6	**Assess expected climate impacts on T6 and identify and implement needed mitigation investment to ensure continued performance and longevity given heat and flood risks.**

Hazards	Jurisdiction/District	No.	Mitigation Action
Earthquake	Port of Portland	7	**Complete the engineering and design for and construct the resilient runway seismic mitigation, construct the resilient airfield regulator building with back-up power, and related improvements needed to ensure a resilient airfield.**
Earthquake	Port of Portland	8	**Set performance goals, update or expand seismic risk assessments and feasibility studies, identify and prioritize mitigation strategies and make investments for the airfield, concourses, terminal, maintenance facilities, parking and transportation infrastructure, passenger processing and critical utility systems, and other PDX systems and facilities as appropriate.**
Earthquake	Port of Portland	9	**Identify system failure points and mitigate harm to people, the environment, and infrastructure systems by implementing Earthquake Early Warning systems.**
Earthquake	Port of Portland	10	**Review and update the T6 seismic plan to address completed projects and identify new needs.**
Earthquake	Port of Portland	11	**Support investments in fueling facilities to mitigate harm resulting from an earthquake.**
Earthquake	Port of Portland	12	**Assess seismic vulnerabilities of flood and stormwater management infrastructure that serves PDX and implement appropriate mitigation measures and risk mitigation plans; plan for and invest to improve seismic resilience and power reliability for pump stations that serve or support PDX, and mitigate flood exposure risk for critical airport facilities.**
Earthquake	Port of Portland	13	**Complete the construction of seismic resilience improvements at Berth 603 to enable T6 to mitigate seismic risk.**
Earthquake	Port of Portland	14	**Mitigate seismic risk by developing a Disaster Recovery Site for technology infrastructure.**
Earthquake	Port of Portland	15	**Plan for and invest in seismically resilient on-site emergency power and district energy systems to mitigate earthquake risk.**

ANNEX D – Collected Public Comment

This annex collects all responses to a question posted in an online survey distributed during the planning phase of this plan update. The question asked how constituents of this plan would like to see resources used. The answers are summarized in Chapter 4, but are presented here in full to preserve the complete words of those who took the time to respond. Those involved with the development of this plan wish to extend their gratitude to those who responded and provided information used to shape this and future planning work.

Answers have been lightly edited for clarity and to correct typos. Not all survey respondents answered this question. No responses were received in Chinese, Somali, or Vietnamese.

If money and other resources were available, how should it be used to make your community or home safer from natural disasters?

English, Respondent Self-Identified Location – City of Fairview

- We've put in a request for emergency disaster preparedness planning and training money through RDPO for Fairview, Troutdale, and Wood Village and hope it is funded. Our plans are 10 years old.
- We need an updated disaster management plan, training with our neighbors, and a ton of community education and engagement. We are at risk!

English, Respondent Self-Identified Location – City of Gresham

- Seismically fitted reservoirs cached around the city that would be accessible to public for safe drinking water - without relying on current infrastructure / plumbing. Encouraging more kitchen gardens especially in place of lawns. Would love to see a program for empty structures to be used for housing. There are so many empty retail spaces. Or houses that just sit empty. If not used for housing, at least for Extreme Heat and Extreme Cold shelters. More effort to build communities and get neighbors to know each other so we don't all just hope 911 will save us. Distribution of mini phone books for resources for all pertinent services to each area. People don't know who to call "in case of..."
- Electrical grid, water and utilities. Alerts on where to go for shelter and help.
- Too many areas of dry grasses in the summer and fall.
- We should have community heating and warming shelters in every school so people don't have to go far. Public employees and other volunteers should be trained to staff them. We should have AC units we could get to renters and low income owners. We would have smoke BMPs available to renters and low income homeowners (window insulation, air purifiers, masks etc.) We should require that houses near forested corridors or in the country be roofed and built of fire resistant materials We should

require reroofs or changes in siding trigger better insulation (and fire retardance when relevant).
- I would get heating sources, water, emergency food, emergency kits
- Prepare for earthquake
- Honestly, this is something that each person has to care enough about to prepare. The City has made lots of outreach regarding being prepared. I would continue on the current course.
- Providing community members with emergency backpacks that include: Drinking water (at least one gallon per person per day), Nonperishable food, such as canned veggies and protein bars, manual can opener, flashlights or portable lanterns and extra batteries, first aid kit, a crank- or battery-powered radio, sanitation supplies: toilet paper, moist towelettes, soap, trash bags and disinfectants, local maps.
- Good public emergency response training and map of needed supply stations strategically established throughout Gresham for all citizens!
- Make sure that Police, Fire and other emergency responders know where gas and water branch turnoffs are located and train them to be able to manage this in the absence of those utilities personnel.
- Early warning system for everyone.
- Establish Neighborhood cache of emergency supplies including water, food, blankets, masks, and other emergency supplies for humans and pets.
- Offshore wind event, drought fueled suburban/urban, wildfire-begun, fire-torrent. No escape routes or fire break lines have yet been planned.
- Assigning certain areas to a specific evacuation route to avoid congestion in case of disaster.
- Cooling stations for this summer. Air filtration units for the smoke that's coming.
- I would love more accessible information to any kind of rendezvous points/resources/aid that the county plans to have available in such disasters.
- Provide low cost items for an emergency "Go-Kit" for each household
- Air conditioning and filtration/purification systems for all low income people. Community cooling & warming shelters (like in elementary schools that people can easily get to not the big centralized ones) especially for homeless people who should be given safe storage for their belongings. Community clinics for respiratory illness/distress during smoke events to ensure healthcare access and prevent acute cases that need ER/Hospital care. Planting more trees in highly urbanized heat islands.

English, Respondent Self-Identified Location – City of Portland

- I would use it to retrofit my home to better prepare for disasters
- Earthquake proof older buildings: attach them to their foundations or secure brick walls and other falling hazards. Distribute AC units and air purifiers to low income houses. Create more safe shelters for any type of emergency.
- If money and other resources were available, how should it be used to make your community or home safer from natural disasters?

Whatever can be done to decrease the chance of wildfire--preparing Forest Park by more careful forestry. Also, free retrofitting of buildings that are in areas that were historically "redlined."

- Stormwater surge management, seismic retrofitting (especially for hazmat facilities like the fuel tank farm by the river). Infrastructure upgrades.
- reduce fuel loads in forest, build up infrastructure for our houseless neighbors living outside in extreme weather conditions
- Help those experiencing homelessness and build disaster preparedness amongst the most vulnerable.
- Let's get that Burnside bridge retrofitted
- in the short term, I believe extreme weather is our worst problem right now. deforestation around the mountains and building on flood plains makes the valley very susceptible to flooding and landslides. In the metro area, extreme heatwaves and extreme cold waves kill people. our physical infrastructure isn't built to withstand it. Fatal car crashes r way too high during ice and snow. We need resources such as home to home emergency relief packages for filtering air from wildfires. Scarcity and poverty makes buying yourself necessary tools to keep your homes, families, and vehicles safe very difficult, from cold, heat, and smoke. i think the city should allocate funds not just to the shelters like last year for the extreme temperature, but create resources for people to make their own homes safe from wildfire smoke. My apartment reached up to 116° during a heat wave this year. the only reason I didn't pass out, or die, from heat exhaustion was because my roommate happened to have an air conditioner in his bedroom that reduced the temperature to 103 degrees. i happened to work at a store selling box fans, so I was able to get one but filters were very difficult to find for months. TriMet also, should be free, especially during extreme heat. Free fares but only once it reached 100 degrees is unacceptable. 99 degrees, 95 degrees, these are also extreme, life-threatening temperatures for people to be outdoors.
- Make sure anyone who is registered to vote in Multnomah County and property tax payers receive information annually about the Cascadia Earthquake risk and earthquake disaster preparedness, make sure all hospitals, bridges and county bridges are seismically sound and retrofit those that are not, work with the Portland Bureau of Emergency NET (Neighborhood Emergency Team) program to provide all county residents with access to earthquake and natural disaster preparedness at least once every three years and sponsor an annual "walk home" event like the ones in New Zealand (where there are community walk home events) to build awareness about the need to prepare.
- Get buildings and bridges earthquake ready. Have snow plows, rock salt, and other things ready for ice and snow storms, and be prepared to keep the government employees at home.
- Preparing for a big earthquake by ensuring critical infrastructure (roads, water lines, etc.) can withstand the event

- I would like for there to be public evacuations options for people who don't have access to cars (e.g. shuttles or buses).
- Reinforce bridges such that we're not cut off. Provide yearly kits or at least yearly updated, ready to read and follow, lists in multiple languages of what we each should have for our local most likely disasters. Maybe kits could model after Finland's baby box, so people can choose between kit and a cash amount. City should have a plan and resources to aid the houseless.
- Prevent Linton petrochemical storage fire and chemical leak in the event of an earthquake or other disaster.
- Offering free home kits to residents to help in emergencies
- Seismic retrofitting an old Portland house is very costly. It would be great if there were some tax credits or something to help offset this expense. It seems like the gov't could do a bulk-buy of an earthquake supply bag and ought to be able to get the price down dramatically (assuming they can avoid being gouged by the seller who learns that it's the gov't doing the bulk buy :-/).
- more free online CNET training seminars for block-level community disaster response planning; door-to-door emergency kit distribution, supply hubs for residents without storage space for 14 days of water/food; improved 211 outreach and staffing during weather events; free property inspection for vulnerabilities and grant funding for seismic retrograding
- Major incentives for solar, ac, general weatherizing of homes. More communication on how to better prepare. Non-electric energy sources for heat/energy/water that are publicly accessible if not installed in each home if power is affected.
- Shelters, supplies etc.
- To retrofit existing buildings to improve their ability to withstand earthquakes
- Public Outreach to train people how to prepare their homes
- We need focus on preparation for the longer term aftermath of an earthquake. We may be able to respond in the moment, but not survive the months that follow. There isn't a roadmap for communities to get what they need and self-organize for this like there is for NET. As an example, NET citywide drills only talk about immediate events... I'd like to see some table top exercises that would help communities really think about the realities of post-earthquake survival. Also, so much of what we talk about locally is not very useful, as we perseverate on deciding how to handle immediate issues in ways that don't reflect the actual likely circumstances of our area. I'd like to see some earthquake damage predictions for our area (e.g. what will flood, landslides, which bridges will come down, what will liquefaction do to our streets) so that when we blithely say we will all evacuate "here" we understand that would not really be possible. We also spend a lot of time speculating about conditions without good data (e.g. will the Willamette Falls dam fail and cause us to flood? will our buildings still be standing? will we be able to drink the underground water?) If we had some expert advice, we could plan better and ignore things we don't need to address and really focus on the likely issues.

- I think development regulations should be revised to preserve as many big trees as possible to reduce the heat island effect, which can produce much bigger temperature changes than global average increases. I also think that investing in community-scale facilities like composting toilets, water storage units (perhaps used for bathing and drinking for people living outdoors), or even solar-powered charging stations would greatly enhance community resilience to events that disrupt lifelines. A major earthquake will disrupt them all, but wind storms, ice storms, or extreme heat would also disrupt some. I know that Multnomah County is investing in making the Burnside Bridge resilient to a major earthquake, which I heartily applaud. I'm not sure which other elements of critical infrastructure fall under the county's purview, but hardening those against fire, flood, and earthquake should be top priorities.
- Access to low cost measures & tools; education about prep. & mitigation.
- Helping pay for supplies to help prepare low income and historically underserved populations.
- Masonry building retrofits, water storage,
- AC units and air purifiers for all who cannot afford them along with assistance for their resulting utility bills, financial incentives for homeowners to secure their homes to foundations, and more money invested in infrastructure in case of a natural disaster such as earthquakes, etc.
- I think we need to help those who cannot afford go-bags and extra food and water storage
- So many people rent and most rentals do not include air conditioners-- which is becoming necessary to living in Multnomah County in the summer. Last summer during the heat wave, stores quickly sold out and even if folks had funds, finding an AC was near impossible. If there was a way to help provide air conditioners to those in need well in advance of hot months- it would undoubtedly save lives in the summer.
- Make sure that an earthquake will be less destructive to our homes and infrastructure.
- Seismic upgrades to bridges, large buildings. Controlled fire burns to reduce wildfire risks. Localized community meeting spaces with resources in the case of a catastrophe. Removing gas and other pollutants from the Willamette banks at risk from liquefaction of the ground during a large earthquake. Education.
- I would have my house (built in 1939) seismically reinforced to protect against earthquakes; add AC to prepare for heatwaves; replace my single pane windows with double pane to protect against both extreme heat and smoke from wildfires; and replace gas furnace, water heater and stove with electric appliances.
- Retrofitting homes for earthquakes. Controlled burns and tree thinning to mitigate damage from wildfires. Perhaps helping with air conditioning costs.
- Help people retrofit their houses.
- I'm working class, but I'm okay except for not having AC/heat during an outage. I'm worried about folks who don't have air conditioners, earthquake kits, air filters, and the like.

- People in each block or cluster of blocks would have kits and training for: downed limbs, pothole repair, first aid, hand-crank radio, water & food supply refreshed quarterly, survival gear, and would be the designated Good Neighbor who would go around and make sure all their people knew about the resource. (What I'm actually most concerned about is anarchy after such a disaster. A person or two with a gun can take away any of what I just mentioned.)
- I've been researching and contacting county and city officials for years about mitigating and surviving the CSZ earthquake. Mostly because I need assistance with funding a retrofit for my home. I've been informed that funds were needed this year for wildfire and heat issues but I have this bad feeling that time is running out so I may just have to go back in debt again to cover the cost. I would like to hear your input on this. thanks!
- Holistic, community-led/community-centered mitigation strategies; building social capital within neighborhoods; equitable distribution of funding to communities with least historic investment; long-term capacity building at community-based organizations that can best reach 'hard-to-reach' households; natural infrastructure solutions (e.g. wetlands protection, green infrastructure); solutions that improve people's daily lives and personal resiliency.
- Purchase water tank, solar charging station, generator, etc. the larger bits!

English, Respondent Self-Identified Location – City of Troutdale

- Offering free home kits to residents to help in emergencies
- Earthquake readiness

English, Respondent Self-Identified Location – Other Unincorporated Community

- Prevent Linton petrochemical storage fire and chemical leak in the event of an earthquake or other disaster.
- Make sure Linton tank farm doesn't rupture and cause fire and pollution in the event of an earthquake.
- An earthquake plan that tells us exactly what do and where to go if we survive.

English, Respondent Self-Identified Location – Outside of Multnomah County

- Seismic retrofit; improving on-site and street stormwater drainage systems

Russian

Как должны использоваться денежные и другие средства, чтобы обезопасить ваше сообщество или дом от стихийных бедствий?

- Инвестировать в программы по предотвращению и использование современных технологий заранее уведомляющих о стихийных бедствиях.

Spanish

Si hubiera dinero y otros recursos disponibles, ¿cómo se deberían usar para proteger a su comunidad u hogar de los desastres naturales?

- Ijole, como responder esta pregunta... tantas cosas...

Chinese

如果可以获得金钱和其他资源，应该如何使用它来使您的社区或家庭免受自然灾害的影响？

Somali

Haddi lacag iyo khayraad kale aad heli karto, sidee ayaa ay tahay in loo isticmaalo si looga dhigo bulshada ama guriga mid ammaan ka ah masiibooyinka dabiiciga ah?

Vietnamese

Nếu tiền và các nguồn lực hỗ trợ khác sẵn có, chúng ta nên tận dụng như thế nào để giúp cho cộng đồng hoặc gia đình của quý vị trở nên an toàn hơn khỏi các thảm họa tự nhiên

ANNEX E – 2017 NHMP Mitigation Actions

- The actions identified in the 2017 plan are listed here for reference. In cases where actions have been continued, that has been noted in the 2023 actions tables. In cases where these actions have moved forward, it is captured in the mitigation activities section for each Jurisdiction/District.

No.	Hazard	Mitigation Action	Jurisdictions
1	ALL HAZARDS	**Leverage existing hazard mitigation public outreach methods to develop a Hazard Mitigation Outreach Strategy for the Planning Area. The strategy will be culturally appropriate, and inclusive of traditionally underserved and underrepresented populations, and access and functional needs.**	Fairview, Gresham, Wood Village
Action Status		Fairview, Gresham, and Wood Village have developed individual ongoing outreach actions that are scaled to their available resources and targeted to specific communities. Wood Village has included natural hazard related articles in its newsletter and has added staff who speak languages other than English. Fairview is planning to develop more outreach at city events and provide resources in languages other than English. Gresham is planning to develop an outreach toolkit and direct programs with local community-based organizations to ensure that outreach efforts are most helpful to communities with barriers to resilience and government services.	
2	ALL HAZARDS	**Share hazard mitigation information to encourage integration into other planning mechanisms, such as comprehensive plans (i.e., Statewide Land Use Goal 7: Areas Subject to Natural Hazards) and development code updates.**	Fairview, Multnomah County, Troutdale
Action Status		Multnomah County continues to explore the possibility of upgrading or adding additional zoning overlays to meet increased concern about hazards. Troutdale added wildfire risk reduction considerations to its Accessory Dwelling Unit code.	
3	ALL HAZARDS	**Enhance the list of plans, policies and codes for each jurisdiction that address hazards in the Hazard Mitigation Plan.**	Fairview, Gresham, Multnomah County
Action Status		These lists have been largely maintained in this updated volume, but some new plans and processes have been added and existing plans and processes have been updated to consider ongoing or new opportunities for integration with mitigation. Gresham plans to update environmental overlays and floodplain code to reflect newer federal guidelines intended to ensure Endangered Species Act considerations are included in floodplain management decisions.	

4	ALL HAZARDS	**Work cross-jurisdiction with the Portland Metro Region's Urban Area Security Initiative's (UASI) Regional Disaster Preparedness Organization (RDPO) to develop a Post-Disaster Recovery Plan for the region. This project has been approved by the RDPO to receive UASI 2016 grant funding.**	Fairview, Multnomah County, Troutdale
	Action Status	The RDPO regional recovery framework was completed in 2019. Multnomah County is in a queue to develop a countywide plan, with a completion date not yet known. Multnomah County action 2 continues a focus on aligning the NHMP with the future Recovery Plan.	
5	ALL HAZARDS	**Integrate hazard risk assessments with jurisdiction/agency continuity of operations requirements to identify mitigation priorities; e.g., facilities that house critical functions and are at risk should be prioritized for mitigation/retrofit/alternative projects within each agency's Capital Improvements Program. Consideration should be given to life safety vs. habitable vs. operational. Document what has already been mitigated and make info easily accessible. The list of mitigation needs can also be used after a disaster to include mitigation during recovery/repair activities.**	Fairview, Multnomah County, Troutdale
	Action Status	Continuity of Operations Planning is being revised in Multnomah County and will use revised risk assessment information. Troutdale is achieving continuity planning through their Public Works Resilience Plan.	
6	ALL HAZARDS	**Explore and document in the plan how hazard mitigation is integrated into the early design process for public facility and infrastructure projects. Explore opportunities to show co-benefits of sustainable and resilient building practices.**	Fairview, Multnomah County, Troutdale, Wood Village
	Action Status	Some major facility projects, such as the new Multnomah County courthouse, Wood Village City Hall, and Fairview Public Works building integrated improved seismic resilience into design. Hazard mitigation is being considered during design processes, at least to the level of current state land use and building codes, which themselves have seen increased hazard resilience elements.	
7	ALL HAZARDS	**Develop Community Executive Summaries that explain the relevant portions of the Hazard Mitigation Plan to elected officials and members of specific communities. Provide annual progress report updates to the Community Summaries.**	Fairview
	Action Status	Specific strategies for coordinating hazard mitigation with elected officials have not been continued as priority actions, but updated mitigation strategies were considered in light of city priorities and budgets and coordination within city departments is ongoing.	
8	ALL HAZARDS	**Collaborate and coordinate across the Planning Area to support applications to FEMA Hazard Mitigation Assistance grants and Oregon Seismic Rehabilitation Grant Program annually.**	Multnomah County

	Action Status	Multnomah County Emergency Management has continued to promote grant opportunities and support participating jurisdictions with grant applications. A follow-up action is included in this plan to support grants that could providing resilience program funding for community-based organizations.	
9	**ALL HAZARDS**	**Assess resources needed for plan implementation and develop capacity options for consideration by participating jurisdictions to pool resources. Develop a cross-jurisdictional team to work on analysis, stakeholder coordination, and grant writing. Partner with state, regional, and academic organizations to coordinate projects related to risk analysis and reduction. Seek opportunities to coordinate planning processes of related plans with similar update cycles, e.g. NHMPs, Community Wildfire Protection Plan, Climate Action Plan.**	Gresham
	Action Status	Work has been coordinated through the NHMP Steering Committee and a Gresham Hazard Mitigation Workgroup. Gresham departments have participated in the update to the Community Wildfire Protection Plan and Gresham is developing a Climate Resilience Plan. Gresham also coordinated with the University of Oregon to develop an infrastructure resilience analysis.	
10	**ALL HAZARDS**	**Seek business alliances and other private sector representation in the mitigation planning process.**	Gresham
	Action Status	Action is continuing, with an updated action to support local business resilience. The Green Business Alliance has been a program that can support mitigation planning in Gresham.	
11	**ALL HAZARDS**	**Either invite existing Equity Council/Work Group or establish an Equity Working Group to provide guidance to the Hazard Mitigation Plan Steering Committee and other emergency management plans (e.g., Emergency Operations Plans) and programs.**	Multnomah County
	Action Status	A representative from Multnomah County Office of Diversity and Equity has been added to the steering committee since 2017. Multnomah County Emergency Management has also coordinated with the county's Community Involvement Committee to continue to develop best practices for equitable implementation of mitigation programs.	
12	**ALL HAZARDS**	**Further integrate social vulnerability data into the hazard risk assessment and use this to inform decisions on mitigation priorities.**	Multnomah County
	Action Status	Considerations of social vulnerability were expanded in this update, when available. Additional research is continuing to be released, including Metro's new Social Vulnerability Tool, and will continue to be used to refine the plan during the maintenance phase and next update.	

13	ALL HAZARDS	**Coordinate with the Joint Office for Homeless Services (JO) to reduce risk to natural hazards for people experiencing homelessness. Work with the JO to educate its staff and partner organizations about hazard exposure maps. Encourage JO to reference hazard exposure maps when siting indoor and outdoor locations for people experiencing homelessness. Coordinate with JO on outreach standard operating procedures for people experiencing homelessness during severe weather, flooding events and other emergency situations.**	Multnomah County
Action Status		Multnomah County Emergency Management now works very closely with JOHS, especially during severe weather and wildfire smoke events. JOHS now has emergency managers who coordinate outreach and coordination for potential natural hazard risks to unhoused communities.	
14	ALL HAZARDS	**Assist the Coalition of Community Health Clinics (CCHC) in identifying a structural engineer certified in multi-hazard building assessments to assess CCHC clinics. Provide technical assistance to CCHC as it seeks funding source(s) for structural assessments. Provide technical assistance to CCHC to prioritize improvements to CCHC clinics based on assessment findings.**	Multnomah County
Action Status		Action not advanced. Coordination with community health clinics needs to be re-established.	
15	EARTHQUAKE	**Advocate for the creation of a Critical Energy Infrastructure (CEI) Hub Disaster Resiliency Workgroup.**	Multnomah County
Action Status		Planning for the CEI Hub became more formalized during the period after the 2017 plan was adopted, culminating with a 2022 joint Portland/Multnomah County risk study and 2022 Oregon Senate Bill 1567 (both described in this plan).	
16	EARTHQUAKE	**Participate in Regional Disaster Preparedness Organization (RDPO)/Oregon Department of Geology and Mineral Industries (DOGAMI) regional HAZUS risk assessment for earthquakes. Provide local data where available. Incorporate new data into next NHMP update.**	Fairview, Gresham, Multnomah County, Troutdale, Wood Village
Action Status		All communities participated in development and engagement with the DOGAMI risk assessment and the new earthquake study was released in 2018 and incorporated into this plan update. Gresham to update city risk maps utilizing new HAZUS data.	
17	EARTHQUAKE	**Between 2016 and 2018, conduct a Seismic Feasibility Study on the Burnside Bridge, a regional lifeline route, to evaluate various rehabilitation and replacement alternatives for a seismically resilient crossing.**	Multnomah County

Action Status	The Earthquake Ready Burnside Bridge project is well under way, with the seismic feasibility study completed in 2018 and a goal of beginning construction on a new resilient span by 2025. The next phase of bridge seismic resilience is continued in Multnomah County mitigation action 15, which continues support for the Burnside Bridge and other bridge projects contemplated by the Willamette River Bridge Critical Infrastructure Plan.		
18	**EARTHQUAKE**	**Seek funding, between 2017 and 2019, for a National Environmental Policy Act (NEPA) study to help the county make an informed decision on which alternatives from the Seismic Feasibility Study should be further evaluated in the design phase.**	Multnomah County
Action Status	The funding for this study was secured in 2018, and the process for determining seismically the preferred resilient Burnside Bridge alternative has been completed.		
19	**EARTHQUAKE**	**Many agencies within the county have begun to analyze facility-specific seismic risk, e.g., Multnomah County and the Port of Portland. County stakeholders should prioritize critical facilities/infrastructure, gather seismic risk data when available (structural and non-structural), prioritize risk assessments where there are gaps, and begin to develop a funding strategy for mitigation of the most critical facilities. Document what has already been mitigated and make information easily accessible. The list of mitigation needs can also be used after a disaster to include mitigation during recovery/repair activities.**	Fairview, Gresham
Action Status	The release of new earthquake risk and vulnerability data has added to building support for major infrastructure projects, including the Earthquake Ready Burnside Bridge, the Port of Portland Resilient Runway, an Emergency Transportation Routes study and priority Triage Routes, and the CEI hub. Gresham seismically retrofitted its last fire station at risk and Fairview built a new, safer, Public Works building. An updated Critical Facility Analysis to be conducted by stakeholders in this plan is an action included in this update.		
20	**EARTHQUAKE**	**Expand seismic retrofit incentive programs for homeowners.**	Multnomah County
Action Status	Strategy continued as Multnomah County action 13.		
21	**EARTHQUAKE**	**Inventory and perform seismic upgrades to suspended wastewater conveyance pipelines (i.e., roadway crossings, pipe bridges, etc.).**	Fairview, Gresham, Troutdale
Action Status	The City of Gresham successfully used this action to acquire a grant to improve the resilience of a suspended conveyance at Johnson Creek. A lifeline was upgraded as part of the ODOT replacement of the Sandy River Bridge in Troutdale. All three cities have actions that point to building natural hazards resilience into infrastructure planning identified through wastewater master plans.		

22	FLOOD	**Over the next five years, install high-water-mark signs to educate the public about flooding potential in targeted locations along or within the leveed areas.**	Multnomah County Drainage District
	Action Status	Action modified to include additional flood risk information, carried forward as Columbia Corridor Drainage District action 20.	
23	FLOOD	**Partners who signed the Declaration of Cooperation will continue participation in Levee Ready Columbia in order to ensure the Portland metro levee system does not lose accreditation by FEMA or become inactive in the U.S. Army Corps of Engineers' Rehabilitation and Inspection Program. The NHMP Steering Committee will continue to integrate flood mitigation relevant to the levee system by staying actively informed and engaged with Levee Ready Columbia, particularly in review of risk assessments and discussions of the appropriate level of protection for the Portland metro levee system. Encourage inclusion of climate, community, economic and environmental considerations.**	Fairview, Multnomah County Drainage District, Sandy Drainage Improvement Company, Troutdale, Wood Village
	Action Status	Participation in Levee Ready Columbia continues, and this action was maintained as an action for the City of Fairview. The inclusion of the Columbia Corridor Drainage Districts into this plan ensures that the coordination between other plan stakeholders and drainage districts around mitigation strategy will be maintained.	
24	FLOOD	**Partners who signed the Declaration of Cooperation to continue participation in Levee Ready Columbia will seek funding to support maintaining certification and accreditation of the Columbia River levee systems, determine appropriate level of flood protection, and educate the public on the benefits and residual risks associated with the levees.**	Fairview, Multnomah County Drainage District, Sandy Drainage Improvement Company, Troutdale
	Action Status	Partners have continued to support the program, including for program funding. Coordination continues as the Columbia Corridor Drainage Districts move towards consolidation as the Urban Flood Safety and Water Quality District.	
25	FLOOD	**Identify target areas for flood mitigation projects, such as high-risk/repetitive risk problem areas. Identify specific mitigation projects and grants for, e.g. land acquisition, home elevation, business flood proofing, floodplain restoration, stormwater infrastructure. Consider if there are areas at risk to multiple hazards that could be targeted for increased cost benefit, e.g. flood + landslide + liquefaction + lahar.**	Gresham
	Action Status	Implementation of flood risk planning was moved in Gresham from the Comprehensive Plan to the Stormwater Master Plan, which was recently updated. A next step is to utilize the updated 2019 FEMA Flood Insurance Rate Maps to identify any new problem areas.	

26	**FLOOD**	**Assess whether local regulations should be updated to better protect citizens based on channel migration zone (CMZ) data. Currently, CMZs are mapped for the Sandy River, including an area around Troutdale. In late 2016, a statewide analysis of CMZ susceptibility will be released. This new data will help prioritize future CMZ mapping projects that may include other portions of the Planning Area.**	Multnomah County
Action Status		Multnomah County continued an action to consider adding channel migration risk reduction to Emergency Management and Land Use programs, using updated risk mapping for the Sandy River.	
27	**FLOOD**	**Identify stormwater stakeholders to participate on the steering committee during the next update. These subject matter experts will help determine how stormwater management planning and projects should be addressed in the next plan update. Explore if a stormwater subcommittee would be beneficial, or if each jurisdiction will track stormwater projects individually through master plans and Capital Improvement Plans. Consider if mitigation grants should be pursued in funding stormwater projects. Consider opportunities to manage stormwater naturally and prepare for increased stormwater runoff from climate change.**	Gresham, Wood Village
Action Status		Public Works and Engineering staff were represented in this update process. Stormwater management was not identified as a significant vulnerability in this update, compared to other hazards, so this action was deprioritized – however both cities have been actively updating and upgrading stormwater management plans. Gresham to identify, prioritize, and implement restoration projects that benefit floodplain conditions, fish habitat and water quality.	
28	**FLOOD**	**Flood-proof wastewater manholes and pipelines within the 100-year floodplain.**	Gresham, Troutdale, Wood Village
Action Status		These projects continue to be identified as wastewater master plans are revised, which are referenced for potential mitigation grant assistance in this plan update. Gresham will continue to repair/rehabilitate leaking manholes and raise/floodproof those manholes below the base flood elevation.	
29	**FLOOD**	**Coordinate with MCDD, SDIC and the Sauvie Island Drainage Improvement Company (SIDIC; collectively, the Districts) when development is proposed in, on or near the levee systems managed by these entities to ensure minimal impact to the levee systems. Land Use, Planning or similar departments will notify the Districts of development that may impact their flood management systems and give them an opportunity to review the plans for impacts to their systems, per U.S. Army Corps of Engineers standards.**	Multnomah County, Multnomah County Drainage District, Sandy Drainage Improvement Company, Troutdale
Action Status		Columbia Corridor Drainage Districts have been actively participating in development reviews for construction within the levee prism.	

30	FLOOD	**Replace, and potentially increase capacity of, the primary stormwater pumping station for the SDIC within the next three years. The current capacity is 37,000 gallons per minute and serves more than 1,550 acres, eight miles of ditches, the Troutdale Airport and a variety of property owners, including a major shipping logistics center and traded-sector manufacturers. Currently, the Port of Portland's Troutdale Reynolds Industrial Park (TRIP) has 350 acres of developable land for sale. Future development will increase impervious area in SDIC, greatly increasing the amount of stormwater entering the system. The pump station may need to have a higher capacity for this reason, and appropriate capacity will be explored as part of the project.**	Sandy Drainage Improvement Company
Action Status		This project is included as a continuing action in this plan (Columbia Corridor Drainage District action 33), with work to integrate into Capital Improvement Planning since the 2017 plan.	
31	FLOOD	**Replace the flow control structure regulating water levels on the TRIP wetland mitigation site within the next year. The current flow control structure insufficiently manages water through two 36-inch culverts placed at different invert elevations. A new flow control structure with an adjustable concrete weir structure and larger diameter culvert with gate valve is needed to properly control the flow of stormwater with greater flexibility to adjust flow in support of flood control in the upstream segment of Salmon Creek and environmental protection.**	Sandy Drainage Improvement Company
Action Status		This structure was fully functional by 2019.	
32	LANDSLIDE	**Consider new DOGAMI landslide data to identify development and infrastructure at risk. This project will be completed by early 2017. Develop and prioritize mitigation projects based on new data. Incorporate new data into other planning mechanisms, such as comprehensive plans and development codes.**	Multnomah County, Troutdale, Wood Village
Action Status		The new DOGAMI landslide risk and vulnerability mapping was incorporated into the risk assessment of this plan, and were used to inform landslide mitigation projects indentified in this volume, as well as becoming the basis for updated or future geological hazards zoning overlays.	
33	LANDSLIDE	**Develop and adopt standards for managing stormwater in landslide hazard areas in accordance with best management practices.**	Multnomah County, Troutdale, Wood Village
Action Status		Actions were modified for Multnomah County and Troutdale – calling for a potential update to the Multnomah County geological hazard overlay (action 20) and for Pubic Works and the Building Department in Troutdale to improve coordination (action 8) for stormwater management opportunities on private sites. Wood Village determined landslide to be of low risk in this update, and does not have an updated action.	
34	LANDSLIDE	**Use new landslide hazard information, available from DOGAMI in early 2017, to examine road and utility maintenance practices.**	Multnomah County, Troutdale, Wood Village

	Action Status	New data has been used to inform the ongoing project to update regional Emergency Transportation Routes. Mitigation strategies for maintenance practices are not described in this plan update, but local and state roads agencies are using the revised mapping in their emergency and capital investment planning.	
35	**SEVERE WEATHER**	**Encourage retrofits that make mobile homes safer in high winds.**	Multnomah County, Troutdale, Wood Village
	Action Status	This action was maintain as an ongoing need in Wood Village, which continues to have a very high proportion of mobile homes in the total of its housing units.	
36	**VOLCANO**	**Explore the feasibility of limiting critical facilities and/or high-density facilities in the lahar zone (e.g., Pierce County, Washington), and if disclosure of lahar hazard can be included in the permitting processes. (e.g., Orting, Washington).**	Troutdale
	Action Status	Modified into Troutdale action 10, which explores disclosure of lahar zones during new development permitting.	
37	**WILDFIRE**	**Update the Community Wildfire Protection Plan (CWPP). Integrate the CWPP into the next NHMP update.**	Multnomah County
	Action Status	The update to the CWPP was in final stages of completion at the same time as this update. The CWPP is similar to the wildfire chapter in this volume, but with more depth. Actions in this updated NHMP refer to the CWPP for wildfire and wildfire smoke mitigation strategies.	
38	**WILDFIRE**	**Provide educational materials, presentations and demonstration projects on defensible space and wildfire mitigation techniques to communities at risk.**	Troutdale
	Action Status	A number of mitigation strategies relating to community engagement and resilience building are included in the revised CWPP, which is referred to by Troutdale action 12 in this plan. The Troutdale Planning Department has worked on educational materials for residents.	
39	**WILDFIRE**	**Develop and maintain a prioritized list of potential fuels-reduction projects (i.e., combustible materials) in high-risk areas, including fuel reduction prescriptions and cost estimates. Conduct outreach to community/property owners for priority projects to get buy-in for reduction projects. Seek funding for priority projects with community support.**	Troutdale

	Action Status	A number of mitigation strategies relating to fuels reduction are included in the revised CWPP, which is referred to by Troutdale action 12 in this plan.	
40	**WILDFIRE**	**Promote fire-safe construction practices for existing and new construction in high-risk areas.**	Multnomah County, Troutdale
	Action Status	A number of mitigation strategies relating to reducing structural ignitability are included in the revised CWPP, which is referred to by Troutdale action 12 and Multnomah County action 25 in this plan.	
41	**WILDFIRE**	**Consider regulations that require fire-safe construction in high-risk areas using Wildland Urban Interface (WUI) overlays.**	Multnomah County
	Action Status	A consideration of a revised wildfire overlay is an action identified by Multnomah County Land Use in the revision to the CWPP, which is used as a mitigation action reference under Multnomah County action 25 in this plan.	
42	**WILDFIRE**	**Use best available data to consider impacts of wildfire risk when developing policy.**	Multnomah County
	Action Status	Best available data for wildfire has been updated in the risk assessment for this plan, and for the update to the CWPP.	

Other Mitigation Actions

- The following nine actions were considered separate from the first 42, and were not aligned to jurisdictions. These actions were intended to be reviewed during the post-adoption period of the 2017 plan and monitored in relation to changing priorities. Several of these actions have been used as the foundation of actions in the 2023 update, especially due to the higher-profile mitigation needs around Severe Weather.

43	ALL HAZARDS	**Assess resources needed for plan implementation and develop capacity options for consideration by participating jurisdictions to pool resources. Develop a cross-jurisdictional team to work on analysis, stakeholder coordination and grant writing. Partner with state, regional and academic organizations to coordinate projects related to risk analysis and reduction. Seek opportunities to coordinate planning processes of related plans with similar update cycles, e.g., NHMP, CWPP, Climate Action Plan.**
	Action Status	Coordination with other planning processes has been increased, and more capacity is now available at the state level to support mitigation grants. A cross-jurisdictional implementation team has not been formed.
44	ALL HAZARDS	**Communicate with utility agencies about NHMP actions and priorities, and encourage integration into their planning.**
	Action Status	Power utilities operating within Multnomah County have become more involved in coordinated hazard mitigation planning, especially for wildfire, where they were part of the planning team for the update to the Community Wildfire Protection Plan.
45	EARTHQUAKE	**Determine a practical method to track existing public buildings that have had seismic upgrades, and to what degree. This information can be included in future risk assessments to provide more accuracy. The public also would benefit from knowing the seismic status of buildings they occupy or visit. Include seismic data for schools, as available. The Portland Public School District will be developing a stand-alone NHMP.**
	Action Status	The City of Portland developed a program to identify buildings with unreinforced masonry, but it proved to be controversial. This action has not been developed by participating members of this plan, apart from ongoing improvements in seismic stability at public buildings and continuing awareness of buildings at risk.
46	FLOOD	**Seek funding to develop future conditions modeling to inform comprehensive planning in floodplain areas.**
	Action Status	Upgraded floodplain modeling has not been a priority since the 2017 plan, due to the increased prominence of other hazards.
47	FLOOD	**Identify target areas for flood mitigation projects. Are there any high-risk/repetitive risk problem areas that should be studied in more detail? Are there specific mitigation projects that should be developed and for which grants should be pursued, e.g., land acquisition, home elevation, business flood-proofing, floodplain restoration, stormwater infrastructure. Consider if there are areas at risk to multiple hazards that could be targeted for increased cost benefit, e.g., flood + landslide + liquefaction + lahar.**

	Action Status	New flood maps were issued for part of Multnomah County in 2019. Flooding in the participating communities was limited since the last version of this plan, except in areas managed by the Columbia Corridor Drainage Districts.
48	**SEVERE WEATHER**	**Collaborate with the Climate Action Plan Committee and City of Portland to decrease the urban heat island effect, especially in areas with populations most vulnerable to heat, through strategies such as revegetation, tree preservation planting and maintenance, depaving and porous pavement, green infrastructure such as bioswales and ecoroofs, and site development performance standards.**
	Action Status	Mitigation strategies for urban heat were much more heavily prioritized in this update. The City of Gresham has been awarded a grant to plant 50 trees in the Rockwood neighborhood, using this 2017 action as a basis for action.
49	**SEVERE WEATHER**	**Use new guidance on planning drought-ready communities to develop a focused project on drought mitigation planning and outreach.**
	Action Status	Drought was not elevated as a priority hazard in this update because of the resilience of local water systems in most of the county.
50	**SEVERE WEATHER**	**Determine what actions are needed to incorporate emergency management criteria into normal maintenance practices to reduce power disruptions from severe weather.**
	Action Status	Long-term power loss was heightened In this update's risk analysis, due to increases in winter storms and preventative power shutoffs due to wildfire risk. Mitigation strategy is now focused on ensuring care to those most harmed due to use of powered medical equipment or refrigerated medications.
51	**WILDFIRE**	**Work with local fire agencies to (1) integrate new local wildfire data with the regional data in the West-wide Wildfire Risk Assessment for the Planning Area, then (2) update the Wildland Urban Interface (WUI) areas within the Planning Area as needed. Once WUI areas are updated, develop a strategy for tracking vulnerable properties and identifying appropriate mitigation strategies. Prioritize properties with fire response access limitations.**
	Action Status	Revised wildfire risk data from the US Forest Service and Oregon Department of Forestry has superseded the previous risk data. WUI risk mapping is continuing as part of state legislation reflecting heightened wildfire risk, and participating Fire Districts will evaluate that data when it is finalized and update the countywide CWPP with revised strategies as applicable.

ANNEX F

2017 Human-Caused and Technological Hazard Identification and Risk Assessment

This report includes hazard profiles for each of the human-caused and technological hazards identified for further evaluation by the Multnomah County Multi-Jurisdictional Natural Hazards Mitigation Plan (NHMP) Steering Committee. It contains the following subsections:

Overview

- 1. Overview
- 2. Asset Inventory

Hazards

- 3. Transportation Incident
- 4. Hazardous Materials Incident
- 5. Pipeline Incident
- 6. Critical Infrastructure Failure
- 7. Utility Interruption/Failure
- 8. Terrorism
- 9. Workplace/School/University Violence
- 10. Fuel/Resource Shortage

Conclusion

- 11. Final Determinations

1. OVERVIEW

Each hazard profile includes a general description of the hazard, its location and extent, notable historical occurrences, and the probability of future occurrences. Each profile also includes specific items noted by members of the NHMP Steering Committee as it relates to unique historical or anecdotal hazard information for Multnomah County or a participating municipality within it.

The following human-caused and technological hazards were identified as hazards of concern for Multnomah County:

- Transportation Incident
- Hazardous Materials Incident
- Pipeline Incident
- Critical Infrastructure Failure
- Utility Interruption/Failure
- Terrorism

- Workplace/School/University Violence
- Fuel/Resource Shortage

For the scope of this analysis, only those hazards with a geospatial component and that would enhance current hazard mitigation planning efforts were included. The most data was available for analyzing Hazardous Materials Incidents and therefore the most thorough risk assessment was provided for this hazard. The other hazards were profiled and may be further analyzed in future updates. The NHMP Steering Committee advised on which hazards to include and focus on.

Table 1 provides a brief description of each of these hazards.

TABLE 1: DESCRIPTIONS OF IDENTIFIED HAZARDS

Transportation Incident	Transportation incidents come in many forms in the United States, especially given the many forms of transportation available today. The most common types of transportation incidents are motor vehicle accidents, but plane, train, and watercraft accidents occur as well and often have higher magnitude impacts.

Hazardous Materials Incident	Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on the nation's highways and on the water. HAZMAT incidents consist of solid, liquid and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A HAZMAT incident can last hours to days, while some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind and possibly wildlife as well.
Pipeline Incident	A pipeline incident may also be considered a hazardous materials incident or critical infrastructure failure but has been split out as a separate hazard in this plan. This type of incident generally refers to a spill, explosion, or fire caused in the transport of flammable liquid or gas being carried by fixed pipes across the United States. These pipes often carry petroleum-based products that are dangerous to health and safety of people as well as the environment if exposed in large quantities.

Critical Infrastructure Failure	A critical infrastructure failure covers a broad range of potential failures, including roads, bridges, or important buildings. Often the impacts of natural hazards such as earthquakes are the cause of critical infrastructure failure. A failure of critical infrastructure would result in impacts that exceed those associated with the failure of other structures or infrastructure and would likely have cascading effects on the population.
Utility Interruption/Failure	Energy/power/utility failures often occur hand in hand with other hazards and are often caused by rising flood waters or high winds. These events most commonly occur when wind events knock down power lines or water treatment plants are flooded by rising waters, thereby shutting down these utilities. The impacts from these failures are often widespread and can affect thousands of people even when small areas of this infrastructure are affected.
Terrorism	Terrorism is defined by FEMA as, "the use of force or violence against persons or property in violation of the criminal laws of the United States for purposes of intimidation, coercion, or ransom." Terrorist acts may include assassinations, kidnappings, hijackings, bomb scares and bombings, cyber attacks (computer-based), and the use of chemical, biological, nuclear and radiological weapons.
Workplace/School/University Violence	The Occupational Safety and Health Administration describes workplace/school/university violence as violence or the threat of violence against workers or students that can occur at or outside of the workplace or school environment. It can range from verbal abuse to physical assaults and homicides, but in the context of this plan, the focus will be on the physical aspect of this violence which can manifest itself in a number of forms including active shooters.
Resource Shortage (Water/Fuel)	A resource shortage occurs whenever supplies of a resource have been depleted to the point that there is very little to none of the resource available to the public. Most commonly resource shortages occur when there has been a steady decrease in the amount of available resource over time, but these shortages can also be the result of a major event that quickly reduces supply.

2. ASSET INVENTORY

An inventory of geo-referenced assets within Multnomah County and its jurisdictions was compiled in order to identify and characterize those properties potentially at risk to the identified hazards. By understanding the type and number of assets that exist and where they are located in relation to known hazard areas, the relative risk and vulnerability for such assets can be assessed. Under this assessment, built environment (section 2.1) and social assets (section 2.2) were considered.

2.1. Built Environment Assets

Two categories of physical assets were identified:

1. Improved Property: Includes all improved properties in Multnomah County according to local parcel data provided by the county. The information has been expressed in terms of the number of parcels, total assessed value of improvements (buildings), and land use type that may be exposed to the identified hazards. In addition, building footprint data was available for all jurisdictions and it was used to improve the overall assessment by providing an accurate assessment of how many buildings are located in hazard areas. However, it should be noted that building footprint data from all jurisdictions has not been updated since 2008, so it likely underestimates building counts.

2. Critical Facilities: Critical facilities vary by jurisdiction and the critical facilities provided by the county are used in this section. It should be noted that this listing is not all-inclusive for assets located in the county, and it is anticipated that it may be expanded or adjusted during future plan updates as more geo-referenced data becomes available for use in GIS analysis.

Table 2 lists the number of parcels, total value of parcels, total number of parcels with improvements, and the total assessed value of improvements for jurisdictions within Multnomah County.[97]

TABLE 2: IMPROVED PROPERTY IN MULTNOMAH COUNTY

Location	Number of Parcels	Total Assessed Value of Parcels	Number of Buildings	Total Assessed Value of Buildings
Fairview	2,499	$896,633,460	2,769	$508,430,610
Gresham	28,477	$9,475,669,670	30,614	$5,770,469,210
Lake Oswego	1,451	$435,386,650	621	$305,430,500
Maywood Park	326	$91,532,100	385	$53,970,540
Portland	225,262	$103,453,408,640	232,590	$65,975,029,740
Troutdale	5,008	$1,743,948,030	5,180	$972,270,780
Wood Village	859	$360,335,480	1,233	$3,455,304,730

[97] Total assessed values for improvements is based on tax assessor records as joined to digital parcel data. This data does not include dollar figures for tax-exempt improvements such as publicly-owned buildings and facilities. It should also be noted that, due to record keeping, some duplication is possible thus potentially resulting in an inflated value exposure for an area.

Location	Number of Parcels	Total Assessed Value of Parcels	Number of Buildings	Total Assessed Value of Buildings
Unincorporated Area	9,428	$5,493,674,920	17,213	$196,653,810
MULTNOMAH COUNTY TOTAL	**273,310**	**$121,950,588,950**	**290,605**	**$77,237,559,920**

Source: Metro Data Resource Center- Watershed Sciences and Multnomah County Tax Assessors

Additionally, **Table 3** contains a breakdown of parcels based on land use code by jurisdiction.

TABLE 3: PARCELS BY LAND USE CODE IN MULTNOMAH COUNTY

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Fairview	1	90	0	2	155	1	1,875	296	79
Gresham	54	1,388	6	26	2,374	48	22,440	1,976	165
Lake Oswego	0	6	0	0	738	0	577	130	0
Maywood Park	0	3	0	0	3	0	304	18	0
Portland	66	14,135	10	185	36,318	524	160,097	12,896	1,031
Troutdale	7	222	1	3	130	8	4,233	388	16
Wood Village	1	75	0	2	152	2	560	65	2
Unincorporated Area	1,129	164	1,372	1	65	1,327	2,895	2,209	266
MULTNOMAH COUNTY TOTAL	**1,258**	**16,083**	**1,389**	**219**	**39,935**	**1,910**	**192,981**	**17,978**	**1,559**

AGR: Agriculture; COM: Commercial; FOR: Forest; IND: Industrial; MFR: Multi-Family Residential; SFR: Single-Family Residential; VAC: Undeveloped; N/A: No Land Use Code Associated with Parcel
Source: Metro Data Resource Center- Multnomah County Tax Assessors

Table 4, Table 5, and **Table 6** list the critical facilities located in Multnomah County that were included in this analysis. These facilities were identified as critical facilities in that they are needed to maintain government functions and protect the life, health, safety, and welfare of citizens. Critical facility spatial data was provided by the Multnomah County GIS department, Metro, Oregon Department of Environmental Quality, and the Oregon Spatial Data Library.

In addition, **Figure 1**, **Figure 2**, and **Figure 3** show the locations of the primary critical facilities in Multnomah County. A complete list of the critical facilities by name, as well as the hazards that affect each facility, is included in **Table 64**. As noted previously, this list is not all-inclusive and only includes information that was readily available in geospatial format.

