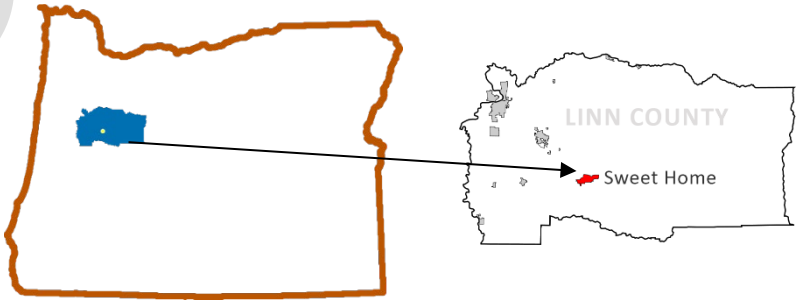
City of Sweet Home

NATURAL HAZARDS MITIGATION PLAN

Sweet Home is in
Linn County, OR



FEMA

Effective month date, 2021 through month date, 2026

The *2021 Sweet Home Natural Hazards Mitigation Plan* is a living document that will be reviewed and updated periodically. It will be integrated with existing plans, policies, and programs. The Disaster Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions maintain an approved NHMP to receive federal funds for pre- and post- disaster mitigation grants.

Comments, suggestions, corrections, and additions are encouraged to be submitted from all interested parties.

For further information and to provide comments, contact:

Ray Towry, City Manager
City of Sweet Home
3225 Main St.
Sweet Home, OR 97386
Phone: 541-367-8969 (office)
Email: rtowry@sweethomeor.gov

Lagea Mull, Communication Specialist
City of Sweet Home
3225 Main St.
Sweet Home, OR 97386
Phone: 541-818-8029 (office)
Email: lmull@sweethomeor.gov

Mission:

Proactively facilitate and support community-wide policies, practices, and programs that make Sweet Home more disaster resistant and disaster resilient.

Sweet Home developed this Natural Hazards Mitigation Plan (NHMP) through a partnership funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation Grant Program (PDM). In 2018, the Department of Land Conservation and Development (DLCD) applied for and received the grant from FEMA through the Oregon Office of Emergency Management (OEM) to assist Sweet Home. This *2021 Sweet Home NHMP* is the result of a substantial collaborative effort between DLCD, Sweet Home, and the Sweet Fire and Ambulance District (SHFAD). The *2021 Sweet Home NHMP* is structured to address the requirements contained in 44 CFR 201.6. Emphasis is placed on identifying and describing the unique attributes of the City of Sweet Home and the SHFAD (Special District).

Cover photos: Sweet Home boat ramp, 12/20/20 (top row left), snowstorm damage 2/8/14 (top row middle), hail storm tree damage 4/22/14 (top row right), Sweet Home area wildfires September 2020 (middle row left), city logo (middle row center), Sweet Home Tamarack flooding 12/20/20 (middle row right), storm damage 4/7/17 (bottom row left), flooded street 6/4/09 (bottom row center), hail storm 4/22/14 (bottom row right). All photos provided by Lagea Mull, Communications Specialist, Sweet Home, from various sources.

Volume I: Basic Plan

Flooding at the boat ramp, 12/20/20

Credit: Kevin Makinson, Sweet Home Public Works

Source: Lagea Mull, Sweet Home, personal communication, 7/19/21

Flooding at Tamarack, 12/20/20

Credit: Kevin Makinson, Sweet Home Public Works

Source: Lagea Mull, Sweet Home, personal communication, 7/19/21

Special Thanks & Acknowledgements

Sweet Home developed this Natural Hazards Mitigation Plan (NHMP) through a partnership funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation Grant Program (PDM). In 2018, the Department of Land Conservation and Development (DLCD) applied for and received the grant from FEMA through the Oregon Office of Emergency Management (OEM) to assist Sweet Home. This *2021 Sweet Home NHMP* is the result of a substantial collaborative effort between DLCD, Sweet Home, and the Sweet Fire and Ambulance District (SHFAD). The *2021 Sweet Home NHMP* is structured to address the requirements contained in 44 CFR 201.6. Emphasis is placed on identifying and describing the unique attributes of the City of Sweet Home and the SHFAD (Special District).

All Partners and Participants Include:

City of Sweet Home
Sweet Home Fire and Ambulance District
Linn County
Oregon Office of Emergency Management (OEM)
Oregon Department of Land Conservation and Development (DLCD)
Federal Emergency Management Agency (FEMA) Region X

Project Managers:

Tricia Sears, Natural Hazards Planner, DLCD
Blair Larsen, Community and Economic Development Director

All Participants / Partners on the NHMP Steering Committee

Representatives from the following organizations served as steering committee members for the *2021 Sweet Home NHMP* update process. Partners that are plan holders are those organizations or jurisdictions that signed IGAs with DLCD for the work on the NHMP. These plan holders are: the City of Sweet Home. All participants on the NHMP Steering Committee are listed below.

Department of Land Conservation & Development Staff

Tricia Sears, Natural Hazards Planner, DLCD

City of Sweet Home

Blair Larsen	Community and Economic Development Director, Convenor
Lagea Mull	Communication Specialist
Brandon Neish	Finance Director
Greg Springman	Public Works Director
Joe Graybill	Engineer
Jeff Lynn	Police Chief

Tommy Mull	Emergency Management Program Director (former)

Sweet Home Fire and Ambulance District

Dave Barringer	Fire Chief

Linn County

Joe Larsen	Emergency Management Coordinator (former)

About the Oregon Department of Land Conservation and Development

Oregon's statewide land use planning program — originated in 1973 under Senate Bill 100 — provides protection of farm and forest lands, conservation of natural resources, orderly and efficient development, coordination among local governments, and citizen involvement. The program affords all Oregonians predictability and sustainability to the development process by allocating land for industrial, commercial and housing development, as well as transportation and agriculture. The Department of Land Conservation and Development (DLCD) administers the program. A seven-member volunteer citizen board known as the Land Conservation and Development Commission (LCDC) guides DLCD. Under the program, all cities and counties have adopted comprehensive plans that meet mandatory state standards that address land use, development, housing, transportation, and conservation of natural resources. Periodic review of plans and technical assistance in the form of grants to local jurisdictions are key elements of the program.[1]

[1] DLCD, http://www.oregon.gov/LCD/Pages/about_us.aspx, accessed November 14, 2018.

Sweet Home
Natural Hazards Mitigation Plan

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Executive Summary

The location of Sweet Home, Oregon is shown on Figure EX-2, Sweet Home Vicinity Map. The City of Sweet Home developed and updated this *2021 Sweet Home Natural Hazards Mitigation Plan* (*2021 Sweet Home NHMP*), in collaboration with DLCD, to prepare for and to mitigate the short- and long-term effects resulting from natural hazards. It is not possible to predict exactly when these hazards will occur, or the extent to which they will affect the community. However, with careful planning and collaboration among the whole community (https://www.fema.gov/whole-community) - public agencies at local, state and federal levels; private sector organizations; businesses; families and individuals; non-profit groups; schools and academia; media outlets; faith based and community organizations - a resilient community can be created that benefits from mitigation planning, including this *2021 Sweet Home NHMP,* and short- and long-term recovery planning efforts, which are described in other plans.

> *44 CFR 201.6 – The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards. . . .*

The Federal Emergency Management Agency (FEMA) defines mitigation as ". . . the effort to reduce loss of life and property by lessening the impact of disasters . . . through risk analysis, which results in information that provides a foundation for mitigation activities that reduce risk." Said another way, natural hazard mitigation is a method of reducing or alleviating the impacts to life, property, and the environment resulting from natural hazards through short- and long-term strategies. Example strategies include policy changes, such as updated ordinances, and projects, such as seismic retrofits to critical facilities; and education and outreach to targeted audiences, such as Spanish speaking residents or the elderly. Natural hazard mitigation is the responsibility of the whole community.

Why Develop this Mitigation Plan?

> *44 CFR 201.6(a)(1) – A local government must have a mitigation plan approved pursuant to this section in order to receive HMGP project grants . . .*

In addition to establishing a comprehensive community-level mitigation strategy, the Disaster Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions maintain an approved NHMP to receive federal funds for mitigation projects. Local and federal approval of this plan ensures that Sweet Home will remain eligible for pre- and post-disaster mitigation grants.

Who Participated in Developing the Plan?

The Oregon Department of Land Development and Conservation (DLCD) led the Sweet Home NHMP Steering Committee through the NHMP update process. Sweet Home, which is also identified as a plan holder because they have signed an IGA with DLCD, collaborated with the Sweet Home Fire and Ambulance (SHFAD) and Linn County to update to the *2015 Sweet NHMP*.

The Sweet Home NHMP Steering Committee includes these partner organizations:

- Sweet Home
- Sweet Home Fire and Ambulance
- Linn County

See the Acknowledgements section for the full list of organizations and representatives that participated on the NHMP Steering Committee.

44 CFR 201.6(c)(1) – Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

In collaboration with DLCD, the initially the Sweet Home Emergency Management Program Director (now former) and the Community and Economic Development Director convened the planning process. During the NHMP update, the Community and Economic Development Director became the convenor. At this time, the Community and Economic Development Director (or the delegate) will take the lead in implementing, maintaining, and updating the NHMP. Sweet Home is dedicated to directly involving the public in the continued review and update of the NHMP. The City of Sweet Home will post the *2021 Sweet Home Natural Hazards Mitigation Plan* on their website.

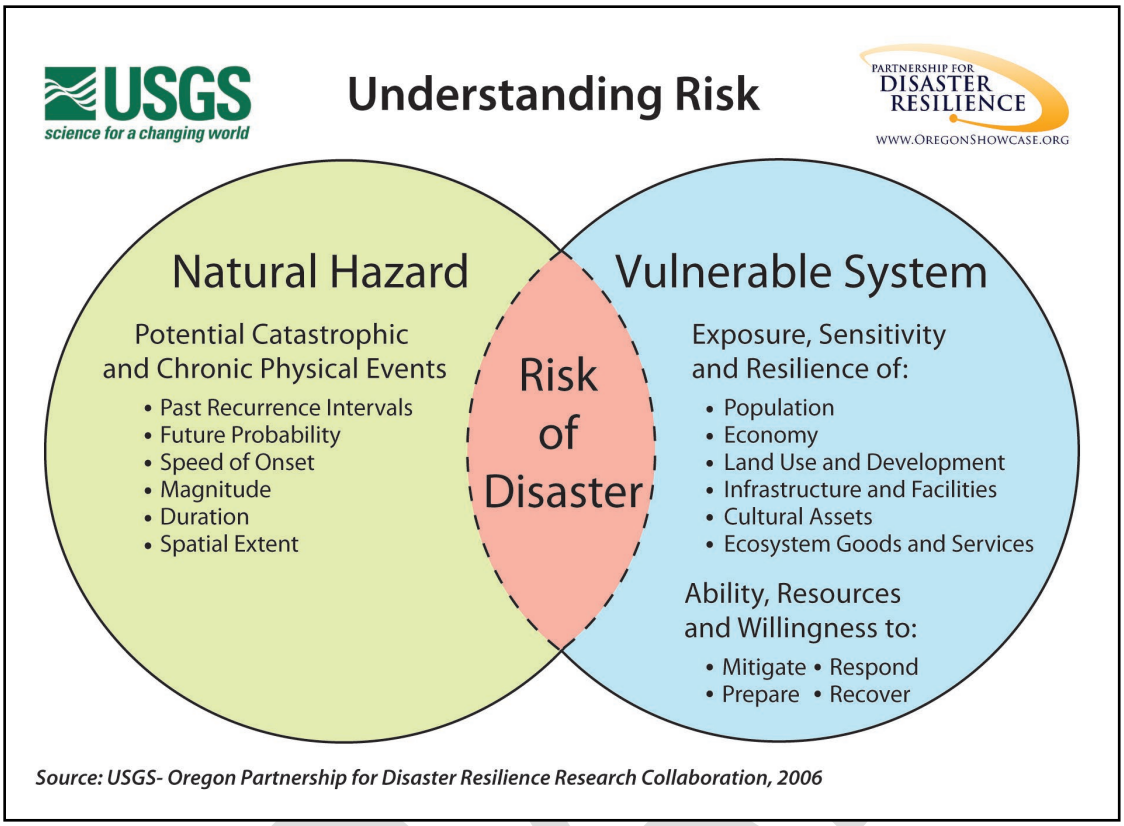
This NHMP was developed through a partnership funded by FEMA's Pre-Disaster Mitigation (PDM) Grant Program (HMGP). In 2018, DLCD applied for and received funding under PDM 19 funds available from FEMA through Oregon's Office of Emergency Management (OEM).

How Does this Mitigation Plan Reduce Risk?

44 CFR 201.6(c)(2) – A Risk Assessment that provides the factual basis for activities proposed in the strategy . . .

The NHMP is intended to assist Sweet Home to reduce the risk from natural hazards by identifying resources, information, and strategies for risk reduction. It will also help guide and coordinate mitigation activities throughout Sweet Home. A key part of the NHMP is the risk assessment. It consists of three phases: hazard identification, vulnerability assessment, and risk analysis. In Figure EX-1, the identification of natural hazards that could impact the community (natural hazard) and the exposure, sensitivity, and resilience of community (vulnerable system) overlap to create the risk of disaster. Recognizing and understanding these three phases is a key to natural hazard mitigation planning. Sweet Home will also coordinate the NHMP work with partners.

Figure EX-1 Understanding Risk



Source: USGS and Oregon Partnership for Disaster Resilience, 2006.

By identifying and understanding the relationship between natural hazards, vulnerable systems, and existing capacity, Sweet Home is better equipped to identify and implement actions aimed at reducing the overall risk to natural hazards. Volume I Section 2 Risk Assessment and Volume II Hazard Annexes provide details on the natural hazards in Sweet Home as well as the vulnerabilities and risks. Mitigation actions are identified to help reduce risk; see Section 3 Mitigation Strategy for details on mitigation actions.

What is the County's Overall Risk to Hazards?

Sweet Home, along with the Sweet Home Fire and Ambulance District and Linn County reviewed and updated their risk assessment to evaluate the probability of each natural hazard as well as the vulnerability of the community to that hazard. All the previously identified natural hazards were retained for this NHMP. The NHMP Steering Committee performed the Hazards Vulnerability Assessment (HVA) at the December 4, 2020 and January 8, 2021 meetings. It was discussed again at the February 5, 2021 meeting and revised. Table EX-1 summarizes the risk score and risk level for each hazard as determined by the Sweet Home NHMP Steering Committee. See also Volume I Section 2 Risk Assessment and Volume II Hazard Annexes for additional hazard information.

Table EX-1 Natural Hazards, Risk Scores, and Risk Levels for Sweet Home

HAZARD	RISK SCORE	RISK LEVEL (H-M-L)
Severe Storms	221	High
Wildland-Urban Interface Fires	166	Medium
Floods	156	Medium
Earthquakes	149	Medium
Volcanic Events	147	Medium
Droughts	94	Low
Landslides	24	Very Low

Source: DLCD Natural Hazards Planner, Tricia Sears, and the Sweet Home NHMP Steering Committee, 2020-2021.

What is the Plan's Mission?

The mission of Sweet Home's NHMP was retained from the *2015 Sweet Home NHM*P for the *2021 Sweet Home NHMP*.

Mission:

Proactively facilitate and support community-wide policies, practices, and programs that make Sweet Home more disaster resistant and disaster resilient.

What are the Plan Goals?

44 CFR 201.6(c)(3)(i) – A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

The plan goals describe the overall direction that the participating jurisdiction's agencies, organizations, and citizens can take toward mitigating risk from natural hazards. The Sweet Home NHMP Steering Committee retained the goals as is from the *2015 Sweet Home NHMP* for the *2021 Sweet Home NHMP*.

Goal 1: Reduce the Threat to Life Safety

A. Enhance life safety by minimizing the potential for deaths and injuries in future disaster events.
B. Enhance life safety by improving public awareness of earthquakes and other natural hazards posing life safety risk to the Sweet Home community.

Goal 2: Reduce the Threats to Sweet Home Buildings, Facilities, and Infrastructure

A. Identify buildings and infrastructure at high risk from one or more hazards.
B. Conduct risk assessments for critical buildings, facilities, and infrastructure at high risk to determine cost effective mitigation actions to eliminate or reduce risk.

C. Implement mitigation measures for buildings, facilities, and infrastructure which pose an unacceptable level of risk.
D. Ensure that new buildings and infrastructure in Sweet Home are adequately designed and located to minimize damages in future disaster events.

Goal 3: Enhance Emergency Response Capability, Emergency Planning, and Post-Disaster Recovery

A. Ensure that critical facilities and critical infrastructure are capable of withstanding disaster events with minimal damage and loss of function.
B. Enhance emergency planning to facilitate effective response and recovery from future disaster events.
C. Increase collaboration and coordination between Sweet Home, nearby communities, utilities, businesses, and citizens to ensure the availability of adequate emergency and essential services for the Sweet Home community during and after disaster events.

Goal 4: Seek Funding Sources for Mitigation Actions

A. Prioritize and fund action items with the specific objective of maximizing mitigation, response and recovery resources.
B. Explore both public (local, state, and federal) funding and private sources for mitigation actions.

Goal 5: Increase Public Awareness of Natural Hazards and Enhance Education and Outreach Efforts

A. Development and implement education and outreach programs to increase public awareness of the risks from natural hazards.
B. Provide information on resources, tools, partnership opportunities and funding sources to assist the community in implementing mitigation activities.
C. Strengthen communication and coordinate participation among and within public agencies, non-profit organizations, business, industry, and the public to encourage and facilitate mitigation actions.

Goal 6: Incorporate Mitigation Planning into Natural Resource Management and Land Use Planning

A. Protect Sweet Home's sources of potable water
B. Balance natural resource management, land use planning, and natural hazard mitigation to protect life, property, and the environment.
C. Preserve, rehabilitate, and enhance environmentally sensitive areas and natural systems within Sweet Home to both entrance habitats and serve natural hazard mitigation functions.

How are the Mitigation Actions Organized?

44 CFR 201.6(c)(3)(ii) – A section that identifies and analyzes a comprehensive range of specific mitigation actions . . .

The mitigation actions are organized within a Mitigation Actions Table included within Section 3 Mitigation Strategy. The Steering Committee agreed to use the risk level scores and rankings from the Hazard Vulnerability Assessment (HVA) - shown in summary in Table EX-1 - as a way to prioritize the mitigation actions. As a result of this, the high priority actions are the multi-hazard (MH) actions and the hazard-specific actions for severe storms. Severe storms is the hazard with the highest risk score, with it obtaining 221 out of 240 points. Wildland-urban interface fires, floods, earthquakes, and volcanic events have

a risk level of medium and thus the mitigation actions are medium. Droughts and landslides are low risk level and thus are low priority mitigation actions. Data collection, research, Steering Committee discussion, and the public participation process resulted in the development of the mitigation actions.

The 2021 Sweet Home NHMP Mitigation Actions is Table 3-1 and the Sweet Home Mitigation Actions 2015 Status is Table 3-2; both are in the Section 3 Mitigation Strategy.

The mitigation actions portray the overall plan framework and identify links between the plan goals and actions. Tables 3-1 and 3-2 document the title of each action along with the coordinating organization, timeline, and the plan goals addressed. Each participating jurisdiction is identified.

There are **39 total mitigation actions** in the *2021 Sweet Home NHMP*. By natural hazard, the totals are as follows: multi-hazard (MH) = 12; drought (DR) = 0; earthquake (EQ) = 5; flood (FL) = 8; severe storms (SS) = 7; wildland-urban interface fires (WF) = 3; volcanic events (VO) = 1, landslides(LS) = 3.

The mitigation actions include both short and long-term activities. Each action includes an estimate of the timeline for implementation.

- *Short-term action items* (ST) are activities that may be implemented with existing resources and authorities in one to two years.
- *Long-term action items* (LT) may require new or additional resources and/or authorities, and may take from one to five years to implement.
- *Ongoing action items* are activities that are currently being performed and will continue into the foreseeable future.

How will the plan be implemented?

44 CFR 201.6(c)(3)(iii) – An action plan describing how the actions . . . will be prioritized, implemented and administered . . .

44 CFR 201.6(c)(4) – A plan maintenance process . . .

Section 4 Plan Implementation and Maintenance details the formal process that will ensure that the *2021 Sweet Home NHMP* remains an active and relevant document. The plan will be implemented, maintained and updated by a designated convener. The Sweet Home Community and Economic Development Director, or the delegate, is the designated convener and is responsible for overseeing the review and implementation processes. The plan maintenance process includes a schedule for monitoring and evaluating the plan twice per year and updating the NHMP every five years to maintain eligibility for pre- and post-disaster funds from FEMA. This section of the NHMP describes how the communities will integrate public participation throughout the plan maintenance process.

Plan Adoption

44 CFR 201.6(c)(5) – Documentation that the plan has been formally adopted by the governing body of the jurisdiction . . .

44 CFR 201.6(d) – Plan review [process] . . .

Once the Sweet Home NHMP is locally reviewed and ready, the Sweet Home NHMP Convener (the Community and Economic Development Director) and the DLCD Natural Hazards Planner submit it to the State Hazard Mitigation Officer (SHMO) at Oregon's Office of Emergency Management (OEM). OEM reviews the NHMP. Once OEM reviews the NHMP and deems it

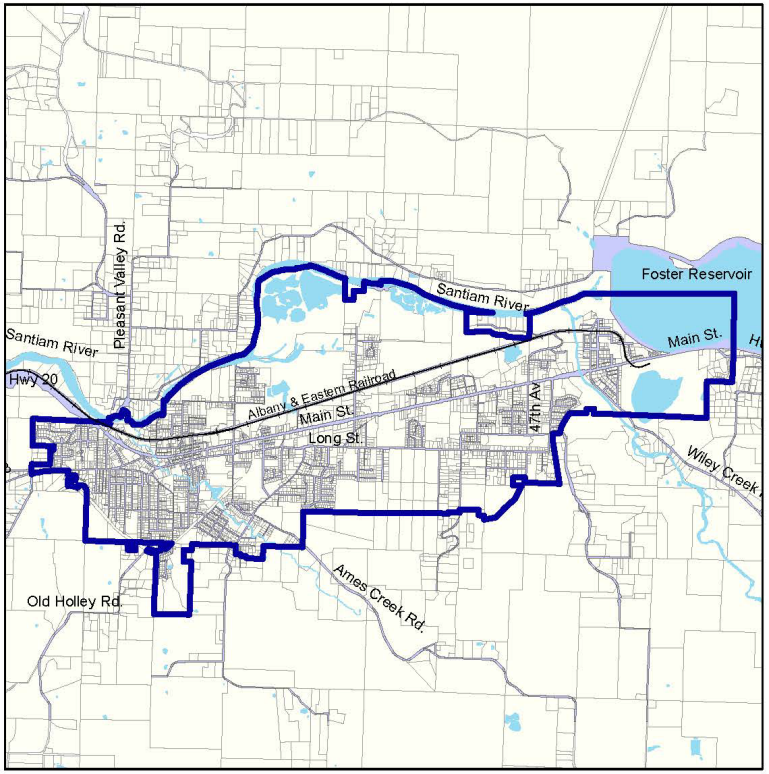
ready; they submit it to the Federal Emergency Management Agency (FEMA) Region X for review. This review addresses the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201.6.

Upon pre-approval by FEMA, indicated by a letter provided from FEMA to Sweet Home called the "Approved Pending Adoption" (APA), the City will then adopt the NHMP via resolution. Following City adoption, the Sweet Home NHMP Convener and the DLCD Natural Hazards Planner will then provide both OEM and FEMA with the resolution.

Once FEMA is provided with final resolution documentation from Sweet Home, they will formally approve the *2021 Sweet Home NHMP*. Sweet Home will then maintain their eligibility for the Hazard Mitigation Assistance (HMA) pre- and post- disaster funds. These funds are distributed through the Building Resilience Infrastructure and Communities (BRIC) program, the Hazard Mitigation Grant Program (HMGP), and the Flood Mitigation Assistance (FMA) program.

The accomplishment of the *2021 Sweet Home NHMP* goals and mitigation actions depends upon regular NHMP Steering Committee participation and support from City, County, and Special District leadership. Thorough familiarity with this NHMP will result in the efficient and effective implementation of mitigation actions and a reduction in the risk and the potential for loss from future natural hazard events.

Figure EX-2 Sweet Home Vicinity Map



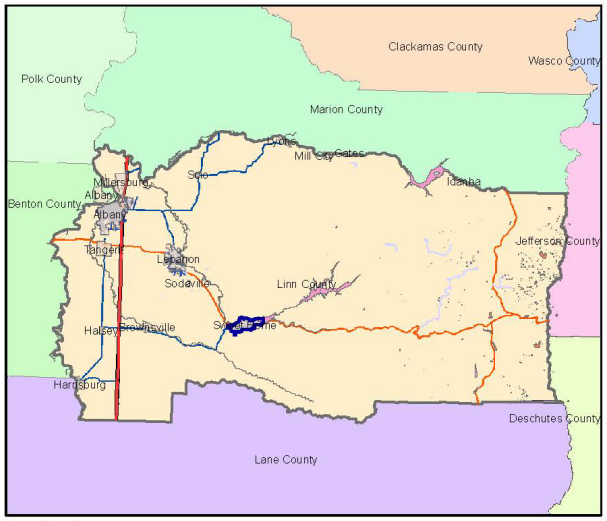
City of Sweet Home
Natural Hazards Mitigation Plan
Sweet Home, Linn County, State of Oregon Vicinity Map

September 2, 2021

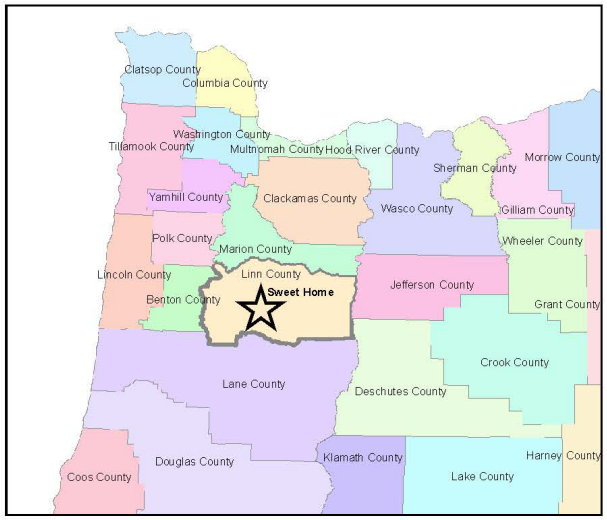
0 0.225 0.45 0.9 1.35 1.8 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots



Linn County



State of Oregon

Source: Joe Graybill, Sweet Home, 8/30/21

Section I: Introduction

This section provides a general introduction to natural hazard mitigation planning in Sweet Home. In addition, Section I: Introduction addresses the planning process requirements contained in 44 CFR 201.6(b) thereby meeting the planning process documentation requirement contained in 44 CFR 201.6(c)(1). The section concludes with a general description of how the plan is organized.

What is Natural Hazard Mitigation?

The Federal Emergency Management Agency (FEMA) defines mitigation as ". . . the effort to reduce loss of life and property by lessening the impact of disasters . . . through risk analysis, which results in information that provides a foundation for mitigation activities that reduce risk."[1] Said another way, natural hazard mitigation is a method of permanently reducing or alleviating the losses of life, property, and injuries resulting from natural hazards through long and short-term strategies. Example strategies include policy changes, such as updated ordinances, projects, such as seismic retrofits to critical facilities; and education and outreach to targeted audiences, such as Spanish speaking residents or the elderly. Natural hazard mitigation is the responsibility of the "Whole Community" – individuals and families; private businesses and industries; non-profit groups; schools and academia; media outlets; faith based and community organizations; and federal, state, and local governments.[2]

Engaging in mitigation activities provides jurisdictions with a number of benefits, including reduced loss of life, property, essential services, critical facilities and economic hardship; reduced short-term and long-term recovery and reconstruction costs; increased cooperation and communication within the community through the planning process; and increased potential for state and federal funding for recovery and reconstruction projects.

Why Develop a Mitigation Plan?

It is not possible to predict exactly when natural hazard events will occur, or the extent to which they will affect community assets. However, with careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, it is possible to minimize the impacts and losses that can result from natural hazards.

Sweet Home collaborated with DLCD and developed this Natural Hazards Mitigation Plan (NHMP) with contributions from Sweet Home Fire and Ambulance District and Linn County to reduce future loss of life and damage to property resulting from natural hazards. With the FEMA approval of the *2021 Sweet Home NHMP*, which updates the *2015 Sweet Home NHMP,* Sweet Home will then maintain their eligibility for the Hazard Mitigation Assistance (HMA) pre- and post- disaster funds. In addition to establishing a comprehensive community-level mitigation strategy, the Disaster

[1] FEMA, *What is Mitigation?* http://www.fema.gov/what-mitigation, accessed December 20, 2018,

[2] FEMA, *Whole Community*, https://www.fema.gov/whole-community, accessed December 20, 2018.

Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions maintain an approved NHMP to receive federal funds for pre- and post- disaster mitigation funds. See the NHMP's Table of contents for details on the contents of the NHMP.

What Federal Requirements Does This Plan Address?

DMA2K is a key piece of federal legislation addressing natural hazards mitigation planning. It reinforces the importance of mitigation planning and emphasizes planning for natural hazards before they occur. As such, this Act established the Pre-Disaster Mitigation (PDM) grant program, which has become the Building Resilient Infrastructure and Communities aka BRIC program, and requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP).

Section 322 of the Act specifically addresses mitigation planning at the state and local levels. State and local jurisdictions must have approved NHMPs to qualify to receive post-disaster HMGP funds. NHMPs must demonstrate that the proposed mitigation actions are based on a sound planning process that accounts for the risk to the individual and their capabilities. Chapter 44 Code of Federal Regulations (CFR), section 201.6, also requires a local government to have an approved NHMP in order to receive HMGP project grants.[3]

Pursuant of Chapter 44 CFR, the Natural Hazard Mitigation Plan planning processes shall include opportunity for the public to comment on the plan during review, and the NHMP shall include documentation of the public planning process used to develop the plan.[4] The NHMP update must also contain a risk assessment, mitigation strategy and a plan maintenance process that has been formally adopted by the governing body.

Development of the *2021 Sweet Home NHMP* was pursued in compliance with subsections from 44 CFR 201.6 guidelines. These four subsections address plan requirements, the planning process, plan content, and plan review.

- Subsection (a) provides an outline of the overall plan requirements, including an overview of general plan components, exceptions to requirements, and multi-jurisdictional participation.
- Subsection (b) outlines the requirements of the planning process, with particular focus on public involvement in the update process, as well as the role of local agencies, organizations and other relevant entities in the development process, as well as standards for adequate levels of review and incorporation of existing plans and policies.
- Subsection (c) outlines requirements concerning the plan update's content, including an overview of necessary components for the update's planning process, risk assessment, mitigation strategy, plan maintenance, and overall process documentation.
- Subsection (d) outlines the steps and agencies required for proper review of the plan before finished plans are adopted by their respective communities.[5]

[3] Code of Federal Regulations, Chapter 44. Section 201.6, subsection (a), 2010

[4] ibid, subsection (b). 2010

[5] ibid, subsection (c). 2010

The Natural Hazard Mitigation Plan must be submitted to Oregon's Office of Emergency Management (OEM) for initial plan review, and then it is submitted to FEMA for review and federal approval.[6] Once FEMA provides the Approved Pending Adoption letter, the local jurisdictions must approve the NHMP. Once the local jurisdictions have provided resolutions showing the adoption of the NHMP, FEMA will send the approval letter with the dates of the NHMP approval. The approval period is for five years.

Additionally, the Emergency Management Performance Grant (EMPG), which helps fund local emergency management programs, also requires a FEMA-approved NHMP.

What is the Policy Framework for Natural Hazards Planning in Oregon?

Planning for natural hazards is an integral element of Oregon's statewide land use planning program, which began in 1973. All Oregon cities and counties have comprehensive plans and implementing ordinances that are required to comply with the Statewide Planning Goals. The challenge faced by state and local governments is to keep this network of local plans coordinated in response to the changing conditions and needs of Oregon communities.

Statewide Planning Goal 7, Areas Subject to Natural Hazards, calls for local plans to include inventories, policies and ordinances to guide development in or away from hazard areas. Goal 7, along with other land use planning goals, has helped to reduce losses from natural hazards. Through risk identification and the recommendation of risk-reduction actions, this NHMP aligns with the goals of the jurisdictions' comprehensive plans, and helps each jurisdiction meet the requirements of Goal 7.

The primary responsibility for the development and implementation of risk reduction strategies and policies lies with local jurisdictions. However, resources exist at the state and federal levels. Some of the key agencies in this area include OEM, Oregon Building Codes Division (BCD), Oregon Department of Forestry (ODF), Oregon Department of Geology and Mineral Industries (DOGAMI), and the Department of Land Conservation and Development (DLCD).

How was the Plan Developed?

The Sweet Home NHMP Steering Committee, with the collaboration of DLCD staff, is updating the *2015 Sweet Home NHMP* which expired in 2019. The *2021 Sweet Home NHMP* is the result of a collaboration. DLCD led the Sweet Home NHMP Steering Committee through the NHMP update process. This *2021 Sweet Home NHMP* is the result of a substantial collaborative effort between DLCD, Sweet Home, Sweet Home Fire and Ambulance, and Linn County. The plan holders are those organizations or jurisdictions that signed IGAs with DLCD for the work on the NHMP; Sweet Home is a plan holder.

Contributing organizations to the *2021 Sweet Home NHMP* include the Federal Emergency Management Agency, the Oregon Office of Emergency Management, the Sweet Home Fire and Ambulance, Linn County, and the U.S. Army Corps of Engineers. A roster of the Sweet Home NHMP Steering Committee is included in the Acknowledgements section of this NHMP.

[6] ibid, subsection (d). 2010

The Sweet Home NHMP Steering Committee formally convened at 13 meetings in person and via Zoom: December 3, 2019 (pre-award, in person); December 4, 2020; January 8, 2021; February 5, 2021; March 5, 2021; April 2, 2021; May 7, 2021; June 4, 2021; June 21, 2021; July 12, 2021; July 19, 2021; August 9, 2021; and September 8, 2021. There was a gap in the meetings from the December 3, 2019 meeting (pre-award) to the December 4, 2020 meeting (post-award) due to the wait for FEMA to obligate the funds for the NHMP update. The DLCD Natural Hazards Planner continued to work with Sweet Home staff on many tasks. However, pre-award work is limited to certain tasks, so we had to wait to have funds obligated to enter the post-award phase and continue much of the update process. In addition, during this time the Covid-19 pandemic was happening. All meetings during the Covid-19 pandemic were held via Zoom.

These Steering Committee meetings were with and lead by the DLCD Natural Hazards Planner, Tricia Sears, to discuss and revise the NHMP. In addition, the DLCD Natural Hazards Planner called and emailed with the Sweet Home NHMP Steering Committee members for continued discussion and collaboration throughout the process. Steering Committee members contributed data and information, did outreach and advocacy for the NHMP, and reviewed and updated the NHMP in collaboration with DLCD.

An open public involvement process is essential to the development of an effective NHMP. To develop a comprehensive approach to reducing the effects of natural disasters, the planning process includes opportunity for the public, neighboring communities, local and regional agencies, and private and non-profit entities to comment on the plan during review.[7] Sweet Home maintained a publicly accessible website throughout the planning process and provided opportunities for the general public to provide feedback. In addition, there were flyers made and distributed about the NHMP, and outreach at events. See Appendix A Planning and Public Process for additional details.

How is the Plan Organized?

Each volume of the NHMP provides specific information and resources to assist readers in understanding the hazard-specific issues facing county and city residents, businesses, and the environment. Combined, the sections work in synergy to create a NHMP that furthers the community's mission to reduce or eliminate risk to people and their property from hazards and their effects. This NHMP structure enables stakeholders to use the section(s) of interest to them; see the Table of Contents in addition to the descriptions below. See the Acknowledgements for a detailed list of participating organizations and their representatives. See Appendix A Planning and Public Process for more information about outreach. The following is a description of the contents of the NHMP for each of the sections of the NHMP.

Cover and Front Pages

The cover and the front pages orient the reader of the NHMP to what the NHMP contains.

- A new NHMP cover was created. The photos for the cover were provided by City of Sweet Home staff, from various sources. The NHMP cover pages include staff contacts for and the mission statement of the *2021 Sweet Home NHMP.*
- Photos were added to the Volume I, II, and III covers.

[7] Code of Federal Regulations, Chapter 44. Section 201.6, subsection (b), 2010.

- The FEMA Approval Pending Adoption (APA) and final approval letter as well as the City's resolution of adoption are included (when available).
- The Acknowledgements have been updated to include the 2019-2021 Sweet Home NHMP Steering Committee members. The Table of Contents has been updated.

Volume I: Basic Plan

Executive Summary

The executive summary provides an overview of the FEMA requirements plans process and highlights the key elements of the risk assessment, mitigation strategy, and implementation and maintenance strategy.

Section 1: Introduction

The Introduction briefly describes the City's mitigation planning efforts and the methodology used to develop the plan.

Section 2: Risk Assessment

Section 2 provides the factual basis for the mitigation strategies contained in Section 3. Additional information is included within Appendix B, Community Profile, which contains an overall description of Sweet Home.

The Risk Assessment section includes a brief description of community sensitivities and vulnerabilities and an overview of the natural hazards further addressed in Volume II Hazard Annexes. Climate change is discussed in the Risk Assessment and the Hazard Annexes.

The Risk Assessment allows readers to gain an understanding of Sweet Home's, sensitivities – those community assets and characteristics that may be impacted by natural hazards, as well as the City's, resilience – the ability to manage risk and adapt to hazard event impacts. Information on the participation in the National Flood Insurance Program (NFIP) is included, with additional details in the Flood Annex.

Section 3: Mitigation Strategy

This section documents the plan vision, mission, goals, and actions and describes the components that guide implementation of the identified mitigation strategies. Mitigation actions are based on community sensitivity and resilience factors and the hazard assessments in Section 2 Risk Assessment and Volume II Hazard Annexes. In Section 3, there are two tables related to mitigation actions: Table 3-1 Sweet Home 2021 NHMP Mitigation Actions and Table 3-2 Sweet Home Mitigation Actions 2015 Status.

Section 4: Plan Implementation and Maintenance

This section provides information on the implementation and maintenance of the plan. It describes the process for prioritizing projects, and includes a suggested list of tasks for updating the plan to be completed at the semi-annual and five-year review meetings. There is a five-year update cycle for the NHMP. As part of this NHMP process, the NHMP will be reviewed and discussed twice per year at plan maintenance meetings. This will help ensure the NHMP is used and stays connected to the plans, policies, and programs of the involved jurisdictions and other Steering Committee members. The Emergency Management Performance Grant (EMPG) requires NHMP review twice per year.

Volume II: Hazard Annexes

The hazard annexes describe the risk assessment process and summarize the best available local hazard data. A hazard summary is provided for each of the hazards addressed in the plan. The summary includes hazard history, location, extent, vulnerability, impacts, and probability.

The hazard specific annexes included with this NHMP are the following:

- Severe Storms;
- Wildland-Urban Interface Fires;
- Floods (includes dams);
- Earthquakes;
- Volcanic Events;
- Drought; and
- Landslides.

Volume III: Mitigation Resources

The resource appendices are designed to provide the users of the *2021 Sweet Home Natural Hazards Mitigation Plan* with additional information and resources to assist them in understanding the contents of the mitigation plan and to assist with plan implementation.

Appendix A: Planning and Public Process

This appendix includes documentation of all the public processes utilized to update the plan. It includes invitation lists, meeting agendas, sign-in sheets, screen shots from websites, and copies of flyers, as well as any other public involvement methods.

Appendix B: Community Profile

The community profile describes Sweet Home from numerous perspectives to help define and understand the regions sensitivity and resilience to natural hazards. The information in this section represents a snapshot in time of the current sensitivity and resilience factors in the region when the plan was updated. Sensitivity factors can be defined as those community assets and characteristics that may be impacted by natural hazards, (e.g., special populations, economic factors, and historic and cultural resources). Community resilience factors can be defined as the community's ability to manage risk and adapt to hazard event impacts (e.g., governmental structure, agency missions and directives, and plans, policies, and programs). This appendix has been greatly updated from the *2015 Sweet Home NHMP*.

Appendix C: Economic Analysis of Natural Hazard Mitigation Projects

This appendix describes FEMA's requirements for benefit/cost analysis in natural hazards mitigation, and two other approaches: the cost effectiveness and the STAPLE/E. This appendix has been updated from the *2015 Sweet Home NHMP*.

Appendix D: Grant Programs and Resources

This appendix lists state and federal resources and programs by hazard. It has been greatly updated from the *2015 Sweet Home NHMP*.

Appendix E: Sweet Home Success Stories

These are stories that illustrate when Sweet Home identifies a problem or concern and then works to solve it. These stories were identified and provided by the members of the Sweet Home NHMP Steering Committee. This is a new appendix.

Appendix F: Sweet Home NHMP Natural Hazards Outreach Calendar

This calendar will be used each year to focus outreach and education efforts on natural hazards each month. It relates to short-term multi-hazard mitigation action #3 in the *2021 Sweet Home NHMP*. See Table 3-1, 2021 Sweet Home NHMP Mitigation Actions for the mitigation actions. This is a new appendix.

Appendix G: Linn County Community Wildfire Protection Plan

This is a new appendix. To reduce the impact of wildfire, Linn County has a Community Wildfire Protection Plan (CWPP) called *the Linn County Community Wildfire Protection* Plan (*Linn County CWPP*) and it is dated November 2007. Sweet Home does not have a city-specific CWPP. The *Linn County CWPP* provides detailed information on the vulnerability and history of wildfire in Linn County; it provides mitigation actions Linn County can implement to reduce the impact of wildfire. This *2021 Sweet Home NHMP* links to the CWPP as it also contains wildfire information and mitigation actions. See Table 3-1, Sweet Home NHMP Mitigation Actions.

Of note, the mission of the *Linn County CWPP* aligns with the mission for the *Linn County Natural Hazards Mitigation Plan*. The mission is: To reduce the impact of natural hazards on the community through planning, communication, coordination, and partnership development.

The *Linn County CWPP* identifies five County-wide goals that could be effectively addressed by a CWPP. These goals are the product of input from community members through the FireWise workshop, and are also coordinated with the *Linn County Natural Hazards Mitigation Plan*.[8]

- Goal #1: Enhance wildfire response capabilities;
- Goal #2: Increase stakeholder knowledge about wildfire risk through education and outreach Linn County Community Wildfire Protection Plan;
- Goal #3: Encourage the treatment of structural ignitability;
- Goal #4: Prioritize fuel reduction projects; and
- Goal #5: Increase opportunities for collaboration and coordination to implement wildfire projects.

[8] *Linn County Community Wildfire Protection Plan*, November 2007, file:///J|/Shared/Scholars%20bank%20local%20docs/County/Hazard%20mitigation%20plans/Linn_County_Wildfire_Plan_Appendices.pdf (uoregon.edu)

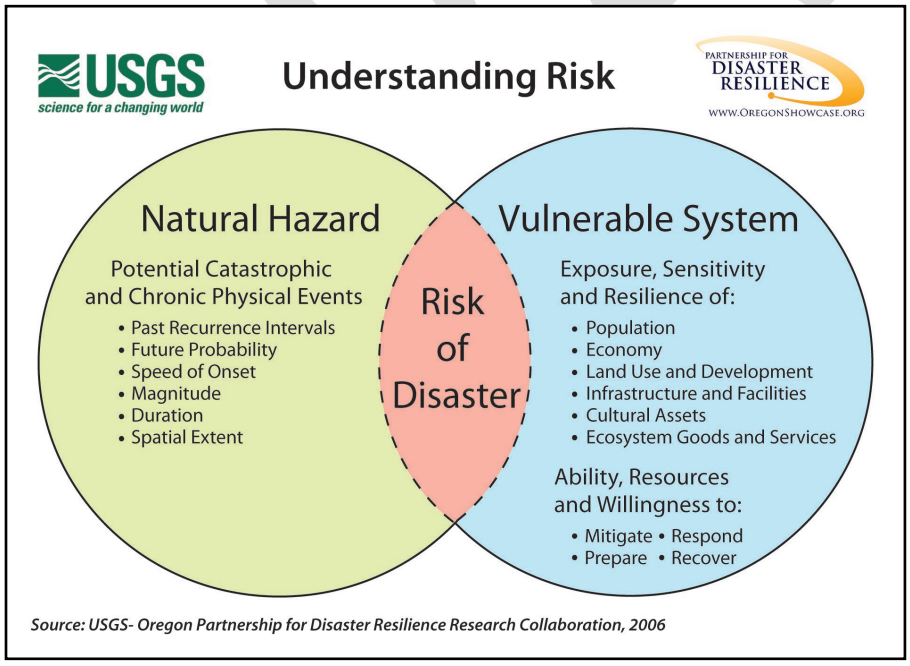
Section 2: Risk Assessment

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

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

The information presented in this Risk Assessment, along with hazard specific information in Volume II Hazard Annexes and the other information in the appendices, is provided as the basis for the mitigation actions in Section 3 Mitigation Strategy in Table 3-1. Figure 2-1 graphically depicts one way to understand risk. Ultimately, the goal of hazard mitigation is to reduce the area where hazards and vulnerable systems overlap, which is the area called the risk of disaster.

Figure 2-1 Understanding Risk

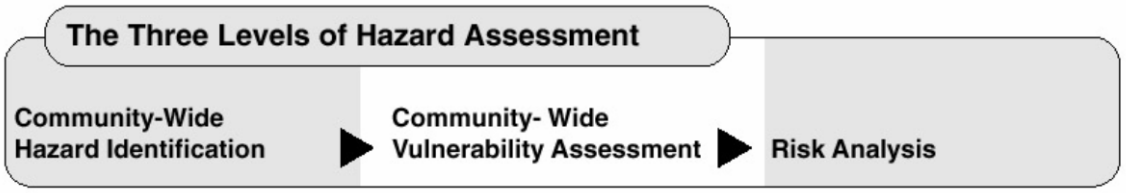


Source: USGS and Oregon Partnership for Disaster Resilience, 2006.

What is a Risk Assessment?

A risk assessment consists of three phases: hazard identification, vulnerability assessment, and risk analysis, as illustrated in the following graphic.

Figure 2-2 Three Phases of a Risk Assessment



Source: *Planning for Natural Hazards: Oregon Technical Resource Guide*, 2001

This three-phase approach to developing a risk assessment is conducted sequentially because each phase builds upon data from prior phases. However, gathering data for a risk assessment need not occur sequentially.

The first phase, **hazard identification**, involves the identification of the geographic extent of a hazard, its intensity, and its probability of occurrence. This level of assessment typically involves producing a map. The outputs from this phase can also be used for land use planning, management, and regulation; public awareness; defining areas for further study; and identifying properties or structures appropriate for acquisition or relocation.[1]

The second phase, **vulnerability assessment**, combines the information from the hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard, and attempts to predict how different types of property and population groups will be affected by the hazard. This step can also assist in justifying changes to building codes or development regulations, property acquisition programs, policies concerning critical and public facilities, taxation strategies for mitigating risk, and informational programs for members of the public who are at risk.[2]

The third phase, **risk analysis**, involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment, and (2) the likelihood or probability of the harm occurring. An example of a product that can assist communities in completing the risk analysis phase is HAZUS, a risk assessment software program for analyzing potential losses from floods, hurricane winds and earthquakes. In Hazards U.S. – Multi-Hazard (HAZUS-MH) current scientific and engineering knowledge is coupled with the latest geographic information systems (GIS) technology to produce estimates of hazard-related damage before, or after a disaster occurs.

[1] Burby, R. 1998. *Cooperating with Nature*, Washington, DC: Joseph Henry Press, 126, https://www.nap.edu/catalog/5785/cooperating-with-nature-confronting-natural-hazards-with-land-use-planning

[2] Burby, R. 1998. *Cooperating with Nature*, Washington, DC: Joseph Henry Press, 133, https://www.nap.edu/catalog/5785/cooperating-with-nature-confronting-natural-hazards-with-land-use-planning

NHMP Planning Area

> *44 CFR 201.6(c)(2)(iii) – Multi-jurisdictional Risk Assessment: The Risk Assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area . . .*

This is not a multi-jurisdictional NHMP; the only plan holder for this NHMP is Sweet Home. A plan holder is a partner that is a jurisdiction that signs the IGA with DLCD for the work on the NHMP. The planning area for the *2021 Sweet Home NHMP* is the City of Sweet Home. There are other partners that participated on the *2021 Sweet Home NHMP,* but they did not sign an IGA with DLCD. All partners are listed in the Special Thanks and Acknowledgements section of the *2021 Sweet Home NHMP*. There are maps throughout the NHMP that illustrate the location of Sweet Home with reference to Linn County and Oregon. In addition, there are maps of Sweet Home in detail.

Within the NHMP, jurisdictions and special districts are called out in specific places as applicable. There are no separate jurisdictional addenda. Information in this Risk Assessment section is supplemented by the Hazard Annexes. While there is no separate *Future Climate Projections* report produced by the Oregon Climate Change Research Institute, which is usually included in NHMP updates that DLCD leads, there is description of climate change and natural hazards. This information is included in this Risk Assessment, in the Introduction to the Hazard Annexes, and in the Hazard Annexes.

Hazard Identification

Sweet Home identifies seven natural hazards that could impact the City. These hazards include drought, earthquake, flood, landslide, volcanic events, wildland-urban interface fires, and severe storms. At the Sweet Home NHMP Steering Committee meeting on December 4, 2020 and January 8, 2021, the DLCD Natural Hazards Planner led the group in an exercise called the Hazard Vulnerability Analysis or Assessment (HVA). At the February 5, 2021 Steering Committee meeting, the HVA was reviewed and revised. The results are discussed in more detail later in this Risk Assessment.

Table 2-1 categorizes the hazards identified by Sweet Home and compares it to the regional hazards identified in the *2020 Oregon Natural Hazard Mitigation Plan* for the Mid/Southern Willamette Valley Region (Region 3). Region 3 includes Linn, Lane (non-coastal), Marion, Polk, and Yamhill Counties.

Table 2-1 Sweet Home NHMP and Oregon NHMP Hazard Identification

Hazard Identified in Sweet Home NHMP*	Hazard identified in Oregon NHMP**
Severe Storms	Winter Storms and Wind Storms
Earthquakes	Earthquakes
Droughts	Droughts
Floods	Floods
Volcanic Events	Volcanoes
Wildland-Urban Interface Fires	Wildfire
Landslides	Landslides

Source: *Sweet Home NHMP Steering Committee, 2020-21, ***2020 Oregon NHMP*, Region 3: Mid/Southern Willamette Valley Region, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

This Hazard Identification section includes descriptions for each natural hazard in the following ways: significant changes since the *2015 Sweet Home NHMP*, characteristics, and the location/extent. For

additional details on the history of events for each hazard, the relationship with climate projections, and maps of the hazards, see Volume II Hazard Annexes.

As part of the NHMP update process, there is a requirement to examine changes in development. Climate change and climate resilience are important parts of this discussion. The climate is changing and the impacts becoming more evident in both quantitative and qualitative information. According to the UN Intergovernmental Panel on Climate Change (IPCC), climate resilience is defined as "the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation."[3]

The Hazard Vulnerability Analysis/Assessment and the analysis of risk are included after the Hazard Identification of this Risk Assessment. This analysis covers all of the identified natural hazards in a relatively brief manner. Note that Table 2-7 Critical / Essential Facilities, Critical Infrastructure, and Vulnerable Population Centers, identifies the critical facilities, critical infrastructure, and vulnerable population centers of Sweet Home. For a more detailed assessment of the hazard-specific vulnerability, see Volume II Hazard Annexes.

Region 3 includes Linn, Lane (non-coastal), Marion, Polk, and Yamhill Counties. As described in the *2020 Oregon Natural Hazards Mitigation Plan* in the Risk Assessment for Region 3 in the Climate Change section[4]:

> "The hazards faced by Region 3 that are projected to be influenced by climate change include drought, wildfire, flooding, landslides, and extreme heat.
>
> Climate models project warmer, drier summers for Oregon. Coupled with projected decreases in mountain snowpack due to warmer winter temperatures, Region 3 is expected to be affected by an increased incidence of drought and wildfire. In Region 3, climate change would result in increased frequency of drought due to low spring snowpack (very likely, >90%), low summer runoff (likely, >66%), and low summer precipitation and low summer soil moisture (more likely than not, >50%). It is very likely (>90%) that Region 3 will experience increasing wildfire frequency and intensity due to warmer, drier summers coupled with warmer winters that facilitate greater cold-season growth.
>
> It is extremely likely (>95%) that the frequency and severity of extreme heat events will increase over the next several decades across Oregon due to human-induced climate warming (very high confidence).
>
> Furthermore, flooding and landslides are projected to occur more frequently throughout western Oregon. It is very likely (>90%) that Oregon will experience an increase in the frequency of extreme precipitation events and extreme river flows (high confidence) that is more likely than not (>50%) to lead to an increase in the incidence and magnitude of damaging floods (low confidence). Because landslide risk depends on a variety of site-specific factors, it is more likely

[3] International Panel on Climate Change (IPCC), *Climate Resilience*, 2014, page 1772.

[4] *2020 Oregon Natural Hazards Mitigation Plan*, Region 3: Mid/Southern Willamette Valley, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

than not (>50%) that climate change, through increasing frequency of extreme precipitation events, will result in increased frequency of landslides.

While winter storms and windstorms affect Region 3, there is little research on how climate change influences these hazards in the Pacific Northwest. For more information on climate drivers and the projected impacts of climate change in Oregon, see Section 2.2.1.2."

Federal Disaster and Emergency Declarations

Looking at the past events that have occurred in Sweet Home and Linn County can provide a general sense of the hazards that have caused significant damage in the County. Where trends emerge, disaster declarations can help inform hazard mitigation project priorities.

President Dwight D. Eisenhower approved the first federal disaster declaration in May 1953 following a tornado in Georgia. Since then, federally declared disasters have been approved within every state as a result of natural hazard related events. When governors ask for presidential declarations of major disaster or emergency, they stipulate which counties in their state they want included in the declaration.

A Major Disaster Declaration provides a wide range of federal assistance programs for individuals and public infrastructure, including funds for both emergency and permanent work. An Emergency Declaration is more limited in scope and without the long-term federal recovery programs of a Major Disaster Declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring. Fire Management Assistance is provided after a State submits a request for assistance to the Federal Emergency Management Agency (FEMA) Regional Director at the time a "threat of major disaster" exists.

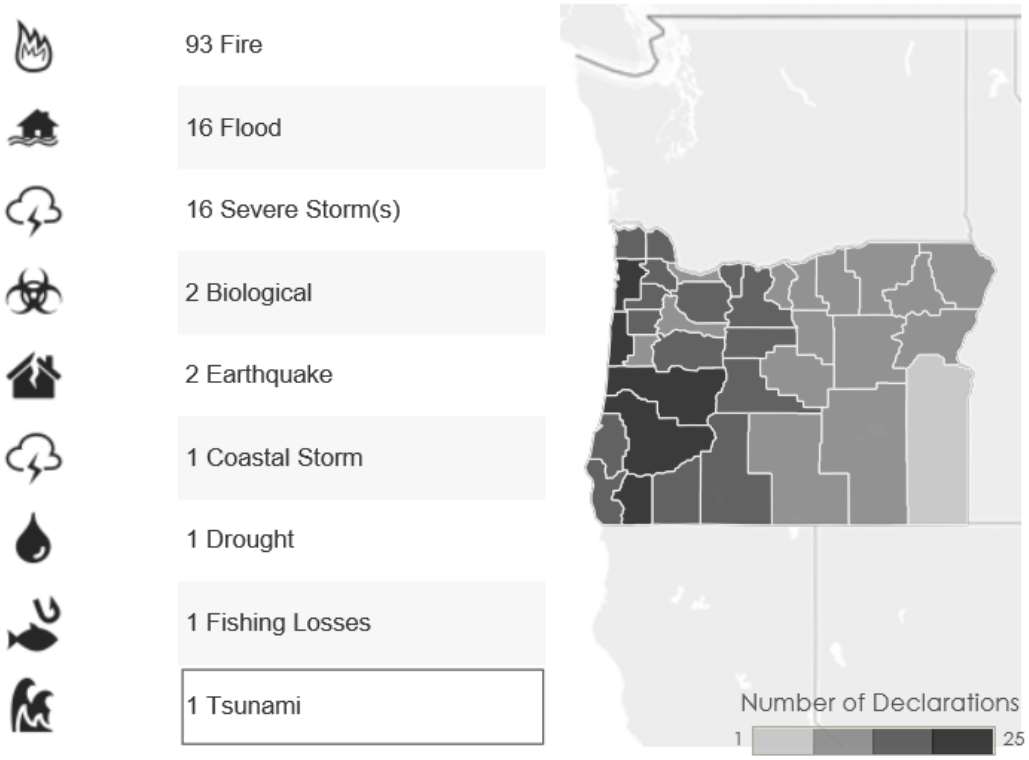
As of June 2021, FEMA has approved a total of 39 federal major disaster (DR) declarations, 4 emergency (EM) declarations and 57 fire management assistance (FM) declarations in Oregon. There are also 36 Fire Suppression Authorizations (FSA) on record for Oregon. Counting all types of disaster declarations (DR, EM, FM, and FSA), the total number of disasters in Oregon is 136 as identified in the FEMA "Disaster Declarations by State/Tribal Government" list on their website[5]

However, this contrasts with the 133 declared disasters since 1953 that FEMA has listed for Oregon on their state by state "Historical Disaster Data" website. The "Historical Disaster Data" website includes the graphic shown in Figure 2-3, illustrating the types of disasters and the location in Oregon, by county, of the disasters.[6] DLCD staff are not able to explain this discrepancy in the FEMA data.

[5] FEMA, *Declared Disasters, Oregon,* https://www.fema.gov/disasters/disaster-declarations?field_dv2_state_territory_tribal_value=OR&field_year_value=1996&field_dv2_declaration_type_value=All&field_dv2_incident_type_target_id_selective=All, accessed 6/9/21;

[6] FEMA, *Declared Disasters, Oregon,* Disaster Declarations for States and Counties | FEMA.gov, accessed 6/9/21;

Figure 2-3 Disaster Declarations in Oregon Since 1953



Source: FEMA, https://recovery.fema.gov/state-profiles/HistoricalDisasterData, most recently accessed 6/9/21

Figure 2-4 Disaster Declarations in Linn County Since 1953

Source: FEMA, https://recovery.fema.gov/state-profiles/HistoricalDisasterData, most recently accessed 6/9/21

Figure 2-4, shown above, uses the Historical Disaster Data information as a visual for the disaster declarations in Linn County. According to the Historical Disaster Data, there have been 17 disaster declarations in Linn County. In Table 2-2, there are 17 disaster declarations listed. According to the Disaster Declarations information there have been twelve major disaster (DR) declarations, three emergency declarations (EM), and two fire management assistance (FM) declaration for Linn County. Table 2-2 summarizes the FEMA disaster declarations declared in Oregon that have directly affected Linn County since 1953; this table uses the Disaster Declarations information as noted in the source listed under the table.[7]

[7] FEMA, *Declared Disasters, Oregon,* https://www.fema.gov/disasters/disaster-declarations?field_dv2_state_territory_tribal_value=OR&field_year_value=1996&field_dv2_declaration_type_value=All&field_dv2_incident_type_target_id_selective=All, accessed 6/9/21; FEMA, https://recovery.fema.gov/state-profiles/HistoricalDisasterData, accessed 6/9/21

Table 2-2 FEMA Major Disaster, Emergency, and Fire Management Declarations for Linn County

Declaration Number	Declaration Date	Incident Period	Incident/Type of Damages	Individual Assistance	Public Assistance Categories
EM-3542	Sep. 10, 2020	Sep. 8-15, 2020	Oregon Wildfires	EM-3542 does not provide IA funds.	EM-3542 provides PA funds.
DR-4499	March 28, 2020	January 20, 2020 - ongoing	Covid-19 Pandemic	DR-4499 provide IA funds.	DR-4499 provides PA funds.
EM-3429	March 13, 2020	January 20, 2020 - ongoing	Covid-19 Pandemic	The status of IA or PA funds is not listed.	The status of IA or PA funds is not listed.
FM-5356	Sep. 8, 2020	Sep. 7-Oct. 15, 2020	Beachie Creek Lionshead Complex	No info	No info
DR-4452	Jul. 9, 2019	Apr. 6-21, 2019	Severe Storms, Flooding, Landslides, and Mudslides	No info	No info
DR-4258	Feb. 17, 2016	Dec. 6-23, 2015	Winter Storms, Straight-Line Winds, Flooding, Landslides,	No info	No info
DR-4169	Apr. 4, 2014	Feb. 6-10, 2014	Severe Winter Storm	DR-4169 does not provide IA funds.	DR-4169 provided PA funds.
DR-4055	Mar. 2, 2012	Jan. 17-21, 2012	Severe Storms, Flooding, Landslides, and Mudslides	DR-4055 does not provide IA funds.	DR-4055 provides PA funds.
DR-1632	Mar. 20, 2006	Dec. 18, 2005-Jan.21, 2006	Severe Storms, Flooding, Landslides, and Mudslides	No info	No info
EM-3228	Sep. 7, 2005	Aug. 29 to Oct. 1, 2005	Hurricane Katrina evacuation	None	B
DR-1510	Feb. 19, 2004	Dec. 26, 2003-Jan. 14, 2004	Severe winter storms	No info	No info
FM-2493	Aug. 20, 2003	Aug. 20-Oct.22, 2003	Oregon Booth Fire	No info	No info

Declaration Number	Declaration Date	Incident Period	Incident/Type of Damages	Individual Assistance	Public Assistance Categories
DR-1405	Mar. 12, 2002	Feb. 7-8, 2002	Severe winter storm with high winds	No info	No info
DR-1107	Mar. 19, 1996	Dec. 10-12, 1996	Severe storms and high winds	No info	No info
DR-1099	Feb. 9, 1996	Feb. 4, 1996 to Feb. 21, 1996	High winds, severe storms, and flooding	No info	No info
DR-319	Jan. 21, 1972	Jan. 21, 1972	Severe storms and flooding	No info	No info
DR-184	Dec. 24, 1964	Dec. 24, 1964	Heavy rains and flooding	Yes	A, B, C, D, E, F, G

Source: FEMA, *Declared Disasters, Oregon,* https://www.fema.gov/disasters/disaster-declarations?field_dv2_state_territory_tribal_value=OR&field_year_value=1996&field_dv2_declaration_type_value=All&field_dv2_incident_type_target_id_selective=All, accessed 6/9/21; FEMA, https://recovery.fema.gov/state-profiles/HistoricalDisasterData, accessed 6/9/21

Severe Storms

Significant changes since 2015 NHMP

In the *2015 Sweet Home NHMP*, severe storms were ranked #1. In the *2021 Sweet Home NHMP*, severe summer storms are ranked #1 out of seven hazards.

Characteristics

Extreme winds occur throughout Oregon, and most communities have some level of vulnerability to wind storms. Wind storms can result in collapsed or damaged buildings, damaged or blocked roads and bridges, damaged traffic signals, utilities, streetlights, and parks, among other impacts. Roads blocked by fallen trees during a wind storm may have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Wind storms can trigger flying debris, which can also damage utility lines; overhead power lines can be damaged even in relatively minor wind storm events. Industry and commerce can suffer losses from interruptions in electric service and from extended road closures.

Although rare, tornados can and do occur in Oregon.[8] Tornadoes are the most concentrated and violent storms produced by the earth's atmosphere. They are created by a vortex of rotating winds and strong vertical motion, which possess remarkable strength and cause widespread damage. Smaller wind events, often known as, "dust devils", can occur and pose some risk to the local community. According to The Tornado History Project, from December 6, 1951 through October 12, 2017, there have been 113 tornadoes in Oregon. There have been six fatalities from the 113 tornadoes.[9]

[8] Taylor, George H. & Chris Hannan, *The Climate of Oregon*, OSU Press, 1999.
[9] The Tornado Project, *Tornadoes in Oregon*, http://www.tornadohistoryproject.com/tornado/Oregon.

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting Sweet Home typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.[10]

Like snow, ice storms are comprised of cold temperatures and moisture, but subtle changes can result in varying types of ice formation, including freezing rain, sleet, and hail. Freezing rain can be the most damaging of ice formations. While sleet and hail can create hazards for motorists when it accumulates, freezing rain can cause the most dangerous conditions. Ice buildup can bring down trees, communication towers, and wires creating hazards for property owners, motorists, and pedestrians.

Location/Extent

The damaging effects of severe summer storms may extend for distances of 100 to 300 miles from the center of storm activity. Wind storms can occur year-round in Sweet Home. In this discussion we focus on the summer, while in the discussion of severe winter storms, we look at storms in the winter. The storm extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain. Sweet Home is susceptible to high winds and strong wind gusts year-round.

It is not uncommon for severe wind storms to cause trees to blow down or tree limbs to break and fall on power lines or roofs of homes or businesses. Severe wind storms can also damage roof beams or break shingles. Wind storms can cause power outages. Typically there are other factors contributing to the outage as well; such as water-saturated soils which allow for trees and power poles to fall easier. Wind storms can blow mobile homes off their foundations if not anchored properly or collapse agricultural storage barns with large, paneled sides.

Oregon and other western states experience tornadoes on occasion, many of which have produced significant damage and occasionally injury or death. Most of the tornadoes that develop in Oregon are caused by intense local thunderstorms. These storms also produce lightning, hail, and heavy rain, and are more common during the warm season from April to October.[11]

For more information on the wind and other storm hazards in Sweet Home, see the Severe Storms Annex in Volume II Hazard Annexes. The Significant Historic Hazard Events Table, Table SS-5, includes winter and summer storms. The table notes the dates, locations, and a description of the event, identifies if there was a disaster declaration related to it.

All of Sweet Home is vulnerable to winter storms and impacts typically extend region-wide. Varied elevations and topography mean that the impact of a storm is variable depending on the location. The mountains and buttes scattered throughout Linn County generally receive the highest amounts of rainfall and snowfall. Large snow packs built during winter months can lead to potentially increased flooding in the spring. State Highways are primary transportation routes that have historically been closed due to severe winter weather. The vulnerable population in Sweet Home is particularly susceptible to winter cold, air quality (wood smoke), and other impacts from severe winter storms.

[10] DLCD, *2012 Oregon Natural Hazards Mitigation Plan*, https://oregonexplorer.info/content/oregon-natural-hazard-mitigation-plan-2012.

[11] Taylor, George H., Holly Bohman, and Luke Foster. August 1996. A History of Tornadoes in Oregon. Oregon Climate Service. Corvallis, OR: Oregon State University. http://www.ocs.orst.edu/pub_ftp/reports/book/tornado.html

Wildland-Urban Interface Fires

Significant changes since 2015 NHMP

Wildfire was ranked fourth in the *2015 Sweet Home NHMP*. In the *2021 Sweet Home NHMP* it is ranked second out of seven natural hazards.

Characteristics

Wildfires are increasingly common to all areas of Oregon. As such, the potential for losses due to Wildland-Urban Interface (WUI) fires in the urbanized region should not be ignored. Fire is an essential part of Oregon's ecosystem, but it is also a serious threat to life and property.

Wildfires that have the potential to affect Sweet Home can be divided into four categories: interface, wildland, firestorms, and prescribed burns. These are described in more detail in the Wildland-Urban Interface Fires Annex. Ignition of a wildfire may occur naturally from lightning or from human causes such as debris burns, arson, careless smoking, and recreational activities or from an industrial accident. Once started, fuel, topography, weather, and development conditions affect fire behavior.

Location/Extent

In Oregon, large costly fires have become regular events, disrupted communities, cost millions of dollars in suppression and recovery costs, and increased the risk to private property owners. According to the Oregon Department of Forestry, "large fires that threaten dwellings are 48% more expensive to fight, and the likelihood of human-caused fires exponentially increases with the addition of each new home. Throughout Oregon's wildland-urban interfaces historically normal fires have become economically and socially unacceptable due to the scale of damage they cause.[12]

According to the Oregon Forest Resources Institute (OFRI), "Despite fire suppression systems regarded as best-in-class for private and public lands, lightning and human-caused wildfires ravaged the state's forest and rangelands, making 2017 one of the worst wildfire seasons on record." The OFRI also noted that both small and significant fires occurred in Oregon in 2017, burning 665,000 acres of forest and rangeland in more than 2,000 fires. The report from OFRI describes how wildfires directly impact our lives by examining these categories: air quality and health; sporting events; travel and tourism; employment and the economy; transportation; local impact; and long-term effects. The overall cost for fire suppression in Oregon in 2017 was $454 million. [13] The 2020 wildfire season was the worst one in Oregon's history; a description of that is described in the Wildland-Urban Interface Fires Annex.

The extent of damage to Sweet Home from WUI fires is dependent on a number of factors, including temperature, wind speed and direction, humidity, proximity to fuels, and steepness of slopes. WUI fires can be intensified by development patterns, vegetation and natural fuels, and can merge into unwieldy and unpredictable events. In addition, wildfire also threatens timber products, cattle ranching and agricultural areas near grasslands. Communities and areas particularly susceptible to wildfires include populated areas on the edges of wild land brush and wooded areas.

The areas where development meets vegetative fuels, such as forestland, are commonly referred to as the wildland-urban interface (WUI). Often these areas where development is next to areas with heavy fuel loads (vegetation) do not have adequate defensible space. Wildfires impact agriculture, buildings,

[12] Oregon Department of Forestry, *Oregon Forests Report*, 2007-2009.

[13] Oregon Forest Resources Institute, *Impacts of Oregon's 2017 Wildfire Season: Time for a Crucial Conservation*, January 2, 2018.

transportation, utilities, and business. Smoke exposure is a hazard throughout Sweet Home when there are wildfires. Roads close because of smoke visibility issues, animals on the rangelands can be affected, and people have respiratory issues due to the poor air quality.