TABLE 4: EMERGENCY SERVICES CRITICAL FACILITY INVENTORY IN MULTNOMAH COUNTY[98]

Location	Ambulance Services	Fire Stations	Hospitals	Licensed Medical Facilities	Law Enforcement	Urgent Care Centers
Fairview	0	0	0	0	1	0
Gresham	0	6	1	5	2	3
Lake Oswego	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0
Portland	4	31	11	54	31	17
Troutdale	0	1	0	0	1	0
Wood Village	0	0	0	0	0	0
Unincorporated Area	0	8	0	1	0	0
MULTNOMAH COUNTY TOTAL	**4**	**44**	**12**	**60**	**35**	**20**

Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Licensed Medical Facilities- Oregon Health Authority; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

TABLE 5: ADMINISTRATIVE CRITICAL FACILITY INVENTORY IN MULTNOMAH COUNTY

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Fairview	0	1	1	4	1
Gresham	0	1	0	18	2
Lake Oswego	0	0	0	0	0
Maywood Park	0	1	0	0	0
Portland	1	1	31	99	15
Troutdale	1	1	0	4	1
Wood Village	0	1	0	0	0
Unincorporated Area	0	0	1	10	0

[98] Emergency Shelters were also identified as a Critical Facility, however, work is currently underway to update the list of these sites, so this information was not included in the current plan with the goal of adding new data to future updates.

Location	Airports	City Halls	Community Centers	County Assets	Libraries
MULTNOMAH COUNTY TOTAL	**2**	**6**	**34**	**136**	**19**

Source: Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

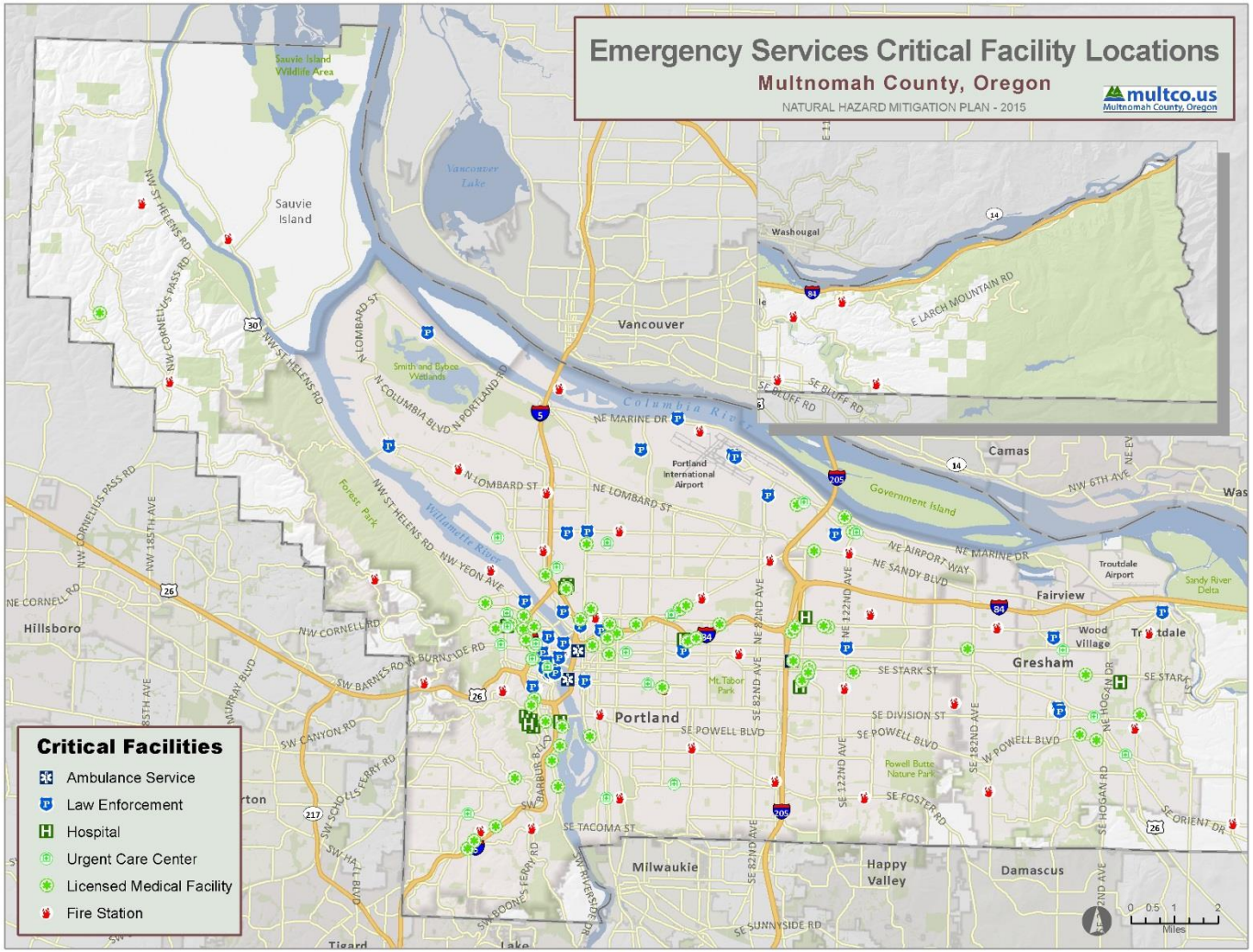
TABLE 6: SPECIAL POPULATION CRITICAL FACILITY INVENTORY IN MULTNOMAH COUNTY

Location	Childcare Facilities	Homeless Shelters	Jails	Residential Care Facilities	Schools
Fairview	1	0	0	0	11
Gresham	47	0	0	32	55
Lake Oswego	2	0	0	0	4
Maywood Park	2	0	0	0	2
Portland	333	29	2	156	325
Troutdale	5	0	0	3	10
Wood Village	2	0	0	2	0
Unincorporated Area	5	0	0	0	16
MULTNOMAH COUNTY TOTAL	**397**	**29**	**2**	**193**	**423**

Source: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health,

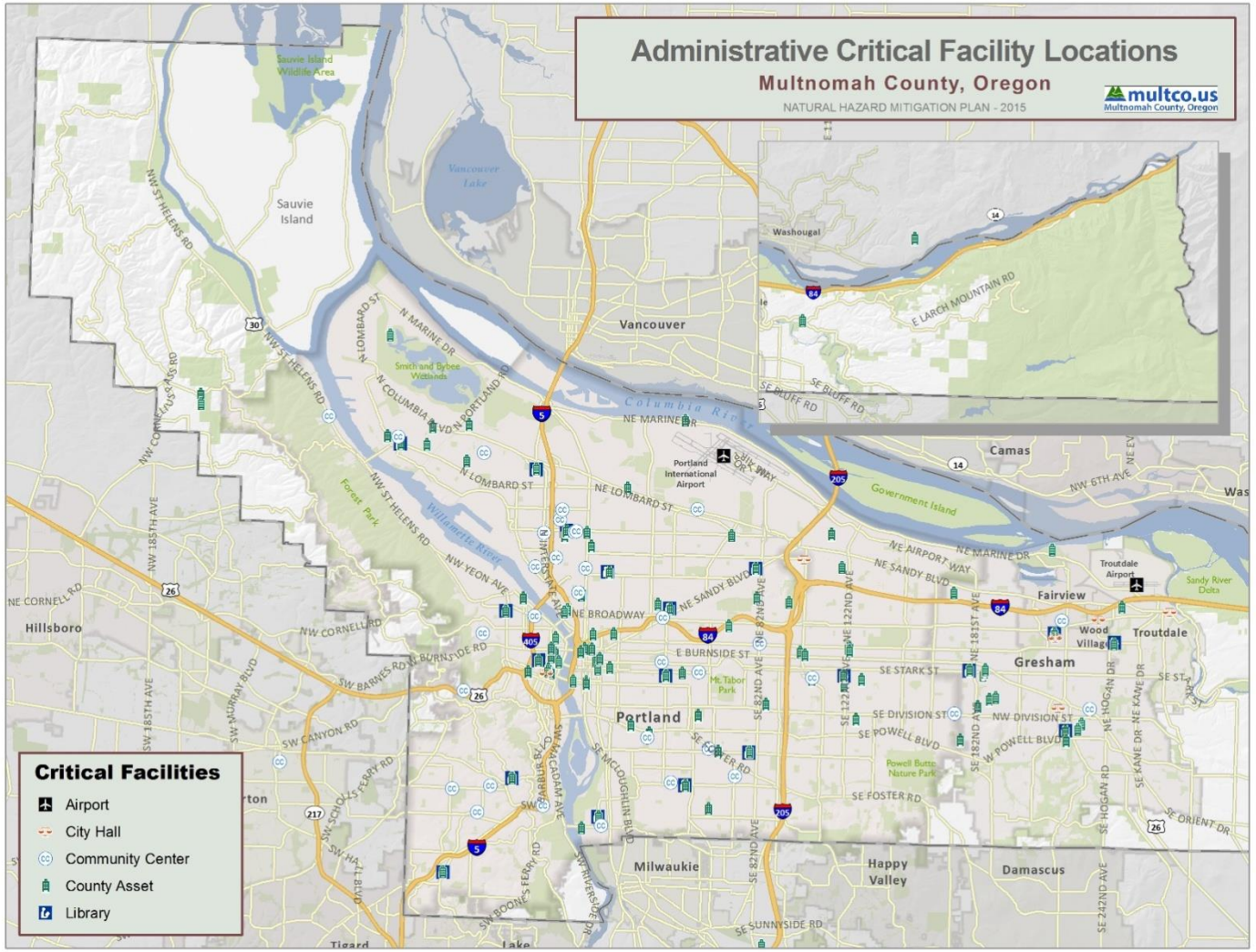
Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

FIGURE 1: EMERGENCY SERVICES CRITICAL FACILITY LOCATIONS IN MULTNOMAH COUNTY



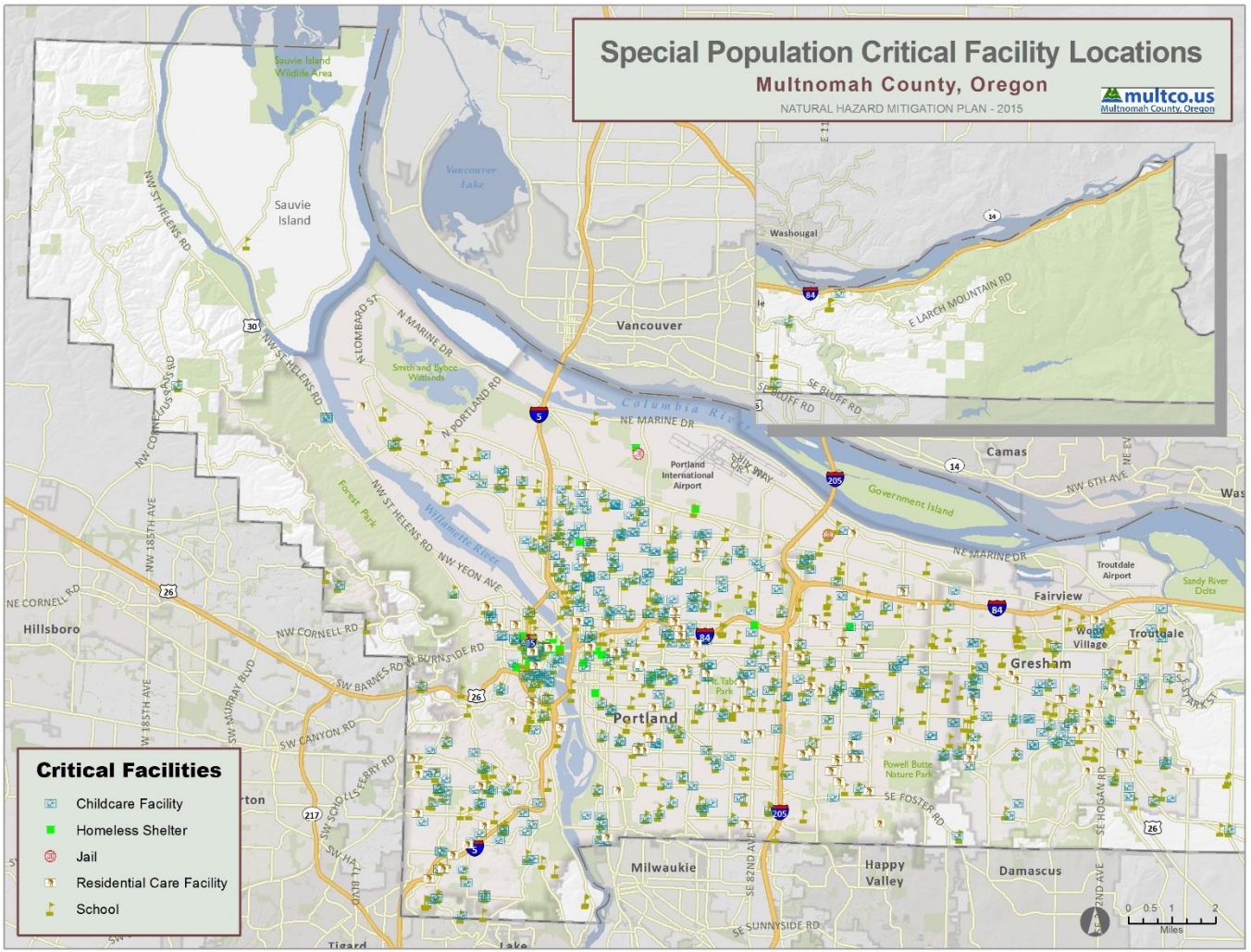
Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

FIGURE 2: ADMINISTRATIVE CRITICAL FACILITY LOCATIONS IN MULTNOMAH COUNTY



Source: Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

FIGURE 3: SPECIAL POPULATION CRITICAL FACILITY LOCATIONS IN MULTNOMAH COUNTY



Sources: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health, Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

2.2. Social Vulnerability

In addition to identifying physical assets potentially at risk to identified hazards, it is important to identify and assess the populations in Multnomah County that are potentially at risk to these hazards. For a full assessment of population and socio-economic indicators in the county, refer to the Multnomah County Multi-Jurisdictional NHMP.

Table 7 lists the population by jurisdiction according to 2013 American Community Survey population estimates. The total population in Multnomah County is 747,641 persons.

TABLE 7: TOTAL POPULATION IN MULTNOMAH COUNTY

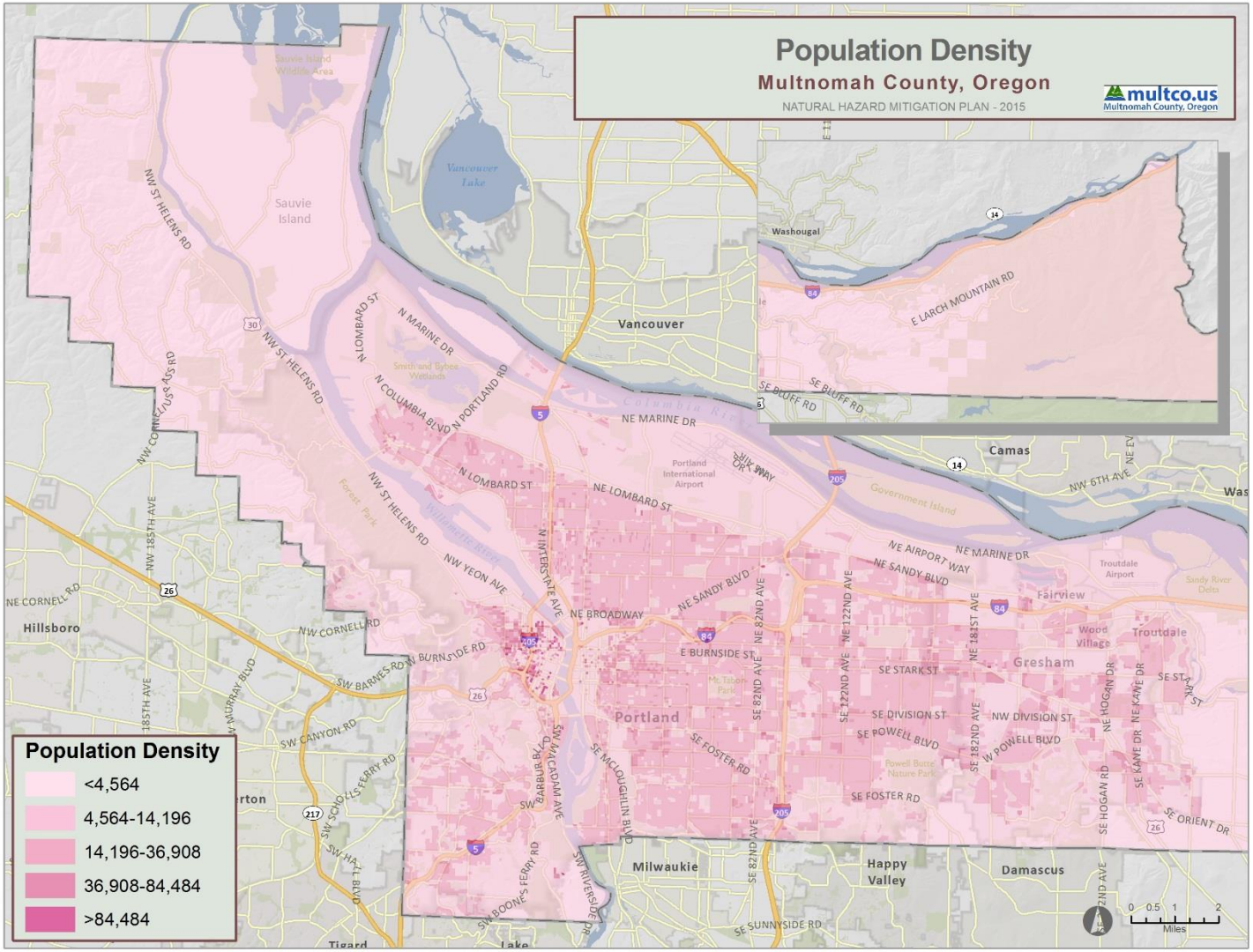
Location	Total 2013 Population Estimate
Fairview	9,003
Gresham	107,196
Lake Oswego	37,037
Maywood Park	939
Portland	594,687
Troutdale	16,188
Wood Village	3,899
MULTNOMAH COUNTY TOTAL	**747,641**

*The population count of Lake Oswego includes populations residing in neighboring counties. These populations are not included in the Multnomah County total.

Source: American Community Survey

In addition, **Figure 4** illustrates the population density (persons per square mile) by census block as it was reported by the U.S. Census in 2010.

FIGURE 4: POPULATION DENSITY IN MULTNOMAH COUNTY



Source: U.S. Census Bureau, 2010

3. TRANSPORTATION INCIDENT

3.1. Overview

Transportation accidents occur on a daily basis, but generally large-scale incidents that cause major disruptions to regional commerce or mass transit are uncommon. Nevertheless, these incidents can have significant impacts on the community. Multnomah County has experienced incidents involving either airplanes, trains, naval vessels, or automobiles in the past. It is notable that occurrence of minor incidents happens relatively frequently and that events of significant impact are rare. The most common impacts of smaller events are generally on travel time and localized commerce. For larger events, impacts can be longer term on the economy and can potentially cause higher numbers of fatalities and injuries.

Within Multnomah County, one of the most prominent transportation features is the Port of Portland or "Port," which is an 800-employee, 24/7 operation with more than $1.6 billion in marine and aviation transportation infrastructure and real estate assets that generate nearly $250 million in annual revenues. The aviation component is comprised of Portland International Airport (PDX) and two general aviation reliever airports. General Port operations include marine and industrial development, navigation, engineering, and administrative divisions. Portland International Airport (PDX) occupies approximately 3,300 acres within the Northeast Portland Metro Region. The airport's northern boundary is bordered by the Columbia River and is generally surrounded by businesses, neighborhoods, and industrial parks. PDX is served by three runways, five concourses, and two parking garages.[99]

Multnomah County is also a major thoroughfare for rail commerce and travel. The Portland light rail line is called the Metropolitan Area Express (or MAX) and passes through the downtown area along four separate lines and serves over 80 stations. Additionally, there are several freight rail lines that pass through the county, most prominently the Union Pacific and BNSF Railroads.

3.2. Historical Occurrences

There have been numerous smaller incidents in Multnomah County. One notable major incident occurred on December 28, 1978 when an airliner crashed in a suburban area of Portland. Although there were a number of survivors of the crash, ten people were killed and many were injured.[100]

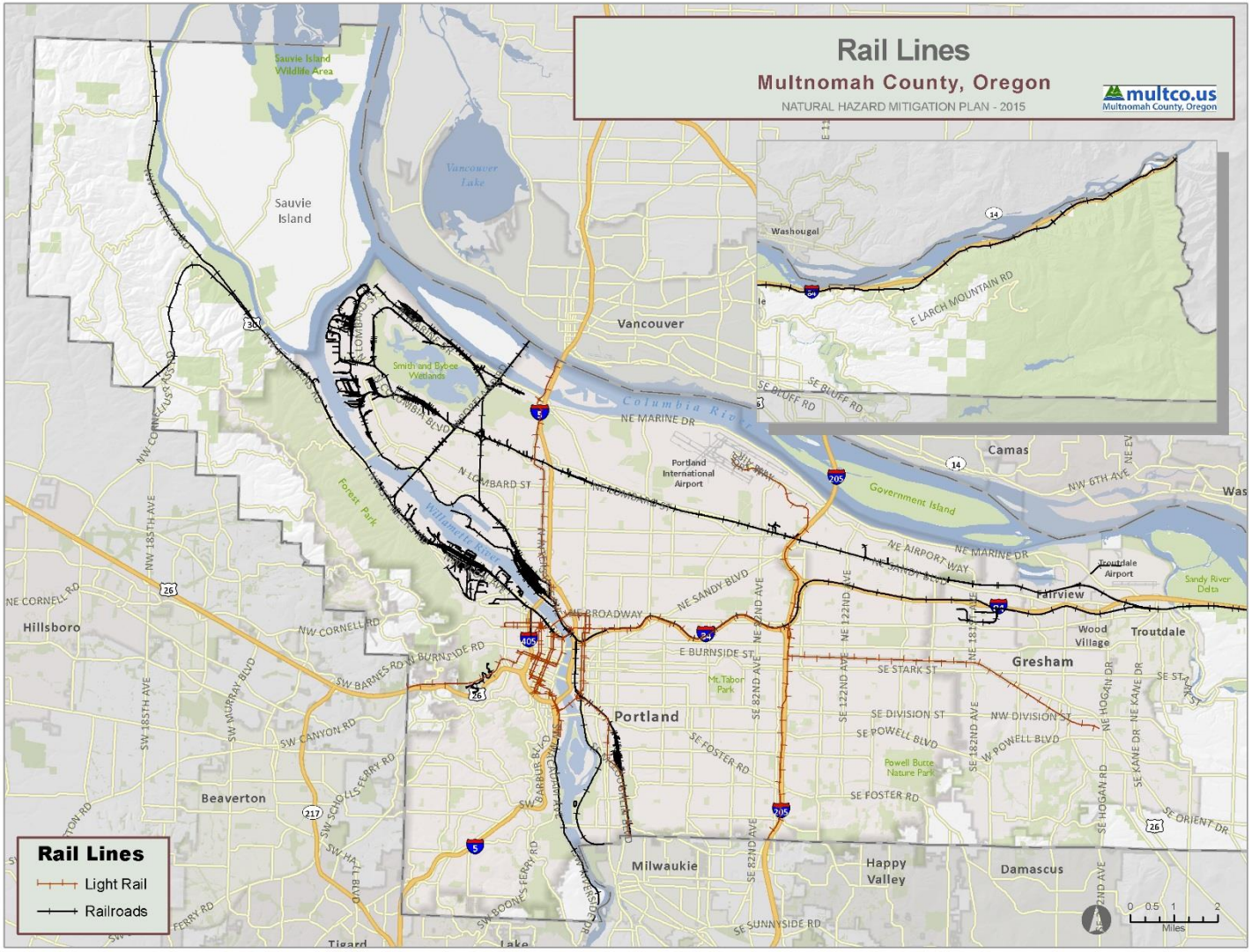
3.3. Location and Spatial Extent

Transportation incidents are most likely to occur along major transportation corridors such as highways, interstates, or railways. **Figure 5** and **Figure 6** show many of the major transportation corridors in the county, thereby demonstrating the areas that are most likely to be impacted by a transportation incident. However, transportation incidents can occur throughout the county, especially given the number of planes that take flight in and out of airports and the widespread transportation infrastructure located throughout the county.

[99] PDX Airport Emergency Plan, April 2013.

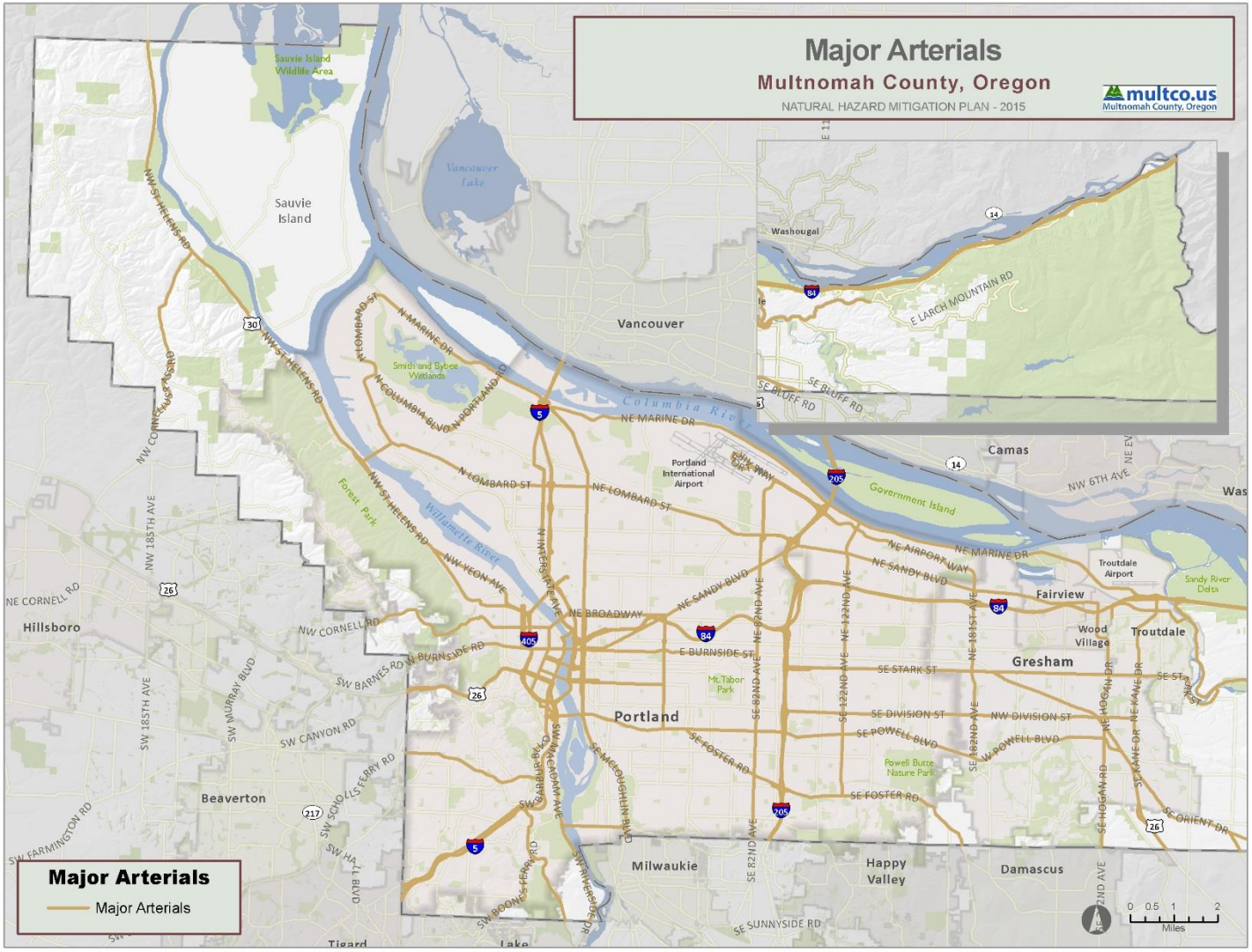
[100] The Oregonian. *Portland airliner crash in 1978 killed 10, but changed the way crews are trained.* Retrieved from: http://www.oregonlive.com/history/2014/12/portland_airliner_crash_in_197.html

FIGURE 5: RAIL LINES IN MULTNOMAH COUNTY



Source: Metro Data Resource Center, Multnomah County GIS, Oregon Department of Environmental Quality, Oregon Office of Emergency Management

FIGURE 6: MAJOR ARTERIALS IN MULTNOMAH COUNTY



Source: Metro Data Resource Center, Multnomah County GIS

3.4. Probability of Future Occurrence

Transportation incidents are a highly likely event given that automobile accidents occur nearly every single day. However, these smaller-scale transportation incidents would have a relatively low impact overall on the community. That said, transportation incidents are fairly common and the probability of a major future occurrence is high.

4. HAZARDOUS MATERIALS INCIDENT

4.1. Overview

Hazardous materials can be found in many forms and quantities that can potentially cause death; serious injury; long-lasting health effects; and damage to property and the environment in varying degrees. This subsection on hazardous material incidents is intended to provide a general overview of the hazard. The threshold for identifying fixed and mobile sources of hazardous materials is limited to information on rail, highway, and identified fixed HAZMAT sites determined to be of greatest significance as appropriate for the purposes of this plan.

Hazardous material (HAZMAT) incidents can apply to fixed facilities as well as mobile, transportation-related accidents in the air, by rail, on roadways, and on the water. Approximately 16,602 HAZMAT events occur each year in the U.S., 14,298 of which are highway incidents, 712 are railroad incidents, and 1,592 are due to other causes.[101] HAZMAT incidents generally consist of solid, liquid, and/or gaseous contaminants that are released from fixed or mobile containers, whether by accident or by design as with an intentional terrorist attack. A HAZMAT incident can last hours to days and some chemicals can be corrosive or otherwise damaging over longer periods of time. In addition to the primary release, explosions and/or fires can result from a release, and contaminants can be extended beyond the initial area by persons, vehicles, water, wind, and possibly wildlife.

Hazardous material incidents can include the spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous material, but exclude: (1) any release which results in exposure to poisons solely within the workplace with respect to claims which such persons may assert against the employer of such persons; (2) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine; (3) release of source, byproduct, or special nuclear material from a nuclear incident; and (4) the

[101] U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration, 10 Year Incident Summary Report 2005-2014.

normal application of fertilizer.[102] It should also be noted that HAZMAT incidents can occur as a result of, or in tandem with, natural hazard events, such as floods, high wind events, and earthquakes.

In the proceeding sections, fixed, roadway, and railway hazardous material incidents will be analyzed in terms of its risk in Multnomah County.

4.2. Fixed Sites- Historic Occurrences

Local information on past HAZMAT incidents was provided by the Oregon Office of State Fire Marshal (OSFM) from 1986 through 2009 and from 2010 through 2015. Since different information was reported for the incidents which occurred between 1986 and 2009 than the incidents which occurred between 2010 and 2015, the incidents cannot be readily combined across the two time periods. It should also be noted that both fixed site incidents and mobile incidents are included in these data sets.

From 1986 to 2009, 2,007 incidents were reported in Multnomah County. These incidents resulted in almost $20.8 million (2015 dollars) in total losses (including vehicle and cargo as well as fixed property losses).[103] **Table 8** presents a summary of these incidents and **Table 9** identifies the causes of incidents by jurisdiction.

TABLE 8: SUMMARY OF HAZMAT INCIDENTS IN MULTNOMAH COUNTY (1986-2009)

Location	Number of Occurrences	Vehicle and Cargo Loss (2015 Dollars)	Fixed Property Loss (2015 Dollars)	Total Loss (2015 Dollars)
Fairview	5	$593	$269	$862
Gresham	101	$310,864	$97,358	$408,223
Lake Oswego	0	$0	$0	$0
Maywood Park	0	$0	$0	$0
Portland	1,840	$5,986,404	$13,523,520	$19,509,924
Troutdale	28	$167,943	$87,843	$255,786
Wood Village	5	$288,768	$0	$288,768
Unincorporated Area	28	$330,877	$5,088	$335,965

102 **42 U.S. Code § 9601. Current through Pub. L. 114-38.**

[103] Adjusted dollar values were calculated based on the average Consumer Price Index for a given calendar year. This index value has been calculated every year since 1913. For 2015, the October 2015 monthly index was used.

Location	Number of Occurrences	Vehicle and Cargo Loss (2015 Dollars)	Fixed Property Loss (2015 Dollars)	Total Loss (2015 Dollars)
MULTNOMAH COUNTY TOTAL	**2,007**	**$7,085,450**	**$13,714,078**	**$20,799,528**

Note: Some of these occurrences are also accounted for in the PHMSA incident data in Table 9 and Table 10 above.

Source: Oregon Office of State Fire Marshal

TABLE 9: HAZMAT INCIDENTS BY CAUSE IN MULTNOMAH COUNTY (1986-2009)

Location	Abandoned	Clandestine Drug Lab	Container Rupture	Derailment	Equipment Malfunction	Excavation	Fire/Explosion	Improper Handling	Improper Storage	Intentional Release	Motor Vehicle Accident	Unknown
Fairview	0	1	0	0	1	0	0	0	0	0	0	3
Gresham	5	25	1	0	0	1	6	0	13	0	3	47
Lake Oswego	0	0	0	0	0	0	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0	0	0	0	0	0	0
Portland	118	400	16	9	18	28	53	22	255	7	69	845
Troutdale	1	4	0	0	1	1	2	0	1	1	3	14
Wood Village	0	1	0	0	1	0	0	0	0	0	2	1
Unincorporated Area	1	7	0	0	2	0	1	1	1	1	4	10
MULTNOMAH COUNTY TOTAL	**125**	**438**	**17**	**9**	**23**	**30**	**62**	**23**	**270**	**9**	**81**	**920**

Note: Some of these occurrences are also accounted for in the PHMSA incident data in Table 26 and Table 27.

Source: Oregon Office of State Fire Marshal

From 2010 to 2015, 506 incidents were reported in Multnomah County.[104] These incidents resulted in 30 evacuations and 1 injury. **Table 10** presents a summary of these incidents and **Table 11** identifies the types of incidents by jurisdiction.

TABLE 10: SUMMARY OF HAZMAT INCIDENTS IN MULTNOMAH COUNTY (2010-2015)

Location	Number of Occurrences	Number of Evacuations	Deaths / Injuries
Fairview	23	0	0/0
Gresham	282	3	0/0
Lake Oswego	0	0	0/0

[104] Incidents that are identified as biological hazard, confirmed or suspected and biological hazard investigation with no hazardous condition found are not included due to their classification as confidential incident types.

Location	Number of Occurrences	Number of Evacuations	Deaths / Injuries
Maywood Park	0	0	0/0
Portland	121	25	0/1
Troutdale	65	2	0/0
Wood Village	14	0	0/0
Unincorporated Area	1	0	0/0
MULTNOMAH COUNTY TOTAL	**506**	**30**	**0/1**

Note: Some of these occurrences are also accounted for in the PHMSA incident data in Table 26 and Table 27.

Source: Oregon Office of State Fire Marshal

TABLE 11: HAZMAT INCIDENTS BY TYPE IN MULTNOMAH COUNTY (2010-2015)

Location	Carbon Monoxide Incident	Chemical Hazard (no spill or leak)	Chemical Spill or Leak	Combustible/ Flammable Gas/Liquid Condition, Other	Gas Leak (natural gas or LPG)	Gasoline or Other Flammable Liquid Spill	HAZMAT Release Investigation w/no HAZMAT	Oil or Other Combustible Liquid Spill	Refrigeration Leak	Toxic Condition, Other
Fairview	3	0	1	1	4	7	3	3	0	1
Gresham	28	8	19	17	78	47	46	29	6	4
Lake Oswego	0	0	0	0	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0	0	0	0	0
Portland	2	2	41	9	28	14	10	7	0	8
Troutdale	4	3	2	14	13	12	15	1	1	0
Wood Village	1	0	1	1	5	5	1	0	0	0
Unincorporated Area	0	0	1	0	0	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**38**	**13**	**65**	**42**	**128**	**85**	**75**	**40**	**7**	**13**

Note: Some of these occurrences are also accounted for in the PHMSA incident data in Table 9 and Table 10 above.

Source: Oregon Office of State Fire Marshal

4.3. Fixed Sites- Location and Spatial Extent

Information on facilities and their locations was provided by the Oregon Office of the State Fire Marshal. This information is collected through the Hazardous Substance Information Survey (HSIS), which is a database that allows the user to search, sort, and filter facilities depending on a number of different variables including hazard class and quantity. As a result of the 1986 Emergency Planning and Community Right to Know Act (EPCR), the Environmental Protection Agency (EPA) provides public information on hazardous materials. One facet of the program is to collect information on significant quantities of hazardous chemicals maintained at fixed facilities. These facilities are known as Tier II facilities. According to the HSIS, which is the State of Oregon's system for Tier II reporting, there are 2,022 Tier II facilities in Multnomah County. Public access to HSIS can be obtained by visiting the Oregon Office of State Fire Marshal website.[105]

The purpose of Tier II reporting is to provide state and local officials and the public with specific information on hazardous chemicals present at facilities during the past year. This information can be used for local government personnel training, HAZMAT pre-planning, and local/regional response to spills and releases. In Oregon, the Hazardous Substances Information Survey form is used by businesses and government entities to comply with state and federal Community Right to Know Requirements for the reporting of hazardous substances. Reportable quantities of hazardous substances that are used, stored, manufactured, or disposed of at business and government sites in Oregon are required to be reported annually.

The Hazard Planning Priority Number (HPPN) used in this analysis is collected from the HSIS database and is an index on a scale of 1 to 15 that identifies the level of severity of a hazardous substance that is located at a facility (see **Table 12**). On this scale, lower numbers represent a higher priority, so a facility with a HPPN of 1 should be considered a higher priority for planning than a facility with a HPPN of 15.

In or within one mile of Multnomah County, there are more than 1,700 facilities that contain substances that are classified as high priority (HPPN 1-5). However, many of these facilities contain relatively small amounts of these substances and some of the substances in the high priority categorization are much less likely to have impacts outside of the facility itself in the event of an incident. **Table 13** includes a breakdown of all of the facilities in Multnomah County that contain each classification of hazardous material (HPPN 1-15) by jurisdiction. It should be noted that many facilities contain materials from multiple hazard classifications and therefore may be counted multiple times. **Figure 7, Figure 8,** and **Figure 9** show the locations of these facilities based on the HPPN of chemicals located at each facility.

[105] http://www.oregon.gov/osp/SFM/pages/cr2k_infoavailable.aspx

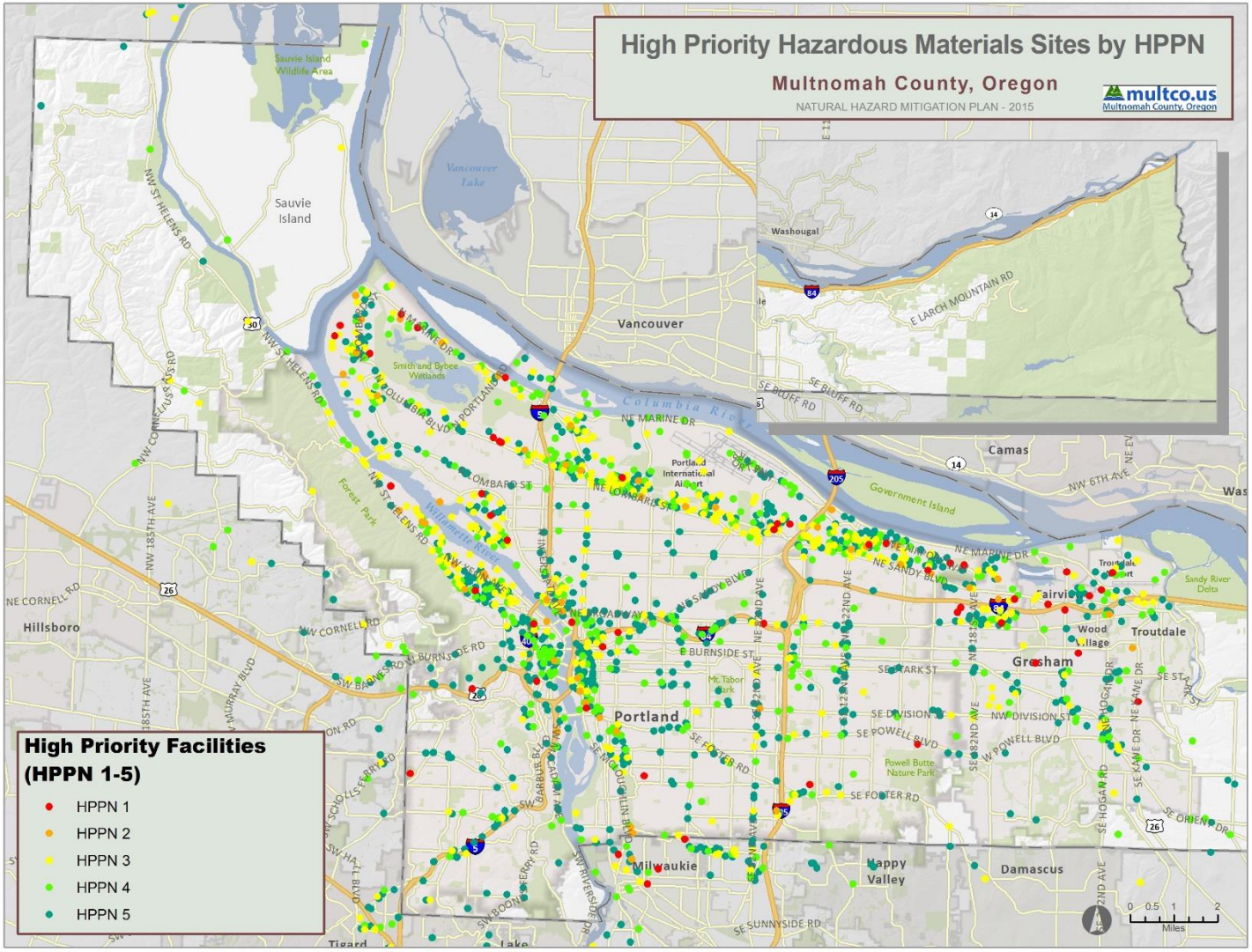
TABLE 12: OFFICE OF STATE FIRE MARSHAL HAZARD PLANNING PRIORITY NUMBERS

	Priority Number	Hazard Class	Hazard Class Description
High Priority	1	2.3	Poisonous Gases
	2	6.1	Poisonous Materials
	3	2.1	Flammable Gases
	4	3.1, 3.2, 3.3	Flammable Liquids
	5	6.3	Acute Health Hazards
Moderate Priority	6	4.1, 4.2, 4.3, 4.4	Flammable Solids, Spontaneously Combustible Materials, Dangerous When Wet, Reactive Materials
	7	1.1, 1.2, 1.3, 1.4, 1.5	Explosives
	8	5.1, 5.2	Oxidizers and Organic Peroxides
	9	4.5	Combustible Materials
	10	8.0	Corrosive Materials
Low Priority	11	6.2, 6.4	Etiologic Materials and Chronic Health Hazard
	12	6.5	Pesticides
	13	7.3	Radioactive Materials
	14	2.2	Non-flammable Gases
	15	9.0	Miscellaneous Hazardous Materials

TABLE 13: SUMMARY OF HAZARDOUS MATERIALS SITES IN MULTNOMAH COUNTY BY HPPN

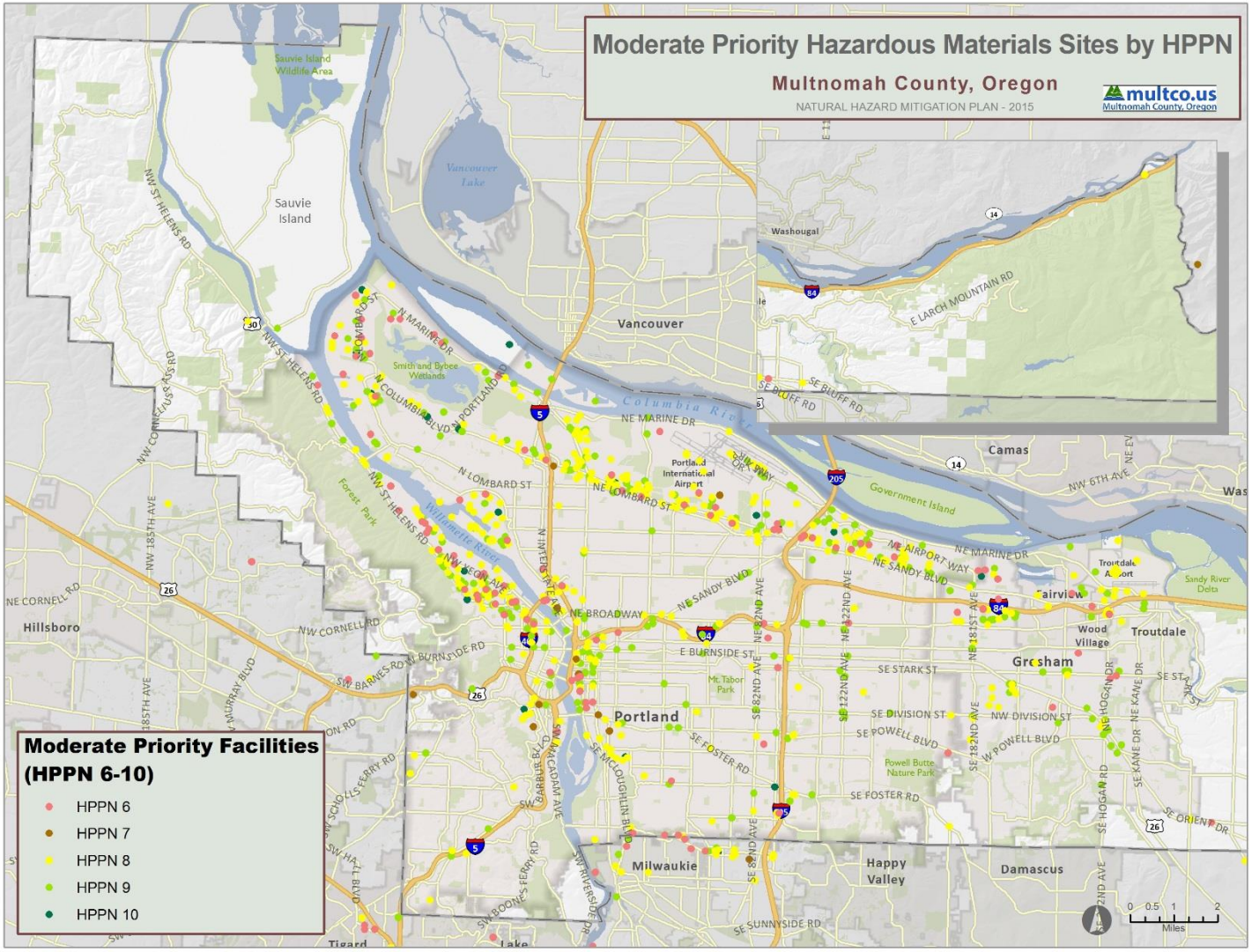
Location	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12	Class 13	Class 14	Class 15
Fairview	4	1	5	7	9	1	0	3	4	0	0	0	0	2	2
Gresham	7	5	30	45	106	9	2	25	43	7	5	0	2	27	27
Lake Oswego	0	0	0	4	13	1	0	0	3	0	0	0	0	0	3
Maywood Park	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0
Portland	36	52	330	496	1,036	91	11	345	373	80	99	6	27	287	245
Troutdale	2	1	10	13	27	0	0	11	8	1	0	0	0	8	4
Wood Village	0	1	1	3	9	2	0	4	3	1	0	0	0	3	1
Unincorporated Area	4	3	45	68	126	12	3	28	15	6	12	2	3	31	28
MULTNOMAH COUNTY TOTAL	**53**	**63**	**421**	**636**	**1,326**	**116**	**16**	**416**	**449**	**95**	**116**	**8**	**32**	**358**	**310**

FIGURE 7: FIXED HAZARDOUS MATERIALS SITES WITH HIGH HPPN



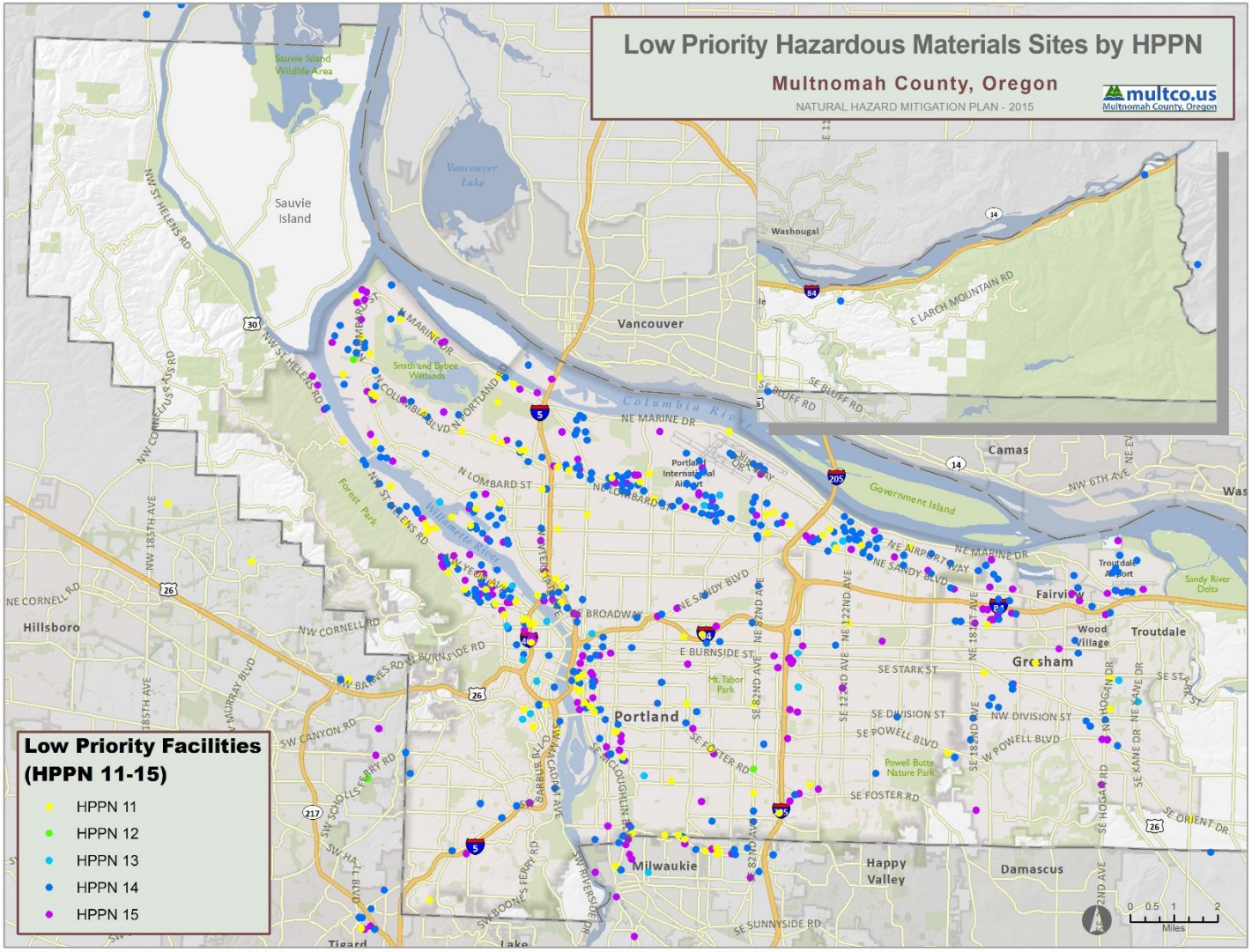
Source: State of Oregon Hazardous Substance Information Survey CR2K

FIGURE 8: FIXED HAZARDOUS MATERIALS SITES WITH MODERATE HPPN



Source: State of Oregon Hazardous Substance Information Survey CR2K

FIGURE 9: FIXED HAZARDOUS MATERIALS SITES WITH LOW HPPN



Source: State of Oregon Hazardous Substance Information Survey CR2K

For the scope of this analysis, it was determined that poisonous gases posed the greatest threat of causing off-site impacts such as injury or fatalities to people since they have a higher likelihood of being dispersed beyond the site on which they are released. Poisonous gas compounds may be respiratory hazards, neurotoxicants, and/or carcinogens. As a result, the release of poisonous gases can cause various health impacts, and there are several factors which can influence the degree of poisoning caused by a chemical. These include route of entry into the body, amount or dose entering the body, toxicity of the chemical, removal from the body, and biological variation.

Acute toxicity, caused by one-time, sudden, high exposures, can result in health effects which may be temporary, including difficulty breathing, nausea, abdominal pain, vomiting, blindness, and mental impairment. Chronic toxicity, caused by repeated exposure day after day over many years, can result in cell damage, disease, or even cancer. Additional information on the impacts of specific poisonous gases is available through the Centers for Disease Control and Prevention website.[106]

There are 53 sites in Multnomah County that contain poisonous gases (HPPN=1). The location of these sites is summarized in **Table 14.**

TABLE 14: SUMMARY OF POISONOUS GAS SITES (HPPN=1) IN MULTNOMAH COUNTY

Location	Total
Fairview	4
Gresham	7
Lake Oswego	0
Maywood Park	0
Portland	36
Troutdale	2
Wood Village	0
Unincorporated Area	4
MULTNOMAH COUNTY TOTAL	**53**

It is also important to note that different sites contain different amounts of each of the gases listed above. Although every facility is potentially susceptible to an incident and any incident can cause negative health impacts, facilities that contain larger volumes of chemicals may experience larger incidents that cause greater impacts to more people.

Information regarding the exact quantity of chemicals stored at each site is considered confidential and thus, was not available for inclusion in this report. However, the number of sites that contain various

[106] http://emergency.cdc.gov/chemical/overview.asp

quantity ranges can be reported and are summarized in **Table 15**. This information is presented in terms of the number of units of gaseous chemical at each site (in gallons or cubic feet).

TABLE 15: SUMMARY OF POISONOUS GAS SITES (HPPN=1) BY QUANTITY

Number of Units of Volume	Number of Sites
10-19	2
20-49	4
50-199	12
200-499	2
500-999	4
1,000-4,999	17
5,000-9,999	7
10,000-49,999	4
7,500,000-9,999,999	1
Total	**53**

Despite the fact that a number of facilities contain these poisonous gases, it should be noted that there have been very few incidents of release of these chemicals in Multnomah County (see historical occurrences section above). This can be mainly attributed to the rigorous safety measures that are in place to regulate facilities that contain larger quantities of these chemicals and the precautions taken by facility managers to ensure safe storage and treatment of hazardous substances. Generally, because of the care and attention paid to these substances, the risk of a spill or release under normal conditions is very low.

Of more concern for local emergency management and response officials is the potential for a release that results from another hazard event such as an earthquake. An earthquake could comprise the integrity of storage tanks or containers, thereby releasing larger quantities of the chemical and creating a public health emergency. This would be especially challenging for local officials because the quick and unpredictable onset of earthquakes could make it difficult to respond to and prepare for the size and location of such an event. Response officials can find pertinent information on the health impacts of various chemicals through the National Institute for Occupational Safety and Health's Emergency Response Safety and Health Database.[107]

4.4. Fixed Sites- Risk Analysis

In order to conduct the vulnerability assessment for this hazard, GIS intersection analysis was used for fixed site impact areas with population data, building footprints, and parcels.[108] In this scenario, two sizes

[107] http://www.cdc.gov/niosh/ershdb/about.html

[108] This type of analysis will likely yield inflated results (generally higher than what is actually reported after an actual event) because structures or parcels that are on the edge of the identified buffer zones and are only located partially

of buffers were used to identify potential impact areas for each scenario. These impact areas were selected based on guidance from the PHMSA Emergency Response Guidebook.

For the fixed site analysis, poisonous gas sites were selected for further analysis as these substances were identified as having the potential to cause severe injury or fatalities to those exposed if they were released in an incident. As noted above, poisonous gases were determined to be the most important to analyze because of their potential for causing off-site impacts to human health. Utilizing the Pipeline and Hazardous Materials Safety Administration's (PHMSA) Emergency Resource Guidebook (ERG) criteria, potential impact areas were identified for these sites based on criteria for the most common poisonous gas in Multnomah County and these buffer distances were used for all HPPN=1 sites.[109]

The ERG defines a spill in terms of several criteria, the first of which is the size or quantity of the spill. Small spills are defined as those that release less than 55 gallons of the substance and large spills are defined as those that release more than 55 gallons of the substance.

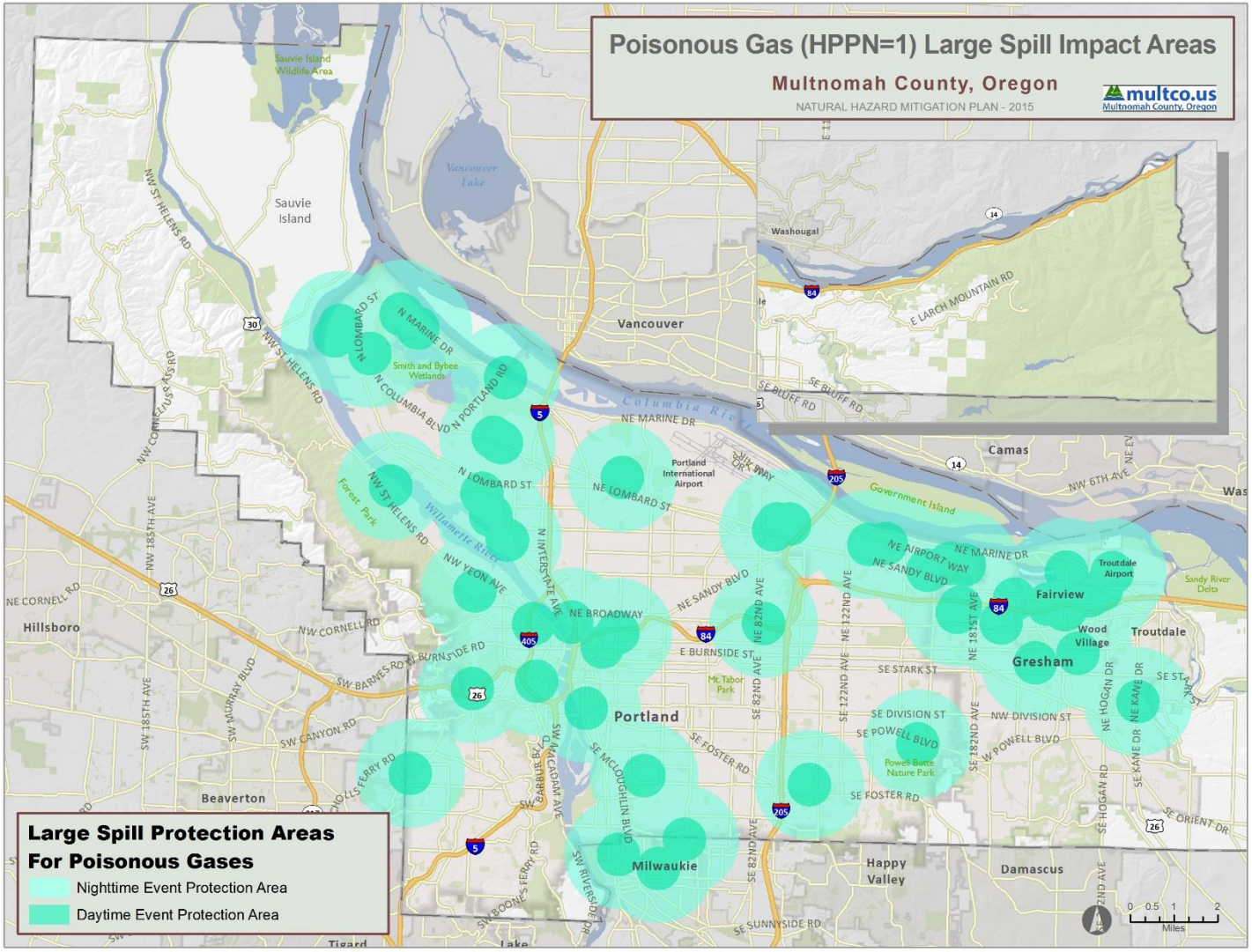
The second criteria relates to whether the incident takes place during the day (sunrise to sunset) or at night (sunset to sunrise). Hazardous materials incidents that involve poisonous gases are often much more dangerous during nighttime hours because during the day, the ground heats up and creates more turbulence and wind, which ultimately causes toxic gases to disperse more quickly. At night, there is generally less turbulence so a dense cloud of gas can travel further without dispersion.

Based on a review of these criteria, two protective action zones were identified for a poisonous gas chemical release based on the time of day of the spill (see **Figure 10**). According the PHMSA Emergency Response Guidebook, the Protective Action Zone defines an area downwind from an incident in which persons may become incapacitated and unable to take protective action and/or incur serious or irreversible health effects. Although the size of a spill was evaluated as a criterion and small spills can have an impact on people and the surrounding environment, this analysis focuses specifically on large spills for both scenarios, since these would have a much more significant impact on a much larger area. It should be noted that one facility was removed from the large spill analysis because it stores less than 50 gallons of poisonous gas on site. All other facilities store 55 gallons or more.

with the projected impact area are counted as if they were completely within the impact area, even though only part of the structure/parcel may be susceptible.

[109] It should be noted that specific chemical identities cannot be revealed in this report due to confidentiality restrictions.

FIGURE 10: PROTECTIVE ACTION AREAS FOR A LARGE SPILL OF POISONOUS GAS IN MULTNOMAH COUNTY



Source: State of Oregon Hazardous Substance Information Survey CR2K

Table 16 shows the results of the analysis in terms of the approximate number of parcels/buildings and improved value located within each zone**.**

TABLE 16: EXPOSURE OF IMPROVED PROPERTY TO LARGE POISONOUS GAS SPILL

Location	Daytime Spill Buffer Area			Nighttime Spill Buffer Area)		
	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[110]	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[111]
Fairview	2,046	2,384	$379,773,040	2,468	2,862	$475,931,460
Gresham	3,245	4,225	$1,187,395,690	12,744	15,304	$3,200,571,310
Lake Oswego	0	0	$0	0	0	$0
Maywood Park	0	0	$0	320	378	$53,100,810
Portland	34,330	24,435	$17,093,281,030	134,697	134,956	$46,159,603,590
Troutdale	74	79	$139,596,140	2,903	3,211	$656,665,150
Wood Village	212	468	$106,924,110	848	1,267	$181,294,850
Unincorporated Area	213	144	$286,916,640	1,842	1,664	$1,028,275,240
MULTNOMAH COUNTY TOTAL	**40,120**	**31,735**	**$19,193,886,650**	**155,822**	**159,642**	**$51,755,442,410**

Additionally, **Table 17** and **Table 18** contain a breakdown of parcels at risk based on land use code.

TABLE 17: PARCELS LOCATED IN DAYTIME BUFFER AREA BY LAND USE CODE

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Fairview	0	73	0	1	141	1	1,530	223	77
Gresham	6	189	0	22	415	0	2,369	205	39
Lake Oswego	0	0	0	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0	0	0	0
Portland	14	3,439	0	108	15,184	97	13,347	1,913	228

[110] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the daytime buffer, since building footprints were not associated with dollar value data.

[111] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the nighttime buffer, since building footprints were not associated with dollar value data.

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Troutdale	0	40	0	2	0	0	2	28	2
Wood Village	1	47	0	1	1	0	124	37	1
Unincorporated Area	5	17	0	7	5	3	125	41	10
MULTNOMAH COUNTY TOTAL	**26**	**3,805**	**0**	**141**	**15,746**	**101**	**17,497**	**2,447**	**357**

Source: Metro Data Resource Center- Multnomah County Tax Assessors

TABLE 18: PARCELS LOCATED IN NIGHTTIME BUFFER AREA BY LAND USE CODE

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Fairview	0	85	0	1	151	1	1,862	290	78
Gresham	10	845	0	25	1,798	0	9,373	617	76
Lake Oswego	0	0	0	0	0	0	0	0	0
Maywood Park	0	3	0	0	1	0	299	17	0
Portland	39	10,142	0	168	29,684	339	86,202	7,442	681
Troutdale	5	140	0	2	103	6	2,405	232	10
Wood Village	1	73	0	1	150	0	559	62	2
Unincorporated Area	72	48	5	8	67	39	1,218	359	26
MULTNOMAH COUNTY TOTAL	**127**	**11,336**	**5**	**205**	**31,954**	**385**	**101,918**	**9,019**	**873**

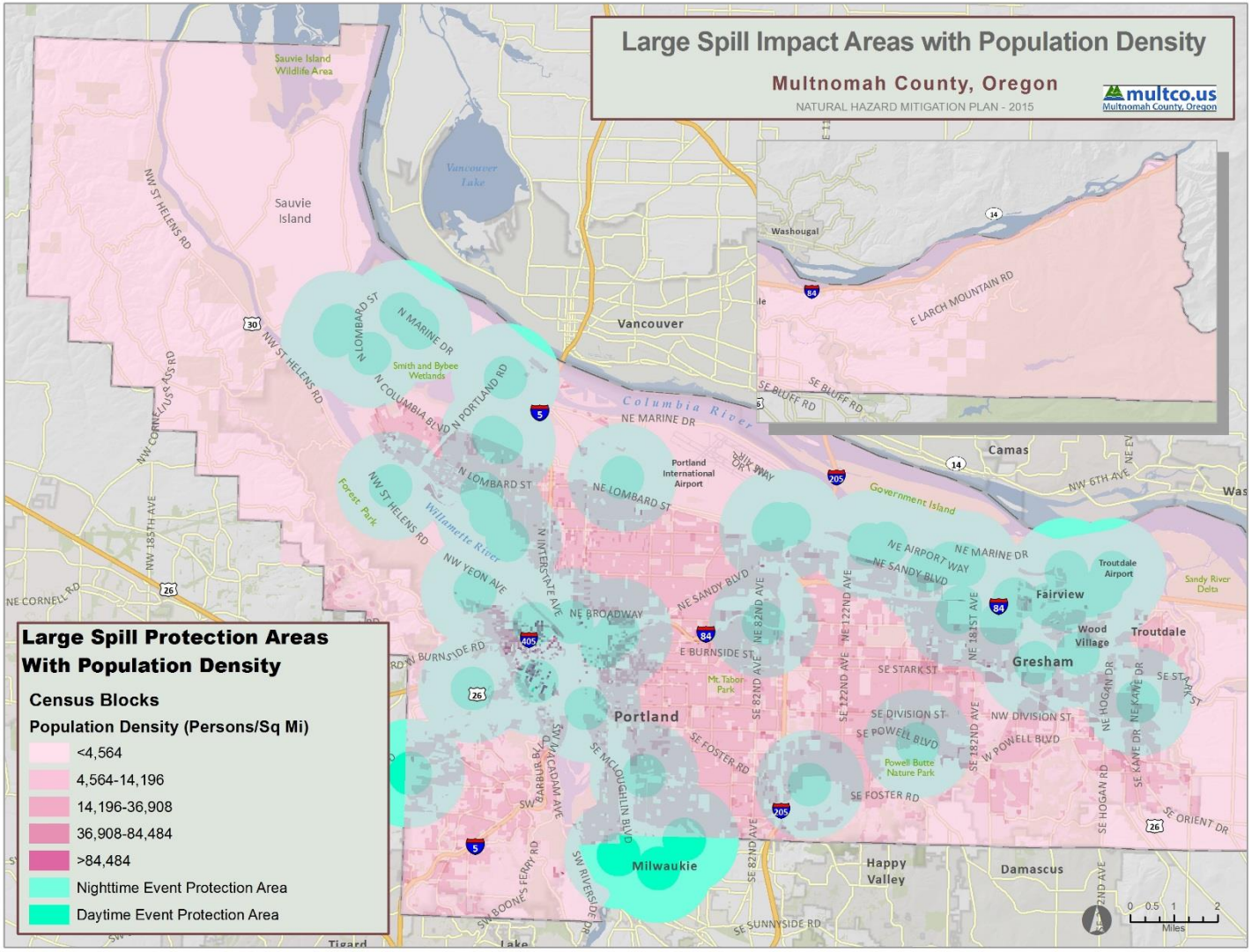
Source: Metro Data Resource Center- Multnomah County Tax Assessors

To determine the population potentially at risk of being impacted by a poisonous gas hazardous materials incident, Census blocks were intersected with the buffer areas described above. The results of this analysis are presented in **Table 19** and **Figure 11**

TABLE 19: COUNTS OF PEOPLE LOCATED WITHIN FIXED SITE BUFFER AREA

Location	Daytime Buffer Area	Nighttime Buffer Area
Fairview	8,470	8,920
Gresham	20,346	60,562
Lake Oswego	0	0
Maywood Park	0	752
Portland	97,384	367,419
Troutdale	5	12,418
Wood Village	2,904	3,878
Unincorporated Area	575	3,974
MULTNOMAH COUNTY TOTAL	**129,684**	**457,923**

FIGURE 11: POPULATION DENSITY IN MULTNOMAH COUNTY WITH LARGE SPILL PROTECTION AREAS



Source: U.S. Census Bureau, 2010, State of Oregon Hazardous Substance Information Survey CR2K

Several critical facilities were located within the large spill areas for poisonous gases. There were 849 facilities located within the nighttime protection area. Of these, 224 were located within the daytime protection area. A summary of the number of critical facilities located in each protection area by jurisdiction can be found in **Table 20, Table 21, Table 22, Table 23, Table 24,** and **Table 25.** These facilities are shown overlaid on the buffer areas in **Figure 12, Figure 13,** and **Figure 14.**

TABLE 20: EMERGENCY SERVICES CRITICAL FACILITY INVENTORY IN DAYTIME PROTECTION AREA

Location	Ambulance Services	Fire Stations	Hospitals	Licensed Medical Facilities	Law Enforcement	Urgent Care Centers
Fairview	0	0	0	0	0	0
Gresham	0	1	0	1	0	1
Lake Oswego	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0
Portland	0	4	0	18	13	5
Troutdale	0	0	0	0	0	0
Wood Village	0	0	0	0	0	0
Unincorporated Area	0	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**0**	**5**	**0**	**19**	**13**	**6**

Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

TABLE 21: ADMINISTRATIVE CRITICAL FACILITY INVENTORY IN DAYTIME PROTECTION AREA

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Fairview	0	0	1	0	0
Gresham	0	0	0	1	0
Lake Oswego	0	0	0	0	0
Maywood Park	0	0	0	0	0
Portland	0	1	4	20	1
Troutdale	0	0	0	0	0
Wood Village	0	0	0	0	0

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Unincorporated Area	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**0**	**1**	**5**	**21**	**1**

Source: Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

TABLE 22: SPECIAL POPULATION CRITICAL FACILITY INVENTORY IN DAYTIME PROTECTION AREA

Location	Childcare Facilities	Homeless Shelters	Jails	Residential Care Facilities	Schools
Fairview	1	0	0	0	6
Gresham	5	0	0	4	6
Lake Oswego	0	0	0	0	0
Maywood Park	0	0	0	0	0
Portland	49	8	0	25	42
Troutdale	0	0	0	0	0
Wood Village	0	0	0	0	0
Unincorporated Area	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**55**	**8**	**0**	**29**	**54**

Source: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health, Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

TABLE 23: EMERGENCY SERVICES CRITICAL FACILITY INVENTORY IN NIGHTTIME PROTECTION AREA

Location	Ambulance Services	Fire Stations	Hospitals	Licensed Medical Facilities	Law Enforcement	Urgent Care Centers
Fairview	0	0	0	0	1	0
Gresham	0	3	1	3	2	3
Lake Oswego	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0
Portland	4	18	9	36	22	12
Troutdale	0	0	0	0	0	0
Wood Village	0	0	0	0	0	0
Unincorporated Area	0	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**4**	**21**	**10**	**39**	**25**	**15**

Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

TABLE 24: ADMINISTRATIVE CRITICAL FACILITY INVENTORY IN NIGHTTIME PROTECTION AREA

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Fairview	0	1	1	4	1
Gresham	0	1	1	8	0
Lake Oswego	0	0	0	0	0
Maywood Park	0	1	0	0	0
Portland	0	1	17	67	7
Troutdale	1	0	0	4	1
Wood Village	0	1	0	0	0
Unincorporated Area	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**1**	**5**	**19**	**83**	**9**

Source: Airports- Metro's Regional Land Information System; Bridges-Multnomah County GIS; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

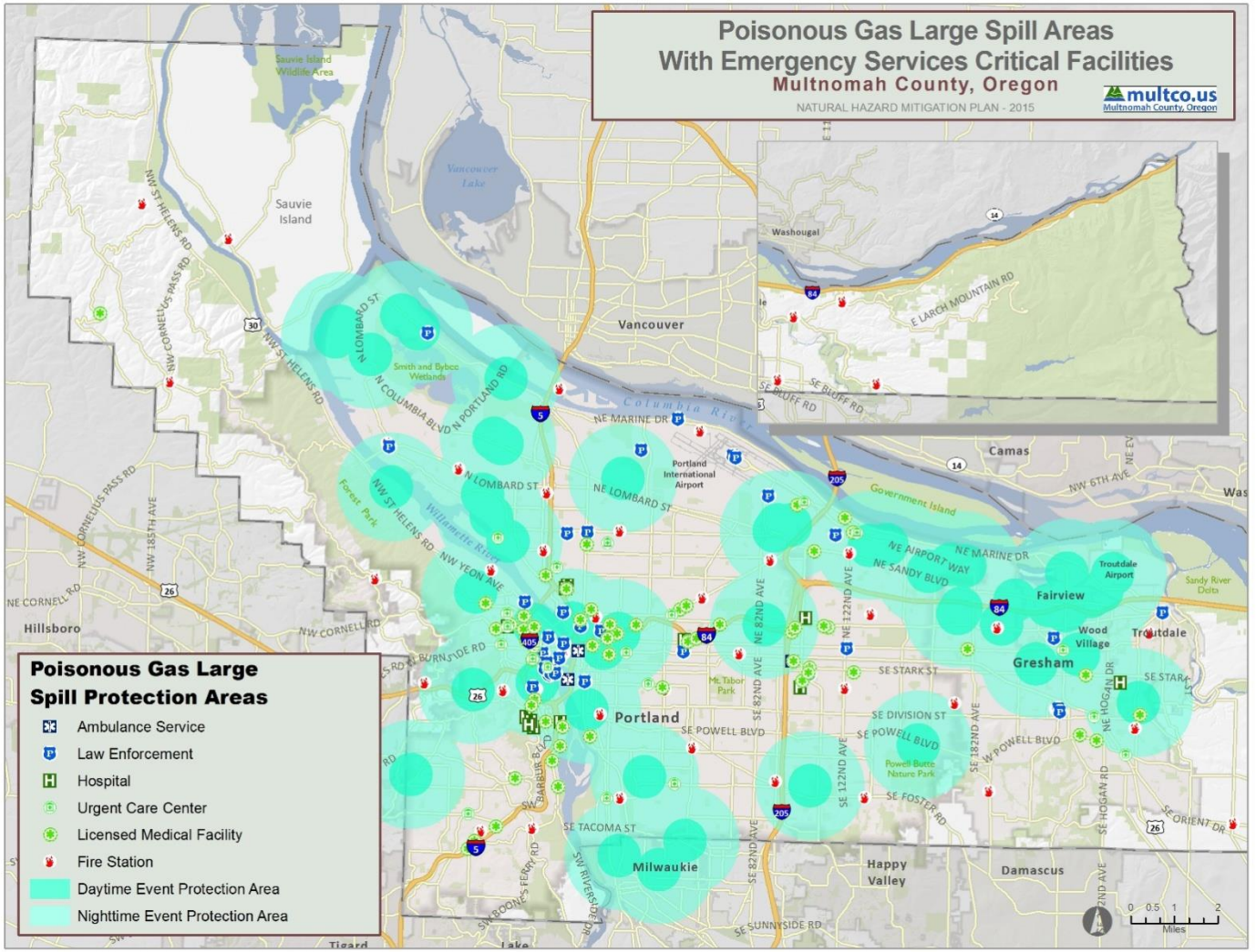
TABLE 25: SPECIAL POPULATION CRITICAL FACILITY INVENTORY IN NIGHTTIME PROTECTION AREA

Location	Childcare Facilities	Homeless Shelters	Jails	Residential Care Facilities	Schools
Fairview	1	0	0	0	11
Gresham	17	0	0	20	29
Lake Oswego	0	0	0	0	0
Maywood Park	2	0	0	0	2
Portland	197	26	2	91	188
Troutdale	2	0	0	0	9
Wood Village	2	0	0	2	0
Unincorporated Area	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**221**	**26**	**2**	**113**	**239**

Source: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health,

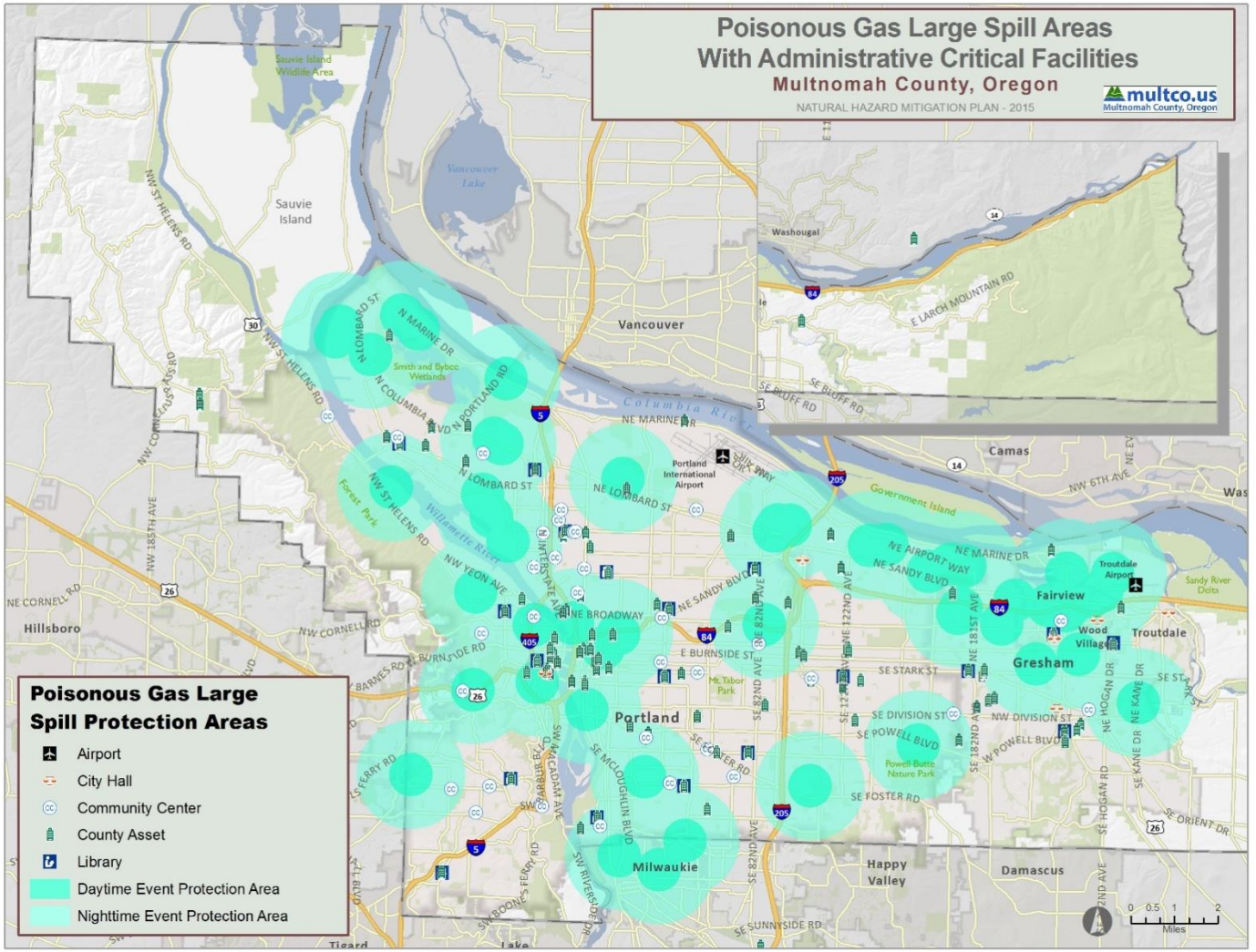
Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

FIGURE 12: EMERGENCY SERVICES CRITICAL FACILITIES WITH POISONOUS GAS LARGE SPILL PROTECTION AREA



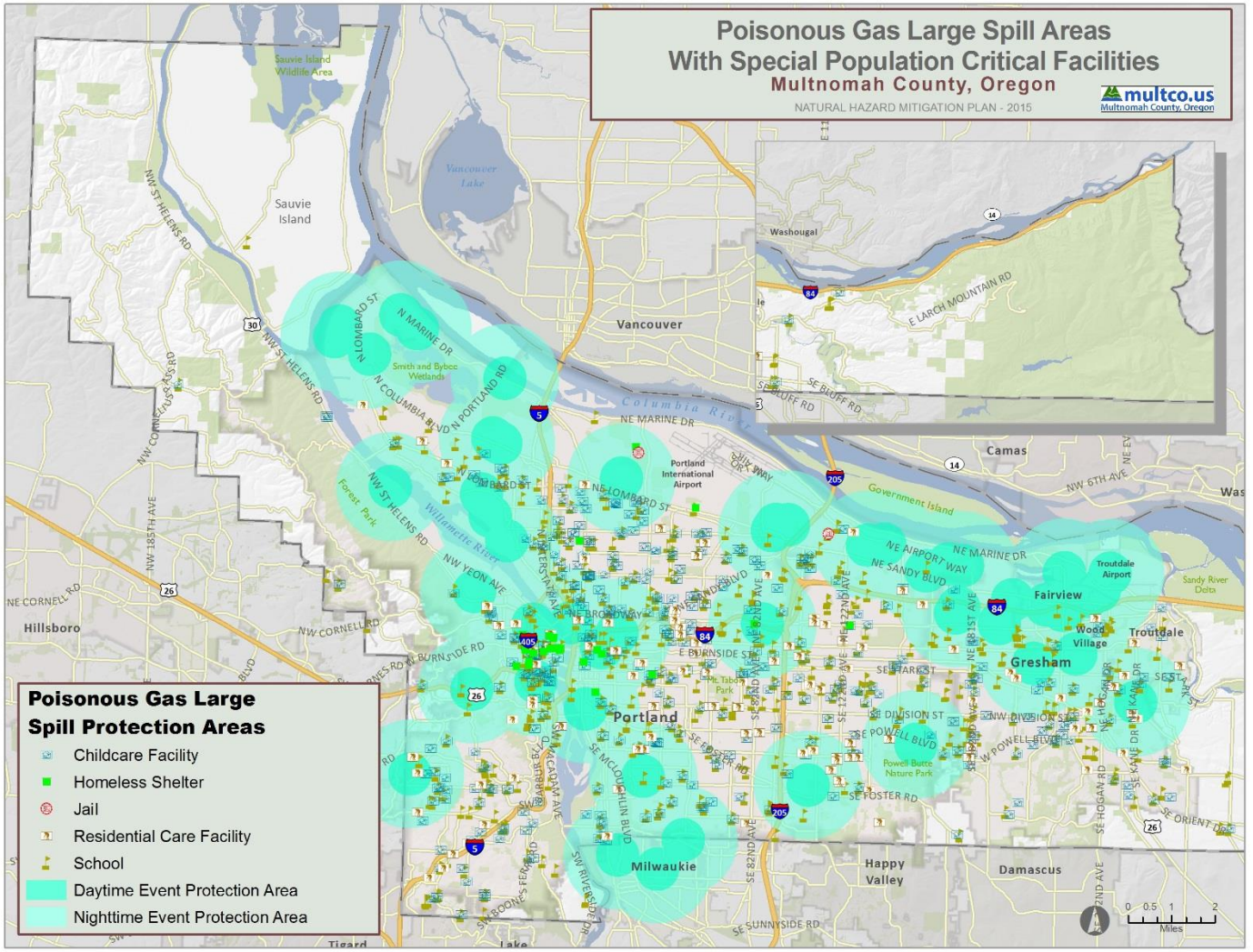
Source: State of Oregon Hazardous Substance Information Survey CR2K, Hazardous Substance Information System; Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

FIGURE 13: ADMINISTRATIVE CRITICAL FACILITIES WITH POISONOUS GAS LARGE SPILL PROTECTION AREA



Source: State of Oregon Hazardous Substance Information Survey CR2K; Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

FIGURE 14: SPECIAL POPULATION CRITICAL FACILITIES WITH POISONOUS GAS LARGE SPILL PROTECTION AREA



Source: State of Oregon Hazardous Substance Information Survey CR2K; Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health, Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

4.5. Mobile Incidents- Historical Occurrences

Many of the mobile incidents that have occurred in the county are outlined in the historic data presented above (in the Fixed Sites sub-section). However, in addition to that local information, the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) lists historical mobile occurrences throughout the nation. In this data, a "serious incident" is a hazardous materials incident that involves[112]:

- a fatality or major injury caused by the release of a hazardous material,
- the evacuation of 25 or more persons as a result of release of a hazardous material or exposure to fire,
- a release or exposure to fire which results in the closure of a major transportation artery,
- the alteration of an aircraft flight plan or operation,
- the release of radioactive materials from Type B packaging,
- the release of over 11.9 gallons or 88.2 pounds of a severe marine pollutant, or
- the release of a bulk quantity (over 199 gallons or 882 pounds) of a hazardous material.

There have been a total of 4,983 recorded mobile HAZMAT incidents in Multnomah County since 1971 (**Table 26**). These events resulted in nearly $3.0 million (2015 dollars) of property damage, 1 fatality, and 99 injuries.[113] **Table 27** presents detailed information on serious HAZMAT incidents in Multnomah County as reported by the PHMSA.

TABLE 26: SUMMARY OF MOBILE HAZMAT INCIDENTS IN MULTNOMAH COUNTY (1971-2015)

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2015 Dollars)
Fairview	1	0/0	$537
Gresham	3	0/1	$4,497
Lake Oswego	2	0/1	$173,197
Maywood Park	0	0/0	$0
Portland	4,751	1/96	$2,817,392
Troutdale	88	0/0	$2,079
Wood Village	1	0/0	$0
Unincorporated Area	137	0/0	$1,052

[112] Prior to 2002, a hazardous materials "serious incident" was defined as: 1) a fatality or major injury due to a hazardous material, 2) closure of a major transportation artery or facility or evacuation of six or more person due to the presence of hazardous material, or 3) a vehicle accident or derailment resulting in the release of a hazardous material.

[113] Adjusted dollar values were calculated based on the average Consumer Price Index for a given calendar year. This index value has been calculated every year since 1913. For 2015, the October 2015 monthly index was used.

Location	Number of Occurrences	Deaths / Injuries	Property Damage (2015 Dollars)
MULTNOMAH COUNTY TOTAL	**4,983**	**1/98**	**$2,998,754**

Source: United States Department of Transportation Pipeline and Hazardous Materials Safety Administration

TABLE 27: SERIOUS MOBILE HAZMAT INCIDENTS IN MULTNOMAH COUNTY (1971-2015)

Report Number	Date	City	Mode	Fatalities / Injuries	Property Damage (2015 Dollars)	Quantity Released* (2015 Dollars)
Fairview						
None Reported	--		--	--	--	--
Gresham						
None Reported	--		--	--	--	--
Lake Oswego						
I-1997020875	1/21/1997	LAKE OSWEGO	Highway	0/0	$173,197	783 LGA
Maywood Park						
None Reported	--		--	--	--	--
Portland						
I-1977050654	4/8/1975	PORTLAND	Highway	0/0	$0	4,600 LGA
I-1977020468	6/21/1976	PORTLAND	Highway	0/0	$0	2,231 LGA
I-1976100532	9/28/1976	PORTLAND	Highway	0/0	$0	4,000 LGA
I-1978031066	1/10/1978	PORTLAND	Rail	0/0	$0	4 LGA
I-1978031066	1/10/1978	PORTLAND	Rail	0/0	$0	120 LGA
I-1978031066	1/10/1978	PORTLAND	Rail	0/0	$0	12 LGA
I-1978051443	5/15/1978	PORTLAND	Highway	0/0	$0	3,570 LGA
I-1979040503	11/2/1978	PORTLAND	Rail	0/0	$0	7,000 SLB
I-1979010665	11/16/1978	PORTLAND	Highway	0/0	$0	300 LGA
I-1978121012	11/20/1978	PORTLAND	Rail	0/0	$0	7,000 SLB
I-1978120568	11/29/1978	PORTLAND	Rail	0/0	$0	5,500 SLB

Report Number	Date	City	Mode	Fatalities / Injuries	Property Damage (2015 Dollars)	Quantity Released* (2015 Dollars)
I-1978120566	12/1/1978	PORTLAND	Rail	0/0	$0	8,000 SLB
I-1978120567	12/6/1978	PORTLAND	Rail	0/0	$0	7,000 LGA
I-1978121013	12/12/1978	PORTLAND	Rail	0/0	$0	2,500 SLB
I-1979030296	12/13/1978	PORTLAND	Rail	0/0	$0	10,000 SLB
I-1980020192	12/27/1979	PORTLAND	Rail	0/0	$0	13,750 SLB
I-1980020560	2/1/1980	PORTLAND	Highway	0/0	$0	2,000 LGA
I-1980061521	5/13/1980	PORTLAND	Rail	0/0	$0	180 LGA
I-1983030261	1/22/1983	PORTLAND	Highway	0/0	$0	650 LGA
I-1983070221	6/24/1983	PORTLAND	Highway	0/0	$0	1,431 LGA
I-1983100094	9/14/1983	PORTLAND	Highway	0/0	$0	1,166 LGA
I-1983120065	11/28/1983	PORTLAND	Highway	0/0	$0	130 LGA
I-1984020407	1/16/1984	PORTLAND	Highway	0/0	$0	690 LGA
I-1986120086	11/22/1986	PORTLAND	Rail	0/0	$0	24,916 LGA
I-1987050002	4/15/1987	PORTLAND	Highway	0/0	$0	664 LGA
I-1987110108	10/24/1987	PORTLAND	Highway	0/0	$0	450 LGA
I-1989010122	12/19/1988	PORTLAND	Highway	0/1	$0	500 LGA
I-1990080588	7/24/1990	PORTLAND	Rail	0/0	$7,464	800 LGA
I-1991060321	5/17/1991	PORTLAND	Highway	0/0	$7,233	250 LGA
I-1991080485	8/7/1991	PORTLAND	Highway	0/0	$18,789	400 LGA
I-1992040082	4/6/1992	PORTLAND	Highway	0/0	$254	2,400 SLB
I-1992060230	5/30/1992	PORTLAND	Highway	0/0	$7,462	400 LGA
I-1995020025	1/25/1995	PORTLAND	Highway	0/0	$0	9,900 LGA
I-1995091476	9/5/1995	PORTLAND	Highway	0/0	$0	167 LGA
I-1996041209	3/26/1996	PORTLAND	Highway	0/0	$2,493	200 LGA
I-1996070135	6/6/1996	PORTLAND	Rail	0/0	$4,266	325 LGA
I-1996110061	9/9/1996	PORTLAND	Highway	0/0	$0	150 LGA

Report Number	Date	City	Mode	Fatalities / Injuries	Property Damage (2015 Dollars)	Quantity Released* (2015 Dollars)
I-1997120231	11/8/1997	PORTLAND	Highway	0/0	$0	0.132086 LGA
I-1998010834	12/2/1997	PORTLAND	Highway	0/0	$59,523	150 LGA
I-1998101421	9/30/1998	PORTLAND	Highway	0/1	$432	120.31 GCF
I-2002110265	2/20/2001	PORTLAND	Water	0/0	$29,884	170 LGA
I-2001091109	8/15/2001	PORTLAND	Highway	0/0	$3,231	200 LGA
I-2001090241	8/17/2001	PORTLAND	Highway	0/0	$168	4,827.7402 LGA
I-2002021168	11/30/2001	PORTLAND	Highway	0/0	$51,055	250 LGA
I-2002060219	5/15/2002	PORTLAND	Air	0/0	$0	66.139999 SLB
I-2003031047	3/6/2003	PORTLAND	Highway	0/0	$0	2,000 LGA
I-2005060931	6/2/2005	PORTLAND	Highway	0/0	$3,826	250 LGA
E-2005080051	7/28/2005	PORTLAND	Highway	0/0	$0	340 LGA
I-2005090996	8/6/2005	PORTLAND	Rail	0/0	$20,624	10 LGA
I-2005090996	8/6/2005	PORTLAND	Rail	0/0	$20,624	20 LGA
I-2007040705	2/20/2007	PORTLAND	Rail	0/0	$808	7,000 LGA
E-2007080137	7/12/2007	PORTLAND	Highway	0/0	$1,148	500 LGA
I-2007110559	10/18/2007	PORTLAND	Highway	0/0	$0	2,000 SLB
I-2008020458	1/15/2008	PORTLAND	Rail	0/0	$2,599	0.125 LGA
I-2010020266	2/3/2010	PORTLAND	Highway	0/0	$7,311	11 SLB
I-2011100330	7/24/2011	PORTLAND	Highway	0/0	$247,666	700 LGA
I-2011080270	7/29/2011	PORTLAND	Highway	0/0	$0	9 SLB
X-2012020001	1/4/2012	Portland	Rail	0/0	$16,064	0.26736 GCF
E-2012080540	5/30/2012	PORTLAND	Highway	0/12	$0	81.375 LGA
I-2012100183	7/16/2012	PORTLAND	Highway	0/1	$0	54 LGA
E-2013070575	6/29/2013	PORTLAND	Highway	0/0	$10,214	600 LGA
I-2014080318	8/6/2014	PORTLAND	Highway	0/2	$0	0.13209 LGA

Report Number	Date	City	Mode	Fatalities / Injuries	Property Damage (2015 Dollars)	Quantity Released* (2015 Dollars)
Troutdale						
I-1977070485	6/16/1977	TROUTDALE	Highway	0/0	$0	300 LGA
Wood Village						
None Reported	--		--	--	--	--
Unincorporated Area						
None Reported	--		--	--	--	--

*LGA: Liquid Gallons; SLB: Solid Pounds; GCF: Gas Cubic Feet
Source: United States Department of Transportation Pipeline and Hazardous Materials Safety Administration

4.6. Mobile Incidents- Location and Spatial Extent

Many roads in the county are subject to hazardous materials transport and all roads that permit hazardous material transport are considered potentially at risk to an incident. In this analysis, it was determined that all interstates should be analyzed since they are likely to be utilized by a much higher number of vehicles carrying hazardous materials, thereby increasing the chances of an incident. The Oregon Department of Transportation's (ODOT) Commodity Flow Study[114] on Hazardous Materials, which analyzed Oregon highways over the course of a one year period, shows that over 80% of the hazardous materials trips that occur on highways in the two ODOT districts that cover Multnomah County happen on one of the major interstates. **Table 28** shows the estimated number of trips carrying hazardous materials on Oregon highways over two annual study periods using a sample selection from weigh stations. It should be noted that these estimates likely underestimate the number of trips that occurred since weigh stations are not open 24 hours a day.

Additional information on roads that are likely used frequently for hazardous materials transport was gathered from the Portland Metro Regional Freight Plan 2035. Although the Freight Plan does not specifically identify roads that are used for hazardous materials transport, it does identify major roadways that are highly trafficked. It is likely that more hazardous material transport takes place on these highly trafficked roads. The Freight Plan confirmed the high traffic on interstate routes and also identified several primary and connector roads that were used in this plan's analysis. **Figure 15** shows the major roadways that are utilized in the roadway hazardous materials analysis.

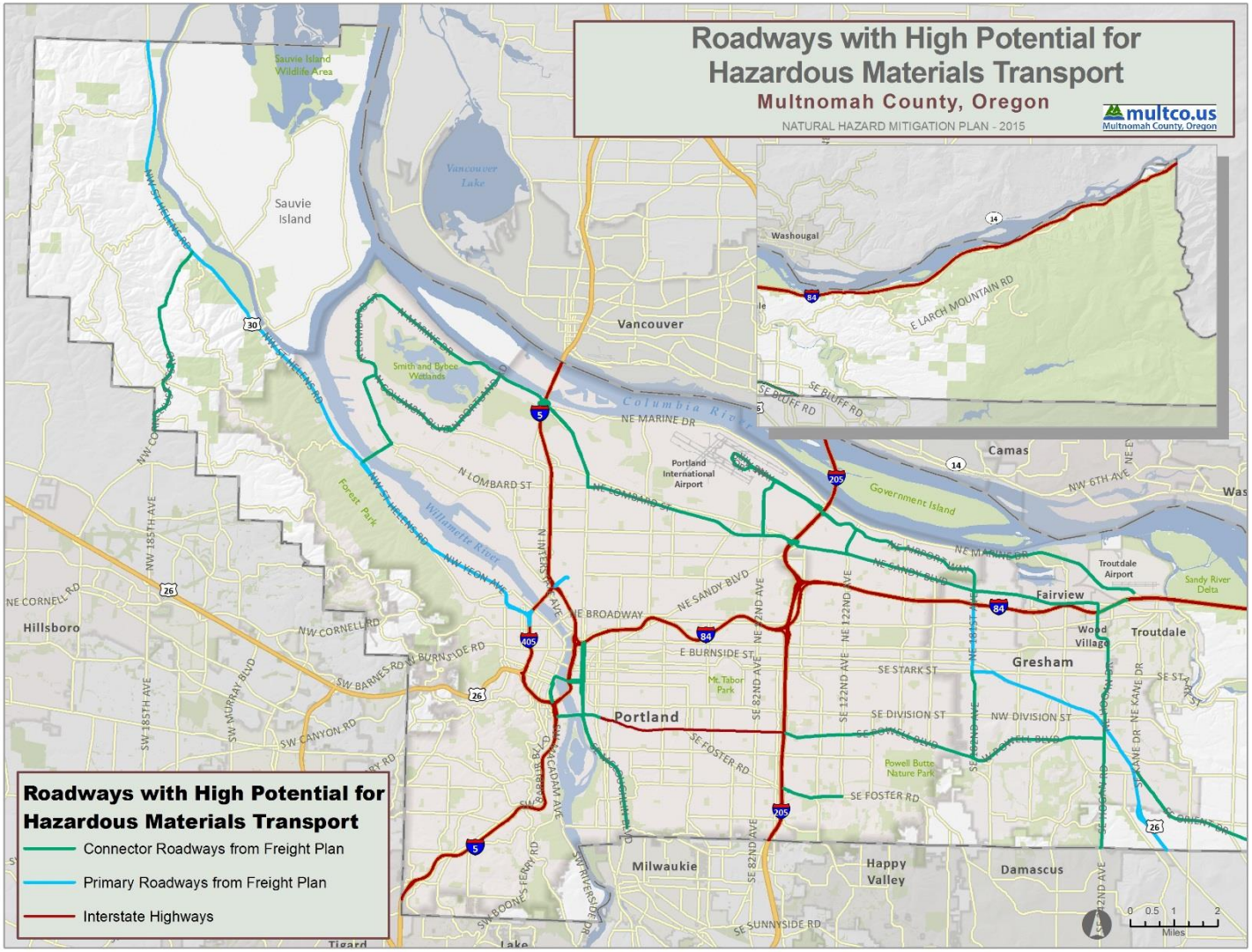
TABLE 28: ESTIMATED NUMBER OF TRIPS CARRYING HAZARDOUS MATERIALS IN ODOT DISTRICTS 2B AND 2C (MULTNOMAH COUNTY)

[114] Oregon Department of Transportation. Procedures and Results of Oregon Department of Transportation Study on the Transportation Patterns of Hazardous Materials in Oregon. November 7, 2011.