Sweet Home is part of the *Linn County Community Wildfire Protection Plan* (CWPP) dated November 2007; this will be discussed in the Wildland-Urban Interface Fires Annex in Volume II Hazard Annexes. For more wildfire information, see Table WF-2 Wildfire Significant Historic Hazard Events Table which notes the dates, locations, a description of the event, and identifies if there was a disaster declaration.

As noted earlier, according to OCCRI's research included in the *2020 Oregon NHMP*, wildfire occurrence is projected to increase in Linn County and elsewhere in Oregon.

Flood

Significant changes since 2015 NHMP

In the *2015 Sweet Home NHMP*, floods were ranked second out of the seven natural hazards. In the *2021 Sweet Home NHMP*, floods are ranked in third place.

Characteristics

The principal types of flood that occur in Sweet Home include riverine floods. Flash floods can also occur. The Santiam River is located on the north side of Sweet Home.

Riverine Flooding

Riverine floods occur when water levels in rivers and streams overflow their banks. Most communities located along such water bodies have the potential to experience this type of flooding after spring rains, heavy thunderstorms, or rapid runoff from snow melt. Riverine floods can be slow or fast-rising, but usually develop over a period of days. The danger of riverine flooding occurs mainly during the winter months, with the onset of persistent, heavy rainfall, and during the spring, with melting of snow.

Local Flash Floods

Summer thunderstorms are common throughout the region. During these events, normally dry gulches can quickly become raging torrents, a flash flood. Although flash flooding occurs throughout Oregon, local geology in the region can increase the impact of this hazard. Flash floods are most common to Eastern Oregon but less so in the Sweet Home area. This is because summer temperatures are much higher east of the Cascades and thunderstorms are common during the summer months.

Location/Extent

The most significant of the FEMA-determined floodplains and floodways near Sweet Home surround the Santiam River and the tributaries. Sweet Home and unincorporated areas could also be affected by flood runoff from the relatively steep areas nearby. As discussed by the Sweet Home NHMP Steering Committee, culvert/ditch areas and dam inundation areas are related hazards of concern.

In Volume II Hazard Annexes, the Flood Annex has floods identified in Table FL-1, Significant Historic Hazard Events. The table note the dates, locations, and a description of the event, identifying if there was a disaster declaration related to it. For more information on the flood hazard in Sweet Home and climate change, see the Flood Annex in Volume II Hazard Annexes.

Earthquake

Significant changes since 2015 NHMP

In the *2015 Sweet Home NHMP*, earthquakes were ranked second. In the HVA for the *2021 Sweet Home NHMP*, earthquakes were ranked fourth out of seven hazards.

Characteristics

Oregon and the Pacific Northwest are susceptible to earthquakes from these sources: 1) shallow crustal events within the North American Plate; 2) deep intra-plate events within the subducting Juan de Fuca Plate; 3) the off-shore Cascadia Subduction Zone; and 4) earthquakes associated with renewed volcanic activity.[14]

The Cascadia Subduction Zone and the subduction process is responsible for most of the earthquakes in the Pacific Northwest as well as for creating the volcanoes in the Cascades. Researchers recently calculated the likelihood of a Magnitude 8 to 9 Cascadia Subduction Zone earthquake at 37% over the next 50 years.[15] The last such event occurred in January of 1700, causing a tsunami in Japan. See the Earthquake Annex in Volume II.

Sweet Home has not experienced damaging earthquakes in recent history. Primary earthquake hazards include ground shaking amplification, liquefaction, and earthquake-induced landslides.

Location/Extent

The areas most susceptible to ground amplification and liquefaction have young, soft alluvial sediments, found along river and stream channels. The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event. Buildings, dams, levees and lifelines including water, sewer, stormwater and gas lines, transportation systems, and utility and communication networks are particularly at risk. Also, damage to roads, bridges and water systems will make it difficult to respond to post-earthquake fires.

In Volume II Hazard Annexes, the Earthquake Annex has earthquakes identified in Table EQ-1, Significant Historic Hazard Events. The table notes the dates, locations, and a description of the event, identifying if there was a disaster declaration related to it. For more information on the earthquake hazard in Sweet Home see the Earthquake Annex in Volume II Hazard Annexes.

Volcanoes

Significant changes since 2015 NHMP

In the *2015 Sweet Home NHMP*, volcanic events were ranked fifth. In the *2021 Sweet Home NHMP*, volcanic events are ranked fifth out of seven hazards.

Characteristics

Sweet Home and the Pacific Northwest lie within the "ring of fire", an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the ring of fire, in part

[14] DLCD, OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, https://oregonexplorer.info/content/planning-natural-hazards-oregon-technical-resource-guide.

[15] Oregon Seismic Safety Policy Advisory Commission (OSSPAC), *The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami, Report to the 77th Legislative Assembly*, February 2013, https://www.oregon.gov/oem/documents/oregon_resilience_plan_final.pdf

because of the movement of the Earth's tectonic plates. Volcanic eruptions have the potential to coincide with numerous other hazards including ash fall, earthquakes, lava flows, pyroclastic flows, lahars and debris flows, and landslides. Ash fall and earthquakes are the two associated hazards that have the potential to impact Sweet Home directly.

Location/Extent

Active volcanoes that could impact Sweet Home include composite volcanoes within the Cascades Mountain Range such as Mt. Hood, Mt. St. Helens, Mt. Adams, Mt. Shasta, and Crater Lake/Mount Mazama. If any of these volcanoes erupted, there is a possibility of ash that could affect air quality and/or the water quality.

The extent of damage from these hazards depends on the distance from the volcano, vent location, and type of hazardous events that occur during an eruption. Blast effects are unlikely to impact Sweet Home. The indirect effects of volcanoes within other counties must be considered; including disruption of engines of motor vehicles, ashfall on transportation routes, and ashfall causing widespread health concerns. Should an event force highways to be closed, Sweet Home will be isolated from the rest of the state. Table VO-1 Significant Historic Hazard Events, lists volcanic events. See the Volcanic Events Annex for additional information about volcanoes.

The Sweet Home NHMP noted concerns about high impacts from landslides such as landslides, road closures, downed power supplies, damage to the water treatment and wastewater treatment plants, and limitations to resources.

Drought

Significant changes since 2015 NHMP

In the *2015 Sweet Home NHMP*, drought was ranked third. In the Hazard Vulnerability Analysis (HVA) for the *2021 Sweet Home NHMP*, the Steering Committee ranked drought sixth of the seventh identified natural hazards.

Characteristics

Droughts are common in Oregon, especially in eastern Oregon. They occur in all parts of the state in both summer and winter months. Droughts are recurring and they can have a profound effect on the economy, particularly the hydropower and agricultural sectors. The financial impact of which affects the economic stability of the county.

The environmental consequences also are far-reaching. They include insect infestations in forests and the lack of water to support endangered fish species. In recent years, the State of Oregon has addressed drought emergencies through the Oregon Drought Council. This interagency (state/federal) council meets to discuss forecasts and to advise the Governor as the need arises.

The Oregon State University Extension Service published a report in June 1979 following the 1977 drought (EM-3039) (listed in Table 2-2 above). Highlights of the survey findings indicate that the 1977 drought affected 80% of ranches in eastern Oregon, decreased forage, increased purchase of feed, reduced rate of gain of cattle, delayed breeding, herd health problems and increased water hauling and

equipment investments[16]. While this report is several decades old, the findings remain current because droughts remain as impactful events in counties across Oregon.

Location/Extent

The extent of drought events depends upon the degree of moisture deficiency, and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city and county. According to the *2020 Oregon NHMP* Risk Assessment for Region 3[17],

> Even though drought may not be declared as often in Western Oregon as in counties east of the Cascades, when drought conditions do develop in the Willamette Valley, the impacts are widespread and severe. Reasons for broad and significant impact include insufficient water for crop irrigation; lack of farmworkers when the growing season begins early; and increased frequency of toxic algal blooms in the Willamette system reservoirs, among other reasons.

See the history of drought events for Sweet Home/Linn County in the Significant Historic Hazard Events Tables in Table DR-1 within the Volume II Drought Annex of this NHMP. The table notes the dates, locations, and a description of the event, identifying if there was a disaster declaration related to it. For more information see the Drought Annex in Volume II Hazard Annexes.

As noted earlier, according to OCCRI's research described in the *Oregon 2020 NHMP*, Region 3 is expected to be affected by an increased incidence of drought.

Landslide

Significant changes since 2015 NHMP

In the *2015 Sweet Home NHMP*, landslides were ranked seventh in the list of seven hazards. In the *2021 Sweet Home NHMP*, the Steering Committee ranked landslides seventh out of seven hazards.

Characteristics

While not all landslides result in private property damage, many landslides impact transportation corridors, fuel and energy conduits, and communication facilities. They can pose a serious threat to human life. "Landslides lead to an estimated 25–50 deaths per year in the United States (Spiker and Gori, 2003). In Oregon, the average annual loss of life is estimated to be nearer to one or two lives per year (Beaulieu and Olmstead, 1999)."[18]

As described in *Preparing for Landslide Hazards: A Land Use Guide for Oregon Communities*," The general term *landslide* refers to a range of slope movement processes including rock falls, debris flows, earth slides, and other mass movements (Varnes, 1978). The main triggers of landslides are precipitation, earthquakes, and human activity."[19] In addition,

[16] Oregon State University Extension Services, *Effects of the 1977 Drought on Eastern Oregon Ranches* (1979), excerpted from the *2013 Lake County NHMP*.

[17] *2020 Oregon NHMP*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

[18] DLCD and DOGAMI, *Preparing for Landslide Hazards: A Land Use Guide for Oregon Communities*, https://www.oregon.gov/lcd/NH/Pages/Natural-Hazards.aspx

[19] Ibid.

"All landslides can be classified into six types of movement: 1) falls, 2) topples, 3) slides, 4) spreads, 5) flows, and 6) complex. Most slope failures are complex combinations of these six distinct types, but the generalized groupings provide a useful means for framing discussion of the type of hazard and potential mitigation actions. Movement type should be combined with other landslide characteristics such as type of material, rate of movement, depth of failure, and water content to understand more fully the landslide behavior. For a more complete description of the different types of landslides, see *U.S. Transportation Research Board Special Report 247, Landslides: Investigation and Mitigation* (Turner & Schuster, 1996), which has an extensive chapter on landslide types and processes."[20]

Location/Extent

In general, areas at risk to landslides can have a range of slopes and or a history of nearby landslides. Landslides can occur along river and creek banks, and along ocean bluff faces. Landslide hazards are also related to excavation and drainage practices, and the reactivation of preexisting landslide hazards.

The severity or extent of landslides is typically a function of geology and the landslide triggering mechanism. Rainfall initiated landslides tend to be smaller, and earthquake induced landslides may be very large. Even small slides can cause property damage, result in injuries, or take lives. Natural conditions and human activities can both play a role in causing landslides. The incidence of landslides and their impact on people and property can be accelerated by development.[21]

Sweet Home has rarely experienced major landslides; in fact, the NHMP Steering Committee noted that they had no specific landslide incident they could recall.

Table LS-1, Landslides Significant Historic Hazard Events, notes the dates, locations, and a description of the event, identifying if there was a disaster declaration related to it. Most of the landslides listed are statewide disaster declarations. For more information on the landslide hazard in Sweet Home and Linn County see the Landslides Annex in Volume II Hazard Annexes.

Hazard Probability

The *2021 Sweet Home NHMP* update provided the opportunity to conduct a new Hazards Vulnerability Analysis (HVA) and to revisit the hazards, update the analysis, and reestablish the mitigation action priorities as necessary. The DLCD Natural Hazards Planner and the NHMP Steering Committee performed a Hazard Vulnerability Analysis on December 4, 2020 and January 8, 2021; and revisited it on February 5, 2021 to make revisions.

Sweet Home's Hazard Vulnerability Analysis was last discussed in 2015 as part of the *2015 Natural Hazards Mitigation Plan (NHMP).* The *2015 Sweet Home NHMP* states that the ten major hazards recognized in the NHMP are also the ten major hazards in the *2012 Sweet Home Emergency Operations Plan (EOP).* Both the *EOP* and the *2015 Sweet Home NHMP* include a table called Sweet Home Area 2003 All Hazards Analysis Matrix which includes more than ten hazards (the source of the table is listed as TCL Planning Consultants/Sweet Home City Staff and SH Fire & Ambulance District Staff Work Sessions December 2003).

[20] Ibid.

[21] DLCD, OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, https://oregonexplorer.info/content/planning-natural-hazards-oregon-technical-resource-guide.

Note that the "Sweet Home's top ten+ hazards" list from the *2015 Sweet Home NHMP* has four hazards marked with an asterisk. These four hazards are not natural hazards; they are technological and human-caused hazards. Of those four, dams will be included in the floods category for the HVA while the three others [(disruption of utility and transportation systems) (technological)], [(hazards materials) (technological)], and [(terrorism) (human-caused)] are not included in the HVA.

With the HVA conducted in 2020 and 2021, **Sweet Home's natural hazards** are updated:

- Severe Storms
- Wildland-Urban Interface Fires
- Floods
- Earthquakes
- Volcanic Events
- Droughts
- Landslides

The methodology for this **hazard analysis** was first developed by FEMA in 1983. It was gradually refined by Oregon's Office of Emergency Management (OEM) and shared with local jurisdictions across Oregon. Although nearly every jurisdiction in Oregon uses this process, the range of values is relative only within the individual jurisdiction; unless two or more jurisdictions conduct their analyses at the same time and utilize the same criteria in determining the values to apply. It is not meant to compare one jurisdiction to another. These calculations and hazard analysis should not be applied to other jurisdictions without familiarization with the process applied.

The methodology produces scores that range from 24 (lowest possible) to 240 (highest possible), one order of magnitude from lowest to highest**. Vulnerability** and **probability** are the two key components of the methodology.

- **Vulnerability** examines both typical and maximum credible events. It accounts for approximately 60% of the total score.
- **Probability** endeavors to reflect how physical changes in the jurisdiction and scientific research modify the historical record for each hazard. It accounts for approximately 40% of the score.

This particular hazard analysis is an early step in determining the risk – the potential for harm – facing a community. When complete, it provides a table of relative risks to focus planning priorities on those hazards most likely to occur and cause the most damage. This analysis is constructed to:

- Establish priorities for planning, capability development, and hazard mitigation,
- Identify needs for hazard mitigation measures,
- Educate the public as well as public officials about hazards and vulnerabilities, and
- Make informed judgments about potential risks.

Values assigned are very subjective.

DESIGNATION	RATING
LOW	0 to 3
MEDIUM	4 to 7
HIGH	8 to 10

History is the record of previous occurrences requiring a response.

Low:	0-1 event in the past 10 years
Medium:	2-3 events in the past 10 years
High:	4+ events in the past 10 years

The weight factor for the history category is 2.

Vulnerability is a measure of the percentage of the population and property likely to be affected during an occurrence of an incident.

Low:	<1% affected
Medium:	1 – 10% affected
High:	>10% affected

The weight factor for the vulnerability category is 5.

Maximum Threat is a measure of the highest percentage of the population or property which could be impacted under a worst-case scenario.

Low:	<5% affected
Medium:	5 – 25% affected
High:	>25% affected

The weight factor for the maximum threat category is 10.

Probability is a measure of the likelihood of a future event occurring within a specified period of time.

Low:	more than 10 years between events
Medium:	from 5 to 10 years between events
High:	likely within the next 5 years

The weight factor for the probability category is 7.

By multiplying the *weight factors* associated with the categories by the *severity ratings*, a sub-score for history, vulnerability, maximum threat, and probability for each hazard is obtained. This information is captured in a table showing each of those four sub-scores as well as the total score for the hazard. Adding the sub-scores will produce a **total** score, called the risk score, for each hazard.

Discussion occurred regarding the definitions of the weighted measures. For example, when defining vulnerability and maximum threat, the percentages are based on those "affected." Questions arose as to how much impact or influence is considered "affected" to the population and property. We noted populations in cities and in unincorporated areas. Property damages could be substantial everywhere. Estimating the appropriate percentage for vulnerability and maximum threat provided some challenge.

Table 2-3 includes the 2021 NHMP Hazard Vulnerability Analysis scores for Sweet Home as well as the full list of natural hazards and their sub-scores for the components that comprise the risk score.

Table 2-3 2021 NHMP Hazard Vulnerability Analysis scores for Sweet Home

HAZARD	HISTORY WF = 2	VULNERABILITY WF = 5	MAX THREAT WF = 10	PROBABILITY WF = 7	RISK SCORE
Floods (includes dam failures)	2 x **7**	5 x **6**	10 x **7**	7 x **6**	**156**
Severe Storms	2 x **8**	5 x **9**	10 x **9**	7 x **10**	**221**
Landslides	2 x **1**	5 x **1**	10 x **1**	7 x **1**	**24**
Wildland-Urban Interface Fires	2 x **2**	5 x **8**	10 x **8**	7 x **6**	**166**
Earthquakes	2 x **0**	5 x **9**	10 x **9**	7 x **2**	**149**
Volcanic Events	2 x **0**	5 x **10**	10 x **9**	7 x **1**	**147**
Droughts	2 x **1**	5 x **1**	10 x **8**	7 x **1**	**94**

Source: DLCD Natural Hazards Planner, Tricia Sears, and the Sweet Home NHMP Steering Committee, 2020-2021.

To begin the discussion, DLCD staff asked the SC what they thought were their most common and impactful hazards are. The SC said severe storms. Interestingly, the risk score results supported the severe storms as high hazards, with it as #1 in the rankings. Sweet Home has seven natural hazards. Looking at the 2015 risk scores and rankings in comparison to the 2020-21 results, severe storms remained at #1, floods dropped from #2 to #3; wildland-urban interface fires moved from #4 to #2, and droughts went from #3 to #6. In reviewing the overall risk scores for each hazard, DLCD staff noticed several tiers. As shown in Table 2-4, staff identified risk scores into risk levels of high, medium, low, and very low. These are shown in a progression of color from red as high to yellow as low.

Discussion occurred regarding the definitions of the weighted measures. For example, when defining vulnerability and maximum threat, the percentages are based on those "affected." Questions arose as to how much impact or influence is considered "affected" to the population and property. Estimating the appropriate percentage for vulnerability and maximum threat provided some challenge, but the group worked through it. The group came to consensus on the ratings for each of the four measures, as well as the total score, for each hazard. Each of the hazards were discussed in detail. This is noted below.

We noted that severe storms was the natural hazard with the highest risk score, and it was noticeably higher than the next four hazards: wildfire, earthquakes, volcanic events, and floods. Severe storms was identified as a high risk level and those next four were identified as a medium risk level. Another noticeable break in the risk scores showed for droughts and landslides which were identified as low risk level. Greg Springman, Public Works Director, noted he thought the wildfire and flood score would be higher, and several folks agreed with that. Several folks thought the earthquake score was a bit high.

We decided to go through the HVA again to evaluate the scores for the history, vulnerability, maximum threat, and probability to see if the risk score for each hazard would change. The scores for floods, severe storms, and wildland-urban interface fires changed. The scores for landslides, earthquakes, volcanic events, and droughts remained the same. A revised HVA Summary was prepared February 11, 2021 in response to the discussion at the February 5, 2021 NHMP Steering Committee meeting.

For the Hazard Vulnerability Analysis discussion, DLCD provided a document called Significant Hazard Events. This document included a short list of significant events for Sweet Home's natural hazards. The document noted the dates, a description of the event, and identified if there was a disaster declaration related to it.

The total risk scores from the HVA are listed in Table 2-4 as the risk score. After establishing the risk scores they were put into levels using a high, medium, and low designation, as shown in Table 2-4.

Table 2-4 Natural Hazards, Risk Scores, and Risk Levels for Sweet Home

HAZARD	RISK SCORE	RISK LEVEL (H-M-L)
Severe Storms	221	High
Wildland-Urban Interface Fires	166	Medium
Floods	156	Medium
Earthquakes	149	Medium
Volcanic Events	147	Medium
Droughts	94	Low
Landslides	24	Very Low

Source: DLCD Natural Hazards Planner, Tricia Sears, and the Sweet Home NHMP Steering Committee, 2020-2021.

Some of the risk scores of the natural hazards changed a few spots between the *2015 Sweet Home NHMP* and the *2021 Sweet Home NHMP*. Here is the comparison of the total risk scores.

Table 2-5 The 2021 NHMP Total Risk Scores and Rankings with Total scores and Rankings for Comparison, from the 2015 NHMP

HAZARD	2020-21 SCORES	2021 RANKING	2015 SCORES	2015 RANKING
Severe Storms	221	1	179.3	1
Wildland-Urban Interface Fires	166	2	134.8	4
Floods	156	3	144.7	2
Earthquakes	149	4	144.7	2
Volcanic Events	147	5	116.7	5
Droughts	94	6	137.6	3
Landslides	24	7	80.8	7

Source: Tricia Sears, DLCD, February 11, 2021

Here is the description of each of the identified natural hazards as included in the Hazard Vulnerability Analysis Summary dated 2/11/21.

The SC dialogue during the HVA was lively, engaged, and thoughtful. We talked about the past and the future, and how these hazards have impacted and could impact Sweet Home. DLCD staff asked about air quality issues. The SC described that air quality used to poor when the practice was to burn fields. However, that practice has stopped and air quality has improved; it is not a problem at this time. Discussing the hazards and the impacts of them led to discussion of possible funding sources and to desired actions. For example, the SC noted that they would like to have a generator for the water treatment plant. Actually they would like two generators. In their research, they have learned that the cost per generator is approximately $500,000. DLCD staff said that there are funding sources and that she would share information about those as the NHMP update continues.

Severe Storms: Severe storms includes wind storms, winter storms with ice and snow, rain and hail events, extreme temperature, and other weather. Severe storms can happen any time of the year. The table for storms in the Significant Historic Hazard Events Tables is substantial, revealing a long and detailed list of events. High winds can occur throughout the year, toppling trees and power lines. Buildings, agriculture, utilities, transportation, and business are impacted. High winds can aggravate wildfires and volcanic events that result in ashfall. Heavy snow and ice can severely impact buildings, agriculture, transportation, utilities, and business. Dust storms and tornadoes were not mentioned by the SC.

Wildland-Urban Interface Fires: The areas where development meets vegetative fuels, such as forestland, are commonly referred to as the wildland-urban interface (WUI). Often these areas where development is next to areas with heavy fuel loads (vegetation) do not have adequate defensible space. Wildfires impact agriculture, buildings, transportation, utilities, and business. Smoke exposure is a hazard throughout the area when there are wildfires. Roads close because of smoke visibility issues, and animals and people have respiratory issues.

The SC stated that they have not had a lot of wildfires, though they recognize the possibility exists. Therefore, the history rating was low. The huge wildfires of 2020 were not normal. The SC noted that the vulnerability and maximum threat for wildfires is high, with the probability as medium for future events. The SC noted that there is primarily privately managed forest nearby, and those are heavily managed. The SC stated that there are two ways out of town that can be greatly impacted by wildfires and other hazards.

Floods: The Sweet Home SC analysis resulted in floods having a risk score of 156 which is third out of seven hazards. History and vulnerability were medium rank, with maximum threat and probability also in the medium range. Floods were ranked second in the *2015 NHMP*, with a score of 144.7, so the score and the ranking in 2020-21 was not greatly different.

Earthquakes: Sweet Home is in the range of earthquakes from the usually cited four sources: (a) the off-shore Cascadia Subduction Zone (CSZ), (b) deep intraplate events within the subducting Juan de Fuca plate, (c) shallow crustal events within the North America Plate, and (d) earthquakes associated with renewed volcanic activity. The Cascadia Subduction Zone and the subduction process is responsible for most of the earthquakes in the Pacific Northwest as well as for creating the volcanoes in the Cascades. Researchers recently calculated the likelihood of a Magnitude 8 to 9 Cascadia Subduction Zone earthquake at 37% over the next 50 years. The last such event occurred in January of 1700, causing a tsunami in Japan.

The SC described there is not an earthquake in the recent past nor do they feel small ones regularly. So the history score is low. However, the SC noted that the vulnerability and maximum impact is high. There were concerns about high impacts from earthquakes such as landslides, road closures, downed power supplies, damage to the water treatment and wastewater treatment plants, and limitations to resources(s).

Volcanic Events: The SC noted that South Sister is within 100 miles and that volcano is listed as the fifth most dangerous volcano in the Pacific Northwest according to at least one source that was accessed by the SC. Although less vulnerable to most direct volcanic hazards such as blast effects, relatively nearby volcanoes could inundate the area with ashfall sufficient to impact transportation and cause widespread health concerns. The history rating was low, but the vulnerability and maximum threat were high.

Drought: The Significant Historic Hazard Events Tables shows drought declarations. Drought has severe implications for agriculture and the economy. The history, vulnerability, and probability were all very low for drought. For maximum threat, the score was high. This was because the SC noted that the worst case scenario for drought would be a really bad situation. There are reservoirs nearby that provide water, even in times of drought. So if the worst case scenario was such that the reservoirs had little water, the impacts would be quite severe.

The SC noted that there is Lake Foster and Lake Greenpeter, these are reservoirs. Water from the Middle and South Santiam Rivers flows out of the Cascades into this area. With a worst case scenario, there would be water and power shortages. The community wells would go dry.

Landslides: The Significant Historic Hazard Events Tables includes a table for landslides, most of which are statewide disaster declarations. There are no other landslide event descriptions specific to Sweet Home. The scores for history, vulnerability, maximum threat, and probability were 1 for each, with each category being weighted differently. The risk score of 24 was the lowest score for all the natural hazards.

Community Vulnerability

Vulnerability is a measure of the exposure of the built environment to hazards. The exposure of community assets to hazards is critical in the assessment of the degree of risk a community has to each hazard. Identifying the facilities and infrastructure at risk from various hazards can assist the county in prioritizing resources for mitigation, and can assist in directing damage assessment efforts after a hazard event has occurred. The exposure of county and city assets to each hazard and potential implications are explained in each hazard section.

Vulnerability includes the percentage of population and property likely to be affected under an "average" occurrence of the hazard. Community vulnerabilities are an important supplement to the NHMP risk assessment. For more in-depth information regarding specific community vulnerabilities, see the Volume II Hazard Annexes and Appendix B Community Profile.

Populations

The socio-demographic qualities of the community population such as language, race and ethnicity, age, income, and educational attainment are significant factors that can influence the community's ability to cope, adapt to and recover from natural disasters. Historically, 80 percent of the disaster burden falls on

the public.[22] Of this number, a disproportionate burden is placed upon vulnerable populations such as children, the elderly, the disabled, minorities, and low-income persons. Outreach and community planning can reduce immediate and long-term socio-demographic impacts from natural hazards.

Population Vulnerabilities

- As of July 1, 2016, 18% of the population in Linn County is over the age of 65. For comparison, note the percentages of several nearby counties. Lane County has 18.7% of the population over the age of 65. Benton County has 15.9% of the population over the age of 65. Marion County has 15.1% of the population over the age of 65.[23]
- While the statewide population is aging, another demographic shift is occurring across Oregon: minority populations are growing as a share of total population. A growing minority population affects both the number of births and average household size.[24]
- Rural counties tend to have a lower per capita personal income than metro counties.[25]
- The Sweet Home NHMP Steering Committee identified the following as vulnerable populations: Wiley Creek Community, Sapphire at Sweet Home, and Sunshine Industries.

Economy

Economic diversification, employment and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources and infrastructure are interconnected in the existing economic picture. The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families, and the community to recover from a disaster.

Economic Vulnerabilities

- In 2016, Linn County had a per capita personal income of $37,355, which is ranked 24th out of 36 counties, in the Per Capita Personal Income for Oregon Counties.[26]
- In 2019, Linn County had a per capital personal income of $44,830, which is ranked 21st out of 36 counties, in the Per Capita Personal Income for Oregon Counties.[27]
- According to the Oregon Employment Department, the Linn County unemployment rate was 6.8% in April 2021.[28] Note, this is during the Covid-19 global pandemic.
- In the event of a large-scale disaster, and in the situation of multiple hazards impacting an area, unemployment has the potential to rise. Businesses and companies may be unable to overcome the hazard(s) event(s).

[22] Hazards Workshop Session Summary #16, *Disasters, Diversity, and Equity*, (July 2000). University of Colorado, Boulder.
[23] Oregon Employment Department, *Employment Landscape of Rural Oregon*. May 2017, https://www.qualityinfo.org/documents/10182/13336/The+Employment+Landscape+of+Rural+Oregon?version=1.2

[24] Ibid.

[25] Ibid.

[26] Ibid.

[27] Oregon Employment Department, *Per Capital Personal Income in Oregon's Counties*, https://www.qualityinfo.org/-/per-capita-personal-income-in-oregon-s-counties?inheritRedirect=true&redirect=%2Fed, article dated 12/16/20, accessed 6/7/21.

[28] Oregon Employment Department, *Local Area Unemployment Statistics (LAUS) All Areas*, https://www.qualityinfo.org/ed-dwnl/?at=1&t1=~unemprate~y~03~2019~2019~, accessed 6/7/21.

- Linn and Benton Counties are expected to add 6,670 jobs from 2019 to 2029, with total employment rising to 44,620. The 10-year projection pegs growth in the area at 7 percent.[29]
- The 2019 to 2029 employment projections bring together several trends that have been building over the past few years: a strong health care sector, due in part to an aging population; continuing strong growth in Linn and Benton counties' construction sector, which was hard hit during the Great Recession; and continuing baby boomer retirements.[30]

Environment

The capacity of the natural environment is essential in sustaining all forms of life including human life, yet it often plays an underrepresented role in community resilience to natural hazards. The natural environment includes land, air, water and other natural resources that support and provide space to live, work and recreate.[31] Natural capital such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from weather-related hazards, such as flooding and landslides. When natural systems are impacted or depleted by human activities, those activities can adversely affect community resilience to natural hazard events.

The physical geography, weather, climate and land cover of an area represent various interrelated systems that affect overall risk and exposure to natural hazards. Climate change variability also has the potential to increase the effects of hazards in the area. These factors combined with a growing population and development intensification can lead to increasing risk of hazards, threatening loss of life, property and long-term economic disruption if land management is inadequate.

Environmental Vulnerabilities

- Sweet Home is 5.3 square miles in size and the population per square mile is 1,684.6 based on the Census, April 2010. The overall population of Sweet Home was 9,977 in 2019 and the population of Linn, County was 129,749. [32]
- Sweet Home and Linn County are within the Willamette Valley ecoregion as described by the *Oregon Conservation Strategy*. The *Oregon Conservation Strategy* describes that Key Conservation Issues of particular concern in this ecoregion include: land use changes, disruption of disturbance regimes (both fire and floodplain function), challenges and opportunities for private landowners to engage in conservation, and invasive species. In addition to the statewide factors, specific hazards to wildlife in urban areas and habitat fragmentation are of conservation concern here. [33]

[29] Oregon Employment Department, *Long-Term Projections Show Broad-Based Job Opportunities in Linn and Benton Counties, 2019-2029*, Long-Term Projections Show Broad-Based Job Opportunities in Linn and Benton Counties - Article Display Content - QualityInfo, accessed 6/7/21

[30] Oregon Employment Department, *Long-Term Projections Show Broad-Based Job Opportunities in Linn and Benton Counties, 2019-2029*, Long-Term Projections Show Broad-Based Job Opportunities in Linn and Benton Counties - Article Display Content - QualityInfo, accessed 6/7/21

[31] Mayunga, J. 2007, *Understanding and Applying the Concept of Community Disaster Resilience: A capital-based approach*, Summer Academy for Social Vulnerability and Resilience Building.

[32] United States Census, *Quick Facts, Sweet Home, Oregon*, U.S. Census Bureau QuickFacts: Sweet Home city, Oregon; Umatilla County, Oregon, accessed 6/7/21

[33] Oregon Fish and Wildlife, *Oregon Conservation Strategy*, *Willamette Valley*, Willamette Valley – Oregon Conservation Strategy, accessed 6/7/21

- For the *2021 Sweet Home NHMP*, DLCD is using Oregon Climate Change Research Institute (OCCRI) information about climate change and future climate projections from the *2020 Oregon NHMP*.

For further consideration of environmental vulnerabilities, see the Hazard Annexes. The Hazard Annexes provide important information regarding the influence and impacts of climate change on existing natural hazards events such as heavy rains, river flooding, drought, heat waves, wildfire, and air quality.

National Flood Insurance Program (NFIP)

Below is a recap of current information related to the NFIP in Sweet Home and Linn County. For more details about NFIP maps and statistics, and other flood related information, see the Flood Annex section of the Hazard Annexes and Table FL-2 Flood Insurance Details.

A brief recap of Table FL-2 is included here:

- Linn County has 451 National Flood Insurance Program (NFIP) policies in force as of 6/8/21. Sweet Home has 19 of those NFIP policies.[34]
- There are 384 residential flood insurance policies in Linn County and there are 67 non-residential flood insurance policies in Linn County.[35]
- There are 17 residential flood insurance policies and there are 2 non-residential flood insurance policies in Sweet Home.[36]
- There have been 82 paid claims in Linn County and 3 paid claims in Sweet Home as of 6/8/21.[37]
- There have been 12 repetitive losses and 0 severe repetitive losses in Linn County; none of the repetitive losses and severe repetitive losses have occurred in Sweet Home as of 6/8/21.[38]
- There have been 3 substantial damage claims in Linn County and no substantial damage claims in Sweet Home as of 6/8/21.[39]
- Linn County had a Community Assistance Visit (CAV) or Community Assistance Contact (CAC) on 6/26/19 and Sweet Home had a CAV or CAC on 6/27/19 according to the FEMA Community Information System database and DLCD's records. See Table FL-2. [40]
- The City of Sweet Home is not member of the Community Rating System (CRS).[41]
- The Linn County floodplain ordinance was adopted 11/22/16 and the Sweet Home floodplain ordinance was adopted on 9/24/10.[42]
- Private insurance (not NFIP) is an option. The DLCD staff did not research the number of private flood insurance policies in Sweet Home.

[34] Katherine Daniel, Natural Hazards Planner, DLCD, 6/8/21.

[35] Ibid.

[36] Katherine Daniel, Natural Hazards Planner, DLCD, 6/8/21.

[37] Ibid.

[38] ibid.

[39] Ibid.

[40] Ibid.

[41] Ibid and FEMA, *Community Rating System Eligible Communities Effective October 1, 2020,* https://www.fema.gov/sites/default/files/2020-08/fema_crs_eligible-communities_oct-2020.pdf, accessed 6/8/21

[42] Katherine Daniel, Natural Hazards Planner, DLCD, 6/8/21.

Critical Infrastructure, Critical Facilities, and Lifelines

Critical facilities (i.e. police, fire, and government facilities), housing supply, and physical infrastructure are critical during a disaster and are essential for proper functioning and response. The lack or poor condition of infrastructure can negatively affect a community's ability to cope, respond and recover from a natural disaster. Following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediately available resources.

Definitions of Critical Infrastructure, Critical Facilities, and Lifelines

One definition of **critical infrastructure** is "Systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters"[43]

A definition of **critical facilities** is **"**Structures and institutions necessary, in the community's opinion, for response to and recovery from emergencies. Critical facilities must continue to operate during and following a disaster to reduce the severity of impacts and accelerate recovery." [44]

A definition of **lifelines** is "Lifelines include utility systems (potable water, wastewater, oil, natural gas, electric power facilities and communication systems) and transportation systems (airways, bridges, roads, tunnels and waterways). Communication facilities are also important lifelines."[45]

The *2015 Sweet Home NHMP* describes vulnerability, critical facilities, and critical infrastructure.

> Vulnerability primarily involves the "inventory" of people and the built environment in harm's way. Inventory can be characterized by the number, size, type, use, and occupancy of buildings as well as by the infrastructure present in any given specific location. Infrastructure includes bridges, roads and other transportation systems, utilities (e.g., potable water, wastewater, natural gas, and electric power), telecommunications systems, and so on.
>
> The various components of a community's "inventory" vary greatly in importance to the vitality and normal functioning of that community. Some types of facilities and infrastructure, "critical facilities" and "critical infrastructure," are especially important to a community, particularly during emergency situations. Examples of critical facilities include police and fire stations, hospitals, 911 centers, emergency operations centers, and emergency shelters. Critical infrastructure include important utility links, utility lines, and life lines, that are essential in providing service to large numbers of people such as potable water, waste water sanitation, electricity, natural gas, and so on.
>
> Traditionally risk assessment focuses on not only "inventory" (persons present at a given site and the quantity and value of buildings or infrastructure present), but also by its vulnerability to

[43] U.S. Department of Homeland Security, *Critical Infrastructure Sectors*, https://www.dhs.gov/cisa/critical-infrastructure-sectors.

[44] FEMA, *Hazard Mitigation Assistance (HMA) Guidance: Hazard Mitigation Grant Program, Pre-Disaster Mitigation Program, and Flood Mitigation Assistance Program,* February 27, 2015, https://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf.

[45] City of Portland, *Portland Local Energy Assurance Plan,* 2012.

each hazard under evaluation. For example, a given facility or infrastructure may or may not be particularly vulnerable to flood damages or earthquake damages, depending on its location as well as the details of its design and construction, but could be vulnerable to landslides and wildland/urban interface fires. Depending on the hazard, different measures of the vulnerability of buildings and infrastructure are often used.[46]

The *2013 Sweet Home Emergency Operations Plan* describes,

> Critical Infrastructure and Key Resources (CIKR) are owned and operated by the Sweet Home Area or local partners and support the delivery of critical and essential services. This is essential to the Sweet Home Area's security, public health and safety, and economic vitality. CIKR includes the assets, systems,
> networks, and functions that provide vital services to a city, state, region, and sometimes the nation. Emergencies, natural hazards, and terrorist attacks on CIKR could significantly disrupt those activities, produce cascading effects, and result in large-scale human suffering, property destruction, economic loss, and damage public confidence and morale.
>
> Key facilities that should be considered in infrastructure protection planning include:
> - Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water reactive materials.
> - Government facilities, such as departments, agencies, and administrative offices.
> - Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
> - Police stations, fire stations, vehicle and equipment storage facilities, and EOCs that are needed for disaster response before, during, and after hazard events.
> - Public and private utilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events.

The *2013 Sweet Home Emergency Operations Plan* describes the following as the "situation,"

> The Sweet Home Area has identified critical infrastructure and resources to be protected and prioritized during an emergency event or disaster, to the greatest extent possible. During an emergency situation, the protection of human lives will take precedence during all facets of response, and essential services within the Sweet Home Area will be maintained as long as conditions permit.
>
> In addition, a utility failure would impact the availability of essential services such as the water supply, electrical power, natural gas, telephone, and sanitary sewer services. While a failure may result from natural or human-created causes, the severity of the incident must be measured by the duration of the disruption of the service and its impact on life and property.[47]

The NHMP Steering Committee decided to categorize the assets as critical or essential facilities. The NHMP Steering Committee noted, during the 7/19/21 meeting discussion, that critical is like you cannot

[46] *2015 Sweet Home NHMP*, https://www.sweethomeor.gov/sites/default/files/fileattachments/community_and_economic_development/page/4031/2015_sweet_home_mitigation_plan.pdf

[47] *2012 Sweet Home Emergency Operations Plan*.

do without that function, and essential is helpful. Also as noted earlier in this Risk Assessment, the NHMP Steering Committeed identified vulnerable populations.

The NHMP Steering Committee decided, in collaboration with the DLCD Natural Hazards Planner, as can be provided with Homeland Security provisions, that the Critical Facilities List in the *2021 Sweet Home NHMP* will not list the address of the asset that is identified in Table 2-7. Note that each asset is identified with what natural hazards might impact them: severe storms, wildland-urban interface fires, floods, earthquakes, volcanic events, droughts, and landslides. Figure 2-5 is the Critical and Essential Facilities Map. Both the Critical and Essential Facilities List and the Critical and Essential Facilities Map were discussed in detail with the NHMP Steering Committee.

The Evacuation Map in Figure 2-6 is based on discussion with the NHMP Steering Committee and the DLCD Natural Hazards Planner identifying the main travel corridors that could and would be used for evacuation purposes. It is recognized that routes may be impacted by the hazards and may need to be changed. Also, that these routes are not recognized, to our knowledge, as official evacuation routes identified in other Sweet Home plans. The NHMP Steering Committee agreed that topic is a discussion that needs to be had.

Table 2-7 Critical and Essential Facilities for Sweet Home and the Natural Hazards that May Impact Them

Sweet Home Critical Infrastructure List For Discussion at NHMP Steering Committee Meetings 7/19/21; 8/9/21; 9/8/21						Natural Hazards That May Impact Sweet Home's Critical Facilities						
						Severe Storms	Wildland-Urban Interface Fires	Floods	Earthquakes	Volcanic Events	Droughts	Landslides
Key to Map	Id #	Facility	Critical or Essential Facilities	Has a Back-up Generator?	Notes							
1	1	Police Dept	critical	yes	Primary ECC/Personnel & Equipment	no	yes	yes	no, built to EQ	no	no	no
2	1	Fire & Ambulance District Station 21	critical	yes	Alternate ECC/Personnel & Equipment	no	yes	yes	no, built to EQ	no	no	no
3	1	Fire & Ambulance District Station 22	critical	yes	Equipment	no	no	yes	yes	no	no	no
4	1	Public Works	critical	yes	Personnel & Equipment	no	no	yes	yes	no	no	no
5	1	City Hall	critical	ordered, not yet arrived		yes	yes	no	no, seismic retrofits done	no	no	no
6	2	Water Treatment Plant	critical	no		yes	yes	yes	no, built to EQ	no	no	no
7	2	Wastewater Treatment Plant	critical	yes		no	yes	no	yes	no	no	no
8	3	Long St Bridge	essential	NA	city owned, box culvert	yes	no	yes	yes	yes	no	no
9	3	Strawberry Water Pump Station	critical	no		yes	yes	no	yes	no	yes	no
10	3	Strawberry Reservoir	critical	no		yes	yes	no	yes	no	yes	no
11	3	10th Ave Water Reservoirs	critical	no		yes	yes	no	yes	no	yes	no
12	3	49th Ave WaterReservoir	critical	no		yes	yes	no	yes	no	yes	no
13	3	Lake Pointe Water Pump Station	critical	yes		yes	yes	no	yes	no	yes	no
14	1	Public Library	essential	no		no	no	no	yes	no	no	no
15	3	Fuel Stations	critical	no	3 days supply + what is on hand	yes	yes	yes	yes	no	no	no
16	1	ODOT Maintenance Station	critical	don't know	ODOT owned	no	no	no	no	no	no	no
17	3	Ames Creek Culvert	critical	NA	ODOT owned	yes	no	yes	yes	yes	no	no
18	3	Wiley Creek Bridge	critical	NA	ODOT owned/ Highway 20	yes	yes	yes	yes	yes	no	no
19	1	Army Corps of Engineers Office (USACE)	critical	yes	owned by USACE	no	yes	yes	no	no	no	no
20	3	Foster Dam	critical	yes	owned by USACE	no	no	yes	yes	no	no	no, gets trees and debris
21		Foster Dam Water Intake Screen	critical	NA	owned by USACE	yes	no	no	no	no	no	yes
22	3	Pacific Power Substation	critical	don't know		yes	no	yes	yes	no	no	no
23	3	Pacific Power Substation	critical	don't know		yes	yes	no	yes	no	no	no
24	3	Pleasant Valley Bridge	critical	NA	county owned	yes	yes	yes	yes	yes	no	no
25	1	Sweet Home High School	critical	no*		yes	no	yes	no, seismic retrofits done	no	no	no
26	1	Sweet Home Junior High School	essential	no*	SC thinks this would be a good place for the Emergency Operations Center	yes	no	yes	no, built to EQ	no	no	no
27	1	Oak Heights Elementary School	essential	no*		yes	yes	no	yes	no	no	no
28	1	Hawthorne Elementary School	essential	no*		yes	yes	no	yes	no	no	no
29	1	Foster Elementary School	essential	no*		yes	yes	yes	yes	no	no	no
30	1	Holley Elementary School	essential	no*	School is located 4 miles SW of Sweet Home, outside city limits. They have a well for water.	yes	yes	no	yes	no	no	no
31	1	Sweet Home School District Administration Building	essential	no*	*One tractor mounted back-up generator and several smaller generators that can be taken to schools as needed. These are stored at 1920 Long St. in the facilities dept.	yes	no	yes	yes	no	no	no
32	2	Sweet Home School District Transportation	essential	no*		yes	no	no	no	no	no	no
33	1	Linn-Benton Community College - Sweet Home Center	essential	don't know		yes	no	no	no	no	no	no
34	1	Sweet Home Community Center	essential	no		yes	no	yes	no	no	no	no
35	1	Sweet Home Family Medicine	essential	don't know		yes	no	no	yes	no	no	no
36	1	Linn County Health Clinic - Sweet Home	essential	don't know		yes	no	no	yes	no	no	no
		Note: Nearest hospital is in Lebanon, OR.				Note: Air quality would be an issue with volcanic hazards.						

Key (from Tommy Mull 10/2/19)	From the 2015 Sweet Home NHMP
1 = Facility	Some types of facilities and infrastructure, "critical facilities" and "critical infrastructure," are especially important to a community, particularly during emergency situations. Examples of critical facilities include police and fire stations, hospitals, 911 centers, emergency operations centers, and emergency shelters. Critical infrastructure include important utility links, utility lines, and life lines, that are essential in providing service to large numbers of people such as potable water, waste water sanitation, electricity, natural gas, and so on.
2 = Combo Facility & Infrastructure	
3 = Infrastructure	

Source: DLCD Natural Hazards Planner, Tricia Sears, and the Sweet Home NHMP Steering Committee, 2020-2021.

Key Observations of Critical /Essential Facilities, Critical Infrastructure, and Vulnerable Population Centers

- It is critical to maintain the quality of built capacity (transportation networks, critical facilities, utility transmission, communication, etc.). For example, if service on Highway 22 was interrupted for an extended amount of time that would be problematic to Sweet Home and nearby unincorporated areas.
- Some roads and bridges in the Sweet Home and Linn County are highly vulnerable to hazards. Because roads bridges vary in size, materials, siting, and design, any given hazard will affect them differently. The City of Sweet Home and the County may want to devote attention to roads and bridges that may become obstructed that serve as primary interstate travel routes, as this will likely have significant impacts on access in and out of the County and region.
- U.S. Census data shows 3,721 housing units, with 2,314 owner-occupied and 1,407 renter-occupied in Sweet Home. Of those, the bulk were built many years ago, before seismic and flood requirements. See Table 2-8 included below.[48]
- Current seismic building standards began in 1990 and the local implementation of the flood elevation requirements began in the 1970's. The FEMA Flood Insurance Study for Linn County has been completed for the FIRMs that initially became effective September 29, 2010 and were revised December 8, 2016**.** Sweet Home has a community number of 410146**.**[49]
- Work on Memorandums of Understanding or Memorandums of Agreement with other agencies and organizations to have access to and share resources.
- Continue to consider impacts to vulnerable communities throughout Sweet Home.

Table 2-8 Housing Units in Sweet Home, OR

Period of Time	Number of Units Constructed
2014 or later	25
2010 to 2013	27
2000 to 2009	564
1980 to 1999	733
1960 to 1979	922
1940 to 1959	1,130
1939 and before	320
Total	3,721

Source: U.S. Census Bureau, American Community Survey, Table S2504, *Physical Housing Characteristics for Occupied Housing Units*, 2019 ACS 1-Year Estimates Subject Tables, https://data.census.gov/cedsci/table?q=S2504&g=1600000US4171950&tid=ACSST5Y2019.S2504&hidePreview=false, accessed 6/7/21

Note that age of housing is another characteristic that influences a structure's vulnerability to hazards. Generally, the older a home is, the greater the risk of damage from natural disasters. This is because stricter building codes have only been implemented in recent decades, following improved scientific understanding of plate tectonics and earthquake risk. In Oregon, many structures built after the late 1960's began utilizing earthquake resistant designs and construction. Similarly,

[48] U.S. Census Bureau, American Community Survey, Table S2504, *Physical Housing Characteristics for Occupied Housing Units*, 2019 ACS 1-Year Estimates Subject Tables, https://data.census.gov/cedsci/table?q=S2504&g=1600000US4171950&tid=ACSST5Y2019.S2504&hidePreview=false, accessed 6/7/21

[49] FEMA, *Flood Insurance Study: Linn County, Oregon, and Incorporated Areas Volume 1 of 2*, flood_ins_study_v1-41043cv001b.pdf (cityofalbany.net), accessed 6/7/21

communities in the northwest began implementing flood elevation ordinances in the 1970's.[50] In 1990, Oregon again upgraded to stricter seismic standards that included earthquake loading in the building design.[51] So housing stock built after 1990 had more stringent building codes in place. This information is also noted in Appendix B Community Profile of this *2021 Sweet Home NHMP*.

Sweet Home Risk Assessment and Community Resilience

The information presented in this Risk Assessment, along with hazard specific information in Volume II Hazard Annexes and the other information in the appendices, is provided as the basis for the mitigation actions in Section 3 Mitigation Strategy in Table 3-1. The mitigation actions in this *2021 Sweet Home NHMP* are ways for Sweet Home to prepare for and to mitigate the short- and long-term effects resulting from natural hazards. This NHMP and the mitigation actions create tools and actions to build community resilience.

Community resilience is a term often used and many definitions abound. From the City Club of Portland, this definition describes, "A resilient community, city or region understands its strengths and vulnerabilities and has developed capabilities to plan for and mitigate the impact of a major earthquake or other disaster, rapidly restore itself to a state of basic well-being, and rebuild to achieve even greater resilience."[52]

Disaster resilience is another common term. "The thing that may distinguish community resilience from broader definitions of disaster resilience efforts is the explicit focus on the risks, needs and resources specific to a given community. Community resilience also includes a focus on incorporating equity and social justice considerations in preparedness planning and response. From a planning perspective, community resilience planning is a bottom-up, rather than a topdown mode of thinking because priorities are likely to be very different when resilience is approached from the perspective of the impacted community as opposed to the state as a whole."[53]

As is demonstrated with the variety of mitigation actions for the identified natural hazards, there are many actions communities can take to build their resilience. According to the Energy Trust of Oregon, "Energy concerns are a vital component of the community resilience equation, because energy powers communities, making modern life possible. Energy efficiency and distributed renewable energy are essential components of any resilience strategy because they aid emergency response and recovery, help with climate change adaptation and mitigation and provide social and economic benefits. They can also help protect communities from the impacts of emerging threats, such as politically motivated cyberattacks on power plants and electric systems. Whatever the threat, energy efficiency and distributed renewables help reduce vulnerability to the diverse hazards a community may face and increase the community's capacity to cope with the damage."[54]

[50] Ibid.

[51] Wang Yumei and Bill Burns, *Case History on the Oregon GO Bond Task Force: Promoting Earthquake Safety in Public Schools and Emergency Facilities*, National Earthquake Conference. January 2006.

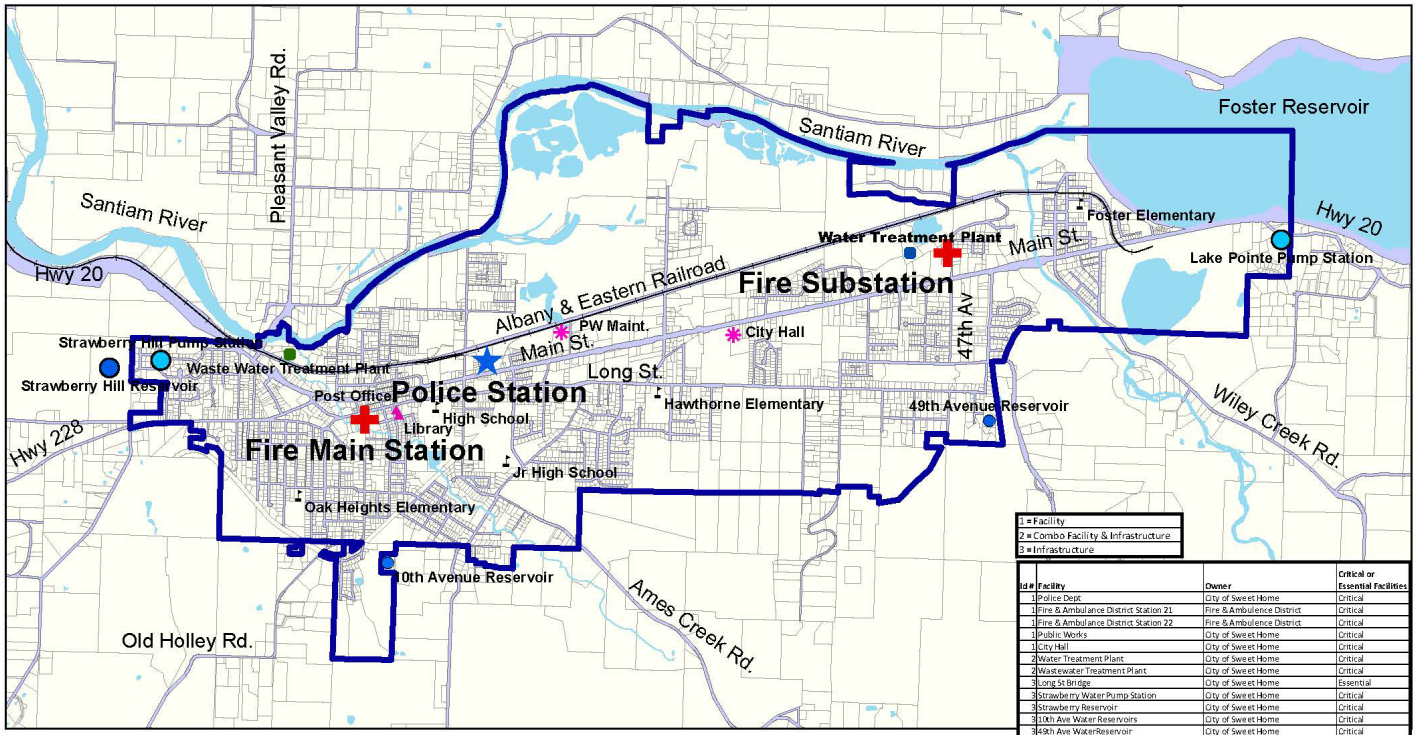
[52] Energy Trust of Oregon, *Community Resilience Board Learning Paper*, Prepared by Lizzie Rubado, Jessica Iplikci, and Becky Engle, April 2018

[53] Ibid.

[54] Ibid.

In this *2021 Sweet NHMP*, the NHMP Steering Committee recognizes the role energy plays in keeping communities resilient and critical infrastructure functioning. There are potential collaborations with PPL. Below, Figure 2-5 is the Critical Infrastructure Map. Figure 2-6 is the Evacuation Map. These maps, along with other maps, supplement the text in this Section 2: Risk Assessment and the text in Appendix B Community Profile, and support the entire NHMP.

Figure 2-5 Sweet Home Critical Infrastructure Map



City of Sweet Home
Natural Hazards Mitigation Plan
Critical & Essential Facilities

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

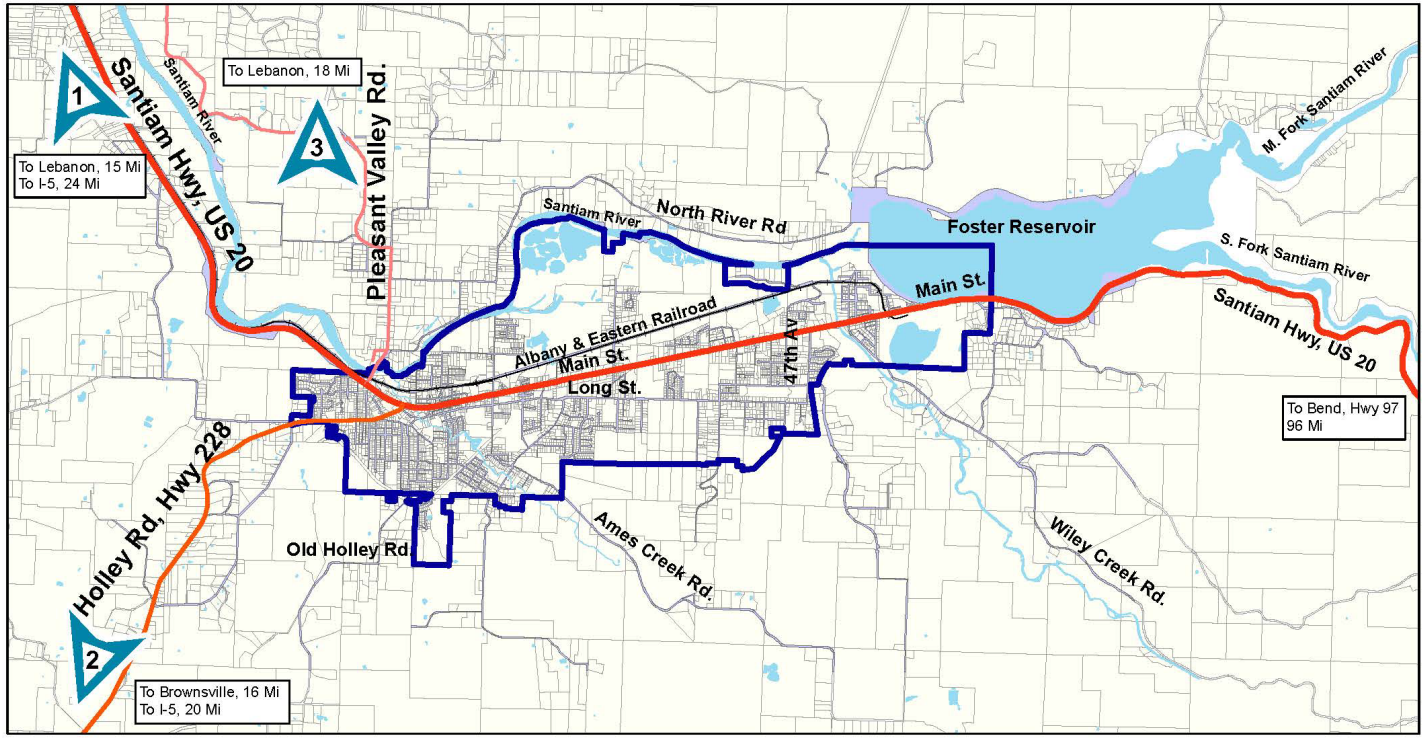
Critical and Essential Facilities Legend
- Fire Station
- Fire Substation
- Police Station
- 10th Avenue Reservoir
- 49th Avenue Reservoir
- Strawberry Hill Reservoir
- Water Treatment Plant
- Waste Water Treatment Plant
- Strawberry Hill Pump Station
- Lake Pointe Pump Station
- City Hall - PW Maint.
- High School
- Jr High School
- Foster Elementary
- Hawthorne Elementary
- Oak Heights Elementary
- Library
- Post Office

1 = Facility
2 = Combo Facility & Infrastructure
3 = Infrastructure

Id#	Facility	Owner	Critical or Essential Facilities
1	Police Dept	City of Sweet Home	Critical
1	Fire & Ambulance District Station 21	Fire & Ambulence District	Critical
1	Fire & Ambulance District Station 22	Fire & Ambulence District	Critical
1	Public Works	City of Sweet Home	Critical
1	City Hall	City of Sweet Home	Critical
2	Water Treatment Plant	City of Sweet Home	Critical
2	Wastewater Treatment Plant	City of Sweet Home	Critical
3	Long St Bridge	City of Sweet Home	Essential
3	Strawberry Water Pump Station	City of Sweet Home	Critical
3	Strawberry Reservoir	City of Sweet Home	Critical
3	10th Ave Water Reservoirs	City of Sweet Home	Critical
3	49th Ave WaterReservoir	City of Sweet Home	Critical
3	Lake Pointe Water Pump Station	City of Sweet Home	Critical
1	Public Library	City of Sweet Home	Essential
3	Fuel Stations	Private	Critical
1	ODOT Maintenance Station	ODOT	Critical
3	Ames Creek Culvert	ODOT	Critical
3	Wiley Creek Bridge	ODOT	Critical
1	Army Corps of Engineers Office (USACE)	USACOE	Critical
3	Foster Dam	USACOE	Critical
3	Foster Dam Water Intake Screen	City of Sweet Home	Critical
3	Pacific Power Substation	Pacific Power	Critical
3	Pacific Power Substation	Pacific Power	Critical
3	Pleasant Valley Bridge	ODOT	Critical
1	Sweet Home High School	School District	Critical
1	Sweet Home Junior High School	School District	Essential
1	Oak Heights Elementary School	School District	Essential
1	Hawthorne Elementary School	School District	Essential
1	Foster Elementary School	School District	Essential
1	Holley Elementary School	School District	Essential
1	Sweet Home School District Administration Building	School District	Essential
2	Sweet Home School District Transportation Yard	School District	Essential
1	Linn-Benton Community College Sweet Home Center	LBCC	Essential
1	Sweet Home Community Center	City of Sweet Home	Essential
1	Sweet Home Family Medicine	Samaritan Health	Essential
1	Linn County Health Clinic - Sweet Home	Linn County	Essential
	Note: Nearest hospital is in Lebanon, OR.		

Source: Joe Graybill, Sweet Home, 9/10/21

Figure 2-6 Sweet Home Evacuation Map



City of Sweet Home
Natural Hazards Mitigation Plan
Primary Evacuation Routes

September 2, 2021

0 0.25 0.5 1 1.5 2 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Santiam Hwy, US 20
- Main Street
- Holley Rd, Hwy 228
- Holley Rd
- Pleasant Valley Rd.
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

1 **Santiam Hwy, US 20.**

2 **Holley Rd, Or 228.**

3 **Pleasant Valley Rd.**

The Sweet Home Transportation System Plan indicates Arterials, Minor Arterials, and Collector Streets as major routes throughout town. While not expressly considering or documenting Evacuation Routes, it shows the roadways with the capacity to handle traffic volumes as needed connecting to Primary Evacuation Routes.

Sources:
Sweet Home 2005 Transportation System Plan.
2012 Sweet Home Emergency Operations Plan.

Source: Joe Graybill, Sweet Home, 9/10/21

Section 3: Mitigation Strategy

Section 3 outlines Sweet Home's strategy to reduce or avoid short- and long-term vulnerabilities to the identified natural hazards. Specifically, this section presents a mission, goals, and mitigation actions thereby addressing the mitigation strategy requirements contained in 44 CFR 201.6(c). The Sweet Home Natural Hazards Mitigation Plan (NHMP) Steering Committee reviewed and retained the mission as is; reviewed and retained the goals as is; and reviewed and updated mitigation actions. Additional planning process documentation is in Appendix A.

Mitigation Plan Mission

The plan mission states the purpose and defines the primary functions of Sweet Home's Natural Hazard Mitigation Plan. It is intended to be adaptable to any future changes made to the plan and need not change unless the community's environment or priorities change.

The **mission** of the *2021 Sweet Home NHMP* is to:

Mission:

Proactively facilitate and support community-wide policies, practices, and programs that make Sweet Home more disaster resistant and disaster resilient.

The 2020-2021 Sweet Home NHMP Steering Committee reviewed the existing NHMP mission statement and agreed it accurately describes the overall purpose and intent of this NHMP. The Steering Committee believes the mission statement allows for a comprehensive approach to mitigation planning.

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that Sweet Home citizens, and public and private partners can take while working to reduce the City's risk from natural hazards. These statements of direction form a bridge between the broad mission statement and particular mitigation actions. The goals listed serve as checkpoints as agencies and organizations begin implementing mitigation actions. The 2020-2021 Sweet Home NHMP Steering Committee reviewed the existing NHMP goals and agreed to keep the goals as is; all the goals are of equal importance.

The **goals** of the *2021 Sweet Home NHMP* are:

Goal 1: Reduce the Threat to Life Safety

A. Enhance life safety by minimizing the potential for deaths and injuries in future disaster events.
B. Enhance life safety by improving public awareness of earthquakes and other natural hazards posing life safety risk to the Sweet Home community.

Goal 2: Reduce the Threats to Sweet Home Buildings, Facilities, and Infrastructure

A. Identify buildings and infrastructure at high risk from one or more hazards.
B. Conduct risk assessments for critical buildings, facilities, and infrastructure at high risk to determine cost effective mitigation actions to eliminate or reduce risk.
C. Implement mitigation measures for buildings, facilities, and infrastructure which pose an unacceptable level of risk.
D. Ensure that new buildings and infrastructure in Sweet Home are adequately designed and located to minimize damages in future disaster events.

Goal 3: Enhance Emergency Response Capability, Emergency Planning, and Post-Disaster Recovery

A. Ensure that critical facilities and critical infrastructure are capable of withstanding disaster events with minimal damage and loss of function.
B. Enhance emergency planning to facilitate effective response and recovery from future disaster events.
C. Increase collaboration and coordination between Sweet Home, nearby communities, utilities, businesses, and citizens to ensure the availability of adequate emergency and essential services for the Sweet Home community during and after disaster events.

Goal 4: Seek Funding Sources for Mitigation Actions

A. Prioritize and fund action items with the specific objective of maximizing mitigation, response and recovery resources.
B. Explore both public (local, state, and federal) funding and private sources for mitigation actions.

Goal 5: Increase Public Awareness of Natural Hazards and Enhance Education and Outreach Efforts

A. Development and implement education and outreach programs to increase public awareness of the risks from natural hazards.
B. Provide information on resources, tools, partnership opportunities and funding sources to assist the community in implementing mitigation activities.
C. Strengthen communication and coordinate participation among and within public agencies, non-profit organizations, business, industry, and the public to encourage and facilitate mitigation actions.

Goal 6: Incorporate Mitigation Planning into Natural Resource Management and Land Use Planning

A. Protect Sweet Home's sources of potable water
B. Balance natural resource management, land use planning, and natural hazard mitigation to protect life, property, and the environment.
C. Preserve, rehabilitate, and enhance environmentally sensitive areas and natural systems within Sweet Home to both entrance habitats and serve natural hazard mitigation functions.

Existing Mitigation Activities

Existing mitigation actions include current mitigation programs and activities that are being implemented by Sweet Home to reduce the community's overall risk to natural hazards. Documenting these efforts can assist the jurisdiction to better understand risk and identifying successes. See Table 3-1 2021 Sweet Home NHMP Mitigation Actions and Table 3-2 Sweet Home Mitigation Actions 2015 Status. For details on each natural hazard see the Volume I Risk Assessment and the Volume II Hazard Annexes. Success stories are included in Appendix E.

Government Structure

In addition to the Emergency Management Department, most departments within the County and City governance structures have some degree of responsibility in building overall community resilience. Each plays a role in ensuring that jurisdiction functions and normal operations resume after an incident, and the needs of the population are met. For further explanation regarding how these departments influence hazard resilience, see Appendix B, Community Profile.

Existing Plan & Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Linking existing plans and policies to the Natural Hazards Mitigation Plan helps identify what resources already exist that can be used to implement the action items identified in the Plan. Plans and policies already in existence have support from local residents, businesses, and policy makers.[1] A list documenting plans and policies already in place in Sweet Home can be found in in Volume I, Section 4 Implementation and Maintenance in Table 4-1, and in Appendix B Community Profile in Table B-14; both tables are Existing Plans for Sweet Home.

Community Organizations and Programs

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Linking existing plans and policies to the NHMP helps identify what resources already exist that can be used to implement the mitigation actions in the NHMP. Plans and policies already in existence have support from local residents, businesses and policy makers.[2] As noted in the previous paragraph, a list documenting plans and policies already in place in Sweet Home can be found in Section 4 Implementation and Maintenance, Table 4-1, and Appendix B Community Profile in Table B-14.

NHMP Mitigation Actions

Mitigation actions identified through the planning process are an important part of the NHMP. Mitigation actions are detailed recommendations for activities that local departments, citizens, and others could engage in to reduce risk. They address both multi-hazard (MH) and hazard-specific issues. Mitigation actions can be developed through a number of sources. A description of how Sweet Home's 2021 NHMP mitigation actions were developed is provided below in the "Mitigation Action Development Process" section. The process resulted in the creation of two mitigation actions tables.

- Table 3-1, 2021 Sweet Home NHMP Mitigation Actions shows the mitigation actions to move forward with this *2021 Sweet Home NHMP*.
- Table 3-2, Sweet Home's Mitigation Actions 2014 Status provides an update on the status of each mitigation action from the *2015 Sweet Home NHMP*.

[1] Burby, Raymond J., ed. 1998. Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities.

[2] Raymond J. Burby, *Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities*, 1998, https://www.nap.edu/catalog/5785/cooperating-with-nature-confronting-natural-hazards-with-land-use-planning

Mitigation Action Development Process

Development of mitigation actions was a multi-step, iterative process that involved brainstorming, discussion, review, and revisions. This work occurred during the NHMP Steering Committee meetings. Additional conversation occurred with the Steering Committee members outside of NHMP Steering Committee meetings.

In collaboration with the DLCD Natural Hazards Planner, the NHMP Steering Committee went through each mitigation action in the *2015 Sweet Home NHMP* and ascertained if the action was completed or in progress.

- *Completed mitigation actions* were deemed a successful accomplishment and removed from the table.
- *No longer included mitigation actions* were removed from the table due to resource constraints or other factors.
- *Mitigation actions that were retained* were retained in full or modified to more accurately reflect the current situation.
- During this process, *new mitigation actions* were also identified.

With the new mitigation actions and the retained existing mitigation actions (some of which were modified), a table was created to include all the mitigation actions that would be moved forward for the *2021 Sweet Home NHMP*; see Table 3-1, 2021 Sweet Home NHMP Mitigation Actions. It includes the mitigation actions that the NHMP Steering Committee supports.

Table 3-2 is the Sweet Home Mitigation Actions 2015 Status; it provides an update on the status of each mitigation action from the *2015 Sweet Home NHMP*.

Mitigation Actions

Each mitigation action for this *2021 Sweet Home NHMP* is listed with the mitigation action title and description, the coordinating organization, the partner organizations, the timeline, and the NHMP goals that it aligns with. For the status update of the mitigation actions, there are additional columns that show the status/what has been done, and whether the mitigation action from 2015 was to be retained, modified, or deleted.

Mitigation Action Title Description

Each mitigation action item includes a title, e.g. short-term multi-hazard mitigation action #2, and a brief description of the proposed action.

Alignment with Plan Goals

The plan goals addressed by each mitigation action are identified as a means for monitoring and evaluating how well the mitigation plan is achieving its goals, following implementation.