Highway	Estimated Number of Trips 2002-2003	Estimated Number of Trips 2010
District 2B (Western and Central Multnomah County)		
Interstate 5	7,611	7,588
Interstate 405	2,137	2,124
Interstate 84	4,791	3,772
Interstate 205	2,271	2,745
Highway 30	2,546	2,215
Highway 26	404	368
Highway 99E	203	231
Highway 224	174	28
Highway 212	294	60
Highway 99W	52	--
Highway 213	113	--
Highway 30BYP	577	--
District 2C (Eastern Multnomah County)		
Interstate 84	4,691	3,375
Highway 26	527	488
Highway 35	33	15
Highway 211	16	--
Highway 224	31	--
Highway 212	23	--
MULTNOMAH COUNTY TOTAL	**26,494**	**23,009**

*Note: The trip counts in this table is inclusive of all trips that occurred on interstates/highways in these ODOT districts, event those outside of Multnomah County.
Source: Oregon Department of Transportation Commodity Flow Study

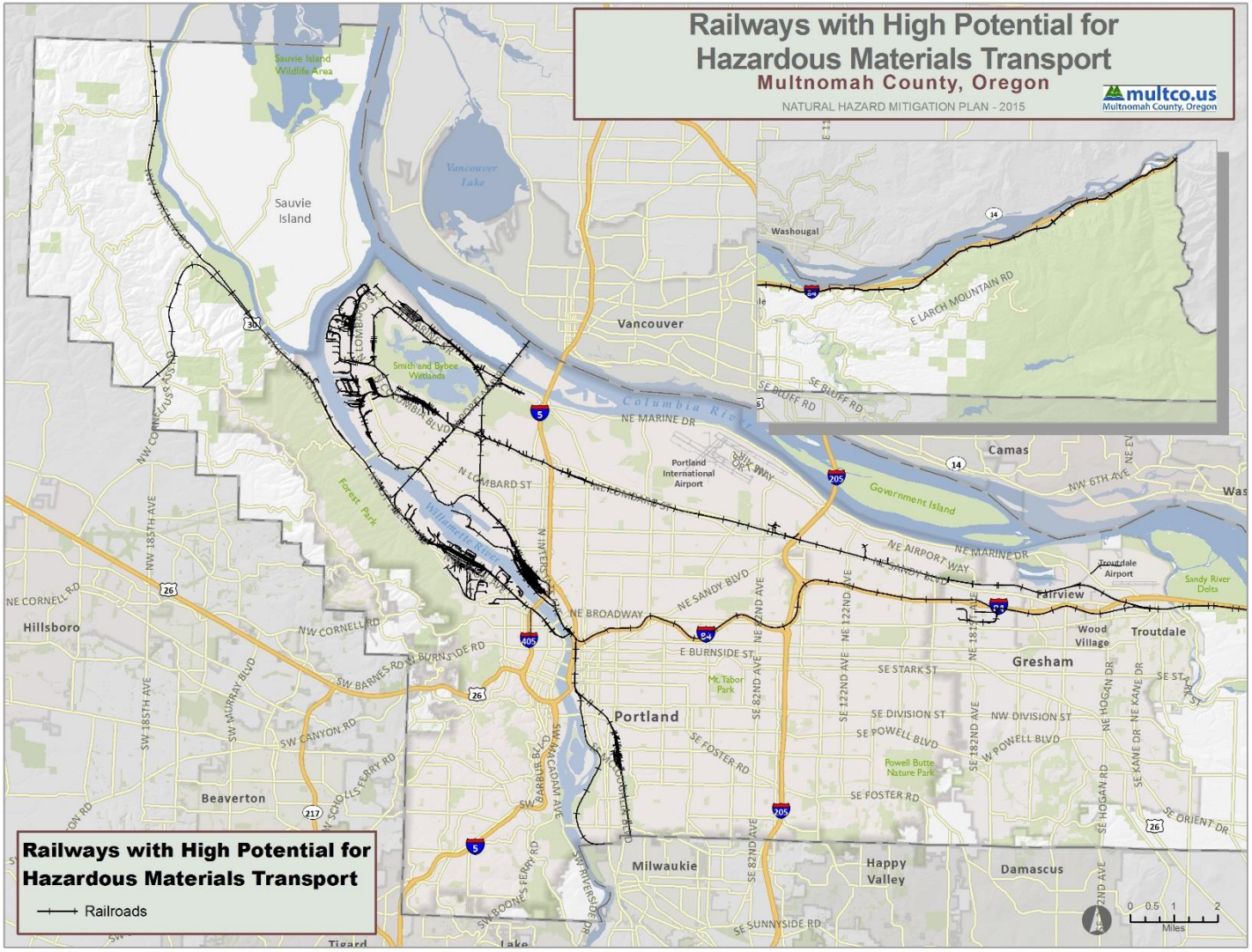
FIGURE 15: ROADWAYS WITH HIGHER POTENTIAL FOR HAZARDOUS MATERIALS TRANSPORT IN MULTNOMAH COUNTY



Source: Metro Data Resource Center, Multnomah County GIS, Oregon Commodity Flow Study, Portland Metro Regional Freight Plan 2035

In addition to roadways, railways also pose a significant threat for hazardous materials release in that many of the same materials that are transported via roads are also transported by rail systems. In general, railroad systems are classified as either heavy or light rail lines, the latter of which are primarily used for passenger transport. Heavy rail lines are often used for both passenger and freight transport, so these lines were identified and used for further analysis. It should be noted that some railways that have been classified as heavy rail lines, such as the Willamette Shore Trolley, Oaks Park Railroad and Washington Park and Zoo Railway, were removed from this analysis because they were known to only carry passengers and would not pose a hazardous materials threat. **Figure 16** shows the major railroad lines that are used in the railways hazardous materials analysis.

FIGURE 16: RAILWAYS WITH HIGHER POTENTIAL FOR HAZARDOUS MATERIALS TRANSPORT IN MULTNOMAH COUNTY

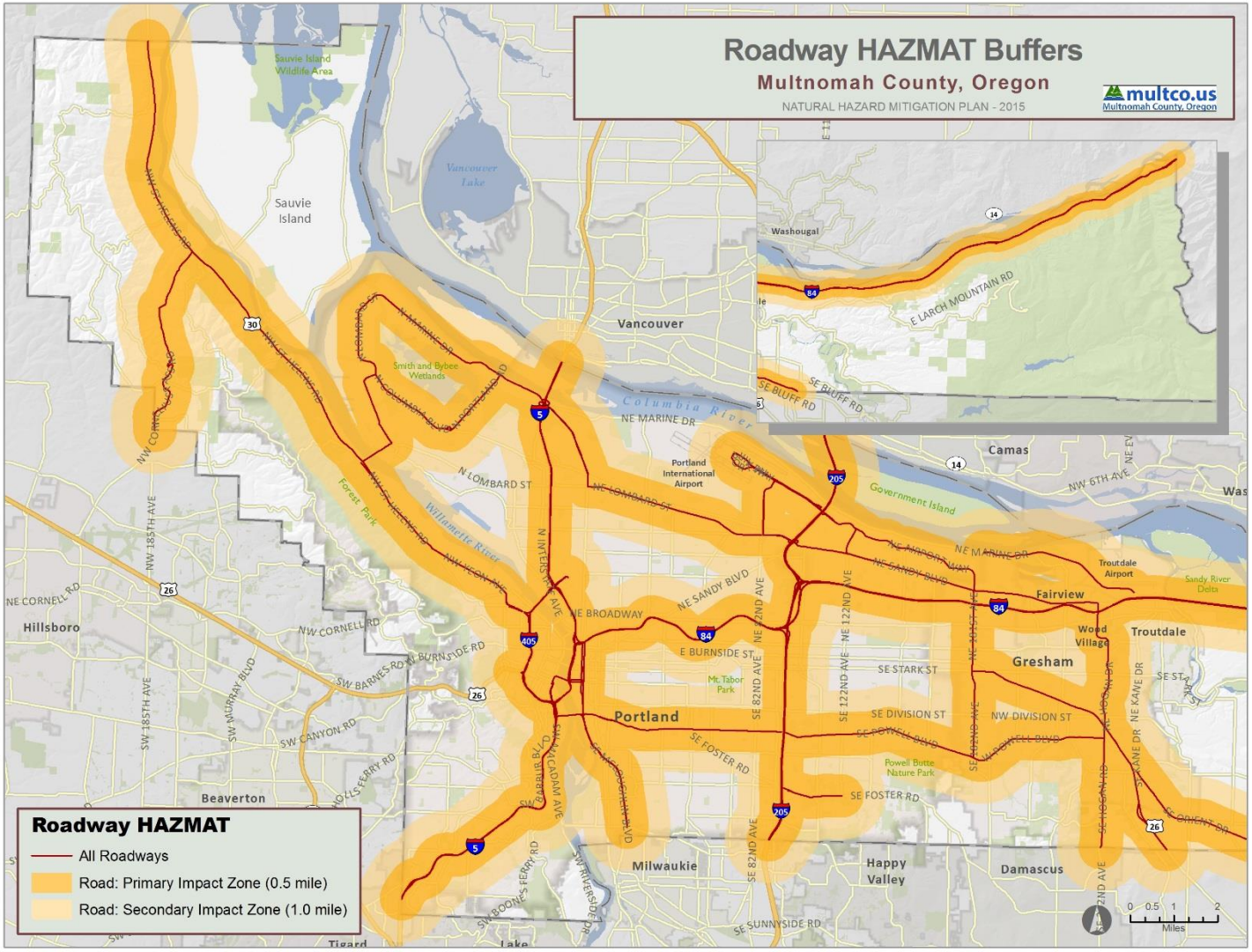


Source: Metro Data Resource Center, Multnomah County GIS, Oregon Department of Transportation

4.7. Mobile Incidents- Risk Analysis

For the mobile analysis, potential impact areas for the major roads (Interstate highways and other roads identified from the Freight Plan) where hazardous materials are most likely to be transported in higher numbers were analyzed. For these roads, buffer areas of 0.5 mile and 1.0 mile were used to estimate areas that may experience impacts or be evacuated due to a HAZMAT incident at a point along the road. **Figure 17** shows the areas used for mobile toxic release buffer analysis for roads. The results of the analysis indicate the approximate number of parcels/buildings and improved value, as shown in **Table 29.**

FIGURE 17*: ROADWAY HAZMAT BUFFERS IN MULTNOMAH COUNTY*



Source: Multnomah County GIS, Oregon Commodity Flow Study, Portland Metro Regional Freight Plan 2035

TABLE 29: EXPOSURE OF IMPROVED PROPERTY TO HAZARDOUS MATERIALS SPILL (MOBILE ANALYSIS - ROAD)

Location	0.5-mile buffer			1.0-mile buffer		
	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[115]	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[116]
Fairview	2,105	2,481	$371,292,200	2,468	2,862	$475,931,460
Gresham	19,393	22,252	$4,283,788,980	26,652	29,875	$5,380,045,480
Lake Oswego	0	0	$0	591	425	$128,878,040
Maywood Park	325	385	$53,970,540	325	385	$53,970,540
Portland	121,446	118,018	$42,671,628,740	189,733	201,150	$57,746,375,010
Troutdale	1,218	1,260	$344,560,790	3,141	3,595	$730,291,000
Wood Village	836	1,134	$160,533,460	848	1,267	$181,294,850
Unincorporated Area	2,895	3,116	$2,294,710,490	4,267	5,129	$2,696,787,170
MULTNOMAH COUNTY TOTAL	**148,218**	**148,646**	**$50,180,485,200**	**228,025**	**244,688**	**$67,393,573,550**

Additionally, **Table 30** and **Table 31** contain a breakdown of parcels at risk based on land use code.

TABLE 30: PARCELS LOCATED IN 0.5 MILE BUFFER AREA BY LAND USE CODE

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Fairview	0	71	0	1	143	1	1,560	253	76
Gresham	15	1250	0	25	1,880	4	14,863	1,217	139
Lake Oswego	0	0	0	0	0	0	0	0	0
Maywood Park	0	3	0	0	1	0	304	17	0
Portland	33	10,392	0	167	29,856	317	73,041	6,960	680
Troutdale	1	184	0	2	94	5	731	192	9
Wood Village	1	61	0	1	150	0	559	62	2

[115] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 0.5-mile buffer, since building footprints were not associated with dollar value data.

[116] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 1.0-mile buffer, since building footprints were not associated with dollar value data.

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Unincorporated Area	213	103	272	6	14	440	739	990	118
MULTNOMAH COUNTY TOTAL	**263**	**12,064**	**272**	**202**	**32,138**	**767**	**91,797**	**9,691**	**1,024**

Source: Metro Data Resource Center- Multnomah County Tax Assessors

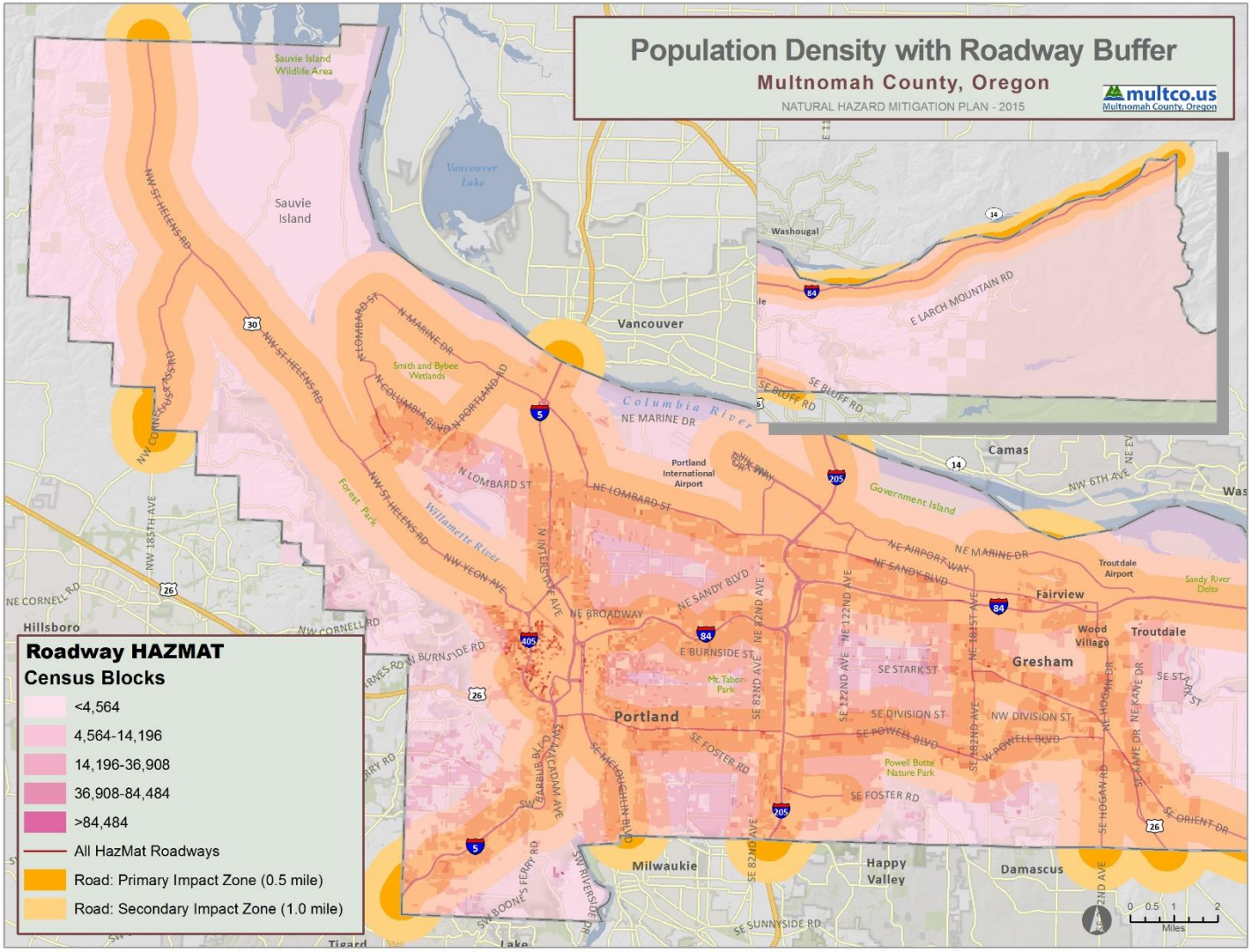
TABLE 31: PARCELS LOCATED IN 1.0 MILE BUFFER AREA BY LAND USE CODE

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Fairview	0	85	0	1	151	1	1,862	290	78
Gresham	28	1,374	3	25	2,371	9	20,951	1,734	157
Lake Oswego	0	0	0	0	168	0	354	69	0
Maywood Park	0	3	0	0	1	0	304	17	0
Portland	44	13,123	0	176	34,494	430	130,288	10,243	935
Troutdale	2	213	0	2	120	7	2,479	304	14
Wood Village	1	73	0	1	150	0	559	62	2
Unincorporated Area	497	137	459	7	35	693	1,035	1,234	170
MULTNOMAH COUNTY TOTAL	**572**	**15,008**	**462**	**212**	**37,490**	**1,140**	**157,832**	**13,953**	**1,356**

Source: Metro Data Resource Center- Multnomah County Tax Assessors

To determine the population potentially at risk of being impacted by a roadway hazardous materials incident, Census blocks were intersected with the buffer areas described above. The results of this analysis are presented in **Table 32** and **Figure 18.**

FIGURE 18: POPULATION DENSITY IN MULTNOMAH COUNTY WITH ROADWAY BUFFER ANALYSIS



Source: U.S. Census Bureau, 2010, Metro Data Resource Center, Oregon Commodity Flow Study, Portland Metro Regional Freight Plan 2035

TABLE 32: COUNTS OF PEOPLE LOCATED WITHIN ROADWAY BUFFER AREA

Location	0.5-mile buffer	1.0-mile buffer
Fairview	8,384	8,920
Gresham	85,611	102,829
Lake Oswego	0	2,050
Maywood Park	752	752
Portland	341,895	505,400
Troutdale	6,209	11,799
Wood Village	3,721	3,878
Unincorporated Area	3,721	8,097
MULTNOMAH COUNTY TOTAL	**450,293**	**643,725**

Given high susceptibility across Multnomah County, it is assumed that the entire population is at some risk to roadway hazardous materials incidents. However, it should be noted that people within the identified impact areas are more likely to be impacted and areas of population concentration may be at an elevated risk due to a greater burden to evacuate large populations from a relatively small area.

The critical facility analysis for road corridors revealed that there are 1,224 critical facilities located in the primary and secondary mobile HAZMAT buffer areas for roads. The 0.5-mile road buffer area includes 902 of those facilities. A summary of the number of critical facilities located in each protection area by jurisdiction can be found in **Table 33, Table 34, Table 35, Table 36, Table 37,** and **Table 38.** These facilities are shown overlaid on the buffer areas in **Figure 19, Figure 20,** and **Figure 21.**

TABLE 33: EMERGENCY SERVICES CRITICAL FACILITY INVENTORY IN 0.5 MILE BUFFER AREA

Location	Ambulance Services	Fire Stations	Hospitals	Licensed Medical Facilities	Law Enforcement	Urgent Care Centers
Fairview	0	0	0	0	0	0
Gresham	0	2	1	3	2	2
Lake Oswego	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0
Portland	4	20	9	44	25	10
Troutdale	0	0	0	0	1	0
Wood Village	0	0	0	0	0	0
Unincorporated Area	0	3	0	0	0	0
MULTNOMAH COUNTY TOTAL	**4**	**25**	**10**	**47**	**28**	**12**

Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

TABLE 34: ADMINISTRATIVE CRITICAL FACILITY INVENTORY IN 0.5 MILE BUFFER AREA

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Fairview	0	0	1	3	0
Gresham	0	1	1	18	2
Lake Oswego	0	0	0	0	0
Maywood Park	0	1	0	0	0
Portland	1	1	17	69	8
Troutdale	1	1	0	4	1
Wood Village	0	1	0	0	0
Unincorporated Area	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**2**	**5**	**19**	**94**	**11**

Source: Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

TABLE 35: SPECIAL POPULATION CRITICAL FACILITY INVENTORY IN 0.5 MILE BUFFER AREA

Location	Childcare Facilities	Homeless Shelters	Jails	Residential Care Facilities	Schools
Fairview	0	0	0	0	4
Gresham	40	0	0	26	46
Lake Oswego	0	0	0	0	0
Maywood Park	2	0	0	0	2
Portland	189	0	1	88	181
Troutdale	1	0	0	0	6
Wood Village	2	0	0	2	0
Unincorporated Area	3	0	0	0	3
MULTNOMAH COUNTY TOTAL	**237**	**25**	**1**	**116**	**242**

Source: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health,

Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

TABLE 36: EMERGENCY SERVICES CRITICAL FACILITY INVENTORY IN 1.0 MILE BUFFER AREA

Location	Ambulance Services	Fire Stations	Hospitals	Licensed Medical Facilities	Law Enforcement	Urgent Care Centers
Fairview	0	0	0	0	1	0
Gresham	0	4	1	5	2	3
Lake Oswego	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0
Portland	4	29	11	53	28	14
Troutdale	0	1	0	0	1	0
Wood Village	0	0	0	0	0	0
Unincorporated Area	0	5	0	0	0	0
MULTNOMAH COUNTY TOTAL	**4**	**39**	**12**	**58**	**32**	**17**

Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

TABLE 37: ADMINISTRATIVE CRITICAL FACILITY INVENTORY IN 1.0 MILE BUFFER AREA

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Fairview	0	1	1	4	1
Gresham	0	1	1	18	2
Lake Oswego	0	0	0	0	0
Maywood Park	0	1	0	0	0
Portland	1	1	27	81	12
Troutdale	1	1	0	4	1
Wood Village	0	1	0	0	0

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Unincorporated Area	0	0	0	4	0
MULTNOMAH COUNTY TOTAL	**2**	**6**	**29**	**111**	**16**

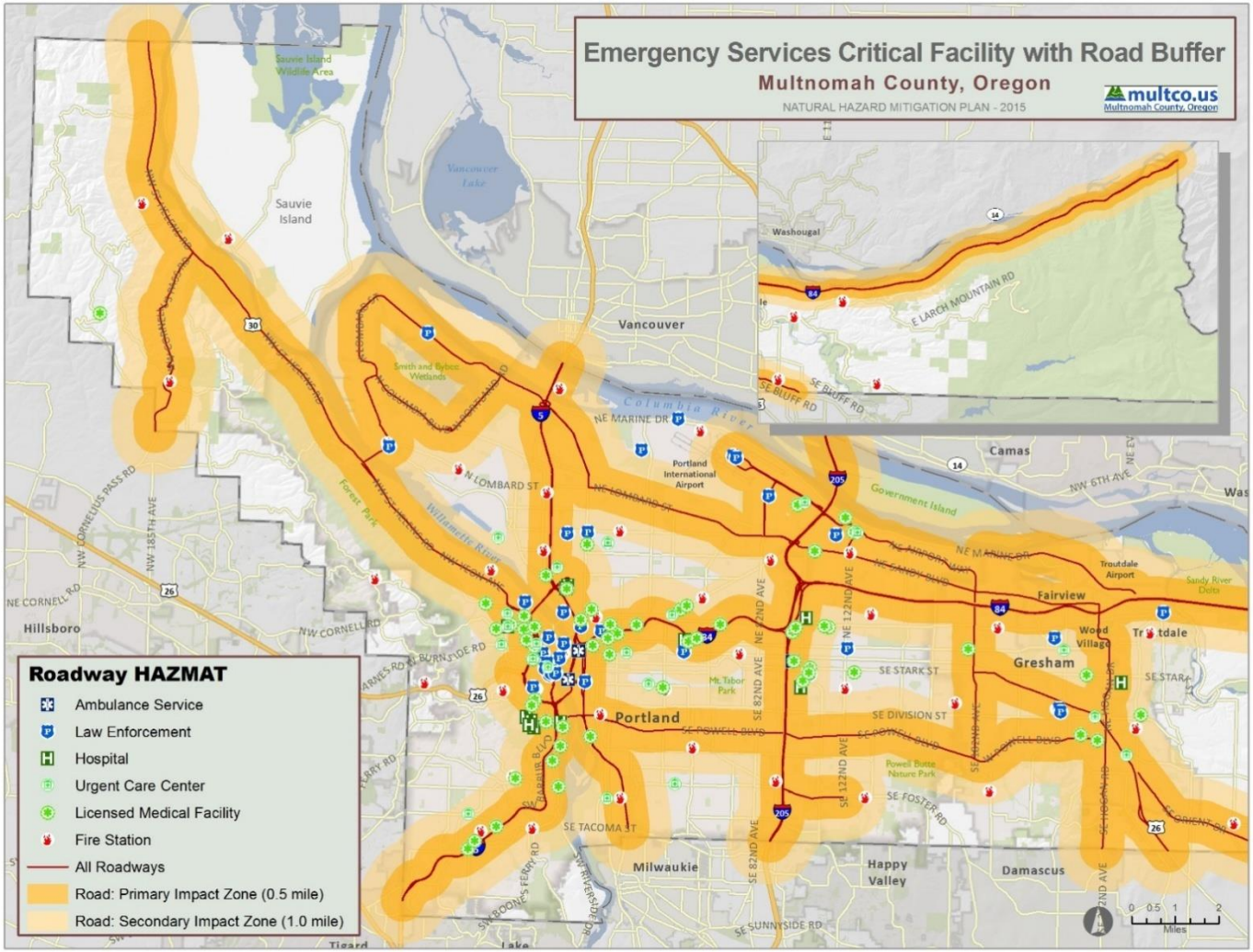
Source: Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

TABLE 38: SPECIAL POPULATION CRITICAL FACILITY INVENTORY IN 1.0 MILE BUFFER AREA

Location	Childcare Facilities	Homeless Shelters	Jails	Residential Care Facilities	Schools
Fairview	1	0	0	0	11
Gresham	44	0	0	32	54
Lake Oswego	1	0	0	0	2
Maywood Park	2	0	0	0	2
Portland	274	27	1	130	262
Troutdale	4	0	0	2	8
Wood Village	2	0	0	2	0
Unincorporated Area	3	0	0	0	8
MULTNOMAH COUNTY TOTAL	**331**	**27**	**1**	**166**	**347**

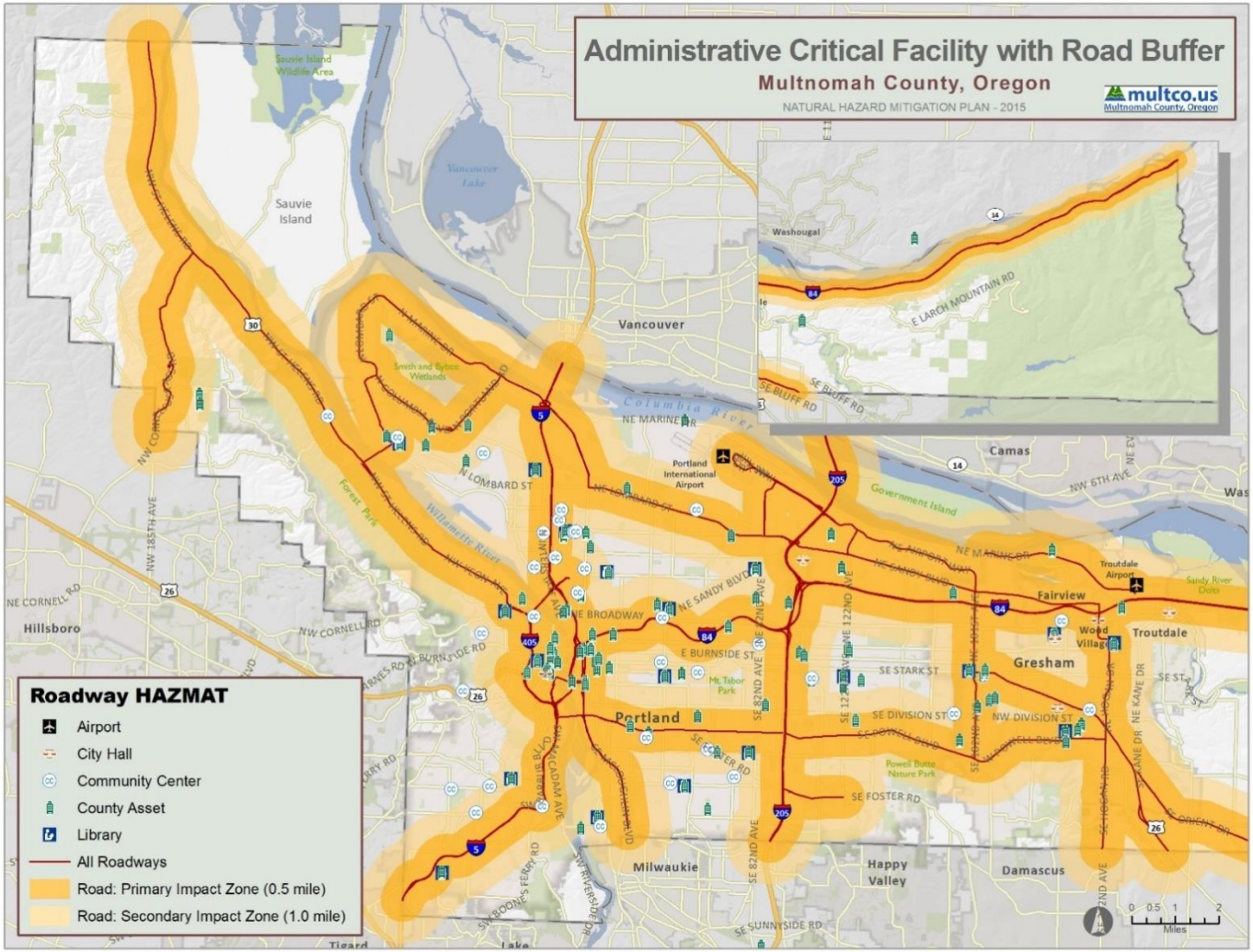
Source: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health, Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

FIGURE 19: EMERGENCY SERVICES CRITICAL FACILITIES IN MULTNOMAH COUNTY WITH ROADWAY BUFFER ANALYSIS



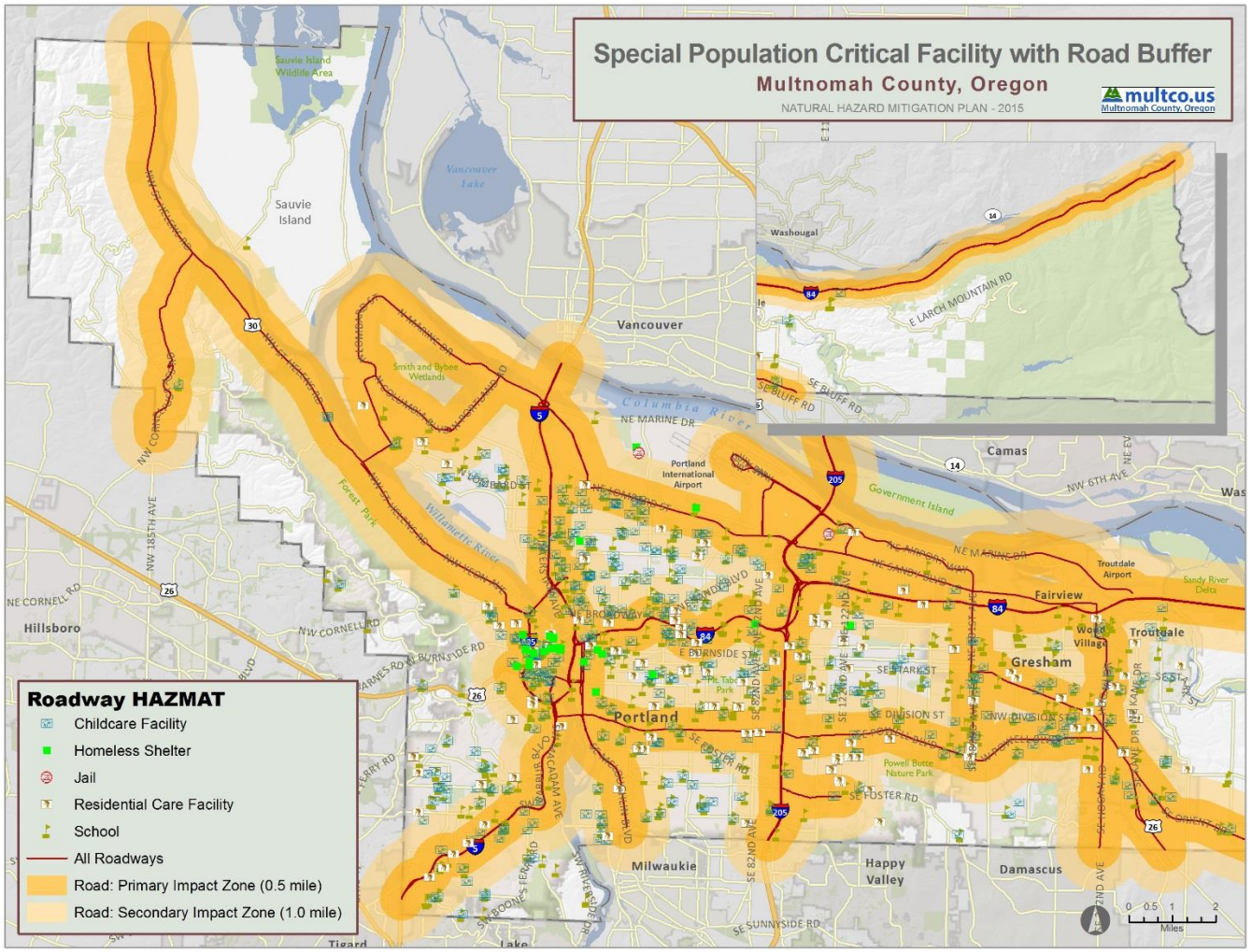
Source: Metro Data Resource Center; Oregon Commodity Flow Study; Portland Metro Regional Freight Plan 2035; Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

FIGURE 20: ADMINISTRATIVE CRITICAL FACILITIES IN MULTNOMAH COUNTY WITH ROADWAY BUFFER ANALYSIS



Source: Metro Data Resource Center; Oregon Commodity Flow Study; Portland Metro Regional Freight Plan 2035; Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

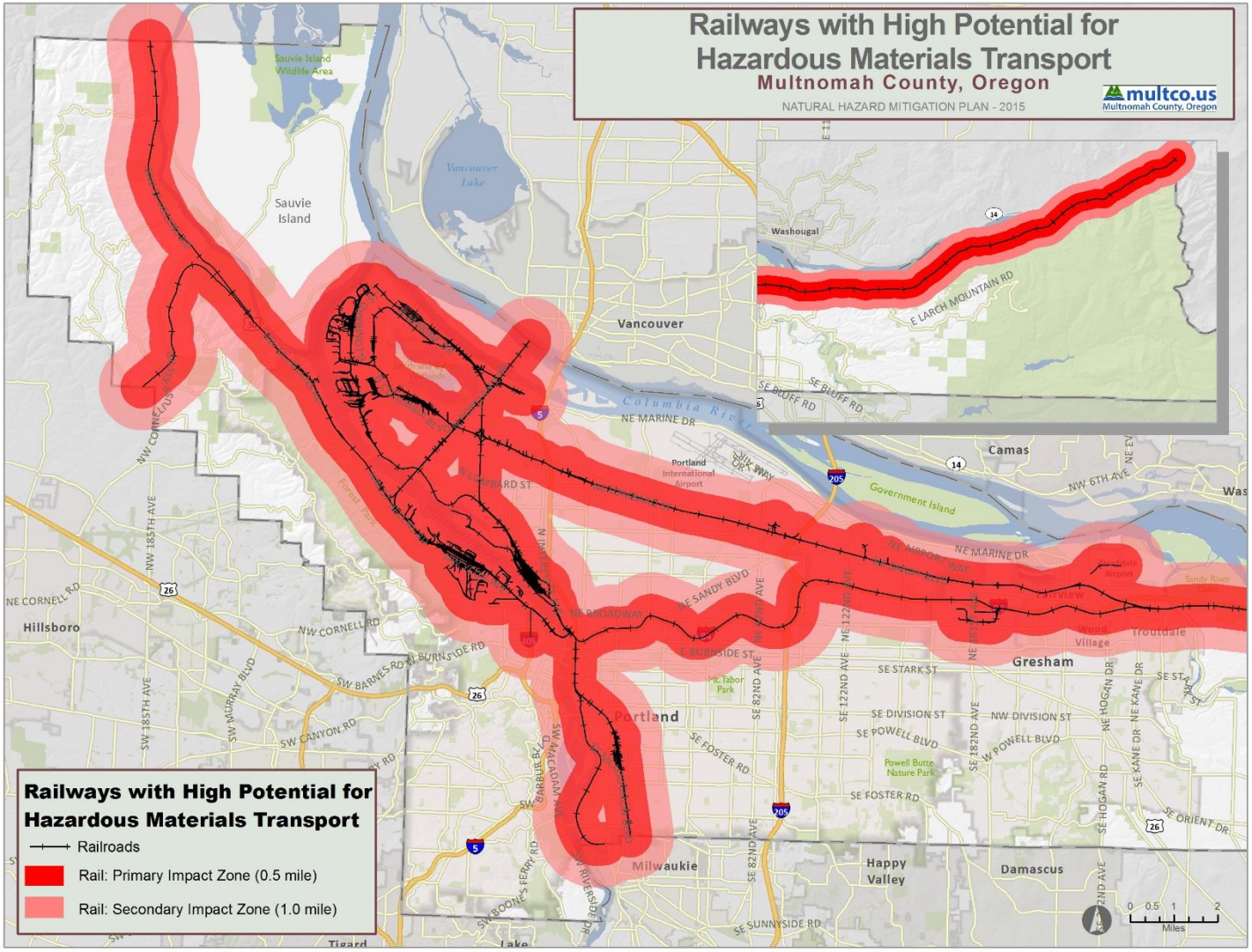
FIGURE 21: SPECIAL POPULATION CRITICAL FACILITIES IN MULTNOMAH COUNTY WITH ROADWAY BUFFER ANALYSIS



Source: Metro Data Resource Center; Oregon Commodity Flow Study; Portland Metro Regional Freight Plan 2035; Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health, Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

In addition to roadway analysis, the mobile analysis in this plan identified potential impact areas for the major railways where hazardous materials are most likely to be transported in higher numbers were analyzed. For these rails, buffer areas of 0.5 mile and 1.0 mile were used to estimate areas that may experience impacts or be evacuated due to a HAZMAT incident at a point along the rail line. **Figure 22** shows the areas used for mobile toxic release buffer analysis for rails. The results of the analysis indicate the approximate number of parcels/buildings and improved value, as shown in **Table 39.**

FIGURE 22: ***RAILWAY HAZMAT BUFFERS IN MULTNOMAH COUNTY***



Source: Metro Data Resource Center, Multnomah County GIS, Oregon Department of Transportation

TABLE 39: EXPOSURE OF IMPROVED PROPERTY TO HAZARDOUS MATERIALS SPILL (MOBILE ANALYSIS - RAIL)

Location	0.5-mile buffer			1.0-mile buffer		
	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[117]	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[118]
Fairview	2,117	2,437	$385,731,640	2,468	2,862	$475,931,460
Gresham	1,745	2,433	$915,599,690	3,908	5,313	$1,278,592,400
Lake Oswego	0	0	$0	0	0	$0
Maywood Park	273	320	$45,942,940	325	385	$53,970,540
Portland	77,943	75,129	$27,480,652,060	129,743	132,962	$44,962,122,770
Troutdale	989	1,121	$362,051,670	2,694	3,007	$634,158,030
Wood Village	597	837	$105,049,180	848	1,267	$181,294,850
Unincorporated Area	2,031	1,873	$1,984,158,810	3,278	3,615	$2,395,739,910
MULTNOMAH COUNTY TOTAL	**85,695**	**84,150**	**$31,279,185,990**	**143,264**	**149,411**	**$49,981,809,960**

Additionally, **Table 40** and **Table 41** contain a breakdown of parcels at risk based on land use code.

TABLE 40: PARCELS LOCATED IN 0.5 MILE BUFFER AREA BY LAND USE CODE

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Fairview	0	75	0	1	148	1	1,563	253	76
Gresham	7	150	0	22	145	0	1,278	129	14
Lake Oswego	0	0	0	0	0	0	0	0	0
Maywood Park	0	3	0	0	0	0	257	13	0
Portland	27	7,441	0	180	20,901	212	44,354	4,323	505
Troutdale	1	169	0	2	95	2	540	172	8
Wood Village	0	52	0	1	110	0	399	34	1

[117] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 0.5-mile buffer, since building footprints were not associated with dollar value data.

[118] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 1.0-mile buffer, since building footprints were not associated with dollar value data.

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Unincorporated Area	113	56	242	4	9	160	518	862	67
MULTNOMAH COUNTY TOTAL	**148**	**7,946**	**242**	**210**	**21,408**	**375**	**48,909**	**5,786**	**671**

Source: Metro Data Resource Center- Multnomah County Tax Assessors

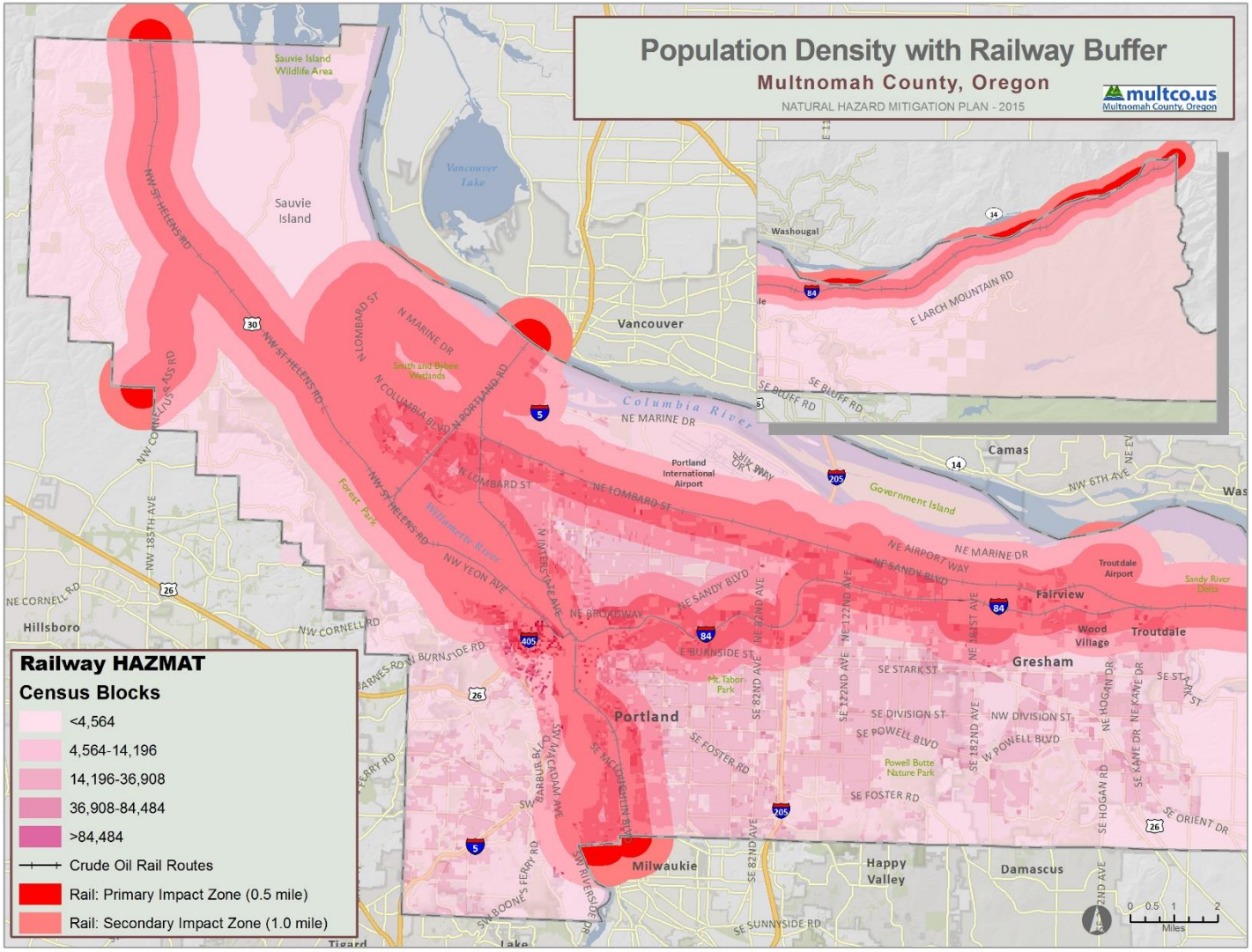
TABLE 41: PARCELS LOCATED IN 1.0 MILE BUFFER AREA BY LAND USE CODE

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Fairview	0	85	0	1	151	1	1,862	290	78
Gresham	8	252	0	24	189	0	3,095	216	24
Lake Oswego	0	0	0	0	0	0	0	0	0
Maywood Park	0	3	0	0	1	0	304	17	0
Portland	28	10,546	0	180	30,168	312	81,506	6,369	634
Troutdale	2	192	0	2	100	6	2,098	285	9
Wood Village	1	73	0	1	150	0	559	62	2
Unincorporated Area	305	78	451	5	30	297	920	1,089	103
MULTNOMAH COUNTY TOTAL	**344**	**11,229**	**451**	**213**	**30,789**	**616**	**90,344**	**8,328**	**850**

Source: Metro Data Resource Center- Multnomah County Tax Assessors

To determine the population potentially at risk of being impacted by a railway hazardous materials incident, Census blocks were intersected with the buffer areas described above. The results of this analysis are presented in **Table 42** and **Figure 23**

FIGURE 23: POPULATION DENSITY IN MULTNOMAH COUNTY WITH RAILWAY BUFFER ANALYSIS



Source: U.S. Census Bureau, 2010, Metro Data Resource Center, Multnomah County GIS, Oregon Department of Transportation

TABLE 42: COUNTS OF PEOPLE LOCATED WITHIN RAILWAY BUFFER AREA

Location	0.5-mile buffer	1.0-mile buffer
Fairview	8,524	8,920
Gresham	9,021	19,207
Lake Oswego	0	0
Maywood Park	714	752
Portland	198,438	329,562
Troutdale	4,321	10,120
Wood Village	3,651	3,878
Unincorporated Area	4,064	6,321
MULTNOMAH COUNTY TOTAL	**228,733**	**378,760**

Given high susceptibility across Multnomah County, there is a large portion of the population that may be affected by a railway hazardous materials incident. However, it should be noted that people within the identified impact areas are more likely to be impacted and areas of population concentration may be at an elevated risk due to a greater burden to evacuate large populations from a relatively small area.