Coordinating Organization

The coordinating organization is the public agency with the regulatory responsibility to address natural hazards, or that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring and evaluation. The coordinating organization is Sweet Home and the main contact is Blair Larsen, Community and Economic Development Director.

Partner Organizations

The partner organizations are listed in the mitigation actions tables included below. There are potential partners recommended by the Steering Committee but not necessarily contacted during the development of the plan. The coordinating organization should contact the identified partner organizations to see if they are capable of and interested in participation. This initial contact is also to gain a commitment of time and/or resources toward completion of the mitigation actions.

Timeline

Mitigation actions include both short- and long-term activities. Each action item includes an estimate of the timeline for implementation.

- *Short-term action items* (ST) are activities that may be implemented with existing resources and authorities in one to two years.
- *Long-term action items* (LT) may require new or additional resources and/or authorities, and may take from one to five years to implement.
- *On-going* action items signify that work has begun and will either exist over an indefinite timeline, or an extended timeline. These are successful mitigation actions that have often been well integrated into the practices of the jurisdiction.

Status

As mitigation actions are implemented or new ones are created during the plan maintenance process, it is important to indicate the status - whether it is new, ongoing, or complete. Documenting the status of the mitigation action will make reviewing and updating the NHMP easier during the plan's five-year update, and can be used as a benchmark for progress.

Mitigation Rationale

Mitigation actions should be fact-based and tied directly to issues or needs identified throughout the planning process. Mitigation actions can be developed at any time during the planning process and can come from a number of sources, including participants in the planning process, noted deficiencies in local capability, or issues identified through the risk assessment. The rationale for proposed mitigation actions is based on the information documented in Volume I Section 2 Risk Assessment and Volume II Hazard Annexes.

Potential Funding Sources

Where possible, identify potential funding sources for the mitigation action. Example funding sources can include: the Federal Hazard Mitigation Grant Program (HMGP), Building Resilient Infrastructure and Communities (BRIC), and Flood Mitigation Assistance (FMA) Programs; state funding sources such as the Oregon Seismic Rehabilitation Grant Program; or local funding sources such as capital improvement or general funds. A mitigation action may have multiple funding sources. The mitigation actions are identified as short- or long-term as described in the "Timeline" description included previously, and as listed in the two mitigation action tables below. That categorization includes an element of funding capacity of the jurisdiction for that action. See the Appendix D Grant Programs and Resources for additional information on funding opportunities.

Implementation through Existing Programs

The *2021 Sweet Home NHMP* includes a range of mitigation actions that, when implemented, will reduce loss from hazard events in the City. Within the NHMP, FEMA requires the identification of existing programs that might be used to implement these action items. Sweet Home currently

address statewide planning goals and legislative requirements through their comprehensive land use plans, capital improvements plans, mandated standards and building codes. Plans and policies already in existence have support from local residents, businesses, and policy-makers. Many land use, comprehensive, and strategic plans are updated regularly, and can adapt easily to changing conditions and needs. Implementing the NHMP's mitigation actions through such plans and policies increases their likelihood of being supported and implemented. Sweet Home will work to incorporate the mitigation actions into existing programs and procedures.

Sweet Home will continue to coordinate and implement the *2021 Sweet Home NHMP* with the monitoring, evaluating, and updating of the NHMP within a 5-year cycle, through the NHMP maintenance meetings. Those meetings may be held with the group referred to as the Sweet Home Emergency Management Committee (EMC). The mitigation actions refer to the NHMP Steering Committee and the Emergency Management Committee.

Mitigation Action Tables

The Mitigation Actions Tables portray the overall action plan framework and identify links between the plan goals, partnerships (coordination and partner organizations), and actions. The tables document a description of the action, the level of priority, the coordinating organization, partner organizations, timeline, and the plan goals addressed.

Table 3-1, 2021 Sweet Home NHMP Mitigation Actions, shows all seven of the natural hazards – severe storms, wildland-urban interface fires, floods, earthquakes, volcanic events, droughts, and landslides - impacting Sweet Home have mitigation actions. There are hazard specific and multi-hazard mitigation actions.

Table 3-2, Sweet Home Mitigation Actions 2015 Status, includes the status and explanation of the *2015 Sweet Home NHMP* mitigation actions as provided by the Sweet Home NHMP Steering Committee (SC) at NHMP meetings in 2020-2021. The decisions to retain, modify, or delete the mitigation actions were also discussed at the meetings. Follow up discussions occurred with SC members by email and phone calls. This table has been refined so as to include an overall summary from the discussions.

The NHMP Steering Committee finalized the mitigation actions for the *2021 Sweet Home NHMP* and determined the factors for prioritizing them. It was agreed that the risk level rankings from the Hazard Vulnerability Assessment (HVA) would be used to prioritize the multi-hazard and hazard-specific mitigation actions. The "Priority" column lists the priority. All the multi-hazard (MH) actions are high priority. The hazard-specific actions are high, medium, and low. The risk level rankings are found in Volume I Section 2 Risk Assessment in Table 2-4 and the rankings are further described in the Risk Assessment section.

Number of mitigation actions in the *2021 Sweet Home NHMP*: 39 (as of 7/23/21)

Number of mitigation actions by hazard: multi-hazard = 12, severe storms = 7, wildland-urban interface fires = 3, flood = 8, earthquake = 5, volcanic events = 1, drought = 0, and landslides = 3.

Table 3-1 Sweet Home NHMP Mitigation Actions

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Retain/ Modify/ Delete
Multi-Hazard (MH) Actions: High Priority							
Short-Term MH #1	Evaluate and develop detailed inventories of at-risk buildings and infrastructure and refine priorities for mitigation actions. Use the Critical Infrastructure List in the Sweet Home NHMP.	City Community Development Department (CCDD)	Sweet Home Public Schools, Sweet Home Fire and Ambulance District	1-2 years	1, 2, 4, 5, 6	City, grants, see also the Grant Programs and Resources appendix	Retain. Revise. Add reference to the Critical Infrastructure List in the 2021 Sweet Home NHMP. Add partners.
Short-Term MH #2	Identify and pursue funding opportunities to implement mitigation actions in the Sweet Home NHMP. Mitigation actions are prioritized as high, medium, and low.	CCDD, SHFAD	Sweet Home Emergency Management Committee	On-going	1-5	see the Grant Programs and Resources appendix	Retain. Revise. Refer to the NHMP mitigation actions and use the priorities for those (high, medium, and low).
Short-Term MH #3	Provide educational information to existing neighborhood groups to enable them to better help their close neighbors during hazard emergencies and to notify emergency response officials if assistance is needed. See the NHMP Outreach Calendar in the Sweet Home NHMP.	Sweet Home Emergency Management Committee		1-2 years	1, 3, 5	City	Retain. Revise. Refer to the NHMP Outreach Calendar created with this NHMP.
Short-Term MH #4	Work with Linn County Shelter Committee (LCSC), including Red Cross, to continually update Emergency Shelter Plans for the Sweet Home	CCDD; LCSC; American Red Cross; Sweet Home Emergency Management Committee	Police, Sweet Home Fire and Ambulance District, Sweet Home Public Schools	On-going	1, 3, 5	City, LCSC	Retain. Add partners.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Retain/ Modify/ Delete
	community. Include assessing needs – especially for vulnerable populations (e.g., needs for generators in shelters).						
Short-Term MH #5	Identify, promote, and make available personal preparedness programs for Sweet Home residents.	Sweet Home Emergency Management Committee	See also the NHMP Outreach Calendar in the Sweet Home NHMP.	On-going	1, 2, 5	City, grant	Retain. Note that the NHMP Outreach calendar identifies partners for outreach.
Short-Term MH #6	Identify and promote public & private sector partnerships to foster hazard mitigation activities.	Sweet Home Emergency Management Committee	Pacific Power, Energy Trust, See also the NHMP Outreach Calendar in the Sweet Home NHMP.	On-going	1, 2, 3, 5	City, grant	Retain. Add reference to the NHMP mitigation activities.
Short-Term MH #7	Set up (thereafter update and maintain) a City Web Page and social media for emergency preparedness information and links for the public.	CCDD; Sweet Home Emergency Management Committee		1 year	1, 5	City	Retain. Modify to include reference to social media.
Long-Term MH #1	Integrate hazard, vulnerability, and risk findings in the NHMP into enhanced emergency operations planning.	Sweet Home Emergency Management Committee		On-going	1, 3, 5	NA	Retain. Revise to say NHMP instead of Mitigation Plan.
Long-Term MH #2	Continue the formal role for the Sweet Home Emergency Management Committee to maintain a sustainable process to encourage, implement, monitor, & evaluate city-wide mitigation actions.	Sweet Home Emergency Management Committee	See also the NHMP Outreach Calendar in the Sweet Home NHMP.	On-going	1, 2, 3, 5	NA	Retain. Perhaps add language about review NHMP 2x year.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Retain/ Modify/ Delete
	Review mitigation actions 2x year.						
Long-Term MH #3	Identify and promote education programs for mitigating hazard risks.	Sweet Home Emergency Management Committee	See also the NHMP Outreach Calendar in the Sweet Home NHMP.	On-going	1, 2, 5	City	Retain. Revise to add reference to the NHMP calendar of outreach.
Long-Term MH #4	Integrate the NHMP information into planning and regulatory documents and programs.	CCDD	Sweet Home Emergency Management Committee	On-going	1, 2, 3, 5, 6	City	Retain. Revise. Refer to the table that will be in the Community Profile that lists plans, programs, and policies.
Long-Term MH #5	Reach out to Sweet Home Public Schools to improve and increase information sharing and collaboration on mitigation of natural hazards.	Sweet Home Emergency Management Committee, Sweet Home Public Schools	Police and Sweet Home Fire and Ambulance District	1-5 years	1-6	City	New mitigation action
Severe Storms (SS): High Priority							
Short-Term SS #1	Assess need for back-up power generators for emergency shelters in Sweet Home. Identify the specifications that are needed to have a generator be appropriate for that shelter. See also the Critical Infrastructure List in the Sweet Home NHMP.	Sweet Home Emergency Management Committee	Police, Sweet Home Fire and Ambulance District, American Red Cross, Sweet Home Public Schools	1-2 years	1, 3	City	Retain. Consider adding language about identifying the specs for a generator that would be appropriate for the shelter.
Short-Term SS #2	Identify critical need locations, vulnerable populations, and vulnerable independent individuals. See also the Critical	CCDD, Sweet Home Emergency Management Committee	Police, Sweet Home Fire and Ambulance District, American Red Cross, Sweet Home Public Schools	1-2 years	1, 3, 5	City	Retain. Revise. Add language to refer to Critical Infrastructure List and incorporate most current information.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Retain/ Modify/ Delete
	Infrastructure List in the Sweet Home NHMP.						
Long-Term SS #1	Consider upgrading lines & poles to improve wind/ice loading, undergrounding critical lines, and adding interconnect switches to allow alternative feed paths and disconnect switches to minimize outage areas.	Electrical Utility (PPL),	Sweet Home Emergency Management Committee	On-going	1, 2, 3	PPL	Retain.
Long-Term SS #2	Encourage Pacific Power (PPL) to prioritize a coordinated emergency response (including enhanced communications) with City Public Works.	CPWD; CCDD, PPL,	Sweet Home Emergency Management Committee	On-going	1, 2, 3	PPL	Retain. Revise to include CCDD as partner. Potentially revise language to note relationship building.
Long-Term SS #3	Assess needs for back-up power generators for all City-owned designated critical facilities (See the Critical Infrastructure List in the NHMP) and ensure that the highest priority critical facilities have generators or are wired to accept "plug-in generators".	CPWD, Police, Fire,	Sweet Home Emergency Management Committee	On-going	1, 2, 3	City, PPL	Retain. Revise. Add reference to the Critical Infrastructure List in this NHMP. Add partner organizations.
Long-Term SS #4	Continue tree trimming efforts to mitigate electrical hazards, especially for transmission lines and trunk distribution lines.	PPL, City Public Works, City Park and Tree Committee	Sweet Home Fire and Ambulance	On-going	1, 2, 3	City, PPL	Retain. Revise. Note CTC is now the City Park and Tree Committee.
Long-Term SS #5	Continue City-wide efforts encouraging property owners to keep trees	Sweet Home Emergency Management	CCDD, Sweet Home Fire and Ambulance,	On-going	1 ,2, 3, 5	City	Delete. Note CTC is now the City Park and Tree Committee.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Retain/ Modify/ Delete
	trimmed near their electrical service drops.	Committee, City Park and Tree Committee	see also the NHMP Outreach Calendar				
Wildfire (WF) Actions: Medium Priority							
Short-Term WF #1	Identify and map evacuation routes and procedures for high-risk areas, disseminate and educate the public. See the evacuation map in the Sweet Home NHMP. See also the Emergency Operations Plan.	City Engineering, Police, Sweet Home Fire and Ambulance District, ODF	See also the NHMP Outreach Calendar	On-going	1, 3, 5	City, FEMA, ODF, SHFAD	Retain. Revise. Expand partner list. Note routes should be reviewed regularly and updated. Refer to map in this NHMP.
Long-Term WF #1	Review and identify information to determine what to use. Encourage fire-safe construction practices for existing and new construction in high-risk areas. In particular, look at the city's perimeter.	Sweet Home Emergency Management Committee,	CCDD, SHFAD, ODF	On-going	1,2, 3, 5, 6	City, FEMA, ODF, SHFAD,	Retain. Revise. Add language about evaluation and review of pertinent information.
Long-Term WF #2	Obtain better information about existing fuels reduction projects. Identify hazard areas and provide public education for them, especially the high hazard areas. Efforts will be on-going since fuels grow back.	Sweet Home Emergency Management Committee,	CCDD, SHFAD, ODF	On-going	1, 2, 3, 5	City, FEMEA, ODF, SHFAD	Retain. Revise. Add language about obtaining information, sharing and collaboration.
Flood (FL): Medium Priority							
Short-Term FL #1	Obtain maps of dam failure inundation areas and update Sweet Home	USACE, CCDD, Police, Public Works, Sweet Home Fire and Ambulance District	Sweet Home Emergency Management Committee	On-going	1 ,3, 5	USACE	Retain. Revise. Add police, fire, public works as partners. Add language about City's EOP and

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Retain/ Modify/ Delete
	Emergency Operations Plan.						collaboration with USACE. Note USACE will have website in Fall 2021 with publicly available dam inundation info.
Short-Term FL #2	Encourage US Corps of Engineers to complete seismic vulnerability assessments for Green Peter and Foster dams make seismic improvements as necessary.	USACE, CCDD, Police, Public Works, Sweet Home Fire and Ambulance District	Sweet Home Emergency Management Committee	On-going	1, 2, 5	USACE	Retain. Revise. Add police, fire, public works as partners. Add language about collaboration with USACE.
Short-Term FL #3	Complete the inventory and mapping of locations in Sweet Home subject to frequent storm water flooding.	CCDD, Public Works	Sweet Home Emergency Management Committee	On-going	5	City	Retain. Revise. Expand partner list.
Long-Term FL #1	Periodically evaluate elevation data for number of structures within the 100-yr floodplain. Coordinate with Linn County Planning each year on obtaining and using LIDAR imaging for elevation information.	CCDD, Linn County	Sweet Home Emergency Management Committee	On-going	5	City, DLCD, Silver Jackets, FEMA	Retain. Revise. Alter language slightly to be more about updating and collaborating.
Long-Term FL #2	For structures within the 100-year floodplain, explore mitigation options with property owners.	CCDD, Emergency Manager	Sweet Home Emergency Management Committee	On-going	1 ,2	City, DLCD, Silver Jackets, FEMA	Retain. Add Emergency Manager to Partner list.
Long-Term FL #3	Identify and evaluation locations with repetitive flooding and significant	CPWD, CCDD	Sweet Home Emergency	On-going	1, 2, 5	City, DLCD, Silver Jackets, FEMA	Retain. Revise. Broaden partner list.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Retain/ Modify/ Delete
	damages or road closures. Determine and implement mitigation remedies.		Management Committee				
Long-Term FL#4	Obtain building database from Linn County each year.	CCDD, Linn County	Sweet Home Emergency Management Committee	1-5 years	1-6	City, DLCD, Silver Jackets, FEMA	New mitigation action
Long-Term FL#5	Obtain LIDAR data for floodplain areas every three years.	CCDD, Linn County	Sweet Home Emergency Management Committee	1-5 years	1-6	City, DLCD, Silver Jackets, FEMA	New mitigation action
Earthquake (EQ): Medium Priority							
Short-Term EQ #1	Obtain and make information available to the public about structural and non-structural retrofitting of vulnerable homes and encourage retrofits.	CCDD, Sweet Home Emergency Management Committee	Sweet Home School District, see also the NHMP Outreach Calendar	On-going	1, 2, 5	City, FEMA	Retain. Revise. Broaden language to include all forms of media. Revise partner and coordinating organizations.
Long-Term EQ #1	Perform an inventory of buildings that may be particularly vulnerable to earthquake damage using most current techniques. See the Critical Infrastructure List in the Sweet Home NHMP.	CCDD, Sweet Home Emergency Management Committee	Sweet Home School District,	On-going	1-6	City, Sweet Home School District, FEMA	Retain. Revise. Language can include evaluation of buildings and prioritization related to needed upgrades that remain. Broaden partner list. Note Critical Infrastructure List in this NHMP.
Long-Term EQ #2	Complete inventory of residential and commercial buildings that may be vulnerable to earthquake damage, including pre-1940s homes, unreinforced masonry buildings, tilt-up	CCDD	Sweet Home Emergency Management Committee	On-going	5	City, FEMA	Retain. Revise. Broaden partner list.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Retain/ Modify/ Delete
	buildings,and buildings with soft first stories.						
Long-Term EQ #3	Seek funding to retrofit important public facilities with significant seismic vulnerabilities. See Critical Facilities List in the Sweet Home NHMP.	CPWD, CCDD, Sweet Home Emergency Management Committee		10 years	1-5	City, FEMA	Retain. Revise. Broaden partner list. Refer to Critical Infrastructure List in this NHMP.
Long-Term EQ #4	Every year, check the building permit records to ascertain which buildings have had seismic upgrades.	CCDD	Sweet Home Emergency Management Committee	On-going	1-6	City	New mitigation action
Volcano (VO): Medium Priority							
Short-Term VO #1	Evaluate capability of the water treatment plant to deal with high turbidity from ash falls. Include volcanic hazards in the Sweet Home Emergency Operations Plan and water treatment plant operations plan.	CPWD		1-2 years	1, 3	City	Retain. Revise. Add language about emergency operations plan. Revise to say check on it every 5 years.
Droughts (DR): Low Priority							
Short-Term #1 DR	None listed						
Long-Term #1 DR	None listed						

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Retain/ Modify/ Delete
Landslides (LS): Low Priority							
Short-Term LS #1	Review existing identified landslide hazard areas mapped by the City. Review and evaluate newer landslide information such as SLIDO and the landslide susceptibility maps from DOGAMI. Consider adoption and integration of newer landslide information into existing City codes and maps, and the comprehensive plan.	CPWD, CCDD	Sweet Home Emergency Management Committee, DOGAMI, DLCD	1-5 years	1, 2, 5, 6	City, FEMA	Retain. Revise. Note landslide hazard information (text and maps) in the NMHP.
Long-Term LS #1	Consider geotechnical evaluation and appropriate mitigation actions for landslides during review of proposed development.	CCDD, CPWD	Sweet Home Emergency Management Committee, DOGAMI, DLCD	On-going	1, 2, 3	City	Retain. Revise. This is too broad and unclear. Combine with Long-Term #2. Reword to focus on evaluating current data about landslides and development.
Long-Term LS #2	Use the information identified in Short-Term LS #1 to review the UGB expansion areas for landslide hazards	CCDD	Sweet Home Emergency Management Committee, DOGAMI, DLCD	On-going	1-6	City	Retain. Revise. Reword. Steering Committee noted UGB areas.

Source: Tricia Sears, DLCD, and the Sweet Home NHMP Steering Committee, 2020-2021

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2015 Sweet Home NHMP Mitigation Actions

The *2015 Sweet Home NHMP* had mitigation actions in the following categories: multi-hazard, wildland-urban interface fires, flood, severe storms, earthquake, volcanic hazards, landslides, and drought for natural hazards. It also included these hazards labeled as technological: dam failures, terrorism, and disruption of utility and transportation systems. The *2015 Sweet Home NHMP* also included HAZMAT hazards. All of these mitigation actions are in Tables 4.2-4.12 in the *2015 Sweet Home NHMP*.

As part of the update to *2015 Sweet Home NHMP*, the Sweet Home NHMP Steering Committee reviewed the existing mitigation actions for current status. Mitigation actions may be deemed accomplished and removed (highlight these as accomplishments). The mitigation actions may also be retained as is, retained and modified, or not accomplished and removed. New mitigation actions will also be created. Mitigation actions were discussed at multiple Sweet Home NHMP Steering Committee meetings. Additional discussions occurred via emails and phone calls.

The mitigation actions in the table below are labeled as they were in the *2015 Sweet Home NHMP* as short-term MH #1-10 and long-term MH #1-10, short-term WF #1-10 and long-term WF #1-10 etc. The mitigation actions were not prioritized. The included mitigation actions here are for natural hazards. Mitigation actions for hazards labeled as technological: dam failures (Table 4-9), terrorism (Table 4-12), HAZMAT (Table 4-11) and disruption of utility and transportation systems (Table 4-10), are not all included. The exception to this is for dam failures because a failure of a dam results in flood type impacts, dam failure is included in floods. Also of note, the individual tables for mitigation actions in the *2015 Sweet Home NHMP* have been consolidated into one table, Table 3-2 Sweet Home NHMP Mitigation Actions 2015 Status.

Number of existing mitigation actions for natural hazards from the *2015 Sweet Home NHMP*: 39

Number of existing mitigation actions by hazard: multi-hazard =11, severe storms = 7, wildland-urban interface fires = 3, flood =7 (includes dam failures), earthquake =5, volcanic hazards =1, droughts = 0, landslides =3, drought =4.

Key to the list of Coordinating Organizations in Table 3-2 Sweet Home NHMP Mitigation Actions 2015 Status:

EMC = Emergency Management Committee

CTC = City Tree Commission

SHMPC = Sweet Home Mitigation Planning Committee

CPWD = City Public Works Department

CCCDD = City Community Development Department

SFHAD = Sweet Home Fire and Ambulance District

LCSC = Linn County Shelter Committee

Table 3-2 Sweet Home NHMP Mitigation Actions 2015 Status

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
Multi-Hazard (MH) Actions								
Short-Term MH #1	Develop detailed inventories of at-risk buildings and infrastructure and refine priorities for mitigation actions.	CCDD		1-2 years	1, 2, 4, 5, 6	City	No progress made.	Retain. Revise. Add reference to the Critical Infrastructure List in the 2021 Sweet Home NHMP. Add partners.
Short-Term MH #2	Identify and pursue funding opportunities to implement mitigation actions.	CCDD, SHFAD		On-going	1-5	NA	No progress made except SHFAD.	Retain. Revise. Refer to the NHMP mitigation actions and use the priorities for those (high, medium, low).
Short-Term MH #3	Provide educational information to existing neighborhood groups to enable them to better help their close neighbors during hazard emergencies and to notify emergency response officials if assistance is needed.	SHMPC		1-2 years	1, 3, 5	City	Former EM did meetings before Covid-19 pandemic. Now there is no one to do that.	Retain. Revise. Refer to the NHMP Outreach Calendar created with this NHMP.
Short-Term MH #4	Work with Linn County Shelter Committee (LCSC), including Red Cross, to continually update Emergency Shelter Plans	CCDD; LCSC; SHMPC		On-going	1, 3, 5	City, LCSC	Former EM and Police have worked with community shelters,	Retain.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
	for the Sweet Home community. Include assessing needs – especially for vulnerable populations (e.g., needs for generators in shelters).						homeless, and schools.	
Short-Term MH #5	Identify, promote, and make available personal preparedness programs for Sweet Home residents.	SHMPC		On-going	1, 2, 5	City, grant	The former EM worked on this the past two years. Now Lagea does some work.	Retain.
Short-Term MH #6	Identify and promote public & private sector partnerships to foster hazard mitigation activities.	SHMPC		On-going	1, 2, 3, 5	City, grant	Not much in the past. Greg is working with Pacific Power about community power storage. They have a Community Resilience Program kickoff (potential success story).	Retain. Add reference to the NHMP mitigation activities.
Short-Term MH #7	Set up (and thereafter update and maintain) a City Web Page for emergency preparedness information and links for the public.	CCDD; SHMPC		1 year	1, 5	City	There is info like this on the website. Lagea updates it.	Retain. Modify to include reference to social media.
Long-Term MH #1	Integrate hazard, vulnerability and risk Mitigation Plan findings	EMC		On-going	1, 3, 5	NA	Former EM was working on updating the Emergency	Retain. Revise to say NHMP instead of Mitigation Plan.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
	into enhanced Emergency Operations planning.						Operations Plan. He successfully (approved by City Council) added the addendum on pandemics.	
Long-Term MH #2	Continue the formal role for the SHMPC to maintain a sustainable process to encourage, implement, monitor, & evaluate city-wide mitigation actions.	SHMPC		On-going	1, 2, 3, 5	NA	Not too many meetings.	Retain. Perhaps add language about review NHMP 2x year.
Long-Term MH #3	Identify and promote education programs for mitigating hazard risks.	SHMPC		On-going	1, 2, 5	City	They are doing this each year.	Retain. Revise to add reference to the NHMP calendar of outreach.
Long-Term MH #4	Integrate the Mitigation Plan findings into planning and regulatory documents and programs.	CCDD		On-going	1, 2, 3, 5, 6	City	Floodplain regulation were updated and approved by City Council in 2020.	Retain. Revise. Refer to the table that will be in the Community Profile that lists plans, programs, and policies.
Wildland-Urban Interface (WF) Actions								
Short-Term WF #1	Identify and map evacuation routes and procedures for high-risk	City Engineering, SHPD, SHFAD, ODF		On-going	1, 3, 5	City, FEMA, ODF, SHFAD	Routes are identified. These are communicated to	Retain. Revise. Expand partner list. Note routes should be

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
	areas, disseminate and educate the public.						the public as needed during emergencies.	reviewed regularly and updated. Refer to map in this NHMP.
Long-Term WF #1	Encourage fire-safe construction practices for existing and new construction in high-risk areas.	SHMPC, CCDD, SHFAD, ODF		On-going	1,2, 3, 5, 6	City, FEMA, ODF, SHFAD,	Steering Committee noted they don't have provisions about this. Need to identify areas and look at what they want to do.	Retain. Revise. Add language about evaluation and review of pertinent information.
Long-Term WF#2	Continue fuels reduction projects and public education for the high hazard areas of SH identified previously. Initial work has been done, but continuing efforts necessary since fuels grow back.	SHFAD, ODF		On-going	1, 2, 3, 5	City, FEMEA, ODF, SHFAD	Steering Committee noted they need more information. They encourage efforts to continue.	Retain. Revise. Add language about information sharing and collaboration.
Flood (FL)								
Short-Term FL #1	Obtain maps of dam failure inundation areas and update emergency response plan.	USACE, CCDD		On-going	1 ,3, 5	USACE	At May 2021 NHMP Steering Committee Ross Hiner of USACE presented information on inundation aeras from Lake Greenpeter and Lake Foster dams.	Retain. Revise. Add police, fire, public works as partners. Add language about City's EOP and collaboration with USACE. Note USACE will have website in Fall

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
								2021 with publicly available dam inundation info.
Short-Term FL #2	Encourage US Corps of Engineers to complete seismic vulnerability assessments for Green Peter and Foster dams make seismic improvements as necessary.	USACE, CCDD		On-going	1, 2, 5	USACE	At May 2021 NHMP Steering Committee Ross Hiner of USACE presented information on seismic vulnerability. Evaluation and improvements are on-going.	Retain. Revise. Add police, fire, public works as partners. Add language about collaboration with USACE.
Short-Term FL #3	Begin process of code revisions for storage in floodplains.	CCDD		1-2 years	5, 6	City	Zoning Code has been revised as of 2020. Model floodplain code was used.	Accomplished. Delete.
Short-Term FL #4	Complete the inventory and mapping of locations in Sweet Home subject to frequent storm water flooding.	CCDD		On-going	5	City	GIS has existing conditions but not specific locations. They have info from a storm in December 2020 that they are reviewing.	Retain. Revise. Expand partner list.
Long-Term FL #1	Survey elevation data for structures within the 100-yr floodplain, including coordination with Linn County Planning on use of	CCDD		On-going	5	City	Sweet Home has elevation data. Info is periodically obtained from Linn County	Retain. Revise. Alter language slightly to be more about

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
	LIDAR imaging for elevation information.						about buildings, LIDAR, and elevation.	updating and collaborating.
Long-Term FL #2	For structures within the 100-year floodplain and especially for structures deep in the floodplain, explore mitigation options with property owners.	CCDD		On-going	1 ,2	City	Mitigation actions are discussed one on one with property owners.	Retain. Add Emergency Manager to Partner list.
Long-Term FL #3	For locations with repetitive flooding and significant damages or road closures, determine and implement remedies.	CPWD		On-going	1, 2, 5	City	Not done.	Retain. Revise. Broaden partner list.
Severe Storms (SS)								
Short-Term SS #1	Assess need for back-up power generators for emergency shelters in SH.	SHMPC		1-2 years	1, 3	City	Police and Fire have looked at this; some assessment. List of shelters is in the EOP. In the next 18 months (from April 2021) city hall will have a generator. Dave B says the middle school, the high school, and the LDS church on 22nd are the three shelters on the Red Cross identified shelters list. All three	Retain. Consider adding language about identifying the specs for a generator that would be appropriate for the shelter.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
							need generators. All three need specs so that the appropriate generator can be obtained.	
Short-Term SS #2	Identify critical need locations, vulnerable populations, and vulnerable independent individuals.	CCDD		1-2 years	1, 3, 5	City	The former EM made a list of critical infrastructure in 2019. They have a vulnerable population list from 2020 wildfires. Lagea will obtain it.	Retain. Revise. Add language to refer to Critical Infrastructure List and incorporate most current information.
Long-Term SS #1	Consider upgrading lines & poles to improve wind/ice loading, undergrounding critical lines, and adding interconnect switches to allow alternative feed paths and disconnect switches to minimize outage areas.	Electrical Utility (PPL)		On-going	1, 2, 3	PPL	Blair has communicated with Pacific Power. Water Treatment Plan will have generator.	Retain.
Long-Term SS #2	Encourage Pacific Power (PPL) to prioritize a coordinated emergency response (including enhanced communications) with City Public Works.	CPWD; PPL		On-going	1, 2, 3	PPL	No particular coordination in the past, but looking at building relationship and future coordination.	Retain. Revise to include CCDD as partner. Potentially revise language to note relationship building.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
Long-Term SS #3	Assess needs for back-up power generators for all City-owned designated critical facilities and ensure that the highest priority critical facilities have generators or are wired to accept "plug-in generators, "as has been done for the waste water treatment plant (generator) and the new water treatment plant (wiring set up). Include assessing generator needs for City Hall and the Community Center.	CPWD		On-going	1, 2, 3	City, PPL	Still in process. City Hall has a generator coming. Waste water treatment plant does not have generator but has ability to plug in.	Retain. Revise. Add reference to the Critical Infrastructure List in this NHMP. Add partner organizations.
Long-Term SS #4	Enhance tree trimming efforts especially for transmission lines and trunk distribution lines.	PPL, CTC		On-going	1, 2, 3	City, PPL	This is on-going.	Retain. Note CTC is now the City Park and Tree Committee.
Long-Term SS #5	Continue City-wide efforts encouraging property owners to keep trees trimmed near their electrical service drops.	SHMPC; CTC		On-going	1 ,2, 3, 5	City	City does not focus on this. SC agreed to keep this as a bullet point on info they share as best practices.	Delete. Note CTC is now the City Park and Tree Committee.
Earthquake (EQ)								
Short-Term EQ #1	Obtain and make available to the public FEMA pamphlets to educate building owners	SHMPC		On-going	1, 2, 5	City	They have info on the City's website. They do not have	Retain. Revise. Broaden language to include all

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
	and residents about structural and non-structural retrofitting of vulnerable homes and encourage retrofits.						pamphlets in the office.	forms of media. Revise partner and coordinating organizations.
Long-Term EQ #1	(1a) Complete inventory of important buildings, including schools, that may be particularly vulnerable to earthquake damage using FEMA's Rapid Visual Screening , (1b) and, as needed and as funding is available, conduct more detailed seismic vulnerability analysis of buildings which appear particularly vulnerable [*may require technical assistance from consultants].	CCDD, Sweet Home School District		On-going		City, Sweet Home School District, FEMA	Some buildings have been evaluated. Joe Graybill will check building permits to create a list of buildings and permits.	Retain. Revise. Language can include evaluation of buildings and prioritization related to needed upgrades that remain. Broaden partner list. Note Critical Infrastructure List in this NHMP.
Long-Term EQ #2	Complete inventory of residential and commercial buildings that may be particularly vulnerable to earthquake damage, including pre-1940s homes, unreinforced masonry buildings, tilt-up buildings and buildings with soft first stories. [*May require technical assistance from consultants, and additional funding.]	CCDD		On-going	5	City, FEMA	They do not have an inventory. Joe Graybill will check building permits to create a list of buildings and permits.	Retain. Revise. Broaden partner list.

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
Long-Term EQ #3	Seek funding to retrofit important public facilities with significant seismic vulnerabilities.	CPWD		10 years	1-5	City, FEMA	Not much funding to do this, says the Steering Committee. City Hall are Police building are retrofitted.	Retain. Revise. Broaden partner list. Refer to Critical Infrastructure List in this NHMP.
Long-Term EQ #4	Same as ST#4 in Table 4-2, and ST#1 and LT#3 in Table 4-4. (Addresses Critical Facilities and Emergency Shelters.)	CPWD		On-going	1, 2, 3, 5	CIty	Some work on critical facilities and infrastructure has been done.	Delete because it is listed elsewhere in the mitigation actions.
Volcano (VO)								
Short-Term VO #1	Evaluate capability of the new water treatment plant to deal with high turbidity from ash falls and upgrade emergency response plan to deal with ash falls.	CPWD		1-2 years	1, 3	City	Public Works Director says the plant can handle it.	Retain. Revise. Add language about emergency operations plan. Revise to say check on it every 5 years.
Landslide/ Debris Flow (LD)								
Short-Term #1 LD	Implementation of geo-tech work for new construction in previously identified areas subject to land slide.	CPWD, CCDD		1-2 years	1, 2, 5, 6	City	Existing code language. Newest construction in Lake Pointe subdivision, they had to do Geotech reports.	Retain.
Long-Term #1 LD	Consider landslide mitigation actions for slides seriously	SHMPC, CPWD		On-going	1, 2, 3	City	Mitigation is considered as part of new	Retain. Revise. This is too broad and

Mitigation Action	Description	Coordinating Organization	Partner Organizations	Timeline	NHMP Goals	Potential Funding Sources	Current Status in 2021 NHMP	Retain/ Modify/ Delete
	threatening buildings or infrastructure.						development and geotechnical review.	unclear. Combine with Long-Term #2.
Long-Term #2 LD	Limit future development in high landslide potential areas.	CCDD		On-going	1-6	City	Appropriateness and mitigation are considered as part of new development and geotechnical review.	Retain. Revise. Reword. Steering Committee noted UGB areas.
Drought (DR)								
Short-Term DR #1	None listed							
Long-Term DR #1	None listed							

Source: Tricia Sears, DLCD, and Sweet Home Steering Committee, 2020-2021

Section 4: Plan Implementation and Maintenance

The Plan Implementation and Maintenance section details the formal process that will ensure that the *2021 Sweet Home Natural Hazards Mitigation Plan* (NHMP) remains an active and relevant document. The plan implementation and maintenance process includes a schedule for monitoring and evaluating the plan semi-annually, as well as updating the plan every five years. This section describes how Sweet Home will integrate public participation throughout the plan maintenance and implementation process.

Implementing the Plan

The success of the *2021 Sweet Home NHMP* depends on how well the mitigation actions In Table 3-1 are implemented. To ensure that the mitigation actions are implemented, the following steps are taken: the NHMP will be formally adopted; a coordinating body is assigned; a convener is designated; the mitigation actions are evaluated and prioritized; and the NHMP will be implemented through existing plans, programs, and policies.

Plan Adoption

Once the *2021 Sweet Home NHMP* is locally reviewed and ready, the Sweet Home NHMP Convener (the City Manager or the designee) and the DLCD Natural Hazards Planner submit it to the State Hazard Mitigation Officer (SHMO) at Oregon's Office of Emergency Management (OEM). OEM reviews the NHMP. Once OEM reviews the NHMP and deems it ready; they submit it to the Federal Emergency Management Agency (FEMA) Region X for review. This review addresses the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201.6.

Upon pre-approval by FEMA, indicated by a letter provided from FEMA to Sweet Home called the "Approved Pending Adoption" (APA), the City will then adopt the NHMP via resolution. There are no other participating plan holder jurisdictions that will need to adopt the NHMP. The Sweet Home Fire and Ambulance District (SHFAD) is participating in the update process but has not signed the IGA with DLCD; therefore, SHFAD is not a plan holder jurisdiction. The Sweet Home NHMP Convener and the DLCD Natural Hazards Planner will then provide both OEM and FEMA with the approved resolution from Sweet Home.

Once FEMA is provided with final resolution documentation from all plan holder jurisdictions, they will formally approve the *2021 Sweet Home NHMP*. At that point Sweet Home will maintain their eligibility for the Hazard Mitigation Assistance (HMA) pre- and post- disaster funds. These funds are distributed through the Building Resilient Infrastructure and Communities (BRIC) program, the Hazard Mitigation Grant Program (HMGP), and the Flood Mitigation Assistance (FMA) program.

The accomplishment of the *2021 Sweet Home NHMP* goals and mitigation actions depends upon regular NHMP Steering Committee participation and support from the City's leadership. Thorough familiarity with this NHMP will result in the efficient and effective implementation of mitigation actions, and the integration of the NHMP into plans, policies, and programs. This will result in a reduction in the risk and the potential for loss from future natural hazard events.

A copy of the resolution of approval from Sweet Home will be included in the *2021 Sweet Home NHMP* once it is received. Copies of the FEMA APA and final approval letters will also be included in the *2021 Sweet Home NHMP* when they are received. The DLCD Natural Hazards Planner will provide the final copy of the *2021 Sweet Home NHMP* in Word and PDF.

Convener and Coordinating Body

The Sweet Home City Manager or the designated delegates, will take responsibility for plan implementation. The Sweet Home City Manager or their designated delegates, are the Conveners of the NHMP Steering Committee and the maintenance meetings. These NHMP Steering Committee meetings that are held after FEMA grants approval of the *2021 Sweet Home NHMP* will be held as part of the existing Emergency Management Committee (EMC) meetings. The Conveners will facilitate the meetings and will assign tasks such as updating and presenting the plan to the rest of the members of the committee. NHMP implementation and evaluation will be a shared responsibility among the NHMP Steering Committee / EMC members. The Convener's responsibilities include:

- Coordinate coordinating body meeting dates, times, locations, agendas, and member notification;
- Documenting the discussions and outcomes of committee meetings;
- Serving as a communication conduit between the coordinating body and the public/stakeholders;
- Identifying emergency management-related funding sources for natural hazard mitigation projects; and
- Utilizing the Risk Assessment as a tool for prioritizing proposed natural hazard risk reduction projects.

Members

The NHMP update was developed by the Sweet Home NHMP Steering Committee which includes City of Sweet Home City Manager and staff, the Fire Chief of the SHFAD, and the Linn County Emergency Manager (who retired during this NHMP update). A roster of the NHMP Steering Committee is included in the Acknowledgements section of this NHMP. It is anticipated the Sweet Home NHMP Steering Committee will continue, as part of the Emergency Management Committee, so as to provide the implementation and evaluation of the progress of the NHMP. This was described above in the Convener and Coordinating Body section. This will help ensure that the NHMP is a living document that is used and stays connected to the plans, policies, and programs of the involved jurisdictions and NHMP Steering Committee members. Of note, the Emergency Management Performance Grant (EMPG) grant, which typically funds Emergency Manager positions, requires review of the NHMP twice per year.

To make the coordination and review of the *2021 Sweet Home NHMP* as broad and useful as possible, the Sweet Home City Manager or their designated delegates, will engage the stakeholders to implement the mitigation actions. Specific organizations have been identified as leads/coordinating agencies and as partners for the mitigation actions listed for the *2021 Sweet Home NHMP*; these are identified in Table 3-1.

Implementation through Existing Programs

The NHMP includes mitigation actions that, when implemented, will mitigate hazard events throughout Sweet Home. Within the NHMP, FEMA requires the identification of existing plans, programs, and policies that might be used to implement these mitigation actions.

Sweet Home currently address Oregon's Statewide Planning Goals and legislative requirements through their comprehensive land use plans, capital improvement plans, mandated standards, and building codes. Sweet Home will incorporate the mitigation actions from this NHMP into existing programs, procedures, plans, and policies. Plans, programs, procedures, and policies already in existence often have support from local residents, businesses, and policy-makers. Many land use, comprehensive, and strategic plans are updated regularly, and can adapt easily to changing conditions and needs. Implementing the mitigation actions from the NHMP through such plans and policies increases their likelihood of being supported and implemented.

Examples of plans, programs or agencies that may be used to implement mitigation actions:

- City and County Budgets,
- Community Wildfire Protection Plans,
- Comprehensive Land Use Plans,
- Economic Development Action Plans,
- Zoning Ordinances & Building Codes, and
- Emergency Operations Plans and Continuity of Operations Plans (COOP).

The specific plans that presently exist related to this NHMP and the FEMA requirement are listed in Table 4-1; these are the same plans listed in Table B-14 in Appendix B Community Profile. For additional examples of plans, programs, policies, procedures, and agencies that may be used to implement mitigation actions, refer to the sections entitled "Government Structure" and "Existing Plans & Policies" in Appendix B Community Profile, and the *2021 Sweet Home NHMP* mitigation actions in Table 3-1.

Table 4-1 Existing Plans for Sweet Home (Same as Table B-14)

Jurisdiction	Document	Year
Sweet Home	Natural Hazards Mitigation Plan	2021 in process, 2015 existing
Sweet Home and Sweet Home Fire and Ambulance District	Emergency Operations Plan	Pandemic Response added in 2020 to existing January 2013
Sweet Home	Sweet Home Code of Ordinances (includes Development Code, Code Compliance, etc.)	Updated 2021, typically annually
Sweet Home	Development Code (Title 16 and 17 of the Sweet Home Code of Ordinances)	Updated 2021, typically annually
Sweet Home	Comprehensive Plan	August 27, 2010
Sweet Home	Sweet Home Transportation System Plan	May 2005

Jurisdiction	Document	Year
Sweet Home	Emergency Action Site Specific Plan for CH2M Hill Sweet Home, OR	October 2017
Sweet Home	Emergency Response Plan: Sweet Home Wastewater and Water Treatment Plants	November 2014
Sweet Home	Sweet Home City Council Vision Statement, Mission Statement, and Goals Resolution	February 2021
Sweet Home	2021 Sweet Home Streetscape Plan	Draft 2021
Sweet Home and Linn County	Community Development Block Grant #H19012 Linn County Housing Rehabilitation Partnership Program	April 2020
Sweet Home	Sweet Home Fair Housing Resolution	2014
Sweet Home	Sweet Home Capital Improvement Plan	Adopted 2021 copy dated March 1, 2019
Sweet Home	Sweet Home Park System Master Plan	January 2014
Sweet Home	Sweet Home Downtown Retail Market Analysis	2010
Sweet Home	Sweet Home Livability Assessment	2014
Sweet Home	Sweet Home Housing and Economic Analysis	May 2001
Sweet Home	2003 Oregon Downtown Development Association Report	2003
Sweet Home	1994 Sweet Home Downtown Redevelopment Assessment Report	1994
Linn County	Linn County Community Wildfire Protection Plan	November 2007
State of Oregon	ORS 401.305 - Emergency management agency of city, county or tribal government - 2020 Oregon Revised Statutes (oregonlaws.org)	2020

Source: Tricia Sears, DLCD; 2015 Sweet Home Natural Hazards Mitigation Plan, https://www.sweethomeor.gov/sites/default/files/fileattachments/community_and_economic_development/page/4031/2015_sweet_home_mitigation_plan.pdf; Sweet Home Code of Ordinances, SWEET HOME, OREGON CODE OF ORDINANCES (amlegal.com); TITLE 16: LAND DIVISIONS AND LINE ADJUSTMENTS (amlegal.com); TITLE 17: ZONING (amlegal.com); Sweet Home Comprehensive Plan, sh_comprehensive_plan_2010_201408151818255696.pdf (sweethomeor.gov); Sweet Home Transportation System Plan, tsp_complete_except_app_g.pdf (sweethomeor.gov); Sweet Home City Council Vision Statement, Mission Statement, and Goals Resolution, SKM_C65821022509200 (sweethomeor.gov); Community Development Block Grant #H19012 Linn County Housing Rehabilitation Partnership Program, final_sweet_home_h19012_err.pdf (sweethomeor.gov), 2021 Sweet Home Streetscape Plan, 2021 Streetscape Plan | Sweet Home Oregon; Sweet Home Fair Housing Resolution, KMBT_C654-20140115083236 (sweethomeor.gov); City of Sweet Home Capital Improvement Plan, March 1, 2019, from Brandon Neish and Blair Larsen, Sweet Home, personal communication 7/8/21; Sweet Home Park System Master Plan, sweet_home_parks_master_plan_2014_201408151834432446.pdf (sweethomeor.gov); Sweet Home Downtown Retail Market Analysis, Microsoft Word - Sweet Home Draft Report 02.12.10.doc (sweethomeor.gov); Sweet Home Livability Assessment, Microsoft Word - SWH Intro & Transpo_11-12.doc (sweethomeor.gov); Sweet Home Housing and Economic Analysis, KMBT_C654-20141010073606 (sweethomeor.gov); 2003 Oregon Downtown Development Association Report, 2003_oregon_downtown_development_association_report.pdf (sweethomeor.gov); 1994 Sweet Home Downtown Redevelopment Assessment Report, KMBT_C654-20150903071406 (sweethomeor.gov); Linn County Community Wildfire Protection Plan,

file:///J|/Shared/Scholars%20bank%20local%20docs/County/Hazard%20mitigation%20plans/Linn_County_Wildfire_Plan_Appendices.pdf (uoregon.edu); Greg Springman, Sweet Home, personal communication, 8/5/21

Plan Maintenance

Plan Maintenance

Plan maintenance is a critical component of the NHMP. Proper maintenance of the plan ensures that this plan will maximize Sweet Home and SHFAD efforts to reduce the risks posed by natural hazards. The Conveners, the coordinating body, and local staff are responsible for implementing, maintaining, and updating the NHMP in meetings described below.

Meetings

The coordinating body is composed of members of the NHMP Steering Committee. This may be as the Sweet Home Emergency Management Committee. The coordinating body will meet at least twice per year to complete the following tasks.

During the first meeting, the NHMP Steering Committee will:

- Review existing mitigation action items to determine appropriateness for funding;
- Educate and train new members on the plan and mitigation in general;
- Identify issues that may not have been identified when the plan was developed; and
- Prioritize potential mitigation projects using the methodology described below.

During the second meeting the NHMP Steering Committee will:

- Review status and progress of the mitigation actions;
- Document the status of the mitigation actions;
- Review existing and new risk assessment data;
- Discuss already held and upcoming continued public involvement events; and
- Document successes and lessons learned during the year.

These meetings are an opportunity for each jurisdiction and organization to report back to the Conveners and the NHMP Steering Committee on progress that has been made towards the mitigation actions and other parts of the NHMP.

The Conveners are the Sweet Home City Manager or their designated delegates, and he/she will be responsible for documenting the outcome of the semi-annual meetings. The process the coordinating body will use to prioritize mitigation projects is described in Section 3 Mitigation Strategy and briefly below in the “Project Prioritization Process” section.

The NHMP format allows Sweet Home and participating jurisdictions and organizations to review and update sections when new data becomes available. New data can be easily incorporated, and discussed with the NHMP Steering Committee, resulting in a NHMP that remains current and relevant to the participating jurisdictions and organizations. The at least twice a year meetings of the NHMP Steering Committee provide an excellent forum for discussions such as those on the status of mitigation actions, new data, and opportunities for funding.

Project Prioritization Process

The Disaster Mitigation Act of 2000 requires that jurisdictions identify a process for prioritizing mitigation actions. Mitigation actions come from a variety of sources such as NHMP Steering Committee members, local government staff, other planning documents, or the risk assessment. Therefore, the project prioritization process needs to be flexible and shaped to the community's needs.

In brief, the selected prioritization format used in the *2021 Sweet Home NHMP* is the risk level rankings from the Hazard Vulnerability Assessment. Of the seven natural hazards, one was identified as a high risk level, four are at the medium risk level, and two are at the low risk level. The high risk level means the mitigation actions are high priority, similarly for medium and low risk level and priority. There are hazard-specific mitigation actions and multi-hazard mitigation actions.

All the multi-hazard mitigation actions are a high priority. The hazard-specific mitigation actions that are a high priority are the severe storms mitigation actions. The medium hazards are wildland-urban interface fires, floods, earthquakes, and volcanic events. Droughts and landslides are low priority mitigation actions. See Table 3-1, 2021 Sweet Home NHMP Mitigation Actions.

Resource availability, including such factors as staff time and funding, are part of the categorization of whether the action is short- or long-term.

- *Short-term actions* are activities that may be implement with existing resources and authorities in one to two years.
- *Long-term actions* are those that may require new or additional resources and/or authorities.
- *Ongoing activities* are those that are currently in process and will continue to be implemented during the next planning period.

In Appendix C Economic Analysis of Natural Hazard Mitigation Projects, there is a detailed description of the three potential approaches of economic analysis to prioritize the mitigation actions: benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E approach. Appendix C includes a diagram, Economic Analysis Flowchart, to illustrate the process. There is also a description of some information from the *2015 Sweet Home NHMP* that is included again.

Continued Public Involvement & Participation

The participating jurisdictions are dedicated to involving the public directly in the continual reshaping and updating of the *2021 Sweet Home NHMP*. In addition to the members of the coordinating body, also known as the NHMP Steering Committee and the Emergency Management Committee, the public will also have the opportunity to continue to provide feedback about the NHMP.

To ensure that these opportunities will continue, the City and participating jurisdictions will:

- Post copies of the *2021 Sweet Home NHMP* on the City's website;
- Place articles in the local newspaper directing the public where to view and provide feedback; and
- Use existing newsletters such as schools and utility bills to inform the public where to view and provide feedback.
- Use social media tools and AlertSense as applicable.

The *2021 Sweet Home NHMP* will be on the Sweet Home website at: Community Development Hazard Mitigation | Sweet Home Oregon.

The NHMP may also be archived and posted on the University of Oregon Libraries' Scholar's Bank Digital Archive at https://scholarsbank.uoregon.edu and on the Oregon Department of Land Conservation and Development's website at https://www.oregon.gov/lcd/Pages/index.aspx.

Five-Year Review of Plan

This plan will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. **With FEMA approval granted in 2021, the Sweet Home NHMP would be due to be updated in 2026.** The Conveners, the Sweet Home City Manager, or their designated delegates, will be responsible for organizing the coordinating body, which is the NHMP Steering Committee and or the Sweet Home Emergency Management Committee, to address plan update needs. Table 4-2 is a toolkit that can assist determining which NHMP actions might be discussed during plan maintenance meetings, and which might require additional meeting time and/or the formation of sub-committees.

Table 4-2 Natural Hazards Mitigation Plan Update Toolkit

Question	Yes	No	Plan Update Action
Is the planning process description still relevant?			Modify this section to include a description of the plan update process. Document how the planning team reviewed and analyzed each section of the plan, and whether each section was revised as part of the update process. (This toolkit will help you do that).
Do you have a public involvement strategy for the plan update process?			Decide how the public will be involved in the plan update process. Allow the public an opportunity to comment on the plan process and prior to plan approval.
Have public involvement activities taken place since the plan was adopted?			Document activities in the "planning process" section of the plan update
Are there new hazards that should be addressed?			Add new hazards to the risk assessment section
Have there been hazard events in the community since the plan was adopted?			Document hazard history in the risk assessment section
Have new studies or previous events identified changes in any hazard's location or extent?			Document changes in location and extent in the risk assessment section
Has vulnerability to any hazard changed?			Document changes in vulnerability in the risk assessment section
Have development patterns changed? Is there more development in hazard prone areas?			Document changes in vulnerability in the risk assessment section
Do future annexations include hazard prone areas?			Document changes in vulnerability in the risk assessment section
Are there new high risk populations?			Document changes in vulnerability in the risk assessment section
Are there completed mitigation actions that have decreased overall vulnerability?			Document changes in vulnerability in the risk assessment section
Did the plan document and/or address National Flood Insurance Program repetitive flood loss properties?			Document any changes to flood loss property status
Did the plan identify the number and type of existing and future buildings, infrastructure, and critical facilities in hazards areas?			1) Update existing data in risk assessment section, or 2) determine whether adequate data exists. If so, add information to plan. If not, describe why this could not be done at the time of the plan update
Did the plan identify data limitations?			If yes, the plan update must address them: either state how deficiencies were overcome or why they couldn't be addressed
Did the plan identify potential dollar losses for vulnerable structures?			1) Update existing data in risk assessment section, or 2) determine whether adequate data exists. If so, add information to plan. If not, describe why this could not be done at the time of the plan update
Are the plan goals still relevant?			Document any updates in the plan goal section
What is the status of each mitigation action?			Document whether each action is completed or pending. For those that remain pending explain why. For completed actions, provide a 'success' story.
Are there new actions that should be added?			Add new actions to the plan. Make sure that the mitigation plan includes actions that reduce the effects of hazards on both new and existing buildings.
Is there an action dealing with continued compliance with the National Flood Insurance Program?			If not, add this action to meet minimum NFIP planning requirements
Are changes to the action item prioritization, implementation, and/or administration processes needed?			Document these changes in the plan implementation and maintenance section
Do you need to make any changes to the plan maintenance schedule?			Document these changes in the plan implementation and maintenance section
Is mitigation being implemented through existing planning mechanisms (such as comprehensive plans, or capital improvement plans)?			If the community has not made progress on process of implementing mitigation into existing mechanisms, further refine the process and document in the plan.

Source: Oregon Partnership for Disaster Resilience (2010).

VOLUME II: HAZARD ANNEXES

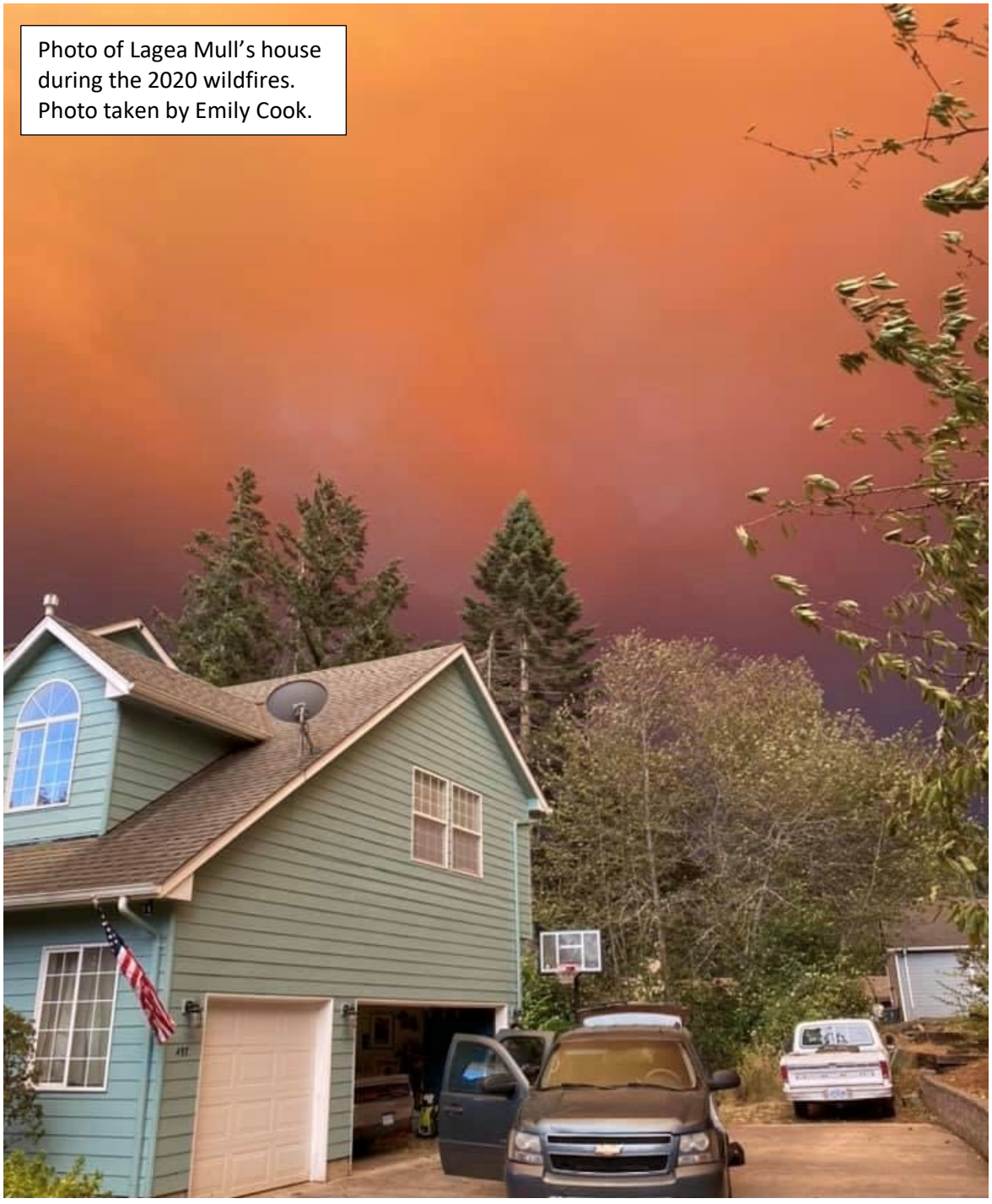


Photo of Lagea Mull's house during the 2020 wildfires. Photo taken by Emily Cook.

Source: Lagea Mull, City of Sweet Home, personal communication, 7/23/21

Introduction

Sweet Home identifies seven natural hazards that could impact the City, as described in Section 2 Risk Assessment and within these Hazard Annexes. Table HA-1 below is the same as Table 2-4 in the Risk Assessment; it summarizes the hazards and their risk scores and risk level. Each hazard has a Hazard Annex.

The natural hazard identification and risk levels were assessed and ascertained by the NHMP Steering Committee; they play into the establishment and prioritization of mitigation actions. It is useful to keep in mind that knowing your hazards is the key to reducing the risk. Without knowing them, the ability to reduce risk is lessoned and appropriate mitigation actions are difficult to establish. Mitigation actions for this *2021 Sweet Home NHMP* are for Sweet Home; these are in Section 3 Mitigation Strategy, Table 3.1. For a status update of the *2015 Sweet Home NHMP* mitigation actions, see Table 3.2.

Table HA-1 Natural Hazards, Risk Scores, and Risk Levels for Sweet Home

HAZARD	RISK SCORE	RISK LEVEL (H-M-L)
Severe Storms	221	High
Wildland-Urban Interface Fires	166	Medium
Floods	156	Medium
Earthquakes	149	Medium
Volcanic Events	147	Medium
Droughts	94	Low
Landslides	24	Very Low

Source: Sweet Home NHMP Steering Committee, 2020-2021.

These Hazard Annexes describe the characteristics, location, extent, history, and probability for each hazard addressed in the *2021 Sweet Home NHMP*. Probability and vulnerability are described and use the OEM Methodology; see the full description of the OEM Methodology in Volume I, Section 2 Risk Assessment. The Risk Assessment and the Hazard Annexes comprise and provide a risk analysis and vulnerability assessment for the natural hazards identified by Sweet Home. More information pertaining to the types and characteristics of each natural hazard is available in the *2020 Oregon Natural Hazards Mitigation Plan,* Region 3 Mid/Southern Willamette Valley Risk Assessment.

Also of note, the *2013 Sweet Home Emergency Operations Plan*, a collaboration between Sweet Home and the Sweet Home Fire and Ambulance District, includes Incident Annexes. The Incident Annexes are on the hazards of drought, earthquake, major fire, flood (including dam failures), severe weather (including landslides), volcano, hazardous materials (accidental release), public health incident, transportation accidents, and utility failure. In 2020, an appendix called Pandemic Response was added to the *Emergency Operations Plan*.

The *Emergency Operations Plan* has four functional annexes. One of the annexes is Emergency Services and that one includes the Evacuation and Population Protection section. In that section it describes,

> The City Council, City Manager (Emergency Program Manager), or the Incident Commander may order an evacuation. The City Council must approve and sign the evacuation order after considering both the legal and social implications of this action. If, however, for the health and safety of citizens, time does not permit access to the City Council, the Emergency Program Manager or Incident Commander may order an evacuation and notify the City Council as soon as practical. Overall, evacuation operations fall under the direction of the City Police Department. However, if the evacuation area is contaminated by hazardous materials, the evacuation will be conducted by the SHFAD.

An evacuation map, discussed by the NHMP Steering Committee, has been prepared and included in this *2021 Sweet Home NHMP*.

In mitigation efforts, it is useful to be aware of information in the *Emergency Operations Plan* and the *2021 Sweet Home NHMP*.

Predicted Climate Variability

Temperatures increased across the Pacific Northwest by 1.3˚F in the period 1895–2011 (the observed record). In that same timeframe, Cascade Mountain snowpacks have declined, and higher temperatures are causing earlier spring snowmelt and spring peak streamflows. In Oregon's forested areas, large areas have been impacted by disturbances that include wildfire in recent years, and climate change is probably one major factor. There is an increasing amount of research on how climate change influences wildfire and other hazards in the Pacific Northwest.

Typically, as part of the grant funds for a NHMP update, the Department of Land Conservation and Development (DLCD) contracts with the Oregon Climate Change Research Institute (OCCRI) to provide an analysis of climate change influences on natural hazards. The collaboration results in products which provide information regarding the influence and impacts of climate change on existing natural hazards events such as but not limited to heavy rains, river flooding, droughts, heat waves, cold waves, wildfire, and air quality. Unfortunately, for this NHMP, DLCD was not able to do that. Therefore, the typical products produced: a Future Climate Projections Report; a Climate Change Two-Pager; and a Future Climate Change Projections Change presentation are not available.

We can refer to the *2020 Oregon NHMP* for climate change information about the Mid/Southern Willamette Valley Region (Region 3). Region 3 includes Linn, Lane (non-coastal), Marion, Polk, and Yamhill Counties.

> The hazards faced by Region 3 that are projected to be influenced by climate change include drought, wildfire, flooding, landslides, and extreme heat.
>
> Climate models project warmer, drier summers for Oregon. Coupled with projected decreases in mountain snowpack due to warmer winter temperatures, Region 3 is expected to be affected by an increased incidence of drought and wildfire. In Region 3, climate change would result in increased frequency of drought due to low spring snowpack (very likely, >90%), low summer runoff (likely, >66%), and low summer precipitation and low summer

soil moisture (more likely than not, >50%). It is very likely (>90%) that Region 3 will experience increasing wildfire frequency and intensity due to warmer, drier summers coupled with warmer winters that facilitate greater cold-season growth.

It is extremely likely (>95%) that the frequency and severity of extreme heat events will increase over the next several decades across Oregon due to human-induced climate warming (very high confidence).

Furthermore, flooding and landslides are projected to occur more frequently throughout western Oregon. It is very likely (>90%) that Oregon will experience an increase in the frequency of extreme precipitation events and extreme river flows (high confidence) that is more likely than not (>50%) to lead to an increase in the incidence and magnitude of damaging floods (low confidence). Because landslide risk depends on a variety of site-specific factors, it is more likely than not (>50%) that climate change, through increasing frequency of extreme precipitation events, will result in increased frequency of landslides.

While winter storms and windstorms affect Region 3, there is little research on how climate change influences these hazards in the Pacific Northwest. For more information on climate drivers and the projected impacts of climate change in Oregon, see Section 2.2.1.2, Introduction to Climate Change.[1]

Of note, the author of *Future Climate Projections: Umatilla County*, and other Future Climate Projections Reports, Meghan Dalton, has provided two ways on how not to use this climate change Information and four possible ways to use this information:

- These are NOT weather predictions;
- These should NOT be used for engineering/design;
- Envision how current systems may respond under climate conditions different from those the systems were designed to operate under;
- Evaluate potential mitigation actions to accommodate future conditions (e.g., NHMP);
- Explore a range of plausible future outcomes taking into consideration the climate system's complex response to increasing greenhouse gases; and
- Influence the assessment of likelihood of a particular climate-related hazard risk.[2]

Notable Changes to the Risk Assessment and Hazard Annexes from the 2015 NHMP to the 2021 NHMP

Notable changes from the *2015 Sweet Home NHMP* to the *2021 Sweet Home NHMP* for the Risk Assessment (see Volume I Section 2) and these Hazards Annexes include:

- The Hazard Annexes were significantly altered for clarity. Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities

[1] *2020 Oregon NHMP,* Region 3: Mid/Southern Willamette Valley Region, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

[2] Meghan Dalton, OCCRI, *Future Climate Change Projections to Support Umatilla County Natural Hazard Mitigation Planning*, presented 10/27/20 at the Umatilla County NHMP Steering Committee meeting

were updated. Extraneous information was removed and links to technical reports, studies, and data were added.
- Hazard Annexes include information for Sweet Home.
- All hazard subsections have been reformatted to emphasize characteristics, location and extent, history, probability, and vulnerability.
- The addition of new hazard history events in all hazards.
- The addition of more extensive climate change information.
- Maps depicting hazard location and local vulnerability were added whenever available.
- Previously included statistics and information was updated with most current data.
- The information from OCCRI (described above, in the Hazard Annexes, and in the Risk Assessment) has been integrated into the *2021 Sweet Home NHMP*.

The Hazard Annexes include the following full page natural hazards maps:

- Figure EX-2 Sweet Home Vicinity Map
- Figure 2-6 Sweet Home Evacuation Map
- Figure 2-5 Sweet Home Critical Infrastructure and Facilities Map
- Figure WF-9 Linn County Community Wildfire Protection Plan (CWPP) Wildland Urban Interface Map 1: Risk
- Figure WF-10 Wildfire Hazard: Linn County Community Wildfire Protection Plan (CWPP) Wildland Urban Interface Map 2: Hazards
- Figure WF-11 Wildfire Hazard: Sweet Home CWPPWUI aka Community Wildfire Protection Plan and Wildland Urban Interface Map
- Figure WF-12 Wildfire Hazard: WUI Risk Assessment
- Figure WF-13 Wildfire Hazard: WUI Density (relates to vegetation, re-title)
- Figure FL-6 Flood Hazard: FEMA 100-Year Floodplain Map
- Figure FL-10 Natural Hazards Combination: Slope and Flood Zone
- Figure EQ-4 Earthquake Hazard: Liquefaction Probability
- Figure EQ-5 Earthquake Hazard: Liquefaction Permanent Deformation
- Figure EQ-6 Earthquake Hazard: Probability Damaging Shaking
- Figure EQ-7 Earthquake Hazard: Spectral Acceleration
- Figure EQ-8 Earthquake Hazard: Fault Lines and Geology
- Figure LS-3 Landslide Hazard: Landslides Potential
- Figure LS-4 Landslide Hazard: Landslide Susceptibility

SEVERE STORMS HAZARD ANNEX

Severe Storms Risk Score: 221

Severe Storms Risk Level: High

Causes and Characteristics of Severe Storms

This annex describes the natural hazards of severe summer and severe winter storms, and other storms. It provides their hazards history, identifies probability and vulnerability, and lists the risk score and risk level. Climate data is included. **The Sweet Home NHMP Steering Committee determined a Hazard Vulnerability Assessment (HVA) risk score (described later in this Annex and previously in Volume 1 Section 2 Risk Assessment) for severe storms together, without separating the hazard into different types of storms.** These storms have significant impacts on the City of Sweet Home and surrounding areas on a year-round basis.

In the *2015 Sweet Home NHMP*, severe storms were ranked first with a risk score of 179.3. In the *2021 Sweet Home NHMP*, severe storms are ranked first out of seven natural hazards.

The *2015 Sweet Home NHMP* did not include specific events listed for natural hazards; the *2021 Sweet Home NHMP* includes a table of natural hazards events in each annex.

Severe Summer Storms

Extreme winds occur throughout Oregon and can occur in summer and winter. The most persistent high winds take place along the Oregon Coast and in the Columbia River Gorge. However, extreme weather events occur in all regions of Oregon.[1] West winds generated from the Pacific Ocean are strongest along the coast and slow down inland due to the obstruction of the Coastal mountain range. Prevailing winds in Oregon vary with the seasons. In summer, the most common wind directions are from the west or northwest; in winter, they are from the south and east. Local topography, however, plays a major role in affecting wind direction.[2]

Although rare, tornados can and do occur in Oregon. Tornadoes are the most concentrated and violent storms produced by the earth's atmosphere. They are created by a vortex of rotating winds and strong vertical motion, which possess remarkable strength and cause widespread damage. Wind speeds in excess of 300 mph have been observed within tornadoes, and it is suspected that some tornado winds exceed 400 mph. The low pressure at the center of a tornado can destroy buildings and other structures.

Tornadoes are most common in the Midwest, and are more infrequent and generally small west of the Rockies. Nonetheless, Oregon and other western states have experienced tornadoes on occasion, many of which have produced significant damage and occasionally injury or death. Oregon's tornadoes can be formed in association with large Pacific storms arriving from the west. Most of them, however, are caused by intense local thunderstorms. These storms also produce lightning, hail, and heavy rain, and are more common during the warm season from April to

[1] *2020 Oregon NHMP*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_11_RA5.pdf

[2] Statesman Journal, February 8, 2002.

October.[3] Central and Eastern Oregon's relatively low population may cause many tornadoes to go unreported.[4]

Severe Winter Storms

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. Winter storms occur over eastern Oregon regularly during December through February, even into March.[5] Places in western Oregon, like Sweet Home, tend to not receive a large amount of annual snowfall. In general, the people living and visiting the region may not be prepared.

Drifting, blowing snow has often brought highway traffic to a standstill. Also, windy, icy conditions have often closed mountain passes and canyons to certain classes of truck traffic. In these situations, travelers must seek accommodations, sometimes in communities where lodging is very limited. Local residents also experience problems. During the winter, heating, food, and the care of livestock and farm animals are everyday concerns. Access to farms and ranches can be extremely difficult and present a serious challenge to local emergency managers.[6]

Ice storms can occur anywhere in Oregon. Like snow, ice storms are comprised of cold temperatures and moisture, but subtle changes can result in varying types of ice formation, including freezing rain, sleet, and hail. Freezing rain can be the most damaging of ice formations. While sleet and hail can create hazards for motorists when it accumulates, freezing rain can cause dangerous conditions within a community. Ice buildup can bring down trees, communication towers, and wires creating hazards for property owners, motorists, and pedestrians alike. The most common place freezing rain occurs in Oregon is near the Columbia Gorge, but it also poses a hazard to Sweet Home. [7]

Climate Data for Sweet Home and Linn County

The NOAA's National Centers for Environmental Information (https://www.ncdc.noaa.gov/) has established climate divisions in the United States for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the Pacific Ocean give the state diversified climates. Linn County is in Climate Divisions 2 and 4 as seen in Figure SS-1. Sweet Home is in Climate Division 2. Oregon Climate Service is the recognized American Association of State Climatologists (AASC) (https://www.stateclimate.org/about) climate office for Oregon. It is housed in the College of Earth, Ocean, and Atmospheric Science at Oregon State University (CEOAS)[8] which also houses the Oregon Climate Change Research Institute (OCCRI). OCCRI has provided climate change information for the *2020 Oregon NHMP*. In addition to the short description of climate change or future changing conditions in this Annex, see also Volume I Section 2 Risk

3Taylor, George H., Holly Bohman, and Luke Foster, August 1996, *A History of Tornadoes in Oregon*, Oregon Climate Service. Corvallis, OR: Oregon State University.

4 Taylor, George; Hatton Raymond, *Oregon Weather Book*, 1999, http://osupress.oregonstate.edu/book/oregon-weather-book.

[5] *2020 Oregon NHMP*, Region 3: Mid/Southern Willamette Valley Region, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

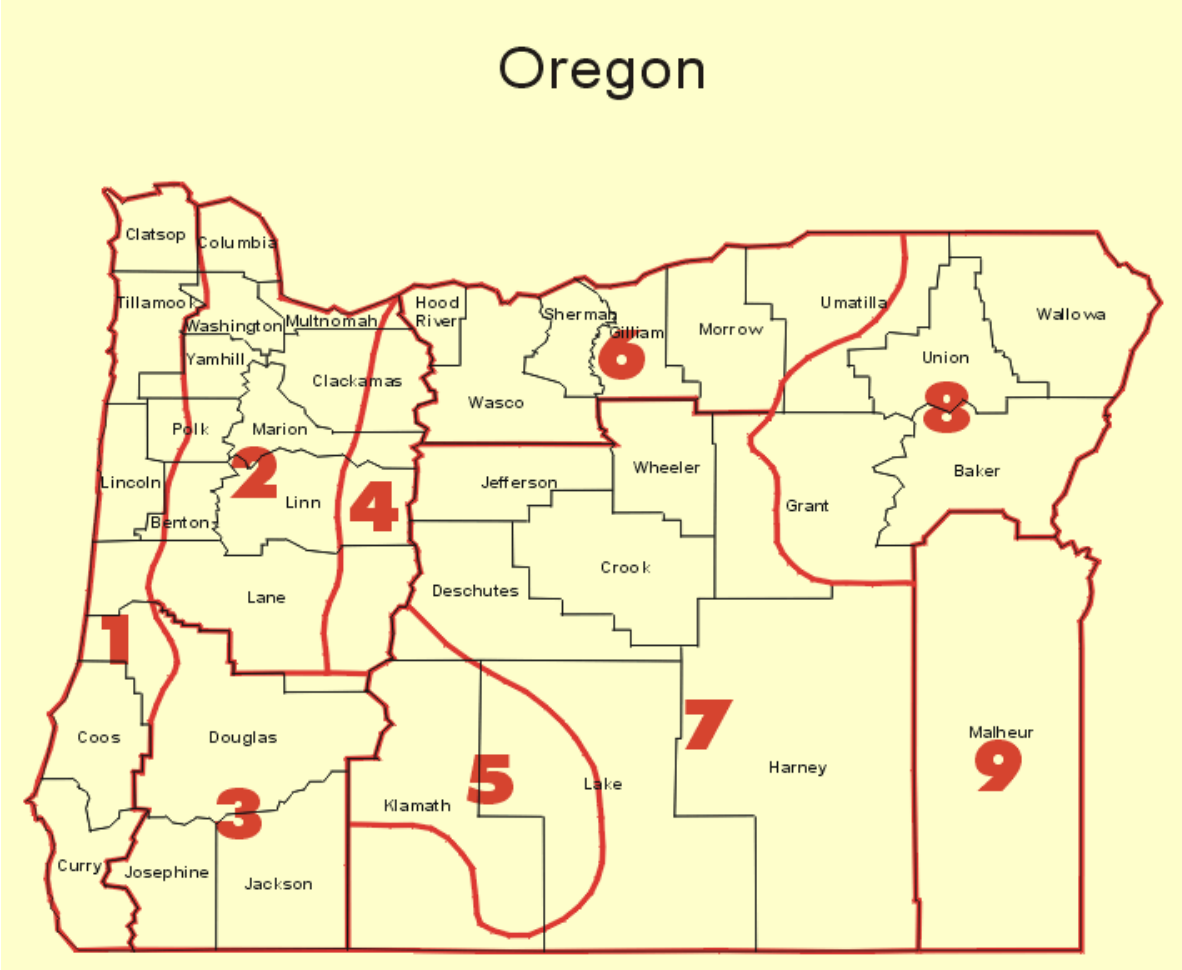
[6] Ibid.

[7] Taylor, George; Hatton Raymond, *Oregon Weather Book*, 1999, http://osupress.oregonstate.edu/book/oregon-weather-book.

[8]Oregon Climate Service, http://ocs.oregonstate.edu/.

Assessment for detailed information on climate change as it relates to natural hazards. Appendix B Community Profile also includes climate information for Sweet Home.

Figure SS-1 Oregon's Climate Divisions



Source: NOAA, National Weather Service Climate Prediction Center, https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/CLIM_DIVS/oregon.gif

Climate data such as precipitation, temperature, and hours of daylight provides a framework for understanding the climate in Sweet Home and Linn County.

Information such as precipitation, temperature, and so forth are included for the two cities near Sweet Home, since Sweet Home is not listed as an option in the city data on the U.S. Climate Data website (https://www.usclimatedata.com/). According to the website, the monthly data for Corvallis and Eugene is based on 1981-2010 normals and the history is 2007-2019. Sweet Home is 35 miles from Corvallis and 45 miles from Eugene.

Table SS-1 Corvallis Weather Averages by Month

Climate Corvallis - Oregon

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F	47	51	56	61	67	73
Average low in °F	34	35	37	40	44	49
Av. precipitation in inch	6.40	5.11	4.44	2.91	2.31	1.52
Av. snowfall in inch	1	1	0	0	0	0

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F	82	83	77	65	53	46
Average low in °F	52	51	48	42	38	33
Av. precipitation in inch	0.49	0.53	1.25	3.10	6.94	7.71
Av. snowfall in inch	0	0	0	0	0	1

Source: U.S. Climate Data, Climate Corvallis - Oregon and Weather averages Corvallis (usclimatedata.com)

Table SS-2 Corvallis Weather Averages by Year

Corvallis weather averages

Annual high temperature	63°F
Annual low temperature	42°F
Average annual precip.	42.71 inch
Av. annual snowfall	3 inch

Source: U.S. Climate Data, Climate Corvallis - Oregon and Weather averages Corvallis (usclimatedata.com)

Table SS-3 Eugene Weather Averages by Month

Climate Eugene - Oregon

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F	47	51	56	61	67	73
Average low in °F	34	35	37	40	44	48
Av. precipitation in inch	6.87	5.43	4.99	3.33	2.74	1.50
Av. snowfall in inch	1	2	0	0	0	0

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F	82	83	77	64	52	46
Average low in °F	51	51	47	41	38	34
Av. precipitation in inch	0.54	0.61	1.29	3.25	7.72	7.83
Av. snowfall in inch	0	0	0	0	0	2

Source: U.S. Climate Data, Climate Eugene - Oregon and Weather averages Eugene (usclimatedata.com)

Table SS-4 Eugene Weather Averages by Year

Eugene weather averages

Annual high temperature	63°F
Annual low temperature	42°F
Average annual precip.	46.1 inch
Av. annual snowfall	5 inch

Source: U.S. Climate Data, Climate Eugene - Oregon and Weather averages Eugene (usclimatedata.com)

History of Severe Storms in Sweet Home and Linn County

All of Sweet Home is susceptible to severe weather. Table SS-5 includes a list of wind storms, winter storms, tornadoes, rain storms, and other natural hazard events that have occurred in Linn County.

Table SS-5 Significant Severe Storms

Date	Location	Type of Severe Weather	Description
Dec. 1861	Statewide	Snow	Snowfall 1-3 inches. Snow in Willamette Valley until late February 1862.
Dec. 1892	Northern counties in OR	Snow	15-30 inches of snow fell throughout the northern counties.
Jan. 1916	Statewide	Snow	Two snow storms, each dropped 5 inches or more.
Dec. 1924	Statewide	Cold	Coldest December on record at that time. Drewsey and Riverside set a state record for the lowest temperature at -53 F.
Winter 1927, 1933, 1936, 1937, 1943, 1949	Portland area, W. Oregon, Statewide	Snow	Heavy snowfall. On January 20-25, 1927, the Harney Experiment Station reached -36 F. In February 1933, it was the coldest February to date for eastern Oregon. Ukiah and Seneca reached -54. Jan. 31 – Feb. 4 in 1937 had heavy snows statewide.
Apr. 1931	Western and central Oregon	Winter, wind, and dust storms	Unofficial wind speeds reported at 78 mph. Damaged fruit orchards and timber. Dust in the Santiam Canyon.
Mar. 1935	Central Oregon	Dust Storm	Dust storm reduced visibility to a few hundred yards over several counties. A fine county of dust on the fields and highways.
Jan. 1950	Statewide	Snow	Friday the 13th Storm. Heaviest snowfall since 1890. Freezing rain. Deep snowdrifts closed all highways west of the Cascades and through the Columbia Gorge. Roads and schools closed. Downed power lines. Severed communication. Hundreds of thousands of dollars in property damage.
Nov. 1951	Statewide	Winter and wind storm	Nov. 10-11. Widespread damage. Transmission and utility lines damaged. Wind speeds were 40-60 mph and gusts 75-80 mph.
Dec. 1951	Statewide	Winter and wind storm	Statewide storm with wind speeds 60 mph in Willamette Valley. Widespread damage to buildings and utility lines.
Dec. 1955	Statewide	Winter and wind storm	Wind speeds 55-65 with 69 mph gust. Considerable damage to buildings and utility lines.
Nov. 1958	Statewide	Wind storm	Wind speeds at 51 mph with 71 mph gusts. Every major highway blocked by fallen trees.
Winter 1956 1960, 1962	W. Oregon	Snow, ice	Packed snow became ice. Many auto accidents.
Mar. 1960	Statewide	Snow	Snowfall amounts were 3-12 inches depending on location.
Oct. 1962	Statewide	Winter storm	DR-136. 1962 Columbus Day Storm. Most severe windstorm for Western Oregon due to sustained wind speeds and damage levels. Winds in the Willamette Valley up to 116 mph. 84 homes destroyed, 5,000 severely damaged. Killed 38 people and created $170-200 million in damages in the state.
Dec. 1964	Statewide	Heavy rains and flooding	DR-184. The statewide event occurred on December 24, 1964. Lake County was affected.
Oct. 1967	W. Oregon	Winter storm	
Jan. 1969	Statewide	Snow	On January. 25-30 there was record-breaking snowfalls. $3 to $4 million in property damage.
Mar. 1971	Statewide	Winter storm	Great damage in the Willamette Valley; homes and power lines destroyed by falling trees.
Jan. 1972	W. Oregon	Storms and flooding	DR-319. Storm and flooding events on January 21, 1972.
Jan. 1974	W. 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. 1980	Statewide	Winter storm	On January 9-11, there were a series of storms bringing snow, ice, wind, and freezing rain. Six fatalities.
Nov. 1981	Statewide	Winter storm	The strongest windstorm since the Columbus Day storm in 1962.

Date	Location	Type of Severe Weather	Description
Feb. 1985	Statewide	Snow	Western valleys received 2-4 inches of snow. Massive power failures (tree limbs broke power lines). 2 feet of snow in northeast mountains. Event occurred on February 7-8.
Feb. 1986	Central and Eastern Oregon	Snow	Heavy snow in the Deschutes Basin and in eastern Oregon. Traffic accidents and broken power lines occurred.
Mar. 1988	Statewide	Winter storm	Strong winds. Heavy snow.
Feb. 1989	Statewide	Winter storm	Heavy snowfall. Record low temperatures. Event occurred February 1-8.
Jan. 1990	Statewide	Winter storm	Heavy rain with winds greater than 75 mph; significant damage; 1 death. Event occurred January 6-8. Snow in Cascades. On January 7 there was a thunderstorm in Malheur County with $152,776 crop damage.
Feb. 1990	Statewide	Snow	Average snowfall from one storm was about 4 inches in the Willamette Valley. The storm brought 24-35 inches of snow to Cascade Locks and Hood River. Event occurred February 11-16.
Jan. 1991	Most of Oregon	Severe wind storm	Severe wind storm impacts. Event occurred January 11-12.
Mar. 1991	Mid-Columbia/ NE Oregon	Severe wind storm	Severe wind storm impacts.
Jul. 1991	Malheur County	Thunder storm	On July 13 there was a thunder storm with $50,000 in crop and property damage.
Dec. 1991	N. Central OR	Severe wind storm	Blowing dust. Event occurred December 12.
Dec. 1992	W. Oregon	Snow and wind	Heavy snow. Interstate 5 closed. Northeastern mountains had severe wind.
Jan. 1993	Northern OR	Wind storm	Severe wind storm. Damage to utilities.
Feb. 1993	W. Oregon	Snow	Record snowfalls.
Nov. 1993	Cascade Mountains, OR	Snow	Heavy snow throughout the region.
Feb. 1994	Southeastern Oregon	Snow	Heavy snow throughout the region. Event occurred February 10.
Mar. 1994	Cascade Mountains, OR	Snow	Heavy snow throughout the region.
Dec. 1995	Statewide	Wind storm	DR-1107. Event occurred on December 10-12. Winds reached 62 mph in the Willamette Valley. Strongest windstorm since 1981.
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; 8 fatalities. 27 counties covered by the disaster declaration.
Dec. 1996	Statewide	Winter storm	DR-1160. Severe snow and ice. Up to 4 to 5 inches of ice in the Columbia Gorge. Interstate 84 closed for 4 days. Hundreds of downed trees and power lines. Lake County was impacted.
Nov. 1997	W. Oregon	Wind storm	Uprooted trees. Considerable damage to small airports. Winds up to 52 mph.
Winter 1998-1999	Statewide	Snow	Series of storms. One of the snowiest winters in Oregon history. The snowfall at Crater Lake was 586 inches.
Oct. 1999	Klamath Basin, OR	Wind storm	On October 23 there were high winds 40-70 mph; a high wind warning was issued for several Oregon zones.
Feb. 2000	Southeast Oregon	Winter and wind storm	February 14 had high winds associated with a winter storm; up to 80 mph. Significant damage to Southeastern Oregon.
Aug. 2000	Klamath County	Winter storm	On August 28 Klamath County received a Secretarial Major Disaster Declaration; Lake County is noted as a contiguous county.
Apr. 2001	Near Klamath Falls, OR	Dust storms	US 97 about 5 miles north of Klamath Falls was closed for approximately 6 hours following 3 separate crashes. There were 11 cards involved, sending 9 people to the hospital. Crashes caused by limited visibility resulting from dust from a plowed field.
Feb. 2002	W. Oregon	Winter storm	Damages $6.14 million. Downed power lines and trees. Buildings damaged. Power outages caused some water supply problems.

Date	Location	Type of Severe Weather	Description
Dec. 2003-Jan. 2004	Statewide	Snow and ice	DR-1510. Much of Portland area shut down. Twenty-six counties receive FEMA assistance. Malheur County was included.
Mar. 2005	Deschutes and Jefferson Counties	Dust storms	Visibilities of ½ mile or less due of blowing dust. Motorists on US 97 north of Madras reported visibilities near zero at times.
Sep. 2005	Statewide	Evacuation	EM 3228. On September 7, there was a declaration for the Hurricane Katrina evacuation.
May 2006	Statewide	Storms, flooding, landslides, mudslides	DR-1632. Statewide impacts from storms, floods, landslides, and mudslides. The winds ranged from 70-80 mph.
Jul. 2006	Statewide	Heatwave	Multiple days of temperatures over 100 degrees Farenheit.
Nov. 2006	W. Oregon	Winter storm, flooding, landslides	DR-1962. The events occurred November 6-8, 2006.
Dec. 2007-Jan. 2008	W. Oregon	Winter storm	DR-1824. Severe winter storm, record and near record snow, landslides and mudslides. January 4 high winds in Harney Co. On January 8 there was 8 in snow across Harney Co. On January 29 there was 4-7 in snow near Burns.
Dec. 2008	Statewide	Winter storms, heavy rain, flooding	DR-1824. Severe winter storm, flooding, winds, record and near record snow, landslides and mudslides. Gresham received, 26" of snow. Many roads closed. Significant damages to public infrastructure, homes and businesses. Event occurred Dec. 20-26. On December 22, 2008, over 22 inches of snow fell on Hood River in 22 hours. Up to 6 inches fell at Burns on December 21 and 60 in around Burns on December 25.
Dec. 2009	Statewide	Winter storm	Snow and freezing rain in Salem, and Portland to Hood River. I-84 closed for 22 hours. On December 14 there was 5 in snow across Harney County.
Nov. 2010	Statewide	Winter storm	Snow, freezing rain, and ice in Portland to Hood River. On November 21, Harney County had 4 in snow.
Jan. 2011	Statewide	Winter storm	DR-1956. Severe winter storm, flooding, mudslides, landslides, and debris flows.
Jan. 2012	W. Oregon	Winter storm	DR-4055. The incident period was January 12-21, 2012. Severe winter storm with flooding, landslides, and mudslides. Declaration involves 12 counties including Hood River County. Harney County had 5-8 in snow on January 24.
Feb. 2014	Western Oregon	Severe winter storm	DR-4169. The event occurred Feb. 6-10, 2014. Counties that were part of the disaster declaration: Linn, Lane, Benton, and Lincoln.
Dec. 2015	Western Oregon	Winter storm	DR-4258. Severe winter storms, straight-line winds, flooding, landslides, and mudslides. Linn County as one of the counties included in the disaster declaration
Jan. 2017	Statewide	Severe winter storms, flooding, landslides, mudslides	DR-4238. The event occurred January 7-10, 2017. Counties that were part of the disaster declaration: Hood River, Columbia, Josephine, and Deschutes. Other counties were also greatly impacted by this and other storms that occurred.
Apr. 2019	Statewide	Severe storms, flooding, landslides, mudslides	DR-4452. The event occurred April 6-21, 2019. Counties that were part of the disaster declaration: Linn, Douglas, Curry, Wheeler, Grant, and Umatilla. Individual and Public Assistance money was approved.

Sources: *2015 Sweet Home NHMP*; Tricia Sears, Natural Hazards Planner, DLCD; Sweet Home Steering Committee; *2020 Oregon NHMP*; FEMA, Disaster Declarations for Oregon, retrieved 2021. Taylor and Hatton, 1999; NOAA Storm Events Database, http://www.ncdc.noaa.gov/stormevents/ (accessed 3/27/13).

Risk Assessment

How are Hazards Identified?

Wind storms in Sweet Home and Linn County can occur in summer and winter; they usually occur from October to March. Their extent is determined by their track, intensity (the air pressure

gradient they generate), and local terrain. The National Weather Service uses weather forecast models to predict oncoming wind storms, while monitoring storms with weather stations in protected valley locations throughout Oregon.[9] Thunderstorms can bring high winds during the warmer months, April to October. Tornadoes are the most violent of wind storms and are occasionally caused by intense local thunderstorms, which are more common during the warm season.

The magnitude or severity of severe winter storms is determined by a number of meteorological factors including the amount and extent of snow or ice, air temperature, wind speed, and event duration. Precipitation, an additional element of severe summer and severe winter storms, is measured by gauging stations. The National Weather Service monitors the stations and provides public warnings on storm, snow, and ice events as appropriate.[10] See Appendix B for more information on a broad spectrum of climate data for Sweet Home and Linn County.

Hazard Risk Analysis

The Sweet Home NHMP Steering Committee completed a Hazard Vulnerability Assessment/Analysis (HVA) during this NHMP update. This was described in Section 2 Risk Assessment. The method used for the HVA was developed from a Federal Emergency Management Agency (FEMA) tool that has been refined by the Oregon Office of Emergency Management (OEM). It addresses and weights (shown as percent within parentheses) probability (29%), vulnerability (21%), maximum threat (42%) and the history (8%) of each natural hazard and attributes a final hazard analysis score. The methodology produces scores that range from 24 to 240.

For local governments, conducting the HVA is a useful step in planning for hazard mitigation. The method provides the jurisdiction with a relative ranking from which to prioritize mitigation actions, but does not predict the occurrence of a particular hazard.

A recap of the changes for the severe storms hazards between the HVA that was included in the *2015 Sweet Home NHMP* (which has a 2003 All Hazards Analysis Matrix) and the one done for the *2021 Sweet Home NHMP* shows that severe storms remain the #1 ranked natural hazard. For more information on all the risk scores and ranks of the natural hazards for Sweet Home, see Volume I Basic Plan, Section 2 Risk Assessment of this NHMP.

Probability of Future Occurrence

The hazard history section details numerous storm events affecting Sweet Home and Linn County since 1861. Some of the report incidents are localized events that do not affect large areas of the County or Cities. Specific probability rates have not been calculated for each of these hazards.

The Sweet Home NHMP Steering Committee, during the HVA on 12/4/20 and 1/8/21, scored severe storms with a probability of 10. Revisions to the HVA were made during the 2/5/21 NHMP Steering Committee meeting. Probability was one of the four weighted factors in the HVA used to calculate the overall risk score. The probability scale used in the HVA identified the scores of 8 to 10 as high,

[9] National Weather Service, *Some of the Area's Windstorms*, https://www.wrh.noaa.gov/pqr/paststorms/wind.php

[10] National Weather Service Forecast Office, Boise, ID, https://www.weather.gov/boi/

defined as likely to occur within the next 5 years. For additional description of the HVA scoring, see Volume I Section 2 Risk Assessment.

Extreme weather events are experienced in all regions of Oregon. The regions that experience the highest wind speeds are in the Oregon Coast of Region 1 and Mid-Columbia in Region 5. Sweet Home is in Region 3. See Table SS-6, the Probability of Severe Wind Events by Natural Hazard Region. The table shows the wind speed probability intervals that structures 33 feet above the ground would expect to be exposed to within a 25-, 50- and 100- year period.

Table SS-6 Probability of Severe Wind Events by Natural Hazard Region

	25-Year Event (4% annual probability)	50-Year Event (2% annual probability)	100-Year Event (1% annual probability)
Region 1: Oregon Coast	75 mph	80 mph	90 mph
Region 2: North Willamette Valley	65 mph	72 mph	80 mph
Region 3: Mid/Southern Willamette Valley	60 mph	68 mph	75 mph
Region 4: Southwest Oregon	60 mph	70 mph	80 mph
Region 5: Mid-Columbia	75 mph	80 mph	90 mph
Region 6: Central Oregon	60 mph	65 mph	75 mph
Region 7: Northeast Oregon	70 mph	80 mph	90 mph
Region 8: Southeast Oregon	55 mph	65 mph	75 mph

Source: DLCD, *2015 Oregon Natural Hazard Mitigation Plan*, https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_5_RAState.pdf

Vulnerability Assessment

Storms and weather information are tracked by numerous agencies such as NOAA/National Weather Service (NWS), USGS, Oregon Climate Services, ODOT, and DOGAMI, and warnings are issued by NWS when certain thresholds are reached. The impacts of severe summer and severe winter storms happen at a range of levels. Communities are vulnerable in many ways such as emergency services may be challenged to respond, critical facilities may be damaged, and economic vitality may be impacted.

Wind storms can cause power outages, transportation, and economic disruptions. Structures most vulnerable to high winds in Sweet Home include insufficiently-anchored manufactured homes and older buildings with roof structures not designed for anticipated wind loads. Fallen trees and debris are common and can block roads for long periods, in addition to bringing down power and/or utility lines. To identify wind speeds and the effects, see Figure SS-7, Effects of Wind Speed.

Manufactured homes, multi-story retirement homes, and buildings in need of roof repair are structures that may be most vulnerable to wind storms. Buildings adjacent to open fields or adjacent to trees are also more vulnerable to wind storms than more protected structures.

Thunderstorms can occur with high winds. When they come with hail they are predominantly an economic concern for Linn County's agricultural community. If a storm occurs or a lightning strike happens during the growing season, damages to row crops can be economically devastating, especially to the uninsured. Microbursts have damaged buildings and have contributed to instances of several inches of rain falling in an hour or less. Severe thunderstorms occurring after a recent wildfire can wash out canals and waterways stripped of undergrowth by fire, which then exacerbate flood issues and can damage roads and irrigation infrastructure.

Table SS-7 Effects of Wind Speed

Wind Speed (mph)	Wind Effects
25-31	Large branches will be in motion.
32-38	Whole trees in motion; inconvenience felt walking against the wind.
39-54	Twids and small branches may break off trees; wind generally impedes progress when walking; high profile vehicles such as trucks and motor homes may be difficult to control.
55-74	Potential damage to TV antennae; may push over shallow rooted trees, especially if the soil is saturated.
75-95	Potential for minimal structural damge, particularly to unanchored mobile homes; power lines, and signs; and tree branches may be blown down.
96-110	Moderate structural damage to walls, roofs, and windows; large signs and tree branches blown down; moving vehicles pushed off roads.
111-130	Extensive structural damage to walls, roofs, and windows; trees blow down; mobile homes may be destroyed.
131-155	Extreme damage to structures and roofs; trees uprooted or snapped.
Greater than 155	Catastrophic damage; structures destroyed.

Source: Washington County, Office of Consolidated Emergency Mngt, Wind Effects.

Snow and ice storms can block traffic; cause traffic accidents and block roads; damage crops, livestock, and agricultural buildings; and delay transportation of products. People may be stranded. Events and activities may be cancelled. Power outages and downed trees can happen. Extreme cold can cause bodies to work harder to maintain themselves which stresses them and cause injury. Accidents can occur.

All of these cause economic disruptions, and pose a high risk for injuries and loss of life. The events can also be typified by a need to shelter and care for adversely impacted individuals.

Community Hazard Issues

What is susceptible to damage during a severe summer storm event?

The damaging effects of wind storms may extend for distances of 100 to 300 miles from the center of storm activity. Positive wind pressure is a direct and frontal assault on a structure, pushing walls,

doors, and windows inward. Negative pressure also affects the sides and roof: passing currents create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact and remove the building protective envelope (doors, windows, and walls), internal pressures rise and result in roof or leeward building component failures and considerable structural damage. As has been stated manufactured homes, multi-story retirement homes, and buildings in need of roof repair are structures that may be most vulnerable to wind storms. Buildings adjacent to open fields or adjacent to trees are also more vulnerable to wind storms than more protected structures.

Wind storms can result in collapsed or damaged buildings, damaged or blocked roads and bridges, damaged traffic signals, streetlights, and parks. Roads blocked by fallen trees during a wind storm may have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Wind storms can cause flying debris which can also damage utility lines. Overhead power lines can be damaged even in relatively minor wind storm events. Industry and commerce can suffer losses from interruptions in electric service and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from wind storms related to both physical damages and interrupted services.

What is susceptible to damage during a severe winter storm event?

Severe winter weather can be a deceptive killer. Winter storms which bring snow, ice, and high winds can cause significant impacts on life and property. Many severe winter storm deaths occur as a result of traffic accidents on icy roads, heart attacks which shoveling snow, and hypothermia from prolonged exposure to the cold. The temporary loss of home heating can be particularly hard on the elderly, young children, and other vulnerable individuals.

Property is at risk due to flooding and landslides that may result if there is a heavy snowmelt. Additionally, ice, wind and snow can affect the stability of trees, power and telephone lines and TV and radio antennas. Down trees and limbs can become major hazards for houses, cars, utilities and other property. Such damage in turn can become major obstacles to providing critical emergency response, police, fire and other disaster recovery services.

Ice storms occur on a frequent basis and cause significant damage, especially to local utilities. Severe winter weather also can cause the temporary closure of key roads and highways, air and train operations, businesses, schools, government offices and other important community services. Below freezing temperatures can also lead to breaks in un-insulated water lines serving schools, businesses, and industry and individual homes. Severe winter storms can isolate small communities, farms, and ranches and create serious problems for open range cattle operations. Early and late season extreme cold can damage agricultural crops, while snow and ice can block access for the distribution of crops and provision of agricultural services. All of these effects, if lasting more than several days, can create significant economic impacts for communities as well for the surrounding region, and even outside of Oregon.

Existing Mitigation Activities and Resources

Existing mitigation activities include current mitigation programs and activities that are being implemented by the community in an effort to reduce the community's overall risk to natural hazards. Documenting these efforts can assist the community in better understanding its risk and can assist in documenting successes.

State Natural Hazard Risk Assessment

The risk assessment in the *2020 Oregon Natural Hazards Mitigation Plan* provides an overview of all the identified natural hazards in Oregon (in the State NHMP but not necessarily all the locally identified natural hazards) and identifies the most significant hazards in Oregon's recorded history. It has overall state and regional information, and includes mitigation actions for the entire state. 2020 Oregon NHMP

Planning for Natural Hazards: Oregon Technical Resource Guide

This guide describes basic mitigation strategies and resources related to natural hazards, including examples from communities in Oregon. https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

Oregon State Building Code Standards

The Oregon Building Codes Division adopts statewide standards for building construction that are administered by the state and local municipalities throughout Oregon. The *2017 Oregon Residential Special Code* (*ORSC*) contains requirements for one- and two-family dwellings (https://codes.iccsafe.org/content/document/1018?site_type=public) and the *2019 Oregon Structural Special Code* (*OSSC*) (https://codes.iccsafe.org/content/OSSC2019P1) contains provisions for grading and site preparation for the construction of building foundations.

Street/ Road/ Highway Maintenance[11]

The Oregon Department of Transportation (ODOT) is responsible for performing precautionary measures to maintain the safety and operability of major roads during winter storm conditions. The road maintenance programs are designed to provide the best use of limited resources to maximize the movement of traffic within the community during winter weather.

During storm events, most agencies at the county and city level focus on clearing major arterial and collector streets first, and then respond to residential connector streets, school zones, transit routes, and steep residential streets as resources become available. The state, counties, and cities, may have agreements, including mutual aid agreements, about road maintenance responsibilities during day to day operations and who does what in storm situations. In general, highways receive more attention. Routes on the National Highway System network, primary interstate expressways and primary roads, will be cleared more quickly and completely than other roads.

Wind Storm

Oregon Building Codes (both residential and other codes) set standards to withstand 80 mph winds (https://www.oregon.gov/bcd/codes-stand/pages/index.aspx).

FEMA recommends having a safe room in homes or small businesses to prevent residents and workers from "dangerous forces" of extreme winds to avoid injury or death. (https://www.fema.gov/fema-p-320-taking-shelter-storm-building-safe-room-your-home-or-small-business).

Existing strategies and programs at the state level are usually performed by the Oregon Public Utility Commission (OPUC), Building Code Division (BCD), Oregon Department of Forestry (ODF), Oregon Emergency Management (OEM), and the Oregon Department of Transportation (ODOT).

The Oregon Emergency Response System (OERS) coordinates and manages state resources in response to natural and technological emergencies and civil unrest involving multi-jurisdictional cooperation between all levels of government and the private sector (https://www.oregon.gov/oem/emops/Pages/OERS.aspx).

OPUC ensures operators manage, construct and maintain their utility lines and equipment in a safe and reliable manner. These standards are listed on this website: http://www.puc.state.or.us/PUC/safety/index.shtml. OPUC promotes public education and requires utilities to maintain adequate tree and vegetation clearances from high voltage utility lines and equipment.

Winter Storm

Studded tires can be used in Oregon from November 1 to April 1. They are defined under Oregon law as a type of traction tire. Research shows that studded tires are more effective than all-weather tires on icy roads, but can be less effective in most other conditions. Winter storm is similar to wind storm in terms of strategies and programs at the state level.

Emergency Operations Plans

This description is excerpted from the *2012 Sweet Home Emergency Operations Plan*.

The Emergency Operations Plan is an all-hazard plan that describes how the City of Sweet Home and Sweet Home Fire and Ambulance District, known as the Sweet Home Area, will organize and respond to emergencies and disasters in the community. It is based on, and is compatible with, Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including Presidential Policy Directive 8, the National Response Framework, State of Oregon Emergency Management Plan, and Linn County Emergency Operations Plan.

Response to emergency or disaster conditions in order to maximize the safety of the public and to minimize property damage is a primary responsibility of government. It is the goal of the Sweet Home Area that responses to such conditions are conducted in the most organized, efficient, and effective manner possible. To aid in accomplishing this goal, the Sweet Home Area has, in addition to promulgating this plan, informally adopted the principles of the National Incident Management System, including the Incident Command System and the National Response Framework.

Consisting of a Basic Plan, Functional Annexes aligned with the Linn County Emergency Support Functions, and Incident Annexes, this Emergency Operations Plan provides a framework for coordinated response and recovery activities during a large-scale emergency. The plan describes how various agencies and organizations in the City of Sweet Home and Sweet Home Fire and

Ambulance District will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.

Future Changing Conditions/ Climate Change

In the *2021 Sweet Home NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Sweet Home and the surrounding area. In the order of appearance in the NHMP it is in the Risk Assessment and the Hazards Annexes. We can refer to the *2020 Oregon NHMP* for climate change information about the Mid/Southern Willamette Valley Region (Region 3). Region 3 includes Linn, Lane (non-coastal), Marion, Polk, and Yamhill Counties. The hazards faced by Region 3 that are projected to be influenced by climate change include drought, wildfire, flooding, landslides, and extreme heat.

Severe Storms Mitigation Actions

The severe storms mitigation actions (SS) have been identified by the Sweet Home NHMP Steering Committee. See Table 3-1, 2021 Sweet Home NHMP Mitigation Actions. In discussion with the NHMP Steering Committee, it was agreed that the risk level rankings from the HVA would be used as the way to prioritize the multi-hazard and hazard-specific mitigation actions. The risk level rankings are in Table 2-4 in Section 2 Risk Assessment.

There are seven SS specific mitigation actions. The SS mitigation actions have a high priority because the Hazard Vulnerability Assessment (HVA) resulted in severe storms having a high risk level. There are multi-hazard mitigation actions for the NHMP and several of those include severe storms related mitigation actions, in conjunction with the other hazards. The multi-hazard mitigation actions are a high priority.

WILDFIRE HAZARD ANNEX

Risk Score: 166

Risk Level: Medium

Causes and Characteristics of Wildfire

A wildfire is a strong and often uncontrollable burning of forest, brush, or rangeland (includes grassland). Fire has always been a part of high desert Western ecosystems and can have both beneficial and devastating effects. Eastern Oregon has a lengthy history of wildfire in both wildlands and in wildland-urban interface (WUI) areas. Western Oregon has historically been less prone and less impacted. Present conditions are different from the past, as wildfires occur throughout Oregon.

WUI areas are where the human developed areas meet the undeveloped areas; it is a transition area. Other areas that are less forested or are covered by brush and grassland also create susceptibility to wildfire. As the population grows across Oregon, development in the WUI increases, posing a larger threat to life and property.

Wildfire was ranked fourth in the *2015 Sweet Home NHMP*. In the *2021 Sweet Home NHMP* it is ranked second out of seven natural hazards.

The *2015 Sweet Home NHMP* did not include specific events listed for natural hazards; the *2021 Sweet Home NHMP* includes a table of natural hazards events in each annex.

Nearly 3,700 sq. mi. or 2.4 million acres are considered WUI areas in Oregon, which is about 3.8% of the state. Of the nearly 1.7 million total homes in Oregon, over 603,000 or 36%, are in the WUI.[1]

Wildfires threaten the limited but valued forestland, agricultural land and rangelands, and individual home sites. Wildland firefighting agencies protect forest and rangeland from wildland fires. While they fight to protect structures from fires spreading from the wildlands, they do not fight fires once they become structural and equipment fires. Notably, once a fire has started, homes and development in wildland and WUI settings complicate firefighting activities and stretch available human and equipment resources.[2]

The loss of property and life, however, can be minimized through cooperation, preparedness, and mitigation activities. Federal agencies with wildland firefighting responsibilities mainly protect federal ownership, while state wildland firefighting agencies protect private forestland along with other public ownership. Both state and federal wildland firefighters can provide wildfire suppression service outside their respective jurisdictions through formal agreements. There are also Rural Fire Districts that have both structural and wildland responsibilities in the more populated (unincorporated) areas and there are Rangeland Fire Protection Associations (RFPA) that provide wildland fire protection on the private rangelands in Oregon counties. There are many agreements between local, state, and federal organizations to assist one another throughout Linn County.

Communities located in areas near rangeland or forests or a WUI may be at risk to wildfire hazards.

[1] Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

[2] Al Crouch, BLM, personal communication, March 4, 2019.

Wildfire information included in this *2021 Sweet Home NHMP* includes but is not limited to the *2007 Linn County Community Wildfire Protection Plan (CWPP)* described here and included in Appendix G, information from the BLM and ODF, information from the Advanced Report from the Oregon Wildfire Risk Explorer, and information from Sweet Home. The CWPP provides detailed information on the vulnerability and history of wildfire in Linn County, and provides mitigation actions Linn County and the Cities can implement to reduce the impact of wildfire. This *2021 Sweet Home NHMP* links to the CWPP as it also contains wildfire information and mitigation actions. See Table 3-1, Sweet Home NHMP Mitigation Actions.

In the *2007 Linn County CWPP*, it describes,

> "to help states and counties identify at-risk communities within their borders, various state and federal agencies collaborated to update a nationwide list called 'Communities in the Vicinity of Federal Lands at Risk from Wildfire'. To identify at-risk communities, state agencies use a process created by a national interagency group; it describes the factors associated with at-risk communities. The updated list of at-risk communities across the country was published in the Federal Register on August 17, 2001."[3]

According to the *2007 Linn County CWPP*, none of the communities in Linn County are at high risk from wildfire, but many of them have a moderate to moderate/high risk. The risk assessment in the *2007 Linn County CWPP* finds that the communities in Table WF-1 are at risk, and that mitigation projects near them should be prioritized.

Table WF-1 Communities in Linn County Most at Risk from a Wildfire Event as Designated by the Linn County CWPP

Community	
Albany	Lebanon
Brownsville	Lyons
Clear Lake Resort	Marion Forks
Crowfoot	Mill City
Gates	Scio
Harrisburg	Sweet Home East
Idanha	Sweet Home West

Source: *Linn Community Wildfire Protection Plan (CWPP)*, file:///J|/Shared/Scholars%20bank%20local%20docs/County/Hazard%20mitigation%20plans/Linn_County_Wildfire_Plan_Appendices.pdf (uoregon.edu),

According to the *2007 Linn County CWPP*, in another list of Oregon Communities at Risk, published by the ODF in April 2006, the at risk communities are: Albany, Brownsville, Corvallis, Gates, Halsey, Harrisburg, Idanha, Detroit, Jefferson, Lebanon, Lyons, Mill City, Millersburg, Scio, Sodaville, Stayton, Sweet Home, Tangent, and Waterloo. The risk assessment in the CWPP begins with the Federal Register and ODF lists, and then based on the results of the analysis described, refines the list to create a localized risk assessment that can assist with prioritizing projects for implementation.

[3] *2007 Linn County Community Wildfire Protection Plan (CWPP)*, file:///J|/Shared/Scholars%20bank%20local%20docs/County/Hazard%20mitigation%20plans/Linn_County_Wildfire_Plan_Appendices.pdf (uoregon.edu), accessed 7/27/21

There are other rural residential areas in Linn County that are identified in the *2007 Linn County CWPP* and may be subject to wildfire hazards because of their location in forested areas or on steep dry slopes. Examples of such rural residential areas include: Bartel's Canyon Estates, Cascadia, Middle Ridge, Mountain Home Drive, Mt. Tom/Wildwood Estates, Northernwood Drive, Powell Hills, Rodger's Mountain, Washburn Heights, the Upper Calapooia, and others.

The impact on communities from wildfire can be huge and has been estimated at 3 times the cost of suppression.[4] Statewide in 2018, according to the Northwest Interagency Coordination Center, the cost of fighting wildfires in Oregon was $514.6 million, which was a substantial increase from the $447 million it cost in 2017.[5] Wildfires in Linn County affect other counties. The History of Wildfires in Sweet Home and Linn County section in this Wildfire Hazard Annex includes a description of documented wildfires in Linn County in Table WF-2; not all the wildfires that have occurred in Linn County are included on this list. The list includes wildfires that have occurred nearby.

See Figures WF-9 through WF-14 for full page maps illustrating wildfire hazards in Sweet Home and Linn County. The maps are from the Sweet Home staff engineer, using various sources of information, and from the *2007 Linn County CWPP*. Each map identifies the source of the information used. There are other maps included in this Wildfire Hazard Annex.

- Figure WF-9 Linn County Community Wildfire Protection Plan (CWPP) Wildland Urban Interface Map 1: Risk
- Figure WF-10 Linn County Community Wildfire Protection Plan (CWPP) Wildland Urban Interface Map 2: Hazards
- Figure WF-11 Wildfire Hazard: Sweet Home CWPPWUI aka Community Wildfire Protection Plan and Wildland Urban Interface Map
- Figure WF-12 Wildfire Hazard: WUI Risk Assessment
- Figure WF-13 Wildfire Hazard: WUI Density (relates to vegetation)

Wildfire can be divided into four categories: interface fires, wildland fires, firestorms, and prescribed fires.[6] These descriptions are provided for a brief but comprehensive understanding of wildfire.

Interface Fires

An interface fire occurs where wildland and developed areas come together with both vegetation and structural development combining to provide fuel. The WUI can be divided into categories.

- The **classic wildland-urban interface** exists where well-defined urban and suburban development presses up against open expanses of wildland areas.

- The **mixed wildland-urban interface** is more typical of the problems in areas of exurban or rural development: isolated homes, subdivisions, resorts and small communities situated in predominantly in wildland settings.

[4] Dustin Gustaveson, ODF, personal communication, 2/24/20

[5] Salem Statesmen-Journal, *Oregon Wildfire Costs Hit Record High of $514 million in 2018*, October 10, 2018, https://www.statesmanjournal.com/story/news/2018/10/10/oregon-wildfire-costs-hit-record-high-2018/1581132002/.

[6] Federal Emergency Management Agency, *Multi-hazard, Identification and Risk Assessment Report*, 1997, Washington, D.C., https://www.fema.gov/media-library/assets/documents/7251.

- The **occluded wildland-urban interface** where islands of wildland vegetation exist within a largely urbanized area.[7]

Wildland Fires

A wildland fire's main fuel source is natural vegetation. Often referred to as forest or rangeland fires, these fires occur in national forests and parks, private timberland, and on public and private rangeland. A wildland fire can become an interface fire if it encroaches on developed areas.

Firestorms and Mega-Fires

A firestorm is a very intense and destructive fire usually accompanied by high winds; it may be a large fire that is difficult to impossible to control. [8] Firestorms are events of such extreme intensity that effective suppression is virtually impossible. Firestorms often occur during dry, windy weather and generally burn until conditions change or the available fuel is consumed.

In 1987, widespread dry lightning in late August ignited fires throughout northern California and southwest Oregon. Two of these were over 10,000 acres, and according to the Oregon Department of Forestry, this series of events fits the definition of a firestorm. Resources were brought in from other states and Canada to fight them.[9] Another term of use is mega-fire which is a fire that is more than 100,000 acres in size.[10] There are fires greater than 100,000 acres listed in Table WF-2, but none of them occurred in Linn County. Fires outside of Linn County are included in the table to demonstrate that nearby fires and / or large or mega-fire wildfires can and do occur in Oregon. Fires in abutting or nearby counties can have substantial impacts on Sweet Home and Linn County.

Prescribed Fires

Prescribed fires are intentionally set or are select natural fires that are allowed to burn for beneficial purposes. Before humans suppressed forest fires, small, low intensity fires cleaned the underbrush and fallen plant material from the forest floor while allowing the larger plants and trees to live through the blaze. These fires were only a few inches to two feet tall and burned slowly. Forest managers now realize that a hundred years of prevention and suppression has contributed to the unnatural buildup of plant material that can flare up into tall, fast moving wildfires. These can be impossible to control and can leave a homeowner little time to react.

Conditions Contributing to Wildfires

Ignition of a wildfire may occur naturally from lightning or from human causes such as debris burns, arson, careless smoking, recreational activities, equipment, or an industrial accident. According to BLM staff in Harney County, over the long term, approximately 20% of fires are caused by humans.

[7] Ibid.

[8] Definition of firestorm, Merriam-Webster Dictionary, https://www.merriam-webster.com/dictionary/firestorm and Cambridge Dictionary, https://dictionary.cambridge.org/us/dictionary/english/firestorm.

[9] Wolf, Jim, ODF, personal communication, May 8, 2001.

[10] Casey O'Connor, BLM, personal communication, July 29, 2019.

This statistic is transferable to other counties in Oregon.[11] Many of the equipment caused fires occur as a result of transportation or creation.[12] Some fires are started by unknown causes.

Once started, four main conditions affect the fire's behavior: fuel, topography, weather and development. Of note, a fire's flame length is commonly used as a visual indication of fire intensity, and is a primary factor to consider for firefighter safety and for gauging potential impacts to resources and assets. A higher flame length may indicate a higher fire intensity, and a lower flame length may indicate a lower fire intensity. A more detailed discussion of flame length and fire intensities is better suited to the CWPP than the NHMP. Fire conditions, which affect the fire's behavior, vary widely with topography, fuels, and weather – especially winds.

Fuel

Fuel is the material that feeds a fire. Fuel is classified by volume and type. Forested lands provide a larger fuel source to wildfires than other vegetated lands due to the presence of large amounts of timber and other dense vegetation in these areas. Grassland are included in the rangeland areas[13] Grasslands, which naturally cover much of the region, are highly susceptible to wildfire. According to BLM staff, there is an increasing amount of invasive grasses in the grasslands; these invasive grasses are more susceptible to burn. The variability of the fire likelihood is great, as the factors of soil moisture, soil temperature, and amount of and nature of grass there varies. Vegetation such as agricultural lands and rangelands also provides fuel for wildfires.[14] Many agencies are finding it cheaper and more effective to reduce fuels than to fight large grassland or rangeland fires.

Topography

Topography influences the movement of air and directs a fire's course. Slope and hillsides are key factors in fire behavior. Hillsides with steep topographic characteristics are often also desirable areas for residential development. In this region, much of the topography is hilly or mountainous which can exacerbate wildfire hazards. These areas can cause a wildfire to spread rapidly and burn larger areas in a shorter period of time, especially, if the fire starts at the bottom of a slope and migrates uphill as it burns. Wildfires tend to burn more slowly on flatter lying areas, but this does not mean these areas are exempt from a rapidly spreading fire. Hazards that can affect these areas after the fire has been extinguished include landslides (debris flows), floods, and erosion.

Weather

Weather is the most variable factor affecting wildfire behavior. High-risk areas in Oregon share a hot, dry season in late summer and early fall with high temperatures and low humidity. Recognition of the variability of the weather and climate in Linn County is important for identifying and accomplishing efforts to mitigate wildfire and other natural hazards. In the Severe Storms Hazard Annex, Tables SS-1 and SS-2 shows the average annual precipitation in Corvallis and Tables SS-3 and

[11] Casey O'Connor, BLM, personal communication, July 29, 2019.

[12] Al Crouch, BLM, personal communication, March 4, 2019.

[13] Ibid.

[14] Al Crouch, BLM, personal communication, March 4, 2019.

SS-4 shows the average annual precipitation in Eugene. Additional weather information is described in Appendix B Community Profile.

The natural ignition of wildfires is largely a function of weather and fuel; human caused fires add another dimension to the probability. Lightning strikes in areas of forest or rangeland combined with any type of vegetative fuel source will always remain as a source for wildfire. Thousands of lightning strikes occur each year throughout much of the region. Fortunately, not every lightning strike causes a wildfire, though they are a major contributor. Figure WF-1 Wildfire Ignitions shows the fire locations from 2008-2019 for fire locations of fires managed by ODF, and it shows fire locations with the cause of the fire (e.g. human or lightning). The cause of the fire is shown in a graph of lightning and human starts per year; there is also a table showing several statistics.

Development

The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element and can sweep through vegetation that is adjacent to a combustible home. New residents in remote locations are often surprised to learn that in moving away from urban areas, they have left behind readily available fire services providing structural protection. Rural locations may be more difficult to access and or simply take more time for fire protection services to get there. There is general observation, and BLM staff concur, that wildland and WUI fires are increasing in severity and size.[15] Looking at the future climate projections described in the *2020 Oregon NHMP*, it is likely these situations are exacerbated by changes in the climate. In the Severe Storms Hazard Annex, see Tables SS-1 and SS-2 which shows the Corvallis average annual precipitation and Tables SS-3 and SS-4 which shows the same information for Eugene. Corvallis is 35 miles and Eugene is 45 miles from Sweet Home. Note that a low mean annual precipitation contributes to wildfire impacts and other natural hazards impacts.

History of Wildfire Sweet Home and Linn County

The following is excerpted from the *2007 Linn County CWPP*.

> The Linn County Natural Hazard Mitigation Plan defines wildfire as an uncontrolled burning of wildlands (forest, brush, or grassland). Although fire is a natural part of forest and grassland ecosystems in Linn County, wildfire can pose a significant risk to life and property in Wildland Urban Interface (WUI) areas. The WUI is the "borderlands" at the edges of urban development, where homes and other structures are built into a forested or natural landscape. If left unchecked, fires in these areas can threaten lives and property.
>
> Over 900,000 acres, or nearly 65% of Linn County, is forested.4 These forested lands play a critical role in the economic, environmental, and social vitality of the County. Wildfire poses a serious threat to economic activity, recreation, life, and property in forested areas. Thirty-five percent of Linn County's population resides outside of cities. Wildfire poses a threat to rural communities, rural residential areas, and other rural home sites located throughout the County.

[15] Al Crouch, BLM, personal communication, March 4, 2019.

Linn County's climate is characterized by warm dry summers. During the summer fire season, the danger of fire in the County's forests and grasslands increases as vegetation dries and increases the potential for fire ignition and spread. The forest lands in eastern Linn County are subject to small to moderate fires annually, but the increase in ladder fuels—in other words, places where grasses and shrubs act the first rung of the 'ladder,' smaller trees and outbuildings create the next rung, and the tree canopy creates the top rung--coupled with the increase in potential ignition sources from WUI development results in the potential for larger, more devastating wildfires.

The *2007 Linn County CWPP* identifies risk reduction activities and takes into consideration the County's diverse geography, population, and land management authorities. The plan identifies general areas with high wildfire risk and provides a framework of technical support and guidance that can assist local communities in developing and refining their own Community Wildfire Protection Plans and risk assessments. The *2007 Linn County CWPP* does not have authority over incorporated communities within the County, but seeks to develop strategies for sharing information and resources between the County and local communities.[16]

Areas in Oregon that contain large tracts of ponderosa pine and mixed conifer forests are highly vulnerable to wildfire because of natural aridity and the frequency of lightning strikes. Grasslands and brush lands also are problematic. The ecosystems of most forest and wildlands depend upon fire to maintain functions. The effects of fire on ecosystem resources can include damages, benefits, or some combination of both. The benefits can include, depending upon location and other circumstances, reduced fuel load, disposal of slash and thinned tree stands, increased forage plant production, and improved wildlife habitats, hydrological processes, and aesthetic environments. Despite the benefits, fire has historically been suppressed for years because of its effects on forestlands, rangelands, grasslands, recreation areas, agricultural operations, and the significant threat to property and human life. Recognizing the economic, human, and environmental impacts, federal agencies have typically sought to alleviate fire-related problems through a controlled burning program.

Knowing the fire history of a place is important to understand the fire environment of the area. Knowing where and why fires start is one of the first steps in prevention and mitigation efforts. Understanding the burn probability, the hazard to potential structures, the fire intensity and flame length, and the sub-watershed level for context, provides comprehensive information for decision-making about wildfire prevention and mitigation. Viewing local fire starts in conjunction with burn probability provides a comprehensive view of local fire history and potential. Statewide, 71% of fires recorded by ODF are human-caused, and many of these fires are near populated areas. Lightning caused fires make up only 29% of fire starts; they tend to burn more acres because they are often located in remote areas.[17]

See Figure WF-1 for fire start data for Linn County from 2008-2019.

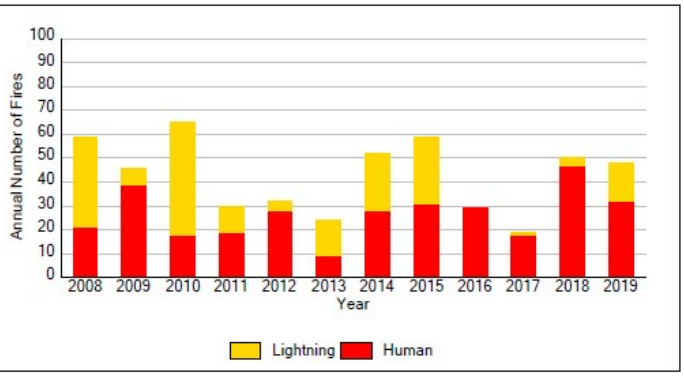
[16] 2007 Linn County CWPP, file:///J|/Shared/Scholars%20bank%20local%20docs/County/Hazard%20mitigation%20plans/Linn_County_Wildfire_Plan_Appendices.pdf (uoregon.edu)

[17] Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

Figure WF-1 Fire Starts Linn County 2008-2019

Linn County fire starts between 2008-2019

Total Acres Burned	14,932
Total Number of Fires	513
Average Acres Burned Per Year	1,493
Average Fires Per Year	51
Percent Lightning Caused	37.8%
Percent Human Caused	62.2%



Source: Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

A list of fires in Sweet Home and Linn County is included in Table WF-2.

Table WF-2 Significant Historic Wildfires in Sweet Home and Linn County

Date	Location	Description
2000	Linn County, OR	The Laslow Fire burned 3 acres.
2002	Linn County, OR	The Lucky Fire burned 81 acres.
2002	Linn County, OR	The Mount Marion Fire burned 29,168 acres.
2002	Linn County, OR	The Undefined Fire burned 40,704 acres.
2003	Linn County, OR	The B&B Complex Fire burned 90,872 acres.
2006	Linn County, OR	The Middle Fork Fire burned 1,072 acres.
2006	Linn County, OR	The Lake George Fire burned 5,571 acres.
2006	Linn County, OR	The Puzzle Fire burned 6,408 acres.
2009	Linn County, OR	The Canal Creek Fire burned 271 acres.
2010	Linn County, OR	The Scott Mountain Fire burned 3,454 acres.

Date	Location	Description
2011	Linn County, OR	The Shadow Lake Fire burned 10,025 acres.
2014	Linn County, OR	The Bingham Ridge Fire burned 394 acres.
2015	Linn County, OR	The 285 Kinney Fire burned 15 acres.
2015	Linn County, OR	The 208 SRZ Marion Fire burned 123 acres.
2016	Linn County, OR	The MR068 Blue Top Fire burned 50 acres.
2017	Linn County, OR	The Potato Hill Fire burned 194 acres.
2017	Linn County, OR	The Whitewater Fire burned 11,513 acres.
Sep. – Nov. 2017	Columbia Gorge, 1 mile south of Cascade Locks	FM-5203. Eagle Creek Fire. The Eagle Creek Fire was reported September 2 at approximately 4 pm in the Columbia River Gorge National Scenic Area near the town of Cascade Locks, Oregon. The fire grew to 3,000 acres overnight that first night. During the night of September 4th and 5th, east winds, combined with excessive heat caused the fire rapidly increase in size pushing westward. Total acres burned is 48,831. (100% contained on 12/1/17)
June 2018	Four miles south of the Metolius River near Culver, OR	FM-5243. Graham Fire The Graham Fire was a wildfire four miles south of the Metolius River near Culver, OR. The fire was caused by a lightning strike and was first reported on 6/21/18. It was one of 70 started over a two-day period of dry conditions and heavy winds in Central Oregon. The fire was contained on 6/27/18 and burned 2,175 acres.
Sep. 2020	East of Eugene/Springfield, OR	FM-5357. Declaration made on 9/8/20. The fire covered 173,393 acres. The fire is listed as 96% contained as of 10/12/20.
Sep. 2020	11 counties in Oregon	EM-3542. Oregon Wildfires. Declaration issued 9/10/20. Declaration includes Linn County and 10 other counties. All are designated for Public Assistance Category B. The cause of the fire is unknown.
Sep. 2020 & continuing	20 counties in Oregon	DR-4562. Oregon Wildfires and Straight-Line Winds. Linn County has Individual Assistance (IA) and Public Assistance (PA), categories A-G. Declaration issued 9/15/20 for 20 counties.
Sep. 2020	Near Sweet Home, OR	On 9/11/20 the Sweet Home Fire District was called to West Brush Creek Road for a fire along the road and in the trees. The fire was 15 acres. The fire was contained by ODF and nearby fire crews. The cause of the fire is under investigation said the Linn County Sheriff's Office.
Sep. – Nov 2020	½ mile southeast of Estacada, OR	The Riverside Fire started 9/8/20. The northern perimeter Is a half mile southeast of Estacada, OR. The human-caused fire covered 138,054 acres. A Level 1 evacuation level was issued for this fire. The containment date is 10/31/20 with the fire 72% contained.
Aug. – Oct. 2020	2 miles south of the Jaw Bone Flats area of Opal Creek Wilderness, OR	The Beachie Fire was first detected 8/16/20 about 2 miles south of the Jaw Bone Flats area of Opal Creek Wilderness. The fire covered 193,573 acres and the cause is unknown. As of 10/22/20 the fire is 100% contained and no longer being monitored.
June 2021 & continuing	Deschutes County, OR	FM 5394: The Oregon 0419 Fire started 6/29/21 in Deschutes County.
July 2021 & continuing	Klamath and Lake Counties, OR	FM 5396: The Bootleg Fire started 7/10/21 and is over 400,000 acres in size in Klamath and Lake Counties.

Sources: DLCD, Oregon NHMP, 2020; FEMA, Disaster Declarations for Oregon, retrieved 2019, 2020, and 2021 www.fema.gov/disaster; InciWeb for Riverside Fire https://inciweb.nwcg.gov/incident/7174/; InciWeb for Beachie Fire https://inciweb.nwcg.gov/incident/7001/; InciWeb for Holiday Farm Fire https://inciweb.nwcg.gov/incident/7170/; West Brush Creek Road https://www.statesmanjournal.com/story/news/2020/09/11/oregon-wildfires-beachie-creek-and-riverside-megafires-canby-molalla-scotts-mills-silver-falls/3466813001/; Graham Fire https://en.wikipedia.org/wiki/Graham_Fire; Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

In looking through the history of wildfires in Oregon, there are numerous examples of large and impactful fires. The Long Draw Fire, the Miller Homestead Fire, and the Holloway Fire occurred in 2012 and did not occur in Linn County. They are described here in recognition of how fires can impact an area within the county of origin and outside of it. Two large fires, Barry Point and Lava, occurred in 2012 in Lake County; both were lightning ignited. They burned more than 114,000 acres combined. They are also described here. The 2002 fire season in Oregon included three significant fires which in total burned 110,000 acres. These fires - the Winter Rim, Silver and Toolbox were located in the Silver Lake Ranger District in Lake County. In 2007, the Egley Fire Complex (FM-2712) burned 140,360 acres from July 8 through July 25. It was started by lightning; threatened Hines and Burns. The 2020 wildfire season in Oregon was the worst ever, a description in included below.

Long Draw Fire (July 2012): This lightning caused wildfire ignited on July 14, 2012 and burned 582,313 acres primarily within Malheur County, but also affecting Nevada and an area south of Burns Junction in Harney County.[18] It did not burn in Linn County but it is included here as an example. The fire spread to more than 200,000 acres in one day making it the third biggest fire in Oregon history at that time. Five crews, five helicopters, 29 engines, seven dozers, thirteen water tenders and 505 personnel were deployed to fight this fire. The fire destroyed range buildings, scorched much-needed grass and destroyed cattle on the perimeter of the fire. It hopped U.S. 95, took out a power line and moved east into the Owyhee Canyon.[19]

Miller Homestead Fire (started July 2012): This lightning caused wildfire started on July 8th and burned approximately 160,850 acres near Frenchglen.[20] More than 450 personnel, including a dedicated structure protection division were deployed to this event. This was the largest Oregon wildfire since 2007, at that time, and the fire threatened the community of Frenchglen and the residents around Harney Lake. In response to this fire event, the Oregon Cattlemen's Association set up a relief fund to aid ranchers affected by the fire; ranchers lost cattle threatening their short- and long-term income potential[21].

Holloway Fire (August 2012): The Holloway Fire, this lightning caused fire ignited on August 5, 2012 and originated 25 miles east of Denio, Nevada and burned approximately 75,000 acres within Harney County (461,047 acres total). Thirteen crews, four helicopters, 69 engines, 27 dozers, 16 water tenders and 826 personnel were deployed to fight this fire.

Lava Fire (July 2012): This lightning caused wildfire ignited on July 23, 2012 north of Christmas Valley and 15 miles northeast of Fort Rock. The fire burned 21,546 acres primarily within Lake County.[22]

18 Capital Press, *Bigger Wildfires Ahead, Researchers Warn*, https://www.capitalpress.com/state/oregon/bigger-wildfires-ahead-researchers-warn/article_8abe005a-cbf7-5528-b153-84b3dbae01a9.html, accessed 7/3/19.

19 InciWeb: Incident Information System, *Long Draw Fire Information*, http://inciweb.nwcg.gov/photos/ORVAD/2012-07-11-08:03-long-draw/related_files/ftp-20120716-100631.pdf, accessed March 26, 2013. Link broken.

20 Oregon Live, *Miller Homestead fire: Evacuation risk lowered in Frenchglen, Harney Lake*, https://www.oregonlive.com/pacific-northwest-news/2012/07/miller_homestead_fire_evacuati.html,

accessed February 2013.

21 InciWeb: *Incident Information System, Cattlemen Launch Fire Relief Effort,* http://www.inciweb.org/incident/article/3003/15198/, accessed March 26, 2013, link broken.

22 Inciweb: Incident Information System http://www.inciweb.org/incident/3064/

Barry Point Fire (August 2012): This lightning caused wildfire ignited on August 6, 2012 twenty-two miles southwest of Lakeview and burned 93,071 acres primarily within Lake County, though it stretched into California.[23] In Lake County, fire primary burned federal land (43,225 acres) though it also burned 11,452 acres of private land.[24] The fire required the mandatory evacuation of over 20 residences,[25] with nearly 1,300 people on the fire lines.[26] The image in Figure WF-3 shows firefighters from the Baker River Hot Shots conducting burnout operations around a structure on the edge of the Fremont-Winema National Forest.

2020 Oregon Wildfire Season: During 2020, wildfires burned over 1.2 million acres in Oregon and destroyed 4,000 homes. Nine civilians and two firefighters lost their lives. 2020 was the most destructive wildfire season in Oregon in history. Figure WF-2 provides a visual of wildfire history from ODF with several statistics for 2020 highlighted.

According to ODF's *2020 Fire Season* document[27], much of the state was in severe drought from spring onward. Numerous wildfires broke out in a very dry southern Oregon in April, leading Southwest Oregon to declare the start of fire season on May 1, which is a month earlier than usual. During the summer, human-caused wildfires were up slightly but fewer lightning-caused fires occurred until mid-August. In August, there were five days of lightning across the state. Fires started by those lightning strikes were fanned by winds and high temperatures into large blazes.

On August 19, 2020 Governor Brown declared a statewide State of Emergency. This made available the Oregon National Guard for firefighting, including personnel and equipment. On September 7, 2020, against a backdrop of drought and historically low fuel moistures and humidity, a high wind warning was issued. A strong cold front arrived in the early evening, with east-northeast winds at sustained speeds of 20 to 30 miles per hour (mph) and gusts to 50 to 60 mph. This was the strongest three-day easterly wind event during fire season since at least 1950 (winds were stronger in the 1962 Columbus Day storm, but that hit after fire season).

There were 14 fires from the Labor Day wind event that would be approved as a FEMA FMAG fire. Five fires in the Cascade Mountains soon spread west to become megafires (over 100,000 acres), almost as many as occurred in Oregon in the entire 20th century. All five of these fires moved into Oregon's top 20 wildfires by size since 1900. Firefighting personnel and equipment poured into Oregon from more than 30 different U.S. states and Canada, peaking at about 7,500. The Labor Day wildfires were mostly contained by late September or October 2020.

23 Capital Press "Bigger wildfires ahead, researchers warn http://www.capitalpress.com/newsletter/ml-wildfire-restoration-073112-art-w-graph-w-side Accessed February 2013

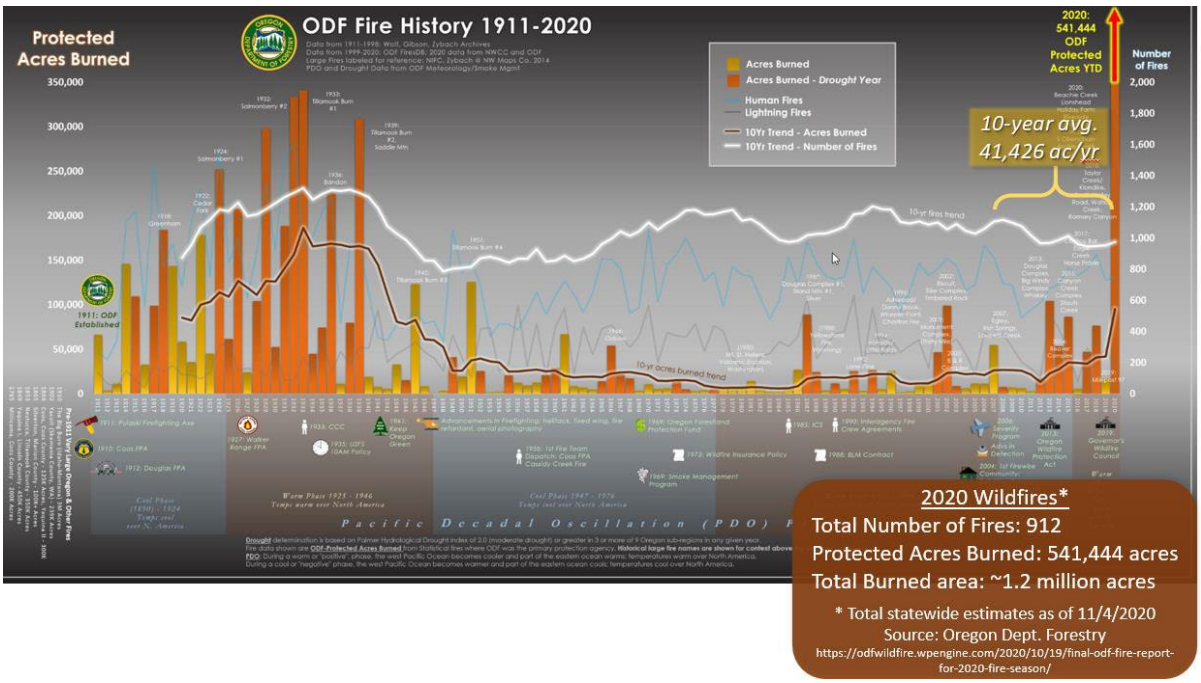
24 Inciweb: Incident Information System http://www.inciweb.org/incident/3105/

25 Oregon Live "Wildfire roundup…" August 2012 http://www.oregonlive.com/pacific-northwest-news/index.ssf/2012/08/wildfire_roundup_lightning_sat.html

26 Oregon Live "Lightning ignites two new fire in Oregon, Washington" August 2012 http://www.oregonlive.com/pacific-northwest-news/index.ssf/2012/08/lightning_ignites_two_new_fire.html

27 Teresa Zena Alcock (TZA), ODF, personal communication, 3/30/21. TZA provided the *2020 Fire Season* document which is in draft form and not yet published.

Figure WF-2 ODF Fire History 1911-2020



Source: Celinda Adair, DLCD, Oregon State NFIP Coordinator, March 4, 2021 presentation "2020 Oregon Wildfires: Post-Wildfire Floodplain Management," part of the National Flood Services Expert Series Webinars

Figure WF-3 Firefighters Performing Structure Protection Burnout Operation

Source: Kevin Abel, BLM Lakeview District

Risk Assessment

Wildfire risk combines the likelihood of a fire occurring with the exposure and susceptibility of valued resources and assets on the landscape.[28] Linn County has a Community Wildfire Protection Plan (CWPP) with the intention of addressing wildfires within the WUI boundaries and affecting the communities throughout the County. One purpose of the CWPP is for communities to take

[28] Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27d/21

advantage of opportunities offered under the Healthy Forests Restoration Act of 2003 (HFRA) legislation.

The *Linn County CWPP* encourage citizens to take an active role in identifying needs, developing strategies, and implementing solutions to address wildfire risk by assisting with the development of local community wildfire plans and participating in countywide fire prevention activities.