The critical facility analysis for rail corridors revealed that there are 800 critical facilities located in the primary and secondary mobile HAZMAT buffer areas for railways. The 0.5-mile rail buffer area includes 499 of those facilities. A summary of the number of critical facilities located in each protection area by jurisdiction can be found in **Table 43, Table 44, Table 45, Table 46, Table 47,** and **Table 48.** These facilities are shown overlaid on the buffer areas in **Figure 24, Figure 25,** and **Figure 26.**

TABLE A43: EMERGENCY SERVICES CRITICAL FACILITY INVENTORY IN 0.5 MILE BUFFER AREA

Location	Ambulance Services	Fire Stations	Hospitals	Licensed Medical Facilities	Law Enforcement	Urgent Care Centers
Fairview	0	0	0	0	0	0
Gresham	0	1	0	0	0	0
Lake Oswego	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0
Portland	3	11	4	29	15	8
Troutdale	0	0	0	0	1	0
Wood Village	0	0	0	0	0	0
Unincorporated Area	0	2	0	0	0	0
MULTNOMAH COUNTY TOTAL	**3**	**14**	**4**	**29**	**16**	**8**

Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

TABLE 44: ADMINISTRATIVE CRITICAL FACILITY INVENTORY IN 0.5 MILE BUFFER AREA

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Fairview	0	0	1	0	1
Gresham	0	0	0	1	0
Lake Oswego	0	0	0	0	0
Maywood Park	0	1	0	0	0
Portland	0	0	9	52	5
Troutdale	1	1	0	3	0
Wood Village	0	1	0	0	0
Unincorporated Area	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**1**	**3**	**10**	**56**	**6**

Source: Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

TABLE 45: SPECIAL POPULATION CRITICAL FACILITY INVENTORY IN 0.5 MILE BUFFER AREA

Location	Childcare Facilities	Homeless Shelters	Jails	Residential Care Facilities	Schools
Fairview	0	0	0	0	5
Gresham	4	0	0	0	3
Lake Oswego	0	0	0	0	0
Maywood Park	2	0	0	0	2
Portland	113	23	1	52	112
Troutdale	2	0	0	0	5
Wood Village	2	0	0	2	0
Unincorporated Area	2	0	0	0	1
MULTNOMAH COUNTY TOTAL	**125**	**23**	**1**	**54**	**128**

Source: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health,

Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

TABLE 46: EMERGENCY SERVICES CRITICAL FACILITY INVENTORY IN 1.0 MILE BUFFER AREA

Location	Ambulance Services	Fire Stations	Hospitals	Licensed Medical Facilities	Law Enforcement	Urgent Care Centers
Fairview	0	0	0	0	1	0
Gresham	0	1	0	1	0	1
Lake Oswego	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0
Portland	4	19	6	43	22	13
Troutdale	0	1	0	0	1	0
Wood Village	0	0	0	0	0	0
Unincorporated Area	0	4	0	0	0	0
MULTNOMAH COUNTY TOTAL	**4**	**25**	**6**	**44**	**24**	**14**

Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

TABLE 47: ADMINISTRATIVE CRITICAL FACILITY INVENTORY IN 1.0 MILE BUFFER AREA

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Fairview	0	1	1	4	1
Gresham	0	0	0	1	0
Lake Oswego	0	0	0	0	0
Maywood Park	0	1	0	0	0
Portland	0	1	19	68	7
Troutdale	1	1	0	4	1
Wood Village	0	1	0	0	0

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Unincorporated Area	0	0	0	1	0
MULTNOMAH COUNTY TOTAL	**1**	**5**	**20**	**78**	**9**

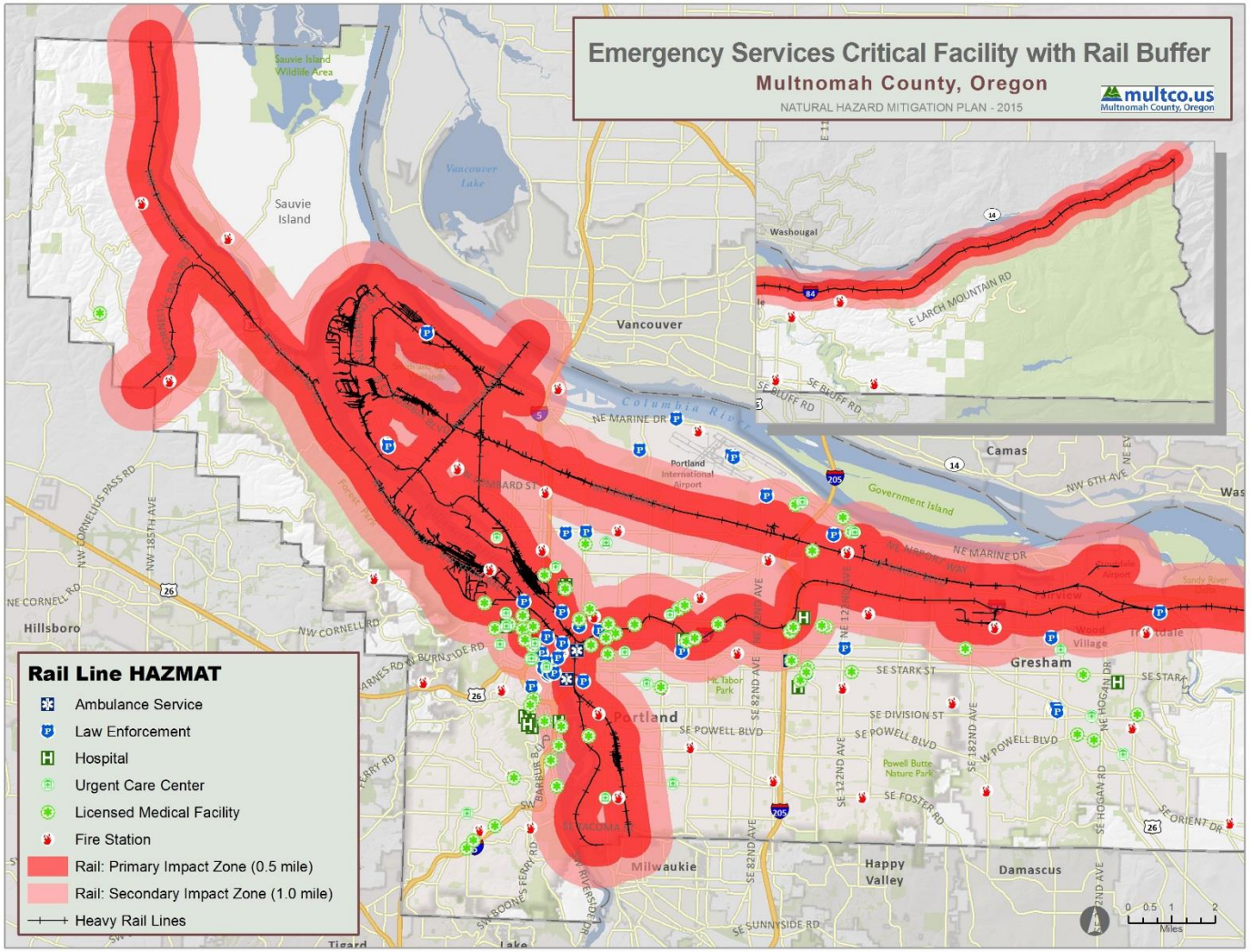
Source: Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

TABLE 48: SPECIAL POPULATION CRITICAL FACILITY INVENTORY IN 1.0 MILE BUFFER AREA

Location	Childcare Facilities	Homeless Shelters	Jails	Residential Care Facilities	Schools
Fairview	1	0	0	0	11
Gresham	5	0	0	1	8
Lake Oswego	0	0	0	0	0
Maywood Park	2	0	0	0	2
Portland	206	26	2	81	181
Troutdale	3	0	0	2	6
Wood Village	2	0	0	2	0
Unincorporated Area	2	0	0	0	7
MULTNOMAH COUNTY TOTAL	**221**	**26**	**2**	**86**	**215**

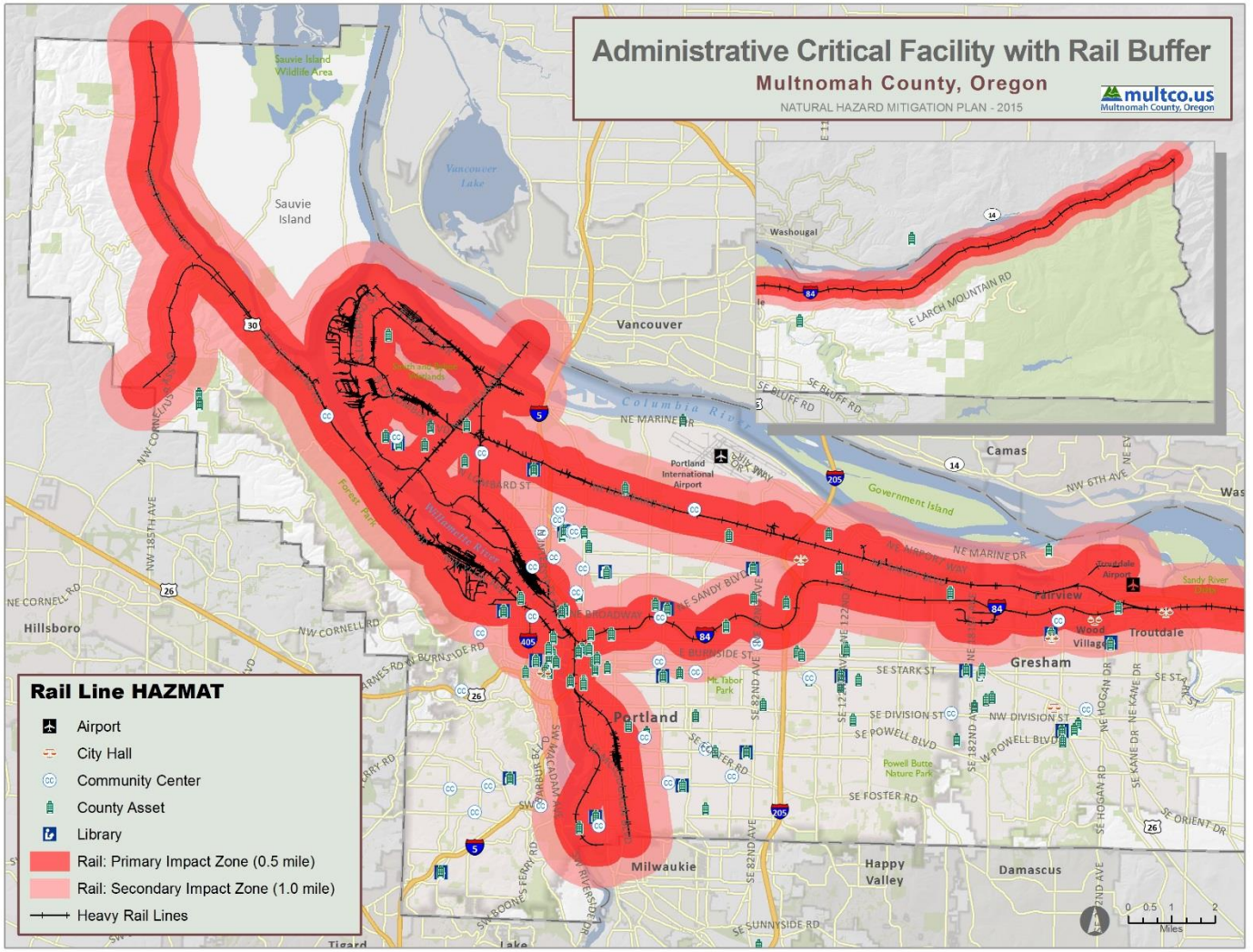
Source: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health, Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

FIGURE 24: EMERGENCY SERVICES CRITICAL FACILITIES IN MULTNOMAH COUNTY WITH RAILWAY BUFFER ANALYSIS



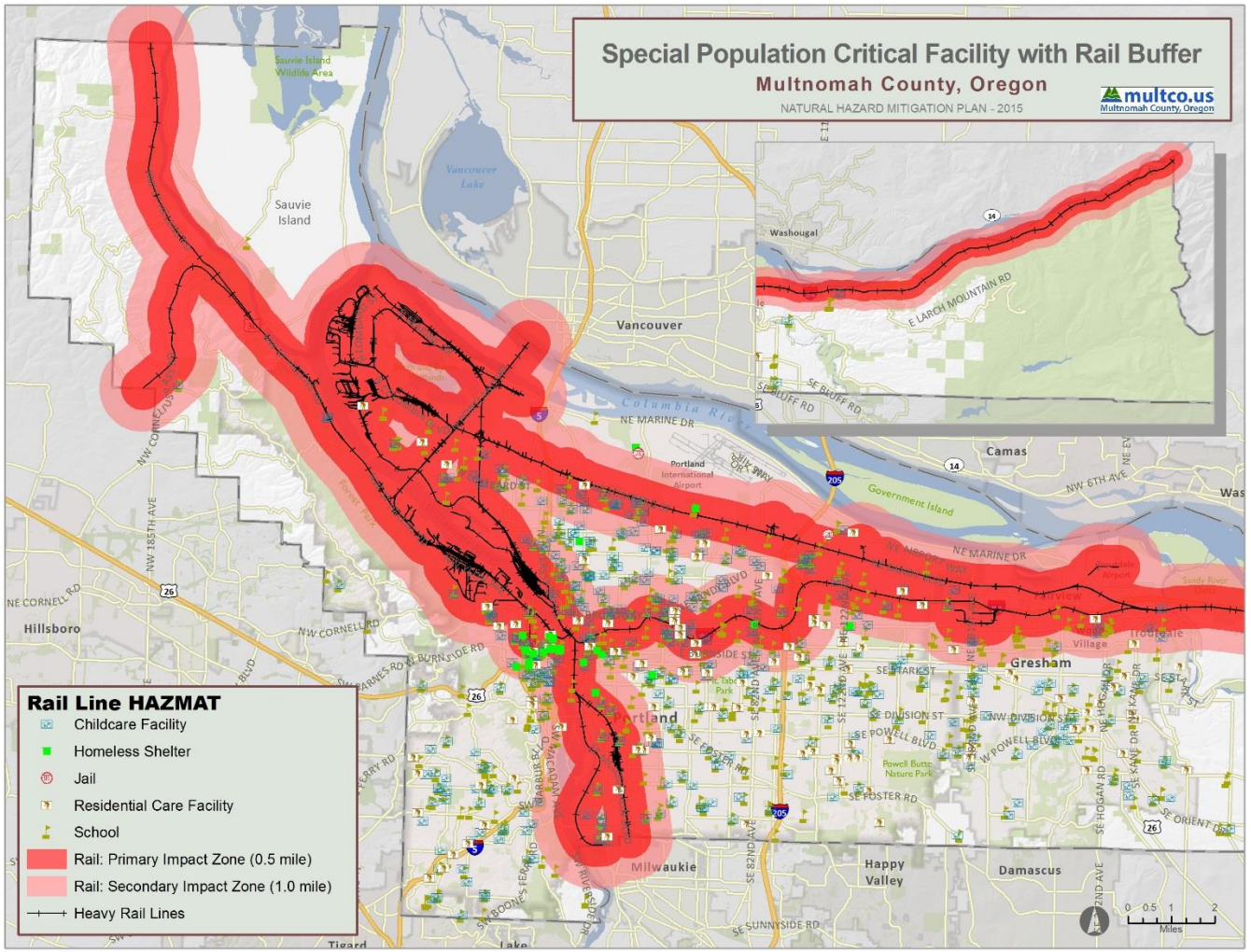
Source: Metro Data Resource Center; Oregon Department of Transportation, Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

FIGURE 25: ADMINISTRATIVE CRITICAL FACILITIES IN MULTNOMAH COUNTY WITH RAILWAY BUFFER ANALYSIS



Source: Metro Data Resource Center; Oregon Department of Transportation; Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

FIGURE 26: SPECIAL POPULATION CRITICAL FACILITIES IN MULTNOMAH COUNTY WITH RAILWAY BUFFER ANALYSIS



Source: Metro Data Resource Center; Oregon Department of Transportation; ***Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health, Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List***

4.8. Oil Train Incidents- Historical Occurrences

Historical rail-related hazardous materials incidents were included in the history of mobile incidents above and it should be noted that most industrial rail lines have been used to transport hazardous materials at some point. However, through research and analysis of potential risk to a rail incident, it was determined that oil train incidents posed an especially significant threat for Multnomah County and should also be a special focus of the hazardous materials rail analysis in this plan.

During the last decade, overall rail accidents have declined, along with accidents involving the transport of hazardous materials. According to the Federal Railroad Administration, the number of derailments on long-haul tracks in the United States has declined by around 21 percent since 2009 (to 2014). However, in spite of that decline in overall derailments, the number of accidents related to fire or violent rupture nearly doubled from 20 in 2009 to 38 in 2014.[119]

Moreover, rail industry statistics indicate that major railroads delivered 435,560 rail cars of crude oil in 2013, which is roughly 300 million barrels. This is a sharp increase compared to 2008 when there were only around 9,500 railcars. Through the first half of 2014, approximately 258,541 railcars of crude oil were transported and delivered domestically, indicating that transport of crude oil via rail continues to increase.[120] For example, in neighboring Washington, the railroads reported moving 19 unit trains of Bakken oil through the state each week in 2014, which amounts to nearly 3 million gallons of oil. If the full build-out of proposed oil facilities is allowed, some projections estimate the number of unit trains per week could increase from 19 to 137.

While historically there have not been a large number of oil train incidents, the numbers above indicate that there is likely an increasing risk of these incidents occurring. Since they can occur at any time and pose potentially devastating consequences to the public, local communities, and the environment, an oil train incident presents tremendous challenges for local planning and response officials. Given the location of several rail lines that transport crude oil in Multnomah County, there is a moderate risk to this hazard with the potential for serious consequences such as fatalities and widespread damage to property and public health.

Although there have not been any major oil train incidents recorded in Multnomah County, there have been several major incidents throughout the United States and Canada as evidenced by the incidents outlined in **Table 49**.

[119] Russell Gold and Paul Vieira. *Wrecks Hit Tougher Oil Railcars.* The Wall Street Journal. March 9, 2015.

[120] Bakken Crude Oil Pamphlet distributed by the NW Area Committee, February 2015

TABLE 49: RECENT OIL TRAIN INCIDENTS IN THE UNITED STATES AND CANADA[121]

Date	Location	Description
07/05/2013	Lac-Mégantic, Quebec, Canada	An unattended freight train transporting petroleum crude oil rolled down a descending grade and subsequently 63 cars derailed. The subsequent fires, along with other effects of the accident, resulted in the confirmed deaths of 47 individuals. In addition, extensive damage to the town center and the evacuation of approximately 2,000 people.
10/19/2013	Gainford, Alberta, Canada	9 tank cars of propane and 4 tank cars of crude oil derailed. About 100 residents were evacuated. 3 propane cars burned, but the oil cars pushed away and did not burn.
11/07/2013	Aliceville, Alabama	26 cars derailed, resulting in 11 cars impinged by a crude oil pool fire. An undetermined amount of petroleum crude oil escaped from derailed cars and found its way into wetlands area nearby the derailment site.
12/30/2013	Castleton, North Dakota	A separation derailment resulted in the derailment of 21 cars of petroleum crude oil. 18 cars ruptured, and an estimated 400,000 gallons of petroleum crude oil was released. The ruptured tank cars ignited, causing a significant fire. Approximately 1,400 people were evacuated.
01/07/2014	Plaster Rock, New Brunswick,	17 cars of a mixed train hauling crude oil, propane, and other goods derailed. 5 cars carrying crude oil caught fire and exploded. 45 homes were evacuated but no injuries were reported.
04/30/2014	Lynchburg, VA	105 tank cars loaded with petroleum crude oil derailed. Seventeen cars derailed, and one breached. A fire ensued. 350 evacuated from immediate area. Three cars came to rest in James River, spilling up to 30,000 gallons of oil into river.

4.9. Oil Train Incidents- Location and Spatial Extent

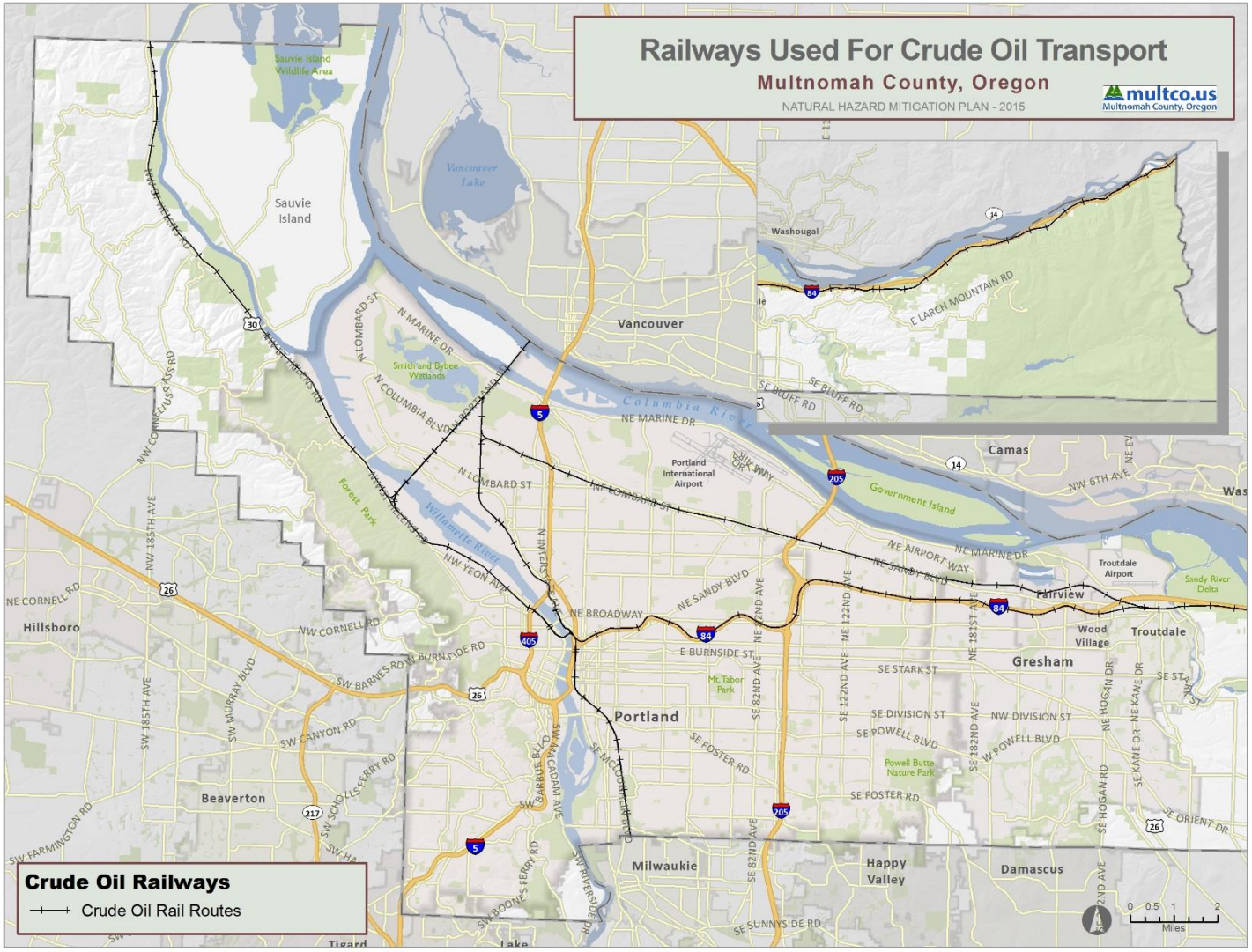
A majority of crude oil is transported by railways. Currently the Emergency Restriction/Prohibition Order applies to all railroad carriers that transport a specified amount of crude oil within its rail cars. To determine the rail carriers of hazardous materials moving through an area and ascertain if crude oil is one of the products being transported, communities are allowed to contact the rail carrier and request a list of hazardous commodities being transported through their community as per the Association of American Railroads (AAR) Circular No. OT-55 protocol. Further, the OT-55 protocol explains that all rail carriers subject to the Order must provide certain information to the State Emergency Response Commission (SERC) concerning trains transporting at or above the threshold. This allows for the identification of railway lines and infrastructure (tracks, bridges, adjacent roadways, etc.) that are at risk for a crude oil incident.

For this analysis, major freight rail lines that are used for the transport of crude oil were identified by the State of Oregon's Office of Emergency Management (OEM) using the information collected by the State Emergency Response Commission.[122] The railroads identified by OEM were utilized in the analysis as these are the most likely lines on which a hazardous materials oil incident might occur. These rail lines can be found in **Figure 27**.

[121] Bakken Crude Oil Pamphlet distributed by the NW Area Committee, February 2015

[122] State of Oregon Office of Emergency Management. OR-IRIS Crude Oil Rail Routes GIS Shapefile. 2015.

FIGURE 27: RAILWAYS IN MULTNOMAH COUNTY USED FOR CRUDE OIL TRANSPORT



Source: Oregon Department of Transportation, Geographic Information Services Unit, Oregon Office of Emergency Management

4.10. Oil Train Incidents- Risk Analysis

Crude oil incidents present various hazardous risks.

Potential Hazards Related to Crude Oil[123]:

- Highly Flammable: Will be easily ignited by heat, sparks or flames.
- Vapors may form explosive mixtures with air.
- Vapors may travel to source of ignition and flash back.
- Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Vapor explosion hazard indoors, outdoors or in sewers.
- Runoff to sewer may create fire or explosion hazard.
- Containers may explode when heated.
- Inhalation or contact with material may irritate or burn skin and eyes.
- Fire may produce irritating, corrosive and/or toxic gases.
- Vapors may cause dizziness or suffocation.
- Runoff from fire control or dilution water may cause pollution.

Table 50 describes the characteristics of the five different types of oil classifications.

[123] Bakken Crude Oil Pamphlet distributed by the NW Area Committee, February 2015

TABLE 50: CHARACTERISTICS OF THE FIVE TYPES OF OIL CLASSIFICATIONS[124]

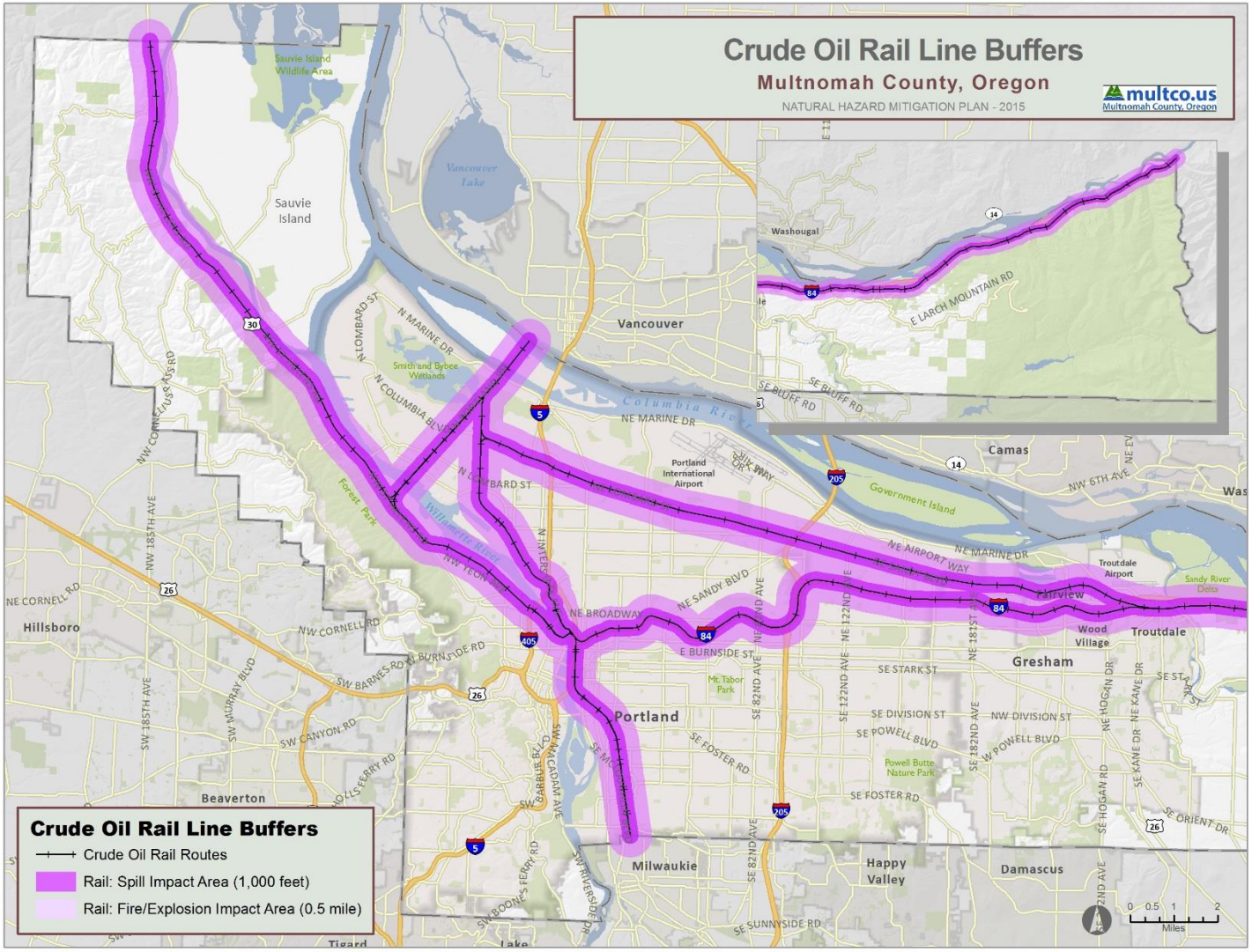
Gasoline Products (Group I)	Diesel-like Products and Light Crude Oils (Group II)	Medium-grade Crude Oils and Intermediate Products (Group III)	Heavy Crude Oils and Residual Products (Group IV)	Low API Oils - heavier than water (Group V)
• Examples – Gasoline	• Examples – No. 2 fuel oil, jet fuels, kerosene, West Texas crude, Alberta crude	• Examples – North Slope crude, South Louisiana crude, No. 4 fuel oil, IFO 180, lube oils	• Examples – Venezuela crude, San Joaquin Valley crude, Bunker C, No. 6 fuel oil	• Examples – Very heavy No. 6 fuel oil, Residual Oils, Vacuum Bottoms, Heavy slurry oils
• Very volatile and highly flammable(flash point near 100°F/40°C)	• Moderately volatile (flash point varies 100-150°F/40-65°C)	• Moderately volatile (flash point higher than 125°F/50°C)	• Slightly volatile (flash point greater than 150°F/65°C)	• Very low volatility
• High evaporation rates; narrow cut fraction with no residues	• Refined products can evaporate to no residue; crude oils do have a residue after evaporation is completed	• Up to one-third will evaporate in the first 24 hours	• Very little product loss by evaporation	• No evaporation when submerged
• Low viscosity; spread rapidly to a thin sheen	• Low to moderate viscosity; spread rapidly into thin slicks • Specific gravity of <0.85; API gravity of 35-45	• Moderate to high viscosity • Specific gravity of 0.85-0.95; API gravity of 17.5-35	• Very viscous to semisolid • Specific gravity of 0.95-1.00; API gravity of 10-17.5	• Very viscous to semisolid • Specific gravity greater than 1.00; API gravity less than 10
• High acute toxicity to biota	• Moderate to high acute toxicity to biota; product-specific toxicity related to type and concentration of aromatic compounds	• Moderate to high acute toxicity to biota; product-specific toxicity related to type and concentration of aromatic compounds	• Low acute toxicity relative to other oil types	• Low acute toxicity relative to other oil types

Figure 28 shows buffer areas for the major oil train railway lines that could impact Multnomah County. The Oregon Office of the State Fire Marshall recommends that in the event of a large oil train incident/spill, initial downwind evacuation should be at least 1,000 feet (300 meters). Further, if the tank or car is involved in a fire, officials should isolate and consider evacuation for 0.5 mile (800 meters) in all directions.[125] Therefore, the buffer areas that have been selected for this analysis are 1,000 feet (spill area) and 0.5 mile (fire/explosion area). The results of the analysis indicate the approximate number of parcels/buildings and improved value, as shown in **Table 51.**

[124] Bakken Crude Oil Pamphlet distributed by the NW Area Committee, February 2015

[125] Office of State Fire Marshal Survey Findings and Recommendations on Crude Oil, January 8, 2015

FIGURE 28: *CRUDE OIL RAIL LINE HAZMAT BUFFERS IN MULTNOMAH COUNTY*



Source: Oregon Department of Transportation, Geographic Information Services Unit, Oregon Office of Emergency Management

TABLE 51: EXPOSURE OF IMPROVED PROPERTY TO CRUDE OIL RAIL HAZARDOUS MATERIALS SPILL

Location	1,000 feet buffer			0.5-mile buffer		
	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[126]	Approx. Number of Parcels	Approx. Number Improved	Approx. Improved Value[127]
Fairview	1,331	1,371	$225,384,810	2,118	2,360	$392,328,560
Gresham	212	433	$499,197,610	630	1,088	$727,378,680
Lake Oswego	0	0	$0	0	0	$0
Maywood Park	14	16	$2,286,710	272	318	$45,656,950
Portland	23,014	19,141	$8,559,378,110	65,068	62,035	$22,319,588,560
Troutdale	374	226	$139,384,610	968	880	$264,319,340
Wood Village	109	199	$56,053,960	605	2,622	$105,731,230
Unincorporated Area	965	1,346	$106,454,650	1,607	811	$1,937,644,260
MULTNOMAH COUNTY TOTAL	**26,019**	**22,732**	**$9,588,140,460**	**71,268**	**70,114**	**$25,792,647,580**

Additionally, **Table 52** and **Table 53** contain a breakdown of parcels at risk based on land use code.

TABLE 52: PARCELS LOCATED IN 1,000 FEET BUFFER AREA BY LAND USE CODE

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Fairview	0	42	0	0	29	1	1,025	169	65
Gresham	7	55	0	14	2	0	76	52	6
Lake Oswego	0	0	0	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0	14	0	0
Portland	17	2,967	0	69	6,136	62	11,679	1,764	320
Troutdale	1	102	0	0	4	0	160	103	4
Wood Village	0	44	0	1	0	0	43	19	1

[126] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 1,000 feet buffer, since building footprints were not associated with dollar value data.

[127] Improved value is estimated based on the building value associated with parcels that have been identified as being located in the 0.5-mile buffer, since building footprints were not associated with dollar value data.

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Unincorporated Area	29	36	53	4	4	89	178	535	37
MULTNOMAH COUNTY TOTAL	**54**	**3,246**	**53**	**88**	**6,175**	**152**	**13,175**	**2,642**	**433**

Source: Metro Data Resource Center- Multnomah County Tax Assessors

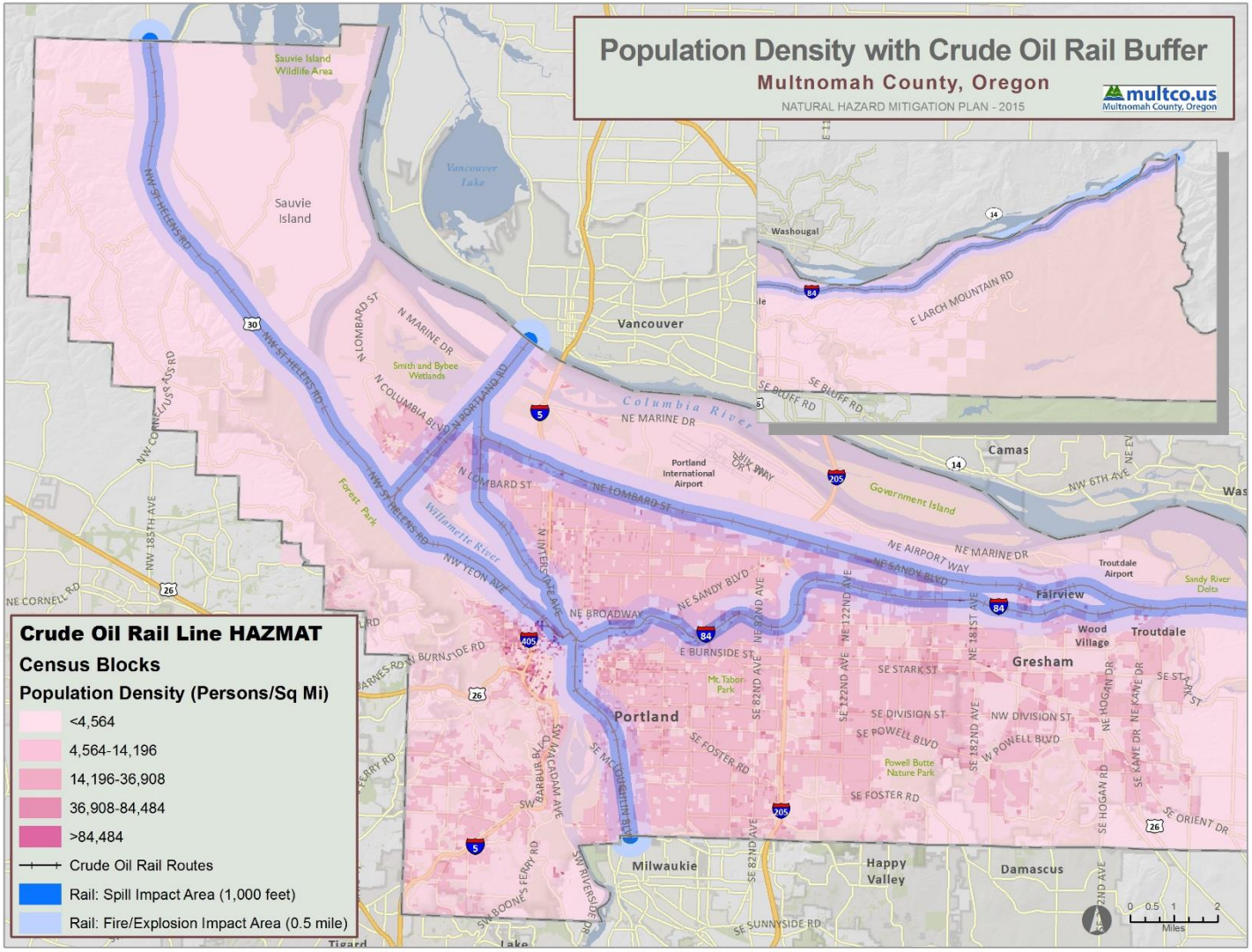
TABLE 53: PARCELS LOCATED IN 0.5 MILE BUFFER AREA BY LAND USE CODE

Location	AGR	COM	FOR	IND	MFR	RUR	SFR	VAC	N/A
Fairview	0	75	0	1	150	1	1562	253	76
Gresham	7	113	0	22	21	0	378	77	12
Lake Oswego	0	0	0	0	0	0	0	0	0
Maywood Park	0	3	0	0	0	0	256	13	0
Portland	27	6426	0	144	15674	168	38631	3597	401
Troutdale	1	157	0	2	95	2	537	167	7
Wood Village	0	52	0	1	115	0	402	34	1
Unincorporated Area	74	50	125	4	8	157	411	724	54
MULTNOMAH COUNTY TOTAL	**109**	**6,876**	**125**	**174**	**16,063**	**328**	**42,177**	**4,865**	**551**

Source: Metro Data Resource Center- Multnomah County Tax Assessors

To determine the population potentially at risk of being impacted by a crude oil rail incident, Census blocks were intersected with the buffer areas described above. The results of this analysis are presented in **Table 54** and **Figure 29**

FIGURE 29: POPULATION DENSITY IN MULTNOMAH COUNTY WITH CRUDE OIL RAIL BUFFER ANALYSIS



Source: U.S. Census Bureau, 2010, Oregon Department of Transportation, Geographic Information Services Unit, Oregon Office of Emergency Management

TABLE 54: COUNTS OF PEOPLE LOCATED WITHIN CRUDE OIL RAILWAY BUFFER AREA

Location	1,000 feet buffer	0.5-mile buffer
Fairview	6,159	8,524
Gresham	2,049	3,469
Lake Oswego	0	0
Maywood Park	106	714
Portland	67,717	169,372
Troutdale	2,929	4,321
Wood Village	1,480	3,651
Unincorporated Area	2,382	3,374
MULTNOMAH COUNTY TOTAL	**82,822**	**193,425**

The analysis of the crude oil railroad buffer areas shows that there are 409 facilities in any hazard area, with 162 facilities located in only the spill area. A summary of the number of critical facilities located in each protection area by jurisdiction can be found in **Table 55, Table 56, Table 57, Table 58, Table 59,** and **Table 60.** These facilities are shown overlaid on the buffer areas in **Figure 30, Figure 31,** and **Figure 32.**

TABLE55: EMERGENCY SERVICES CRITICAL FACILITY INVENTORY IN 1,000 FEET BUFFER AREA

Location	Ambulance Services	Fire Stations	Hospitals	Licensed Medical Facilities	Law Enforcement	Urgent Care Centers
Fairview	0	0	0	0	0	0
Gresham	0	0	0	0	0	0
Lake Oswego	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0
Portland	3	5	1	13	6	1
Troutdale	0	0	0	0	1	0
Wood Village	0	0	0	0	0	0
Unincorporated Area	0	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**3**	**5**	**1**	**13**	**7**	**1**

Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

TABLE 56: ADMINISTRATIVE CRITICAL FACILITY INVENTORY IN 1,000 FEET BUFFER AREA

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Fairview	0	0	0	0	0
Gresham	0	0	0	0	0
Lake Oswego	0	0	0	1	0
Maywood Park	0	0	0	0	0
Portland	0	0	6	17	0
Troutdale	0	1	0	3	0
Wood Village	0	1	0	0	0
Unincorporated Area	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**0**	**2**	**6**	**21**	**0**

Source: Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

TABLE 57: SPECIAL POPULATION CRITICAL FACILITY INVENTORY IN 1,000 FEET BUFFER AREA

Location	Childcare Facilities	Homeless Shelters	Jails	Residential Care Facilities	Schools
Fairview	0	0	0	0	2
Gresham	2	0	0	0	1
Lake Oswego	0	0	0	0	0
Maywood Park	0	0	0	0	0
Portland	35	6	0	20	25
Troutdale	1	0	0	0	0
Wood Village	0	0	0	2	0
Unincorporated Area	1	0		0	0
MULTNOMAH COUNTY TOTAL	**39**	**6**	**0**	**22**	**28**

Source: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health,

Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

TABLE 58: EMERGENCY SERVICES CRITICAL FACILITY INVENTORY IN 0.5 MILE AREA

Location	Ambulance Services	Fire Stations	Hospitals	Licensed Medical Facilities	Law Enforcement	Urgent Care Centers
Fairview	0	0	0	0	0	0
Gresham	0	1	0	0	0	0
Lake Oswego	0	0	0	0	0	0
Maywood Park	0	0	0	0	0	0
Portland	3	9	4	19	12	6
Troutdale	0	0	0	0	1	0
Wood Village	0	0	0	0	0	0
Unincorporated Area	0	1	0	0	0	0
MULTNOMAH COUNTY TOTAL	**3**	**11**	**4**	**19**	**13**	**6**

Source: Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

TABLE 59: ADMINISTRATIVE CRITICAL FACILITY INVENTORY IN 0.5 MILE AREA

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Fairview	0	0	1	0	1
Gresham	0	0	0	1	0
Lake Oswego	0	0	0	0	
Maywood Park	0	1	0	0	0
Portland	0	0	7	47	3
Troutdale	1	1	0	3	0
Wood Village	0	1	0	0	0

Location	Airports	City Halls	Community Centers	County Assets	Libraries
Unincorporated Area	0	0	0	0	0
MULTNOMAH COUNTY TOTAL	**1**	**3**	**8**	**51**	**4**

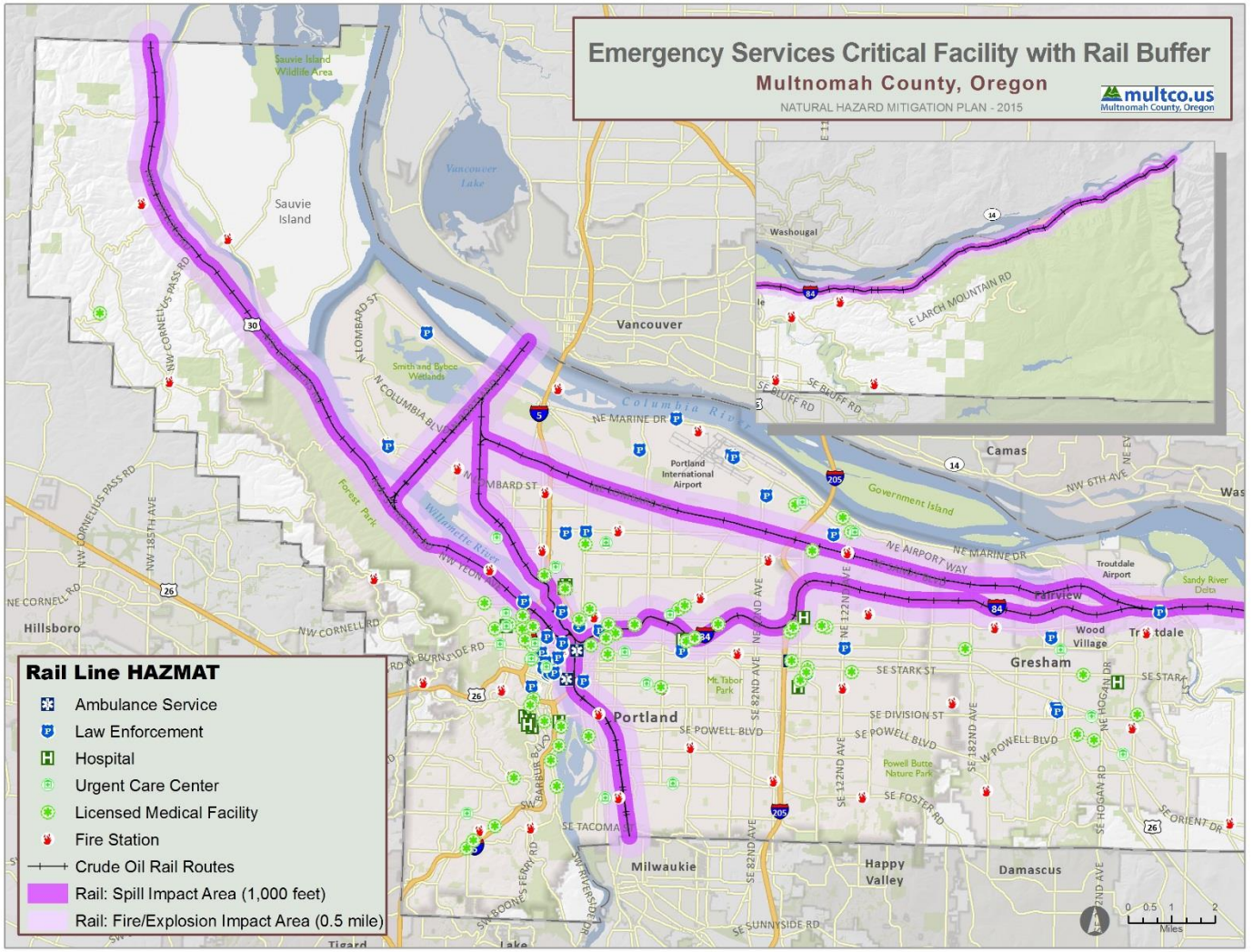
Source: Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

TABLE 60: SPECIAL POPULATION CRITICAL FACILITY INVENTORY IN 0.5 MILE AREA

Location	Childcare Facilities	Homeless Shelters	Jails	Residential Care Facilities	Schools
Fairview	0	0	0	0	5
Gresham	2	0	0	0	1
Lake Oswego	0	0	0	0	0
Maywood Park	2	0	0	0	2
Portland	91	18	1	40	95
Troutdale	2	0	0	0	5
Wood Village	2	0	0	2	0
Unincorporated Area	1	0	0	0	0
MULTNOMAH COUNTY TOTAL	**100**	**18**	**1**	**42**	**108**

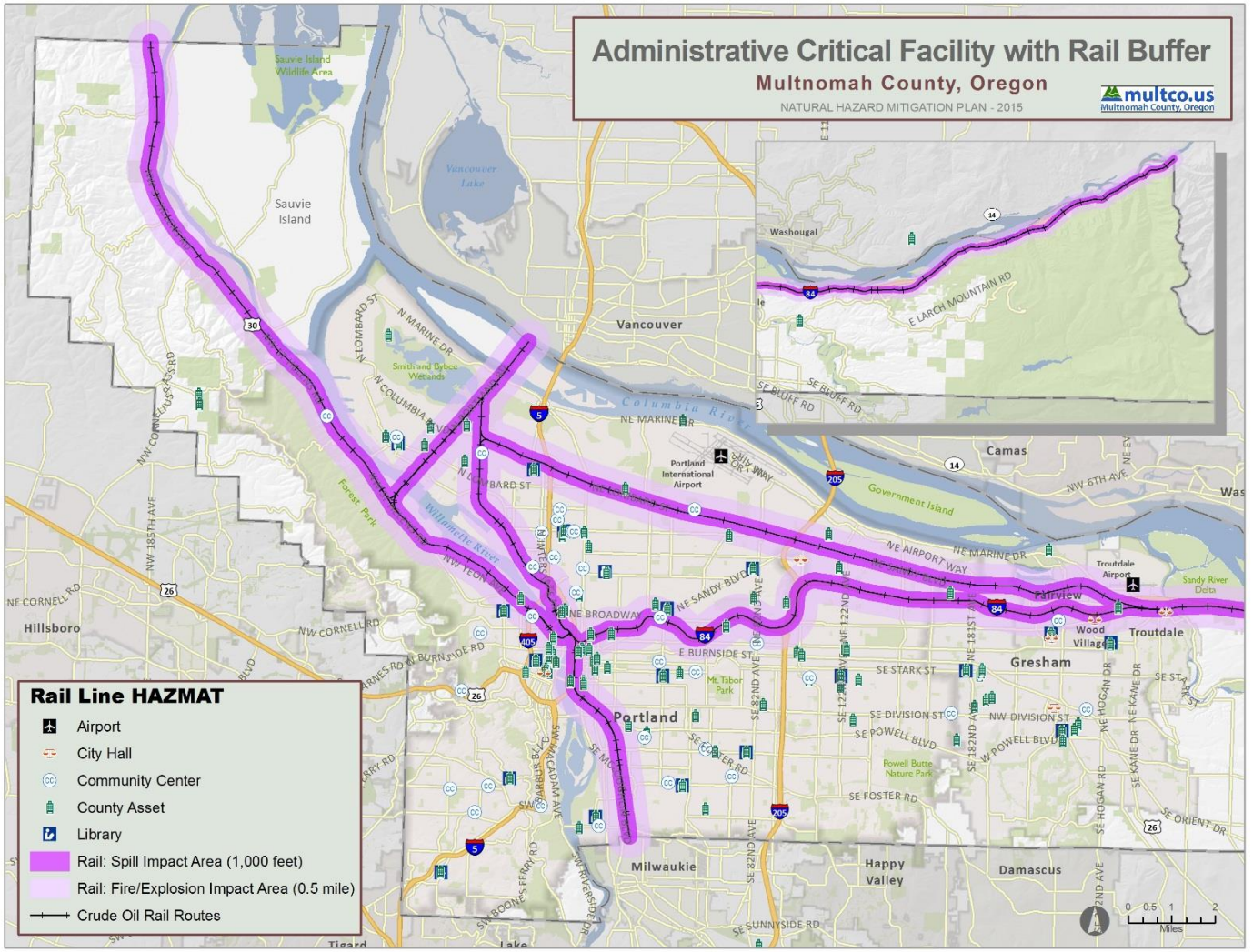
Source: Childcare Facilities- Oregon DHS, Portland State University-College of Spatial Analysis and Research; Residential Care Facilities- Oregon Public Health, Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

FIGURE 30: EMERGENCY SERVICES CRITICAL FACILITIES IN MULTNOMAH COUNTY WITH CRUDE OIL RAIL BUFFER ANALYSIS



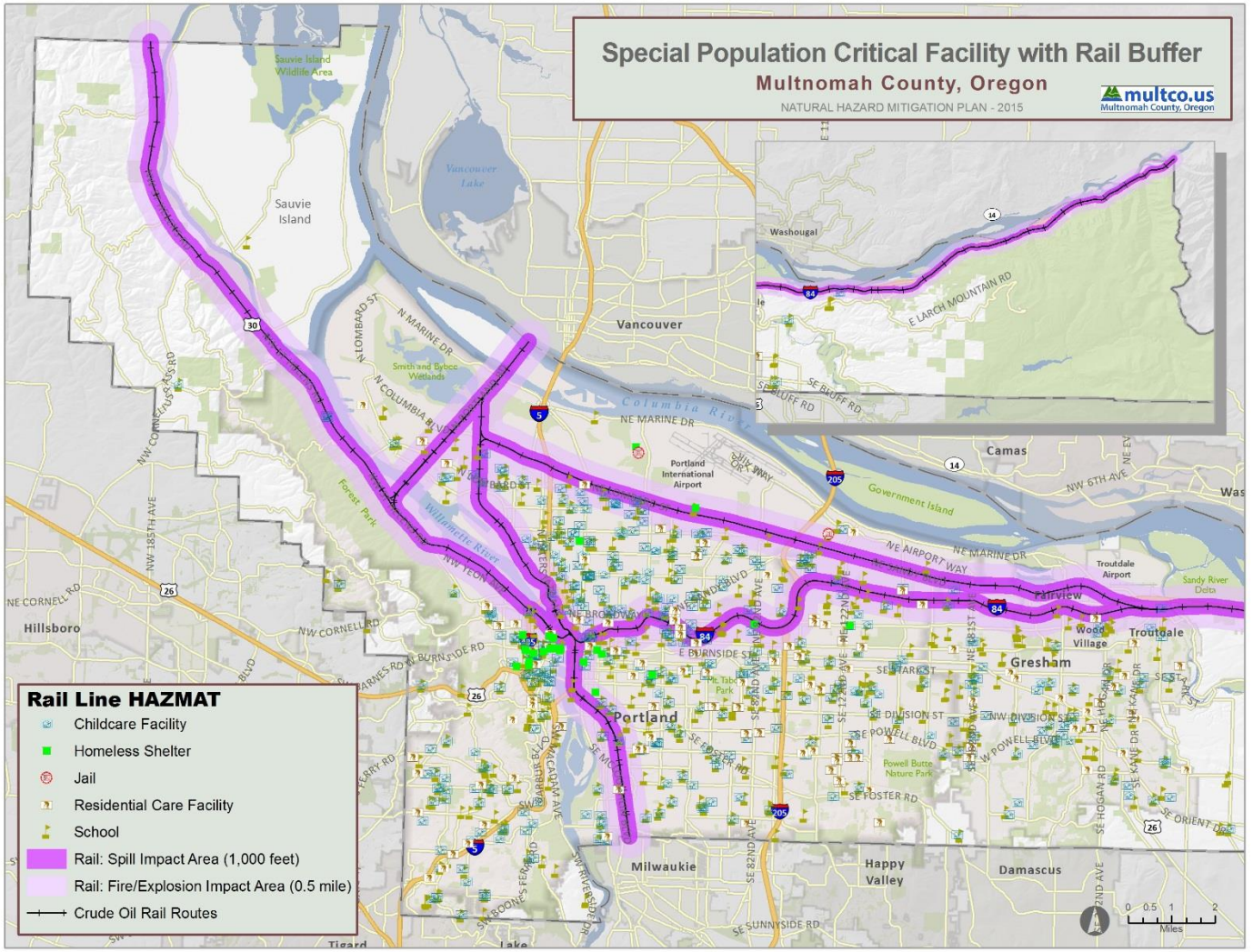
Source: Oregon Department of Transportation; Geographic Information Services Unit; Oregon Office of Emergency Management; Ambulance Services-Multnomah County GIS; Law Enforcement- Oregon Spatial Data Library, Oregon Department of Geology and Mineral Industries, OR-IRIS Version 2; Hospitals- Metro's Regional Land Information System; Urgent Care Centers- Oregon Department of Environmental Quality; Fire Stations- Metro's Regional Land Information System

FIGURE 31: ADMINISTRATIVE CRITICAL FACILITIES IN MULTNOMAH COUNTY WITH CRUDE OIL RAIL BUFFER ANALYSIS



Source: Oregon Department of Transportation; Geographic Information Services Unit; Oregon Office of Emergency Management; Airports- Metro's Regional Land Information System; City Halls- Metro's Regional Land Information System; Community Centers- Metro's Regional Land Information System Parks Layer; County Assets- Metro's Regional Land Information System; Libraries- Metro's Regional Land Information System

FIGURE 32: SPECIAL POPULATION CRITICAL FACILITIES IN MULTNOMAH COUNTY WITH CRUDE OIL RAIL BUFFER ANALYSIS



Source: Oregon Department of Transportation; Geographic Information Services Unit; Oregon Office of Emergency Management; Homeless Shelters- Multnomah GIS; Jails- Multnomah GIS; Residential Care Facilities- Oregon Public Health, Portland State University-College of Spatial Analysis and Research, Oregon Health Authority; Schools- Oregon Department of Education Open Institution List

4.11. Probability of Future Occurrence

Given the location of numerous Tier II facilities (as identified by HSIS) in Multnomah County as well as prior roadway, railway, air, water, and other hazardous materials incidents it is highly likely that a hazardous material incident may occur in the county. Over the 44-year PHMSA reporting period, there have been 5,003 roadway, railway, air, and water incidents, so on average there have been 114 incidents per year. Over the 29-year OSFM reporting period, there have been 2,513 hazardous material incidents, so on average there were 87 incidents per year. Based on these figures, the county can reasonably expect at least 80 hazardous materials incidents a year going forward. However, county and municipal officials are extremely vigilant and recognize this possibility, which allows them to analyze these potentials risks and take safety measures to reduce the likelihood that these events will occur.