Human life and welfare are values at risk to wildfire because of the buildup of hazardous fuels around communities and structures, poor emergency vehicle ingress and egress, a large area to cover with the fire authorities, and inadequately trained and/or equipped fire suppression authorities. Throughout Linn County, there are scattered small communities and ranches with houses and out-buildings without structural fire protection because they are outside the fire protection districts and municipal fire departments. Economic values at risk include businesses, farmland, ranchland, grazing land, hunting and other recreational land, historic and cultural sites, and critical infrastructure.

Linn County has mitigation actions for wildfire in the 2007 *Linn County CWPP*. The CWPP lists mitigation actions that communities and the County can implement to reduce the risk of fires on communities. This NHMP will be an additional tool to mitigate wildfires as it too has mitigation actions; it strives to incorporate CWPP and NHMP information to ensure consistency between plans. The *2021 Sweet Home NHMP* has wildfire-specific mitigation actions that the Sweet Home NHMP Steering Committee has adopted. See Table 3-1, 2021 Sweet Home NHMP Mitigation Actions. The CWPP is included in this NHMP in Appendix G.

The Healthy Forests Restoration Act of 2003 (HFRA) provides the impetus for wildfire risk assessment and planning at the county and community level. The HFRA refers to this level of planning as Community Wildfire Protection Plans (CWPP). The minimum requirements for a CWPP as described in the HFRA are:

- Collaboration: A CWPP must be collaboratively developed by local and state government representatives, in consultation with federal agencies and other interested parties. Prioritized Fuel Reduction: A CWPP must identify and prioritize areas for hazardous fuel reduction treatments and recommend the types and methods of treatment that will protect one or more at-risk communities and essential infrastructure.
- Treatment of Structural Ignitability: A CWPP must recommend measures that homeowners and communities can take to reduce the ignitability of structures throughout the area addressed by the plan.[29]

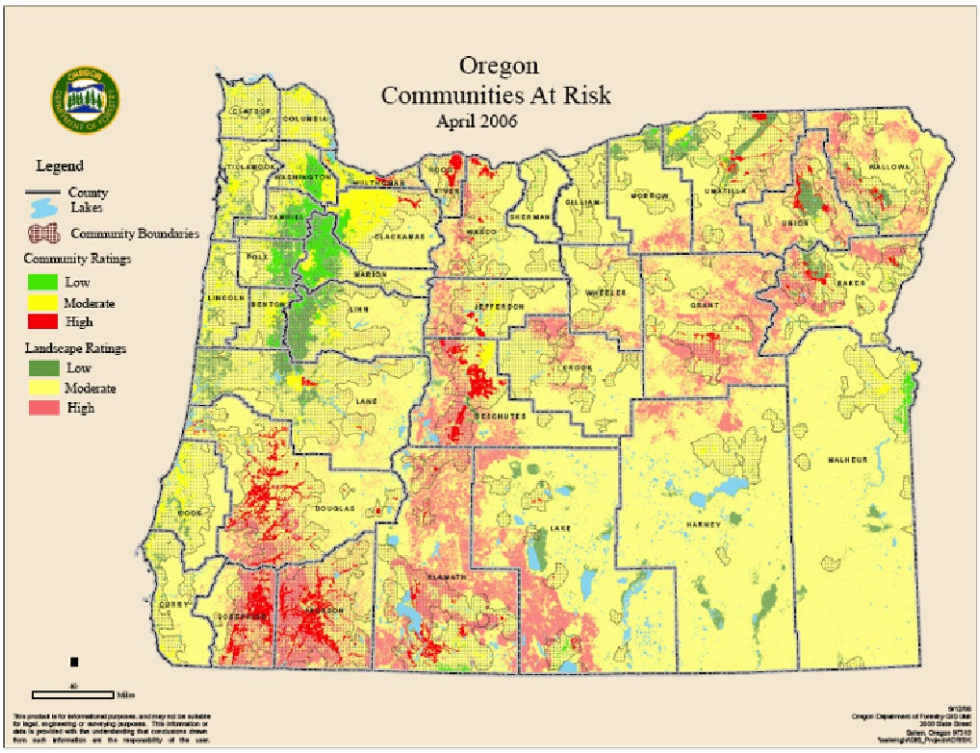
A community at risk is a geographic area within and surrounding permanent dwellings (at least one home per 40 acres) with basic infrastructure and services, under a common fire protection jurisdiction, government, or tribal trust or allotment, for which there is a significant threat due to wildfire. A statewide *Communities at Risk* map was created in 2006 to identify and assess communities at risk of wildfire in the state of Oregon; the map is used to establish wildland urban interface (WUI) boundaries in the absence of a CWPP.

According to *Oregon's Communities at Risk Assessment, "*A Community at Risk includes the geographic area within and surrounding the populated areas - adjacent landscapes that contain vegetation creating a risk to the community, generally a sixth field watershed, and municipal watersheds. It is based upon a "fire shed" concept, including the area surrounding the community

[29] *2011 Lake County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

where economic, social, cultural, and visual values important to the community exist, and where strategic fuel reduction planning needs to occur to protect the community from large catastrophic wildfires. The statewide process identified areas within two km of populated jurisdictions, as well as the adjacent sixth field watershed(s), not exceeding 8 km. NOTE: This is a significant change from the 2001 Community at Risk (CAR) map for Oregon, which primarily identified populated areas."[30]

Figure WF-4 Communities at Risk



Source: Oregon Department of Forestry, *Oregon's Communities at Risk Assessment*, September 12, 2006, http://library.state.or.us/repository/2007/200710150832491/index.pdf.

Hazard Risk Analysis

The Sweet Home NHMP Steering Committee completed a Hazard Vulnerability Assessment/Analysis (HVA) during this NHMP update. This was described in Section 2 Risk Assessment. The method used for the HVA was developed from a Federal Emergency Management Agency (FEMA) tool that has been refined by the Oregon Office of Emergency Management (OEM). It addresses and weights (shown as percent within parentheses) probability (29%), vulnerability (21%), maximum threat (42%) and the history (8%) of each natural hazard and attributes a final hazard analysis score. The methodology produces scores that range from 24 to 240.

For local governments, conducting the HVA is a useful step in planning for hazard mitigation. The method provides the jurisdiction with a relative ranking from which to prioritize mitigation actions, but does not predict the occurrence of a particular hazard.

[30] ODF, *Oregon's Communities at Risk Assessment*, September 12, 2006, http://library.state.or.us/repository/2007/200710150832491/index.pdf.

Wildfire was ranked fourth in the *2015 Umatilla County NHMP*. In the *2021 Sweet Home NHMP* it is ranked second out of seven natural hazards.

For more information on all the risk scores and ranks of the natural hazards, see Volume I Basic Plan, Section 2 Risk Assessment of this NHMP.

Probability Assessment

In Oregon, wildfires are inevitable. Although usually thought of as being a summer occurrence, wildfires can occur during any month of the year. The vast majority of wildfires burn during June to October time period. Dry spells during the winter months, especially when combined with winds and dead fuels, may result in fires that burn with intensity and a rate of spread that surprises many people. Wildfire risk to human welfare and economic and ecological values is more serious today than in the past because of the buildup of hazardous fuels, construction of houses in proximity to forests and rangelands, increased outdoor recreation, and a lack of public appreciation of wildfire.[31]

The natural ignition of forest fires is largely a function of weather and fuel; human-caused fires add another dimension to the probability. Dry and diseased forests can be mapped accurately and some statement can be made about the probability of lightning strikes. Each forest is different and consequently has different probability and recurrence estimates.

Figure WF-1 Wildfire Ignitions shows the fire locations from 2008-2019 for fires managed by ODF. It also shows a graph of fire starts categorized as lightning caused or human caused. A table of other statistics is included. It is interesting to compare this to Figure WF-x, the Sweet Home Wildland Urban Interface map, and Figures WF-9 and WF-10, which are the Wildland Urban Interface Risk and Hazards maps from the *2007 Linn County Community Wildfire Protection Plan*.

Wildfire has always been a part of these ecosystems. The intensity and behavior of wildfire depends on a number of factors including fuel, topography, weather, and density of development. Strategies to reduce the negative impacts of wildfire include: land-use regulations, management techniques, site standards, building codes, and state level legislation (e.g. the Oregon Forestland-Urban Interface Fire Protection Act of 1997, HFRA in 2003, etc.). All of these strategies have a bearing on a community's ability to prevent, withstand, and recover from a wildfire event.

Vulnerability Assessment

As was discussed earlier, each year a significant number of people build homes within or on the edge of the forest (WUI), thereby increasing wildfire hazards. Many Oregon communities (incorporated and unincorporated) are within or abut areas subject to serious wildfire hazards, complicating firefighting efforts and significantly increasing the cost of fire suppression.

Each forest is different and consequently has different probability/recurrence estimates. As population growth continues to expand and development increases in the WUI, the threat to life and property increases and ultimately, greater losses to are likely to result. The level of risk from wildfire can be determined through the comparison of the overlap of hazard and exposure.

[31] ODF, *Oregon's Communities at Risk Assessment*, September 12, 2006, http://library.state.or.us/repository/2007/200710150832491/index.pdf.

In the *2007 Linn County CWPP*, it describes that historic wildfire regimes helped to shape the forest landscape of Linn County.

> Natural cycles of fire disturbance influence all facets of ecosystem dynamics, from structure and composition to wildlife habitat and nutrient cycling. Fire suppression, timber harvesting, the introduction of exotic species, and other human factors have disturbed natural fire cycles. West of the Cascade Mountains, fire frequency and severity depend upon environmental variables, such as
> temperature, moisture, ignitions, and broad, fire-driving winds.
>
> Linn County is composed of two distinct ecoregions with differing vegetative, geographic, and fire regime characteristics.7 These ecoregions are described below:
>
> • Willamette Valley: The Valley landforms include floodplains and terraces that are interlaced with surrounding rolling hills. The natural vegetation includes Cottonwood, Alder, Oregon Ash, and Big Leaf Maple. Douglas Fir and Western Red Cedar occur in moister areas. The Valley has lower precipitation, warmer temperatures, and fire regimes of higher frequency and lower severity than the adjacent Cascade Range.
>
> • Western Cascades: This ecoregion is characterized by ridge crests at similar elevations, separated by steep valleys. The natural vegetation consists of forests of Douglas Fir and Western Hemlock at lower elevations and Silver Fir and Mountain Hemlock at higher elevations.
>
> Throughout Linn County, Douglas Fir and Western Hemlock are the predominant forest types. Fire regimes in moist Douglas-fir habitat types are mixed, ranging from low to moderate severity surface fires at relatively frequent intervals (7 to 20 years) to severe crown fires at long intervals (50 to 400 years). Significant annual precipitation and low occurrence of lightning throughout much of Linn County contribute to a low probability of natural fire ignitions in many areas. However, once ignited, the high vegetative fuel loads are vulnerable to catastrophic fires - those that "burn more intensely than the natural or historical range of variability, thereby fundamentally changing the ecosystem, destroying communities.[32]

For more information on fire regimes, risks, and other details, read the *2007 Linn County CWPP*. Using the *Linn County CWPPs* in addition to other information provides a blend of wildfire information in this NHMP from the past, present, and future.

Community Hazard Issues

What is susceptible to damage during a hazard event?

Air Quality

Air Quality is a concern for residents of Sweet Home and other areas of Linn County due to cold air inversions (capping inversions) and wildfires that occur primarily during summer months. In the

[32] *2007 Linn County CWPP*

past, the sources of air pollution in the region included field burning, vehicle emissions, industry and residential wood stoves, which emit particulate matter and carbon monoxide. Substantial efforts have been made to reduce these emissions. More recently, concerns for air quality arise when smoke from regional wildfires either blows through or becomes trapped during inversions. Wood stove, industrial, and motor vehicle emissions also continue to be a source of air (and other types of) pollution.

Threat to Life and Property

As has been described, there is a lot of exposure to life and property from wildfire. In many cases, existing fire protection services cannot adequately protect new development. Wildfires that also involve structures present complex and dangerous situations. Knowing the landownership and management is important for hazard planning and for awareness when wildfires occur.

The total land base in Oregon is approximately 63 million acres, or just over 98,000 square miles. Linn County contains 1, 475,502Acres: (2,305 Sq. Miles). Within the entire state, the US Forest Service (USFS) manages just over 17 million acres, and US Bureau of Land Management (BLM) manages nearly 16 million acres; together they manage about 52% of the total land base. Other landownership and management types include other federal lands (e.g. US Fish and Wildlife Service [USFWS]), state, tribal, and private. Of the nearly 30 million acres of forestland in Oregon, approximately 18 million is federal, 10 million is private, 1 million is state, and 475,000 acres are tribal. Many forested areas in Oregon are private, owned and managed for industrial timber and in small family farms and woodlands.[33]

In Linn County, 60% of the land is privately owned. The federal government owns 39% of the land within Linn County, while the state of Oregon owns 2%. The largest agency with authority over federal land is the U.S. Forest Service (USFS) with 31%. Tribal ownership is less than 1%. See Figure WF-5 and Figure WF-6 for graphics about land ownership within Linn County.[34]

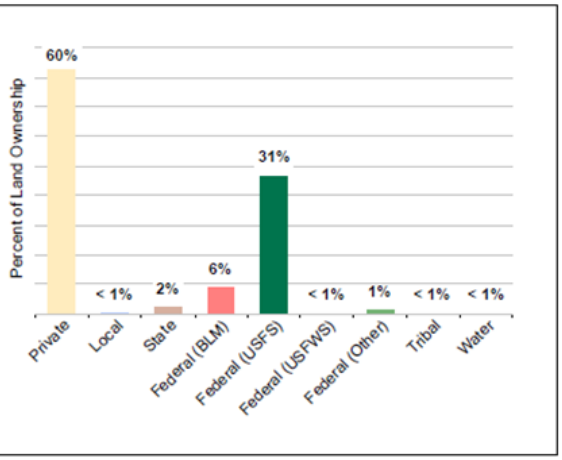
[33] Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

[34] Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

Figure WF-5 Land Ownership and Management in Linn County, OR

Linn County

	Major Landowner/Manager	Acres
	Private	890,242
	Local	1,209
	State	22,668
	Bureau of Land Management (BLM)	87,039
	US Forest Service (USFS)	462,508
	US Fish & Wildlife (USFWS)	375
	Other Federal	10,766
	Tribal	4
	Water	691



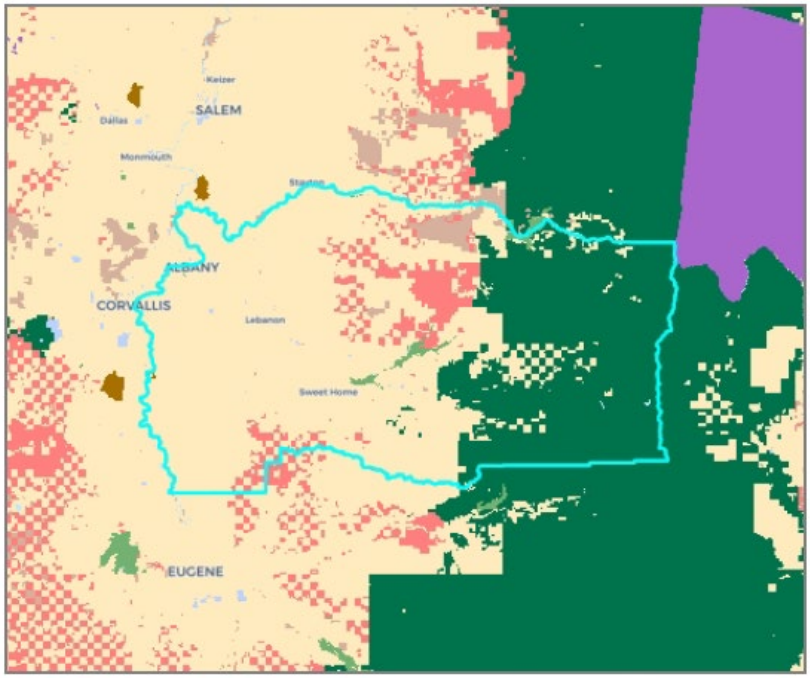
Source: Bureau of Land Management, 2015

** Values may add up to over 100% due to rounding precision*

Source: Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

Figure WF-6 Landownership in Linn County, OR

Use landownership color code shown in Figure WF-5.



Source: Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

Personal Choices and Private Lands

Many interface areas, found at lower elevations and drier sites, are also desirable real estate. More people in Oregon are becoming vulnerable to wildfire by choosing to live in wildfire-prone areas.[35]

Private development in Linn County located outside of rural fire districts where structural fire protection is not provided is at risk. In certain areas fire trucks cannot negotiate steep grades, poor road surfaces, narrow roads, flammable or inadequately designed bridges, or traffic attempting to evacuate the area. Little water during the fire season, and severe fuel loading problems add to the problem. In some areas, current protection resources are stretched thin, thus both property in the interface and traditionally protected property in the forests and cities are at greater risk from fire.

While the Firewise program has increased knowledge of fire risk, many property owners in the wildland-urban interface are not aware of the problems and threats that they face, and owners in some areas have done little to manage or offset fire hazards or risks on their own property.

The importance of development in wildfire prone areas is aptly described here, excerpted from a BLM Summary Profile for another county in Oregon (not Linn).

> ”The conversion of open space and agricultural land to residential development has occurred at a rapid pace in many parts of the U.S. The popularity of exurban lot sizes in much of the country has exacerbated this trend. (Low-density development results in a larger area of land converted to residential development). The pattern of development can reflect a number of factors, including demographic trends, the increasingly "footloose" nature of economic activity, the availability and price of land, and preferences for homes on larger lots. Locations with a large percent change in the area of residential development often have experienced significant in-migration from more urbanized areas. Counties with a small percent change either experienced little growth or were already highly urbanized in 2000.
>
> Development of homes adjacent to fire-prone federal public lands poses several challenges including the rising cost of protecting homes from wildfires; increased danger to wildland firefighters; and the consumption of funds that might otherwise be used for restoration, recreation, research, and other activities. When protecting homes is a priority, agencies are unable to allow otherwise beneficial fires to burn, even those that could reduce fuel loads.”[36]

Of the nearly 1.7 million homes in Oregon, over 603,000, or 36%, are in the WUI.[37] In looking at the WUI developed areas in Linn County, further analysis can be made to see where the areas are that are low, moderate, and high hazard in the WUI and what amount of land there is of each. We can also look at the housing density in Linn County. The map and table in Figure WF-7 and Table WF-3 show the location and density of where people live in Linn County.

[35] National Wildland/Urban Interface Fire Protection Program, *Fire protection in the Wildland/Urban Interface: Everyone’s responsibility*, http://www.geosci.sfsu.edu/Geosciences/classes/e360/OaklandHillsFire/www.firewise.org/pubs/everyones_resp/pdf/resp.pdf

[36] BLM Summary Profile, *Umatilla County, OR*, 5/26/20

[37] Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

Table WF-3 Housing Density in Linn County Per Acre

Linn County housing density

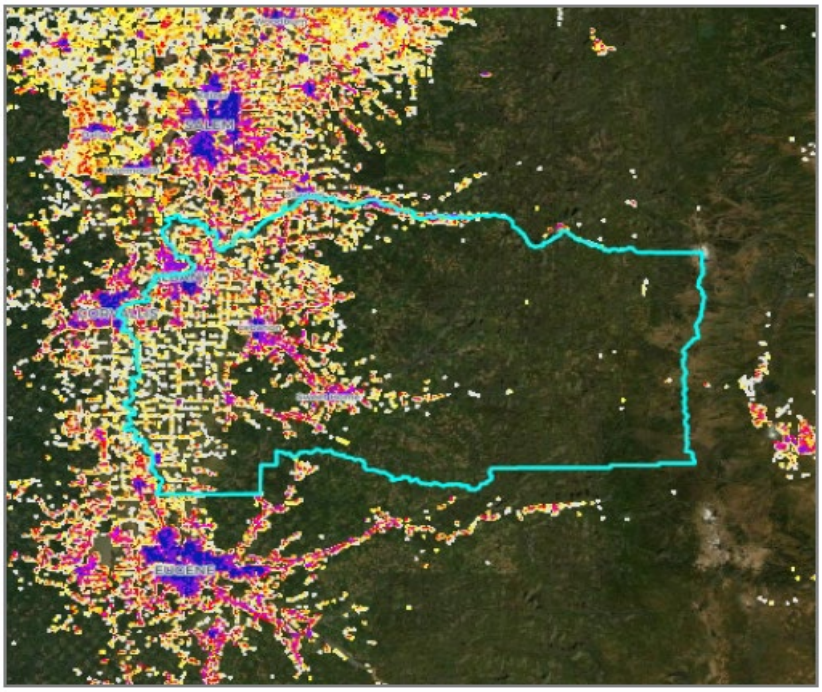
Category	Acres	%*
<1 house per 40 acres	45,160	3
1 per 40 acres to 1 per 20 acres	38,679	3
1 per 20 acres to 1 per 10 acres	34,799	2
1 per 10 acres to 1 per 5 acres	27,264	2
1 per 5 acres to 1 per 2 acres	20,129	1
1 per 2 acres to 3 per acres	13,733	< 1
> 3 per acres	3,917	< 1

Source: 2013 West Wide Wildfire Risk Assessment, ODF

** Values may add up to over 100% due to rounding precision*

Source: Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

Figure WF-7 Housing Density Map in Linn County



Source: Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

Table WF-4 Linn County Potential Impacts to People and Property

Linn County potential impact to people and property, if a wildfire were to occur.

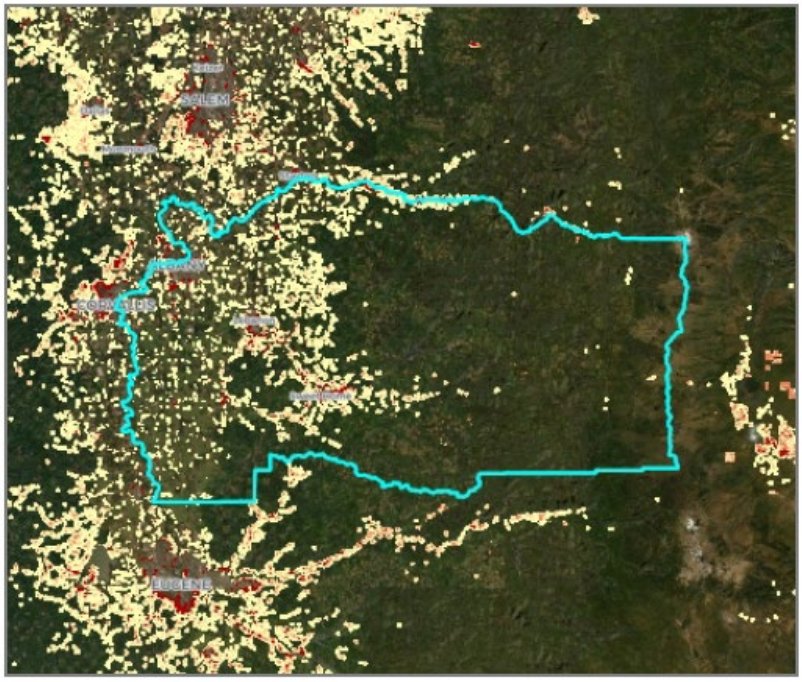
Category	Description	Acres	%*
Very High	Potential impact is very highly negative to people and property (top 5%).	2,679	< 1
High	Potential impact is highly negative (80-95th percentile).	3,273	< 1
Moderate	Potential impact is moderately negative (50-80th percentile).	14,233	< 1
Low	Potential impact is slightly negative (0-50th percentile).	42,664	3
No Data	There is no people and property mapped in the area or it is considered non-burnable (urban, agriculture, barren,etc).	1,412,646	96

Source: 2018 Pacific Northwest Quantitative Wildfire Risk Assessment, US Forest Service

** Values may add up to over 100% due to rounding precision*

Source: Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

Figure WF-8 Linn County Map of Potential Impacts to People and Property



Source: Oregon Wildfire Risk Explorer, *Linn County Advanced Report*, 7/27/21

Drought

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. Unusually dry winters and hot summers increase the likelihood of a wildfire event, and place importance on mitigating the impacts of wildfire before an event takes place. See the Drought Annex in this NHMP for more information about droughts.

Existing Hazard Mitigation Activities and Resources

Ordinances

People proposing to construct new buildings in Sweet Home and other cities in Linn County are given instructions from the appropriate fire district to ensure fire access for their structure. The instructions are not a binding ordinance, but are based on recommended state standards. Contact the respective jurisdiction with authority.

Zoning ordinances for Sweet Home can be found here: https://www.sweethomeor.gov/ced

State Natural Hazard Risk Assessment

The risk assessment in the *2020 Oregon Natural Hazards Mitigation Plan* provides an overview of wildfires risk in Oregon and identifies the most significant wildfires in Oregon's recorded history. It has overall state and regional information, and includes wildfire mitigation actions for the entire https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

Planning for Natural Hazards: Oregon Technical Resource Guide

This guide describes basic mitigation strategies and resources related to wildfires and other natural hazards, including examples from communities in Oregon.
https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

Emergency Operations Plans

This description is excerpted from the *2012 Sweet Home Emergency Operations Plan*.

The Emergency Operations Plan is an all-hazard plan that describes how the City of Sweet Home and Sweet Home Fire and Ambulance District, known as the Sweet Home Area, will organize and respond to emergencies and disasters in the community. It is based on, and is compatible with, Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including Presidential Policy Directive 8, the National Response Framework, State of Oregon Emergency Management Plan, and Linn County Emergency Operations Plan.

Response to emergency or disaster conditions in order to maximize the safety of the public and to minimize property damage is a primary responsibility of government. It is the goal of the Sweet Home Area that responses to such conditions are conducted in the most organized, efficient, and effective manner possible. To aid in accomplishing this goal, the Sweet Home Area has, in addition to promulgating this plan, informally adopted the principles of the National Incident Management System, including the Incident Command System and the National Response Framework.

Consisting of a Basic Plan, Functional Annexes aligned with the Linn County Emergency Support Functions, and Incident Annexes, this Emergency Operations Plan provides a framework for coordinated response and recovery activities during a large-scale emergency. The plan describes how various agencies and organizations in the City of Sweet Home and Sweet Home Fire and Ambulance District will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.

Existing Fire Authorities

Mutual Aid Agreements exist among the various fire authorities for support and help as needed. Each authority has its regulations and limitations, which dictates its fire management activity. In and around Sweet Home, there is the Sweet Home Fire and Ambulance District (SHFAD). SHFAD is a special district.

http://Sweethomefire.org

Federal and State Agencies

There are other existing fire suppression and management authorities within Linn County. The federal land management agencies (USFS, BLM, USFWS) all have wildland fire suppression responsibilities on their respective ownerships. The state, through ODF, provides wildland fire suppression on private and other public forestlands. There are fire protection districts, municipal fire departments, and rangeland fire protection associations.

Fire Protection Districts

Rural Fire Districts (RFD)

Rural Fire Districts in Oregon are formed under the Oregon State Fire Marshall and provide both structural and wildland fire protection. Rural fire districts currently promote fire safe education and other related outreach, as well as encourage landowners to observe Oregon Department of Forestry fire prevention practices.

Rangeland Fire Protection Associations (RFPA)

Rangeland Fire Protection Associations (RFPAs) provide wildfire protection of private rangeland within some counties in Oregon.[38] RFPAs (formed under ORS 477.315) protect over 3.2 million acres of private land in eastern Oregon with support from ODF. RFPAs operate as independent associations of landowners that provide their own protection with the support of the ODF (chiefly technical support for grants, grant writing, procurement of equipment and fire-fighting training)[39].

A statewide agreement between the Bureau of Land Management and Oregon exists. The ODF provides a small source of funding for the RFPAs, however, the majority of funds come from federal grants (primarily Volunteer Fire Assistance and Rural Fire Assistance). Additional fees are collected from voluntary membership dues. As noted above, BLM also supports the RFPAs.

The RFPA has a responsibility to protect private lands of members and non-members alike pursuant the agreement formed with ODF when the RFPA is created. These all-volunteer crews of ranchers have training and legal authority to respond to fires on private and state lands where there had been no existing fire protection, and can become authorized to respond on federal lands as well. Oregon has a robust network of 23 RFPAs covering over 16 million acres of rangeland.[40]

[38] Matt Hoehna, ODF, personal communication, 3/29/21

[39] Foster, Gordon. Oregon Department of Forestry, *Status of Rangeland Fire Protection Associations*, 2011, http://library.state.or.us/repository/2011/201112200820542/index.pdf, accessed March 2013 and January 2019.

[40] BLM, *Facts at Your Fingertips*, February 2019, https://www.blm.gov/sites/blm.gov/files/documents/files/facts-your-fingertips-feb-2019.pdf.

RFPAs are an increasingly popular model of community fire-based management. The RFFA model harnesses the benefits: members can respond quickly; members possess local knowledge; and members have a strong desire and culture around helping neighbors and protecting livelihoods.[41]

Oregon Department of Forestry (ODF)

ODF provides wildland fire protection to private and other public forestland within Linn County. ODF has connection with the RFPAs and agreements with the RFD's.

Linn County has worked with the Oregon Department of Forestry on Oregon Senate Bill 360 plan implementation to regulate existing and proposed non-resource zoned development in wildlands urban interface areas. The program is designed to promote defensible space and fire free areas around structures.

ODF's firefighting policy is to put out fires quickly at the smallest possible size. Most of the lands protected by the agency are working forests that produce revenue and support jobs. It is crucial to prevent fire damage to the timber resource that is an essential element of Oregon's economy. This aggressive approach to firefighting also safeguards ecosystem values such as fish and wildlife habitats (https://www.oregon.gov/odf/fire/pages/default.aspx).

According to the ODF website, under the About the Fire Program page,

> "As Oregon's largest fire department, ODF's Fire Protection program protects 16 million acres of forest, a $60 billion asset. These lands consist of privately owned forests as well as some public lands, including state-owned forests and, by contract, US Bureau of Land Management forests in western Oregon. ODF is also part of an extensive fire protection network that includes landowner resources, contract crews and aircraft, inmate crews, and agreements with public agencies across Oregon, the US and British Columbia."

U.S. Forest Service (USFS)

The USFS owns 31% of the federally owned land in Linn County.[42] The USFS has a fuel-loading program to assess fuels and reduce hazardous buildup on U.S. forestlands. The USFS is a cooperating agency and, it has an interest in preventing fires in the WUI, as fires often burn up the hills and into the higher elevation U.S. forestlands.

The USFS and other federal, tribal, state, and local government agencies work together to respond to tens of thousands of wildfires annually. Each year, an average of more than 73,000 wildfires burn about 7 million acres of federal, tribal, state, and private land and more than 2,600 structures[43].

The USFS recognizes the wildland fire management environment has profoundly changed. Longer fire seasons; bigger fires and more acres burned on average each year; more extreme fire behavior; and wildfire suppression operations in the WUI have become the norm. To address the challenges, the USFS and its federal, tribal, state, and local partners have developed and are implementing a

[41] Davis, Emily Jane "EJ," *Fire Adapted Communities on the Range: Why Rangeland Fire Protection Districts Matter*, June 21, 2018, https://fireadaptednetwork.org/fire-adapted-communities-on-the-range-why-rangeland-fire-protection-associations-matter/.

[42] Oregon Wildfire Risk Explorer, *Umatilla County Advanced Report*, 3/16/21

[43] USFS, *Wildland Fire*, https://www.fs.fed.us/managing-land/fire

National Cohesive Wildland Fire Management Strategy that has three key components: Resilient Landscapes, Fire Adapted Communities, and Safe and Effective Wildfire Response.[44]

https://www.fs.fed.us/managing-land/fire

Bureau of Land Management (BLM)

The Bureau of Land Management (BLM) is responsible for "managing public lands for a variety of uses such as energy development, livestock grazing, recreation, and timber harvesting while ensuring natural, cultural, and historic resources are maintained for present and future use." According to their website, the BLM manages 1/10 of the nation's surface area and 30% of the nation's mineral and soils (https://www.blm.gov/about/our-mission).

In Oregon, BLM is responsible for fire protection for all federal agencies. They also provide fire protection on Department of State Lands (DSL) land and on some Oregon State Parks' lands. BLM has a memorandum of agreement with Oregon to provide support to the Rangeland Fire Protection Associations (RFPA).[45]

There is a new program through the BLM, called the Rural Fire Readiness Program. It's a separate cooperative agreement that a RFPA can sign with BLM; it removes them from the statewide memorandum of agreement with Oregon. The cooperative agreement provides more money to the RFPAs for training and equipment.[46] See the descriptions of Rangeland Fire Protection Associations, Oregon Department of Forestry, and the US Forest Service for additional information.

Firewise

Related to wildfire risk, Sweet Home is not part of a formal Firewise program. The Firewise standards are promoted.[47] Sweet Home is part of the Linn County Community Wildfire Protection Plan as described earlier. Information about fires can be found in the CWPP, the 2021 Sweet Home NHMP, and the Linn County Emergency Management office. Currently the Emergency Manager position at Sweet Home is vacant.

Developed by the National Fire Protection Association, the Firewise program features templates to help communities to reduce risk and protect property from the dangers of wildland fires. Along with an interactive, resource rich website full of free materials, the program offers training throughout the nation on utilizing their program.

https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Regional-risks/Wildfire/Firewise-USA

Senate Bill 360

Linn County has worked with the Oregon Department of Forestry on Oregon Senate Bill 360 plan implementation to regulate existing and proposed non-resource zoned development in wild

[44] Ibid.

[45] Al Crouch, BLM, personal communication, March 4, 2019.

[46] Ibid.

[47] Matt Hoehna, ODF, personal communication, 3/29/21.

lands/urban interface areas. The program is designed to promote defensible space and fire free areas around structures.

Future Changing Conditions/ Climate Change

In the *2021 Sweet Home NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Sweet Home and to some extent, the surrounding areas. In the order of appearance in the NHMP: the Risk Assessment and the Hazards Annexes contain this information. Documents such as the DEQ *Oregon Air Quality Annual Reports* describe that with climate change we expect more fires in the Pacific Northwest and higher temperature days; resulting in more elevated ozone days.

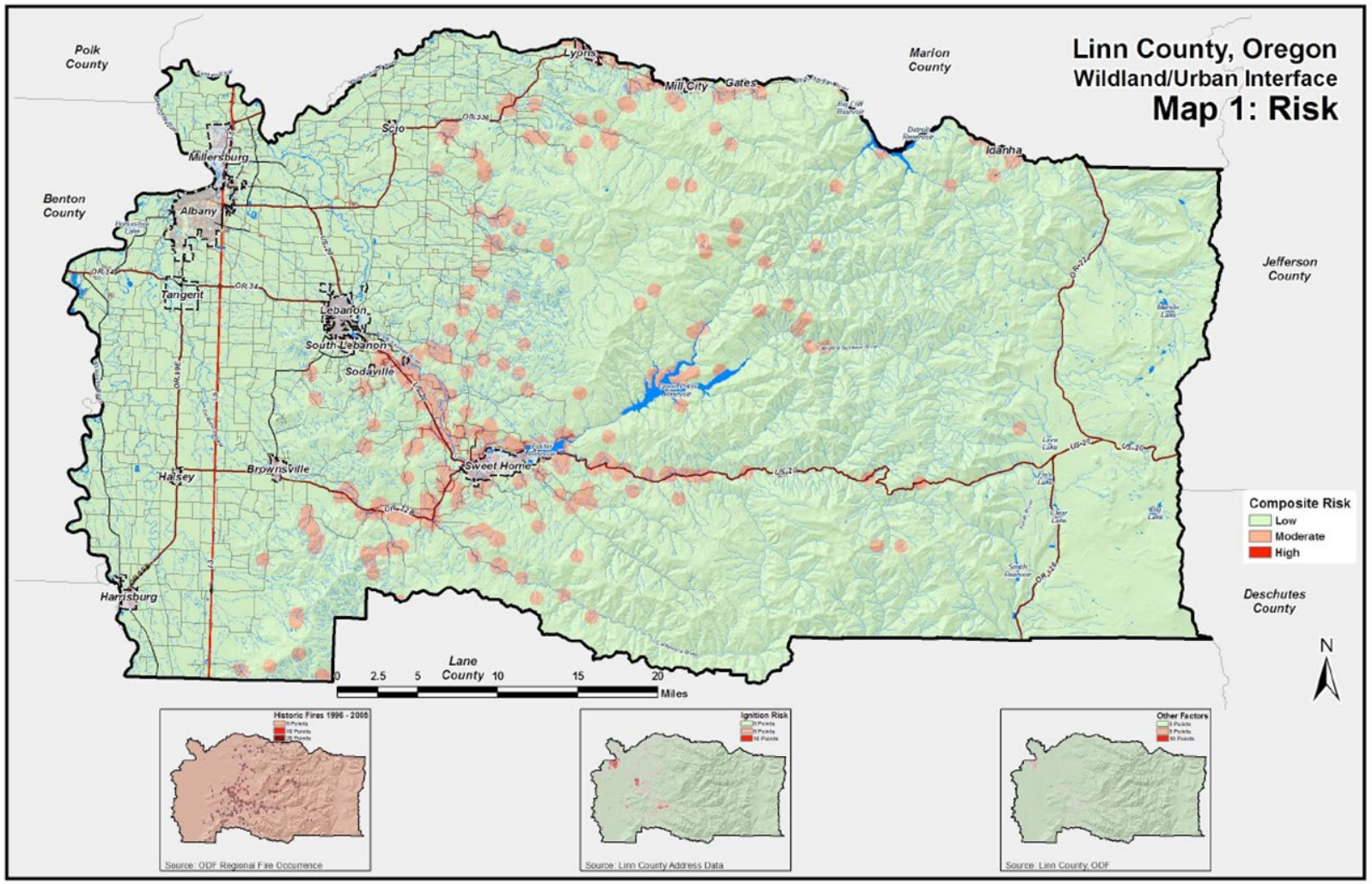
Wildfire Mitigation Actions

The wildfire (WF) mitigation actions have been identified by the Sweet Home NHMP Steering Committee. See Table 3-1, 2021 Sweet Home County NHMP Mitigation Actions.

The WF mitigation actions have a medium priority because the Hazard Vulnerability Assessment (HVA) resulted in WF having a medium risk level. The risk score for wildfire was the second highest out of the seven identified natural hazards. There are multi-hazard mitigation actions for the NHMP and several of those include wildfire related mitigation actions, in conjunction with the other hazards. The multi-hazard mitigation actions are a high priority.

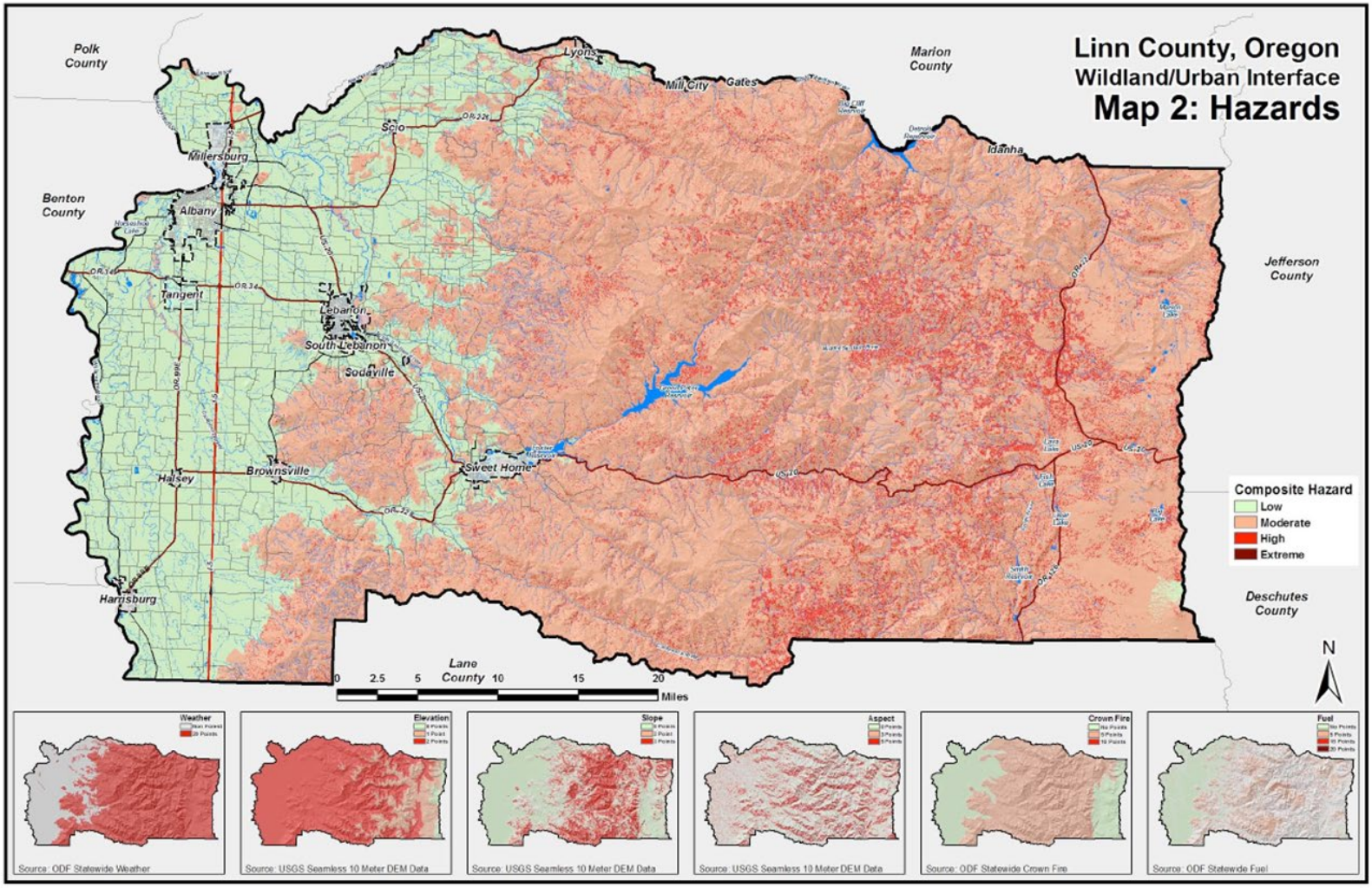
In discussion with the Sweet Home Community and Economic Development Director and the NHMP Steering Committee, it was agreed that the risk level rankings from the HVA would be used as the way to prioritize the multi-hazard and hazard-specific mitigation actions. The risk level rankings are in Table 2-4 in Section 2 Risk Assessment.

WF-9 Linn County Community Wildfire Protection Plan (CWPP) Map 1: Wildland Urban Interface Risk



Source: *2007 Linn County Community Wildfire Protection Plan*

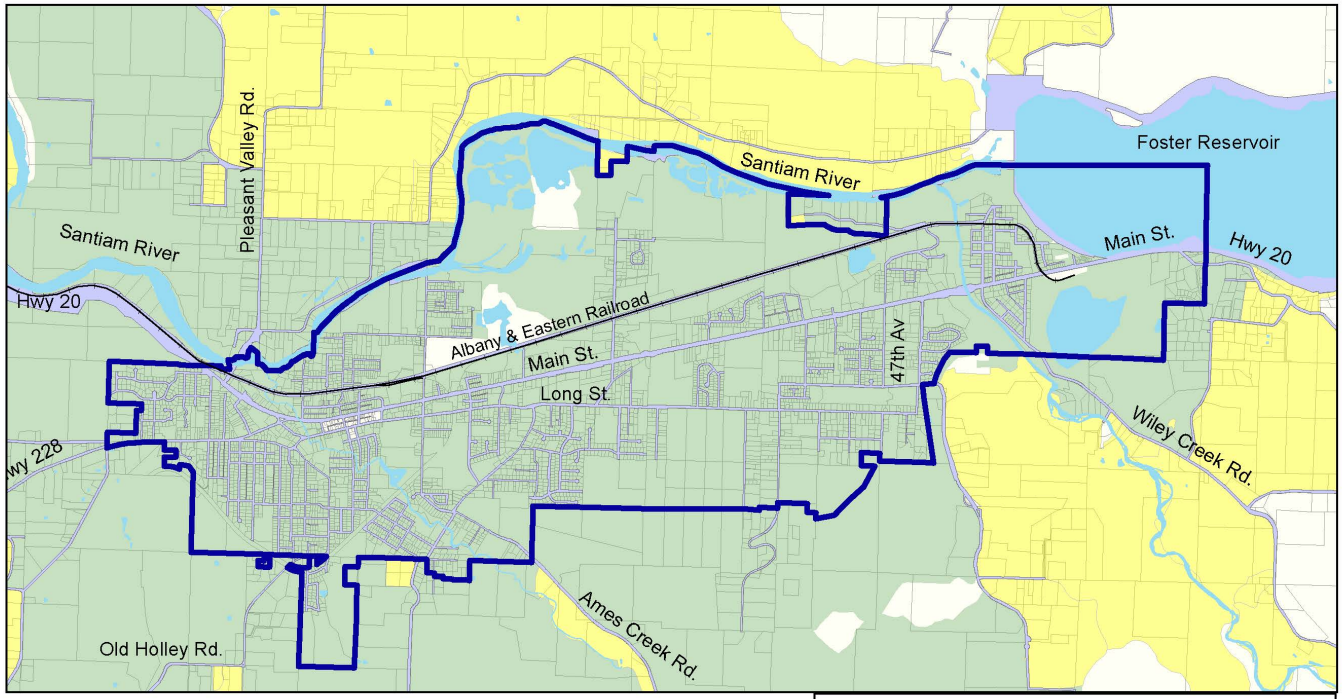
Figure WF-10 Linn County Community Wildfire Protection Plan (CWPP) Map 2: Wildland Urban Interface Hazards



Linn County Community Wildfire Protection Plan October 2007 ECONorthwest Page 25

Source: *2007 Linn County Community Wildfire Protection Plan*

Figure WF-11 Wildfire Hazard: CWPPWUI aka Community Wildfire Protection Plan and Wildland Urban Interface Map



City of Sweet Home
Natural Hazards Mitigation Plan
Community Wildfire & Wildland Urban Interface Risk Assessment

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

Natural Hazard Legend
- No Data

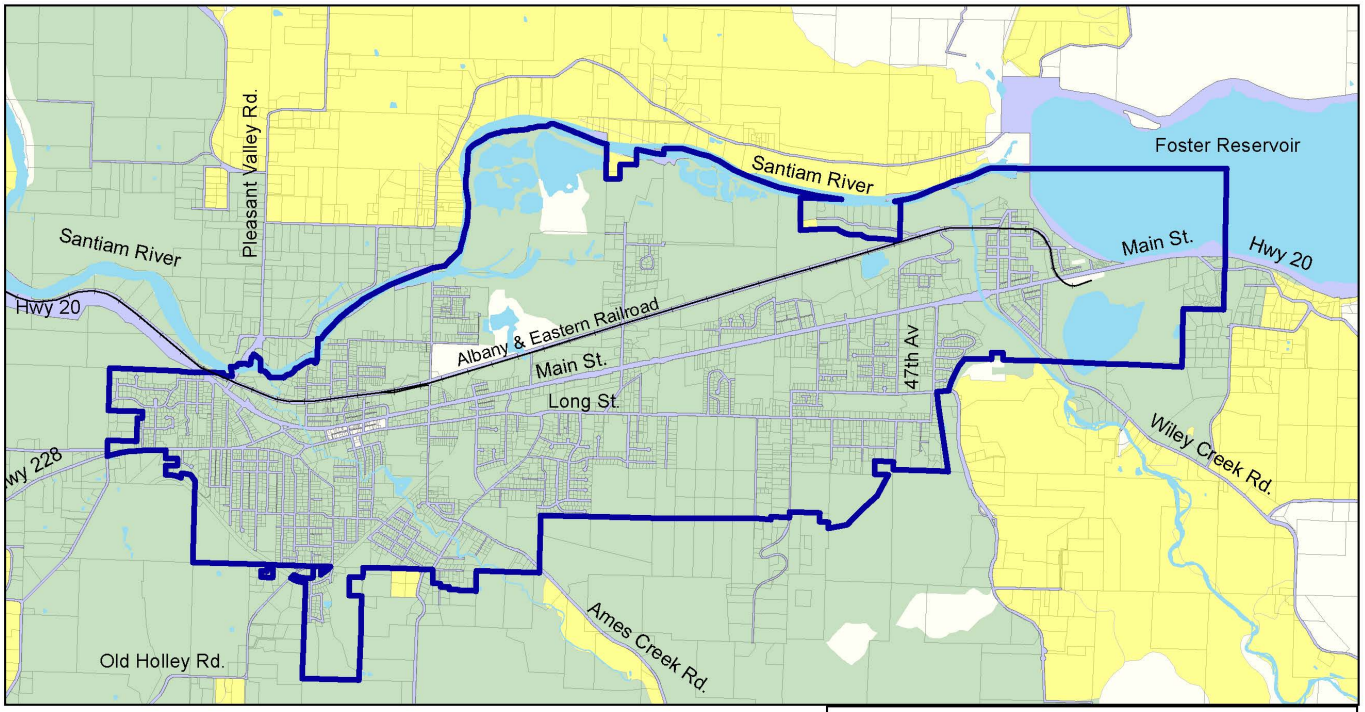
Burn Probability
- High
- Moderate
- Low

The Wildland-Urban Interface (WUI) is the area where structures and other human development meet or intermingle with undeveloped wildland, and it is where wildfires have their greatest impacts on people. The WUI is composed of both interface and intermix communities.
Sweet Home is part of the 2007 Linn County Wildfire Protection Plan.

Sources:
-- The 1990-2010 wildland-urban interface of the conterminous United States - geospatial data. 2nd Edition. Fort Collins, CO: Forest Service Research Data Archive. http://silvis.forest.wisc.edu/data/wui-change
-- USFS RDA link
http://www.fs.usda.gov/rds/archive/catalog/RDS-2015-0012-2
-- Wildfire Hazard Ratings from Pacific Northwest Quantitative Wildfire Risk Assessment 2018.
-- CWPP info from county CWPPs of Oregon
https://www.oregon.gov/odf/Fire/Pages/CWPP.aspx

Source: Joe Graybill, Sweet Home, 8/30/21

Figure WF-12 Wildfire Hazard: WUI Risk Assessment



City of Sweet Home
Natural Hazards Mitigation Plan
Community Wildfire & Wildland Urban Interface Risk Assessment

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

Natural Hazard Legend
- No Data

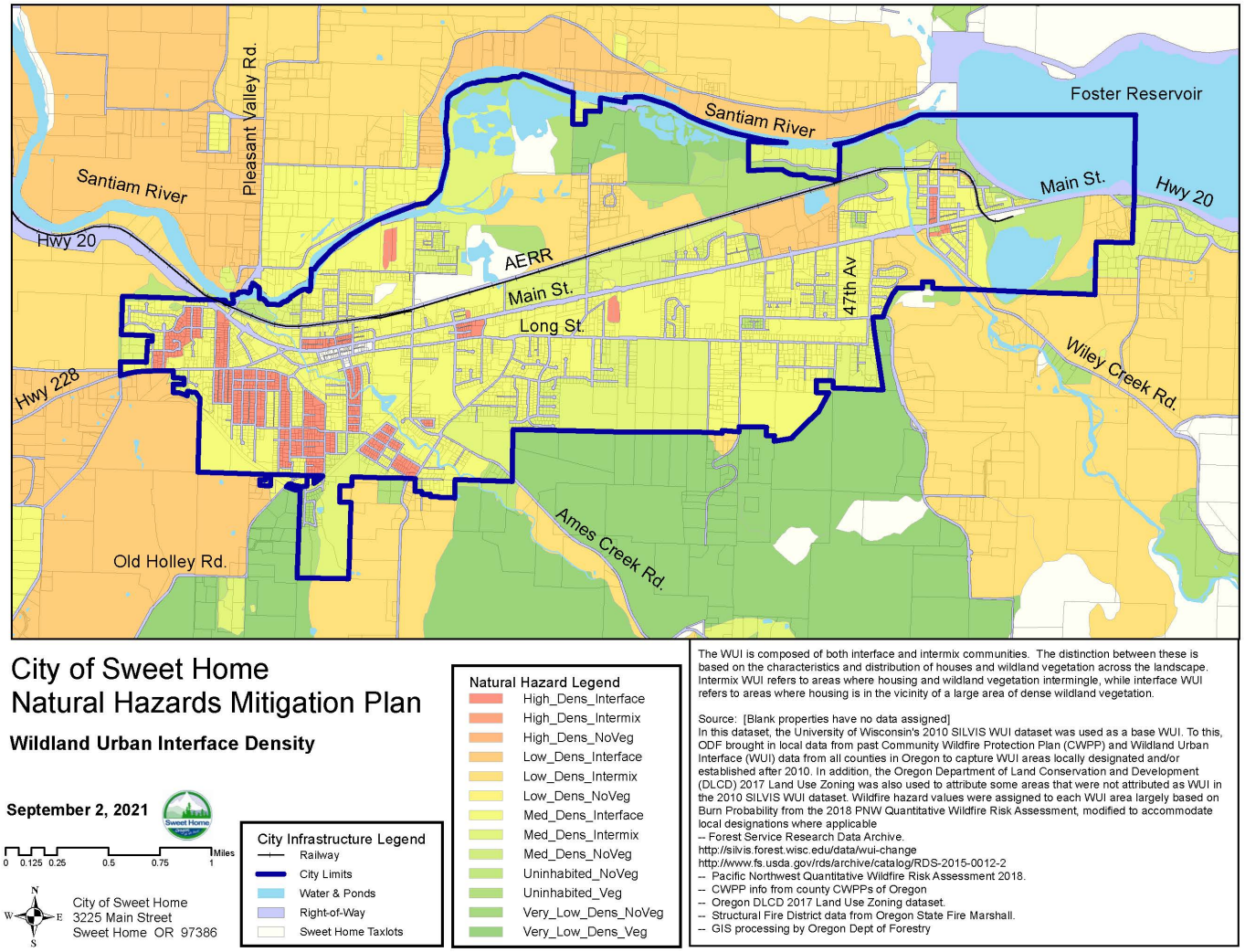
Burn Probability
- High
- Moderate
- Low

The Wildland-Urban Interface (WUI) is the area where structures and other human development meet or intermingle with undeveloped wildland, and it is where wildfires have their greatest impacts on people. The WUI is composed of both interface and intermix communities.
Sweet Home is part of the 2007 Linn County Wildfire Protection Plan.

Sources: [Blank properties have no data assigned]
-- The 1990-2010 wildland-urban interface of the conterminous United States - geospatial data. 2nd Edition. Fort Collins, CO: Forest Service Research Data Archive. http://silvis.forest.wisc.edu/data/wui-change
-- USFS RDA link
http://www.fs.usda.gov/rds/archive/catalog/RDS-2015-0012-2
-- Wildfire Hazard Ratings from Pacific Northwest Quantitative Wildfire Risk Assessment 2018.
-- CWPP info from county CWPPs of Oregon
https://www.oregon.gov/odf/Fire/Pages/CWPP.aspx

Source: Joe Graybill, Sweet Home, 8/30/21

Figure WF-13 Wildfire Hazard: WUI Density (relates to vegetation)



Source: Joe Graybill, Sweet Home, 8/30/21

FLOOD HAZARD ANNEX

Risk Score: 156

Risk Level: Medium

Causes and Characteristics of Flood

Flooding results when rain and snowmelt creates water flow that exceeds the carrying capacity of rivers, streams, channels, ditches, and other watercourses. In Oregon, flooding is most common from October through April when storms from the Pacific Ocean bring intense rainfall. Most of Oregon's most destructive natural disasters have been floods.[1] Flooding can be aggravated when rain is accompanied by snowmelt and frozen ground; the spring cycle of melting snow is the most common source of flood in the region.

Anticipating, planning, and mitigating for flood events is an important activity for Sweet Home. Federal programs provide insurance and funding to communities engaging in flood hazard mitigation. The Federal Emergency Management Association (FEMA) manages the National Flood Insurance Program (NFIP) and the Hazard Mitigation Assistance (HMA) program. The HMA includes these grant programs: Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) program, and the Building Resilient Infrastructure and Communities (BRIC) program.

- The NFIP provides flood insurance and pays claims to policyholders who have suffered losses from floods.
- The HMA provides grants to help in a broad range of areas including mitigating flood hazards by elevating structures or relocating or removing them from flood hazard areas.
- The HMGP provides funding to state, local, tribal and territorial governments so they can rebuild in a way that reduces, or mitigates, future disaster losses in their communities. This grant funding is available after a presidentially declared disaster.
- The FMA program is a competitive grant program that provides funding to states, local communities, federally recognized tribes and territories. Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the NFIP.
- The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.[2]

These programs provide grant money to owners of properties who have suffered losses from floods, and in some cases, suffered losses from other natural hazard events.

In the *2015 Sweet Home NHMP*, floods were ranked in second place. In the *2021 Sweet Home NHMP*, floods are ranked in third place out of seven hazards.

The *2015 Sweet Home NHMP* did not include specific events listed for natural hazards; the *2021 Sweet Home NHMP* includes a table of natural hazards events in each annex.

[1] Taylor, George H. and Chris Hannan, *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press, 1999.

[2] FEMA, *Hazard Mitigation Assistance Grants*, https://www.fema.gov/grants/mitigation

The principal types of flood that occur in Sweet Home and Linn County are described here.

Snowmelt (Spring) Flooding

Flooding throughout the region is most commonly linked to the spring cycle of melting snow. However, rain-on-snow floods, common in Western Oregon, also occur east of the Cascades. The weather pattern that produces these floods may occur during the winter or spring months and has come to be associated with La Nina events, a three to seven year cycle of cool, wet weather. In brief, cool, moist weather conditions are followed by a system of warm, moist air from tropical latitudes. The intense warm rain associated with this system quickly melts foothill and mountain snow. Above-freezing temperatures may occur well above pass levels (4,000-5,000 feet). Some of Oregon's most devastating floods are associated with these events.

Local Flash Floods

Summer thunderstorms are common throughout the region. During these events, normally dry gulches can quickly become raging torrents, a flash flood. Flash floods are most common to Eastern Oregon. This is because summer temperatures are much higher east of the Cascades and thunderstorms are common during the summer months. Although flash flooding occurs throughout Oregon, local geology in the region can increase the impact of this hazard. Bedrock, composed mostly of igneous rocks, is exposed at the surface throughout much of the region. Consequently, runoff is increased significantly in those areas.

All Flooding

Sweet Home is adjacent to the Santiam River. It lies below the Foster and Green Peter Dams and Reservoirs. Ames Creek and Wiley Creek flow through the city.

Flood is one of the identified climate change metrics in OCCRI's analysis that is included in the *2020 Oregon NHMP* for the Mid/Southern Willamette Valley Region (Region 3). Region 3 includes Linn, Lane (non-coastal), Marion, Polk, and Yamhill Counties.

> Furthermore, flooding and landslides are projected to occur more frequently throughout western Oregon. It is very likely (>90%) that Oregon will experience an increase in the frequency of extreme precipitation events and extreme river flows (high confidence) that is more likely than not (>50%) to lead to an increase in the incidence and magnitude of damaging floods (low confidence). Because landslide risk depends on a variety of site-specific factors, it is more likely than not (>50%) that climate change, through increasing frequency of extreme precipitation events, will result in increased frequency of landslides.[3]

Dam Failure

Major flooding could result from partial or complete failure of man-made structures constructed to restrict the flow of water on Sweet Home's waterways, either impounding reservoirs or diversion dams. There are thirteen dams located in Linn County that meet the statutory definition and are regulated by the State of Oregon. These are listed in the Oregon Water Resources Department's dam inventory database (https://apps.wrd.state.or.us/apps/misc/dam_inventory/).The statutory

[3] *2020 Oregon Natural Hazards Mitigation Plan*, Region 3: Mid/Southern Willamette Valley, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

definition is a dam that is 10 feet or higher and has a capacity for storage of at least 3 million gallons of water. This definition includes all the Bureau of Reclamation dams.[4] See Table FL-3 for the categorization of those as high, medium, and low hazard level dams regulated by the State of Oregon. Dams are further discussed in the Hazard Vulnerability section of this Flood Hazard Annex.

Factors that contribute to flooding in Sweet Home & Linn County

Precipitation

Sweet Home, Oregon gets 51 inches of rain, on average, per year. The U.S. average is 38 inches of rain per year. Sweet Home averages 2 inches of snow per year. The U.S. average is 28 inches of snow per year. On average, there are 154 sunny days per year in Sweet Home. The U.S. average is 205 sunny days. Sweet Home gets a form of precipitation, on average, 165 days per year. Precipitation is rain, snow, sleet, or hail that falls to the ground. For precipitation to be counted, there has to be at least .01 inches on the ground to measure.[5]

Geography

Sweet Home, Oregon is 35 miles southeast from Corvallis and 45 miles northeast from Eugene. Sweet Home is, as has been described, near the Santiam River, Highway 20, Green Peter Dam and Reservoir, and Lake Foster Dam and Reservoir. The city lies below areas of steep, forested slopes. Additional geographic information is provided in the Community Profile of this *2021 Sweet Home NHMP*. The Vicinity Map, Figure EX-2, in this *2021 Sweet Home NHMP* provides an illustration of the location of Sweet Home within Oregon.

Location of Development

When development is located in the floodplain, it may cause floodwaters to rise higher than before the development was located in the hazard areas. This is particularly true if the development is located within the floodway. When structures or fill are placed in the floodplain, water is displaced. Development raises the base-flood elevation by forcing the river to compensate for the flow space obstructed by the inserted structures. Over time, when structures or materials are added to the floodplain and no fill is removed to compensate, serious problems can arise. Linn County and Sweet Home have floodplain development requirements.

Displacement of a few inches of water can mean the difference between no structural damage occurring in a given flood event and the inundation of many homes, businesses, and other facilities. Careful attention must be paid to development that occurs within the floodplain and floodway of a river system to ensure that structures are prepared to withstand base flood events.

Surface Permeability

In urbanized areas, increased pavement leads to an increase in volume and velocity of runoff after a rainfall event, exacerbating potential flood hazards. Stormwater systems collect and concentrate

[4] Keith Mills, Oregon Water Resources Department, personal communication, December 27, 2018.

[5] Best Places, *Climate in Sweet Home, Oregon*, https://www.bestplaces.net/climate/city/oregon/sweet_home, accessed 8/12/21

rainwater and then rapidly deliver it into the local waterway. Traditional stormwater systems are a benefit to urban areas, by quickly removing captured rainwater. However, they can be detrimental to areas downstream because they cause increased stream flows due to the rapid influx of captured stormwater into the waterway. It is very important to evaluate stormwater systems in conjunction with development in the floodplain to prevent unnecessary flooding to downstream properties. Frozen ground is another contributor to rapid runoff in the urban and rural environment.

Terms Related To Flooding

Floodplain

A floodplain is land adjacent to a river, stream, lake, estuary or other water body that is subject to inundation of water, otherwise known as flooding. These areas, if left undisturbed, act to store excess floodwater. The floodplain is made up of two areas: the flood fringe and the floodway. These are described below and illustrated in Figures FL-1 and FL-2.

Floodplains perform functions valuable to humans and wildlife. Important functions of the floodplain include: flood water storage, water quality maintenance, fish and wildlife habitat, and recreation/open space. Floodplains provide important habitat areas including river channels, riparian buffers, and wetlands. The variety of habitat types, the presence of water, and other factors result in a rich diversity of plant and animal species. Also, vegetation that grows in the floodplain influences how water flows across the land and can play a major role in controlling erosion and sediment deposition. When these features are lost, habitat and species diversity suffer.[6]

Under the National Floodplain Insurance Program (NFIP), areas that have a 1% chance in any given year of being covered by flood waters are mapped as a Special Flood Hazard Areas (SFHA), requiring floodplain management according to NFIP standards.[7] SFHA is the area where flood insurance is typically required for structures with federally-backed mortgages. The SFHA represents inundation from a given flooding source, such as a river, ocean, or lake, during a 1 percent annual chance probability (aka 100-year) flood event. The Base Flood Elevation (BFE) is the elevation of the 100-year flood event at a specific location in the SFHA.[8]

Floodway

The floodway is the portion of the floodplain that is closer to the river or stream. For NFIP and regulatory purposes, floodways are defined as the channel of a river or stream, and the over-bank areas adjacent to the channel. Unlike floodplains, floodways do not reflect a recognizable geologic feature. The floodway carries the bulk of the floodwater downstream and is usually the area where water velocities and forces are the greatest. See Figures FL-2 and FL-3.

[6] Oregon Department of Land Conservation and Development, *National Flood Insurance Program (NFIP) in Oregon*, https://www.oregon.gov/lcd/NH/Pages/NFIP.aspx, accessed December 26, 2018.

[7] Ibid.

[8] DOGAMI, *Base Flood Elevation Determinations Fact Sheet*, https://www.oregongeology.org/pubs/fs/BFE-fact-sheet.pdf, accessed December 26, 2018.

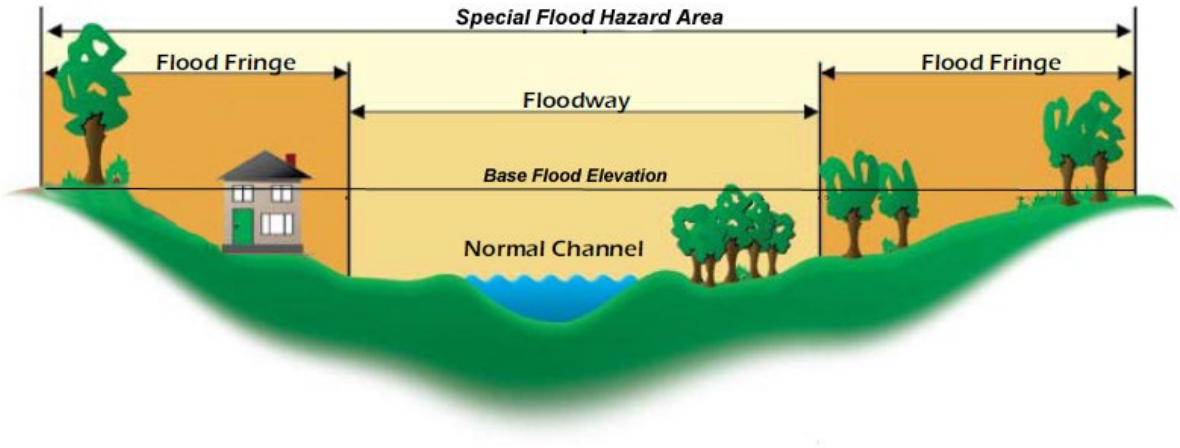
NFIP regulations require that the floodway be kept open and free from development or other structures, so that flood flows are not obstructed or diverted onto other properties. Floodways are not mapped for all rivers and streams but are typically mapped in developed areas.

According to FEMA, a "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. Communities must regulate development in these floodways to ensure that there are no increases in upstream flood elevations. For streams and other watercourses where FEMA has provided Base Flood Elevations (BFEs), but no floodway has been designated, the community must review floodplain development on a case-by-case basis to ensure that increases in water surface elevations do not occur or identify the need to adopt a floodway if adequate information is available.[9]

The Flood Fringe

The flood fringe refers to the outer portions of the floodplain, beginning at the edge of the floodway and continuing outward. This is the area where development is most likely to occur, and where precautions to protect life and property need to be taken.

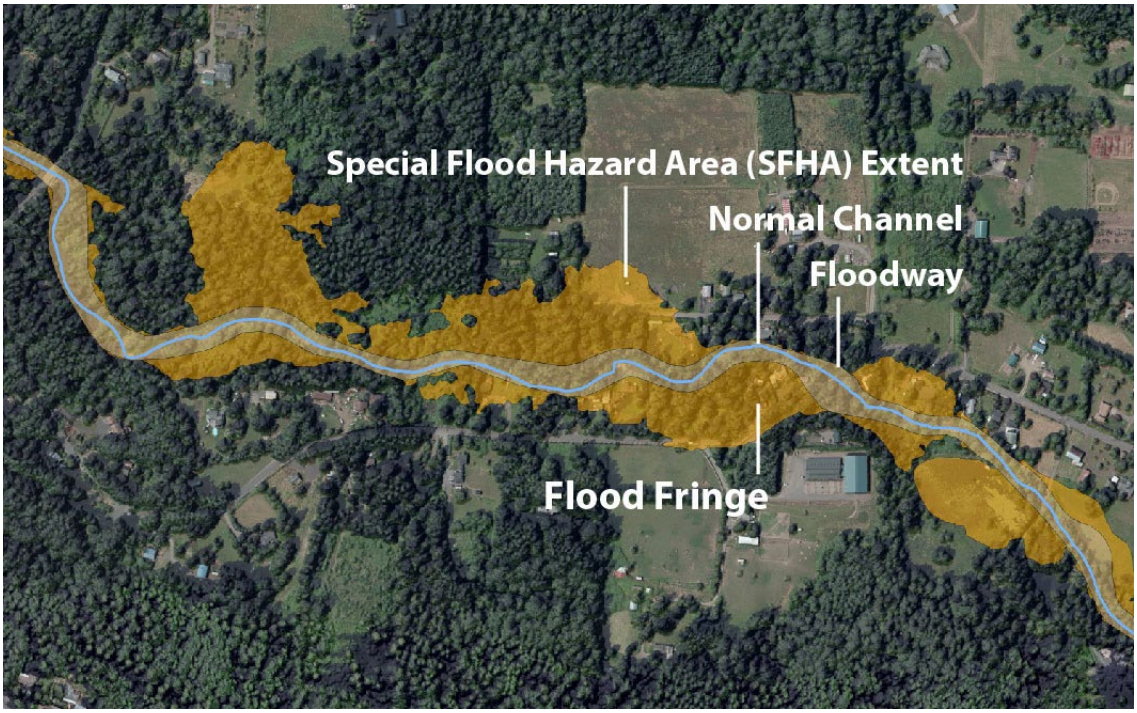
Figure FL-1 Cross Section View of the SFHA and its Components



Source: DOGAMI, *Base Flood Elevation Determinations Fact Sheet*, https://www.oregongeology.org/pubs/fs/BFE-fact-sheet.pdf, accessed December 26, 2018.

[9] FEMA, *Definition of Floodway*, https://www.fema.gov/floodway, accessed December 26, 2018.