Furthermore, county response teams have an excellent record when it comes to responding to hazardous materials events. As noted above, there have been a number of hazardous materials incidents in the county, but most have been contained before major injuries or loss of life have occurred. The fact that few major incidents have occurred in the county is a testament to the emphasis that local officials have put on preparedness and their efforts to develop detailed plans to respond to an occurrence. Response personnel in the county are focused on ensuring citizens are well-protected from a hazardous materials event and that the proper actions are taken when an event does occur.

4.12. Conclusions on Hazardous Materials Incidents

In conclusion, a hazardous material incident has the potential to impact many existing and future buildings, critical facilities, and populations in Multnomah County. Those areas in a smaller buffer for each analysis are at the highest risk, though all areas carry some vulnerability due to variations in conditions that could alter the impact area, such as direction and speed of wind and volume of release.

In terms of jurisdiction-specific risk, the City of Portland carries the most risk due to the high concentration of population and structures located in the city. The high density of people living and working in the city, combined with the location of a number of fixed sites and transportation routes makes Portland especially high risk to future hazardous materials incidents. In addition, it should be noted that according to PHMSA records, most of the mobile hazardous materials incidents and related injuries that have occurred historically in the county have been within Portland, so there is a notable history that indicates a high likelihood of future incidents.

Although Portland certainly has a higher absolute risk than the other jurisdictions in the county because of its size and density, other jurisdictions also face significant risk. In some cases, their risk relative to their sizes is much higher than Portland's relative risk. For instance, even though Gresham has a population that is roughly 1/6th the size of Portland, local records from the Oregon Office of State Fire Marshal show that in the last 5 years (2010-2015) it has experienced more than twice as many hazardous materials incidents. Moreover, when comparing the percentage of total population located in impact areas for a poisonous gas release, both Portland and Gresham have roughly the same percent of their population located in each impact area. This indicates that although Portland has a higher absolute number of people and property at risk, Gresham faces the same level of relative risk.

Similarly, most of the other jurisdictions in the county face high relative risks in terms of their overall population that is susceptible to an incident. In some cases, smaller jurisdictions face an even higher

relative risk than larger jurisdictions. For example, nearly the entire population of Fairview, Maywood Park, Troutdale, and Wood Village are located within the potential impact area for a nighttime incident at an HPPN=1 fixed site. Similarly, due to the location of a crude oil route directly through Fairview, nearly 80 percent of its population is potentially at risk to a rail oil spill and almost 95 percent is at risk to a fire/explosion from such a spill.

In terms of infrastructure and critical facilities, it should be noted that many facilities were determined to be located in the defined impact areas for this analysis. The summary tables above provide a general overview of the number of critical facilities located in each impact area by jurisdiction, but a list of specific critical facilities and their associated risk can also be found in **Table 64** at the end of this section.

These examples illustrate that most jurisdictions within the county face significant risks when it comes to hazardous materials. Although the greatest amounts of people and property are at risk in Portland when compared to other jurisdictions, a majority of the jurisdictions have high relative risks to hazardous materials incidents and must develop appropriate strategies to mitigate these risks.

5. PIPELINE INCIDENT

5.1. Overview

Pipelines in the United States are used to transport and distribute a number of products from their extraction point to sites where those materials are utilized throughout the country. Pipelines are most commonly used to transport energy sources such as natural gas and petroleum products, but are also often used in the transportation of other hazardous liquids. Transportation of these products via pipeline is abundant in the United States due to the cost-effectiveness of the process which allows quick movement with relatively minimal cost.

Generally pipelines are safe and effective, transporting materials where they are needed without incident. However, many pipelines in the United States were installed over 60 years ago and were made with materials such as cast and wrought iron or bare steel which degrade over time. This presents a definitive danger to people and property as a leak or spill of hazardous products from a degraded pipeline could prove disastrous, causing costly damage to property and injury or death.

As a result, there has been a recent movement to replace many of these older pipelines with newer materials such as plastics that can reduce the risk of a pipeline failure and a hazard incident. In 2011, the Pipeline Safety, Regulatory Certainty, and Job Creation Act was passed and called for the US Department of Transportation to conduct a state by state survey of pipelines and accelerate repairs of aging infrastructure. The following website provides a state by state update of the progress of this initiative: http://primis.phmsa.dot.gov/comm/states.htm?nocache=4496.

Not only do pipelines present potential damage to an area and its residents but infrastructure related to pipeline functioning contributes to vulnerability considerations. Pumps, compressor stations, breakout tanks, tank farms, and valves can cause possible negative impacts related to the overall pipeline hazard.

To determine the potential vulnerability to pipelines and other energy infrastructure, site-specific analysis is required. Due to lack of availability of the exact location of pipelines (which is not released to the public for reasons of confidentiality), this kind of site-specific analysis was not performed in this plan. Local officials interested in performing site-specific analysis should note that the PHMSA recommends that consultation zones be delineated along major pipelines to restrict construction and safely develop in these areas. Although the buffer distance utilized for a pipeline should be based on site-specific characteristics, if insufficient information is available, a standard consultation zone of 660 feet on either side of the pipe centerline should be used for natural gas transmission pipelines and a range of 660 to 1,000 feet should be used for hazardous liquid pipelines.[128]

5.2. Historical Occurrences

There have been no reported incidents of major pipeline disruptions or failures within Multnomah County. However, there have been significant pipeline spills and other incidents in nearby areas and similar incidents could occur within Multnomah County. One of the most notable pipeline incidents to occur in the Pacific Northwest in recent history was the Olympic Pipeline explosion in 1999. This incident occurred in Bellingham, Washington within Whatcom Falls Park.

The Olympic Pipeline explosion was the result of a failure to identify and repair damage to the pipe that had been caused several years prior, causing the pipeline to burst and spill hundreds of thousands of gallons of gas. This resulted in three deaths and a number of injuries due to both the fumes and the ensuing explosion. In addition, there was extensive damage to nearby buildings and infrastructure including the city's water treatment plant which caused the city to have to manually treat water while the plant was rebuilt. In the end, the pipeline operators were held responsible in the ensuing legal proceedings, leading to the first conviction against a pipeline company under the 1979 Hazardous Liquid Pipeline Safety Act.[129]

Pipeline accidents can originate in a number of different ways. According to the Pipeline and Hazardous Materials Safety Administration (PHMSA), some of the most prominent causes of pipeline accidents include: corrosion, excavation damage, incorrect operation, material/weld/equipment failure, natural force damage, and other outside force damage.[130]

Table 61 and **Table 62** describe incidents caused by natural forces for liquid and gas pipelines throughout the United States from 2004 to 2013. Although these tables only include incidents that resulted from

[128] United States Department of Transportation Pipeline and Hazardous Materials Safety Administration, 2015. Hazard Mitigation Planning: Practices for Land Use Planning and Development near Pipelines.

[129] McClary, Daryl C. June 11, 2003. Olympic Pipe Line accident in Bellingham kills three youths on June 10, 1999. Historylink.org

[130] United States Department of Transportation Pipeline and Hazardous Materials Safety Administration, 2015. Hazard Mitigation Planning: Practices for Land Use Planning and Development near Pipelines.

natural causes, the percentage values reflect the percent based on incidents of all types, not just those from natural causes.

TABLE 61: HAZARDOUS LIQUID PIPELINE INCIDENTS CAUSED BY NATURAL FORCES (2004-2013)[131]

Reported Cause of incident	Number of incidents	% of all incidents	Fatalities	Injuries	Property damage	% of property damage from all incidents & causes
Temperature	54	1.5%	0	0	$9,087,167	0.3%
Unspecified Natural Force	35	0.9%	0	0	$326,397	0.0%
Heavy Rains/Floods	31	0.8%	0	0	$205,421,552	8.2%
High Winds	30	0.8%	0	0	$244,985,232	9.8%
Lightning	20	0.5%	0	0	$42,889,182	1.7%
Earth Movement	19	0.5%	0	0	$62,829,034	2.5%
Other Natural Force	4	0.1%	0	0	$581,732	0.0%
Sub Total	**193**	**5.3%**	**0**	**0**	**$566,120,296**	**22.7%**

Source: Oregon Office of State Fire Marshal

TABLE 62: HAZARDOUS GAS PIPELINE INCIDENTS CAUSED BY NATURAL FORCES (2004-2013)[132]

Reported Cause of incident	Number of incidents	% of all incidents	Fatalities	Injuries	Property damage	% of property damage from all incidents & causes
Heavy Rains/Floods	90	7.7%	0	0	$280,235,208	20.5%
Earth Movement	23	1.9%	0	0	$13,424,896	0.9%
Lightning	17	1.4%	0	0	$1,901,676	0.1%
High Winds	14	1.2%	0	0	$108,472,981	7.9%
Temperature	10	0.8%	0	0	$752,059	0.0%
Other Natural Force	5	0.4%	0	0	$4,840,820	0.3%
Sub Total	**159**	**13.6%**	**0**	**0**	**$409,627,640**	**30.0%**

Source: Oregon Office of State Fire Marshal

5.3. Location and Spatial Extent

Pipeline impacts can vary when it comes to people and the environment, ranging from personal injuries such as inhalation of toxins to ecological damage and water contamination. Pipeline incidents can affect

[131] United States Department of Transportation Pipeline and Hazardous Materials Safety Administration, 2015. Hazard Mitigation Planning: Practices for Land Use Planning and Development near Pipelines.

[132] United States Department of Transportation Pipeline and Hazardous Materials Safety Administration, 2015. Hazard Mitigation Planning: Practices for Land Use Planning and Development near Pipelines.

local and regional economies resulting in potential shortages and/or increases in energy costs. A vulnerability assessment of pipeline impacts greatly depends on various factors such as location, severity of incident, environmental factors, proximity to waterways, and infrastructure operation. However, as mentioned above, due to the unavailability of precise location data for pipelines across the county, a thorough analysis of pipeline incidents was not carried out in this plan.

Pipelines are located throughout the state of Oregon and in Multnomah County. Across the state, there are over 416 miles of hazardous liquid line, 2,499 miles of gas transmission gathering lines, and 15,522 miles of gas distribution main lines. In Multnomah County, there are a number of these gas and liquid lines that are for both gathering and transmission.

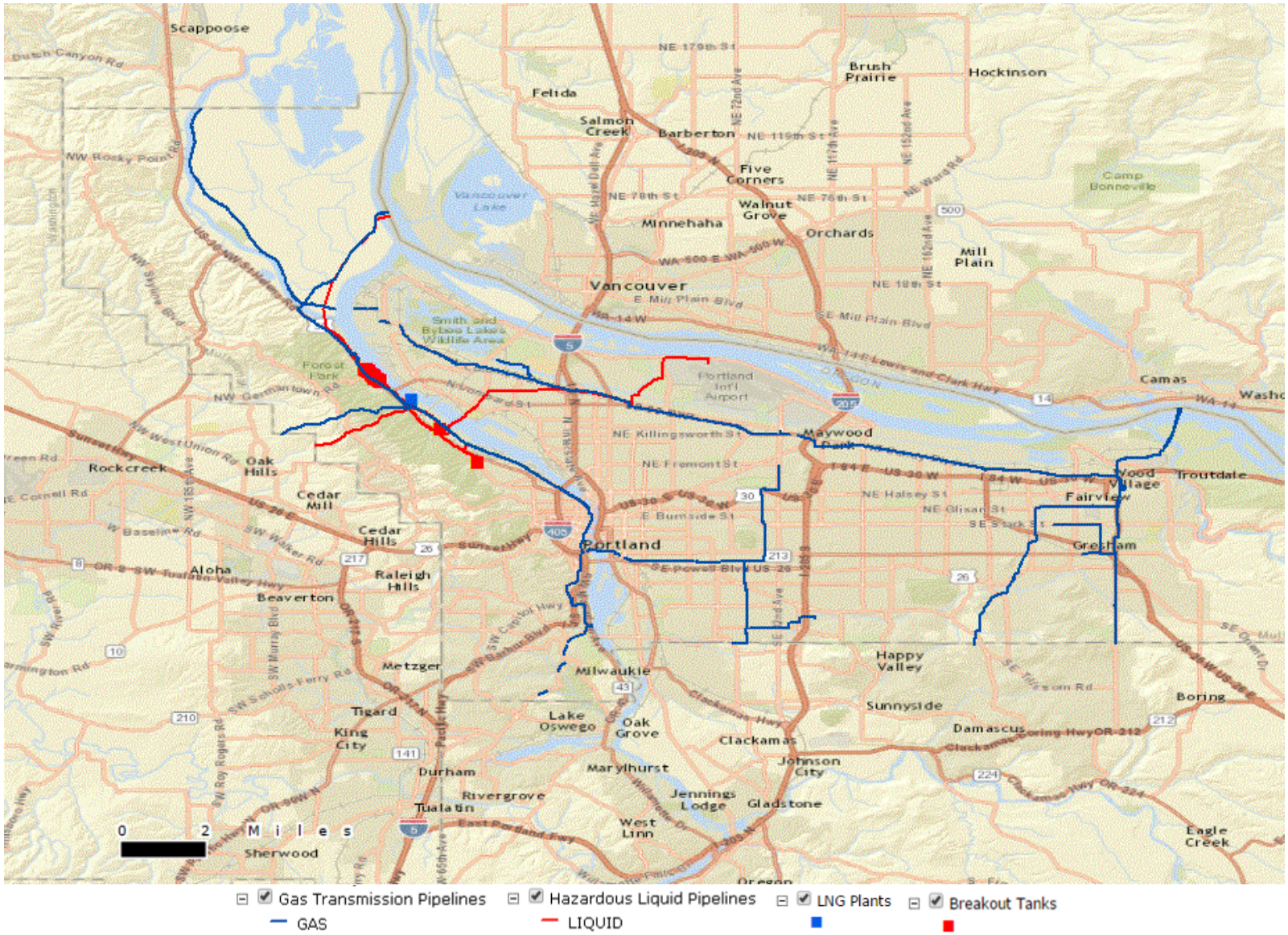
In addition to transmission and gathering lines, it should be noted that Oregon's critical energy infrastructure hub resides in Multnomah County. According to the Oregon State Energy Assurance Plan, a concentration of this infrastructure is located in the heart of the high seismic hazard area along an eight mile stretch of the lower reach of the Willamette River in northwest Portland. This infrastructure includes marine oil terminals, fuel tank farms, liquefied natural gas, natural gas, and power transmission systems. This area acts as a regional crossroads for the transport of fuel and energy via pipelines, rail, shipping, and trucking.[133] The Critical Energy Infrastructure Hub (CEI Hub) sits on top of very poor soils that are highly susceptible to earthquake-induced permanent ground deformation, placing this concentration of key infrastructure at risk of failure.[134]

Figure 33, **Figure 34**, **Figure 35**, and **Figure 36** illustrate the location of several types of pipeline infrastructure including gas transmission lines, hazardous liquid lines, liquefied natural gas (LNG) plants, and breakout tanks.

[133] Portland Local Energy Assurance Plan, June 2012.

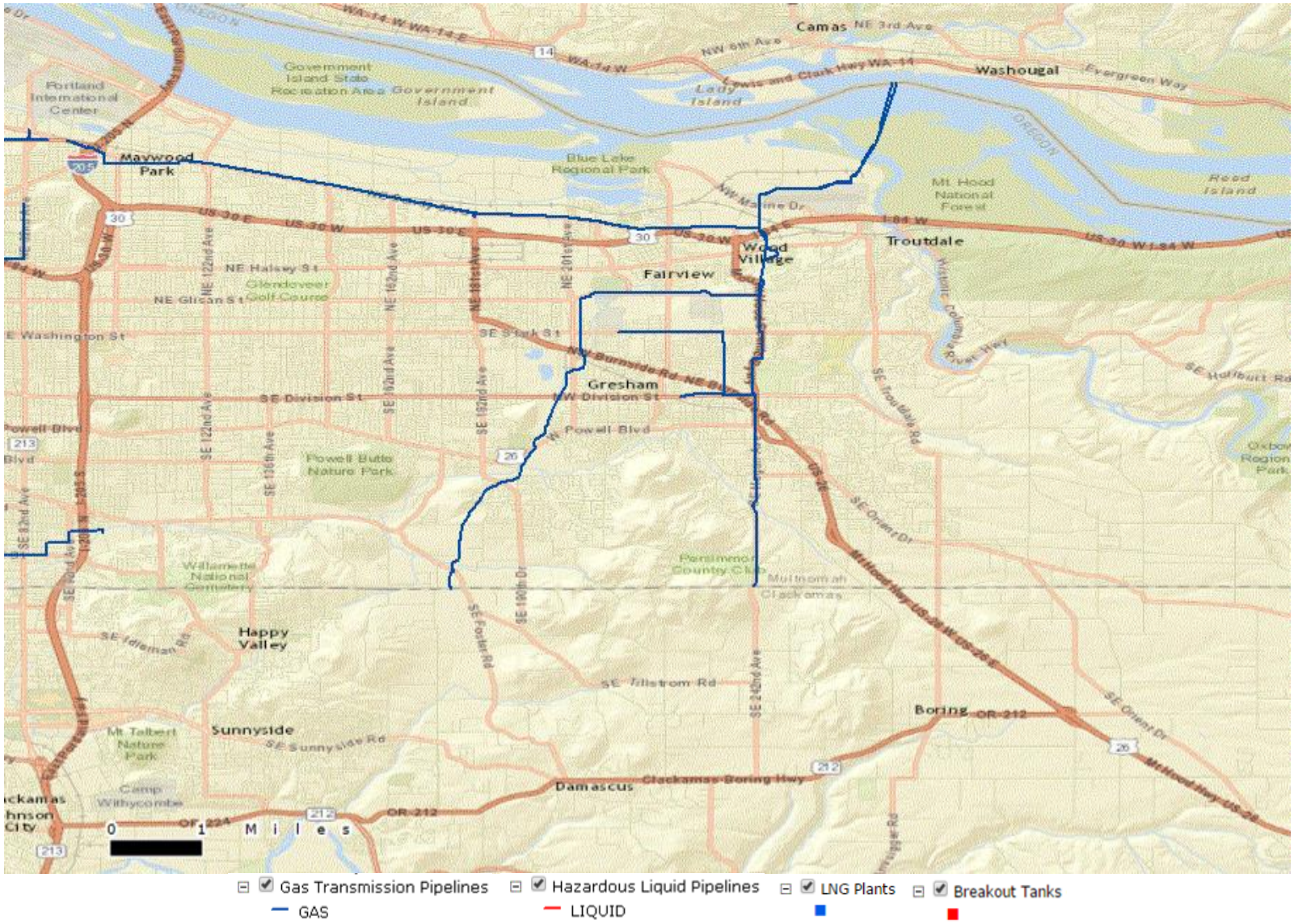
[134] Oregon State Energy Assurance Plan, March 2011.

FIGURE 33: PIPELINES AND CRITICAL ENERGY INFRASTRUCTURE IN MULTNOMAH COUNTY



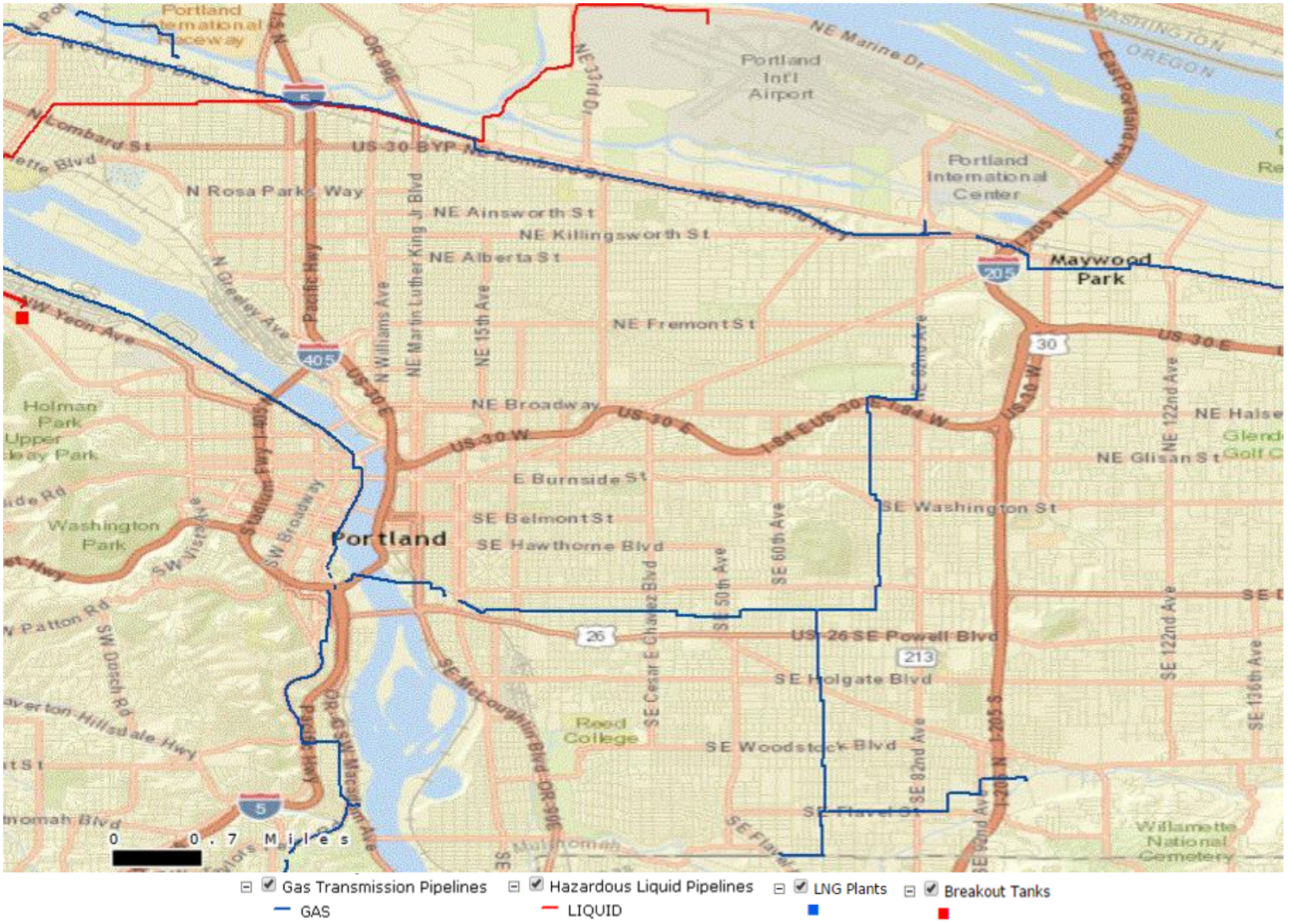
Source: PHMSA

FIGURE 34: PIPELINES AND CRITICAL ENERGY INFRASTRUCTURE IN EASTERN MUNICIPALITIES



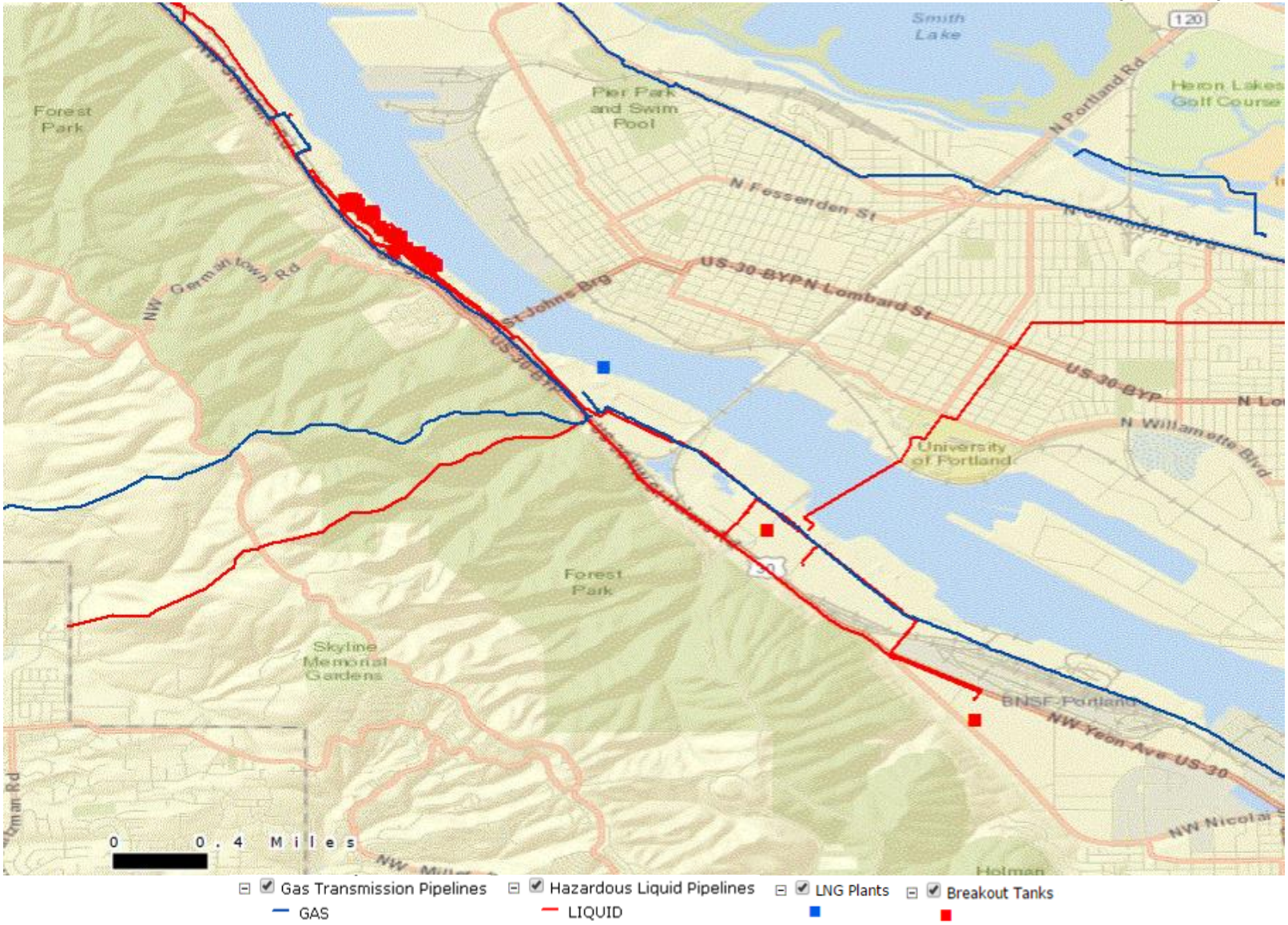
Source: PHMSA

FIGURE 35: PIPELINES AND CRITICAL ENERGY INFRASTRUCTURE IN PORTLAND AREA



Source: PHMSA

FIGURE 36: PIPELINES AND CRITICAL ENERGY INFRASTRUCTURE IN NORTHWEST MULTNOMAH COUNTY (CEI HUB)



Source: PHMSA

5.4. Probability of Future Occurrence

Although there have been few historic incidents to indicate a high likelihood of a pipeline incident occurring, there is some possibility that this type of hazard could occur, especially in conjunction with a major earthquake or other natural disaster. Therefore the probability of future occurrence has been classified as possible.

6. CRITICAL INFRASTRUCTURE FAILURE

6.1. Overview

A Critical Infrastructure Failure can describe many different scenarios in which a component of infrastructure is prevented from carrying out its intended purpose. For example, it could be caused by destruction or damage to the infrastructure or it could be that the service was merely disrupted. One example of this type of failure would be damage to a roadway or bridge that renders the asset no longer passable by motor vehicles.

A failure of infrastructure can be caused by a number of precipitating events including many natural hazards such as earthquakes or flooding. A critical infrastructure failure can also be caused by aging infrastructure that needs to be replaced, or could be human caused through accidental or purposeful damage to the structure.

This type of event can have serious consequences in terms of maintaining daily operations and can create a danger to life and safety if damage to the infrastructure is not repaired in a timely manner or is carried out improperly. There can also be longer term impacts to commerce as a result of restrictions on travel to and from the area or businesses that must be temporarily shut down.

6.2. Historical Occurrences

Although there have not been any major, notable instances of infrastructure failure in the Multnomah County area, there have certainly been past events in other areas of the country. Many of these infrastructure failures resulted from natural hazard events such as earthquakes such as in the case of the Loma Prieta earthquake of 1989 in the San Francisco area. During this event, many components of critical infrastructure failed including a number of transportation structures and other public utilities which experienced catastrophic failure. For example, the Bay Bridge failed and a large section of the Nimitz Freeway in Oakland collapsed.

Although critical infrastructure failures are most often associated with other natural hazard events, some past critical infrastructure failures have resulted from poor construction or old age. For example, in 2007, a large section of I-35W collapsed into the Mississippi River in Minneapolis, Minnesota. This failure was ultimately attributed to a design flaw in the bridge that had been stressed over many years and collapsed under the weight of rush hour traffic.

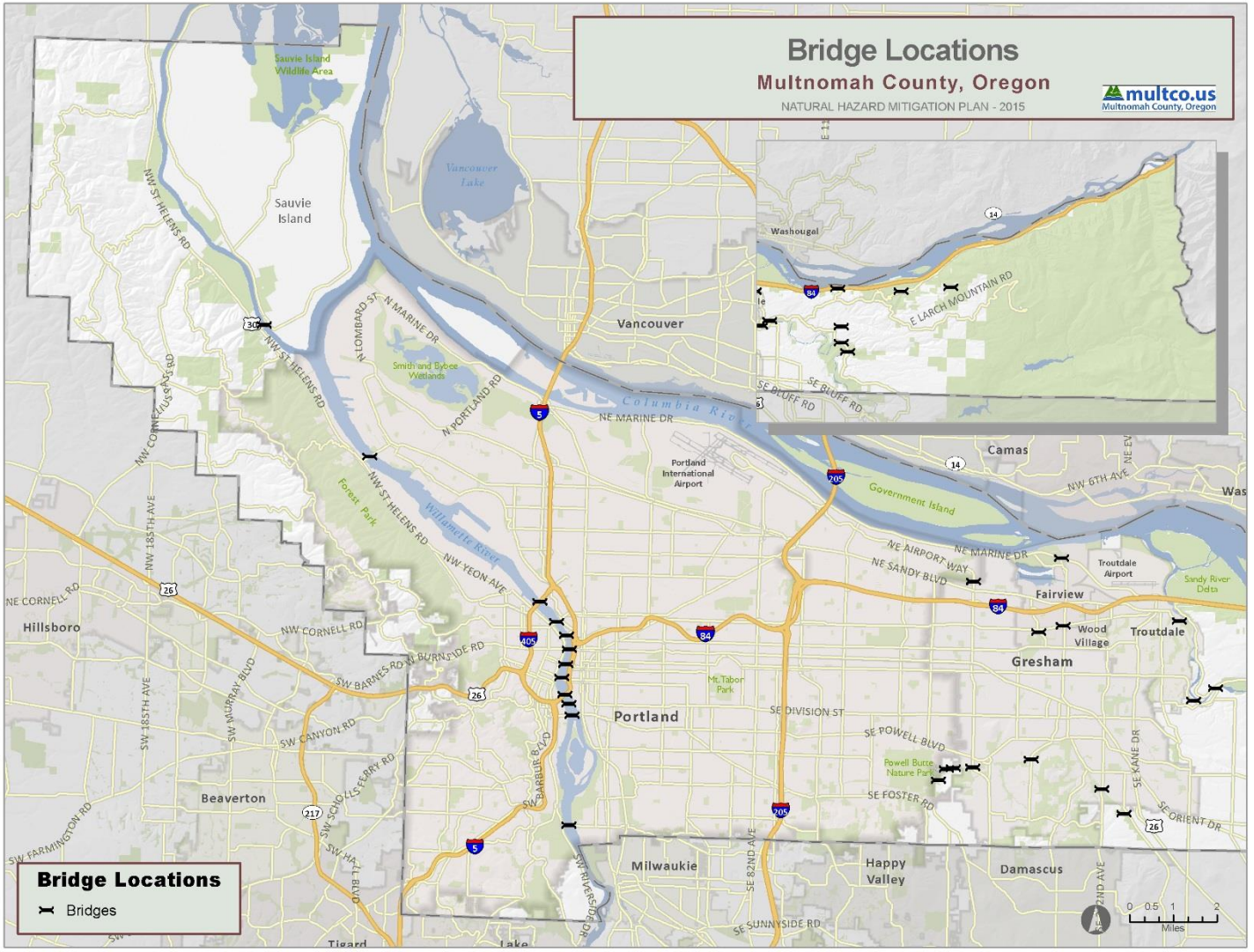
Therefore, while there have not been any incidents of infrastructure failure in Multnomah County that have been noteworthy on a national scale, these events can be unpredictable and the fact that there have been incidents in other parts of the United States should be kept in mind. In addition, local officials have

some understanding of what infrastructure and facilities are more vulnerable to failures that might result from an earthquake event due to poor design or age.

6.3. Location and Spatial Extent

Since there is critical infrastructure located throughout most of the county and the impacts of any infrastructure failure will be widespread, the entire county is considered susceptible to this hazard. Although this report does not go in to detail on the location of every type of critical infrastructure, this may be carried out in future updates of the report. **Figure 37** shows an example of one type of critical infrastructure by identifying the location of county-maintained bridges throughout the county. Similar information for other types of critical infrastructure may be added in the future.

FIGURE 37: BRIDGE LOCATIONS IN MULTNOMAH COUNTY



Source: Multnomah County GIS

6.4. Probability of Future Occurrence

Although there have been a limited number of major infrastructure failures in the past in Multnomah County, evidence from other areas of the country suggests that an infrastructure failure could occur at any time. Some of these failures may result from natural hazards, such as earthquakes, which can have major impacts. Based on the likelihood of an earthquake event occurring, which would be the most likely cause of a critical infrastructure failure, there is a high probability that the county will be impacted by a major critical infrastructure failure in the future.

7. UTILITY INTERRUPTION/FAILURE

7.1. Overview

There are a number of different types of utility failure that can cause an interruption to the daily lives of citizens and normal government operations. Among these are failures of water/sewer systems, gas lines, and electricity/power systems. A long-term outage of any of these systems would present significant challenges, though each of these would have different impacts on the public and may be the result of different precipitating events. This report focuses on power system interruptions/failures, though other utility system failures may be evaluated in future updates.

For example, a failure in the power distribution network can happen for varying reasons. Some possible examples include the physical failure of power lines due to other hazards such as ice or wind events, or it may be the result of problems within the network itself including faults at a power station, shorts or overloading in a circuit(s), or physical damages at a substation.

There are three different types of power outages - transient faults, brownouts, and blackouts. A transient fault is a brief outage caused by a fault in a power line. The issue is corrected when the power flow clears the faulty part of the circuit, and power is returned. A brownout occurs when voltage falls to an inadequate level. A blackout occurs when there is a complete loss in the power supply. Blackouts are generally longer lasting outages than the previous two examples and may involve significant repairs. These outages can range from minutes to weeks or more depending on the significance of the failure in the network.

According to the Oregon Energy Assurance Plan, the vulnerability of energy facilities and systems across the petroleum, electricity, and natural gas sectors vary to a great extent. Some facilities have infrastructure that is over 100 years old and which was built using antiquated standards, while others have new infrastructure that has been built to the current state-of-practice standards. Because of this wide range of ages and associated construction practices, the seismic vulnerability of the facilities also spans a wide range.

All of the facilities in the CEI Hub are considered vulnerable to seismic hazards. As explained in the Portland Local Energy Assurance Plan (LEAP), ground shaking from a magnitude 8 or 9 Cascadia Subduction Zone earthquake would make the NW Industrial Area susceptible to earthquake-induced liquefaction, lateral spreading and landslides. Secondary seismic hazards including destructive fires and hazardous material releases may also be triggered by an earthquake.[135]

[135] Portland Local Energy Assurance Plan, June 2012.

7.2. Historical Occurrences

Earthquakes and severe weather pose the highest threat in terms of long term utility interruption and/or failure. Multnomah County faces danger from two types of earthquakes. They include Crustal earthquakes and the Cascadia Subduction Zone earthquakes. Both types could produce widespread damage and have potentially significant consequences.[136]

In addition, many power outages that have occurred in Multnomah County have been due to other natural hazards such as winter storms. One recent example that caused widespread power outages in Multnomah County was in December 1996. During these types of events, ice accumulation can cause branches, trees, and power lines to break or fall, ultimately creating power disruptions or outages. Power outages can vary depending on the amount of precipitation, its location, and its form. Many of the natural hazards discussed in the Multnomah County Multi-Jurisdictional NHMP, including high wind events and winter weather, could potentially cause a long term power outage and a full list of historic events can be found in the main body of the plan.

It should also be noted that power outages can result from non-weather-related events. Recently in December 2013, the Portland downtown core experienced a power outage for several days causing several business and government buildings to shut down. The outage was caused by a fire in the vaults underneath downtown Portland and affected several blocks. A larger example, in 2003, was the Northeast Blackout that demonstrated how large networks that serve many customers are potentially vulnerable to widespread outages. During this event, an estimated 55 million people were without power after a critical failure in the network. Many power plants in Ontario, Canada and the Northeast went offline and there was no single cause that could be attributed to this incident. Instead, several issues led to a cascading failure. In short, overload protection could not isolate a small problem in the system and stop it from affecting other parts of the system, leading to larger scale effects throughout the area.

7.3. Location and Spatial Extent

Due to the unpredictable nature of where exactly a power or utility outage will occur, the entire county is considered to be susceptible to this hazard. However, in areas where power lines are located underground, there will likely be a significantly reduced threat of power outage, especially from high wind and winter storm events.

[136] Oregon State Energy Assurance Plan, March 2011.

7.4. Probability of Future Occurrence

Based on the high number of outages that have occurred in past years according to the Multnomah County Hazard Multi-Jurisdictional NHMP, the probability of a power or utility failure is considered high in the future.

8. TERRORISM

8.1. Overview

Terrorism is defined in the United States by the Code of Federal Regulations as: "the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives."[137] Academic literature identifies some overarching political goals that terrorism seeks to achieve, including spreading anxiety and alarm among immediate victims, families, and the general public; eliminating opponents and destroying symbolic targets; and generating direct damage on society, such as affecting business confidence.

There are two general types of terrorist groups: network and hierarchical. The type of organization a group adopts largely depends on how long the group has existed. More recently developed groups tend to organize or adapt to the possibilities of the network model. Older, more established groups lean toward the hierarchical structure and are often more associated with violence of a political nature.[138] Terrorist acts can be committed by large, formally organized groups with terrorist cells in different parts of the world, or they can originate from smaller groups or individuals from a small city or domestic "homegrown" location. In the United States, terrorists that are "homegrown" do not belong to a defined group, may operate very effectively "under the radar," and may pose the biggest threat initially at the local level.[139]

8.2. Historical Occurrences

Perhaps the most notable terrorist incident in recent memory was the attacks on the World Trade Center and Pentagon on September 11, 2001. These events resulted in more than an estimated 3,000 deaths and caused destruction of many buildings including both of the World Trade Center buildings. Prior to this, in 1995, the bombing of the federal office building in Oklahoma City was one of the most devastating attacks on U.S. soil, causing more than 150 deaths and damage to more than 200 buildings.

Because of Oregon's key role in international commerce and U.S. border security, numerous investigations into potential terrorist threats have been conducted by the Portland Division of the Federal Bureau of Investigation (FBI). One of the most serious threats involved a group of Americans who sought to join international terrorists in attacking the United States. In 2002, following an extensive Portland Division investigation later named the "Portland Seven" case, a federal grand jury indicted five men with Portland ties on charges that they planned to travel to Afghanistan to wage war against U.S. troops. An additional

[137] U.S. Code of Federal Regulations. 23 C.F.R. Section 0.85

[138] Terrorism Research. *Terrorist groups*. Retrieved December 27, 2011, from http://www.terrorism-research.com/groups/

[139] *Ibid*.

person was indicted on money laundering charges related to the conspiracy and a seventh subject was picked up as a material witness and later charged in the case.[140]

8.3. Location and Spatial Extent

A terror threat could potentially occur at any location in the county. However, the very definition of a terrorist event indicates that it is most likely to be targeted at a critical or symbolic resource/location/event. Ensuring and protecting the continuity of critical infrastructure and key resources (CIKR) of the United States is essential to the Nation's security, public health and safety, economic vitality, and way of life. CIKR includes physical and/or virtual systems or assets that, if damaged, would have a detrimental impact on national security, including large-scale human casualties, property destruction, economic disruption, and significant damage to morale and public confidence. **Table 63** lists the U.S. Department of Homeland Security's (DHS) identified main critical infrastructure sectors.

TABLE 63: U.S. DEPARTMENT OF HOMELAND SECURITY CRITICAL INFRASTRUCTURE SECTORS

- Agriculture and Food
- Banking and Finance
- Chemical
- Commercial Facilities
- Communications
- Critical Manufacturing
- Dams
- Defense Industrial Base
- Emergency Services
- Energy
- Government Facilities
- Healthcare and Public Health
- Information Technology
- National Monuments and Icons
- Nuclear Reactors, Materials, and Waste
- Postal and Shipping
- Transportation Systems
- Water

8.4. Probability of Future Occurrences

Multnomah County has had no recorded major terrorist events. However, since Portland is the largest city in Oregon and it is home to many government complexes, notable structures, and significant landmarks, there is a possibility that a terrorist incident might occur. Due to few recorded incidents against the county, the probability of future occurrences of a terrorist attack may be low but would require more classified information to be determined.

9. WORKPLACE/SCHOOL/UNIVERSITY VIOLENCE

9.1 Overview

Workplace/school/university violence can be a devastating event in the community because these sometimes violent events often result in injuries or deaths and have a strong, negative impact on the

[140] Federal Bureau of Investigation. Portland Division. A Brief History. https://www.fbi.gov/portland/about-us/history-1

emotions of the internal sub-community in which they occur. Although this type of event is primarily thought of as physical, violence can also come in the form of oral or written threats against a person.

In any case, violence at education centers and places of work is extremely detrimental to the community and the people who learn and work in this location. Whether the threat is from an active shooter or from a threat that a student makes towards another student, this type of action has consequences on the well-being of the community overall.

9.2. Historical Occurrences

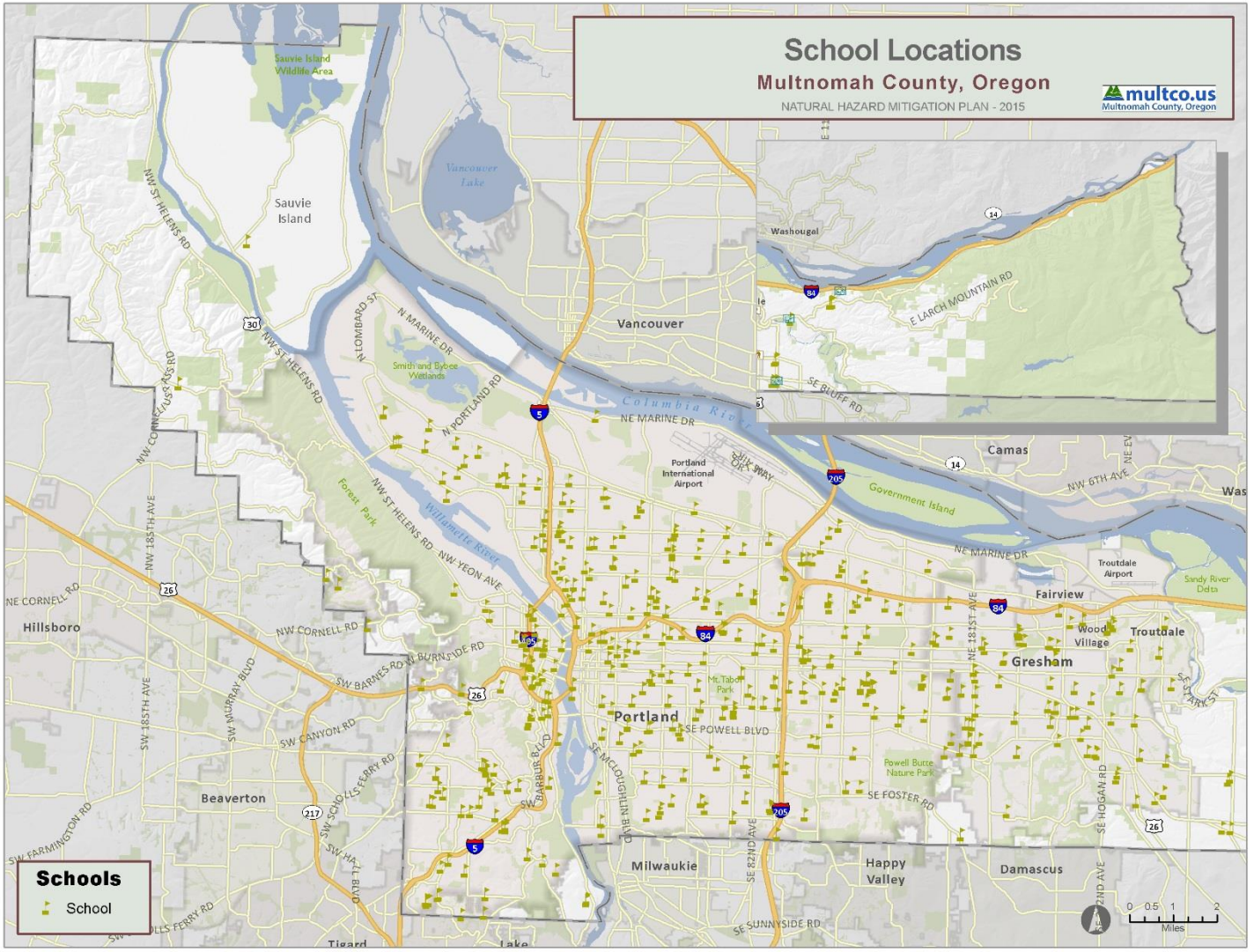
There have been some incidents of school/workplace violence in Multnomah County in the past. Though these incidents have not had as much national attention as some of the larger scale incidents in places like Newtown, Connecticut or Columbine, Colorado, they are indicative of the fact that school and workplace violence can occur anywhere. The effects of these incidents on communities can be devastating due to their sudden and unpredictable occurrence.