Figure FL-2 Map View of the SFHA and its Components



Source: DOGAMI, *Base Flood Elevation Determinations Fact Sheet*, https://www.oregongeology.org/pubs/fs/BFE-fact-sheet.pdf, accessed December 26, 2018.

History of Floods in Sweet Home and Linn County

Records of past flooding in Sweet Home and Linn County vary greatly depending on location. Of note, river gages are typically installed in areas where a waterway runs close to structures or heavily settled areas. Gages are maintained and owned by many different authorities, including the United States Geographical Survey (USGS), the National Weather Service (NWS), the Bureau of Reclamation (USBR), Bureau of Indian Affairs (BIA), and local water control and irrigation districts.[10]

For this discussion of the history of floods in Sweet Home and Linn County, there are multiple sources of information which, when put together, provide an overall background that frames the present and the future. The Sweet Home NHMP Steering Committee, during the Hazard Vulnerability Analysis (HVA) for this *2021 Sweet Home NHMP*, determined a risk score for floods that placed it third out of seven hazards, with a medium risk level. It is important to note that floods do not have to be categorized with a disaster declaration by FEMA to be impactful. Impacts can occur at any level of flooding.

To provide additional context about floods, let's look at some flood related information for Oregon as well as Sweet Home and Linn County.

[10] *2014 Umatilla County NHMP*, May 2015. A statement that applies to other counties in addition to Umatilla.

Table FL-1 Significant Historic Floods in Sweet Home and Linn County, Oregon

Date	Location	Type of Flood	Description
May 1948	Columbia River	River flooding	Columbia River crested at 34.4 ft. Flood stage at that time was 15 ft. This is the flood that destroyed the City of Vanport. Fifteen people died in the flood.
Dec. 1955	Statewide	Rain on snow	DR-49. Event occurred on December 29, 1955. Flooding and strong winds; 5 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.
1959	Malheur County	Flooding	Flooding on Jordan Creek in Jordan Valley.
Oct. 1962	Statewide	Storms	DR-136. Event occurred on October 12, 1962. Referred to as the Columbus Day Storm.
Feb. 1963	Statewide	Flooding	DR-144. Event occurred on February 25, 1963. There was flooding in Vale area along the Malheur River.
Dec. 1964	Statewide	Heavy rains, flooding, rain on snow	DR-184. Event occurred on December 24, 1964. Statewide damage totaled $157 million and 17 deaths.
Jan. 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.
Feb. 1986	Statewide	Snow melt, flooding	Intense rain, a melting snow, and flooding. Some homes evacuated. Event occurred February 22-23.
Jul. 1989	South and Central Oregon	Flooding	On July 15, there was snow melt flood in Lake, Malheur, and neighboring counties. Warm rains, hail caused extensive snowpack melt which occurred quickly; many rivers and creeks overflowed.
1990	Western Oregon	Rain on snow, flooding	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; 8 fatalities. There are 27 counties covered by the disaster declaration.
Dec. 1996-Jan. 1997	Statewide	Winter storm, flooding	DR-1160. Severe snow and ice. Up to 4 to 5 inches of ice in the Columbia Gorge. Interstate 84 closed for 4 days. Hundreds of downed trees and power lines. Lake County received $219,382; Lakeview receive $30,701, and Paisley received $2,909 from FEMA to repair and replace damaged structures.
Jan.-Feb. 1999	NW Oregon	Rain, flooding, landslides, mudslides	Widespread flooding on smaller rivers and streams; numerous landslides and mudslides.
Mar. 2006	19 counties in Oregon	Severe Storms, Flooding, Landslides, and Mudslides	DR-1632. The disaster declaration occurred on March 20, 2006 for the incident that occurred December 18, 2005 through January 21, 2006. Linn County was one of 19 counties in the declaration.
Nov. 2006	Statewide	Severe storms, flooding, landslides, mudslides	DR-1672. The events occurred November 6-8, 2006. The declared disaster included Hood River, Clatsop, Lincoln, and Tillamook Counties.
Dec. 2008	Statewide	Winter storms, heavy rain, flooding	DR-1824. Severe winter storm, flooding, winds, record and near record snow, landslides and mudslides. Gresham received, 26” of snow. Many roads closed. Significant damages to public infrastructure, homes and businesses. Event occurred Dec. 13-26. Counties in the declaration: Clackamas, Clatsop, Columbia, Marion, Multnomah, Polk, Yamhill, and Hood River.
Jan. 2011	Statewide	Winter storm	DR-1956. Severe winter storm, flooding, mudslides, landslides, and debris flows. Malheur River flooded on January 17.

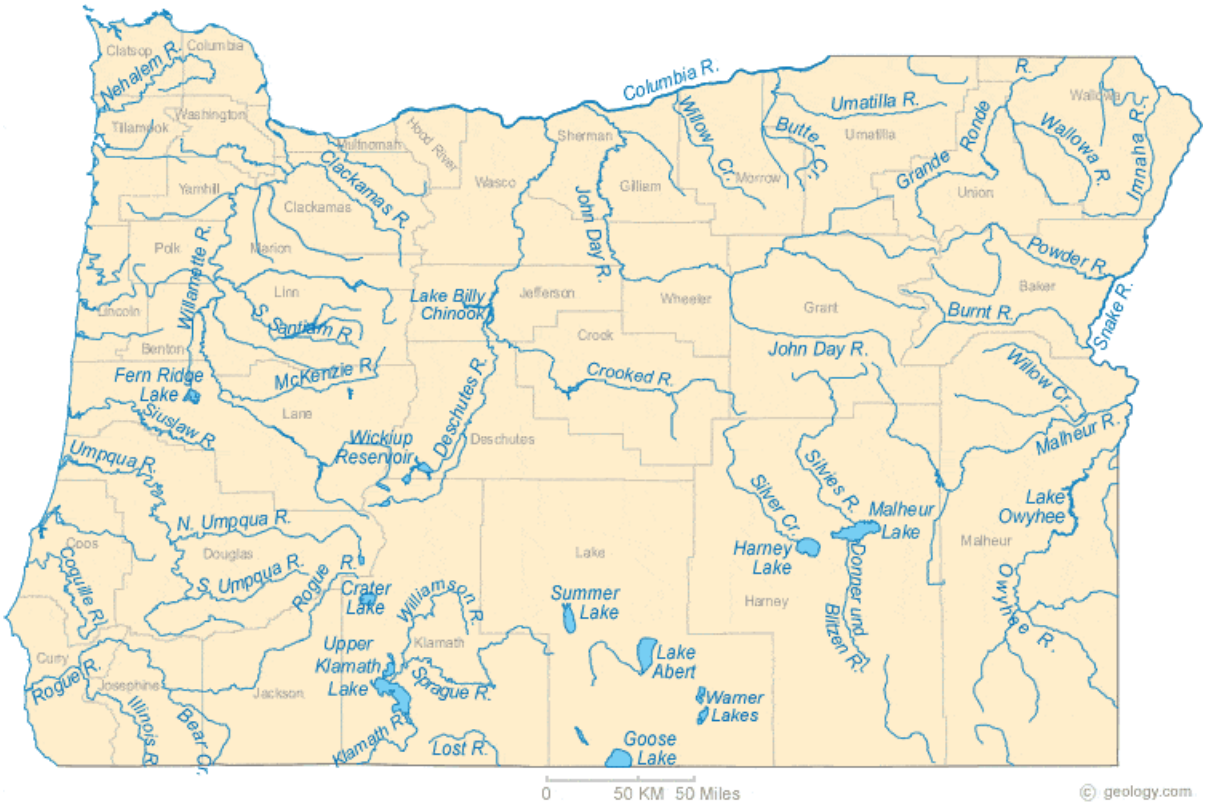
Date	Location	Type of Flood	Description
Jan. 2012	W. Oregon	Severe winter storms, flooding, landslides, mudslides	DR-4055. The incident period was January 12-21, 2012. Severe winter storm with flooding, landslides, and mudslides. Declaration involves 12 counties including Linn County.
Dec. 2015	Western Oregon	Winter storm, heavy rain	DR-4258. Severe winter storms, straight-line winds, flooding, landslides, and mudslides.
Jan. 2017	Hood River, Columbia, Deschutes, Josephine Counties	Severe winter storms, flooding, landslides, mudslides	DR-4238. The event occurred January 7-10, 2017.
Apr. 2019	Statewide	Severe storms, flooding, landslides, mudslides	DR-4452. The event occurred April 6-21, 2019. Counties that were part of the disaster declaration: Linn, Douglas, Curry, Wheeler, Grant, and Umatilla. Individual and Public Assistance money was approved.

Sources: DLCD, Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017, 2019, and 2020; Taylor and Hatton, 1999.

Figure FL-3 shows the major drainage basins, streams, rivers, and lakes in Oregon. Within Table FL-1 Significant Historic Floods provides details on the date, location, type of flood, and a description of the flood that occurred in Oregon. Figure FL-6 shows the 100-year floodplain in Sweet Home.

Local, state, and federal agencies as well as other organizations are actively involved in mapping flood hazard areas and working on flood hazard issues. All involved must recognize the ability to assess the probability of a flood and the level of accuracy is influenced by modeling methodology advancements, better knowledge, longer periods of information on record for the water body in question, as well as communication and collaboration.

Figure FL-3 Map of Major Drainage Basins, Lakes, Streams, and Rivers in Oregon



Source: Geology.com, Oregon Lakes, Rivers and Water Resources, https://geology.com/lakes-rivers-water/oregon.shtml

Risk Assessment

How are Hazards Identified?

Sweet Home and Linn County's flood hazards are identified through its FEMA issued Flood Insurance Rate Maps (FIRM), in conjunction with its Flood Insurance Study (FIS). Flood records are often not well documented, particularly in unincorporated areas because their floodplains are sparsely developed. Incorporated areas tend to have more development in and documentation about floodplains. See Figures FL-6 Flood Hazard: FEMA 100-Year Floodplain Map and FL-10 Natural Hazards Combination: Slope and Flood Zone.

Repetitive Flood Loss in Sweet Home and Linn County

Repetitive flood loss properties (those which have experienced multiple flood insurance claims) have been identified as high priority hazard mitigation projects by the NFIP. Based on the FEMA CIS database, in Oregon, repetitive loss properties represent about 1.53% of all insured properties, and account for about 9.89% of all claims paid (23.3% of the dollar amounts paid).[11]

A brief recap of Table FL-2 is included here:

- Sweet Home (19) and Linn County (451) have National Flood Insurance Program (NFIP) policies in force as of 6/8/21.
- Sweet Home has 17 residential and 2 non-residential flood insurance policies. Linn County has 384 residential and 67 non-residential flood insurance policies.
- There have been 3 paid claims in Sweet Home and 82 in Linn County as of 6/8/21.
- There have been no repetitive losses in Sweet Home and 12 repetitive losses in Linn County. There have been no severe repetitive losses in Sweet Home and Linn County as of 6/8/21.
- Sweet Home and Linn County have had recent Community Assistance Visits (CAV) and Community Assistance Contacts (CAC) according to the FEMA Community Information System database and DLCD's records. See Table FL-2.
- Sweet Home and Linn County are not members of the Community Rating System (CRS).[12]

Sweet Home updated their floodplain ordinance in 2020 and it is compliant with requirements.

In the past several years, there has been an increase in the availability of private flood insurance and many people have chosen to obtain it. DLCD Natural Hazards Planner, Tricia Sears, did not research the number of private flood insurance policies in Sweet Home. Identifying the number of NFIP and non-NFIP flood insurance policies can be very useful in many ways such as but not limited to for mitigation actions in the NHMP, and outreach and education.

[11] Celinda Adair, National Floodplain Insurance Program Coordinator, DLCD, July 22, 2019.

[12] Katherine Daniel, Natural Hazards Planner, DLCD, 6/8/21 (all items listed I the recap were provided by Katherine)

Table FL-2 Flood Insurance Detail for Sweet Home and Linn County, Oregon

Community	Date of Last CAV or CAC	Date of Flood Ordinance	# of NFIP Insurance Policies	Member of CRS?	Average Annual Premium	# of Paid Loses	# of Repetitive Loss Properties	# of Severe Repetitive Loss Properties	# of Substantial Damage claims
Linn County	6/26/2019	11/22/2016	451 (67 non-res; 384 res)	no	$1,076.53	82	12	0	3
Sweet Home	6/27/2019	9/24/2010	19 (2 non-res; 17 res)	no	$1,044.95	3	0	0	0

Source: Katherine Daniel, DLCD Natural Hazards Planner, 6/8/21

Hazard Risk Analysis

The Sweet Home NHMP Steering Committee completed a Hazard Vulnerability Assessment/Analysis (HVA) during this NHMP update. This was described in Section 2 Risk Assessment. The method used for the HVA was developed from a Federal Emergency Management Agency (FEMA) tool that has been refined by the Oregon Office of Emergency Management (OEM). It addresses and weights (shown as percent within parentheses) probability (29%), vulnerability (21%), maximum threat (42%) and the history (8%) of each natural hazard and attributes a final hazard analysis score. The methodology produces scores that range from 24 to 240.

For local governments, conducting the HVA is a useful step in planning for hazard mitigation. The method provides the jurisdiction with a relative ranking from which to prioritize mitigation actions, but does not predict the occurrence of a particular hazard.

In the *2015 Sweet Home NHMP*, floods were ranked in second place. In the *2021 Sweet Home NHMP*, floods are ranked in third place out of seven hazards.

For more information on all the risk scores and ranks of the natural hazards, see Volume I Basic Plan, Section 2 Risk Assessment of this NHMP.

Probability Assessment

The probability of an occurrence has been assessed by FEMA and is displayed on the Federal Insurance Rate Maps (FIRM). FEMA has mapped the 10, 50, 100, and 500-year floodplains. This corresponds to a 10%, 2%, 1% and 0.2% chance of a certain magnitude flood in any given year. In addition, FEMA has mapped the 100-year floodplain (i.e., 1% flood) in the incorporated cities. The 100-year flood is the benchmark upon which the National Flood Insurance Program (NFIP) is based.

Vulnerability Assessment

One limiting factor to sound development in an area is the lack of accurate floodplain maps, an issue that has larger ramifications for development. The Linn County Flood Insurance Rate Maps (FIRMs) are dated September 29, 2010. The Flood Insurance Study has been completed for the FIRMs.[13]

According to the Sweet Home NHMP Steering Committee, as discussed at the 9/8/21 meeting, the following areas are the most flood prone:

Between 12th and 18th Aves north of Poplar St,

Around 37th and 38th Aves and Long Street, and

45th Ave south of Main St.

The first two areas have drainage issues, so water collects. City staff work to alleviate issues. Note that the 45th Ave area drainage issues run through private property, not public, so it is harder for the City staff to work on alleviating the situation. One location, 43rd Ave and Long St has been cleaned up such that it now drains properly and is no longer considered problematic.

[13] FEMA Flood Map Service Center: Search by Address, FEMA Flood Map Service Center | Search By Address, accessed 8/12/21

Sweet Home does not have an existing stormwater management master plan, but it is a funded project for FY 2021-2022. An existing City stormwater fee was raised to provide funding for a position and the writing of the stormwater management master plan. The fee was raised after a study was conducted and it was recommended that a $4 fee per home be made. However, only $1 increase was adopted as fee. In 2021, the fee was raised to $2. It was discussed that in the future the fee may be raised again to address the items in the plan and for maintenance. On May 1, 2021 the stormwater system development charge went into effect for capital improvements in the stormwater system.

See FL-6 for the 100-year floodplain map and Figure FL-10 for a map showing the combination of slope hazard and floodplain.

Dams and levees are another potential source of flooding if they break. The Oregon Water and Resources Department (OWRD) has updated their website to more clearly describe that it only includes dams regulated by the State. The database no longer includes Corps of Engineers, Bureau of Reclamation, or hydropower dams regulated by FERC. To provide a more comprehensive identification of the dams in Linn County, the OWRD staff recommends the use of the National Inventory of Dams (NID).[14] Information in Table FL-3 is from the Oregon Water Resources Department Dam Query Inventory, not the NID. A little background on the NID is provided here as a framework. To narrow the focus of potential dam impacts, after the NID description, there is a description of the USACE dams nearest to Sweet Home.

> "Congress first authorized the U.S. Army Corps of Engineers (USACE) to inventory dams in the United States with the National Dam Inspection Act (Public Law 92-367) of 1972. The NID was first published in 1975, with a few updates as resources permitted over the next ten years. The Water Resources Development Act of 1986 (P.L. 99-662) authorized USACE to maintain and periodically publish an updated NID, with re-authorization and a dedicated funding source provided under the Water Resources Development Act of 1996 (P.L. 104-3). USACE also began close collaboration with the Federal Emergency Management Agency (FEMA) and state regulatory offices to obtain more accurate and complete information. The National Dam Safety and Security Act of 2002 (P.L. 107-310) and the Dam Safety Act of 2006 reauthorized the National Dam Safety Program and included the maintenance and update of the NID by USACE. More recently, the NID was reauthorized as part of the Water Resources Reform and Development Act of 2014 and the Water Resources Development Act of 2018."[15]

It is important to recognize the NID consists of dams meeting at least one of the following criteria;

1) High hazard potential classification - loss of human life is likely if the dam fails,
2) Significant hazard potential classification - no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns,
3) Equal or exceed 25 feet in height and exceed 15 acre-feet in storage,
4) Equal or exceed 50 acre-feet storage and exceed 6 feet in height.[16]

[14] Keith Mills, Oregon Water Resources Department, personal communication, 3/30/21

[15] U.S. Army Corps of Engineers, Welcome, NID - Welcome (army.mil), accessed 3/31/21

[16] U.S. Army Corps of Engineers, Welcome, NID - Welcome (army.mil), accessed 3/31/21

Sweet Home is located near and at the base of two dams and reservoirs. Due to interest and concern about the two nearby dams, the Green Peter and Foster Dams on Lake Green Peter and Lake Foster Reservoirs, DLCD Natural Hazards Planner, Tricia Sears, reached out to the U.S. Army Corps of Engineers (USACE) staff. On 5/7/21, Ross Hiner, Dam Safety Program Manager, USACE - Portland District, presented to the Sweet Home NHMP Steering Committee. His presentation on Lake Foster and Lake Green Peter Dams, describing the dam safety action plans and inundation maps was fascinating and generated lively discussion. Tom Voldback, USACE, Operations Manager at Greenpeter and Foster Dams, also joined the meeting.

Foster Dam is closer to Sweet Home than Green Pater Dam. Green Peter Dam is quite a bit larger and has more storage capacity than Foster Dam. Safety evaluations of both dams has occurred and work is in progress to maintain the safety of them. The risk classification for Green Peter Dam is low, according to the 2020 Advanced Risk Assessment. The next assessment of risk will be the 2024 Routine Risk Assessment. The risk classification for Foster Dam is high, according to the 2015 Routine Risk Assessment. The next assessment of risk is the on-going Advanced Risk Assessment.

Ross Hiner noted that the USACE is scheduled to have dam breach inundation maps available to the public via the USACE website in Fall 2021. These maps will be updated and will be dynamic rather than static. He described three important points about the purpose of the dam inundation maps, which is to help USACE and local governments understand and plan for dam failure consequences. These three points are that the maps are used for: USACE emergency actions plans, risk assessment consequence estimates, and local evacuation and response plans. He cautioned that the dam breach inundation maps are based on extremely unlikely and severe dam failure scenarios. These would be extremely large flood events and would be rapid and severe failures. They are based on data that is protected by Homeland Security regulations.

Excerpts from the presentation are included as several figures in this Flood Annex.

Figure FL-4 Green Peter Dam and Lake Green Peter Reservoir

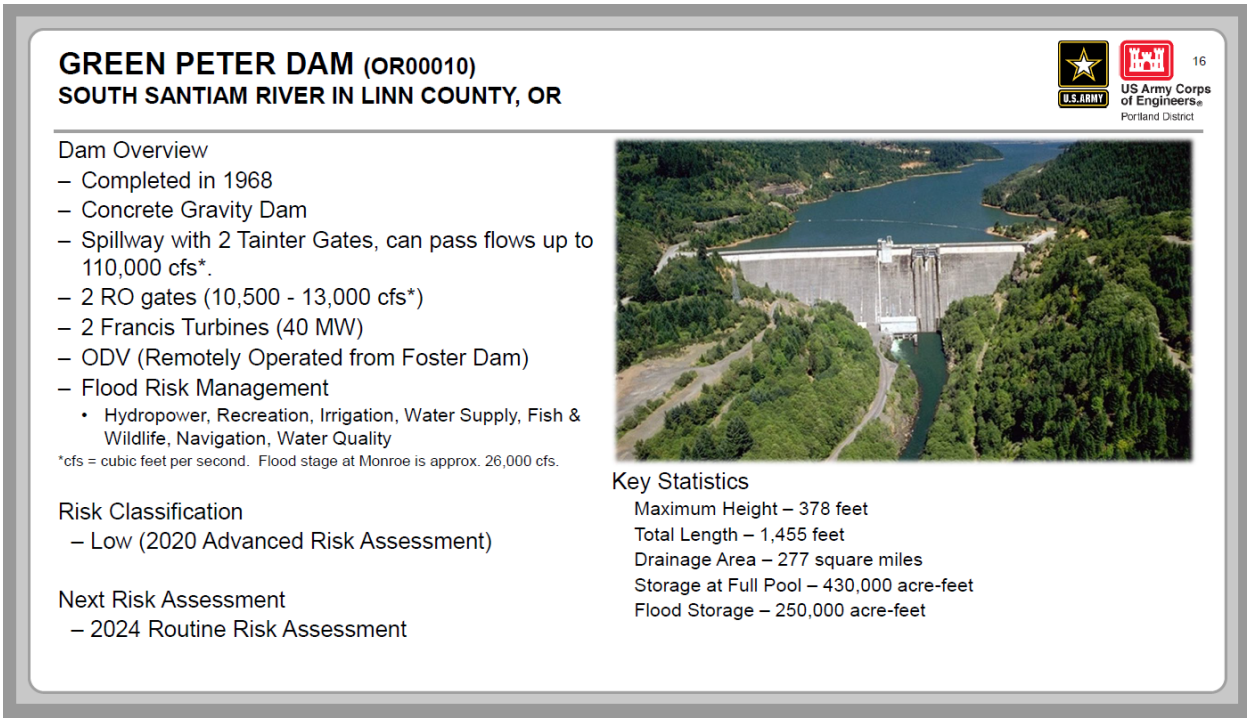
Figure FL-5 Foster Dam and Lake Foster Reservoir

Figure FL-7 USACE Willamette Valley Multi-Purpose Dams

Figure FL-8 USACE Location Map of Big Cliff, Detroit, Green Peter and Foster Dams

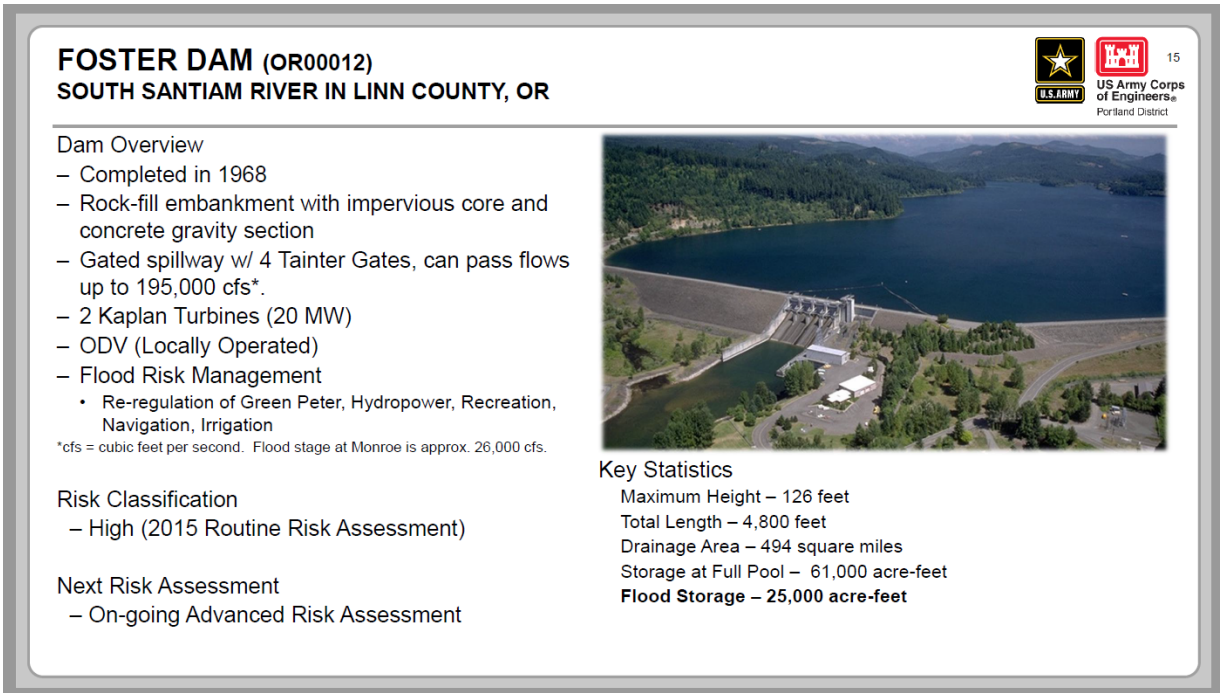
Figure FL-9 USACE Location Map of Green Peter and Foster Dams

Figure FL-4 Green Peter Dam Overview



Source: Ross Hiner, PE, Dam Safety Program Manager, USACE, personal communication 5/7/21

Figure FL-5 Foster Dam Overview



Source: Ross Hiner, PE, Dam Safety Program Manager, USACE, personal communication 5/7/21

Table FL-3 Linn County Dam Inventory for Dams Regulated by State of Oregon

Dam Name	River	Hazard Level
Foster Log Pond	South Santiam River	High
Helms Reservoir	Trib to South Santiam River	Low
American Can Dams (lagoon)	Off channel lagoon	Low
Freres Log Pond	North Santiam River	Low
Mt. Jefferson Lumber Log Pond	North Santiam River	Low
Bentz Bros. Pond 3	Unnamed, Trib to Thomas Creek	Low
Freres Lumber Company Log Pond	No name	Low
Johnson Creek Reservoir (Linn)	Johnson Creek	Low
Gann Reservoir #1 (Linn)	Unnamed Trib, Tub Run	Low
Macedo Dairy Lagoon	Off channel	Low
Tadmore Lake Dam	No name	Low
Merritt Dairy (Lagoon)	No name	Low
Sullivan Pond 3	No Name	Significant

Source: Oregon Water Resources Department, Dam Inventory Query, https://apps.wrd.state.or.us/apps/misc/dam_inventory/, accessed 8/13/21

The ORWRD website lists thirteen dams in Linn County that are regulated by the State of Oregon. The dams are categorized in hazard level or potential: High, Significant, and Low. Of the thirteen dams listed, there is one High hazard dam, one Significant, and eleven Low level hazard dams.[17] High hazard dams are inspected annually.[18] All high hazard dams are required to have an Emergency Action Plan.[19]

There are likely multiple levees that serve as an important piece of physical infrastructure, providing flood control in areas of Linn County. Although the levee control districts are not listed as participants in the planning process for the NHMP, they could serve as important partners for the proposed mitigation actions, especially those related to flooding. In addition to the levees managed by special districts, there could also be private levee systems located along rivers and creeks.

What is susceptible to damage during a hazard event?

The extent of the damage and risk to people caused by flood events is primarily dependent on the depth and velocity of floodwaters. Fast moving floodwaters can wash buildings off their foundations and sweep vehicles downstream. Roads, bridges, other infrastructure, and lifelines (pipelines, utility,

[17] Oregon Water Resources Department, OWRD Dam Inventory Query, http://apps.wrd.state.or.us/apps/misc/dam_inventory/, accessed 8/13/21. Additional information provided by Keith Mills, OWRD, personal communication, 3/30/21.

[18] Arden Babb, Oregon Water Resources Department, personal communication, 2/10/20

[19] Oregon Water Resources Department, *Dam Safety Program*, accessed 2/10/20

water, sewer, communications systems, etc.) can be seriously damaged when high water combines with flood debris, mud and ice. Extensive flood damage to residences and other structures can result in basement flooding and landslide damage related to soil saturation. Surface water entering into crawlspaces, basements, and daylight basements is common during flood events not only in or near flooded areas but also on hillsides and other areas far removed from floodplains. Most damage is caused by water saturating materials susceptible to loss (e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings and appliances). If not properly protected from the entry of floodwaters, mechanical, electrical and similar equipment can also be damaged or destroyed by flooding. Economic damage from floods can be substantial.

Community Flood Issues

Human Life

Protection of human life is of primary importance. This is paramount and is tied to several other community issues. Keeping homes safe from floodwaters will also help protect human life.

Critical /Essential Facilities, Critical Infrastructure, and Vulnerable Population Centers

Recognizing the history of flooding in the region, and the location of the assets of critical/ essential facilities, critical infrastructure, and vulnerable population centers in the floodplain increases awareness of vulnerability to floods and other natural hazards. The critical/ essential facilities, critical infrastructure, and vulnerable population centers are described in detail in Section 2 Risk Assessment in Table 2-7 and have an “x” indicating which natural hazards may impact them. See also Figure 2-5 for the Critical Facilities Map and Figure 2-6 for the Evacuation Map.

Homes

Homes in frequently flooded areas can experience blocked sewer lines and damage to septic systems and drainfields. This is particularly the case of residences in rural flood prone areas who commonly utilize private individual sewage treatment systems. Inundation of these systems can result in the leakage of wastewater into surrounding areas creating the risk of serious water pollution and public health threats. This kind of damage can render homes unlivable.

Many older manufactured home parks are located in floodplain areas. Manufactured homes have a lower level of structural stability compared to traditional lumber-built homes. Manufactured homes in floodplain zones should be anchored to provide additional structural stability during flood events.

Businesses

Floods damage property and interrupt commerce. The economic losses due to business closures often total more than the initial property losses that result from floods. Direct damages from flooding are the most common impacts, but indirect damages, such as diminished clientele, can be just as debilitating to a business. Floods can cut off customer access and close businesses for repairs. A quick response to the needs of businesses affected by flood events can help a community maintain economic viability in the face of flood damage.

In addition, there are several historic structures that are susceptible to flooding events and if damaged, would negatively affect the tourist economy of the area.

Public Infrastructure Flood Issues

Public buildings such as libraries, schools and government buildings are of concern to the County due to their potential utility in the event of a flood. These buildings can be used as temporary locations for medical and emergency housing services.

Road systems are important to the local economy, and during hazard events, resilient road connections are critical for providing essential and emergency services. Roads are maintained by multiple jurisdictions. Federal, state, county, and city governments all have a stake in protecting roads from flood damage. Some roads in Sweet Home cross floodplain and floodway areas.

Bridges

Bridges are key points of concern during flood events for two primary reasons:

- Bridges are often important links in road networks, crossing watercourses or other significant natural features.
- Bridges can be obstructions in the floodway, collecting debris and inhibiting the flow of water during flood events. This can cause water to back up and inundate areas upstream from the bridge that would not otherwise be affected. Also, this build-up of water can suddenly release, causing a flash flood of larger magnitude downstream.

Wastewater and Drinking Water Systems

Floods significantly impact drinking water and waste water systems. When sewer systems are inundated with floodwaters, raw sewage can be flushed into the waterways, posing a significant health hazard. Additionally, drinking water supplies can be contaminated with flushed wastewater or high levels of solids (eroded soil for example), and made unsafe for consumption. Both water and sewage systems often require significant repair and maintenance work following a flood.

Stormwater

Stormwater systems collect and concentrate rainwater and rapidly deliver it into the local waterway. This infusion of water causes increased flows downstream. During large rainstorms and floods, these systems are pushed past their capacity and stormwater begins flowing over-ground, causing other infrastructure damage. Traditional stormwater systems are a benefit to urban areas by quickly removing captured rainwater, however, they can be detrimental to areas downstream.

Other problems often develop where open ditches enter culverts or go underground into stormwater systems. An obstruction at these intersections causes overland water flow. The filling of ditches and swales near buildings can inhibit or prevent the flow of water can compound these problems. Inadequate maintenance, especially following leaf accumulation in the fall, can also contribute to the flood hazard in urban areas.

Parks and Open Space

Public parks and publicly owned open space can provide a buffer between flood hazards and private property. Wetlands in public ownership can reduce flood impacts by absorbing floodwaters and buffering water level fluctuations.

Power Supply

Flooding also significantly impacts electrical supply systems. Floodwaters short-out electrical lines and cause transformers to fail. Additionally, debris transported by floodwaters can knock down power poles and put live, high-voltage lines in the water, posing an electrocution hazard to people.

Communications/Phone Lines

Telephone and cable lines are similarly susceptible to floodwaters and floating debris. Underground lines are more resistant to flood damage, but often are exposed and damaged by swift currents.

Existing Hazard Mitigation Activities and Resources

There are numerous programs currently under way in Sweet Home and Linn County designed to mitigate the impacts of flooding. These programs range from federally funded national programs to individual projects by landowners and projects by watershed councils and special districts.

Federal Programs

The National Flood Insurance Program (NFIP)

The NFIP is a federal program administered by the Federal Emergency Management Agency (FEMA). The function of the NFIP is to provide flood insurance to homes and businesses located in floodplains at a reasonable cost, and to encourage the location of new development away from the floodplain. The program maps flood risk areas, and requires local implementation to reduce the risk, primarily through restricting new development in floodplains. The Linn County Flood Insurance Rate Maps (FIRMs) are dated September29, 2010. The Flood Insurance Study has been completed for the FIRMs.[20]

Insurance is available to help recover from losses incurred from flooding events. As Table FL-2 indicates, there are 19 NFIP policies in Sweet Home. Also as mentioned previously, there are private flood insurance policies available and private insurance has become an increasingly popular option.

Flood insurance covers only the improved land, or the actual building structure. It is important to note that property located outside the SFHA may still be subject to severe flooding. FEMA reports that 25% to 30% of all flood insurance claims are from owners of property located in low to moderate-risk areas located outside of the SFHA.[21]

Repetitive loss structures are defined as a NFIP - insured structure that has had at least two paid flood losses of more than $1,000 each in any 10-year period since 1978.[22] Repetitive loss structures are troublesome because they continue to expose lives and property to the flooding hazard. Local governments as well as the federal agencies, such as FEMA, attempt to address losses by encouraging and requiring floodplain insurance and funding projects such as acquiring land and improvements, relocating homes, or elevating structures. Continued repetitive loss claims from

[20] FEMA Flood Map Service Center: Search by Address, FEMA Flood Map Service Center | Search By Address, accessed 8/12/21

[21] FEMA, National Flood Insurance Program: *Frequently Asked Questions, Repetitive Loss*, https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt

[22] Ibid.

flood events lead to an increased amount of damage caused by floods, higher insurance rates, and contribute to the rising cost of taxpayer funded disaster relief for flood victims.

Community Rating System (CRS)

The Community Rating System (CRS) voluntary program recognizes and rewards efforts that go beyond the minimum standards of the NFIP. This recognition is in the form of reduced flood insurance premiums for communities that adopt such standards. CRS encourages voluntary community activities that reduce flood losses, facilitate accurate insurance rating, and promote flood insurance awareness. For CRS communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount.[23] Table FL-4 illustrates how the CRS point system is broken down. Sweet Home and Linn County do not participate in the CRS.

Table FL-4 Summary of Points and Insurance Rate Discounts Under CRS

Credit Points	Class	Premium Reductions
0-499	10	0%
500-999	9	5%
1000-1499	8	10%
1500-1999	7	15%
2000-2499	6	20%
2500-2999	5	25%
3000-3499	4	30%
3500-3999	3	35%
4000-4599	2	40%
4500+	1	45%

Source: FEMA, *National Flood Insurance Program*, http://www.fema.gov/national-flood-insurance-program, accessed December 27, 2018.

State Programs

State Natural Hazard Risk Assessment: Flood

The risk assessment in the *2020 Oregon Natural Hazards Mitigation Plan* provides an overview of flood risk in Oregon and identifies the most significant floods in Oregon's recorded history. It has overall state and regional information, and includes flood related mitigation actions for the entire state. https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

Planning for Natural Hazards: Oregon Technical Resource Guide

This guide describes basic mitigation strategies and resources related to coastal hazards, floods, and other natural hazards, including examples from communities in Oregon.
https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

[23] Ibid.

Statewide Planning Goals

There are 19 Statewide Planning Goals that guide land use in the State of Oregon. These became law via Senate Bill 100 in 1973.[24] One goal in particular focuses on land use planning and natural hazards. Goal 7 Areas Subject to Natural Disasters and Hazards,[25] requires local governments to identify hazards and adopt appropriate safeguards for land use and development. Goal 7 advocates the continuous incorporation of hazard information in local land use plans and policies. The jurisdictions participating in this *2021 Sweet Home NHMP* have approved comprehensive plans that include information pertinent to Goal 7. https://www.oregon.gov/lcd/OP/Pages/Goals.aspx

ODOT

ODOT has a Trip Check link on its website that provides information to help the public detour away from hazard areas during times of emergency. The Trip Check link also has road camera images to inform the public of road conditions prior to making a trip. https://tripcheck.com/

Silver Jackets

The Silver Jackets program is a joint state-federal-local flood mitigation subcommittee, which is tied to a national USACE initiative. In Oregon, Silver Jackets provides a forum where DLCD, DOGAMI, OEM, USACE, FEMA, USGS, and additional federal, state and sometimes local and Tribal agencies can come together to collaboratively plan and implement flood mitigation, optimizing multi-agency utilization of federal assistance by leveraging state/ local/ Tribal resources, including data/ information, talent and funding, and preventing duplication among agencies.

The State of Oregon established Silver Jackets as a subcommittee to the Interagency Hazard Mitigation Team (IHMT), with the primary intents of strengthening interagency relationships and cooperation, optimizing resources, and improving risk communication and messaging.

The Oregon Silver Jackets act as acatalyst in developing comprehensive and sustainable solutions to state flood hazard challenges. Objectives of this IHMT subcommittee include:

- Facilitate strategic life-cycle flood risk reduction,
- Create or supplement a continuous mechanism to collaboratively solve state-prioritized issues and implement or recommend those solutions,
- Improve processes, identifying and resolving gaps and counteractive programs,
- Leverage and optimize resources,
- Improve and increase flood risk communication and present a unified interagency message, and
- Establish close relationships to facilitate integrated post-disaster recovery solutions.[26]

https://silverjackets.nfrmp.us/State-Teams/Oregon

[24] Oregon Department of Land Conservation and Development, https://www.oregon.gov/lcd/OP/Pages/History.aspx, accessed December 27, 2018.

[25] Oregon Department of Land Conservation and Development, https://www.oregon.gov/lcd/OP/Pages/Goals.aspx, accessed December 27, 2018.

[26] Silver Jackets, *Oregon Silver Jackets*, https://silverjackets.nfrmp.us/State-Teams/Oregon.cfm, accessed December 11, 2019.

County and City Programs

Zoning Ordinance – Floodplain Standards

Community participation in the National Flood Insurance Rate Program (NFIP) requires the adoption and enforcement of a local floodplain management ordinance that controls development in the floodplain. Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent.[27]

The Sweet Home Code of Ordinances (which includes zoning and other provisions) is located here: Sweet Home, OR Laws (amlegal.com)

Floodplain Development and FEMA Maps

The flood maps are known as Flood Insurance Rate Maps (FIRM). To minimize damage to structures during flood events, jurisdictions require all new construction in the floodplain to get a floodplain development permit. The permit requires development to be anchored against movement by floodwaters, resistant to flood forces, constructed with flood resistant materials, and flood-proofed or elevated so that the first floor of living space, as well as all mechanical and services, is at least one foot above the elevation of the 100-year flood. These standards apply to new structures and to substantial improvements of existing structures. Critical facilities are required to the extent possible to be outside of the SFHA. Other types of development within the floodplain, such as, grading, cut and fill, installation of riprap, and other bank stabilization techniques also require a floodplain development permit.[28]

Elevation Certificate Maintenance

Elevation certificates are administered by Community and Economic Development Department at Sweet Home. The certificates are required for buildings constructed in the floodplain to demonstrate that the building is elevated adequately to protect it from flooding. The elevation certificate is an important administrative tool of the NFIP. It is used to determine the proper flood insurance premium rate; it can be used to document elevation information necessary to ensure compliance with community floodplain management regulations; and it may be used to support a request for a Letter of Map Amendment (LOMA) or Letter of Map Revision based on fill (LOMR-F). Sweet Home and Linn County have elevation certificates on file for many developed properties.

NOAA NWS and Sweet Home Emergency Management

The National Weather Service (NOAA NWS) has the ability to predict severe weather events that may trigger prolonged or flash flood events. NOAA NWS is able to issue notices to response agencies and to the public via television, radio, internet and Weather Radios (formerly Tone Alert Radios) when the potential for flooding is likely. Sweet Home Emergency Management, Sweet Home Police,

[27] FEMA, Region 10, *Floodplain Management: a Local Administrator's Guide to the National Flood Insurance Program*, https://www.fema.gov/media-library-data/20130726-1647-20490-1041/nfipguidebook_5edition_web.pdf

[28] FEMA, Region 10, *Floodplain Management: a Local Administrator's Guide to the National Flood Insurance Program*, https://www.fema.gov/media-library-data/20130726-1647-20490-1041/nfipguidebook_5edition_web.pdf

and the Sweet Home Fire and Ambulance District coordinate with NOAA NWS when notices may be required to inform response agencies and the general public of potential flooding events.

This description is excerpted from the *2012 Sweet Home Emergency Operations Plan*.

The Emergency Operations Plan is an all-hazard plan that describes how the City of Sweet Home and Sweet Home Fire and Ambulance District, known as the Sweet Home Area, will organize and respond to emergencies and disasters in the community. It is based on, and is compatible with, Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including Presidential Policy Directive 8, the National Response Framework, State of Oregon Emergency Management Plan, and Linn County Emergency Operations Plan.

Response to emergency or disaster conditions in order to maximize the safety of the public and to minimize property damage is a primary responsibility of government. It is the goal of the Sweet Home Area that responses to such conditions are conducted in the most organized, efficient, and effective manner possible. To aid in accomplishing this goal, the Sweet Home Area has, in addition to promulgating this plan, informally adopted the principles of the National Incident Management System, including the Incident Command System and the National Response Framework.

Consisting of a Basic Plan, Functional Annexes aligned with the Linn County Emergency Support Functions, and Incident Annexes, this Emergency Operations Plan provides a framework for coordinated response and recovery activities during a large-scale emergency. The plan describes how various agencies and organizations in the City of Sweet Home and Sweet Home Fire and Ambulance District will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.

Future Changing Conditions/ Climate Change

In the *2021 Sweet Home NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Sweet Home. In the order of appearance in the NHMP: the Risk Assessment and the Hazards Annexes contain this information.

Flood Mitigation Actions

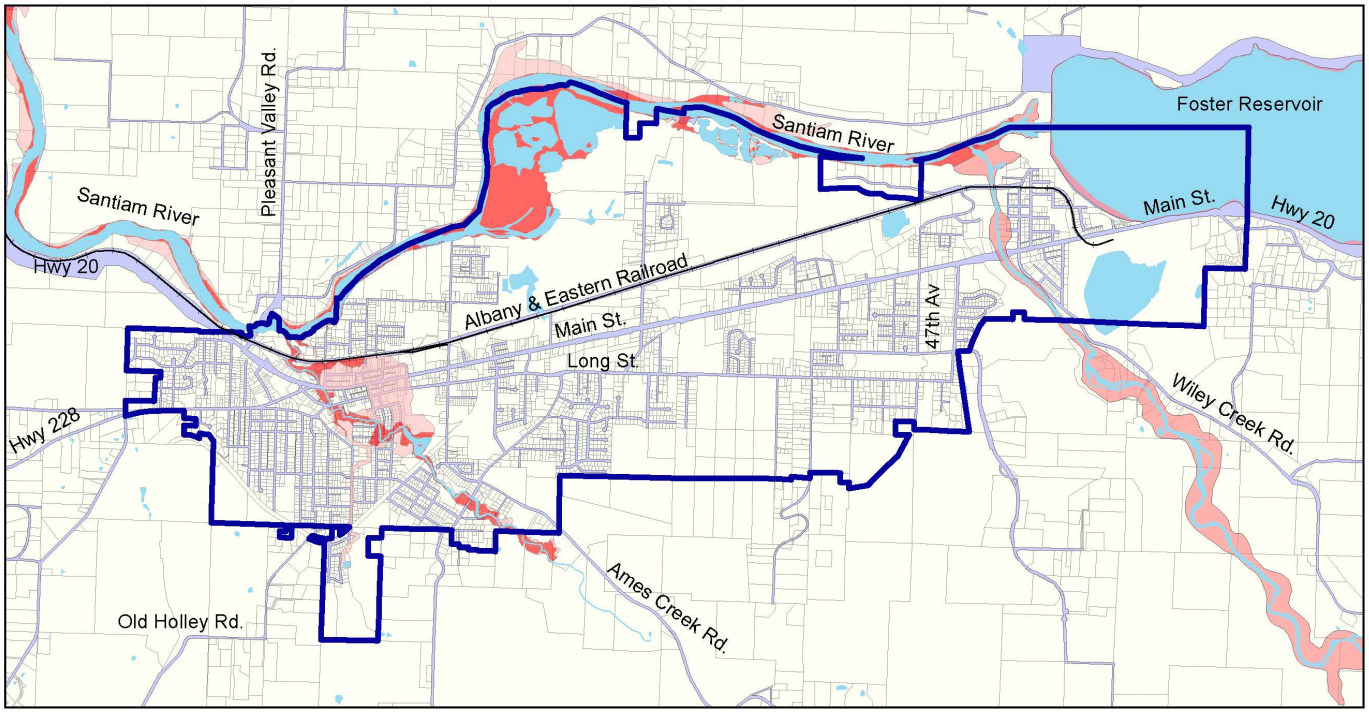
The flood mitigation actions have been identified by the Sweet Home NHMP Steering Committee. See Table 3-1, Sweet Home NHMP Mitigation Actions for a more detailed description of the mitigation actions in this NHMP.

In discussion with the NHMP Steering Committee, it was agreed that the risk level rankings from the HVA would be used as the way to prioritize the multi-hazard and hazard-specific mitigation actions. The risk level rankings are in Table 2-4 in Section 2 Risk Assessment.

In the *2021 Sweet Home NHMP*, there are 8 flood specific mitigation actions. The flood mitigation actions have a medium priority because the HVA resulted in floods having a medium risk level.

There are multi-hazard mitigation actions for the NHMP and those include flood related mitigation actions, in conjunction with the other hazards. The multi-hazard mitigation actions are a high priority.

Figure FL-6 Sweet Home Floodplain Map



City of Sweet Home
Natural Hazards Mitigation Plan
100 Year Floodplain

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

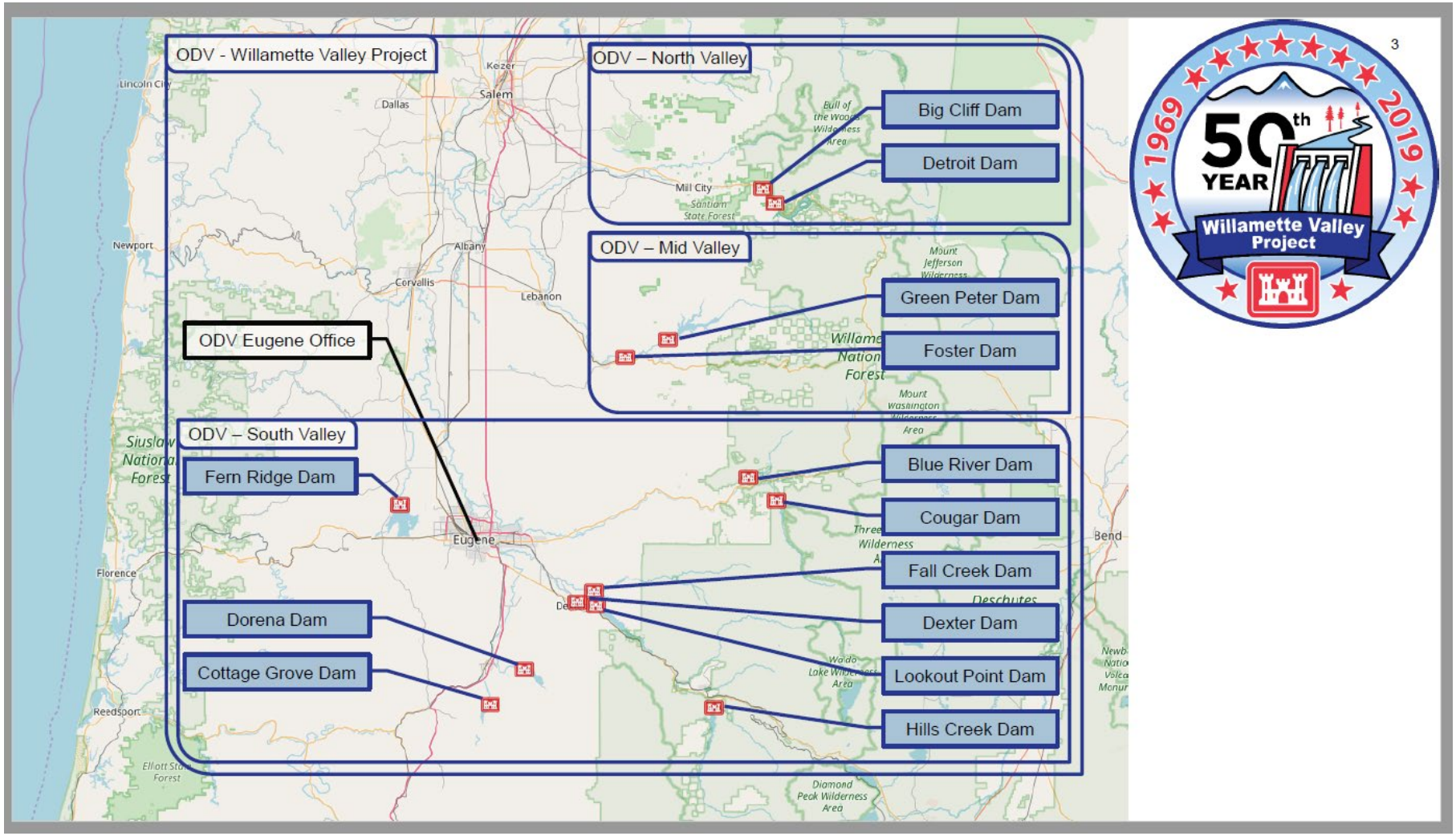
Natural Hazard Legend
- Zone AE -1.0% (100yr) BFE Determined
- Zone A - 1.0% (100yr) No BFE
- Zone X - 0.2% (500yr) No BFE

This data set is the FEMA boundary extents of the Floodway, 1.0% (100yr) and 0.2% (500yr) Base Flood Elevations (BFE).

Source:
The FEMA Flood Map Service Center (MSC) is the official public source for flood hazard information produced in support of the National Flood Insurance Program (NFIP).
Sweet Home area FEMA Maps are 41043C0911G, 41043C0912G, 41043C0916G, 41043C0913G, 41043C0914G, and 41043C0918G.

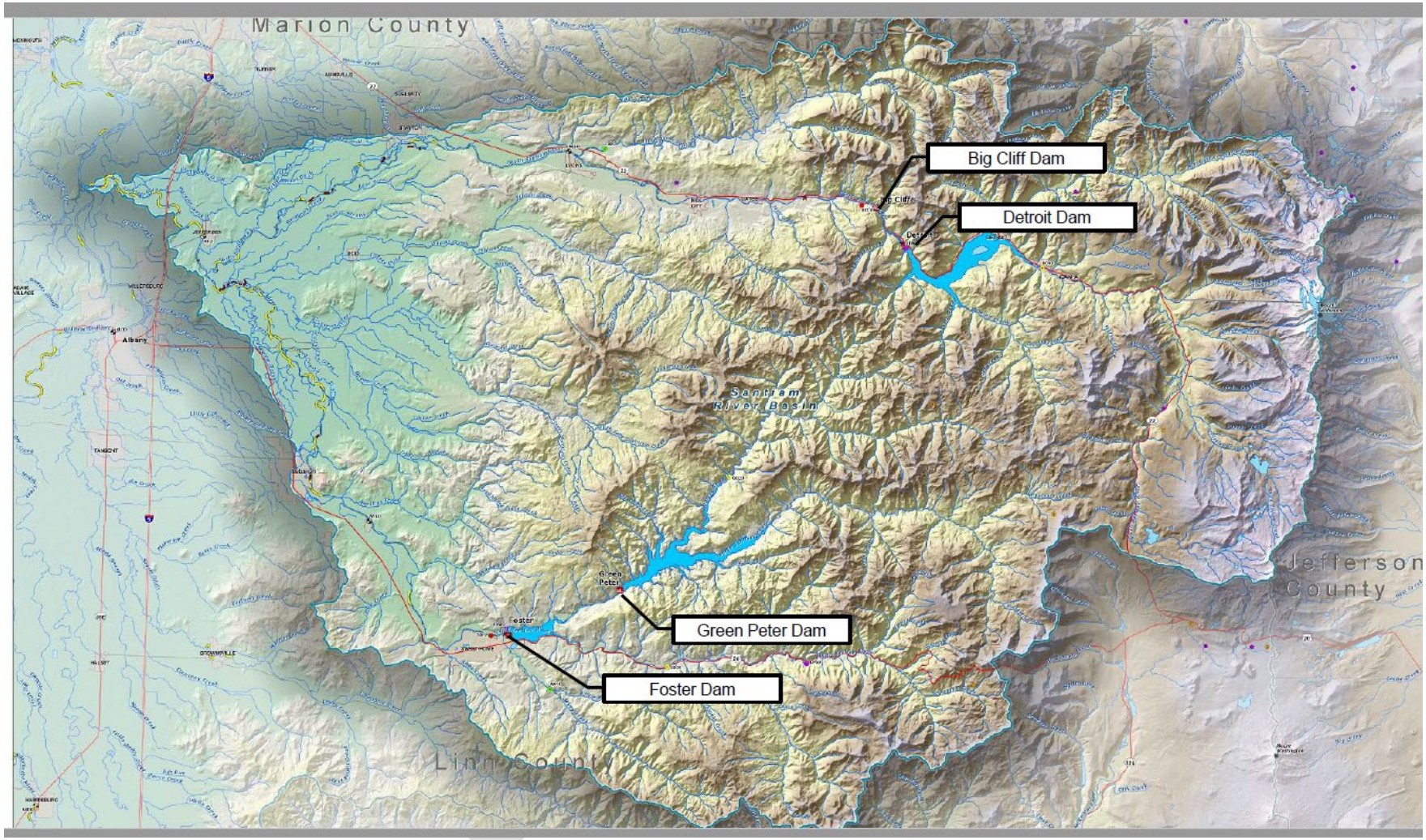
Source: Joe Graybill, Sweet Home, 8/30/21

Figure FL-7 USACE Willamette Valley Multi-Purpose Dams



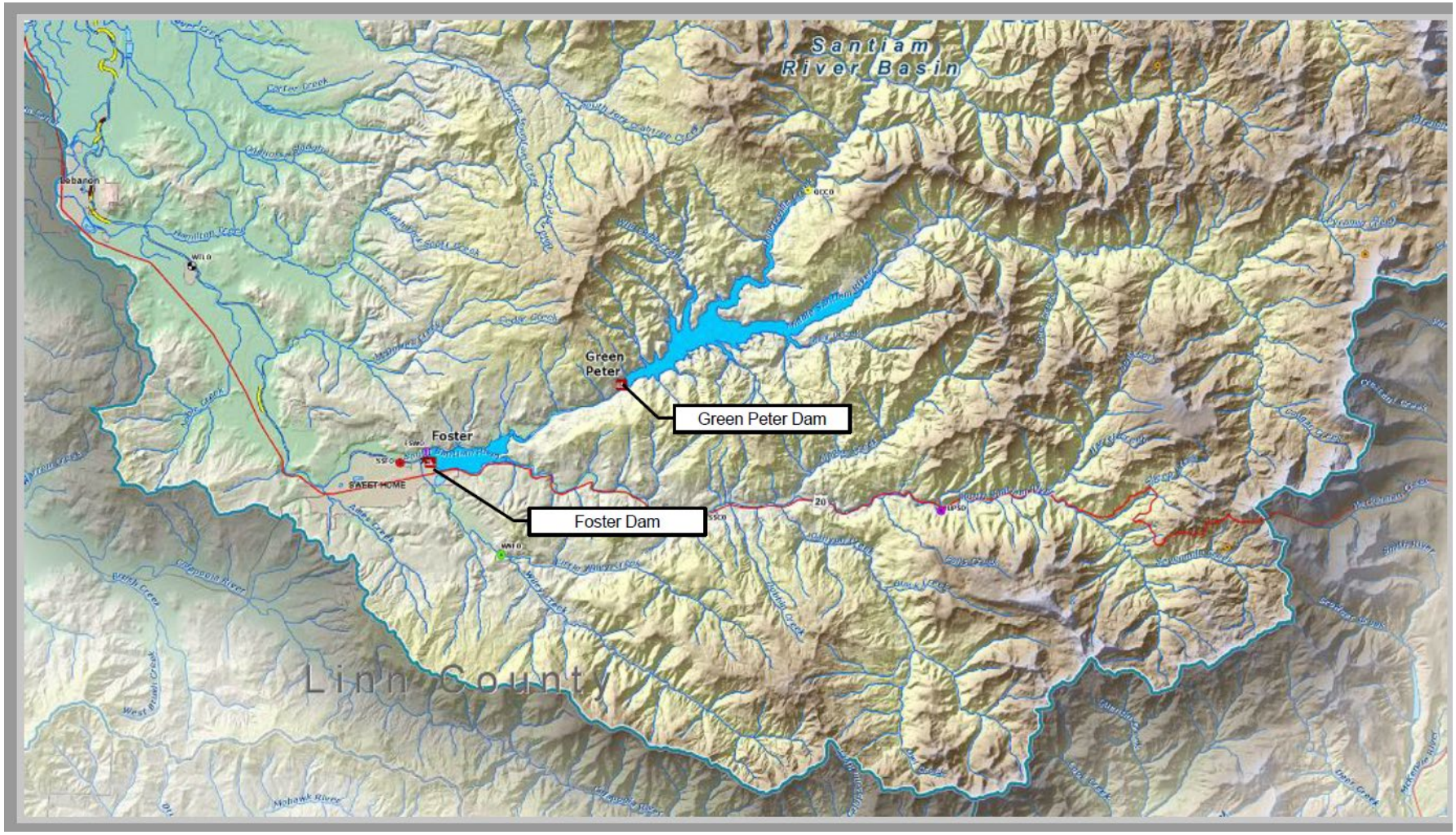
Source: Ross Hiner, PE, Dam Safety Program Manager, USACE, personal communication 5/7/21

Figure FL-8 USACE Location Map of Big Cliff, Detroit, Green Peter and Foster Dams



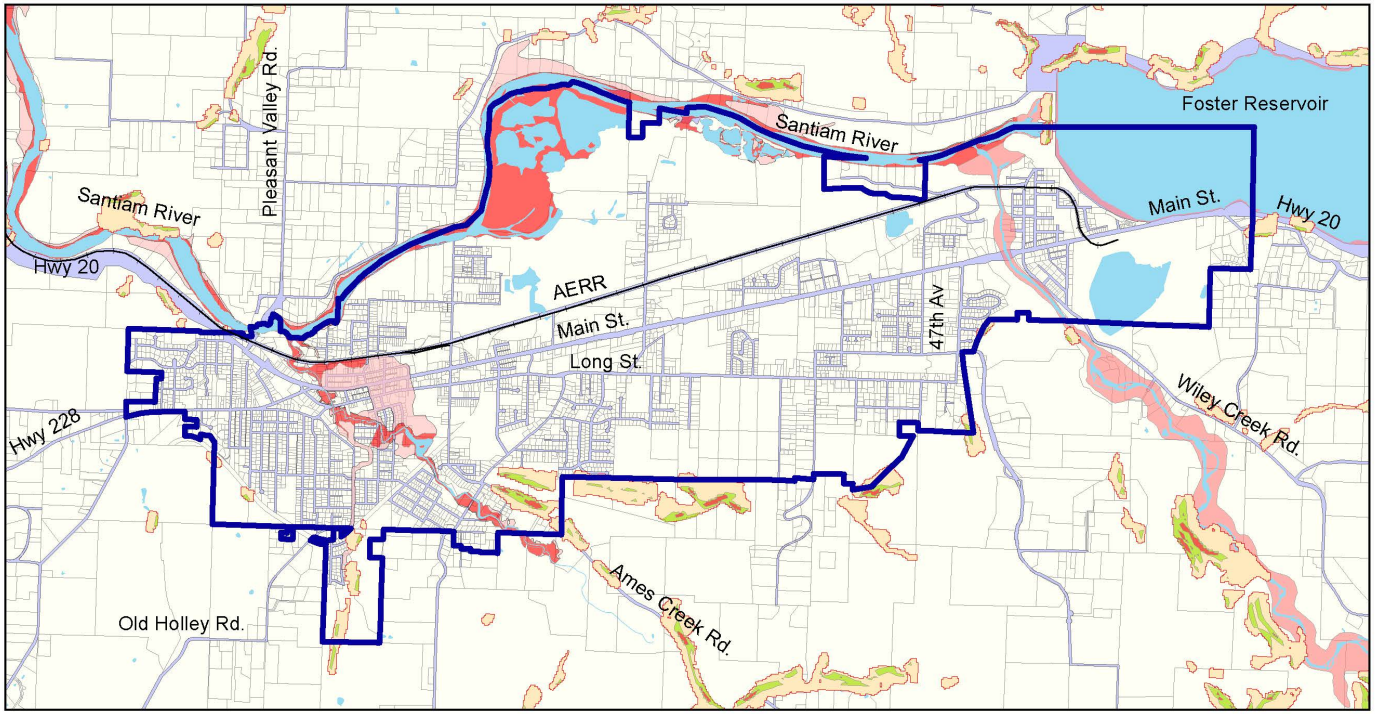
Source: Ross Hiner, PE, Dam Safety Program Manager, USACE, personal communication 5/7/21

Figure FL-9 USACE Location Map of Green Peter and Foster Dams



Source: Ross Hiner, PE, Dam Safety Program Manager, USACE, personal communication 5/7/21

Figure FL-10 Natural Hazards Combination: Slope and Flood Zone



City of Sweet Home
Natural Hazards Mitigation Plan
Natural Hazards Potential Combination Effects

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

Natural Hazard Legend

Slope
- 60 - 80% Slope
- Over 80% Slope
- Landslide Potential

Flood Zone
- Zone AE - 1.0% (100yr) BFE
- Zone A - 1.0% (100yr) No BFE
- Zone X - 0.2% (500yr) No BFE

Source: Joe Graybill, Sweet Home, 8/30/21

Earthquake Hazard Annex

Risk Score: 149

Risk Level: Medium

"An earthquake is a sudden movement of a fault in the earth's crust, abruptly releasing strain that has accumulated over a long period of time. The movement along the fault produces waves of strong shaking that spread in all directions. Two potential damage-causing threats shaking are liquefaction and earthquake-induced landslides. Liquefaction is when saturated soils substantially lose stability due to ground-shaking, causing it to behave like a liquid, which can be a source of tremendous damage. If the earthquake occurs near a populated area, it may cause causalities, economic disruption, and extensive property damage. Oregon is underlain by a large and complex system of faults that can produce damaging earthquakes. Although smaller faults produce smaller earthquakes, they are often close to populated areas and damage can be extensive to nearby buildings."[1]

Causes and Characteristics of Earthquake

Earthquakes occur in Oregon every day; every few years an earthquake is large enough for people to feel; and every few decades there is an earthquake that causes damage. Each year, the Pacific Northwest Seismic Network locates more than 1,000 earthquakes greater than magnitude 1.0 in Washington and Oregon. Of these, approximately two dozen are large enough to feel. These noticeable events offer a subtle reminder that the Pacific Northwest is an earthquake-prone region.

Seismic hazards pose a real and serious threat to many communities in Oregon, including Sweet Home, requiring local governments, planners, and engineers to consider their community's safety. Currently, no reliable scientific means exists to predict earthquakes. Identifying seismic-prone locations, adopting strong policies and implementing measures, and using other mitigation techniques are essential to reducing risk from seismic hazards in Sweet Home and Linn County.

In the *2015 Sweet Home NHMP*, earthquakes were ranked in second place, tied with floods. In the HVA for the *2021 Sweet Home NHMP*, earthquakes were ranked fourth out of seven hazards.

The *2015 Sweet Home NHMP* did not include specific events listed for natural hazards; the *2021 Sweet Home NHMP* includes a table of natural hazards events in each annex.

Oregon and the Pacific Northwest in general are susceptible to earthquakes from these sources: 1) shallow crustal fault slippage events within the North American Plate; 2) deep intra-plate events within the subducting Juan de Fuca Plate; 3) the off-shore Cascadian Subduction Zone[2]; and 4) earthquakes related to volcanic activity can also affect the region.[3]

[1] DOGAMI, *Natural Hazard Risk Report for Harney County, OR: Including the Cities of Burns, Hines, and the Burns Paiute Reservation and Trust Lands*, May 15, 2018.

[2] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, p. 8-9, https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

[3] DOGAMI, *Earthquakes in Oregon*, https://www.oregongeology.org/earthquakes/earthquakehome.htm.

Crustal Fault Earthquakes

Crustal fault earthquakes are the most common earthquakes and occur at relatively shallow depths of 6-12 miles below the surface.[4] When crustal faults slip, they can produce earthquakes of magnitudes up to 7.0. Although most crustal fault earthquakes are smaller than 4.0 and generally create little or no damage, some of them can cause extensive damage. Crustal earthquakes occur in the North American plate at relatively shallow depths of 10–20 km (6–12 mi) below the surface. Two sizable crustal earthquakes occurred in 1993 in Oregon: the Scotts Mills earthquake at magnitude 5.6 and the Klamath Falls earthquakes at magnitude 5.9 and 6.0.[5]

Deep Intraplate Earthquakes

Occurring at depths from 18 to 60 miles below the earth's surface in the subducting oceanic crust, deep intraplate earthquakes can reach magnitude 7.5.[6] This type of earthquake is more common in the Puget Sound; in Oregon these earthquakes occur at lower rates and have none have occurred at a damaging magnitude.[7] The February 28, 2001 earthquake in Nisqually, Washington was a deep intraplate earthquake. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah.[8]

Subduction Zone Earthquakes

The Pacific Northwest is located at a convergent continental plate boundary, where the Juan de Fuca and North American tectonic plates meet. The two plates are converging at a rate of about 1.5 inches per year[9]. This boundary is called the Cascadia Subduction Zone (CSZ). It extends from British Columbia to northern California. See Figure EQ-1 for an illustration. Earthquakes are caused by the abrupt release of this slowly accumulated stress.

Earthquakes Related to Volcanoes

Volcanic eruptions can be triggered by seismic activity or earthquakes can occur during or after a volcanic eruption. Earthquakes produced by stress changes are called volcano-tectonic earthquakes. These earthquakes, typically small to moderate in magnitude, occur as rock is moving to fill in spaces where magma is no longer present and can cause land to subside or produce large ground cracks.[10] In addition to being generated after an eruption and magma withdrawal, these earthquakes also occur as magma is intruding upward into a volcano, opening cracks and pressurizing systems.[11]

[4] Madin, Ian P. and Zhenming Wang, *Relative Earthquake Hazard Maps Report*, DOGAMI, 1999.

[5] DOGAMI, *Earthquakes in Oregon*, https://www.oregongeology.org/earthquakes/earthquakehome.htm.

[6] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, p. 8-8, https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

[7] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

[8] Hill, Richard, *Geo Watch Warning Quake Shook Portland 40 Years Ago*, The Oregonian. October 30, 2002.

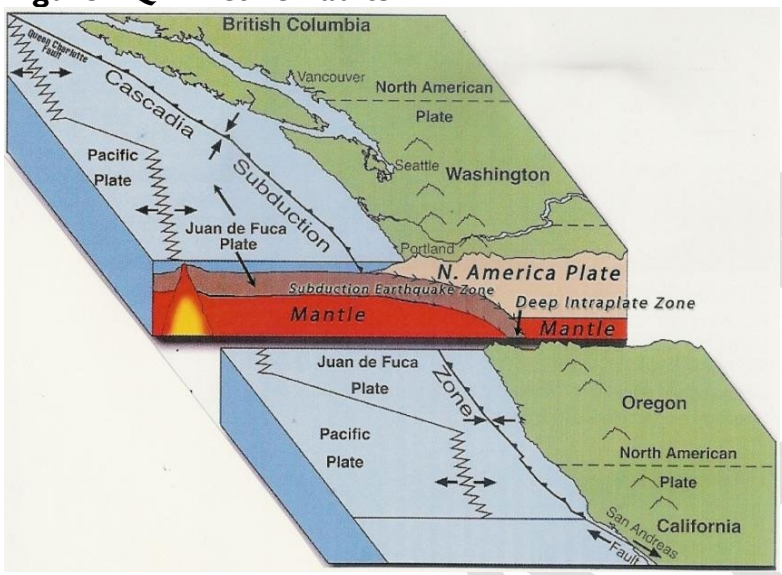
[9] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

[10] Riley, Colleen M., *A Basic Guide to Volcanic Hazards*, Michigan Technological University, http://www.geo.mtu.edu/volcanoes/vc_web/overview/o_health.html.

[11] Scott, W. E., USGS Cascades Volcano Observatory, personal communication, 7/5/01.

Volcano-tectonic earthquakes do not indicate that the volcano will be erupting but can occur at any time and cause damage to manmade structures or provoke landslides.

Figure EQ-1 Active Faults



Source: Cascadia Region Earthquake Workgroup (2005), http://www.oregongeology.org/pubs/ofr/O-05-05.pdf

Although there have been no large recorded earthquakes along the offshore Cascadia Subduction Zone, similar subduction zones worldwide do produce "great" earthquakes with magnitudes of 8 or larger. Historic subduction zone earthquakes include the 1960 Chile earthquake (magnitude 9.5), the 1964 southern Alaska (magnitude 9.2) earthquakes, the 2004 Indian Ocean earthquake (magnitude 9.0) and the 2011 Tohoku earthquake (magnitude 9.0). Returning to closer to home, geologic evidence shows that the Cascadia Subduction Zone has generated great earthquakes, most recently about 300 years ago.[12] Large earthquakes also occur at the southern end of the Cascadia Subduction Zone (in northern California near the Oregon border) where it meets the San Andreas Fault system.

These earthquakes occur because the oceanic crust "sticks" as it is being pushed beneath the continent, rather than sliding smoothly. Over hundreds of years, large stresses build which are released suddenly in great earthquakes. Such earthquakes typically have a minute or more of strong ground shaking, and are quickly followed by numerous large aftershocks.

While all three types of earthquakes have the potential to cause major damage, subduction zone earthquakes pose the greatest danger. A major event could generate an earthquake with a magnitude of 9.0 or greater resulting in devastating damage and loss of life. Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon. Sweet

[12] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

Home is likely to be directly affected by a subduction zone earthquake. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes.[13]

The specific hazards associated with an earthquake are:

- ground shaking,
- ground shaking amplification,
- surface faulting,
- liquefaction and subsidence, and
- earthquake induced landslides and rockfalls.

The specific hazards associated with an earthquake are explained below. Overall, all things considered, the level of seismic hazard in Sweet Home is relatively high. Shaking and building impacts are notable. Most of the damage in earthquakes occurs directly because of ground shaking which affects buildings and infrastructure. However, there are several other aspects of earthquakes that can result in very high levels of damage in localized sites: liquefaction, landslides, dam failures and tsunamis.

The *2015 Sweet Home NHMP* describes there is an earthquake hazard description for Benton, Lane and Linn Counties that is reviewed in detail in Chapter 3 of the *Regional Mitigation Plan, Phase Two Technical Appendix, Benton, Lane and Linn Counties Oregon, Seismic Loss Potential* (2001). Additional and more current information can also be found in the *2020 Oregon NHMP* in the Region 3 Risk Assessment and in this *2021 Sweet Home NHMP*.

Ground Shaking

Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. Ground shaking is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault that is slipping, and distance from the epicenter (where the earthquake originates). Buildings on poorly consolidated and thick soils will typically see more damage than buildings on consolidated soils and bedrock. Figure EQ-6 is the Earthquake Hazard: Probability Damaging Shaking map for Sweet Home. Figure EQ-7 is the Earthquake Hazard: Spectral Acceleration map. Spectral acceleration "is approximately what is experienced by a building, as modeled by a particle on a massless vertical rod having the same natural period of vibration as the building."[14]

Another definition of spectral acceleration is:

> "Spectral acceleration(SA) is a unit measured in *g* (the acceleration due to earth's gravity, equivalent to g-force) that describes the maximum acceleration in an earthquake on an object – specifically a damped, harmonic oscillator moving in one physical dimension. This can be measured at (or specified for) different oscillation frequencies and with different degrees of damping, although 5% damping is commonly applied. Spectral acceleration, with a value related to the natural frequency of vibration of the building, is used in earthquake

[13] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, p. 8-9, https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909.

[14] USGS, *Earthquake Hazards Program*, spectral acceleration definition, Earthquake Glossary (usgs.gov) accessed 8/16/21

engineering and gives a closer approximation to the motion of a building or other structure in an earthquake than the peak ground acceleration value."[15]

As described in the *2015 Sweet Home NHMP*, damage levels experienced in an earthquake vary with the intensity of ground shaking and with the seismic capacity of structures. Ground motions of only 1 or 2% g are widely felt by people; hanging plants and lamps swing strongly. Damage levels, if any, are usually very low. Ground motions below about 10% g usually cause only slight damage. Ground motions between about 10% g and 30% g may cause minor to moderate damage in well-designed buildings, with higher levels of damage in poorly designed buildings. Ground motions above about 30% g may cause significant damage in well-designed buildings and very high levels of damage (including collapse) in poorly designed buildings. Ground motions above about 50% g may cause high levels of damage in most buildings, even those designed to resist seismic forces.

Both maps, Figures EQ-6 and EQ-7, are included at the end of the Earthquake Annex.

Ground Shaking Amplification

Ground shaking amplification refers to the soils and soft sedimentary rocks near the surface that can modify ground shaking from an earthquake. Such factors can increase or decrease the amplification (i.e., strength) as well as the frequency of the shaking. The thickness of the geologic materials and their physical properties determine how much amplification will occur. Ground motion amplification increases the risk for buildings and structures built on soft and unconsolidated soils.

> The amount of damage sustained by a building during a strong earthquake is difficult to predict and depends on the size, type and location of the earthquake, the characteristics of the soils at the building site, and the characteristics of the building itself.
>
> DOGAMI, https://www.oregongeology.org/earthquakes/earthquakehome.htm, 7/31/19

Surface Faulting

Surface faulting are planes or surfaces in Earth materials along which failure occurs. Such faults can be found deep within the earth or on the surface. Earthquakes occurring from deep lying faults usually create only ground shaking.

An article published by DOGAMI and others in September 2018 describes a newly discovered fault zone on Mount Hood. The fault zone includes two faults, the Blue Ridge and the Twin Lakes Faults. The discovery of "this active fault system is important for understanding the potential seismic threat for nearby communities." Based on the estimates of the earthquake capability, which are based on observations of average displacement and surface rupture, the fault could produce an earthquake of 6.5 or greater.[16]

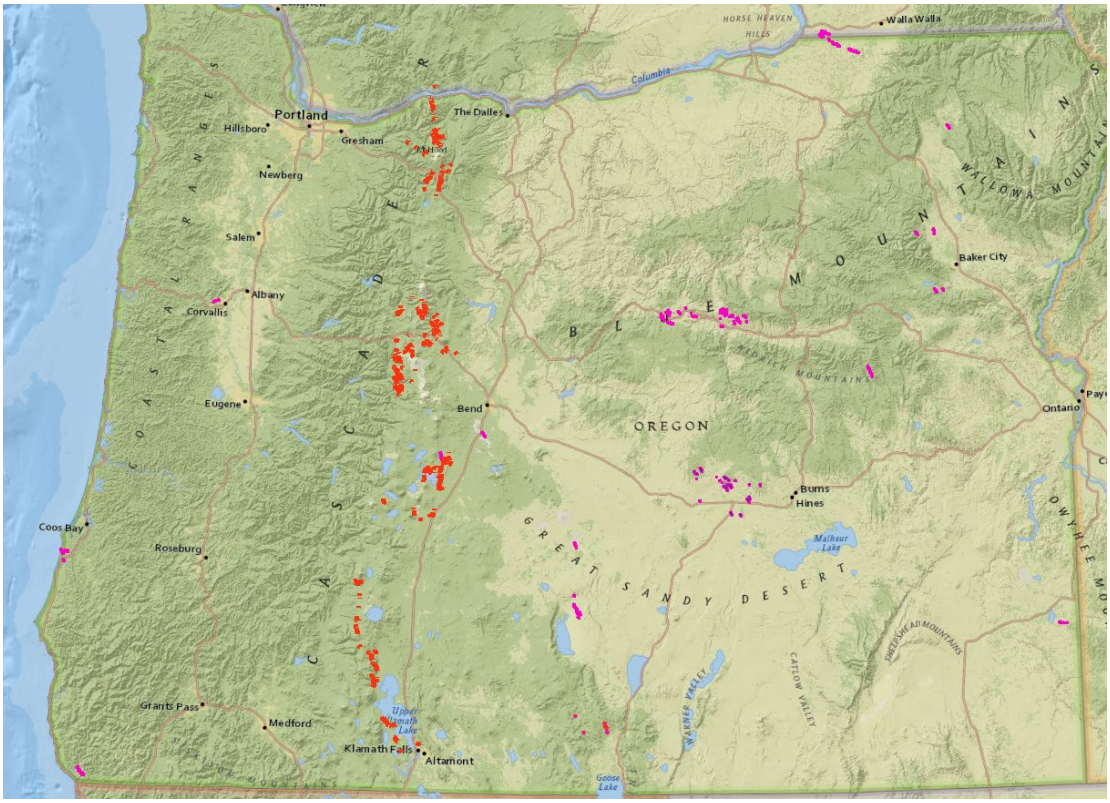
While it is distant from major population centers, the fault zone "poses serious seismic threat to the cities of Hood River, Odell, Parkdale, White Salmon, Stevenson, Cascade Locks, Government Camp, and the Villages at Mount Hood" as well as highway and rail transportation corridors in the Columbia Gorge, power generation facilities at Bonneville Dam, storage reservoirs, and the City of

[15] Wikipedia, Spectral Acceleration, Spectral acceleration - Wikipedia, accessed 8/16/21

[16] Madin, Ian, Ashley Streig, William J. Burns, and Lina Ma, *The Mount Hood Fault Zone – Late Quaternary and Holocene Fault Features Newly mapped with High-Resolution Lidar Imagery*.

Portland's drinking water system in Bull Run. Impacts to these areas would likely have impacts to other parts of Oregon.[17] Figure EQ-2 shows the faults in Oregon identified by DOGAMI using Lidar.

Figure EQ-2 Map of Faults in Oregon Identified with Lidar



Source: Ian Madin, DOGAMI, personal communication, October 30, 2018

The faults in Linn County are shown in Figure EQ-8 Earthquake Hazard: Fault Lines Geology. Some fault lines are within the Sweet Home city limits. The map is included at the end of the Earthquake Annex.

Liquefaction and Subsidence

Liquefaction occurs when ground shaking causes wet, granular soils to change from a solid state into a liquid state. This results in the loss of soil strength and the soil's ability to support weight. When the ground can no longer support buildings and structures (subsidence), buildings and their occupants are at risk. Liquefaction susceptibility in Sweet Home is shown on two maps, Figure EQ-5 Earthquake Hazard: Liquefaction Permanent Deformation and Figure EQ-4 Liquefaction Probability. The maps are included at the end of the Earthquake Annex. According to the *2015 Sweet Home NHMP.* "A DOGAMI study of liquefaction found virtually nil potential for liquefaction in the Sweet Home area because the soils are predominantly course gravels not subject to liquefaction (DOGAMI, Relative Earthquake Hazard Maps for selected urban areas in Western Oregon (IMS-8, 1999)."

[17] Ibid.

Earthquake-Induced Landslides and Rockfalls

Earthquake-induced landslides are secondary hazards that occur from ground shaking and can destroy roads, buildings, utilities and critical facilities necessary to recovery efforts after an earthquake. Some Linn County communities are built in areas with steep slopes. These areas often have a higher risk of landslides and rockfalls triggered by earthquakes.

Factors for Severity of an Earthquake

The severity of an earthquake is dependent upon a number of factors including: 1) the distance from the earthquake's source (or epicenter); 2) the ability of the soil and rock to conduct the earthquake's seismic energy; 3) the degree (i.e., angle) of slope materials; 4) the composition of slope materials; 5) the magnitude of the earthquake; and 6) the type of earthquake.[18]

History of Earthquakes in Oregon, Linn County, and Sweet Home

The Pacific Northwest has experienced major earthquakes in 1949 (magnitude 7.1), 1962 (magnitude 5.2), and 2001 (magnitude 6.8). Table EQ-1 shows the date, location, size, and description of selected earthquakes that have occurred in Oregon and Washington.

All of Oregon west of the Cascades is at risk from the four earthquake types and associated hazards. East of the Cascades the earthquake hazard is predominately of the crustal type. No deep intraplate earthquakes have occurred in Oregon at a recordable magnitude. A subduction zone earthquake is anticipated to occur off the Oregon and Washington coasts in the next 50 years, as described below in the "Probability Assessment." The amount of earthquake damage at any place will depend on its distance from the epicenter, local soil conditions, and types of construction. Due to Oregon's relatively short written history and the infrequent occurrence of severe earthquakes, few Oregon earthquakes have been recorded in writing. Of note, the 6.0 earthquake from Klamath Falls in 1993 is the largest regional earthquake in the last 30 years.

The *2015 Sweet Home NHMP* describes there is an earthquake hazard for Benton, Lane and Linn Counties that is reviewed in detail in Chapter 3 of the *Regional Mitigation Plan, Phase Two Technical Appendix, Benton, Lane and Linn Counties Oregon, Seismic Loss Potential* (2001). Included in the seismic risk assessment for Benton, Lane, and Linn Counties is an estimated extent of damage and casualties likely in each of the two scenario earthquakes on the Cascadia Subduction Zone: a M8.5 interface earthquake and a M7.5 intraplate earthquake.

The *2015 Sweet Home NHMP* states, "These (Cascadia Subduction Zone) earthquakes occur at about 20 to 60 kilometers (12 to 40 miles) offshore from the Pacific Ocean coastline. Ground shaking from such earthquakes would be very strong near the coast and moderately strong ground shaking would be felt throughout Linn County, with the level of shaking decreasing towards eastern Linn County."

Figure EQ-3 is Figure 10-2 from the *2015 Sweet Home NHMP* and it shows the location of Lane, Benton, and Linn Counties in relationship to the Juan de Fuca plate.

[18] Burns, et al, 2007. Unpublished Report. *Geologic Hazards, Earthquakes and Landslide Hazard Maps, and Future Earthquake Damage and Loss Estimates for three Counties in the southeastern Region including Lake, Malheur, and Harney*. DOGAMI Open File Report.

Figure EQ-3 Cross Section of Seismicity Centered on Latitude 45.5 with Inferred Location of Subduction Portion of Juan de Fuca Plate

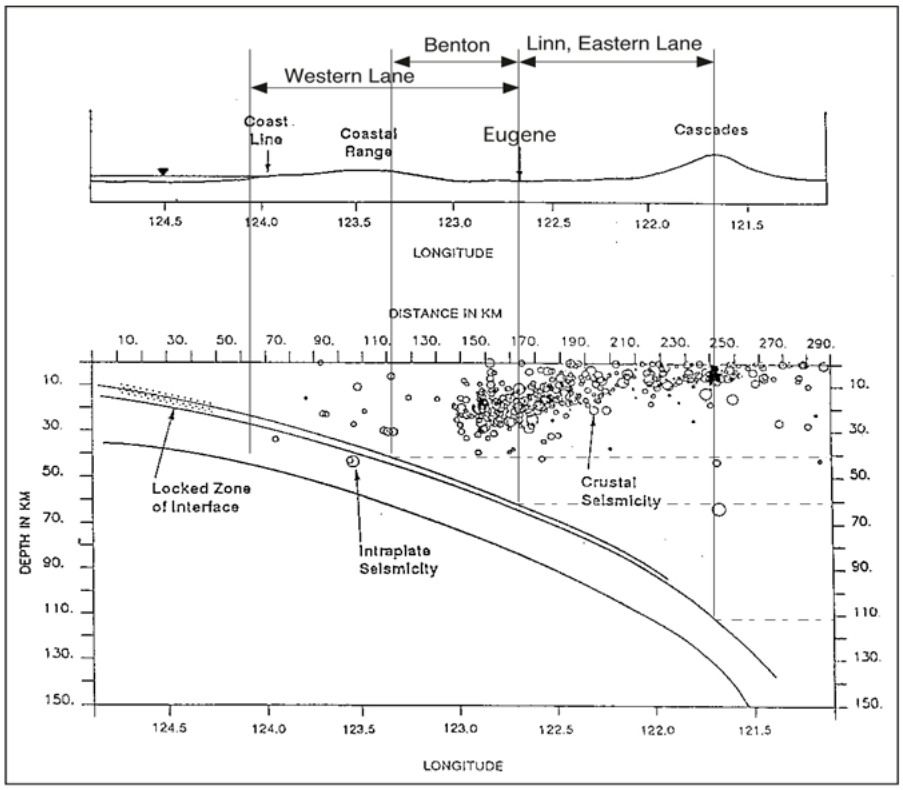


Figure 10-2. Cross Section of Seismicity Centered on Latitude 45.5 with Inferred Location of Subduction Portion of Juan de Fuca Plate

Source: *2015 Sweet Home NHMP*

Table EQ-1 shows selected earthquakes in the Pacific Northwest that have been documented.

Table EQ-1 Significant Historic Earthquakes

Date	Location	Size (M)	Description
Approx: 1400 BCE*, 1050 BCE, 600 BCE, 400. 750, 900	Offshore Cascadia Subduction Zone (CSZ)	Probably 8.0-9.0	Based on studies of earthquake and tsunami at Willapa Bay, Washington. These are the mid-points of the age ranges for these six events.
Jan. 1700	CSZ	About 9.0	On January 26, 1700, an approximately 9.0 earthquake generated a tsunami that struck Oregon, Washington, and Japan. Destroyed Native American villages along the coast.
Nov. 1873	Brookings, OR	7.3	Impacts: chimneys fell in Port Orford, Grants Pass, and Jacksonville; no aftershocks; origin probably in the Gorda block of the Juan de Fuca plate; intraplate event.
Oct. 1897	Gresham, OR	6.7	Occurred on October 12, 1897.
Feb, 1892	Portland, OR	5.6	Occurred on February 4, 1892.
Mar. 1893	Umatilla, OR	5.7	Occurred on March 7, 1893.
1906	Lakeview, OR	unrecorded	Lakeview area experienced an earthquake.
May 1916	Richland, WA	5.7	Earthquake on May 13, 1916 centered on Richland, WA.

Date	Location	Size (M)	Description
Apr. 1920	Fort Klamath, OR	5.0	Three shocks felt at Fort Klamath; the center was probably in the vicinity of Crater Lake.
1923	Lakeview, OR	unrecorded	Lakeview area experienced an earthquake.
Jul. 1936	Milton-Freewater, OR	6.1	The earthquake occurred on July 16, 1936. There were two foreshocks and many aftershocks felt. Damages were approximately $100,000 (1936 dollars).
Apr. 1949	Olympia, WA	7.1	Significant damage in Washington, including eight deaths. Minor damage in NW Oregon.
Jan. 1951	Hermiston, OR	V on the Modified Mercalli Intensity	Damage unknown.
Dec. 1953	Portland, OR	5.6	Occurred on December 16, 1953.
1958	Adel, OR	4.5	Adel experienced an earthquake with a magnitude 4.5.
Nov. 1962	Vancouver, WA	5.5	Occurred on November 5, 1962. Centered in Vancouver and felt in the metro area, including Portland.
Oct. 1964	Portland, OR	5.3	Occurred on October 1, 1964 on Sauvie Island in the Columbia River
Apr. 1965	Seattle-Tacoma, WA	6.5	3 people killed. Only felt shaking in Multnomah County.
May 1968	Near Lakeview, OR	5.1	A swarm of earthquakes occurred on May 30, 1968 and lasted through July, decreasing in intensity. Earthquake near the Adel-Warner Lakes in south central Oregon. Largest of the tremors was 5.1.
Apr. 1976	Near Maupin, OR	4.8	Sounds described as distant thunder, sonic booms, and strong wind.
Feb. 1981	Mt. St. Helens, WA	5.5	Occurred on February 13, 1981. Centered near Mt. St. Helens and shook the Portland area.
Apr. 1992	Cape Mendocino, CA	7.0	Subduction earthquake at the triple junction of the Cascadia Subduction Zone, San Andreas, and Mendocino faults.
Mar. 1993	Scotts Mills, OR	5.6	DR-985. On Mt. Angel-Gales Creek fault. $30 million damage (including Oregon Capitol Building in Salem). Magnitude 5.6 centered near Woodburn occurred on March 23, 1993.
Sep. 1993	Klamath Falls, OR	6.0	DR-1004. Two earthquakes in Klamath Falls, 2 people killed. Occurred on September 20, 1993. Magnitude 6.0 centered 10 mi NW of Klamath Falls and caused damaged to the courthouse and county offices. Magnitude 5.9 centered 15 mi NW of Klamath Falls closed highways and bridges.
Apr 1999	Christmas Valley	3.9	Christmas Valley experienced a swarm of at least six earthquakes. The highest magnitude earthquake was 3.8.
Feb. 2001	Nisqually, WA	6.8	Felt in the region. No damage reported.
Jun 2004	Lakeview, OR	4.4	Lakeview residents experienced a swarm of at least 20 earthquakes. The source of the earthquakes was SE of Lakeview near the Warner Mountains. The highest magnitude earthquake was 4.4.
May 2007	Lakeview, OR	3.4	Lakeview experienced a small swarm of earthquakes. The highest magnitude earthquake was 3.4.

*BCE: Before the Common Era.
Sources: Wong and Bolt, 1995; DLCD, Oregon NHMP, 2020; FEMA, Disaster Declarations for Oregon, retrieved 2021.

The Pacific Northwest Seismic Network (PNSN) website has a tool to search for recent (https://pnsn.org/earthquakes/recent) and historic earthquakes that have been recorded in the PNSN reporting area. The reporting area for PNSN is shown in an interactive map on the website. DLCD Natural Hazards Planner, Tricia Sears, performed a search, with the parameter of recorded earthquakes between magnitude 3 and 10 that have occurred from February 14, 1969 to August 16, 2021; the results identified 13 earthquakes that have occurred. The location, date and time, magnitude, depth, and other information related to each earthquake is provided in the list that is generated. The interactive map provides options to vary the search parameters. The area delineated

for this search was in a rectangle with the latitude of minimum of 43.9 and maximum of 45.0, and with the longitude of minimum 123.3 and maximum of 122.2.

Risk Assessment

How are Hazards Identified?

The Oregon Department of Geology and Mineral Industries (DOGAMI), in partnership with other state and federal agencies, has undertaken a rigorous program in Oregon to identify seismic hazards, including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. DOGAMI has published a number of seismic hazard maps that are available for Oregon communities to use. The maps show liquefaction, ground motion amplification, landslide susceptibility, and relative earthquake hazards.

Sweet Home and DLCD used the DOGAMI Statewide Geohazards Viewer to create maps of:

- EQ-4 Earthquake Hazard: Liquefaction Probability
- EQ-5 Earthquake Hazard: Liquefaction Permanent Deformation
- EQ-6 Earthquake Hazard: Probability Damaging Shaking
- EQ-7 Earthquake Hazard: Spectral Acceleration
- EQ-8 Earthquake Hazard: Fault Lines Geology

The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event.

Hazard Risk Analysis

The Sweet Home NHMP Steering Committee completed a Hazard Vulnerability Assessment/Analysis (HVA) during this NHMP update. This was described in Section 2 Risk Assessment. The method used for the HVA was developed from a Federal Emergency Management Agency (FEMA) tool that has been refined by the Oregon Office of Emergency Management (OEM). It addresses and weights (shown as percent within parentheses) probability (29%), vulnerability (21%), maximum threat (42%) and the history (8%) of each natural hazard and attributes a final hazard analysis score. The methodology produces scores that range from 24 to 240.

For local governments, conducting the HVA is a useful step in planning for hazard mitigation. The method provides the jurisdiction with a relative ranking from which to prioritize mitigation actions, but does not predict the occurrence of a particular hazard.

In the *2015 Sweet Home NHMP*, earthquakes were ranked in second place, tied with floods. In the HVA for the *2021 Sweet Home NHMP*, earthquakes were ranked fourth out of seven hazards.

For more information on all the risk scores and ranks of the natural hazards, see Volume I Basic Plan, Section 2 Risk Assessment of this NHMP.

Probability Assessment

Paleoseismic studies along the Oregon coast indicate that the state has experienced seven Cascadia Subduction Zone (CSZ) events possibly as large as M9 in the last 3,500 years. These events are estimated to have an average recurrence interval between 500 and 600 years, although the time interval between individual events ranges from 150 to 1,000 years. The last CSZ event occurred

approximately 300 years ago. Scientists estimate the chance in the next 50 years of a great subduction zone earthquake is between 10 and 20 percent, assuming that the recurrence is on the order of 400 +/- 200 years.[19]

It is simply not scientifically feasible to predict, or even estimate, when the next CSZ earthquake will occur, but research efforts show the calculated odds that a CSZ earthquake will occur in the next 50 years range from 7-15 percent for a great earthquake affecting the entire Pacific Northwest to about 37 percent for a very large earthquake affecting southern Oregon and northern California. The likelihood of a M9 CSZ earthquake and the consequences of such an earthquake are both so great that it is prudent to consider the CSZ earthquake when designing new structures or retrofit of existing structures, evaluating the seismic safety of existing structures, or planning emergency response and preparedness.[20]

New research from Oregon State University suggests that the CSZ has at least four segments that sometimes rupture independently of one another. Magnitude-9 ruptures affecting the entire subduction zone have occurred 19 times in the past 10,000 years. Over that time, shorter segments have ruptured farther south in Oregon and Northern California, producing magnitude-8 quakes. As such, the risks of a subduction zone earthquake may differ from north to south. Earthquakes originating in the northern portion of the CSZ tend to rupture the full length of the subduction zone. In southern Oregon and Northern California, quakes along the subduction zone appear to strike more frequently.[21]

In August 2016, new analysis about CSZ earthquakes, from Oregon State University (OSU), was published. The analysis suggests that CSZ earthquakes affecting more heavily populated areas are slightly more frequent than previously thought. These findings show the chances of an earthquake in the next 50 years have increased. "For central and northern Oregon, the chance of a seismic event during that period has been changed to 15-20 percent instead of 14-17 percent. In the zone area within Washington and British Columbia, the chance of an event has increased to 10-17 percent from 8-14 percent."[22]

According to Chris Goldfinger of OSU, "These new results are based on much better data than has been available before, and reinforce our confidence in findings regarding the potential for major earthquakes on the Cascadia Subduction Zone, especially the northern parts. The frequency, although not the intensity, of earthquakes there appears to be somewhat higher than we previously estimated."[23]

[19] DOGAMI, *Oregon Geology*, Volume 64, No. 1, Spring 2002, https://www.oregongeology.org/pubs/og/p-OG.htm

[20] Oregon Seismic Safety Policy Advisory Commission (OSSPAC), *The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami, Report to the 77th Legislative Assembly*, February 2013, https://www.oregon.gov/oem/documents/oregon_resilience_plan_final.pdf

[21] Rojas-Burke, Joe, *Predicting the next Northwest mega-quake still a struggle for geologists*, The Oregonian. April 20, 2010.

[22] Meny, E. (2016, August 5). *Subduction zone earthquakes more frequent than originally thought, OSU finds*. KVAL-TV. Retrieved from http://kval.com/news/local/osu-researchers-find-subduction-zone-earthquakes-more-frequent-than-originally-thought

[23] Ibid.

Establishing a probability for crustal earthquakes is more difficult. Oregon's seismic record is short and the number of earthquakes above a magnitude 4 centered in the southeastern Oregon region is small. Therefore, with such limited data, any kind of prediction would be questionable. Earthquakes generated by volcanic activity in Oregon's Cascade Range are possible, but likewise unpredictable.

In the Risk Assessment in the *2020 Oregon NHMP*, Region 3, the Mid/Southern Willamette Valley,

> The CSZ is the chief earthquake hazard for the Mid/Southern Willamette Valley. This area is particularly vulnerable due to the large area susceptible to earthquake-induced landslide, liquefaction, and ground shaking. In a 500-year model for a CSZ event or combined crustal events, five of the 15 counties with highest expected damages and losses are in this region: Lane, Marion, Benton, Linn, and Yamhill. Seismic lifelines will be affected by prolonged ground shaking with several roadways susceptible to landslide, rockfall, or liquefaction. In Region 3, a CSZ event could cause a potential loss of almost $843M in state building and critical facility assets, 93% of it in Marion County alone. The potential loss in local critical facilities is somewhat greater at almost $1.2B. Again, Marion County's potential loss is greatest at 48%. Potential losses in Lane Line, Polk, and Yamhill Counties are similar, ranging 9-14%. Benton County's potential loss is significantly less.[24]

The NHMP Steering Committee described that there is not an earthquake in the recent past nor do they feel small ones regularly. However, the NHMP Steering Committee noted that the vulnerability and maximum impact is high. There were concerns about high impacts such as landslides, road closures, downed power supplies, damage to the water treatment and wastewater treatment plans, and limitations to resources.

Vulnerability Assessment

The effects of earthquakes span a large area. The degree to which earthquakes are felt, however, and the damages associated with them may vary. At risk from earthquake damage are unreinforced masonry buildings, bridges built before earthquake standards were incorporated into building codes, sewer, water, and natural gas pipelines, petroleum pipelines, and other critical facilities and private property located within Sweet Home and Linn County.

Earthquake damage to roads and bridges can be particularly serious by hampering or cutting off the movement of people and goods and disrupting the provision of emergency response services. Such effects in turn can produce serious impacts on the local and regional economy by disconnecting people from work, home, food, school and needed commercial, medical and social services. A major earthquake can separate businesses and other employers from their employees, customers, and suppliers thereby further hurting the economy. Should an earthquake damage transportation routes, people in Sweet Home could find themselves isolated. Following an earthquake event, the cleanup of debris can be a huge challenge for the community.

Building Collapse Potential

In 2007, DOGAMI completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon Legislature in Senate Bill 2 (2005). RVS is a

[24] *2020 Oregon NHMP*, Regional Risk Assessments, Region 3 Mid/Southern Willamette Valley, 2020 Oregon NHMP, accessed 8/16/21

technique used by the Federal Emergency Management Agency (FEMA), known as FEMA 154, to identify, inventory, and rank buildings that are potentially vulnerable to seismic events.

DOGAMI scored each building with a 'low,' 'moderate,' 'high,' or 'very high' potential of collapse in the event of an earthquake. It is important to note that these rankings represent a probability of collapse based on limited observed and analytical data and are therefore approximate rankings.[25] To fully assess a building's potential of collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to retrofit.

There are Seismic Rehabilitation Grants available through the State of Oregon's competitive Seismic Rehabilitation Grant Program (SRGP; see below for more information). See end of this annex and Appendix D for more information.

Community Earthquake Issues

Earthquake damage occurs because humans have built structures that cannot withstand severe shaking. Buildings, airports, schools, and lifelines (highways, phone lines, gas, water, etc.) suffer damage in earthquakes and can ultimately result in death or injury to humans.

Death and Injury

Death and injury can occur both inside and outside of buildings due to falling equipment, furniture, debris, and structural materials. Likewise, downed power lines or broken water and gas lines endanger human life. Death and injury are highest in the afternoon when damage occurs to commercial and residential buildings and during the evening hours in residential settings.[26]

Building Damage

Wood structures tend to withstand earthquakes better than structures made of brick or unreinforced masonry buildings.[27] Building construction and design play a vital role in the survival of a structure during earthquakes. Damage can be quite severe if structures are not designed with seismic reinforcements or if structures are located atop soils that liquefy or amplify shaking. Whole buildings can collapse or be displaced.

For the *2021 Sweet Home NHMP*, City Engineer Joe Graybill checked the building permit records of the last 10-15 years to see if there were seismic upgrades made to buildings in Sweet Home. According to Graybill, no seismic upgrades have been done during that time except for the upgrades done by the Sweet Home School District. Appendix E Sweet Home Success Stories describes the schools that had seismic upgrades made.[28]

[25] State of Oregon Department of Geologic and Mineral Industries, *Implementation of 2005 Senate Bill 2 Relating to Public Safety, Seismic Safety and Seismic Rehabilitation of Public Building,* May 22, 2007, Open File Report 0-07-02.
[26] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, p. 8-9, https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909.

[27][27] Wolfe, Myer, et al. *Land Use Planning for Earthquake Hazard Mitigation: A Handbook for Planners*, Special Publication 14, Natural Hazards Research and Applications Information Center, https://scholarcommons.usf.edu/fmhi_pub/82/.

[28] Joe Graybill, Sweet Home, personal communication, 8/30/21

Bridge Damage

All bridges can sustain damage during earthquakes, leaving them unsafe for use. More rarely, some bridges have failed completely due to strong ground motion. Bridges are a vital transportation link – damage to them can make some areas inaccessible.

Because bridges vary in size, materials, siting, and design, earthquakes will affect each bridge differently. Bridges built before the mid 1970's often do not have proper seismic reinforcements. These bridges have a significantly higher risk of suffering structural damage during a moderate to large earthquake. Bridges built in the 1980's and after are more likely to have the structural components necessary to withstand a large earthquake.[29]

Damage to Lifelines

Lifelines are the connections between communities and critical services such as water and gas lines, transportation systems, electricity, and communication networks. Ground shaking and amplification can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio or telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. Functioning lifelines allow for rescue, recovery, and rebuilding efforts and to relay important information to the public. In the *2021 Sweet Home NHMP*, Section 2 Risk Assessment includes this information specific to Sweet Home; see Table 2-7, Critical /Essential Facilities, Critical Infrastructure, and Vulnerable Population Centers.

Disruption of Critical Facilities, Infrastructure, and Lifelines

Critical facilities sometimes referred to as essential facilities, are police stations, fire stations, hospitals, and shelters. These are facilities that provide services to the community and need to be functional after an earthquake event. The earthquake effects outlined above can cause emergency response to be disrupted.[30] Section 2 Risk Assessment includes Table 2-7, Critical Facilities, Critical Infrastructure, and Lifelines and more details on them.

Economic Loss: Equipment and Inventory Damage, Lost Income

Seismic activity can cause great loss to businesses, either a large-scale corporation or a small retail shop. Losses not only result in rebuilding cost, but fragile inventory and equipment can be destroyed. When a company is forced to stop production for just a day, business loss can be tremendous. Residents, businesses, and industry all suffer temporary loss of income when their source of finances are damaged or disrupted.

Fire

Downed power lines or broken gas mains can trigger fires. When fire stations suffer building or lifeline damage, quick response to quench fires is less likely.

[29] University of Washington, www.geophys.washington.edu/SEIS/PNSN/INFO_GENERAL/faq.html#3, the legacy domains of geology.washington.edu and geophys.washington.edu are no longer fully functional; rather they will now simply redirect you to this page, accessed 7/12/19.

[30] DOGAMI, Yumei Wang and J.L. Clark, *Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses*, https://www.oregongeology.org/pubs/sp/SP-29.pdf.

Debris

After damage occurs to a variety of structures, access may be limited in many places. It will take time to clean up brick, glass, wood, steel or concrete building elements, office and home contents, and other materials.

Disruption of Critical Facilities

Critical facilities are police stations, fire stations, hospitals, and shelters. These are facilities that provide services to the community and need to be functional after an earthquake event. The earthquake effects outlined above can all cause emergency response to be disrupted after a significant event.[31] More information about Sweet Home's critical infrastructure and evacuation routes can be found in Section 2 Risk Assessment.

Economic Loss: Equipment and Inventory Damage, Lost Income

Seismic activity can cause great loss to businesses, either a large-scale corporation or a small retail shop. Losses not only result in rebuilding cost, but fragile inventory and equipment can be destroyed. When a company is forced to stop production for just a day, business loss can be tremendous. Residents, businesses, and industry all suffer temporary loss of income when their source of finances are damaged or disrupted.

Fire

Downed power lines or broken gas mains can trigger fires. When fire stations suffer building or lifeline damage, quick response to quench fires is less likely.

Debris

After damage occurs to a variety of structures, much time is spent cleaning up brick, glass, wood, steel or concrete building elements, office and home contents, and other materials.

Existing Hazard Mitigation Activities and Resources

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public, and provide solutions to increase safety in the event of an earthquake.[32]

Ordinances

The Sweet Home Code of Ordinances (which includes zoning and other provisions) is located here: Sweet Home, OR Laws (amlegal.com)

[31] DOGAMI, Yumei Wang and J.L. Clark, *Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses*, https://www.oregongeology.org/pubs/sp/SP-29.pdf

[32] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, p. 8-20. https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

Studies/Reports

The USGS *Open File Report for Quaternary Faults and Folds in Oregon* contains a map that shows faults and folds in the state of Oregon that exhibit evidence of Quaternary deformation, and includes data on timing of most recent movement, sense of movement, slip rate, and continuity of surface expression. The primary purpose of this compilation is for use in earthquake-hazard evaluations. Paleoseismic studies, which evaluate the history of surface faulting or deformation along structures with evidence of Quaternary movement, provide a long-term perspective that augments the short historic records of seismicity in many regions. Published or publicly available data are the primary sources of data used to compile this report.
https://pubs.usgs.gov/of/2003/ofr-03-095/

Oregon Senate Bill 2, Statewide Seismic Needs Assessment Using Rapid Visual Screening (RVS) (2005) directed DOGAMI, in consultation with project partners, to develop a statewide seismic needs assessment that included seismic safety surveys of K-12 public school buildings and community college buildings that had, at the time, a capacity of 250 or more persons, hospital buildings with acute inpatient care facilities, fire stations, police stations, sheriffs' offices and other law enforcement agency buildings.
https://www.oregonlegislature.gov/bills_laws/lawsstatutes/2005orLaw0763ses.html.

In 2007, DOGAMI released the Statewide Seismic Needs Assessment Using Rapid Visual Screening (RVS), which contains a preliminary assessment of the seismic resilience of critical infrastructure in each county in Oregon. For more information on the Statewide Seismic Assessment Using Rapid Visual Screenings, see https://www.oregongeology.org/rvs/default.htm.

State Natural Hazard Risk Assessment

The risk assessment in the *2020 Oregon Natural Hazards Mitigation Plan* provides an overview of seismic risk in Oregon and identifies the most significant earthquakes in Oregon's recorded history. It has overall state and regional information, and includes earthquake related mitigation actions for the entire state. 2020 Oregon NHMP

Published in 2013, *The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami* provides excellent information on the seismic situation in Oregon. https://www.oregon.gov/oem/documents/oregon_resilience_plan_final.pdf

Planning for Natural Hazards: Oregon Technical Resource Guide

This guide describes basic mitigation strategies and resources related to earthquakes and other natural hazards, including examples from communities in Oregon.
https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

Individual Preparedness

At an individual level, preparedness for an earthquake is minimal as perception and awareness of earthquake hazards are low. Strapping down heavy furniture, water heaters and expensive personal property as well as having earthquake insurance, is a step towards earthquake mitigation. The *2021 Sweet Home NHMP* includes Table 3-1, 2021 Sweet Home Mitigation Actions. There are earthquake-

specific mitigation actions in addition to the multi-hazard mitigation actions which includes all hazards. See also the Earthquake Mitigation Actions section below.

Earthquake Awareness Month

April is Earthquake Awareness Month. Oregon Office of Emergency Management coordinates activities such as earthquake drills and encourages individuals to strap down computers, heavy furniture and bookshelves in homes and offices.

School Education

Schools conduct earthquake drills regularly throughout Oregon and teach students how to respond when an earthquake event occurs.

Building Codes

The Oregon State Building Codes Division adopts statewide standards for building construction that are administered by the state, cities, and counties throughout Oregon. The codes apply to new construction and to the alteration of, or addition to, existing structures. Within these standards are six levels of design and engineering specifications that are applied to areas according to the expected degree of ground motion and site conditions that a given area could experience during an earthquake.

The *2019 Oregon Structural Special Code* (*OSSC*) requires a site-specific seismic hazard report for projects including critical/essential facilities such as hospitals, fire and police stations, emergency response facilities, and special occupancy structures, such as large schools and prisons. See https://codes.iccsafe.org/content/OSSC2019P1.

The seismic hazard report required by *OSSC* for critical/essential facilities and special occupancy structures considers factors such as the seismic zone, soil characteristics including amplification and liquefaction potential, any known faults, and potential landslides. The findings of the seismic hazard report must be considered in the design of the building.

The *2017 Oregon Residential Special Code* (*ORSC*) incorporates prescriptive requirements for foundation reinforcement and framing connections based on the applicable seismic zone for the area. The cost of these requirements is rarely more than a small percentage of the overall cost for a new building. See https://codes.iccsafe.org/content/document/1018?site_type=public.

Requirements for existing buildings vary depending on the type and size of the alteration and whether there is a change in the use of the building that is considered more hazardous. Oregon State Building Codes recognize the difficulty of meeting new construction standards in existing buildings and allow some exception to the general seismic standards. Upgrading existing buildings to resist earthquake forces can be more expensive than meeting code requirements for new construction. The state code only requires seismic upgrades when there is significant structural alteration to the building or where there is a change in use that puts building occupants and the community at greater risk.

Local building officials are responsible for enforcing these codes. Although there is no statewide building code for substandard structures, local communities have the option of adopting a local building code to mitigate hazards in existing buildings. Oregon Revised Statutes allow municipalities

to create local programs to require seismic retrofitting of existing buildings within their communities. The building codes do not regulate public utilities or facilities constructed in public right-of-way, such as bridges.

Emergency Operations Plans

This description is excerpted from the *2012 Sweet Home Emergency Operations Plan*.

The Emergency Operations Plan is an all-hazard plan that describes how the City of Sweet Home and Sweet Home Fire and Ambulance District, known as the Sweet Home Area, will organize and respond to emergencies and disasters in the community. It is based on, and is compatible with, Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including Presidential Policy Directive 8, the National Response Framework, State of Oregon Emergency Management Plan, and Linn County Emergency Operations Plan.

Response to emergency or disaster conditions in order to maximize the safety of the public and to minimize property damage is a primary responsibility of government. It is the goal of the Sweet Home Area that responses to such conditions are conducted in the most organized, efficient, and effective manner possible. To aid in accomplishing this goal, the Sweet Home Area has, in addition to promulgating this plan, informally adopted the principles of the National Incident Management System, including the Incident Command System and the National Response Framework.

Consisting of a Basic Plan, Functional Annexes aligned with the Linn County Emergency Support Functions, and Incident Annexes, this Emergency Operations Plan provides a framework for coordinated response and recovery activities during a large-scale emergency. The plan describes how various agencies and organizations in the City of Sweet Home and Sweet Home Fire and Ambulance District will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.

Future Changing Conditions/ Climate Change

In the *2021 Sweet Home NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Sweet Home and the surrounding areas. In the order of appearance in the NHMP: the Risk Assessment and the Hazards Annexes.

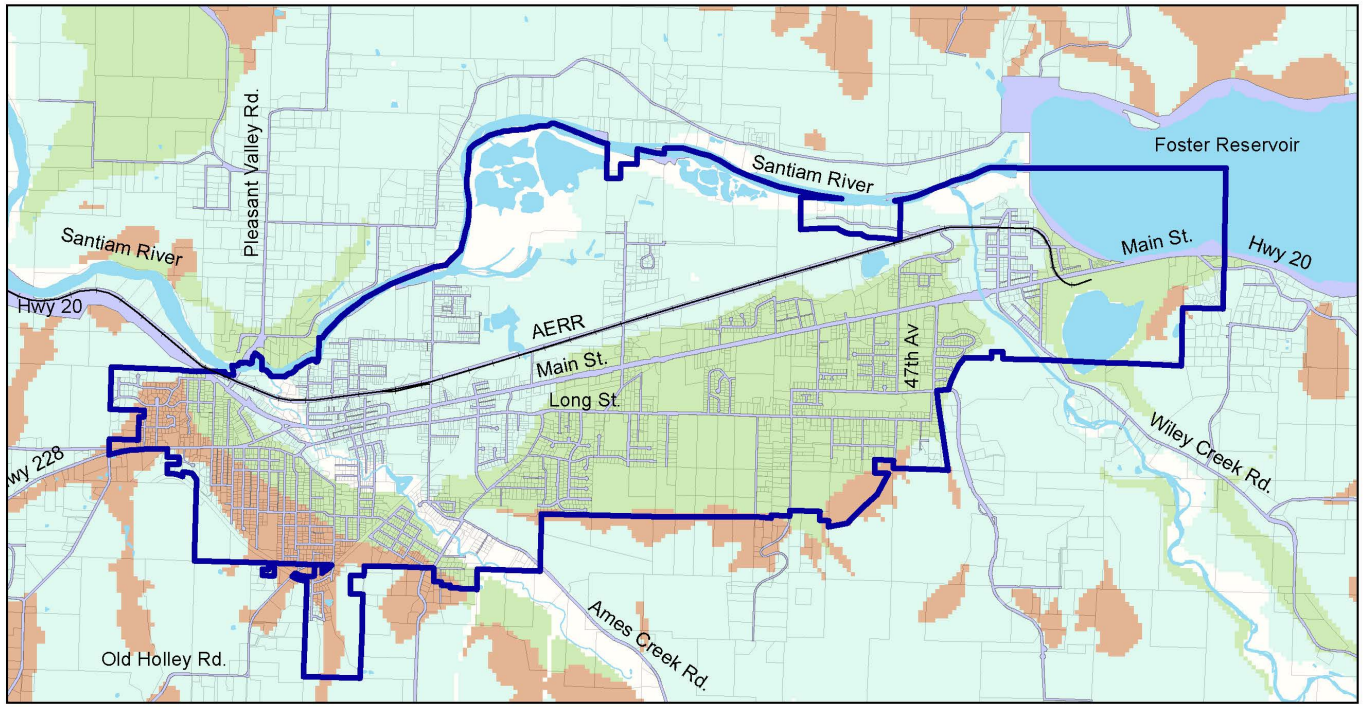
Earthquake Mitigation Actions

There are multi-hazard mitigation actions that include all hazards and earthquake-specific mitigation actions; all have been identified by the Sweet Home NHMP Steering Committee. See Table 3-1, 2021 Sweet Home Mitigation Actions.

The NHMP Steering Committee agreed to use the HVA risk scores as the priority level for the mitigation actions. There are two earthquake-specific mitigation actions. The earthquake specific mitigation actions have a medium priority because the Hazard Vulnerability Assessment (HVA) resulted in earthquakes having a medium risk level. There are multi-hazard mitigation actions that relate to earthquakes; multi-hazard mitigation actions are high priority.

The HVA, risk scores, and risk levels are also described in Section 2 Risk Assessment. The Critical Infrastructure List, Critical Infrastructure Map, and Evacuation Map are in Section 2 Risk Assessment.

Figure EQ-4 Sweet Home Earthquake Hazard: Liquefaction Probability



City of Sweet Home
Natural Hazards Mitigation Plan
Liquifaction Probability 0 - 25%

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

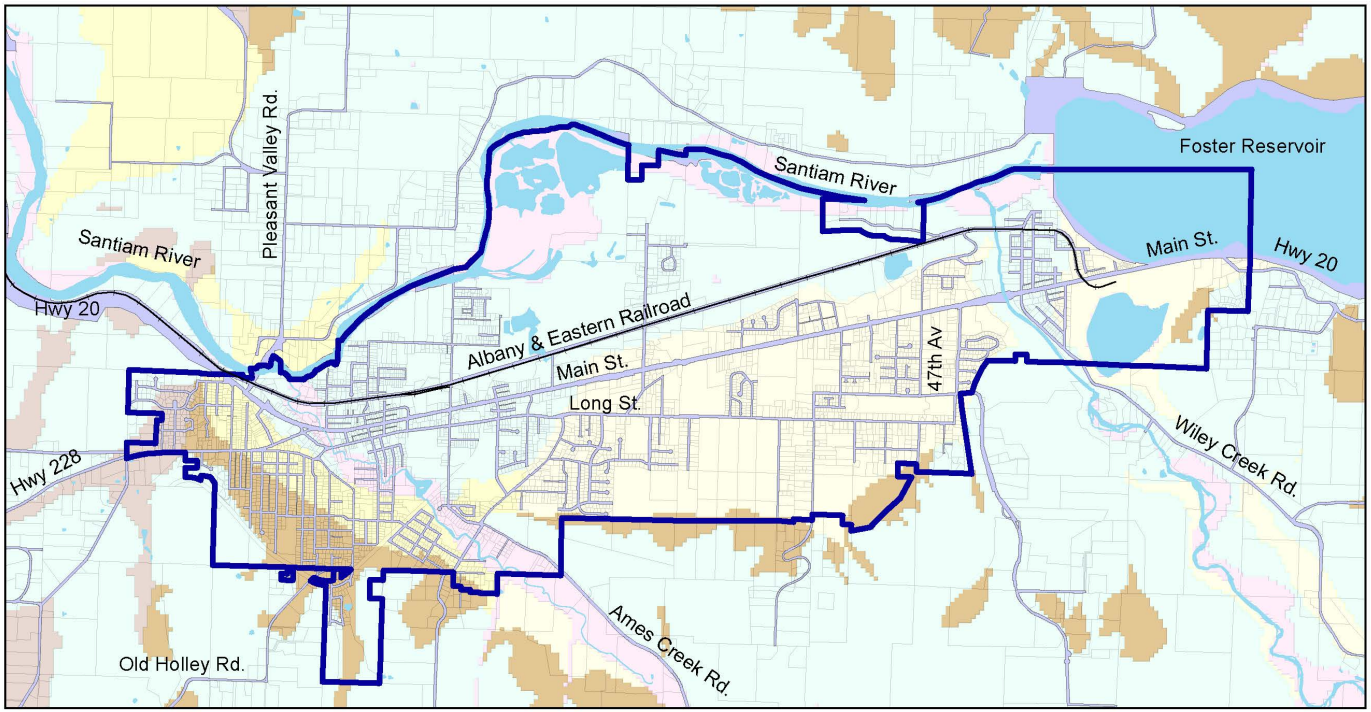
Natural Hazard Legend
%
- 0 - 1
- 1.000000001 - 3
- 3.000000001 - 5
- 5.000000001 - 7
- 7.000000001 - 9
- 9.000000001 - 11
- 11.00000001 - 13
- 13.00000001 - 16
- 16.00000001 - 18
- 18.00000001 - 22
- 22.00000001 - 25

This raster GIS dataset contains values ranging from 0 to 25 percent depicting the liquefaction probability for the Oregon Seismic Hazard Database.

Source:
Funding from Oregon Geospatial Enterprise Office, Framework Data Development Program

Source: Joe Graybill, Sweet Home, 8/30/21

Figure EQ-5 Sweet Home Earthquake Hazard: Liquefaction Permanent Deformation



City of Sweet Home
Natural Hazards Mitigation Plan
Liquefaction Permanent Ground Deformation

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

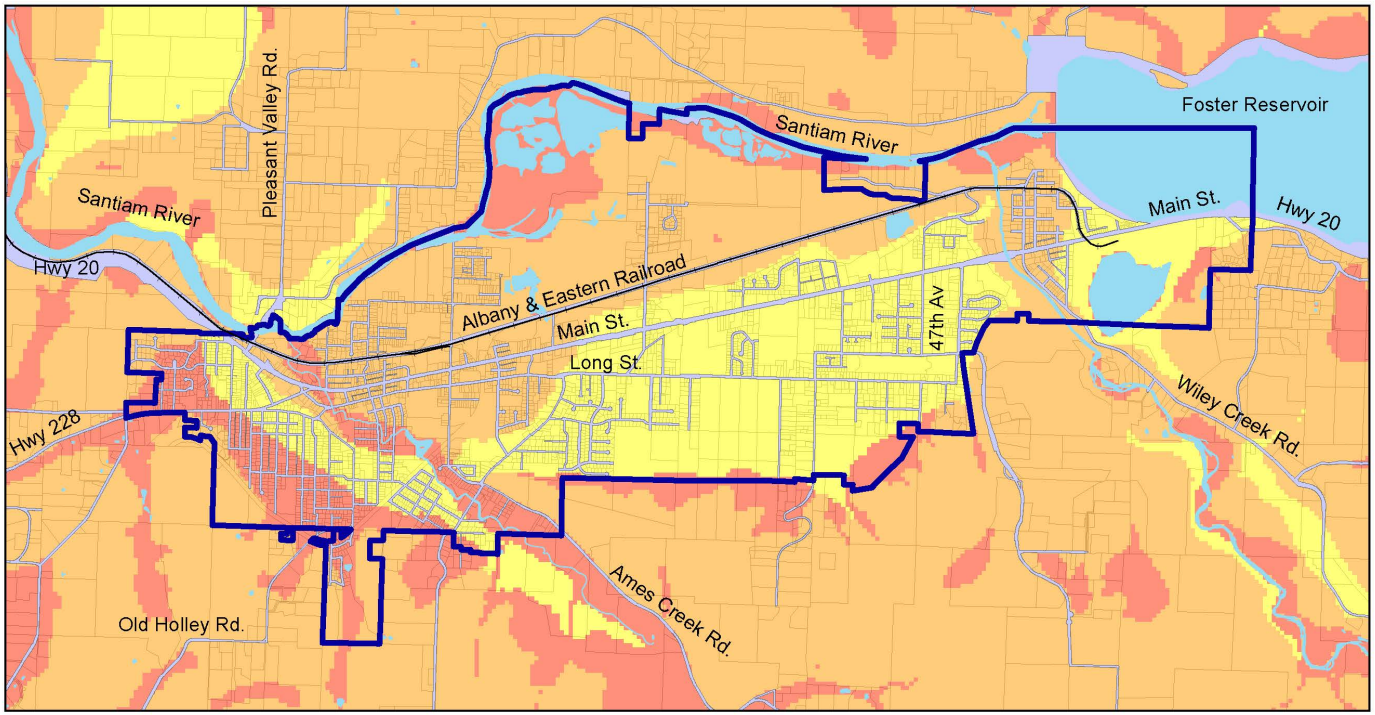
Natural Hazard Legend
Permanent Deformation (cm)
- 466.6352942 - 536
- 348.9254903 - 466.6352941
- 235.4196079 - 348.9254902
- 166.0549021 - 235.4196078
- 128.2196079 - 166.054902
- 96.69019609 - 128.2196078
- 63.05882354 - 96.69019608
- 33.63137256 - 63.05882353
- 10.50980393 - 33.63137255
- 0 - 10.50980392

This raster GIS dataset contains values ranging from 0 to greater than 500 cm depicting the liquefaction permanent ground deformation (lateral spread deformation values) for the Oregon Seismic Hazard Database.

Source:
Funding from Oregon Geospatial Enterprise Office, Framework Data Development Program

Source: Joe Graybill, Sweet Home, 8/30/20

Figure EQ-6 Sweet Home Earthquake Hazard: Probability Damaging Shaking



City of Sweet Home
Natural Hazards Mitigation Plan
Probability of Damaging Shaking

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

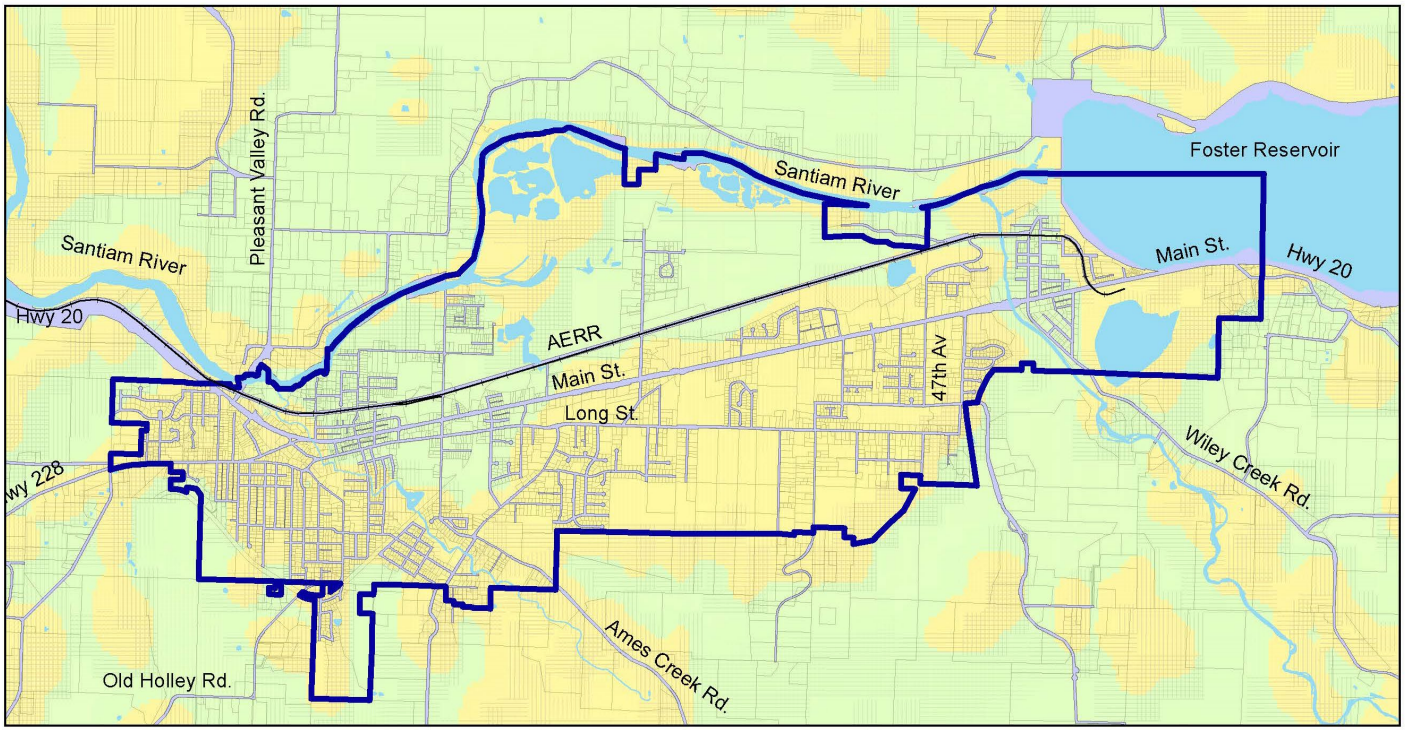
Natural Hazard Legend
Probability of Damaging & Shaking
- Very High
- High
- Moderate
- Low
- Very Low

This raster GIS dataset contains values ranging from 1 to 5 (very low to very high) depicting the probability of damaging shaking for the Oregon Seismic Hazard Database.

Geospatial Enterprise Office, Framework Data Development Program

Source: Joe Graybill, Sweet Home, 8/30/21

Figure EQ-7 Sweet Home Earthquake Hazard: Spectral Acceleration



City of Sweet Home
Natural Hazards Mitigation Plan
Spectral Acceleration 1.0 sec.

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

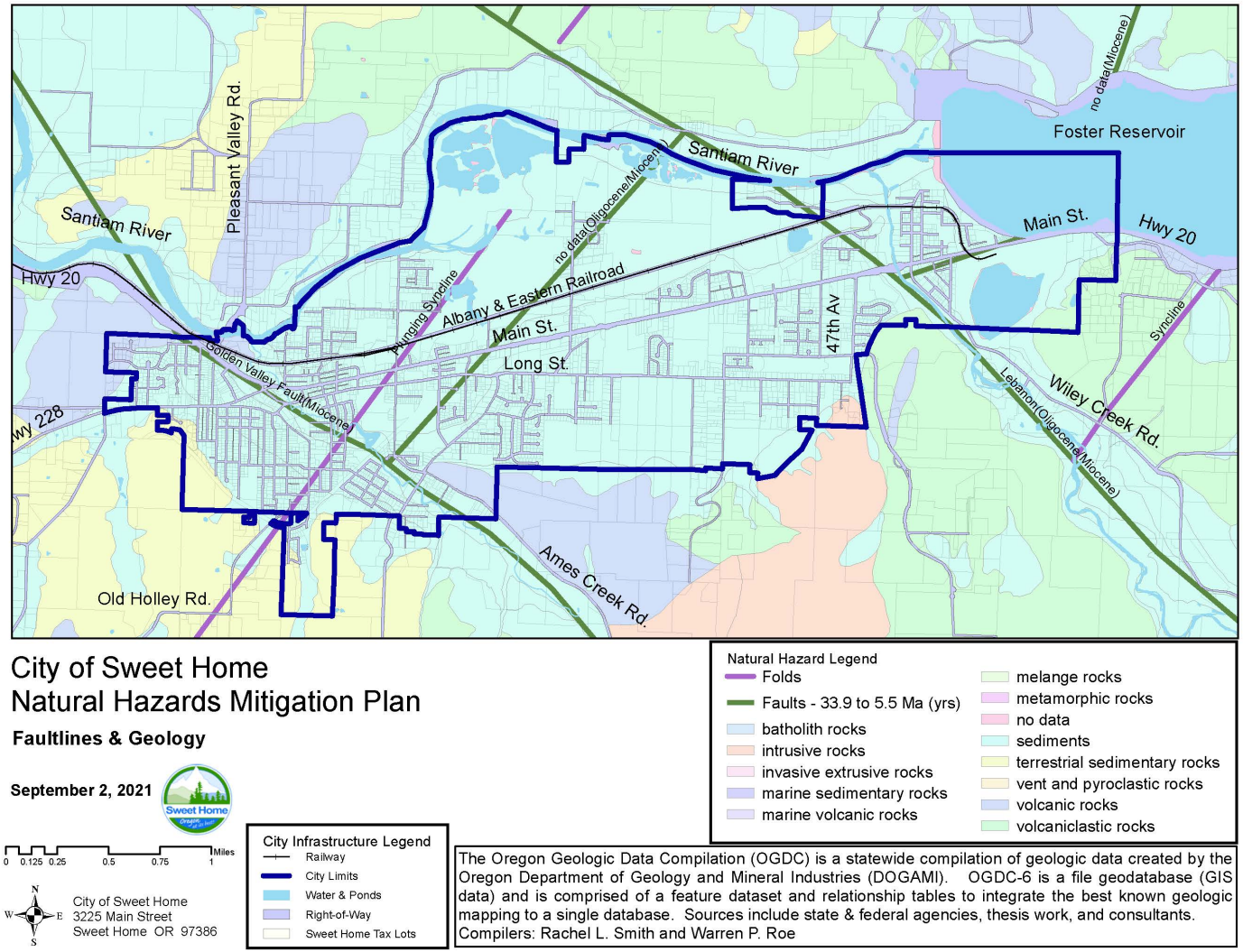
Natural Hazard Legend
Spectral Acceleration
1 Sec, 0.0g to 2.0g
- 0.0073537 - 0.059258684
- 0.059258684 - 0.156580528
- 0.156580528 - 0.266878619
- 0.266878619 - 0.409617325
- 0.409617325 - 0.623725383
- 0.623725383 - 1.661825061

This raster GIS dataset contains values ranging from 0 to 2.0 g depicting the 1.0 second spectral acceleration for the Oregon Seismic Hazard Database.

Source:
Funding from Oregon Geospatial Enterprise Office, Framework Data Development Program

Source: Joe Graybill, Sweet Home, 8/30/20

Figure EQ-8 Sweet Home Earthquake Hazard: Fault Lines Geology



Source: Joe Graybill, Sweet Home, 8/30/20

Volcanic Events Hazard Annex

Risk Score: 147

Risk Level: Medium

A volcano is an opening in the Earth's crust that allows molten rock, gases, and debris to escape to the surface.[1] Volcanoes are present in Washington, Oregon, and California where volcanic activity is generated by continental plates moving against each other (see the Earthquake Annex). Because the population of the Pacific Northwest is rapidly expanding, and scientists have increased their knowledge about the threats from the volcanoes of the Cascade Mountain Range, more people are aware of the dangers of these mountains.[2] In the Cascade Range vicinity, the number of people at immediate risk during volcanic eruptions is greater than at any other volcanic area within the United States. The 2010 census states that more than 10 million people live in Washington and Oregon.[3]

Besides the hazards, volcanoes provide benefits such as fertile soil, valuable metallic minerals, geothermal resources, and scenic beauty. They produce volcanic products that are used as building or road-building materials, as abrasive and cleaning agents, and as raw materials for many chemical and industrial uses. Soil rich in mineral nutrients and beautiful scenery encourages humans to settle in areas with volcanoes.[4]

In the *2015 Sweet Home NHMP*, volcanic events ranked 5th. In the *2021 Sweet Home NHMP*, volcanic events scored 147 and ranked fifth out of seven natural hazards.

The *2015 Sweet Home NHMP* did not include specific events listed for natural hazards; the *2021 Sweet Home NHMP* includes a table of natural hazards events in each annex.

Causes and Characteristics of Volcanic Eruption

Linn County, and the Pacific Northwest, lie within the "ring of fire," an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the ring of fire, in part because of the movement of the Earth's tectonic plates. The Earth's outermost shell, the lithosphere, is broken into a series of slabs known as tectonic plates. These plates are rigid, but they float on a hotter, softer layer in the Earth's mantle. As the plates move about on the layer beneath them, they spread apart, collide, or slide past each other. Volcanoes occur most frequently at the boundaries of these plates and volcanic eruptions occur when the hotter, molten materials, or magma, rise to the surface.

[1] FEMA, *Be Prepared for a Volcano*, https://www.fema.gov/media-library-data/1533576019429-bb1357b03a5a2993bd8ee37767e47d86/Volcano_InfoSheet_080118.pdf

[2] Dzurisin, Dan, Peter H. Stauffer, and James W. Hendley II, *Living with Volcanic Risk in the Cascades*, USGS Fact Sheet 165-97, https://pubs.usgs.gov/fs/1997/fs165-97/fs165-97.pdf

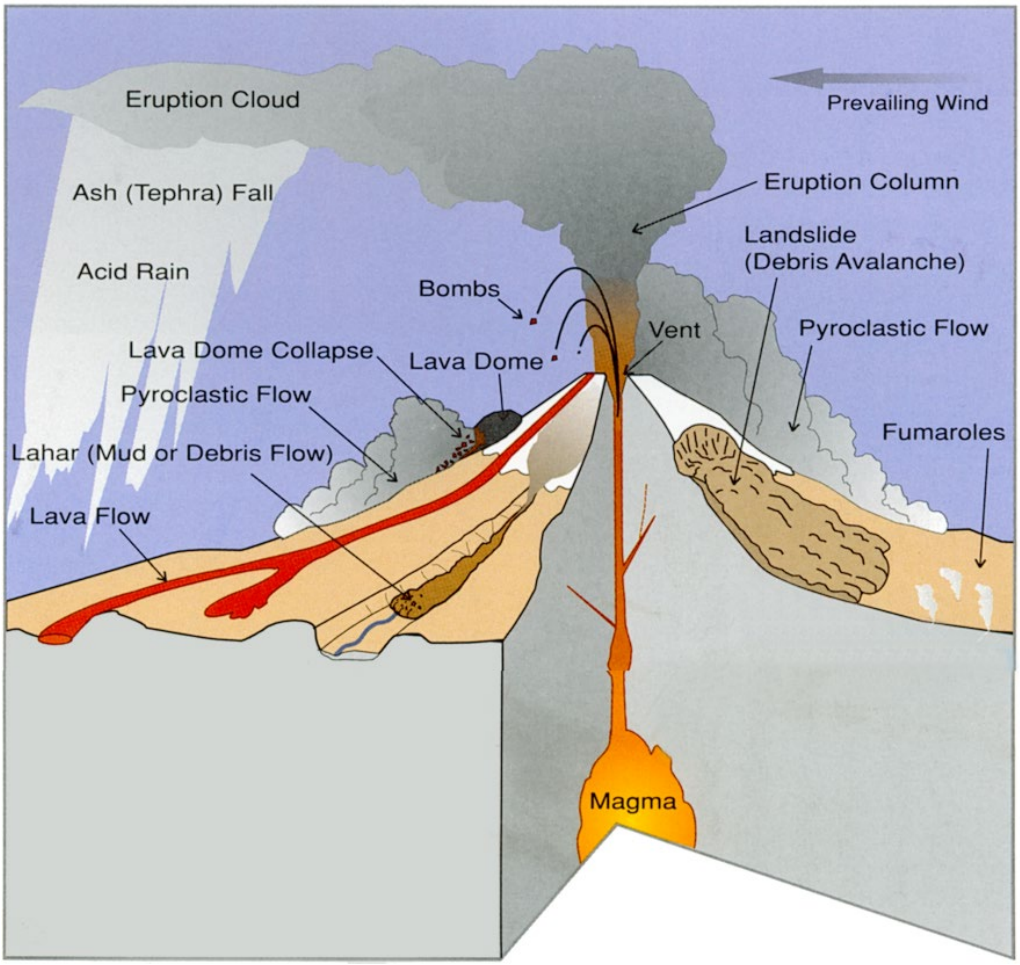
[3] USGS, *Volcano Hazards in the Cascade Range*, https://volcanoes.usgs.gov/observatories/cvo/hazards.html

[4] USGS, *What are some Benefits of Volcanoes?* https://www.usgs.gov/faqs/what-are-some-benefits-volcanic-eruptions?qt-news_science_products=0#qt-news_science_products

The primary threat to lives and property from active volcanoes is from violent eruptions that unleash tremendous blast forces, generate mud and debris flows, and produce flying debris and ash clouds. The immediate danger area in a volcanic eruption generally lies within a 20-mile radius of the blast site. The following section outlines the specific hazards posed by volcanoes.

Volcanoes are commonly conical hills or mountains built around a vent that connect with reservoirs of molten rock below the surface of the earth.[5] Some younger volcanoes may connect directly with reservoirs of molten rock, while most volcanoes connect to empty chambers. Unlike most mountains, which are pushed up from below, volcanoes are built up by an accumulation of their own eruptive products: lava or ash flows and airborne ash and dust. When pressure from gases or molten rock becomes strong enough to cause an upsurge, eruptions occur. Gases and rocks are pushed through the opening and spill over, or fill the air with lava fragments. Figure VO-1 diagrams the basic features of a volcano.

Figure VO-1 Volcanic Hazard from a Composite Type Volcano



[5] Tilling, Robert I., *Volcanoes*, USGS General Interest Publication, (1982), https://books.google.com/books/about/Volcanoes.html?id=5eVjblx7IC8C

Source: Walder et al, "Volcano Hazards in the Mount Jefferson Region," 1999; W.E. Scott, R.M. Iverson, S.P. Schilling, and B.J. Fischer, Volcano Hazards in the Three Sisters Region, Oregon: U.S. Geological Survey Open-File Report 99-437, 14p., 2001.,

Related Hazards

Ash / Tephra

Tephra consists of volcanic ash (sand-sized or finer particles of volcanic rock) and larger fragments. During explosive eruptions, tephra together with a mixture of hot volcanic gas are ejected rapidly into the air from volcanic vents. Larger fragments fall down near the volcanic vent while finer particles drift downwind as a large cloud. When ash particles fall to the ground, they can form a blanket-like deposit, with finer grains carried further away from the volcano. In general, the thickness of ash fall deposits decreases in the downwind direction. Tephra hazards include impact of falling fragments, suspension of abrasive fine particles in the air and water, and burial of structures, transportation routes and vegetation.