Recent examples of violence occurred in Multnomah County involving firearms at or near school campuses. One was in December of 2014 when a man fired shots at several high school students in Portland, injuring four of them. Another recent incident occurred in June of 2014 when a gunman who was a student at a school in Troutdale shot and killed another student and then took his own life.
There have also been several other incidents that occurred outside of Multnomah County, but within the Portland Metro Region. In November 2009, a man began firing into the Legacy Metrolab in Tualatin, Oregon, his wife's place of employment after she filed for divorce one week earlier. His wife was killed and two others were wounded. The shooter committed suicide before the police arrived. Additionally, in December 2012, a man began shooting at people waiting to see Santa Claus in the Clackamas Town Center Mall in Happy Valley, Oregon. Two people were killed and one was wounded. The shooter committed suicide before police arrived.

9.3. Location and Spatial Extent

Workplace/school/university violence can occur in many locations throughout the county, but by definition, it will take place in a work or school location. Because workplaces are prevalent throughout the county, an exact spatial location is not available. School locations are identified in **Figure 38**. However, it should be noted that this type of violence can occur countywide.

FIGURE 38: PRIMARY AND SECONDARY SCHOOL LOCATIONS IN MULTNOMAH COUNTY (PUBLIC AND PRIVATE)



Source: Oregon Department of Education Open Institution List

9.4. Probability of Future Occurrence

There have been few occurrences of this type of violence in Multnomah County, but these types of events are often unpredictable, so the probability of future occurrences is possible. Between 2009 and 2014, there have been five incidents of workplace/school violence in and around Multnomah County, so on average there has been one incident per year. Based on this figure, the county can reasonably expect and should prepare for additional incidents to occur.

10. FUEL/RESOURCE SHORTAGE

10.1. Overview

Without critical resources, the public's way of life can be significantly impacted. Water, electricity, and fuel are among the most critical resources and are also subject to failures and supply problems. Power outages were addressed in the Utility Interruption/Failure section, so this section will primarily address water and fuel shortages.

Petroleum fuel is also a limited resource that is used for a number of different purposes. Petroleum alone makes up about 40% of the total energy consumption in the United States.[141] Shortages of fuel can cause major interruptions to regular activities and commerce of the area. Often, difficult decisions must be made to maintain levels of service within the government, such as first response capabilities. Rationing or the elimination of nonessential activities is often necessary to maintain these functions and preserve life and safety.

In Multnomah County, a resource shortage that results from an earthquake may have the most prominent impacts. Fuel and water storage and transmission lines may rupture during an earthquake event, causing a loss of service. This may lead to long term unavailability of resources through traditional transmission systems, requiring government officials to find other ways to provide these resources to citizens.

To address potential future concerns regarding fuel shortages, the Oregon Department of Energy maintains an Oregon Petroleum Emergency Preparedness Plan which outlines the priorities for fuel consumption and describes how continuity of operations would be maintained in the event of a fuel crisis.

10.2. Historical Occurrences

Probably the most memorable fuel shortage situation in the area occurred during the OPEC fuel crisis in 1973 and 1974. Some gas stations implemented limits on refueling which showed how the geopolitical climate can have a significant impact on the supply of fuel in the United States.

10.3. Location and Spatial Extent

Since a water or fuel shortage would impact the entire county when it occurs, the location of this hazard is considered to be countywide.

[141] The National Academy of Sciences, *What You Need to Know About Energy – Supply and Demand*, http://www.nap.edu/reports/energy/supply.html

10.4. Probability of Future Occurrence

Water shortages are becoming more common in the western U.S. as many areas are experiencing severe drought conditions. However, Multnomah County has not yet had to deal with a major shortage of water supplies due to drought since most of the population is provided for by the Bull Run Watershed as a primary source and ground water as a secondary source. Fuel shortages have impacted the county, notably during the 1970s oil crisis, and could occur again. Major resource shortages are most likely to occur due to impacts from a Cascadia Subduction Zone Earthquake damaging critical infrastructure. Due to this concern, the probability of future occurrences is likely.

11. FINAL DETERMINATIONS

The results of this analysis are useful in at least three ways:

- Improving our understanding of the risk associated with the human-caused hazards in Multnomah County through better understanding of the complexities and dynamics of risk, how levels of risk can be measured and compared, and the myriad of factors that influence risk. An understanding of these relationships is critical in making balanced and informed decisions on managing the risk.
- Providing a baseline for policy development and comparison of mitigation alternatives. The data used for this analysis presents a current picture of risk in Multnomah County. Updating this risk "snapshot" with future data will enable comparison of the changes in risk with time. Baselines of this type can support the objective analysis of policy and program options for risk reduction in the region.
- Comparing the risk among the hazards addressed. The ability to compare the risk to all these hazards relative to one another helps in a balanced, multi-hazard approach to risk management at each level of governing authority. This final step in the risk assessment provides the necessary information for local officials to craft a strategy to focus resources on those hazards that pose the most threat to Multnomah County and its municipalities.

The conclusions drawn from the hazard profiling process and analysis for Multnomah County should provide useful information to local officials making decisions about the threats they face from human-caused hazards. This information can help local officials better understand what hazards they face and provide more detailed data on what people and property are at the greatest risk of being impacted.

Notably, an in-depth analysis of the hazardous materials-related hazards in this plan has provided a basis for understanding potential impact areas from various types of hazardous materials incidents that might occur in the county. These potential impact areas can be used for identifying areas in need of additional evacuation planning or which may require additional public outreach to inform residents and businesses of their potential risk.

As noted previously, all existing and future buildings and populations (including critical facilities) are vulnerable to some of the identified hazards including Transportation Incident, Critical Infrastructure Failure, Utility Interruption/Failure, Terrorism, Workplace/School/University Violence, and Fuel/Resource Shortage. **Table 64** shows the critical facilities vulnerable to the hazards analyzed in this section. The table lists those assets that are determined to be exposed to each of the identified hazards (marked with an "**X**").

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TABLE 64: AT-RISK CRITICAL FACILITIES IN MULTNOMAH COUNTY

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Fairview									
207th Avenue Bridge	Bridge		X	X	X	X	X		X
223rd/Marine Drive Overpass	Bridge	X	X	X	X		X		
Halsey Street Box Culvert	Bridge	X	X	X	X	X	X		X
La Petite Academy - Fairview	Childcare Facility	X	X		X		X		
Fairview City Hall	City Hall		X		X		X		
Fairview Community Center	Community Center	X	X	X	X	X	X		X
Fairview Library	County Asset		X		X		X		
River Patrol Chinook Landing	County Asset		X	X	X		X		
River Patrol Chinook Landing Boathouse	County Asset		X	X	X		X		
River Patrol Chinook Landing Garage	County Asset		X	X	X		X		
Fairview Police Department	Law Enforcement		X		X		X		
Fairview-Columbia Library	Library		X		X	X	X		X
La Petite Academy of Fairview	School- Private	X	X		X		X		
MHCC Head Start-Fairview Site	School- Private	X	X	X	X	X	X	X	X
Fairview Elementary	School- Public	X	X	X	X	X	X	X	X
MESD Program at Reynolds MS	School- Public		X		X	X	X		X
MESD Program at Woodland Elementary	School- Public		X		X		X		
Multisensory Learning Academy	School- Public	X	X	X	X	X	X		X

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Reynolds Learning Academy	School- Public	X	X	X	X	X	X		X
Reynolds Middle	School- Public	X	X		X		X		
Reynolds SD 7	School- Public		X		X		X		
Salish Ponds Elementary	School- Public		X		X		X		
Woodland Elementary	School- Public		X		X		X		
Gresham									
209th/Towle Av Bridge	Bridge			X	X				
242nd/Hogan Road Bridge	Bridge			X	X				
Highland Road Bridge	Bridge			X	X				
A Step Above The Rest	Childcare Facility			X	X				
Ascension Early Childhood Center	Childcare Facility			X	X				
Champions - Butler Creek	Childcare Facility								
Champions - Hall	Childcare Facility	X	X	X	X				
Champions - Highland	Childcare Facility		X	X	X				
Champions - Hogan Cedars	Childcare Facility			X	X				
Champions - Hollydale	Childcare Facility			X	X				
Champions - North Gresham	Childcare Facility		X	X	X				
Champions - Powell Valley	Childcare Facility				X				
Champions - West Gresham	Childcare Facility			X	X				
Children’s Learning Center-Powell	Childcare Facility			X	X				
Children's World-Hogan	Childcare Facility		X	X	X				
Children's World-NE 181st	Childcare Facility		X	X	X	X	X		

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Discovery Preschool EHC	Childcare Facility			X	X				
Discovery Preschool Kindergarten-CC	Childcare Facility			X	X				
Eastside Christian School	Childcare Facility		X	X	X				
Goodman Family Childcare	Childcare Facility		X	X	X				
Gresham Heights Learning Center	Childcare Facility			X	X				
Gresham Montessori Center	Childcare Facility			X	X				
Heidi Ho Rockwood DC Inc	Childcare Facility		X	X	X		X		
Highland Community Church Preschool	Childcare Facility			X	X				
Kellie's Daycare	Childcare Facility								
Kiddie Koop	Childcare Facility			X	X				
Kids And Company-Powell Valley After Pro	Childcare Facility				X				
Kindercare - Division	Childcare Facility		X	X	X				
Kindercare Learning Center-Hogan Drive	Childcare Facility		X	X	X				
Kindercare Learning Center-NE 181st Ave	Childcare Facility		X	X	X	X	X		
Kindercare-Division	Childcare Facility			X	X				
King's Kids Adventist PSC	Childcare Facility			X	X				
Learning Tree- Highland Powell	Childcare Facility			X	X				
Little Friends Day School	Childcare Facility			X	X				
Love Bug Daycare	Childcare Facility			X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Morningstar Montessori House Of Children	Childcare Facility			X	X				
Mt Hood Christian Activity Center	Childcare Facility			X	X				
Mt Hood Comm Clg Head Start-Kellys PLC	Childcare Facility			X	X				
Mt Hood Community College Child Development	Childcare Facility	X	X		X				
New Beginnings Child Development Center	Childcare Facility	X	X	X	X	X	X	X	X
Oregon Child Development Center-Anderson	Childcare Facility			X	X				
Pilgrim Christian D.C.	Childcare Facility			X	X				
Portland Luth. Ext Care	Childcare Facility			X	X				
Small World Learning Ctr	Childcare Facility		X		X				
Stepping Stone Day School Center Inc	Childcare Facility			X	X				
Tinker Tots Childcare	Childcare Facility	X	X	X	X				
Trinity Lutheran Ctr	Childcare Facility			X	X				
United Methodist Preschool	Childcare Facility			X	X				
YMCA - Portland Lutheran	Childcare Facility			X	X				
YMCA - Wilkes Elementary	Childcare Facility	X	X	X	X	X	X	X	X
Gresham City Hall	City Hall		X	X	X				
GSI Community Center	Community Center		X	X	X				
Centennial High School	County Asset		X	X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Columbia Gorge Corporate Center	County Asset	X	X	X	X	X	X	X	X
East County Courthouse	County Asset			X	X				
East County Office Building	County Asset		X	X	X				
Gresham District Court	County Asset			X	X				
Gresham Library	County Asset			X	X				
Gresham Probation	County Asset			X	X				
John B Yeon Annex	County Asset		X	X	X				
John B Yeon Facility	County Asset		X	X	X				
Multnomah County East	County Asset			X	X				
Rockwood Community Health Center	County Asset			X	X				
Rockwood Fred Meyer Retail Development	County Asset		X	X	X				
Rockwood Library	County Asset			X	X				
Vance Crusher Pump House	County Asset			X	X				
Vance Crusher Road Shop	County Asset			X	X				
Vance Crusher Storage Building	County Asset			X	X				
Yeon Car Wash	County Asset		X	X	X				
Yeon Gas Station	County Asset		X	X	X				
Gresham Fire & Emerg Srvcs 71	Fire Station		X	X	X				
Gresham Fire & Emerg Srvcs 72	Fire Station		X		X				
Gresham Fire & Emerg Srvcs 73	Fire Station				X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Gresham Fire & Emerg Srvcs 74	Fire Station		X	X	X	X	X		X
Legacy Mount Hood	Hospital		X	X	X				
Gresham Police Department	Law Enforcement		X	X	X				
Gresham Police Dept	Law Enforcement		X	X	X				
Gresham Library	Library			X	X				
Rockwood Library	Library			X	X				
Comfort Hospice And Palliative Care LLC	Licensed Medical Facility		X	X	X		X		
FMC Dialysis Services Of Mt Hood	Licensed Medical Facility		X		X				
Good Samaritan Society - Services At Home	Licensed Medical Facility	X	X		X				
US Renal Care Gresham Dialysis	Licensed Medical Facility			X	X				
Visiting Angels	Licensed Medical Facility			X	X				
Alterra Wynwood Of Mt. Hood	Residential Care Facility		X	X	X				
Chestnut Lane Assisted Living Community	Residential Care Facility		X	X	X				
Courtyard Fountains	Residential Care Facility		X	X	X				
Encore Senior Village At Portland	Residential Care Facility			X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Encore Senior Village Retirement	Residential Care Facility			X	X				
Fairlawn Good Samaritan Village And Health Center	Residential Care Facility	X	X		X				
Fairlawn Good Samaritan Village Retirement	Residential Care Facility	X	X		X				
Farmington Square	Residential Care Facility		X	X	X				
Farmington Square - Gresham	Residential Care Facility		X	X	X				
Good Samaritan Society - Fairlawn Village	Residential Care Facility	X	X		X				
Good Samaritan Society-Fairlawn Village	Residential Care Facility	X	X		X				
Gresham Manor Retirement	Residential Care Facility		X	X	X				
Gresham Rehab & Specialty Care	Residential Care Facility			X	X				
Gresham Rehab And Specialty Care	Residential Care Facility			X	X				
Huntington Terrace	Residential Care Facility		X	X	X				
Huntington Terrace Assisted Living Residence	Residential Care Facility		X	X	X				
Marquis Care At Centennial	Residential Care Facility		X	X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Marquis Care Centennial	Residential Care Facility		X	X	X				
Mattie Younkin Manor Retirement	Residential Care Facility		X	X	X				
Oharas Manor Inc	Residential Care Facility			X	X				
Pacific Gardens Alzheimers Special Cre Ctr	Residential Care Facility		X	X	X		X		
Powell Valley Asstd Living-Memory Care	Residential Care Facility			X	X				
Powell Valley Memory Care Community	Residential Care Facility			X	X				
Powell Vista Manor Retirement	Residential Care Facility			X	X				
Regency Gresham Nursing & Rehabilitation Center	Residential Care Facility				X				
Regency Gresham Rehabilitation-Nursing	Residential Care Facility				X				
Silvia & John's Residential Care	Residential Care Facility		X	X	X				
The Village Retirement Center	Residential Care Facility		X	X	X				
Villa North Retirement Center	Residential Care Facility		X	X	X				
Village Health Care	Residential Care Facility			X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Village Health Care I LLC	Residential Care Facility			X	X				
Wynwood-Mt Hood Retirement	Residential Care Facility		X	X	X				
Apostolic Christian Academy	School- Private		X	X	X		X		
Ascension Early Childhood	School- Private			X	X				
Eastside Christian School	School- Private		X	X	X				
Gresham Heights Learning Center	School- Private			X	X				
Gresham United Methodist Preschool	School- Private			X	X				
Highland Community Preschool	School- Private			X	X				
Kindercare Learning Centers, Gresham	School- Private		X	X	X				
MHCC Head Start-Kelly Place Site	School- Private			X	X				
MHCC Head Start-Mt. Hood Site	School- Private	X	X		X				
Phonics Phactory	School- Private			X	X				
Portland Adventist Elementary	School- Private			X	X				
Portland Lutheran	School- Private			X	X				
Rosemary Anderson High -East Campus	School- Private			X	X				
SOAR Academy	School- Private		X	X	X				
The Phonics Phactory	School- Private	X	X		X				
Adult Living Program	School- Public		X	X	X				
Alpha High	School- Public		X	X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Butler Creek Elementary	School- Public								
Centennial High	School- Public		X	X	X				
Centennial Learning Center	School- Public			X	X				
Centennial Middle	School- Public		X	X	X				
Centennial School District 28j	School- Public			X	X				
Center For Advanced Learning	School- Public		X	X	X				
Clear Creek Middle	School- Public	X	X		X				
Davis Elementary	School- Public		X	X	X		X		
Dexter McCarty Middle	School- Public			X	X				
East Gresham Elementary	School- Public			X	X				
Gordon Russell Middle	School- Public		X	X	X				
Gresham Arthur Academy	School- Public			X	X				
Gresham High	School- Public			X	X				
Gresham-Barlow SD 10j	School- Public		X	X	X				
Gresham-Barlow Web Academy	School- Public			X	X				
Hall Elementary	School- Public	X	X	X	X				
Hartley Elementary	School- Public		X	X	X	X	X		
Hauton B Lee Middle	School- Public		X		X	X	X		
Highland Elementary	School- Public		X	X	X				
Hogan Cedars Elementary	School- Public			X	X				
Hollydale Elementary	School- Public			X	X				
Kelly Creek Elementary	School- Public			X	X				

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Kerr Youth & Family Center DTP	School- Public		X		X		X		
Kerr Youth Center/Wynne Watts School	School- Public		X		X		X		
KNOVA Learning School	School- Public		X	X	X				
Lynch Meadows Elementary	School- Public			X	X				
MESD Program At Centennial HS	School- Public		X	X	X				
MESD Program At Davis Elementary	School- Public		X	X	X		X		
MESD Program At Kelly Creek Elementary	School- Public			X	X				
Mt. Hood Community College	School- Public	X	X		X				
North Gresham Elementary	School- Public		X	X	X				
Oregon Child Development Coalition Of MC	School- Public			X	X				
Pathways Community School	School- Public			X	X				
Powell Valley Elementary	School- Public				X				
Springwater Trail High	School- Public			X	X				
West Gresham Elementary	School- Public			X	X				
Wilkes Elementary	School- Public	X	X	X	X	X	X	X	X
77 Dollar Urgent Care	Urgent Care Center		X	X	X				
Gohealth Urgent Care - Fairview	Urgent Care Center	X	X		X		X		
Gohealth Urgent Care - Gresham	Urgent Care Center		X	X	X				
Lake Oswego									

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PCC Sylvania Child Dev Center	Childcare Facility				X				
Sonshine Express Preschool And Kindergar	Childcare Facility								
Alternative Services Oregon Inc.	School- Private				X				
Kindercare	School- Private								
Sonshine Express Preschool MPC	School- Private								
Student Visions	School- Private				X				
Maywood Park									
Headstart-Knott Center	Childcare Facility		X	X	X	X	X		X
Theodore Bear Day Care	Childcare Facility		X	X	X	X	X		X
Maywood Park City Hall	City Hall		X	X	X	X	X		X
MHCC Maywood Campus	School- Public		X	X	X	X	X		X
Mt. Hood Community College Head Start	School- Public		X	X	X	X	X		X
Portland									
Portland International Airport	Airport			X	X				
American Medical Response Northwest	Ambulance Service		X	X	X	X	X	X	X
American Medical Response-Multnomah Co	Ambulance Service		X	X	X	X	X	X	X
Community Ambulance	Ambulance Service		X	X	X		X		
Portland Fire And Rescue-EMS	Ambulance Service		X	X	X	X	X	X	X
Airport Way Bridge	Bridge	X	X	X	X	X	X	X	X

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Broadway Bridge	Bridge	X	X	X	X	X	X	X	X
Burnside Bridge	Bridge		X	X	X	X	X	X	X
Circle Avenue Bridge #1	Bridge		X	X	X				
Fremont Bridge	Bridge		X	X	X	X	X		X
Hawthorne Bridge	Bridge		X	X	X	X	X		X
Marquam Bridge	Bridge		X	X	X	X	X		X
Morrison Bridge	Bridge		X	X	X	X	X		X
Ross Island Bridge	Bridge	X	X	X	X	X	X		X
Sellwood Bridge	Bridge				X	X	X		
St. Johns Bridge	Bridge		X	X	X	X	X	X	X
Steel Bridge RR	Bridge	X	X	X	X	X	X	X	X
Tilikum Crossing Bridge	Bridge	X	X	X	X	X	X		X
A Mothers Love Childcare	Childcare Facility	X	X	X	X	X	X		X
ABC & 123 Day Care	Childcare Facility		X	X	X	X	X		X
ABC Kids Childcare And Preschool	Childcare Facility		X	X	X				
ABC University Preschool At Linnton Comm	Childcare Facility			X	X	X	X	X	X
Active Learning Center	Childcare Facility								
Adventure Camp/After Bell	Childcare Facility	X	X	X	X	X	X	X	X
Ainsworth After School Association	Childcare Facility		X	X	X				
Airport Learning Tree	Childcare Facility		X	X	X		X		

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Alameda Beaumont Childcare	Childcare Facility								
Alberta Early Learning Community	Childcare Facility								
Albina Brooklyn	Childcare Facility		X		X		X		
Albina Carlton Court Head Start	Childcare Facility			X	X	X	X		X
Albina Early Head Start - University Park	Childcare Facility	X	X		X	X	X	X	X
Albina Early Head Start-Infant Room	Childcare Facility		X	X	X		X		
Albina Early Head Start-Normandale	Childcare Facility			X	X	X	X	X	X
Albina Head Start	Childcare Facility		X		X		X		
Albina Head Start - Benjamin M Priestley	Childcare Facility		X	X	X		X		
Albina Head Start - Hughes Center	Childcare Facility			X	X		X		
Albina Head Start - Lutheran Center	Childcare Facility				X				
Albina Head Start-Dekum Court	Childcare Facility		X	X	X	X	X	X	X
Albina Head Start-Jackson Center	Childcare Facility		X		X		X		
Albina Head Start-Maya Angelou Ctr	Childcare Facility			X	X		X		
Albina Head Start-Mccormack-Matthews	Childcare Facility			X	X		X		

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Albina Head Start-Richard C Brown Ctr	Childcare Facility		X	X	X		X		
Albina Head Start-Salvation Army	Childcare Facility				X				
Albina Head Start-Young Center	Childcare Facility				X				
Albina-Tina Clegg Center	Childcare Facility		X		X		X		
Alder Street Learning Center	Childcare Facility		X	X	X	X	X		
Allroads Learning Community	Childcare Facility								
Andi Panda Childcare And Enrichment Ctr	Childcare Facility		X		X		X		
Angel Academy	Childcare Facility				X		X		
Angel Loft Preschool	Childcare Facility		X	X	X	X	X	X	X
Annie's Quality Care	Childcare Facility		X	X	X	X	X		X
Apple Blossom Nursery School	Childcare Facility								
Archbishop Howard School	Childcare Facility				X		X		
Arleta Baptist Child Ctr	Childcare Facility				X				
Art 4 Life - Abernathy	Childcare Facility	X	X	X	X	X	X		X
Art 4 Life - Maplewood School	Childcare Facility		X						
Art 4 Life - Sunnyside	Childcare Facility		X						
Art 4 Life-The Emerson School	Childcare Facility		X	X	X	X	X		X
Art 4 Life-Winterhaven	Childcare Facility		X	X	X	X	X		X
As I Grow Childcare	Childcare Facility								
ASPSU Children’s Center	Childcare Facility	X	X	X	X		X		

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Aunt Genes Childcare	Childcare Facility				X		X		
Beaumont Children's Ctr	Childcare Facility						X		
Belmont Schools Inc DBA Belmont Academy	Childcare Facility								
Bethany Elementary School	Childcare Facility	X	X	X	X	X	X	X	X
Blossom House Preschool	Childcare Facility		X	X	X	X	X	X	X
Boise-Eliot Elem-Sun Program	Childcare Facility		X	X	X	X	X		X
Bottles-2-Books Childcare	Childcare Facility			X	X	X	X		X
Bright Beginnings	Childcare Facility				X				
Building Blocks Playschool	Childcare Facility			X	X				
Busy Bee Daycare And Preschool	Childcare Facility				X				
Calvary Christian DC	Childcare Facility		X	X	X				
CDC/Little Persons	Childcare Facility	X	X	X	X		X		
CDC/Portland Heights DC	Childcare Facility		X	X	X		X		
CDC/Young Friends	Childcare Facility				X		X		
CDI-Early Head Start CRN	Childcare Facility		X		X	X	X		
CDI-Early Head Start-Gladstone	Childcare Facility		X	X	X		X		
CDI-Early Head Start-North	Childcare Facility		X	X	X		X		
Cedar Montessori Preschool	Childcare Facility			X	X		X		
Champions - Cherry Park	Childcare Facility			X	X				
Champions - Earl Boyles	Childcare Facility		X	X	X				
Champions - Gilbert Heights	Childcare Facility			X	X				

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Champions - Gilbert Park	Childcare Facility			X	X				
Champions - Harold Oliver	Childcare Facility								
Champions - International School	Childcare Facility	X	X	X	X		X		
Champions - Lincoln Park	Childcare Facility				X				
Champions - Menlo	Childcare Facility								
Champions - Mill Park	Childcare Facility				X				
Champions - Ventura Park	Childcare Facility								
Champions - West Powellhurst	Childcare Facility			X	X				
Childcare At Laveta's	Childcare Facility		X		X				
Childpeace Montessori (105 NW Park Ave)	Childcare Facility		X		X	X	X		X
Childpeace Montessori (1516 NW Thurman St)	Childcare Facility	X	X		X	X	X	X	X
Childpeace Montessori The Terrace	Childcare Facility		X		X		X		
Children's Club Inc (PO Box 14834)	Childcare Facility	X	X		X	X	X	X	X
Children's Club Inc (3520 SE Yamhill St)	Childcare Facility		X						
Children's Elite Home	Childcare Facility				X				
Children's Garden Day Care And Preschool	Childcare Facility		X		X	X	X		
Children's Relief Nursery	Childcare Facility		X		X	X	X		
Child's Reach Childcare	Childcare Facility	X	X			X	X	X	X

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Childs View Montessori School	Childcare Facility				X				
Childswork Learning Ctr Inc	Childcare Facility								
Chrysalis Home School	Childcare Facility				X		X		
Circle Of Life-Maplewood	Childcare Facility	X	X	X	X		X		
Clark Little Feet	Childcare Facility			X	X				
Class Academy	Childcare Facility	X	X	X	X	X	X	X	X
Cloud Nine Childcare	Childcare Facility			X	X				
Cloud Nine Too Childcare	Childcare Facility			X	X				
Columbia Academy	Childcare Facility								
Community Childcare-RLC	Childcare Facility		X		X		X		
Community Learning Center School	Childcare Facility								
Cong Nev Shalom Found Sch	Childcare Facility								
Creative Minds Learning Center-Gateway	Childcare Facility								
Creative Minds Learning Center-Woodstock	Childcare Facility		X						
Daddy Daycare	Childcare Facility		X	X	X	X	X	X	X
Danforth Associates After Care Program	Childcare Facility		X	X	X	X	X		
David Douglas Child Development Center	Childcare Facility								
David Douglas Day Care Inc	Childcare Facility				X				
Debs House Childcare	Childcare Facility	X	X			X	X		X

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Discoveryland Child Care Center	Childcare Facility				X		X		
DNCW & Associates AS	Childcare Facility		X	X	X	X	X		X
Duniway After School	Childcare Facility		X	X	X	X	X		X
Early Years Development Center	Childcare Facility				X		X		
Easy Spirit Childcare	Childcare Facility	X	X		X	X	X		X
Emanuel Child Care Center	Childcare Facility		X	X	X		X		
Emmanuel Helping Hands	Childcare Facility		X	X	X		X		
Escuela Viva Childcare	Childcare Facility			X	X		X		
Escuela Viva Two	Childcare Facility	X	X	X	X		X		
Faubion Elementary-YMCA After School	Childcare Facility		X	X	X	X	X		X
First Christian Ch Center	Childcare Facility	X	X	X	X		X		
First Presbyterian Church	Childcare Facility		X	X	X	X	X		
Franciscan Montessori School	Childcare Facility		X	X	X				
French American School	Childcare Facility		X						
Friendly Chaps Child Dev (1445 NW 26th Ave)	Childcare Facility		X	X	X	X	X		
Friendly Chaps-Com Center (2617 NW Savier St)	Childcare Facility		X	X	X	X	X		
Friendly House Childcare	Childcare Facility		X	X	X	X	X		
Fruit And Flower Child Care Center	Childcare Facility		X		X		X		
Gateway Hunny Hollow D.S.	Childcare Facility		X	X	X		X		

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German American School	Childcare Facility	X	X	X	X	X	X	X	X
Golden Key Children's Ctr	Childcare Facility		X	X	X		X		
Grace Collins Mem Center	Childcare Facility		X	X	X		X		
Grand Central Station	Childcare Facility				X				
Grandmas Place - Center Village	Childcare Facility			X	X	X	X	X	X
Grandmas Place - Columbia Knoll	Childcare Facility		X		X		X		
Grandmas Place - Rose Quarter	Childcare Facility	X	X	X	X	X	X		X
Grandmas Place Childcare - Lloyd Place	Childcare Facility	X	X	X	X	X	X		X
Great Beginning Childcare	Childcare Facility		X		X				
Growing Seed Childcare	Childcare Facility	X	X	X	X	X	X		X
Growing Seeds - North	Childcare Facility		X	X	X		X		
GSR Community Support Childcare	Childcare Facility		X	X	X	X	X		X
GSR Phase II Infant And Toddler Center	Childcare Facility		X	X	X	X	X		X
Hand In Hand - Rose City Park School (9046 E Burnside St)	Childcare Facility		X	X	X		X		
Hand In Hand-Rose City Pk (2334 NE 57th Ave)	Childcare Facility				X		X		
Happy Bear Day Care (3001 NE Ainsworth St)	Childcare Facility		X	X	X	X	X		
Happy Bear Day Care Center (4326 NE Killingsworth St)	Childcare Facility				X		X		X

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Happy Day-CCM	Childcare Facility			X	X				
Happy Hearts Childcare	Childcare Facility			X	X				
Harmony Montessori School	Childcare Facility				X				
Headstart-Thompson ES	Childcare Facility		X	X	X	X	X		X
Heartwood Preschool	Childcare Facility			X	X	X	X		X
Helen Gordon Child Development Ctr	Childcare Facility	X	X	X	X		X		
Helping Hands Family Daycare	Childcare Facility		X			X	X		X
Holladayland Day Nursery	Childcare Facility		X	X	X	X	X		X
Holy Family Ext. Care	Childcare Facility		X		X		X		
Holy Redeemer Beyond The Classroom	Childcare Facility			X	X		X		
Huggy Bear Day Care Ctr	Childcare Facility		X	X	X		X		
Huggy Bear Infant Toddler	Childcare Facility		X	X	X		X		
Imagination Station Daycare Center	Childcare Facility		X			X	X		
Immanuel Lutheran Preschool	Childcare Facility		X		X		X		
In A Childs Path-Ford	Childcare Facility				X		X		
In A Childs Path-Wiederhold	Childcare Facility				X		X		
International School	Childcare Facility	X	X	X	X		X		
Irvington Extended DC	Childcare Facility		X		X		X		
Joyful Learning Preschool And Childcare	Childcare Facility	X	X	X	X	X	X	X	X

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Joyful Noise - City Kids	Childcare Facility	X	X	X	X		X		
Joyful Noise - Metro Kids	Childcare Facility	X	X	X	X	X	X	X	X
Joyful Noise Childcare Center	Childcare Facility		X	X	X	X	X		X
Just Little People CC	Childcare Facility								
Just Little People Preschool	Childcare Facility								
Kiddie Academy	Childcare Facility				X		X		
Kids Community Learning Center	Childcare Facility		X	X	X	X	X		
Kids Klub Too!	Childcare Facility		X	X	X		X		
Kidz Korner	Childcare Facility			X	X				
Kidz Own Daycare	Childcare Facility			X	X	X	X		X
Kindercare - Downtown	Childcare Facility	X	X	X	X		X		
Kindercare - Legacy Northwest	Childcare Facility		X	X	X	X	X		
Kindercare Learning Center	Childcare Facility	X	X	X	X		X		
Kindercare-Fred Meyer	Childcare Facility		X	X	X	X	X	X	X
Kindercare-Naegli	Childcare Facility	X	X	X	X				
Lad 'N' Lassie Nursery	Childcare Facility	X	X	X	X				
Laurelhurst Montessori Preschool	Childcare Facility		X	X	X	X	X		X
Lauries House	Childcare Facility				X				
Learn And Play	Childcare Facility		X	X	X		X		
LICM Community Ctr	Childcare Facility	X	X	X	X	X	X	X	X
Lily Garden Montessori Preschool	Childcare Facility			X	X	X	X		X
Linnton Community Center	Childcare Facility			X	X	X	X	X	X

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Little Angels Daycare	Childcare Facility		X		X				
Little Footsteps Inc	Childcare Facility	X	X		X		X		
Little Lambs Lutheran Preschool	Childcare Facility			X	X				
Little Pandas Playschool	Childcare Facility		X		X		X		
Little Red Wagon DC Ctr	Childcare Facility		X	X	X				
Love N Learn	Childcare Facility		X						
Luv N' Fun DC Center	Childcare Facility								
Markham Child Care Assn (PO Box 19849)	Childcare Facility	X	X	X	X	X	X	X	X
Markham Childrens Care Association Inc (10531 SW Capitol Hwy)	Childcare Facility			X	X				
Martis Place Childcare	Childcare Facility			X	X	X	X		X
Marysville Sch Daycare	Childcare Facility				X				
Meadowlark Chld Dev Ctr	Childcare Facility	X	X	X	X	X	X	X	X
Middendorf Mary E	Childcare Facility		X						
Mittleman Jewish-Early	Childcare Facility				X				
Montessori Of Alameda	Childcare Facility				X		X		
Morning Star School	Childcare Facility		X						
Mountain Valley Homecare And Preschool	Childcare Facility			X	X				
Mounthood Comm CLG Head Start	Childcare Facility								

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Mt Carmel Preschool And Daycare	Childcare Facility								
Mt Hood Comm Clg Head Start-Russellville	Childcare Facility		X	X	X		X		
Mult Co-Child Dev Ctr	Childcare Facility		X	X	X	X	X		X
Multnomah Afterschool Ctr	Childcare Facility		X	X	X	X	X		
Neveh Shalom Foundation School	Childcare Facility								
New Day Sunrise School	Childcare Facility		X	X	X	X	X		X
Northeast Community Child Development	Childcare Facility		X	X	X	X	X		X
NW Community Child Care	Childcare Facility		X	X	X	X	X		
Open Bible Day Care	Childcare Facility			X	X				
Open Minds Childcare	Childcare Facility								
Our Lady Of Sorrows EC	Childcare Facility		X						
Our Lady Of The Lake	Childcare Facility			X	X				
Parkrose Daycare	Childcare Facility		X	X	X	X	X		X
Parkrose Daycare II	Childcare Facility		X	X	X	X	X		X
PCC Sylvania Child Dev Ct	Childcare Facility				X				
PCS-Toddler Devel Center	Childcare Facility	X	X	X	X	X	X		X
Peace Child Dev Center	Childcare Facility				X				
Peninsula Childrens Center - Astor	Childcare Facility		X		X	X	X		
Peninsula Childrens Center - Boise Eliot (620 N Fremont St)	Childcare Facility		X	X	X	X	X		X

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Peninsula Children's Center - Maryland	Childcare Facility		X	X	X		X		
Peninsula Children's Center Latch Key (8125 N Emerald Ave)	Childcare Facility		X		X		X		
Peninsula Children's Center-Sabin School	Childcare Facility		X						
Peninsula-Boise Eliot (2408 N Farragut St)	Childcare Facility		X	X	X		X		
Peninsula-Latchkey (4720 N Maryland Ave)	Childcare Facility		X				X		
Piedmont Peace Place After School Prgm	Childcare Facility		X	X	X				
Pixie Day Nursery	Childcare Facility		X	X	X				
PJA Child Care	Childcare Facility				X				
PJA Kidspace At Forrest Park	Childcare Facility								
PJA Kidzone	Childcare Facility				X		X		
Play School Daycare	Childcare Facility								
Pocketful Of Posies I	Childcare Facility		X	X	X	X	X		X
Pocketful Of Posies II	Childcare Facility			X	X	X	X		X
Pockets Full Of Posies	Childcare Facility				X				
Portland Jewish Academy Kids Corner	Childcare Facility				X				
Portland Metro A/G Church	Childcare Facility				X				
Portland Public School Head Start	Childcare Facility		X	X	X		X		

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Powellhurst Day Care - John Barbs	Childcare Facility			X	X				
Powellhurst Day Nursery	Childcare Facility			X	X				
Project Networklifeworks Northwest	Childcare Facility		X	X	X	X	X	X	X
Providence Montessori School	Childcare Facility			X	X	X	X	X	X
Providence Wee Care (4805 NE Glisan St)	Childcare Facility			X	X	X	X	X	X
Providence Wee Care (830 NE 47th Ave)	Childcare Facility			X	X	X	X	X	X
PSU Helen Gordon Child Ct	Childcare Facility	X	X	X	X	X	X	X	X
Puddletown Preschool	Childcare Facility		X	X	X		X		
Raleigh Park After S C A	Childcare Facility	X	X	X	X	X	X	X	X
Rivercrest Church After School	Childcare Facility		X	X	X	X	X		X
Rocking Horse Day School	Childcare Facility			X	X				
Rosa Watson Day Care G.H.	Childcare Facility		X	X	X	X	X		
Rose City Day Nursery	Childcare Facility				X		X		
Rowanberry Preschool	Childcare Facility		X	X	X	X	X		X
Sabin Daycare Center	Childcare Facility	X	X	X	X	X	X	X	X
Schoolita Alegria	Childcare Facility		X	X	X	X	X	X	X
SE YMCA Child Development Center	Childcare Facility			X	X				
Sellwood-Bilingual Childcare-Preschool	Childcare Facility	X	X		X	X	X		

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Shannon's Day Care	Childcare Facility			X	X				
Shepherds Door Childrens Center	Childcare Facility				X		X		
Smiling Faces Daycare	Childcare Facility		X		X		X		
Sonbeam Day Care Ctr	Childcare Facility	X	X	X	X	X	X		X
Sonshine Christian DC	Childcare Facility	X	X			X	X	X	X
Spindlewood Preschool	Childcare Facility		X	X	X		X		
St Agatha School	Childcare Facility		X		X		X		
St Clare After Sch Prgm	Childcare Facility			X	X				
St James Child Development Center	Childcare Facility	X	X	X	X		X		
St John Fisher Sch Ext.	Childcare Facility		X						
St Stephens School	Childcare Facility				X				
Step By Step CDC 5	Childcare Facility				X		X		
Stephenson Childrens Care Association	Childcare Facility								
Sunflower School	Childcare Facility		X		X		X		
Sunshine Daycare School	Childcare Facility			X	X				
SW School-Kinderland	Childcare Facility		X						
The Creative Learning Place	Childcare Facility		X		X	X	X		
The Day Watch - DBA Lil Rookies	Childcare Facility	X	X	X	X		X		
The Jackson Club After School	Childcare Facility			X	X				
The Madeleine Youth Development Program	Childcare Facility		X				X		

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The Salvation Army-White Shield Center	Childcare Facility	X	X		X	X	X		
Trinity Learning Center	Childcare Facility		X	X	X	X	X		X
Vermont Hill Family Life-After School-Rieke	Childcare Facility			X	X				
Vermont Hills - Atkinson	Childcare Facility				X				
Vermont Hills - Bridger	Childcare Facility				X				
Vermont Hills - Bridlemile	Childcare Facility		X						
Vermont Hills - Buckman	Childcare Facility	X	X		X		X		
Vermont Hills - Creston Elementary	Childcare Facility			X	X				
Vermont Hills - Hayhurst	Childcare Facility		X						
Vermont Hills - Jason Lee School	Childcare Facility		X	X	X	X	X		X
Vermont Hills - Kelly Elementary	Childcare Facility		X	X	X				
Vermont Hills - Rieke School	Childcare Facility			X	X				
Vermont Hills - St Andrews	Childcare Facility								
Vermont Hills - St Ignatius	Childcare Facility			X	X				
Vermont Hills - St John Fisher	Childcare Facility		X						
Vermont Hills - VA	Childcare Facility		X	X	X				
Vermont Hills - Whitman School	Childcare Facility		X		X				
Vermont Hills Fam Life Ct	Childcare Facility	X	X						
VHFLC-Barnes School	Childcare Facility	X	X	X	X	X	X	X	X
VHFLC-Holladay	Childcare Facility	X	X	X	X	X	X	X	X

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VHFLC-St Claire	Childcare Facility			X	X				
Village Child Care At Immaculate Heart	Childcare Facility		X	X	X		X		
Violet Garden Waldorf Preschool	Childcare Facility		X		X	X	X		
Visions Childcare	Childcare Facility		X		X	X	X		
VOA-Cottage	Childcare Facility		X	X	X	X	X		X
Volunteers Of America Oregon Family Religious	Childcare Facility	X	X	X	X	X	X		X
Wee Care Day Care	Childcare Facility		X						
Wee Works (2106 NE 40th Ave)	Childcare Facility			X	X	X	X		X
Wee Works (3918 NE Hancock St)	Childcare Facility		X	X	X	X	X		X
West Hills Early Childhood Learning Cent	Childcare Facility				X				
West Hills Mont II Preschool	Childcare Facility		X						
West Hills Montessori	Childcare Facility		X						
Wonderworks-All Saints	Childcare Facility				X		X		
YMCA - Alameda	Childcare Facility				X		X		
YMCA - Beach School	Childcare Facility		X	X	X	X	X		X
YMCA - Grout	Childcare Facility		X	X	X	X	X		
YMCA - Hollyrood	Childcare Facility		X	X	X	X	X		X
YMCA - Humboldt	Childcare Facility			X	X				
YMCA - Llewellyn	Childcare Facility		X		X	X	X		
YMCA - Richmond	Childcare Facility				X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
YMCA - Tabor Heights	Childcare Facility				X		X		
YMCA - Vernon	Childcare Facility				X		X		
YMCA - Vestal School	Childcare Facility		X		X		X		
YMCA - Woodlawn	Childcare Facility		X	X	X	X	X	X	X
YMCA - Woodstock	Childcare Facility		X						
YMCA - YS Choice Child Development Ctr	Childcare Facility				X		X		
YMCA Before After School - Arleta	Childcare Facility				X				
YMCA Before After School - Arthur Academy	Childcare Facility				X				
YMCA Before After School - David Douglas	Childcare Facility		X	X	X				
YMCA Before After School - Faubian	Childcare Facility		X	X	X	X	X		X
YMCA Before After School - Harvey Scott	Childcare Facility		X		X		X		
YMCA Before After School - Laurelhurst	Childcare Facility		X	X	X	X	X		X
YMCA Before After School - Lewis	Childcare Facility		X						
YMCA Before After School - Rigler	Childcare Facility				X		X		
YMCA Before After School - Trinity Lutheran	Childcare Facility			X	X	X	X		X
YMCA Child Dev Center	Childcare Facility		X	X	X	X	X	X	X
YMCA Childcare - St Anthony's	Childcare Facility			X	X				

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YMCA ODS Towers Child Development Center	Childcare Facility		X	X	X	X	X		X
YMCA Preschool-Before-After - King Elem	Childcare Facility				X				
YMCA SE-Brooklyn	Childcare Facility		X	X	X		X		
Young Wonders Preschool	Childcare Facility								
Youth Employment Institute Childcare	Childcare Facility		X	X	X	X	X		X
Ys Choice Childcare	Childcare Facility				X		X		
Portland City Hall	City Hall	X	X	X	X		X		
Charles Jordan Community Center	Community Center	X	X		X	X	X	X	X
Community Music Center	Community Center		X	X	X		X		
East Portland Community Center	Community Center				X				
Ethos Music Center	Community Center		X	X	X		X		
Fulton Park Community Center	Community Center			X	X		X		
Hillside Community Center	Community Center		X		X		X		
Historic Overlook House Community Center	Community Center		X	X	X	X	X	X	X
In Other Words Feminist Community Center	Community Center				X				
June Key Delta Community Center	Community Center			X	X				
Laurelhurst Dance Studio	Community Center		X		X		X		

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Linnton Community Center	Community Center			X	X	X	X	X	X
Matt Dishman Community Center	Community Center		X	X	X		X		
Mittleman Jewish Community Center	Community Center				X				
Montavilla Community Center	Community Center	X	X	X	X	X	X		X
Moore Street Community & Worship Center	Community Center				X				
Mt Scott Community Center	Community Center								
Multnomah Arts Center	Community Center				X				
Muslim Community Center Of Portland	Community Center			X	X		X		
Native American Youth And Family Center	Community Center			X	X	X	X	X	X
Northeast Community Center	Community Center		X	X	X	X	X	X	X
Peninsula Park Community Center	Community Center			X	X		X		
Portland Children's Museum	Community Center	X	X						
Q Center	Community Center		X	X	X		X		
Sellwood Community Center	Community Center		X		X	X	X		
Slavic Community Center Of NW	Community Center		X	X	X				
Southwest Community Center	Community Center		X						
St Johns Community Center	Community Center		X	X	X	X	X		
Taborspace	Community Center				X		X		
Woodstock Community Center	Community Center		X						

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YMCA Arts Center	Community Center			X	X				
Zimmerman Community Center	Community Center	X	X	X	X	X	X	X	X
Albina Library	County Asset				X				
Baltazar F Ortiz Community Center	County Asset		X	X	X	X	X		X
Belmont Library	County Asset								
Blanchard Fleet Shops	County Asset	X	X	X	X	X	X	X	X
Bridge Shop Modular Office 1	County Asset		X	X	X	X	X	X	X
Bridge Shops	County Asset		X	X	X	X	X	X	X
Capitol Hill Library	County Asset			X	X				
Central Library	County Asset	X	X	X	X		X		
Central Office	County Asset	X	X	X	X	X	X		X
Cesar Chavez K-8 School	County Asset		X		X	X	X		X
Cherry Blossom Plaza	County Asset				X				
Cleveland High School	County Asset		X	X	X	X	X		X
Columbia Pacific Plaza	County Asset	X	X	X	X	X	X	X	X
David Douglas Modular Office	County Asset								
East Portland Community Center	County Asset	X	X		X		X		
Elections Building	County Asset		X	X	X	X	X		X
Franklin High School	County Asset			X	X				
Gateway Childrens Center MDT Building	County Asset		X	X	X		X		

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Gateway Childrens Center Residential Building	County Asset		X	X	X		X		
Gateway Childrens Center Service Building	County Asset		X	X	X		X		
George Middle School	County Asset			X	X	X	X		X
Gladys McCoy Building	County Asset		X	X	X	X	X		X
Grant High School	County Asset		X	X	X	X	X		X
Gregory Heights Library	County Asset		X		X		X		
Hansen Building	County Asset								
Hansen Building A	County Asset								
Hansen Building B	County Asset								
Hansen Building C	County Asset								
Hansen Building D	County Asset								
Hansen Station	County Asset								
Harrison Park School	County Asset			X	X				
Hillsdale Library	County Asset				X				
Holgate Library	County Asset			X	X				
Hollywood Library	County Asset			X	X	X	X		X
Hooper Memorial Center	County Asset	X	X	X	X	X	X	X	X
James Hawthorne Apartments	County Asset	X	X	X	X		X		
Jefferson High School	County Asset			X	X				
Justice Center	County Asset	X	X	X	X		X		

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Juvenile Justice Complex	County Asset		X	X	X	X	X	X	X
Kenton Library	County Asset		X	X	X	X	X		X
Lane Middle School	County Asset		X						
Library Administration	County Asset		X	X	X		X		
Lincoln Bldg	County Asset		X	X	X	X	X		X
Lloyd Corporate Plaza	County Asset	X	X	X	X	X	X	X	X
Madison High School	County Asset		X	X	X	X	X		X
Martin Luther King Jr Neighborhood Facility	County Asset				X				
Mead Building	County Asset		X	X	X		X		
Medford Building	County Asset		X	X	X	X	X	X	X
Mid-County District Office	County Asset								
Mid-County Health Center	County Asset			X	X				
Midland Library	County Asset								
Motor Pool Modular Office	County Asset		X	X	X	X	X		X
Multnomah Building	County Asset		X	X	X	X	X		X
Multnomah Building Garage	County Asset		X	X	X	X	X		X
Multnomah County Court House	County Asset	X	X	X	X		X		
Multnomah County Inverness Jail Laundry	County Asset		X	X	X	X	X		X
Multnomah County Inverness Jail Storage	County Asset		X	X	X	X	X		X

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Multnomah County Inverness Jail Work Crew Shed	County Asset		X	X	X	X	X		X
Multnomah County Wapato Facility	County Asset		X		X	X	X		
North Portland Health Clinic	County Asset		X	X	X	X	X		
North Portland Library	County Asset			X	X				
Northwest Library	County Asset		X	X	X	X	X		X
Old Town Recovery Center	County Asset		X	X	X	X	X		X
Parking Attendant Booth	County Asset		X	X	X	X	X		X
Parkrose High School	County Asset		X	X	X	X	X		X
Portage Storage Building	County Asset								
Portland Building	County Asset	X	X	X	X		X		
Professional Plaza 102	County Asset		X	X	X		X		
River Patrol Columbia	County Asset								
River Patrol Columbia Boathouse 1	County Asset								
River Patrol Columbia Boathouse 2	County Asset								
River Patrol Columbia Boathouse 3	County Asset								
River Patrol Columbia Boathouse 4	County Asset								
River Patrol Willamette	County Asset		X	X	X	X	X	X	X

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River Patrol Willamette Boathouse	County Asset		X	X	X	X	X	X	X
Robert W Blanchard Education Service Center	County Asset	X	X	X	X	X	X	X	X
Robert W Blanchard Maintenance Building 1	County Asset	X	X	X	X	X	X	X	X
Robert W Blanchard Maintenance Building 2	County Asset	X	X	X	X	X	X		X
Robert W Blanchard Parking Shed	County Asset	X	X	X	X	X	X		X
Rocky Butte	County Asset		X	X	X	X	X		X
Roosevelt High School	County Asset		X	X	X	X	X		X
Sellwood Bridge Modular Office	County Asset		X		X	X	X		
Sellwood Lofts	County Asset		X		X	X	X		
Southeast Health Center	County Asset		X	X	X		X		
St Francis Dining Hall	County Asset	X	X	X	X	X	X		X
St Johns Library	County Asset		X	X	X	X	X		
State Office Building	County Asset	X	X	X	X	X	X	X	X
Tabor Square Office Building	County Asset				X		X		
Title Wave Bookstore	County Asset		X	X	X		X		
Towne Building	County Asset		X	X	X	X	X	X	X
Vector Control	County Asset		X	X	X	X	X	X	X
Vector Control Modular Office	County Asset		X	X	X	X	X	X	X
Vector Control Parking Shed	County Asset		X	X	X	X	X	X	X

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Walnut Park Complex	County Asset				X				
Wikman Building	County Asset			X	X				
Womens Transition 1	County Asset	X	X	X	X	X	X		X
Womens Transition 2	County Asset	X	X	X	X	X	X		X
Womens Transition 3	County Asset	X	X	X	X	X	X		X
Woodstock Library	County Asset		X						
Mult Co Fd #8 PDX (Port Of Portland) 80	Fire Station				X				
Portland Fire & Rescue 1	Fire Station		X	X	X	X	X		X
Portland Fire & Rescue 10	Fire Station			X	X				
Portland Fire & Rescue 11	Fire Station		X	X	X				
Portland Fire & Rescue 12	Fire Station		X	X	X		X		
Portland Fire & Rescue 13	Fire Station		X	X	X	X	X		X
Portland Fire & Rescue 14	Fire Station		X		X		X		
Portland Fire & Rescue 15	Fire Station		X		X				
Portland Fire & Rescue 16	Fire Station		X						
Portland Fire & Rescue 17	Fire Station			X	X		X		
Portland Fire & Rescue 18	Fire Station			X	X				
Portland Fire & Rescue 19	Fire Station		X		X		X		
Portland Fire & Rescue 2	Fire Station	X	X	X	X	X	X	X	X
Portland Fire & Rescue 20	Fire Station		X	X	X	X	X	X	X
Portland Fire & Rescue 21	Fire Station		X	X	X	X	X	X	X

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Portland Fire & Rescue 22	Fire Station		X	X	X	X	X		
Portland Fire & Rescue 23	Fire Station	X	X	X	X	X	X	X	X
Portland Fire & Rescue 24	Fire Station		X	X	X	X	X		
Portland Fire & Rescue 25	Fire Station			X	X				
Portland Fire & Rescue 26	Fire Station		X		X	X	X		X
Portland Fire & Rescue 28	Fire Station				X		X		
Portland Fire & Rescue 29	Fire Station				X				
Portland Fire & Rescue 3	Fire Station	X	X	X	X	X	X		X
Portland Fire & Rescue 30	Fire Station			X	X		X		
Portland Fire & Rescue 4	Fire Station	X	X	X	X		X		
Portland Fire & Rescue 5	Fire Station				X				
Portland Fire & Rescue 6	Fire Station		X	X	X	X	X	X	X
Portland Fire & Rescue 7	Fire Station								
Portland Fire & Rescue 8	Fire Station			X	X		X		
Portland Fire & Rescue 9	Fire Station				X				
Portland/Gresham - Shared 31	Fire Station			X	X				
13 Salmon Family Center	Homeless Shelter	X	X	X	X		X		
Catholic Charities Housing Transit	Homeless Shelter	X	X	X	X	X	X		X
City Team Ministries	Homeless Shelter		X	X	X	X	X		X
Common Cup Shelter	Homeless Shelter		X						

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DayWatch Operated-Julia West House	Homeless Shelter		X	X	X	X	X		
Dignity Village	Homeless Shelter		X						
Downtown Chapel	Homeless Shelter		X	X	X	X	X		X
Family Winter Warming Center	Homeless Shelter				X		X		
Goose Hollow Shelter	Homeless Shelter		X	X	X		X		
Janus Youth Program	Homeless Shelter		X	X	X	X	X		
JOIN	Homeless Shelter	X	X	X	X	X	X	X	X
MACE Center Calvary Christian Center	Homeless Shelter				X				
Native American Youth and Family	Homeless Shelter			X	X	X	X	X	X
New Avenues for Youth -NAFY	Homeless Shelter		X	X	X	X	X		X
Outside In OI	Homeless Shelter	X	X	X	X		X		
Porchlight Crisis Shelter	Homeless Shelter		X	X	X	X	X		
Portland Rescue Mission	Homeless Shelter		X	X	X	X	X		X
Red Cross Severe Weather Emergency	Homeless Shelter	X	X	X	X	X	X		X
Rose Haven	Homeless Shelter	X	X	X	X	X	X		
Salvation Army Female Emergency Shelter	Homeless Shelter		X	X	X	X	X		X
Salvation Army Harbor Light Men's	Homeless Shelter		X	X	X	X	X		X
Salvation Army Men's Day Center	Homeless Shelter		X	X	X	X	X		X

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Streetlight Youth Shelter	Homeless Shelter		X	X	X	X	X		
Transition Projects Community Srvc	Homeless Shelter		X	X	X	X	X	X	X
Transition Projects Clark Center	Homeless Shelter	X	X	X	X	X	X	X	X
Transition Projects Glisan Shelter	Homeless Shelter		X	X	X	X	X	X	X
Transition Projects Jeans Place	Homeless Shelter	X	X	X	X	X	X		X
Union Gospel Mission	Homeless Shelter		X	X	X	X	X		X
Women's Winter Warming Center	Homeless Shelter		X	X	X	X	X	X	X
Adventist Medical Center	Hospital			X	X				
Legacy Emanuel	Hospital		X	X	X	X	X		X
Legacy Good Samaritan	Hospital		X	X	X		X		
OHSU Center For Health & Healing	Hospital		X	X	X		X		
OHSU Doernbecher Children's Hospital	Hospital		X		X				
Oregon Health & Science University	Hospital		X	X	X				
Portland VA Medical Center	Hospital		X		X				
Providence Portland	Hospital			X	X	X	X		X
Randall Children's Hospital At Legacy Emanuel	Hospital		X	X	X	X	X		X
Shriners Hospitals For Children	Hospital		X	X	X				
Vibra Specialty Hospital	Hospital		X	X	X	X	X		X

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Columbia River Correctional	Jail		X				X		
Multnomah County Inverness Jail	Jail		X	X	X	X	X		X
Bureau Of Alcohol Tobacco Firearms And Explosives - Portland I	Law Enforcement	X	X	X	X	X	X		X
Bureau Of Land Management - Oregon State Field Office	Law Enforcement		X	X	X	X	X		X
Bureau Of Reclamation - Lower Columbia Area Field Office	Law Enforcement	X	X	X	X	X	X		X
Columbia River Correctional Institution	Law Enforcement		X						
Multnomah County Inverness Jail	Law Enforcement		X	X	X	X	X		X
Multnomah County Sheriff	Law Enforcement		X	X	X	X	X		X
Multnomah County Sheriff	Law Enforcement	X	X	X	X	X	X		
Multnomah County Sheriff's Ofc	Law Enforcement	X	X	X	X	X	X		X
Multnomah County Sheriffs Office	Law Enforcement		X	X	X	X	X		X
Multnomah County Sheriffs Office	Law Enforcement								
Multnomah County Sheriffs Office - Columbia River Patrol Office	Law Enforcement								
Oregon State Police - Portland	Law Enforcement				X				
Port Of Portland Police	Law Enforcement			X	X				
Port Of Portland Police	Law Enforcement			X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Portland Police Bureau - East Precinct	Law Enforcement				X				
Portland Police Bureau - North Precinct	Law Enforcement		X	X	X	X	X		
Portland Police Bureau - Northeast Precinct	Law Enforcement				X				
Portland Police Bureau - Southeast Precinct	Law Enforcement			X	X	X	X		X
Portland Police Department	Law Enforcement	X	X	X	X		X		
Portland Police Dept	Law Enforcement			X	X				
Portland School Police	Law Enforcement	X	X	X	X	X	X	X	X
Portland State University Campus Public Safety	Law Enforcement	X	X	X	X		X		
Portland Transit Police Division	Law Enforcement		X	X	X	X	X	X	X
United States Customs And Border Protection - Portland Deferred Inspection Site	Law Enforcement	X	X	X	X	X	X	X	X
United States Customs And Border Protection - Service Port - Portland	Law Enforcement		X	X	X		X		
United States Drug Enforcement Administration - Portland	Law Enforcement	X	X	X	X		X		
United States Marshals Service - District Headquarters	Law Enforcement	X	X	X	X		X		
United States Marshals Service - Portland	Law Enforcement	X	X	X	X		X		

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
United States Marshals Service - Portland	Law Enforcement	X	X	X	X		X		
United States Marshals Service - Portland	Law Enforcement	X	X	X	X	X	X		X
United States Postal Inspection Service - Portland Office	Law Enforcement		X	X	X	X	X		
Albina Library	Library				X				
Belmont Library	Library								
Capitol Hill Library	Library			X	X				
Central Library	Library	X	X	X	X		X		
Gregory Heights Library	Library		X		X		X		
Hillsdale Library	Library				X				
Holgate Library	Library			X	X				
Hollywood Library	Library			X	X	X	X		X
Kenton Library	Library		X	X	X	X	X		X
Midland Library	Library								
North Portland Library	Library			X	X				
Northwest Library	Library		X	X	X	X	X		X
Sellwood-Moreland Library	Library		X		X	X	X		
St. Johns Library	Library		X	X	X	X	X		
Woodstock Library	Library		X						
Adventist Health Home Health	Licensed Medical Facility	X	X	X	X	X	X		

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Adventist Health Hospice	Licensed Medical Facility	X	X	X	X	X	X		
Aesthetic Breast And Cosmetic Surgery Center	Licensed Medical Facility			X	X				
Alma Midwifery Services, LLC	Licensed Medical Facility	X	X	X	X		X		
Andaluz Birth Center	Licensed Medical Facility		X	X	X		X		
Assured Community-Based Services	Licensed Medical Facility			X	X		X		
Brightstar Care Of Portland North & East	Licensed Medical Facility	X	X	X	X	X	X	X	X
Calaroga Terrace Ambassador Program	Licensed Medical Facility	X	X	X	X	X	X		X
Care Givers Northwest	Licensed Medical Facility		X	X	X	X	X	X	X
Caregiver Connection, Inc	Licensed Medical Facility			X	X				
Circle Of Care Caregivers Services, Inc	Licensed Medical Facility				X				
Columbia River Surgery Center	Licensed Medical Facility	X	X	X	X		X		
Connected Home Health	Licensed Medical Facility				X		X		
FMC Maywood Park	Licensed Medical Facility		X	X	X		X		

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Futures Outpatient Surgical Center	Licensed Medical Facility	X	X	X	X	X	X		X
Healthy Living At Home - Portland, LLC	Licensed Medical Facility		X	X	X		X		
Holladay Park Plaza	Licensed Medical Facility	X	X	X	X	X	X	X	X
Home Instead Senior Care	Licensed Medical Facility			X	X	X	X		X
Homewatch Caregivers Of Portland	Licensed Medical Facility		X	X	X	X	X		
Hospice Care Of The Northwest, LLC	Licensed Medical Facility	X	X	X	X	X	X	X	X
Housecall Providers Hospice	Licensed Medical Facility			X	X		X		
Interim Healthcare Of Oregon, Inc	Licensed Medical Facility			X	X				
Interstate Ambulatory Surgical Center	Licensed Medical Facility		X	X	X	X	X	X	X
Kaiser Permanente Continuing Care Services Hospice	Licensed Medical Facility	X	X	X	X	X	X		
Kaiser Permanente Home Health Agency	Licensed Medical Facility	X	X	X	X	X	X		
Legacy Hopewell House Hospice	Licensed Medical Facility				X				
Legacy Hospice Services	Licensed Medical Facility	X	X	X	X	X	X	X	X

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Lovejoy Surgicenter, Inc	Licensed Medical Facility		X		X		X		
Mirabella Portland Home Care	Licensed Medical Facility		X	X	X	X	X		
NGC Endoscopy Services, LLC	Licensed Medical Facility		X	X	X	X	X		
Northeast Portland Renal Center	Licensed Medical Facility		X	X	X		X		
Northwest Ambulatory Surgery Center, LLC	Licensed Medical Facility	X	X	X	X	X	X		X
Northwest Senior Management Services	Licensed Medical Facility				X		X		
Oregon Kidney Center	Licensed Medical Facility			X	X	X	X	X	X
Pacific Cataract & Laser Institute, Inc	Licensed Medical Facility	X	X	X	X	X	X		X
Pearl Surgicenter, Inc.	Licensed Medical Facility	X	X	X	X	X	X		
Pegasus Social Services - Portland	Licensed Medical Facility		X	X	X		X		
Pinnacle Hospice Care Of Portland	Licensed Medical Facility				X				
Plaza Ambulatory Surgery Center, LLC	Licensed Medical Facility			X	X	X	X	X	X
PNRS Emanuel Pediatric Dialysis	Licensed Medical Facility		X	X	X	X	X		X

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
PNRS Hollywood Dialysis Center	Licensed Medical Facility	X	X	X	X	X	X	X	X
PNRS Portland Home Dialysis	Licensed Medical Facility	X	X	X	X		X		
PNRS Rose Quarter Dialysis Center	Licensed Medical Facility				X				
Portland Gateway Dialysis	Licensed Medical Facility		X	X	X	X	X	X	X
Providence Home Health	Licensed Medical Facility		X	X	X	X	X	X	X
Providence Hospice	Licensed Medical Facility		X	X	X	X	X	X	X
Senior Helpers	Licensed Medical Facility								
Senior Helpers Of Portland	Licensed Medical Facility	X	X	X	X	X	X		
Terwilliger Plaza In-Home Care Services	Licensed Medical Facility		X	X	X				
The Oregon Clinic Endoscopy Center	Licensed Medical Facility		X	X	X	X	X	X	X
The Portland Clinic Surgical Center	Licensed Medical Facility		X	X	X	X	X		
Us Renal Care East Portland Home Dialysis	Licensed Medical Facility				X		X		
Us Renal Care Portland Dialysis	Licensed Medical Facility				X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
VOTO Health Care, Inc	Licensed Medical Facility			X	X				
Addus Healthcare In Home Support Services	Residential Care Facility			X	X	X	X		
Addus Healthcare, Inc.	Residential Care Facility			X	X	X	X		X
Adventist Health Home Health Agency	Residential Care Facility	X	X	X	X	X	X		X
Adventist Health Hospice	Residential Care Facility	X	X	X	X	X	X		
All Comfort Residential Care	Residential Care Facility			X	X				
ASA Care	Residential Care Facility		X		X				
Assisted Living At Summer Place	Residential Care Facility		X	X	X	X	X	X	X
Assumption Village	Residential Care Facility			X	X	X	X		X
At Your Home Care, Inc.	Residential Care Facility								
Avamere Crestview Of Portland	Residential Care Facility								
Avamere Crestview Of Portland	Residential Care Facility								
Calaroga Terrace	Residential Care Facility	X	X	X	X	X	X		X

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Calaroga Terrace	Residential Care Facility	X	X	X	X	X	X		X
Care Center East	Residential Care Facility				X		X		
Care Center East Health & Specialty Care Center	Residential Care Facility				X		X		
Cascade Terrace Care Center	Residential Care Facility		X	X	X				
Cascade Terrace Nursing Center	Residential Care Facility		X	X	X				
Catered Living At Laurelhurst Village-The Gardens	Residential Care Facility		X		X		X		
Chaucer Court Apartments	Residential Care Facility	X	X	X	X		X		
Cherry Blossom Cottage	Residential Care Facility				X				
Cherry Blossom Cottage Retirement	Residential Care Facility				X				
Cherrywood Village Retirement Community	Residential Care Facility				X				
Clarendon Court Alzheimers Residence	Residential Care Facility		X	X	X				
Clarendon Court Alzheimer's Residence	Residential Care Facility		X	X	X				
Cornerstone Care Option	Residential Care Facility			X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Cornerstone Care Option	Residential Care Facility			X	X				
Cornerstone Residential Option	Residential Care Facility			X	X				
Court Yard Senior Living	Residential Care Facility				X				
Courtyard Senior Living	Residential Care Facility				X				
Courtyard Senior Living	Residential Care Facility				X				
Courtyard Senior Plaza	Residential Care Facility				X				
Donham Care Home	Residential Care Facility		X		X	X	X		X
Donham Place	Residential Care Facility		X		X	X	X		X
Dr Linus Johnson Assisted Living	Residential Care Facility		X	X	X	X	X		X
Emerson House	Residential Care Facility				X				
Emilie House	Residential Care Facility			X	X	X	X	X	X
Evergreen Portland Health And Rehabilitation Cent*	Residential Care Facility								
Expressions At Summerplace	Residential Care Facility		X	X	X	X	X	X	X

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Fernhill Estates	Residential Care Facility			X	X		X		
Fernhill Estates	Residential Care Facility			X	X		X		
Firwood Garden Retirement	Residential Care Facility								
Friendship Health Center	Residential Care Facility		X	X	X		X		
Gateway Care & Retirement Center	Residential Care Facility		X	X	X		X		
Gateway Care And Retirement Center	Residential Care Facility		X	X	X		X		
Gateway Care And Retirement Center	Residential Care Facility		X	X	X		X		
Glisan Care Center	Residential Care Facility		X	X	X	X	X		X
Glisan Care Center	Residential Care Facility		X	X	X	X	X		X
Golden Acres Retirement Center	Residential Care Facility		X		X				
Golden Acres Retirement Center	Residential Care Facility		X		X				
Gracelen Terrace Care Center	Residential Care Facility		X	X	X				
Gracelen Terrace Long Term Care Facility	Residential Care Facility		X	X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Harbor Care Reedwood	Residential Care Facility		X	X	X		X		
Harbor Care Reedwood	Residential Care Facility		X	X	X		X		
Harvest Homes	Residential Care Facility		X	X	X	X	X		
Harvest Homes Inc Retirement	Residential Care Facility		X	X	X	X	X		
Harvest Homes RCF	Residential Care Facility		X	X	X	X	X		
Hawthorne Gardens Memory Care Community	Residential Care Facility		X						
Hawthorne Gardens Senior Living Community	Residential Care Facility		X						
Healthcare At Foster Creek	Residential Care Facility				X				
Healthcare At Foster Creek	Residential Care Facility				X				
Helping Hands Home Care	Residential Care Facility		X	X	X				
Hill House	Residential Care Facility		X		X				
Holgate Center	Residential Care Facility		X	X	X		X		
Holladay Park Plaza	Residential Care Facility	X	X	X	X	X	X	X	X

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Holladay Park Plaza	Residential Care Facility	X	X	X	X	X	X	X	X
Holladay Park Plaza Nursing Home	Residential Care Facility	X	X	X	X	X	X	X	X
Holladay Park Plaza, Inc.	Residential Care Facility	X	X	X	X	X	X	X	X
Home Instead Senior Care	Residential Care Facility			X	X	X	X		X
Home Instead Senior Care	Residential Care Facility			X	X				
Home Lifecare, Inc.	Residential Care Facility			X	X	X	X	X	X
Hope N Care	Residential Care Facility		X		X				
Irvington Village	Residential Care Facility				X				
Johnson Assisted Living	Residential Care Facility		X	X	X	X	X		X
Kaiser Permanente Home Health Agency	Residential Care Facility	X	X	X	X	X	X		
Kaiser Permanente Home Health/Hospice	Residential Care Facility	X	X	X	X	X	X		
Kenilworth Park Plaza	Residential Care Facility		X	X	X		X		
Kirkland Union Manor	Residential Care Facility			X	X				

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Laurel Hurst Village	Residential Care Facility		X		X		X		
Laurelhurst House	Residential Care Facility			X	X	X	X		X
Laurelhurst Village	Residential Care Facility				X		X		
Lawrence Convalescent Center	Residential Care Facility				X		X		
Lawrence Convalescent Center	Residential Care Facility				X		X		
Legacy Hopewell House Hospice	Residential Care Facility				X				
Legacy VNA Hospice	Residential Care Facility	X	X	X	X	X	X	X	X
Macdonald Residence	Residential Care Facility		X	X	X	X	X		X
Macdonald Residence	Residential Care Facility		X	X	X	X	X		X
Markham House Retirement Community	Residential Care Facility			X	X				
Marquis Care At Mt Tabor Nursing Home	Residential Care Facility				X		X		
Marquis Care At Mt. Tabor	Residential Care Facility				X		X		
Marquis Care At Piedmont	Residential Care Facility		X	X	X	X	X	X	X

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Marquis Care At Piedmont Nursing Home	Residential Care Facility		X	X	X	X	X	X	X
Marquis Care At Powellhurst	Residential Care Facility				X				
Marquis Care At Powellhurst	Residential Care Facility				X				
Marquis Care At Vermont Hills	Residential Care Facility	X	X						
Marquis Care At Vermont Hills	Residential Care Facility	X	X						
Marquis Vintage Suites At Piedmont	Residential Care Facility		X	X	X	X	X	X	X
Marshall Union Manor	Residential Care Facility	X	X	X	X	X	X		X
Maxim Healthcare Services, Inc.	Residential Care Facility			X	X				
Maxim Healthcare Services, Inc.	Residential Care Facility			X	X				
Menlo Park Health Care	Residential Care Facility								
Menlo Park Health Care	Residential Care Facility								
Mirabella Portland Home Care	Residential Care Facility		X	X	X	X	X		
Mt Scott Residential Care-Residential	Residential Care Facility				X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Northwest Place	Residential Care Facility		X	X	X	X	X		
Northwest Senior Management Systems, Inc.	Residential Care Facility				X		X		
Odd Fellows Retirement Home	Residential Care Facility		X	X	X	X	X		X
Oregon Baptist Retirement Homes	Residential Care Facility		X	X	X	X	X		X
Oregon Elder Options	Residential Care Facility		X	X	X		X		
Paradigm Senior Living	Residential Care Facility	X	X	X	X	X	X	X	X
Park Forest Care Center	Residential Care Facility		X	X	X		X		
Park Forest Care Center	Residential Care Facility		X	X	X		X		
Parkrose Chateau Retirement	Residential Care Facility		X	X	X	X	X	X	X
Porthaven Care Center	Residential Care Facility				X		X		
Porthaven Healthcare Center	Residential Care Facility				X		X		
Portland Health And Rehab Ctr	Residential Care Facility								
Premier Enhanced Care Facility	Residential Care Facility		X		X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Premier Living Center	Residential Care Facility		X		X				
Providence Child Center	Residential Care Facility			X	X	X	X	X	X
Providence Child Center SNF	Residential Care Facility			X	X	X	X	X	X
Providence Elder Place-Glendover	Residential Care Facility								
Providence Elderplace In Cully	Residential Care Facility				X		X		
Providence Elderplace In Glendoveer	Residential Care Facility								
Providence Home Health	Residential Care Facility			X	X	X	X	X	X
Providence Hospice	Residential Care Facility			X	X	X	X	X	X
Robison Jewish Health Center	Residential Care Facility	X	X						
Robison Jewish Health Center	Residential Care Facility	X	X						
Robison Residence, The	Residential Care Facility	X	X						
Rose City Nursing Home	Residential Care Facility	X	X	X	X	X	X		X
Rose City Nursing Home	Residential Care Facility	X	X	X	X	X	X		X

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Rose Schnitzer Manor	Residential Care Facility	X	X						
Rose Schnitzner Manor	Residential Care Facility	X	X						
Royal Anne Assisted Living Facility	Residential Care Facility				X				
Saint Andrews Care Center	Residential Care Facility				X				
Saint Anthony Village	Residential Care Facility			X	X				
Sellwood Landing Assisted Living Community	Residential Care Facility	X	X	X	X	X	X		
Senior Care Inc	Residential Care Facility		X		X				
St. Andrews Care Center	Residential Care Facility				X				
St. Anthony Village	Residential Care Facility				X				
Summerplace Assisted Living Community	Residential Care Facility		X		X	X	X	X	X
Tabor Crest Residential Care	Residential Care Facility				X				
Tabor Crest Residential Care	Residential Care Facility				X				
Taft Home	Residential Care Facility		X	X	X	X	X		

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Taft Home, The	Residential Care Facility		X	X	X	X	X		
Terrace At Laurelhurst Village, The	Residential Care Facility		X		X		X		
Terwilliger Plaza - Metcalf Unit	Residential Care Facility		X	X	X				
Terwilliger Plaza Retirement	Residential Care Facility		X	X	X				
Terwilliger Terrace Assisted Living Facility	Residential Care Facility	X	X	X	X		X		
The Grandparents House-Adult Foster Home	Residential Care Facility			X	X				
The Terrace	Residential Care Facility		X		X		X		
Trinity Mission Health & Rehab Of Portland	Residential Care Facility		X	X	X				
Trinity Mission Hlth And Rehab-Portland	Residential Care Facility		X	X	X				
West Hills Health & Rehabilitation Center	Residential Care Facility		X						
West Hills Health And Rehab	Residential Care Facility		X						
West Hills Village	Residential Care Facility		X						
West Hills Village	Residential Care Facility		X						

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Westmorelands Union Manor	Residential Care Facility		X	X	X	X	X	X	X
A Renaissance School Of Arts And Sciences	School- Private	X	X	X	X	X	X		
Albina Headstart	School- Private			X	X		X		
Albina Youth Opportunity School	School- Private			X	X	X	X		X
All Saints School	School- Private		X	X	X	X	X		X
Archbishop Howard School	School- Private				X		X		
Belmont Academy	School- Private				X				
Bridges Middle	School- Private				X				
Cathedral School	School- Private		X	X	X	X	X		
Cedarwood Waldorf School	School- Private		X	X	X		X		
Central Catholic High School	School- Private		X		X		X		
Childpeace Montessori Community School	School- Private	X	X	X	X	X	X	X	X
Childpeace Montessori School	School- Private		X	X	X	X	X		X
Children's Relief Nursery – Mill Park Site	School- Private								
Children's Relief Nursery – St. Johns Site	School- Private		X	X	X	X	X		
Childroots NW	School- Private	X	X	X	X	X	X		
Childwork Learning Center	School- Private								
City Christian School	School- Private		X	X	X		X		
Class Academy	School- Private	X	X	X	X	X	X		

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Columbia Christian	School- Private		X	X	X	X	X		X
Community Transitional School	School- Private		X	X	X	X	X		X
Concordia University	School- Private		X	X	X	X	X		X
Crossroads Christian	School- Private		X	X	X	X	X	X	X
De La Salle North Catholic High School	School- Private			X	X	X	X		
Early Childhood Learning Center	School- Private				X				
Edwards Day Treatment	School- Private				X				
Franciscan Montessori Earth School SFA	School- Private		X	X	X				
French American International School	School- Private								
Gabriel Park Preschool	School- Private	X	X						
Grace Lutheran	School- Private			X	X				
Greenhouse Alternative High School	School- Private		X	X	X	X	X		X
Hancock Street Preschool	School- Private		X	X	X	X	X		X
Helen Gordon Child Development Center-PSU	School- Private	X	X	X	X		X		
Hilltop Preschool & Kindergarten	School- Private								
Hilltop School Of Music	School- Private								
Holy Cross Catholic School	School- Private		X			X	X		X
Holy Family Catholic School	School- Private		X		X		X		
Holy Redeemer Catholic School	School- Private			X	X		X		

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Insight School Of Oregon-OAHS	School- Private	X	X	X	X	X	X	X	X
IRCO Africa House	School- Private		X	X	X		X		
Islamic School Of Portland	School- Private			X	X				
Judon Academy	School- Private			X	X				
Kindercare Learning Centers, Downtown Portland	School- Private	X	X	X	X		X		
Kindercare Learning Centers, Fred Meyer	School- Private		X	X	X	X	X	X	X
Kindercare Learning Centers, Powell	School- Private		X	X	X				
Lee Owen Stone Preschool	School- Private		X		X		X		
Lewis & Clark College	School- Private						X		
Lewis & Clark Law School	School- Private								
Maimonides Jewish Day School	School- Private				X				
MARTINIAMINC School For Entrepreneurship	School- Private		X	X	X	X	X		X
MHCC Head Start David Douglas Site	School- Private								
MHCC Head Start-Cascade Crossing	School- Private		X		X		X		
MHCC Head Start-Gateway Children's	School- Private			X	X		X		
MHCC Head Start-Harold Oliver Site	School- Private								
MHCC Head Start-Lynchwood Site	School- Private		X		X				

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MHCC Head Start-Russellville Site	School- Private			X	X		X		
MHCC Head Start-Thompson Site	School- Private			X	X	X	X		X
Mill Park Preschool	School- Private								
Montessori Alameda	School- Private				X		X		
Mt. Scott Learning Center High	School- Private				X				
Multnomah Playschool	School- Private								
Multnomah University	School- Private	X	X	X	X	X	X		X
National College Of Natural Medicine	School- Private	X	X	X	X		X		
National College Of Natural Medicine	School- Private		X	X	X		X		
NAYA Early College Academy	School- Private			X	X	X	X		X
Neveh Shalom Foundation School	School- Private								
New Avenues For Youth	School- Private		X	X	X	X	X		X
New Day Ananda Marga School Of Portland	School- Private		X	X	X	X	X		X
North Portland Bible College	School- Private			X	X				
OHSU-Children's Psychiatric Day Treatment	School- Private		X		X				
OOI- The Gladys McCoy Academy	School- Private			X	X		X		
Open Meadow Alternative Schools Administration	School- Private	X	X			X	X		X
Open Meadow High	School- Private	X	X			X	X		X
Open Meadow Middle	School- Private		X				X		

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Oregon College Of Oriental Medicine	School- Private		X	X	X	X	X		X
Oregon Council For Hispanic Advancement	School- Private		X	X	X	X	X		X
Oregon Museum Of Science And Industry	School- Private	X	X	X	X	X	X	X	X
Oregon Outreach Inc. Rosi Hinton High	School- Private								
Out Front House	School- Private		X		X		X		
Outside In-Urban Ed	School- Private	X	X	X	X		X		
Pacific Crest Community School	School- Private		X	X	X	X	X		X
Pacific Northwest College Of Art	School- Private	X	X	X	X	X	X		X
Pathfinder Academy	School- Private		X	X	X	X	X		
Portland Adventist Academy	School- Private			X	X				
Portland Bible College	School- Private		X	X	X	X	X		X
Portland Chinese School	School- Private	X	X	X	X		X		
Portland Christian Elementary	School- Private								
Portland Christian Junior/Senior High	School- Private			X	X	X	X		X
Portland Jewish Academy	School- Private				X				
Portland Opportunities Industrialization Center	School- Private		X	X	X				
Portland School Of Experiential Education	School- Private		X		X		X		

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Portland Tillamook Preschool	School- Private		X	X	X	X	X		X
Portland Youthbuilders	School- Private		X	X	X				
Puddletown School	School- Private		X		X		X		
Reed College	School- Private	X	X		X		X		
Rose City Cooperative Preschool	School- Private				X		X		
Rosemary Anderson High -North Campus	School- Private		X	X	X				
School Of Autism Inc.	School- Private	X	X	X	X	X	X		X
SE Works Community Learning Center	School- Private				X				
Serendipity	School- Private		X	X	X				
SERP Enterprises Inc.	School- Private		X		X				
Slavic Christian Academy-Se Portland	School- Private		X	X	X				
St. Agatha School	School- Private		X		X		X		
St. Andrew Nativity School	School- Private				X				
St. Clare Preschool	School- Private			X	X				
St. Clare School	School- Private			X	X				
St. Ignatius School	School- Private			X	X				
St. John Fisher School	School- Private		X		X				
St. Mary's Academy School	School- Private	X	X	X	X		X		
St. Therese School	School- Private				X		X		
St. Thomas More School	School- Private	X	X						

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Sunnyside Mennonite Montessori School	School- Private								
Sunshine School	School- Private			X	X				
Sunstone Montessori School	School- Private			X	X		X		
Sylvan Learning Center	School- Private								
Sylvan Learning Center #150	School- Private								
The Art Institute Of Portland	School- Private	X	X	X	X	X	X		X
The International School	School- Private	X	X	X	X		X		
The Madeleine School	School- Private		X		X		X		
The Northwest Academy	School- Private	X	X	X	X		X		
Trinity Lutheran	School- Private			X	X	X	X		X
Tucker-Maxon Oral	School- Private		X	X	X	X	X		X
University Of Portland	School- Private		X			X	X		
Urban League Of Portland Street Academy	School- Private		X	X	X	X	X		X
Village Home Education Resource Center: Pc	School- Private				X		X		
Walla Walla University-Portland Campus	School- Private			X	X				
Warner Pacific College	School- Private				X				
Wee Works Child Care Center & Preschool	School- Private		X	X	X	X	X		X
West Hills Christian	School- Private			X	X				
West Hills Schools	School- Private				X				

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West Hills Schools-Montessori And Elementary	School- Private		X						
West Hills Schools-Montessori Pathways Mc	School- Private				X				
Western Seminary	School- Private								
Western States Chiropractic College	School- Private		X	X	X	X	X	X	X
Whole Child Montessori Center, Inc.	School- Private	X	X		X		X		
Wildwood Preschool	School- Private		X						
Youth Employment Institute	School- Private		X	X	X	X	X		X
Abernethy Elementary	School- Public	X	X	X	X	X	X		X
Access Academy At Rose City Park	School- Public				X		X		
Access Alternative Program	School- Public								
ACE Academy	School- Public	X	X	X	X	X	X		X
Ainsworth Elementary	School- Public		X	X	X				
Alameda Elementary	School- Public						X		
Albina Head Start	School- Public		X		X		X		
Alder Elementary	School- Public			X	X				
Alice Ott Middle	School- Public		X	X	X				
Alliance High	School- Public				X		X		
Applegate Head Start	School- Public		X	X	X	X	X	X	X
Arleta Elementary	School- Public				X				

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Arthur Academy	School- Public		X		X				
Arthur Academy (Charter)	School- Public		X	X	X				
Astor Elementary	School- Public		X			X	X		
Atkinson Elementary	School- Public				X				
Beach Elementary	School- Public		X	X	X	X	X		X
Beaumont Middle	School- Public								
Benson Polytechnic High	School- Public	X	X	X	X	X	X	X	X
Beverly Clearly At Rose City Park Campus	School- Public				X		X		
Beverly Cleary At Fernwood Campus	School- Public		X	X	X	X	X	X	X
Beverly Cleary At Hollyrood Campus	School- Public		X	X	X	X	X		X
Boise-Eliot/Humboldt Elementary	School- Public		X	X	X	X	X		X
Breakthrough (DART)	School- Public		X	X	X	X	X	X	X
Bridger Elementary	School- Public				X				
Bridlemile Elementary	School- Public		X						
Buckman Elementary	School- Public	X	X		X		X		
Capitol Hill Elementary	School- Public			X	X				
Cesar Chavez Elementary	School- Public		X		X	X	X		X
Chapman Elementary	School- Public		X	X	X	X	X		
Cherry Park Elementary	School- Public			X	X				
Chief Joseph Elementary	School- Public		X		X		X		

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Clarendon Early Learning Academy	School- Public		X	X	X	X	X		X
Clark Head Start At Creative Science School	School- Public			X	X				
Cleveland High	School- Public		X	X	X	X	X		X
Clinton (DART)	School- Public	X	X	X	X	X	X	X	X
Columbia Regional Program	School- Public		X	X	X	X	X		X
Community Transition Program	School- Public								
Community Transition Program On MLK	School- Public		X	X	X		X		
Community Transitions Program At Green Thumb	School- Public		X						
Community Transitions Program Center	School- Public		X						
Creative Science School At Clark	School- Public			X	X				
Creston Annex Head Start	School- Public			X	X				
Creston Elementary	School- Public			X	X				
Da Vinci Arts Middle	School- Public	X	X	X	X	X	X		X
David Douglas Evening Academy	School- Public								
David Douglas High	School- Public								
David Douglas SD 40	School- Public								
Doernbecher Children's Hospital	School- Public		X		X				
Donald E. Long	School- Public		X	X	X	X	X	X	X
Duniway Elementary	School- Public		X	X	X	X	X		X

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Earl Boyles Elementary	School- Public		X	X	X				
Early Learners Academy At The Ramona	School- Public	X	X	X	X	X	X	X	X
East Sylvan Middle	School- Public		X						
Emerson School (Charter)	School- Public		X	X	X	X	X		X
ESD Program At Donald E Long	School- Public		X	X	X	X	X	X	X
Faubion Elementary	School- Public		X	X	X	X	X	X	X
Fir Ridge Campus	School- Public				X				
Floyd Light Middle	School- Public				X				
Forest Park Elementary	School- Public								
Four Corners Program	School- Public								
Franklin High	School- Public			X	X				
George Middle	School- Public			X	X	X	X		X
Gilbert Heights Elementary	School- Public		X	X	X				
Gilbert Park Elementary	School- Public		X	X	X				
Glencoe Elementary	School- Public				X				
Glenfair Elementary	School- Public								
Grant High	School- Public		X	X	X	X	X		X
Gray Middle	School- Public								
Grout Elementary	School- Public		X	X	X	X	X		X
Hand In Hand (DART)	School- Public			X	X	X	X		X
Harrison Park Elementary	School- Public			X	X				

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Hayhurst Elementary	School- Public		X						
Head Start Sacajawea	School- Public		X	X	X		X		
Helensview High	School- Public	X	X	X	X	X	X	X	X
Hosford Middle	School- Public		X		X		X		
Incarcerated Youth Program At Donald E Long	School- Public		X	X	X	X	X	X	X
Inverness Jail Educational Program	School- Public		X	X	X	X	X		X
Irvington Elementary	School- Public		X		X		X		
Jackson Middle	School- Public			X	X				
James John Elementary	School- Public		X	X	X	X	X		
Janus Youth Programs	School- Public	X	X	X	X	X	X	X	X
Jason Lee Elementary	School- Public		X	X	X	X	X		X
Jefferson High	School- Public			X	X				
Kelly Center Head Start	School- Public		X	X	X				
Kelly Elementary	School- Public		X	X	X				
King Elementary	School- Public				X				
Lane Middle	School- Public		X						
Laurelhurst Elementary	School- Public		X	X	X	X	X		X
Le Monde French Immersion Pc School	School- Public	X	X	X	X		X		
Leadership And Entrepreneurship Public Charter	School- Public	X	X		X		X		

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Learning Gardens Laboratory	School- Public		X						
Legacy Emanuel Hospital	School- Public		X	X	X	X	X		X
Lent Elementary	School- Public		X	X	X				
Lewis Elementary	School- Public		X						
Lincoln High	School- Public		X	X	X		X		
Lincoln Park Elementary	School- Public				X				
Llewellyn Elementary	School- Public		X		X	X	X		
Lynch View Elementary	School- Public				X				
Lynch Wood Elementary	School- Public		X	X	X				
Madison High	School- Public		X	X	X	X	X		X
Maplewood Elementary	School- Public		X						
Margaret Scott Elementary	School- Public		X	X	X	X	X		X
Markham Elementary	School- Public			X	X				
Marysville Elementary	School- Public				X				
Menlo Park Elementary	School- Public								
MESD Multnomah Early Childhood Pa 6	School- Public		X	X	X		X		
MESD Program At Cleveland HS	School- Public		X	X	X	X	X		X
MESD Program At David Douglas HS	School- Public								
MESD Program At Harold Oliver Intermediate	School- Public								
MESD Program At Madison HS	School- Public		X		X	X	X		X

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MESD Program At Ventura Park	School- Public								
Metropolitan Learning Center	School- Public		X	X	X	X	X		
MHCC Head Start-Knott Site	School- Public			X	X	X	X		X
Mill Park Elementary	School- Public				X				
Mt. Tabor Middle	School- Public			X	X	X	X		X
Multnomah Education Service District	School- Public		X	X	X		X		
Neighborhood House	School- Public				X				
Nickerson (DART)	School- Public								
North Powellhurst School	School- Public								
Ockley Green Elementary	School- Public		X	X	X		X		
Odyssey	School- Public		X						
Oliver Elementary	School- Public								
Opal Public Charter School Of The PCM	School- Public	X	X						
Oregon Health & Science University	School- Public		X		X				
Oregon State Hospital-Portland Campus	School- Public	X	X	X	X	X	X		X
Parklane Elementary	School- Public								
Parkrose High	School- Public		X	X	X	X	X		X
Parkrose Middle	School- Public		X	X	X	X	X		X
Parkrose SD 3	School- Public		X	X	X	X	X		X

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Parry Center For Children (DART)	School- Public		X	X	X		X		
Parry Center SCIP	School- Public		X	X	X		X		
PCC/Hillsboro Basic English	School- Public			X	X				
PCC/Lep (Limited English Proficiency)	School- Public				X				
PCC/Tuition Reimbursement Program	School- Public				X				
PCC-Portland Workforce Training Ctr	School- Public				X	X	X		X
Peninsula Children's Center	School- Public		X	X	X		X		
Peninsula Elementary	School- Public		X			X	X		X
Pioneer High At Tubman	School- Public		X	X	X	X	X		X
Pioneer Middle At Youngson	School- Public			X	X				
Pioneer Special School-Holladay	School- Public			X	X				
Pioneer Special School-Holladay Annex	School- Public				X				
Portland Community College-Cascade	School- Public			X	X				
Portland Community College-CLIMB Center	School- Public		X	X	X	X	X	X	X
Portland Community College-Downtown	School- Public		X	X	X	X	X		X
Portland Community College-Southeast	School- Public				X				

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Portland Community College-Sylvania	School- Public				X				
Portland SD 1J	School- Public	X	X	X	X	X	X	X	X
Portland State University	School- Public	X	X	X	X		X		
Portland Village School	School- Public		X		X		X		
Prescott Elementary	School- Public		X	X	X	X	X		X
Providence Child Center	School- Public			X	X	X	X	X	X
Richmond Elementary	School- Public				X				
Rieke Elementary	School- Public				X				
Rigler Elementary	School- Public				X		X		
Riverdale High	School- Public				X				
Ron Russell Middle	School- Public		X	X	X				
Roosevelt High	School- Public		X	X	X	X	X		X
Rosa Parks Elementary	School- Public	X	X		X	X	X	X	X
Roseway Heights Elementary	School- Public		X		X		X		
Russell Academy	School- Public			X	X	X	X		X
Sabin Elementary	School- Public								
Sacramento Elementary	School- Public				X		X		
Scott Elementary	School- Public		X		X		X		
Scuola Italiana	School- Public	X	X	X	X	X	X	X	X
SEI Academy	School- Public			X	X		X		
Sellwood Middle	School- Public		X		X	X	X		

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Shaver Elementary	School- Public		X	X	X	X	X		X
Shriners Hospital	School- Public		X	X	X				
Sitton Elementary	School- Public			X	X	X	X		
Sitton Head Start	School- Public			X	X	X	X		
Southwest Charter School	School- Public		X	X	X		X		
Stephenson Elementary	School- Public								
Sunnyside Environmental	School- Public								
TAG Office At Rice School	School- Public		X	X	X	X	X		X
The Ivy Montessori Public Charter	School- Public		X	X	X		X		
The Ivy Montessori Public Charter LE	School- Public								
Trillium Public Charter	School- Public		X	X	X		X		
Ventura Park Elementary	School- Public								
Vernon Elementary	School- Public				X		X		
Vestal Elementary	School- Public		X		X		X		
West Powellhurst Elementary	School- Public			X	X				
White Shield (DART)	School- Public	X	X		X	X	X		
Whitman Elementary	School- Public		X		X				
Wilson High	School- Public			X	X				
Winterhaven Elementary	School- Public		X	X	X	X	X		X
Woodlawn Elementary	School- Public		X	X	X	X	X	X	X
Woodmere Elementary	School- Public				X				

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Woodstock Elementary	School- Public		X						
Concentra Urgent Care (12518 NE Airport Way)	Urgent Care Center	X	X	X	X	X	X		
Concentra Urgent Care (3449 N Anchor St)	Urgent Care Center	X	X		X	X	X		X
Doctors Express Urgent Care	Urgent Care Center		X		X		X		
Legacy Good Samaritan Ambulatory Care Clinic	Urgent Care Center		X	X	X		X		
Portland Urgent Care	Urgent Care Center			X	X	X	X	X	
The Portland Clinic	Urgent Care Center		X	X	X	X	X		
Zoomcare (10201 NE Cascades Pkwy)	Urgent Care Center		X	X	X		X		
Zoomcare (1400 NE Alberta St)	Urgent Care Center								
Zoomcare (1662 NW 23rd Ave)	Urgent Care Center		X	X	X	X	X		X
Zoomcare (202 NW 13th Ave)	Urgent Care Center	X	X	X	X	X	X		X
Zoomcare (2400 E Burnside St)	Urgent Care Center	X	X		X		X		
Zoomcare (3325 SE Hawthorne Blvd)	Urgent Care Center								
Zoomcare (3872 N Mississippi Ave)	Urgent Care Center			X	X	X	X		X
Zoomcare (4415 SE Woodstock Blvd)	Urgent Care Center		X						
Zoomcare (6910 SE Milwaukie Ave)	Urgent Care Center		X	X	X	X	X		X
Zoomcare (7855 SW Capitol Hwy)	Urgent Care Center				X				

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Zoomcare (900 SW 5th Ave)	Urgent Care Center	X	X	X	X		X		
Troutdale									
Troutdale Airport	Airport		X	X	X	X	X		X
Beaver Creek Bridge	Bridge			X	X	X	X		X
Lancaster Learning Tree	Childcare Facility			X	X	X	X	X	X
Little Lambs Christian (503 SW 9th Cir)	Childcare Facility				X	X	X		X
Little Lambs Christian Learning Center (27000 SE Stark St)	Childcare Facility		X						
Mt Hood Cc Child Care Ctr	Childcare Facility		X		X				
YMCA Before After School - Troutdale	Childcare Facility				X		X		
Troutdale City Hall	City Hall			X	X	X	X	X	X
Animal Services	County Asset		X	X	X	X	X	X	X
Animal Services Modular Office	County Asset		X	X	X	X	X	X	X
Animal Services Pole Barn	County Asset		X	X	X	X	X	X	X
Troutdale Library	County Asset		X	X	X		X		
Gresham Fire & Emerg Srvcs 75	Fire Station				X		X		
Troutdale Police Department	Law Enforcement			X	X	X	X	X	X
Troutdale Library	Library		X	X	X		X		
Alterra Clare Bridge - Troutdale	Residential Care Facility				X		X		
Clare Bridge Of Troutdale	Residential Care Facility				X		X		

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Home Helpers	Residential Care Facility								
Morrison Center Counterpoint Program	School- Private		X	X	X	X	X		X
Tree Of Knowledge	School- Private		X	X	X				
Arata Creek School	School- Public		X	X	X	X	X		X
Edgefield Children's Center	School- Public		X	X	X	X	X		X
MESD Program At Arata Creek	School- Public		X	X	X	X	X		X
Reynolds Arthur Academy	School- Public		X						
Reynolds High	School- Public		X		X		X		
Sweetbriar Elementary	School- Public		X						
Troutdale Elementary	School- Public				X	X	X		X
Walt Morey Middle	School- Public		X	X	X				
Wood Village									
Step By Step Childcare	Childcare Facility		X	X	X	X	X		X
Treehill Day School	Childcare Facility		X	X	X	X	X		X
Wood Village City Hall	City Hall		X	X	X	X	X	X	X
Village Manor	Residential Care Facility		X	X	X	X	X	X	X
Village Manor Nursing Home	Residential Care Facility		X	X	X	X	X	X	X
Unincorporated Area									
252nd Avenue Bridge	Bridge			X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Circle Avenue Bridge #2	Bridge		X		X				
Corbett Hill Viaduct	Bridge			X	X	X	X	X	X
Gordon Creek Bridge	Bridge								
Gordon Creek Road Viaduct	Bridge								
Jenne Road/174th Av Bridge	Bridge		X	X	X				
Latourell Falls Road Bridge	Bridge			X	X	X	X	X	X
Littlepage Rd Box Culvert	Bridge								
Sauvie Island Bridge	Bridge			X	X	X	X	X	X
Smith Road Bridge	Bridge								
Stark Street Bridge	Bridge								
Stark Street Viaduct	Bridge								
Champions - East Orient	Childcare Facility			X	X				
Champions - Pleasant Valley	Childcare Facility								
Children's World-Corbett	Childcare Facility			X	X	X	X	X	X
PCS-Springdale Child Dev	Childcare Facility								
Portland Jewish Academy	Childcare Facility			X	X	X	X		
Beaverton Community Center	Community Center								
Biddle Butte	County Asset								
Skyline Road Shop	County Asset				X				
Skyline Road Shop Garage	County Asset				X				
Skyline Road Shop Pump House	County Asset				X		X		
Skyline Road Shop Shed	County Asset				X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
Spindrift Cottage	County Asset								
Springdale Road Shop	County Asset								
Springdale Road Shop Shed	County Asset								
Springdale Road Shop Storage	County Asset								
State Medical Examiner	County Asset								
Gresham Fire & Emerg Srvcs 76	Fire Station			X	X				
Multnomah Co RFPD 14 61	Fire Station								
Multnomah Co RFPD 14 62	Fire Station				X		X		
Multnomah Co RFPD 14 63	Fire Station								
Portland Fire & Rescue 27	Fire Station								
Sauvie Island Vol Fd #30 30	Fire Station				X		X		
Scappoose RFPD 436	Fire Station			X	X	X	X		X
Tualatin Valley Fire & Rescue 368	Fire Station			X	X	X	X		
5 Star Home Care Of Oregon	Licensed Medical Facility								
Springdale Job Corps Center	School- Private								
Corbett Charter	School- Public				X		X		
Corbett Elementary	School- Public				X		X		
Corbett High	School- Public				X		X		
Corbett Middle	School- Public				X		X		
Corbett SD 39	School- Public				X		X		
East Orient Elementary	School- Public			X	X				

FACILITY NAME	FACILITY TYPE	Fixed HAZMAT Daytime Buffer	Fixed HAZMAT Nighttime Buffer	Mobile HAZMT0.5-mile (road)	Mobile HAZMT1.0-mile (road)	Mobile HAZMT 0.5-mile (rail)	Mobile HAZMT 1.0-mile (rail)	Crude Oil Rail 1,000 feet	Crude Oil Rail 0.5-mile
MESD Program At Sam Barlow HS	School- Public								
Pleasant Valley Elementary	School- Public								
Riverdale Grade	School- Public								
Riverdale SD 51J	School- Public								
Sam Barlow High	School- Public								
Sauvie Island Elementary	School- Public						X		
Skyline Elementary	School- Public			X	X	X	X		
Terra Nova Community Farm	School- Public								
West Orient Middle	School- Public			X	X				