During an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. [6] The predominant wind pattern over the Cascades is from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes. [7]

Earthquakes

Volcanic eruptions can be triggered by seismic activity or earthquakes can occur during or after a volcanic eruption. Earthquakes produced by stress changes are called volcano-tectonic earthquakes. These earthquakes, typically small to moderate in magnitude, occur as rock is moving to fill in spaces where magma is no longer present and can cause land to subside or produce large ground cracks. [8] In addition to being generated after an eruption and magma withdrawal, these earthquakes also occur as magma is intruding upward into a volcano, opening cracks and pressurizing systems. [9] Volcano-tectonic earthquakes do not indicate that the volcano will be erupting but can occur at any time and cause damage to manmade structures or provoke landslides.

Lava flows

Lava flows are streams of molten rock that erupt relatively non-explosively from a volcano and move downslope, causing extensive damage or total destruction by burning, crushing, or burying everything in their paths. Secondary effects can include forest fires, flooding, and permanent reconfiguration of stream channels. [10]

Pyroclastic flows and surges

Pyroclastic flows are avalanches of rock and gas at temperatures of 600 to 1500 degrees Fahrenheit. They typically sweep down the flanks of volcanoes at speeds of up to 150 miles per hour. Pyroclastic

[6] DLCD, *2020 Oregon State Natural Hazard Mitigation Plan*, Volcanic Hazards Chapter, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

[7] Ibid.

[8] Riley, Colleen M., *A Basic Guide to Volcanic Hazards*, Michigan Technological University, http://www.geo.mtu.edu/volcanoes/vc_web/overview/o_health.html.

[9] Scott, W. E., USGS Cascades Volcano Observatory, personal communication, 7/5/01.

[10] DLCD, *2020 Oregon State Natural Hazard Mitigation Plan*, Volcanic Hazards Chapter, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

surges are a more dilute mixture of gas and rock. They can move even more rapidly than a pyroclastic flow and are more mobile. Both generally follow valleys, but surges sometimes have enough momentum to overtop hills or ridges in their paths. Because of their high speed, pyroclastic flows and surges are difficult or impossible to escape. If it is expected that they will occur, evacuation orders should be issued as soon as possible for the hazardous areas. Objects and structures in the path of a pyroclastic flow are generally destroyed or swept away by the impact of debris or by accompanying hurricane-force winds. Wood and other combustible materials are commonly burned. People and animals may also be burned or killed by inhaling hot ash and gases. The deposit that results from pyroclastic flows is a combination of rock bombs and ash and is termed *ignimbrite.* These deposits may accumulate to hundreds of feet thick and can harden to resistant rock. [11]

Lahars and debris flows

Lahar is an Indonesian term that describes a hot or cold mixture of water and rock fragments flowing down the slopes of a volcano or river valley.[12] Lahars typically begin when floods related to volcanism are produced by melting snow and ice during eruptions of ice-clad volcanoes like Mount Shasta, and by heavy rains that may accompany eruptions. Floods can also be generated by eruption-caused waves that could overtop dams or move down outlet streams from lakes.

Lahars react much like flash flood events in that a rapidly moving mass moves downstream, picking up more sediment and debris as it scours out a channel. This initial flow can also incorporate water from rivers, melting snow and ice. By eroding rock debris and incorporating additional water, lahars can easily grow to more than ten times their initial size. But as a lahar moves farther away from a volcano, it will eventually begin to lose its heavy load of sediment and decrease in size.[13]

Lahars often cause serious economic and environmental damage. The direct impact of a lahar's turbulent flow front or from the boulders and logs carried by the lahar can easily crush, abrade, or shear off at ground level just about anything in the path of a lahar. Even if not crushed or carried away by the force of a lahar, buildings and valuable land may become partially or completely buried by one or more cement-like layers of rock debris. By destroying bridges and key roads, lahars can also trap people in areas vulnerable to other hazardous volcanic activity, especially if the lahars leave deposits that are too deep, too soft, or too hot to cross.[14]

Volcanic Landslides (debris avalanches)[15]

Landslides – or debris avalanches – are a rapid downhill movement of rocky material, snow, and/or ice. Volcanic landslides range in size from small movements of loose debris on the surface of a volcano to massive collapses of the entire summit or sides of a volcano. Steep volcanoes are susceptible to landslides because they are built up partly of layers of loose volcanic rock fragments.

[11] Ibid.

[12] USGS, Volcano Hazards Program, *Understanding Volcanoes Can Save Lives*, http://volcanoes.usgs.gov/Hazards/What/Lahars/lahars.html.

[13] Ibid.

[14] Ibid.

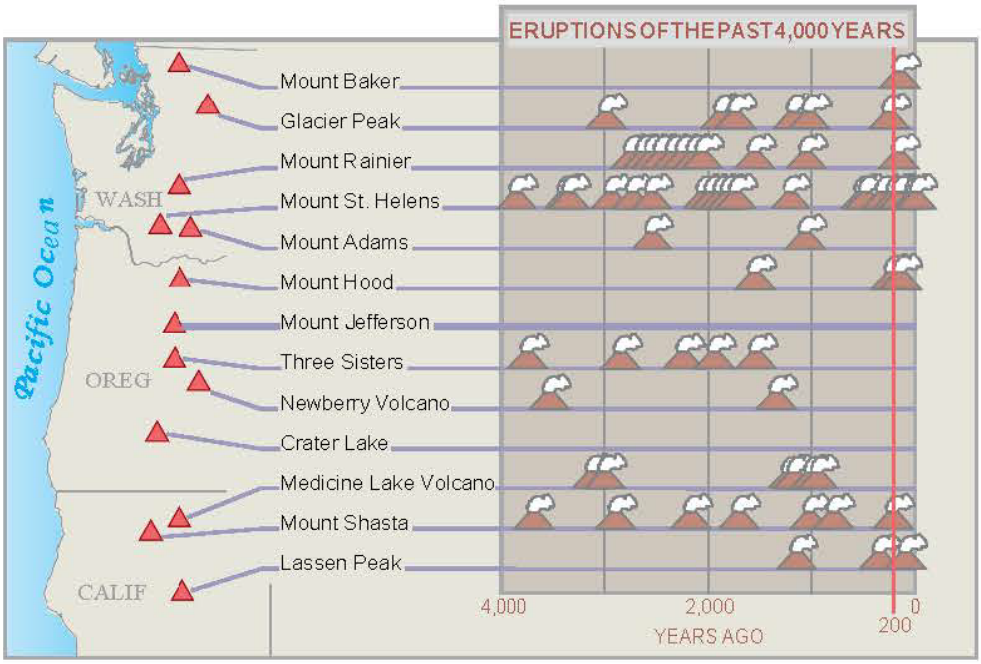
[15] Wright and Pierson, Living With Volcanoes, USGS Volcano Hazards Program Circular 1973, (1992).

Landslides on volcano slopes are triggered not only by eruptions, but also by heavy rainfall or large earthquakes that can cause materials to break free and move downhill.

History of Volcanic Events in Linn County

Although there have been no recent volcanic events in the Linn County area, it is important to note the area is active and susceptible to eruptive events since the region is a part of the volcanically active Cascade Mountain Range. Figure VO-2 displays the potentially active volcanoes of the western United States as identified by the USGS.

Figure VO-2 Potentially Active Volcanoes of the Western United States



Of the 13 potentially active volcanoes in the Cascade Range of the Pacific Northwest, 11 have erupted in the past 4,000 years. More than 100 eruptions, most of which were explosive, have occurred during that period, making the volcanoes of the Cascade Range some of the most hazardous in the United States. Each eruption symbol in the diagram represents from one to several eruptions closely spaced in time at or near the named volcano. Eruptions have also occurred from other vents (not shown) scattered throughout the Cascade Range, especially in central Oregon and southwestern Washington.

Source: Dzurisin, Dan, Peter H. Stauffer, and James W. Hendley II, *Living with Volcanic Risk in the Cascades*, USGS Fact Sheet 165-97, https://pubs.usgs.gov/fs/1997/fs165-97/fs165-97.pdf

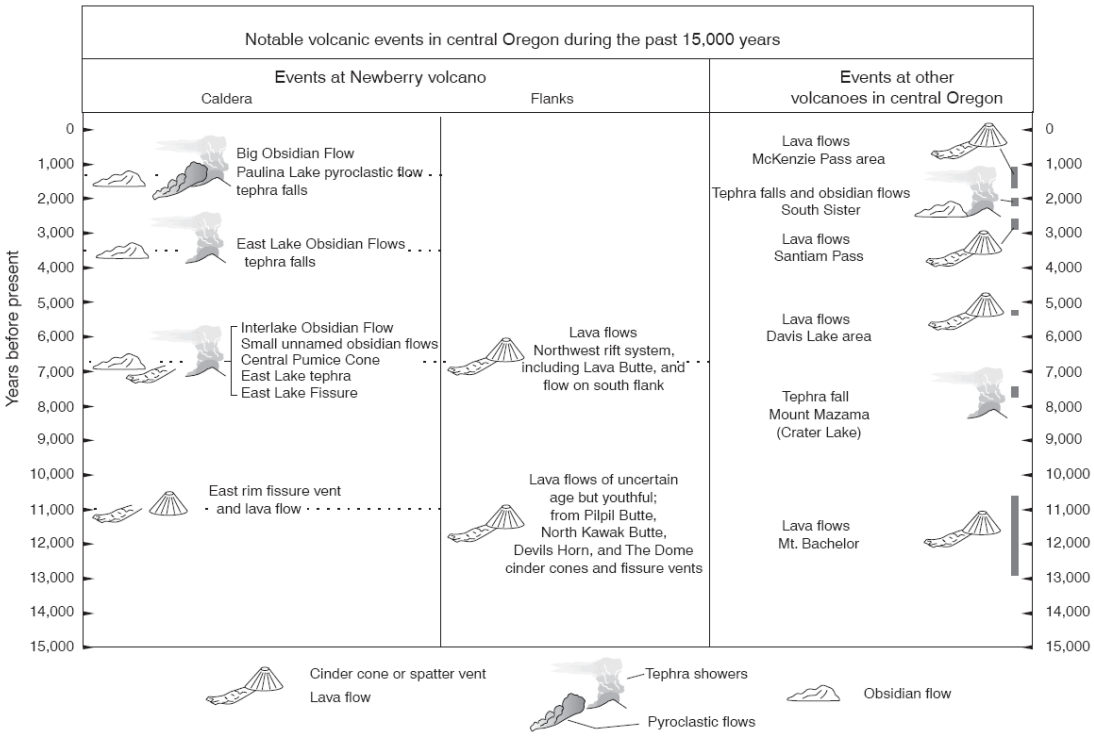
There are active volcanic areas that could potentially impact Sweet Home and the broader region. These include: Mt. Saint Helens, Mt. Hood, Newbery Volcano, Mt. Bachelor, Three Sisters and Mt. Broken Top, and Mt. Mazama/ Crater Lake. All of these are in the very high threat category except Mt. Bachelor which is a moderate threat.[16]

Volcanoes in the Cascade Mountain Range have been erupting for hundreds of thousands of years. Newberry Volcano, for example, has had many events in the last 15,000 years as shown Figure VO-3. The Three Sisters region has also had some activity during this time while the last major eruptive activity at Mt. Mazama occurred approximately 7,700 years ago, forming Crater Lake in its wake.

[16] USGS, *2018 Update to the U.S. Geological Survey National Volcanic Threat Assessment*, https://pubs.usgs.gov/sir/2018/5140/sir20185140.pdf.

Some of the most recent events include Big Obsidian Flow at Newberry Volcano. All of the Cascade Range volcanoes are characterized by long periods of quiescence and intermittent activity. And these characteristics make predictions, recurrence intervals, or probability very difficult to ascertain.

Figure VO-3 Notable Volcanic Events in Central Oregon during the Past 15,000 Years



Source: D.R. Sherrod, L.G. Mastin, W.E. Scott, and S.P. Schilling, 1997, *Volcano Hazards at Newberry Volcano, Oregon: U.S. Geological Survey Open-File Report 97-513*, https://pubs.er.usgs.gov/publication/ofr97513.

In addition to the many online sources of information, a detailed report of the Pacific Northwest's catastrophic hazards and history written by Rick Gore appears in the May 1998 National Geographic, Vol. 193, No. 5. Table VO-1 describes volcanic events in Oregon and Washington.

Table VO-1 Significant Historic Volcanic Events

Date	Location	Description
About 18,000 to 7,7000 YBP	Mount Bachelor, central Cascades	Cinder cones and lava flows.
About 20,000 to 13,000 years before present (YBP)	Polallie eruptive episode, Mount Hood	Lava dome, pyroclastic flows, lahars, and tephra.
About 13, 000 YBP	Lava Mountain, south central Oregon	Lava Mountain field and lava flows.
About 13,000 YBP	Devils Garden, south central Oregon	Devils Garden field and lava flows.
About 13,000 YBP	Four Craters, south central Oregon	Four Craters field and lava flows.
About 7,780 to 15,000YBP	Cinnamon Butte, Southern Cascades	Balsatic scaria cone and lava flows.

Date	Location	Description
About 7,700 YBP	Crater Lake Caldera	Formation of Crater Lake caldera, pyroclastic flows, and widespread ashfall.
About 7,7000 YBP	Parkdale, north central Oregon	Eruption of Parkdale lava flow.
About 7,000 YBP	Diamond Craters, eastern Oregon	Lava flows and tephra in Diamond Craters field.
About <7,700 YBP; 5,300 to 5,600 YBP	Davis Lake, southern Cascades	Lava flows and scoria cones in Davis Lake field.
About 10,000 to <7,7000 YBP	Cones south of Mount Jefferson; Forked Butte and South Cinder Peak	Lava flows.
About 4,000 to 3,000 YBP	Sand Mountain, central Cascades	Lava flows and cinder cones in Sand Mountain field.
About <3,2000 YBP	Jordan Craters, eastern Oregon	Lava flows and tephra in Jordan Craters field.
About 3,000 to 1,5000 YBP	Belknap Volcano, central Cascades	Lava flows and tephra.
About 2,000 YBP	South Sister Volcano	Rhyolite lava flow.
About 1,500 YBP	Timberline eruptive period, Mount Hood	Lava dome, pyroclastic flows, lahars, and tephra.
About 1,300 YBP	Newberry Volcano, central Oregon	Eruption of Big Obsidian flow.
About 1,300 YBP	Blue Lake Crater	Spatter cones and tephra.
1760–1810	Crater Rock/Old Maid Flat on Mount Hood	Pyroclastic flows in upper White River; lahars in Old Maid Flat; dome building at Crater Rock.
1859/1865	Crater Rock on Mount Hood	Steam explosions and tephra falls.
1907 (?)	Crater Rock on Mount Hood	Steam explosions.
1980	Mount St. Helens (Washington)	Mt. St. Helens erupts: Debris avalanche, ashfall, and flooding on Columbia River. 57 people died.
1981-1986	Mount St. Helens (Washington)	Lava dome growth, steam, and lahars.
1989-2001	Mount St. Helens (Washington)	Hydrothermal explosions.
2004-2008	Mount St. Helens (Washington)	Lava dome growth, steam, and ash.

Sources: USGS, n.d.; Wolfe and Pierson, 1995; Scott et al, 1997; University of Oregon; DLCD, *Oregon NHMP*, 2020; FEMA, Disaster Declarations for Oregon, retrieved 2017.

Mount St. Helen's Case Study

On May 18, 1980, following two months of earthquakes and minor eruptions and a century of dormancy, Mount St. Helens in Washington, exploded in one of the most devastating volcanic eruptions of the 20th century. Although less than 0.1 cubic mile of magma was erupted, 58 people died, and damage exceeded 1.2 billion dollars. Fortunately, most people in the area were able to evacuate safely before the eruption because the U.S. Geological Survey (USGS) and other scientists had alerted public officials to the danger. As early as 1975, USGS researchers had warned that Mount St. Helens might soon erupt. Coming more than 60 years after the last major eruption in the

Cascade Range (Lassen Peak), the explosion of St. Helens was a spectacular reminder that the millions of residents of the Pacific Northwest share the region with live volcanoes.[17]

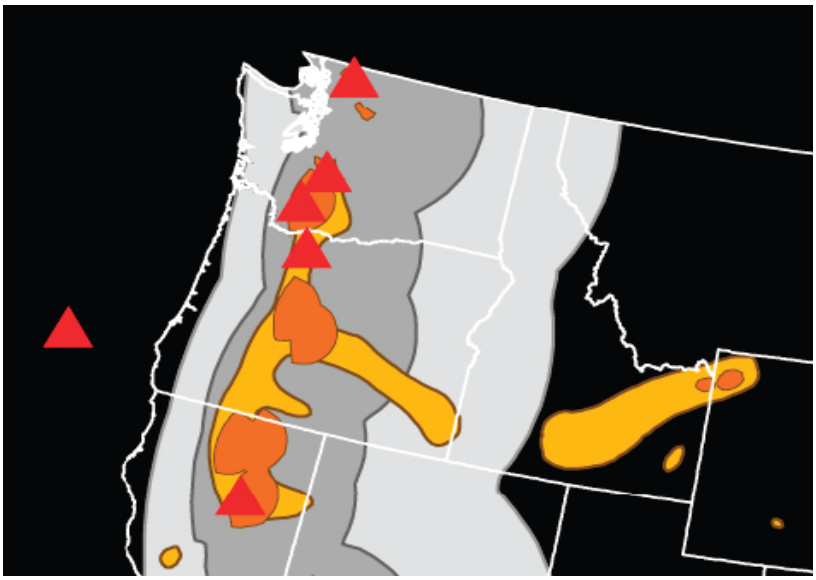
Risk Assessment

How are Hazards Identified?

Communities that are closer to volcanoes may be at risk to the proximal hazards – ash fall, debris avalanches, pyroclastic flows, lahars, and lava flows - as well as the distal hazards - lahars, lava flows, and ash fall. The communities that are farther away are most likely only at risk from the distal hazards, (mainly ash fall). Figure VO-4 shows the locations of some of the Cascade Range volcanoes (red triangles) with relative volcanic hazard zones. The dark orange areas have a higher volcanic hazard; light-orange areas have a lower volcanic hazard. Dark-grey areas have a higher ash fall hazard; light-grey areas have a lower ash fall hazard.

Geologic hazard maps have been created for most of the volcanoes in the Cascade Range by the USGS Volcano Program at the Cascade Volcano Observatory in Vancouver, WA and are available at http://vulcan.wr.usgs.gov/Publications/hazards_reports.html.

Figure VO-4 National Volcanic Hazard Map



Note: The red triangles are volcano locations. Dark-orange areas have a higher volcanic hazard; light-orange areas have a lower volcanic hazard. Dark-gray areas have a higher ash fall hazard; light-gray areas have a lower ash fall hazard. Information is based on data during the past 10,000 years.

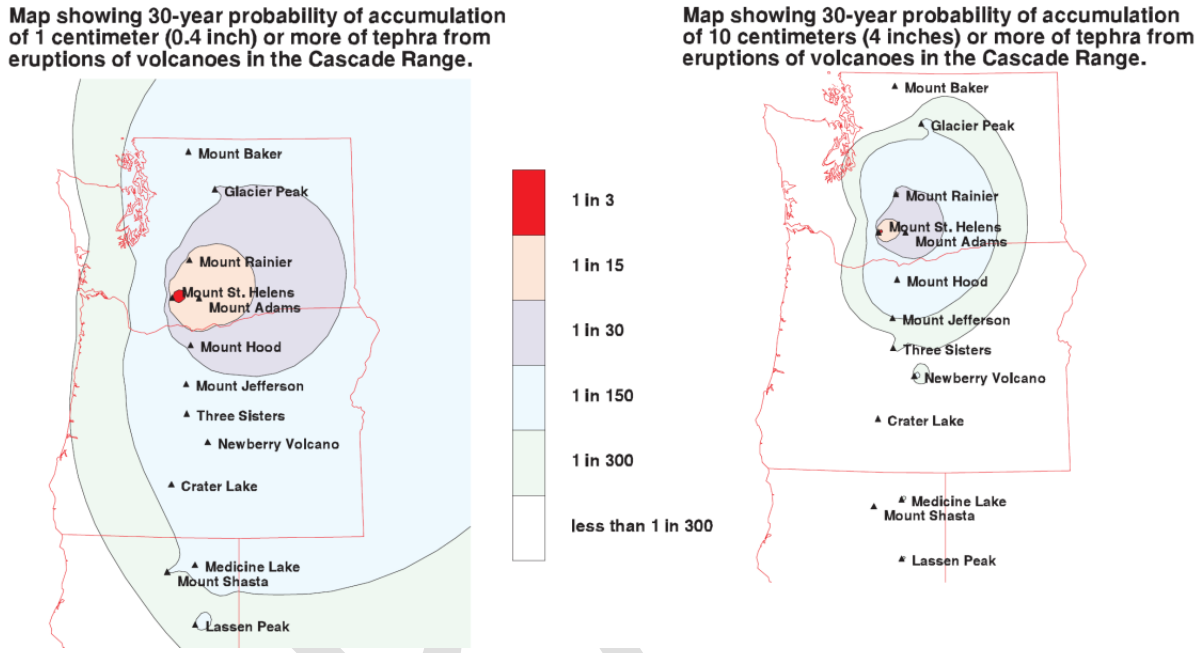
Source: Image modified from USGS, *Volcano Hazards – A National Threat, Fact Sheet 2006-3014*, https://pubs.usgs.gov/fs/2006/3014/2006-3014.pdf

Scientists also use wind direction to predict areas that might be affected by volcanic ash. During an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. The predominant wind pattern over the Cascade Range originates from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes.

[17] Dzurisin, Dan, Peter H. Stauffer, and James W. Hendley II, *Living with Volcanic Risk in the Cascades*, USGS Fact Sheet 165-97, https://pubs.usgs.gov/fs/1997/fs165-97/fs165-97.pdf

Regional tephra fall shows the annual probability of ten centimeters or more of ash accumulation from Pacific Northwest volcanoes. Figure VO-5 depicts the potential and geographic extent of volcanic ash fall from several volcanoes in the Pacific Northwest.

Figure VO-5 Probable Geographic Extent of Volcanic Ashfall from Select Volcanic Eruptions in the Pacific Northwest



Source: Scott, W.E., Pierson, T.C., Schilling, S.P., Costa, J.E., Gardner, C.A., Vallance, J.W., & Major, J.J. (1997), *Volcano Hazards in the Mount Hood region (Hazard Zonation Map for Mt. Hood), Oregon: USGS Open-File Report 97-89*, Reston, VA, http://vulcan.wr.usgs.gov/Volcanoes/Hood/Hazards/ OFR97-89/OFR97-89.pdf

An excellent resource on volcanoes is published by USGS, most recently in 2018, which is called the *National Volcanic Threat Assessment*. The USGS assesses active and potentially active volcanoes in the U.S., focusing on history, hazards and the exposure of people, property and infrastructure to harm during the next eruption. They use 24 factors to obtain a score and threat ranking for each volcano that is deemed potentially eruptible.[18]

In a description on the USGS website "the update names 18 very high threat, 39 high threat, 49 moderate threat, 34 low threat, and 21 very low threat volcanoes. The volcanoes are in Alaska, Arizona, California, Colorado, Hawaii, Idaho, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, American Samoa and the Commonwealth of the Northern Mariana Islands. The threat ranking is not an indication of which volcano will erupt next. Rather, it indicates how severe the impacts might be from future eruptions at any given volcano."[19]

The website further states, "Since 1980, there have been 120 eruptions and 52 episodes of notable volcanic unrest at 44 U.S. volcanoes. When erupting, all volcanoes pose a degree of risk to people

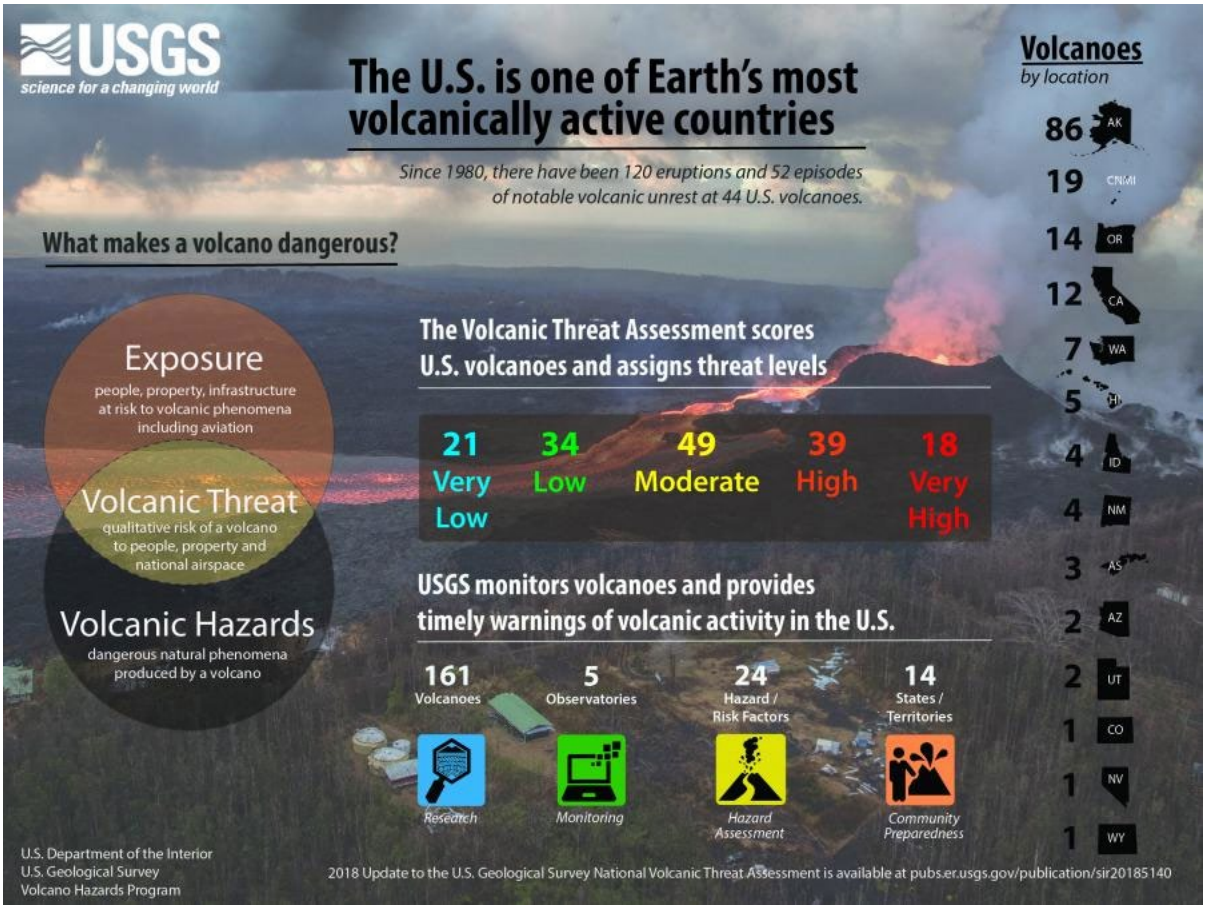
[18] USGS, *The U.S. is one of Earth's most Volcanically Active Countries*, https://volcanoes.usgs.gov/index.html.

[19] Ibid.

and infrastructure. However, the risks are not equivalent from one volcano to another because of differences in eruptive style and geographic location."[20]

The USGS describes that the volcanic threat assessment "helps prioritize U.S. volcanoes for research, hazard assessment, emergency planning, and volcano monitoring. It is a way to help focus attention and resources where they can be most effective, guiding the decision-making process on where to build or strengthen volcano monitoring networks and where more work is needed on emergency preparedness and response."[21]

Figure VO-6 Volcanic Threat Assessment Statistics



Source: USGS, *The U.S. is one of Earth's most Volcanically Active Countries*, https://volcanoes.usgs.gov/index.html

Hazard Risk Analysis

The Sweet Home NHMP Steering Committee completed a Hazard Vulnerability Assessment/Analysis (HVA) during this NHMP update. This was described in Section 2 Risk Assessment. The method used for the HVA was developed from a Federal Emergency Management Agency (FEMA) tool that has been refined by the Oregon Office of Emergency Management (OEM). It addresses and weights (shown as percent within parentheses) probability (29%), vulnerability (21%), maximum threat

[20] Ibid.

[21] Ibid.

(42%) and the history (8%) of each natural hazard and attributes a final hazard analysis score. The methodology produces scores that range from 24 to 240.

For local governments, conducting the HVA is a useful step in planning for hazard mitigation. The method provides the jurisdiction with a relative ranking from which to prioritize mitigation actions, but does not predict the occurrence of a particular hazard.

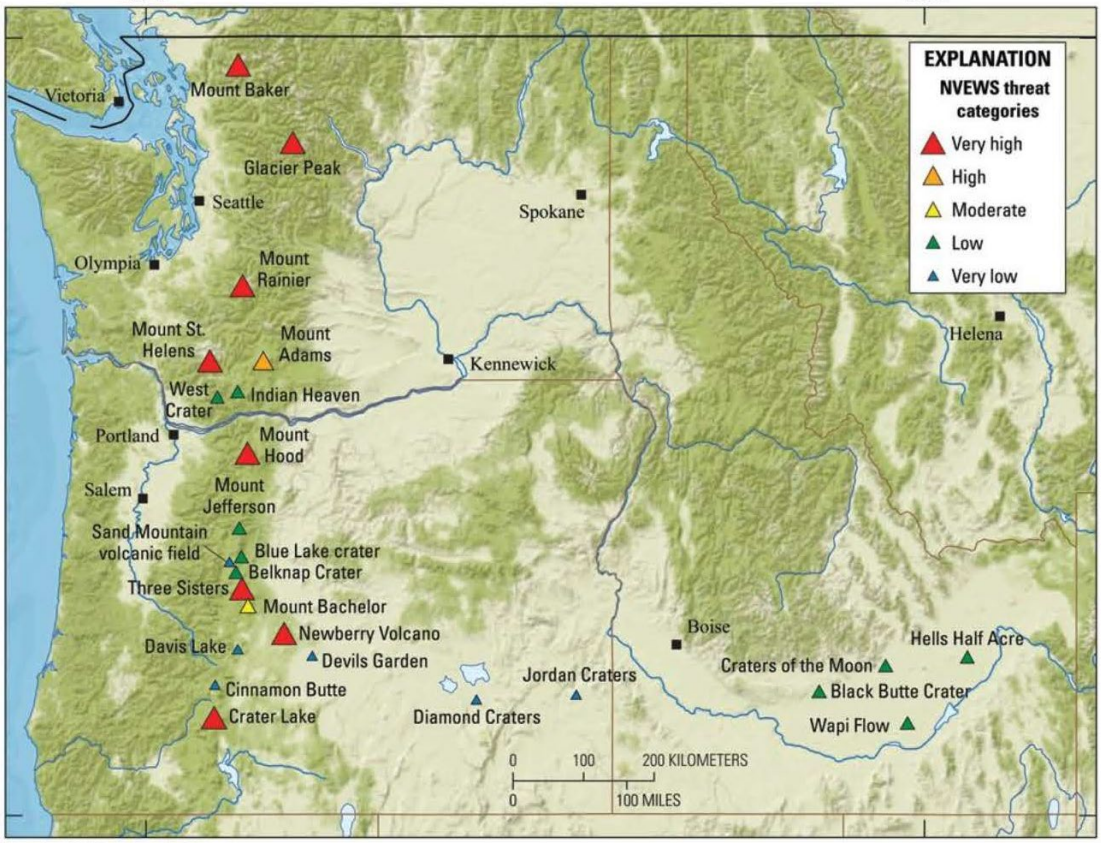
In the *2015 Sweet Home NHMP*, volcanic events ranked 5th. In the *2021 Sweet Home NHMP*, volcanic events scored 147 and ranked fifth out of seven natural hazards.

For more information on all the risk scores and ranks of the natural hazards, see Volume I Basic Plan, Section 2 Risk Assessment of this NHMP.

Probability Assessment

There are active volcanic areas that could potentially impact Sweet Home and the broader region. These include: Mt. Hood, Mt. Saint Helens, Newbery Volcano, Mt. Bachelor, Three Sisters and Mt. Broken Top, and Mt. Mazama/ Crater Lake. See Figure VO-7.

Figure VO-7 Map Showing Volcano Locations within the Area of Responsibility of the Cascades Volcano Observatory



Source: USGS, *2018 Update to the U.S. Geological Survey National Volcanic Threat Assessment*, https://pubs.usgs.gov/sir/2018/5140/sir20185140.pdf

Mt. St. Helens remains a probable source of airborne tephra as shown in the figures above. It has repeatedly produced voluminous amounts of this material and has erupted much more frequently in recent geologic time than any other Cascade volcano. It blanketed Yakima and Spokane, Washington during the 1980 eruption and again, in 2004.[22]

The eruptive history of the nearby Cascade volcanoes to this region can be traced to late Pleistocene times (approximately 700,000 years ago) and will no doubt continue. But the central question remains: When? The most recent series of events at Newberry Volcano, which occurred about 1,300 years ago, consisted of lava flows and tephra fall. Newberry Volcano's recent history also includes pyroclastic flows and numerous lava flows. Volcanoes in the Three Sisters region, such as Middle and South Sister, and Crater Lake have also erupted explosively in the past. These eruptions have produced pyroclastic flows, lava flows, lahars, debris avalanches, and tephra. Any future eruptions at these volcanoes would most likely resemble those that have occurred in the past.[23]

Geoscientists have provided some estimates of future activity in the vicinity of Newberry Caldera and its adjacent areas. They estimate a 1 in 3000 chance that some activity will take place in a 30-year period. The estimate for activity at Crater Lake for the same time period is significantly smaller at 0.003 to 0.0003. In the Three Sisters region, the probability of future activity is roughly 1 in 10,000 but any restlessness would greatly increase this estimate. [24]

The Sweet Home NHMP Steering Committee noted that South Sisters is within 100 miles and that volcano is listed as the fifth most dangerous volcano in the Pacific Northwest in at least one resource that was accessed. The area is less vulnerable to direct volcanic hazards such as blast effects, relatively nearby volcanoes could inundate the area with ashfall sufficient to impact transportation and cause widespread health concerns. Potentially the area could be an area of refuge if other areas have a volcanic eruption disaster.

Vulnerability Assessment

All of the Pacific Northwest is vulnerable to impacts from volcanic activity. Like the rest of Oregon, Sweet Home has some risk of being impacted by volcanic activity in the Cascade Range. The principal sources are Mt. Hood, Mt. Saint Helens, Newbery Volcano, Mt. Bachelor, Three Sisters and Mt. Broken Top, and Mt. Mazama/ Crater Lake. Because of its geographic distance from these volcanic sites, Sweet Home is not at risk for proximal hazards such as lava flows, except for ones from South Sister. However, it is at risk for distal hazards, primarily ash fall (tephra). The location, size, and shape of the area affected by tephra fall is determined by both the vigor and duration of the eruption and the wind direction at the time of eruption, making prediction of the area to be affected impossible more than a few hours in advance. The vulnerability to ash fallout is multi-pronged; for example ash can disrupt the engines of motor vehicles, reduce visibility, and exacerbate or induce respiratory illnesses.

While a quantitative vulnerability assessment - an assessment that describes number of lives or amount of property exposed to the hazard - has not yet been conducted for Sweet Home volcanic

[22] USGS, *2018 Update to the U.S. Geological Survey National Volcanic Threat Assessment*, https://pubs.usgs.gov/sir/2018/5140/sir20185140.pdf, and the USGS website

[23] Ibid.

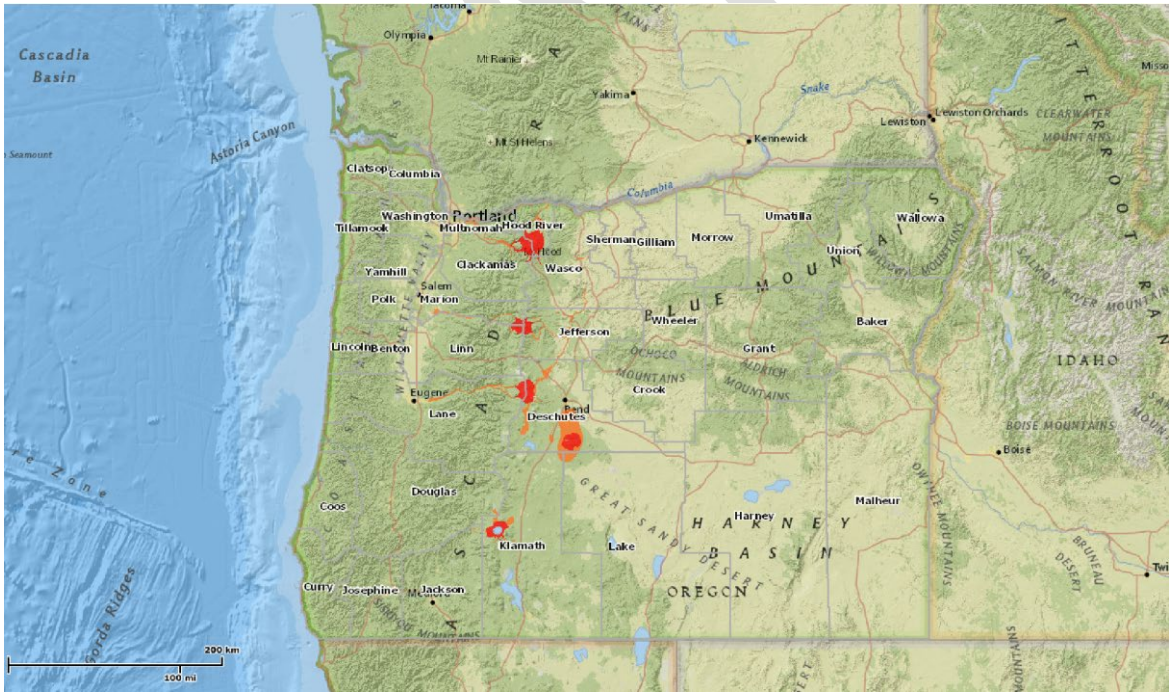
[24] Ibid.

eruption events, there are many qualitative factors - issues relating to what is in danger within a community - that point to potential vulnerability.

Figure VO-8 shows that that Sweet Home is not within an identified high or moderate volcanic event hazard zone. DOGAMI used data from the USGS Cascades Volcano Observatory (CVO) for this web application. CVO maintains proximal and distal hazard zone data for volcanic areas in the Western Cascades of Oregon. These areas include but are not limited to Mount St. Helens, Mount Hood, Crater Lake, Newberry, Mount Jefferson, and the Three Sisters.[25] HazVu shows two hazard zones: the high hazard zone (proximal zone) and moderate hazard zone (distal zone). Mt. Bachelor, which is listed as a moderate threat by the USGS,[26] is a dormant volcano monitored by the Jaffe Group at the University of Washington at Bothell.[27]

For Sweet Home, the largest vulnerability in terms of volcanic hazards lies in ash fallout from a volcanic event in the Cascades. Ash can disrupt the engines of motor vehicles and can affect vulnerable populations such as people with asthma. In Sweet Home, as in other Oregon counties, should an event force highways to close, the County could be isolated.[28]

Figure VO-8 Map of Generalized Vulnerability of the Region



Source: DOGAMI HazVu: Statewide Geohazards Viewer

[25] USGS, *Cascades Volcano Observatory*, https://volcanoes.usgs.gov/observatories/cvo/cascade_volcanoes.html.

[26] USGS, *2018 Update to the U.S. Geological Survey National Volcanic Threat Assessment*, https://pubs.usgs.gov/sir/2018/5140/sir20185140.pdf

[27] University of Washington, *INTEX-B 2006: Mount Bachelor Observatory*, https://atmos.washington.edu/~thornton/MBO.html

Risk Analysis

Many parts of Oregon, including this region, are susceptible to volcanic hazards, particularly in the portions close to the volcano centers of the Three Sisters region, Newberry Crater and Crater Lake. Volcanoes can pose significant threats to people and infrastructure. As population growth continues to expand and development becomes closer to the potentially active volcanoes, greater losses from volcanic hazards are likely to result. The level of risk from volcanic hazards can be determined through the comparison of the overlap of hazard and exposure.

Based on the HVA and collective memory, the Sweet Home NHMP Steering Committee determined the overall risk score of 147. The HVA identified that the history of volcanic events is low, with 1 or 0 events occurring over the last 100 years. The maximum threat of a volcanic event is high; considering the percentage of population and property that could be impacted under a worst-case scenario is greater than 25%. The vulnerability is high and the probability is low. The evaluation of these factors - history, maximum threat, vulnerability, and probability - resulted in the risk score of 147. See the Hazard Vulnerability Analysis in the Risk Assessment in Section 2 of Volume I.

Community Hazard Issues

What is susceptible to damage during a hazard event?

Volcanic eruptions can send ash airborne, spreading the ash for hundreds or even thousands of miles. An erupting volcano can also trigger flash floods, earthquakes, rockfalls, and mudflows. Volcanic ash can contaminate water supplies, cause electrical storms, and collapse roofs.[29]

Businesses and individuals can make plans to respond to volcano hazards. Planning is prudent because once an emergency begins, public resources (e.g. local governments, non-profits, and schools) can be overwhelmed, and people will need to make informed decisions and provide for themselves. Knowledge of volcano hazards can help citizens make a plan of action based on the relative safety of areas around home, school, and work.[30]

Building and Infrastructure Damage

Buildings and other property in the path of a flash flood, debris flow, or tephra fall can be damaged. Thick layers of ash can weaken roofs and cause collapse, especially if wet. Clouds of ash often cause electrical storms that start fires or damp ash can short-circuit electrical systems and disrupt radio communication.

Pollution and Visibility

Tephra fallout from an eruption column can blanket areas within a few miles of the vent with a thick layer of pumice. High-altitude winds may carry finer ash tens to hundreds of miles from the volcano, posing a hazard to flying aircraft, particularly those with jet engines. In an extreme situation, the airports in Linn County and surrounding areas might need to close to prevent the detrimental effect

[29] Dzurisin, Dan, Peter H. Stauffer, and James W. Hendley II, *Living With Volcanic Risk in the Cascades*, USGS Fact Sheet 165-97, (2000), https://pubs.usgs.gov/fs/old.1997/fs165-97/.

[30] Scott, W.E. et al, *Volcano Hazards in the Three Sisters Region, Oregon*, USGS Open-File Report 99-437, (2001), https://pubs.er.usgs.gov/publication/ofr99437.

of fine ash on jet engines and for pilots to avoid total impaired visibility. Fine ash in water supplies will cause brief muddiness and chemical contamination.

Economic Impacts

Volcanic eruptions can disrupt the normal flow of commerce and daily human activity without causing severe physical harm or damage. Ash a few millimeters thick can halt traffic, possibly up to one week, and cause rapid wear of machinery, clog air filters, block drains and water intakes, and can kill or damage agriculture.

Transportation of goods between Sweet Home and nearby communities and trade centers could be deterred or halted. Airport closures can disrupt airline schedules for travelers. Fine ash can cause short circuits in electrical transformers, which in turn cause electrical blackouts. Volcanic activity can also force nearby recreation areas to close for safety precautions long before the activity ever culminates into an eruption. The interconnectedness of the region's economy would be disturbed after a volcanic eruption due to the interference of tephra fallout with transportation.

Death and Injury

Inhalation of volcanic ash can cause respiratory discomfort, damage or result in death for sensitive individuals who are miles away from the cone of a volcano. Likewise, emitted volcanic gases such as fluorine and sulfur dioxide can kill vegetation for livestock or cause a burning discomfort in the lungs. Hazards to human life from debris flows are burial or impact by boulders and other debris.

County and City Statement

Potential hazards resulting from a volcanic eruption include damage from seismic activity and damage to health and property resulting from ash deposits. Therefore, when addressing existing response and mitigation activities to mitigate potential damage from volcanic events we must include the activities associated with hazard response, advanced warning and seismic protection. An important tool for advanced warning is the AlertSense or other alert system.

Existing Hazard Mitigation Activities and Resources

USGS and DOGAMI

A major existing strategy to address volcanic hazards is to publicize and distribute volcanic hazard maps and information through DOGAMI and USGS.

The volcanoes most likely to constitute a hazard to Oregon communities have been the subject of USGS research. Open-file reports (OFR) address the geologic history of these volcanoes and lesser-known volcanoes in their immediate vicinity. These reports also cover associated hazards, the geographic extent of impacts, and possible mitigation strategies. They are available for the active volcanoes such as: Mount Saint Helens, Three Sisters, Newberry Volcano, and Crater Lake. While there is not an OFR for Mt. Bachelor, there are other resource materials that provide considerable information.

Of note, after the 1980 eruption of Mount St. Helens, Congress provided increased funding that enabled the USGS to establish a volcano observatory for the Cascade Range. Located in Vancouver, Washington, the David A. Johnston Cascades Volcano Observatory (CVO) was named for a USGS

scientist killed at a forward observation post by the May 18, 1980, eruption (https://pubs.usgs.gov/fs/1997/fs165-97/fs165-97.pdf).

USGS, https://volcanoes.usgs.gov/index.html

DOGAMI, https://www.oregongeology.org/volcano/volcanoes.htm

State Natural Hazard Risk Assessment

The risk assessment in the *2020 Oregon Natural Hazards Mitigation Plan* provides an overview of volcanic hazards in Oregon and identifies the most significant volcanic eruptions in Oregon's recorded history. It has overall state and regional information, and includes volcano related mitigation actions for the entire state. 2020 Oregon NHMP

Emergency Operations Plans

This description is excerpted from the *2012 Sweet Home Emergency Operations Plan*.

The Emergency Operations Plan is an all-hazard plan that describes how the City of Sweet Home and Sweet Home Fire and Ambulance District, known as the Sweet Home Area, will organize and respond to emergencies and disasters in the community. It is based on, and is compatible with, Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including Presidential Policy Directive 8, the National Response Framework, State of Oregon Emergency Management Plan, and Linn County Emergency Operations Plan.

Response to emergency or disaster conditions in order to maximize the safety of the public and to minimize property damage is a primary responsibility of government. It is the goal of the Sweet Home Area that responses to such conditions are conducted in the most organized, efficient, and effective manner possible. To aid in accomplishing this goal, the Sweet Home Area has, in addition to promulgating this plan, informally adopted the principles of the National Incident Management System, including the Incident Command System and the National Response Framework.

Consisting of a Basic Plan, Functional Annexes aligned with the Linn County Emergency Support Functions, and Incident Annexes, this Emergency Operations Plan provides a framework for coordinated response and recovery activities during a large-scale emergency. The plan describes how various agencies and organizations in the City of Sweet Home and Sweet Home Fire and Ambulance District will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.

Future Changing Conditions/ Climate Change

In the *2021 Sweet Home NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Sweet Home and the surrounding areas. In the order of appearance in the NHMP: the Risk Assessment and the Hazards Annexes.

Volcanic Event Mitigation Actions

There is one volcanic events specific mitigation action that have been identified by the Sweet Home NHMP Steering Committee. The mitigation action has a medium priority because the Hazard

Vulnerability Assessment (HVA) resulted in volcanic events having a medium risk score and medium risk level. There are multi-hazard mitigation actions for the NHMP and several of those include volcanic related mitigation actions, in conjunction with the other hazards. The multi-hazard mitigation actions are a high priority.

In discussion with the NHMP Steering Committee, it was agreed that the risk level rankings from the HVA would be used as the way to prioritize the multi-hazard and hazard-specific mitigation actions. The risk level rankings are in Table 2-4 in Section 2 Risk Assessment.

See Table 3-1, Sweet Home NHMP Mitigation Actions for a more detailed description of the mitigation actions in this NHMP.

Drought Hazard Annex

Risk Score: 94

Risk Level: Low

Causes and Characteristics of Drought

A drought is a period of drier than normal conditions that results in water-related problems.[1] In the most general sense, drought is defined as a deficiency of precipitation over an extended period of time (usually a season or more), resulting in a water shortage. The effects of this deficiency are often called drought impacts. Natural impacts of drought can be made worse by the demand that humans place on a water supply.[2] Drought is a temporary condition – it is seen in an interval of time, generally months or years, when moisture is consistently below normal.[3] It differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate. [4]

In the *2015 Sweet Home NHMP*, drought ranked third in the risk scores of the natural hazards. In the *2021 Sweet Home NHMP*, drought sixth out of the seven natural hazards.

The *2015 Sweet Home NHMP* did not include specific events listed for natural hazards; the *2021 Sweet Home NHMP* includes a table of natural hazards events in each annex.

The National Drought Mitigation Center (NDMC) categorizes drought into types: meteorological, agricultural, hydrological, socioeconomic, and ecological. The descriptions included below are largely excerpted from the definitions on the NDMC's website.[5] Oregon's *Emergency Operations Plan* includes the *Incident Annex for Drought*; all the drought types except ecological are described in that document. The *2020 Oregon Natural Hazards Mitigation Plan* (*2020 Oregon NHMP*) also includes all the drought types except ecological. Noting the impact of climate change and the local NHMP requirements to address future changing conditions, the DLCD Natural Hazards Planner decided to include ecological drought.

Meteorological or Climatological Droughts

Meteorological droughts are defined in terms of the departure from a normal precipitation pattern and the duration of the event. These are region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region. This drought type may relate specific precipitation departures to average amounts on a monthly, seasonal, or yearly basis.

[1] Moreland, A. USGS, *Drought. Open File Report 93-642*, 1993, https://pubs.er.usgs.gov/publication/ofr93642.

[2] National Drought Mitigation Center, *Drought Basics.* https://drought.unl.edu/Education/DroughtBasics.aspx, accessed January 24, 2019.

[3] National Drought Mitigation Center, *Types of Drought*, https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx, accessed January 24, 2019.

4 National Drought Mitigation Center, *Types of Drought*, https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx, accessed January 24, 2019.

[5] Ibid.

Agricultural Droughts

Agricultural drought links various characteristics of meteorological or hydrological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced groundwater or reservoir levels. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil. A good definition of agricultural drought accounts for the variable susceptibility of crops during different stages of crop development, from emergence to maturity.

Hydrological Droughts

Hydrological droughts refer to deficiencies in surface water and sub-surface water supplies. It is measured as stream flow, and as lake, reservoir, and ground water levels. When precipitation is reduced or deficient over an extended period of time, the shortage will be reflected in declining surface and sub-surface water levels. Hydrological droughts are usually out of phase with the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, streamflow, and groundwater and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors. Also, water in hydrologic storage systems (e.g., reservoirs, rivers) is often used for multiple and competing purposes (e.g., flood control, irrigation, recreation, navigation, hydropower, and wildlife habitat), further complicating the sequence and quantification of impacts. Competition for water in these storage systems escalates during drought and conflicts between water users increase significantly.

Socioeconomic Droughts

Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. It differs from the aforementioned types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods, such as water, forage, food grains, fish, and hydroelectric power, depends on weather. Because of the natural variability of climate, water supply is ample in some years but unable to meet human and environmental needs in other years. Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.

In most instances, the demand for economic goods is increasing as a result of increasing population and per capita consumption. Supply may also increase because of improved production efficiency, technology, or the construction of reservoirs that increase surface water storage capacity. If both supply and demand are increasing, the critical factor is the relative rate of change. Is demand increasing more rapidly than supply? If so, vulnerability and the incidence of drought may increase in the future as supply and demand trends converge.

Ecological Droughts

A more recent effort focuses on ecological drought, defined as "a prolonged and widespread deficit in naturally available water supplies — including changes in natural and managed hydrology — that create multiple stresses across ecosystems."[6]

Oregon's Drought Planning and Monitoring

The State of Oregon's *Emergency Operations Plan* (EOP), dated April 2017, includes an *Incident Annex for Drought*, dated January 2016. The drought types included there are meteorological, agricultural, hydrological, and socioeconomic. The *Incident Annex for Drought* describes the way a drought is determined in Oregon. A brief description is included here.

> "To trigger specific actions from the Water Resources Commission and the Governor, a "severe and continuing drought" must exist or be likely to exist. Oregon relies upon two inter-agency groups to evaluate water supply conditions, and to help assess and communicate potential drought-related impacts. The Water Supply Availability Committee (WSAC) is a technical committee chaired by the Water Resources Department. The other group—the Drought Readiness Council—is a coordinating body of state agencies co-chaired by the Water Resources Department and the Office of Emergency Management."[7]

The WSAC utilizes the Surface Water Supply Index (SWSI). The SWSI is an index of current water conditions throughout the state. The index utilizes parameters derived from snow, precipitation, reservoir and streamflow data. The data is gathered each month from key stations in each basin. The lowest SWSI value, -4.1, indicates extreme drought conditions. The highest SWSI value, +4.1, indicates extreme wet conditions. The mid-point is 0.0, which indicates a normal water supply.[8] Additional information can be found on the Natural Resource Conservation Service's website; https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/snow/waterproducts/?cid=stelprdb1244919.

The following are indicators used by the WSAC for evaluating drought conditions:

- Snowpack,
- Precipitation,
- Temperature anomalies,
- Long range temperature outlook,
- Long range precipitation outlook,
- Current stream flows and behavior,
- Spring and summer streamflow forecasts,
- Ocean surface temperature anomalies (El Nino, La Nina),
- Storage in key reservoirs,
- Soil and fuel moisture conditions, and
- NRCS Surface Water Supply Index.[9]

[6] National Drought Mitigation Center, *Types of Drought*, https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx, accessed July 31, 2019.

[7] State of Oregon, *Emergency Operations Plan*, *Incident Annex for Drought*, April 2016, https://www.oregon.gov/oem/Documents/2015_OR_EOP_IA_01_drought.pdf.

[8] Barry Norris, Administrator, Technical Services Division, Water Resources Department, Planning for Drought, 2001.

[9] State of Oregon, *Emergency Operations Plan*, *Incident Annex for Drought*, April 2016, https://www.oregon.gov/oem/Documents/2015_OR_EOP_IA_01_drought.pdf.

In the *2020 Oregon Natural Hazards Mitigation Plan* (*2020 Oregon NHMP*), it describes the eight Oregon Natural Hazard Regions (which are different from the climatic regions shown in Figure DR-2). It also notes that "Going forward, drought indices that can account for a changing climate, such as the Standard Precipitation-Evapotranspiration Index (SPEI), may provide a more accurate estimate of future drought risks."[10]

As described in the *2020 Oregon NHMP*, Sweet Home and Linn County are part of Oregon Natural Hazard Region 3 Mid/Southern Willamette Valley which includes: Benton, Lane (non-coastal), Linn, Marion, Polk, and Yamhill Counties. The *2020 Oregon NHMP* notes that "Even though drought may not be declared as often in Western Oregon as in counties east of the Cascades, when drought conditions do develop in the Willamette Valley, the impacts are widespread and severe. Reasons for broad and significant impact include insufficient water for crop irrigation; lack of farmworkers when the growing season begins early; and increased frequency of toxic algal blooms in the Willamette system reservoirs, among other reasons." Besides the agriculture and the economy, the *2020 Oregon NHMP* also describes impacts of droughts on the environment, population, infrastructure, critical/essential facilities, and state-owned and operated facilities.

Since 1991, Linn County has been under an emergency drought declaration from the Governor of Oregon on three occasions: 1992, 2014, and 2015. These drought declarations generally included multiple other counties in the region or across Oregon in addition to Linn County. See the History of Drought in Linn County and Table DR-1 Significant Historic Drought Events for more details on how many drought events have occurred.

History of Drought in Sweet Home and Oregon

Quantifying drought requires an objective criterion for defining the beginning and end of a drought period. The Palmer Drought Severity Index is most effective in determining long-term drought — e.g. several months — and is not as good with short-term forecasts, e.g. a matter of weeks.

As described in the *2020 Oregon NHMP*, "Most federal agencies use the Palmer Method which incorporates precipitation, runoff, evaporation, and soil moisture. However, the Palmer Method does not incorporate snowpack as a variable. Therefore, it is does not provide a very accurate indication of drought conditions in Oregon and the Pacific Northwest, although it can be very useful because of its long-term historical record of wet and dry conditions."[11]

The *2020 Oregon NHMP* further describes, "With climate change, snow droughts—the type of drought in which snowpack is low, but precipitation is near normal—are expected to occur more often. The 2015 drought in Oregon was a "snow drought" and serves as a good example of what future climate projections indicate may become commonplace by mid-21st century (Dalton, Dello, Hawkins, Mote, & Rupp, 2017).

The Palmer Method or Palmer Drought Severity Index (PDSI) indicates the prolonged and abnormal moisture deficiency or excess. It indicates general conditions and not local conditions caused by

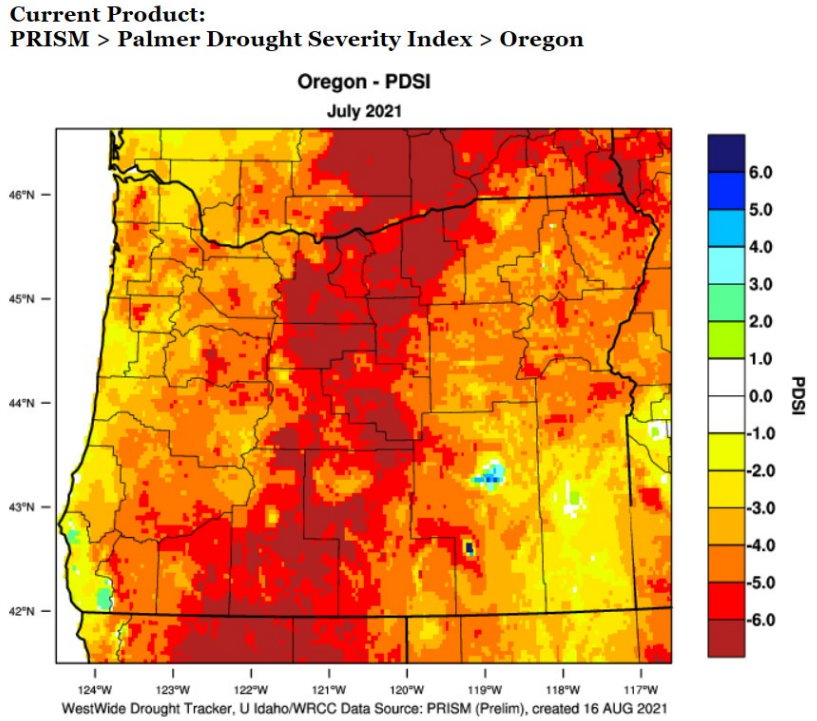
[10] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

[11] Ibid.

isolated rain. The PSDI is an important climatological tool for evaluating the scope, severity, and frequency of prolonged period of abnormally dry or wet weather. It can be used to delineate disaster areas and indicate the availability of irrigation water supplies, reservoir levels, range conditions, amount of stock water, and potential intensity of forest fires.[12]

The PDSI uses readily available temperature and precipitation data to estimate relative dryness. It is a standardized index that spans -10 (dry) to +10 (wet). As it uses temperature data and a physical water balance model, it can capture the basic effect of global warming on drought through changes in potential evapotranspiration. Monthly PDSI values do not capture droughts on time scales less than about 12 months;[13] The PDSI uses a zero (0) as normal, and drought is shown in terms of negative numbers; for example, negative two (-2.00) is moderate drought, negative three (-3.00) is severe drought, and negative four (-4.00) is extreme drought. See Figure DR-1.

Figure DR-1 Oregon Counties Palmer Drought Severity Index Map for July 2021



Source: West Wide Drought Tracker, Oregon – PDSI, https://wrcc.dri.edu/wwdt/index.php?region=or

Some Oregon droughts were especially significant during the period of 1928 to 1994. The period from 1928 to 1941 was a prolonged drought that caused major problems for agriculture. The only

[12] Oregon Drought Conditions Map – May 13, 2017, https://www.plantmaps.com/interactive-oregon-drought-conditions-map.php

[13] National Center for Atmospheric Research, *The Climate Data Guide: Palmer Drought Severity Index (PDSI),* https://climatedataguide.ucar.edu/climate-data/palmer-drought-severity-index-pdsi

area spared was the northern coast, which received abundant rains in 1930-33. The three Tillamook burns (1933, 1939, and 1945) were the most significant results of this very dry period.[14]

During 1959-1962 stream flows were low throughout Eastern Oregon, but areas west of the Cascades had few problems. The driest period in Western Oregon was the summer following the benchmark 1964 flood. Low stream flows prevailed in Western Oregon during the period from 1976-81, but the worst year, by far, was 1976-77, the single driest year of the century. The Portland airport received only 7.19 inches of precipitation between Oct. 1976 and Feb. 1977, only 31% of the average 23.16 inches for that period. The 1985-94 drought was not as severe as the 1976-77 drought in any single year, but the cumulative effect of ten consecutive years with mostly dry conditions caused statewide problems.[15]

The peak year of the drought was 1992, when a drought emergency was declared for all of Oregon. Forests throughout the state suffered from a lack of moisture. Fires were common and insect pests, which attacked the trees, flourished.[16] In 2001, 2002, and 2003 Oregon experienced drought conditions, and in 2005, 2008, 2014, 2015, 2018 and 2020. In addition to drought declarations by the State, the United States Department of Agriculture (USDA) can issue drought declarations. The USDA declarations provided access to emergency loans for crop losses.[17]

Table DR-1 Significant Historic Drought Events

Date	Location	Description
1094-05	Statewide	Drought period of about 18 months.
1917-31	Statewide	Very dry period punctuated by brief wet spells (1920, 1927). The 1920s and 30s were commonly known as the Dust Bowl.
1939-41	Statewide	Three-year intense drought.
1965-68	Statewide	Three-year drought following the big regional floods of 1964-65.
1976-77	Statewide	EM-3039. Oregon Drought. Declared April 29, 1977. Brief very intense statewide drought. There were significant impacts to agriculture. Affected Lake County.
1991	Statewide	Governor declared drought in 10 counties via several Executive Orders (Executive Order 91-06).
1992	Statewide	Governor declared drought (Executive Order 92-21) in many counties, including Linn, for the period of September through October.
1985-94	Statewide	Generally dry period, capped by statewide droughts in 1992 and 1994. In 1994, the Governor declared drought in 11 counties within regions 4, 5, 6, 7, and 8.
2001-2003	Statewide	Governor declared drought (Executive Order 01-12) from May 2001 through June 2003 (additional Executive Orders such as 01-05, 02-21, 04-03 and 03-05) in 18 counties including: Malheur, Harney, Lake, Hood River, Wasco, Sherman, and Gilliam. Linn County was not declared.
2007	Several counties	Governor declared drought for Harney (Executive Order 07-10), Malheur (Executive Order 07-11), and Lake (07-16) County and three other counties (other Executive Orders). Linn County was not declared.
2014	Regions 4, 6-8	Governor declared drought in 10 counties (via several Executive Orders). This was the third driest Nov.-Jan. period since 1895. State drought

[14] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

[15] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

[16] Ibid.

[17] Ibid.

Date	Location	Description
		declarations: Baker, Crook, Grant, Harney, Jackson, Josephine, Klamath, Lake, Malheur and Wheeler counties. USDA drought disaster declarations: Baker, Benton, Coos, Crook, Curry, Deschutes, Douglas, Grant, Harney, Jackson, Jefferson, Josephine, Klamath, Lake (Ex Order 14-01), Lane, Lincoln, Linn, Malheur (Ex Order 14-01), Morrow, Umatilla, Union, Wallowa and Wheeler counties.
2015	Statewide	Governor declared drought for Linn County (Executive Order 15-11), Harney County (Executive Order 15-03), Lake and Malheur Counties (Executive Order 15-02), and others (via other Executive Orders) in 2015.
2016-August 2021	Linn County	No drought declarations for Linn County during this timeframe.

Sources: DLCD, Oregon NHMP, 2015 and 2020; FEMA, Disaster Declarations for Oregon, retrieved 2017-2021. The Oregonian, http://www.oregonlive.com/weather/index.ssf/2014/09/oregon_drought_not_much_relief.html; Oregon Water Resources Department Public Declaration Report and Drought Declaration Map, http://apps.wrd.state.or.us/apps/wr/wr_drought/declaration_status_report.aspx and Drought Declaration Status Map (state.or.us), Haberman, Margaret (September 15, 2014). The Oregonian. http://www.oregonlive.com/weather/index.ssf/2014/09/oregon_drought_not_much_relief.html; Taylor and Hatton, 1999.

Groundwater Administrative Areas

There are 22 designated groundwater administrative areas in Oregon, with differing levels of restriction. These include critical groundwater areas (CGWAs), groundwater limited/classified areas, and areas withdrawn from further appropriation. Restrictions vary from time-limited permit restrictions for uses requiring water rights, closed to new appropriations, or those that have well construction requirements to protect senior water rights. Oregon Water Resources Department (OWRD) staff monitor these areas to ensure that the restrictions adequately protect the groundwater resource and existing users.[18]

There is one area listed in Linn County as a Groundwater Limited Area. It is listed as Kingston, March 13, 1992, Columbia River Basalt, Exempt Uses Only, 5 square miles.[19] The Oregon Administrative Rule (OAR) related to this area is OAR 690-502-0180 and can be accessed here: Oregon Secretary of State Administrative Rules. See Figure DR-3 for a map of the ORWD Groundwater Restricted Areas.

Crop Land Cover

One of the most impactful consequences for drought is on agriculture. Because the 2021 Sweet Home NHMP is really focused on the City of Sweet Home, rather than Linn County, crop cover data is not included. For information and maps of crop land cover, see CropScape, a mapping program courtesy of the US Department of Agriculture (USDA).

Risk Assessment

How are Hazards Identified?

The extent of the drought depends upon the degree of moisture deficiency, and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than

[18] Oregon Water Resources Department, *Groundwater*, https://www.oregon.gov/OWRD/programs/GWWL/GW/Pages/AdminAreasAndCriticalGWAreas.aspx

[19] Oregon Water Resources Department, *Groundwater*, https://www.oregon.gov/OWRD/programs/GWWL/GW/Pages/AdminAreasAndCriticalGWAreas.aspx

one city and county. In severe droughts, environmental and economic consequences can be significant.

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Hazard Risk Analysis

The Sweet Home NHMP Steering Committee completed a Hazard Vulnerability Assessment/Analysis (HVA) during this NHMP update. This was described in Section 2 Risk Assessment. The method used for the HVA was developed from a Federal Emergency Management Agency (FEMA) tool that has been refined by the Oregon Office of Emergency Management (OEM). It addresses and weights (shown as percent within parentheses) probability (29%), vulnerability (21%), maximum threat (42%) and the history (8%) of each natural hazard and attributes a final hazard analysis score. The methodology produces scores that range from 24 to 240.

For local governments, conducting the HVA is a useful step in planning for hazard mitigation. The method provides the jurisdiction with a relative ranking from which to prioritize mitigation actions but does not predict the occurrence of a particular hazard.

In the *2015 Sweet Home NHMP*, drought ranked third in the risk scores of the natural hazards. In the *2021 Sweet Home NHMP*, drought sixth out of the seven natural hazards.

For more information on all the risk scores and ranks of the natural hazards, see Volume I Basic Plan, Section 2 Risk Assessment of this NHMP.

Probability Assessment

According to the Probability section for drought that is within the *2020 Oregon NHMP*,

> "Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It is a temporary condition and differs from aridity because the latter is restricted to low rainfall regions and is a permanent feature of climate. It is rare for drought not to occur somewhere in North America each year. Despite impressive achievements in the science of climatology, estimating drought probability and frequency continues to be difficult. This is because of the many variables that contribute to weather behavior, climate change, and the absence of historic information."[20]

The *2020 Oregon NHMP* also notes that,

> "a combination of factors increases the likelihood that Oregon will experience increased frequency of one or more types of droughts under future climate change. In addition, Oregon is projected to experience an increase in the frequency of summer drought conditions as summarized by the standard precipitation-evaporation index (SPEI) due largely

[20] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

to projected decreases in summer precipitation and increases in potential evapotranspiration (Dalton, Dello, Hawkins, Mote, & Rupp, 2017)."[21]

Vulnerability Assessment

According to the *2020 Oregon NHMP*, "While the communities most vulnerable to drought are all located east of the Cascades, drought occurs and its impacts are felt statewide. We do not have the data to make a quantitative assessment of risk from drought; however, there has been a drought event in fourteen of the last twenty years. Qualitatively, the risk of drought in Oregon is at least moderate to high, and likely to become very high in future years."[22]

In Region 3 of Oregon's Natural Hazard Regions, which Linn County is part of, and as described in the *2020 Oregon NHMP*,

> According to the CDC Social Vulnerability Index, social vulnerability in the region is highest in Marion County, followed by Linn and Yamhill Counties… Linn County's high vulnerability is driven by moderately high scores across the CDC index. Notably, however, the county is in the 80th percentile for its share of single-parent households and has a smaller per capita income and a higher percentage of persons aged 17 and younger than 70 percent of all counties… Marion County's social vulnerability score is very high, Linn and Yamhill Counties' high... The social vulnerability score indicates the extent of impact of any natural hazard, including drought, on a county's population. Marion, Linn, and Yamhill are the communities most vulnerable to drought in Region 3.[23]

In addition, droughts have many effects, including but not limited to those on lake and river levels, which harms wildlife, farmers, and ranchers. Its effect on forest is less obvious but still impactful. For example, during extended periods of drought trees are weakened by water shortages and tree pests proliferate. Wildfires also often coincide with droughts. The severity of a drought occurrence impacts agricultural and timber losses, property damage, and disruption of water supplies and availability in urban and rural areas. Factors used to assess drought risk include agricultural practices, such as crop types and varieties grown, soil types, topography, and water storage capacity (e.g. behind dams and in reservoirs).[24] In droughts, environmental, infrastructure, critical/essential facilities, state-owned and operated facilities, population, and economic consequences can be significant.

[21] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

[22] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

[23] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_00_Complete.pdf

[24]Water availability and precipitation are not always correlated; drought conditions affect regions differently than others due to available water supplies.

Community Hazard Issues

What is susceptible to damage during a hazard event?

Droughts can happen at any time of the year. Given the breadth of impacts identified in this Drought Annex as possibly resulting from drought, losses from a drought could be extensive and far-reaching.

As described in the Risk Assessment for Region 3 in the *2020 Oregon NHMP*,

> Even though drought is infrequent in the mid-southern Willamette Valley, climate models project warmer, drier summers for Oregon, including Region 3. These summer conditions coupled with projected decreases in mid-to-low elevation mountain snowpack due to warmer winter temperatures increases the likelihood that Region 3 would experience increased frequency of one or more types of droughts under future climate change. In Region 3, climate change would result in increased frequency of drought due to low spring snowpack (very likely, >90%), low summer runoff (likely, >66%), and low summer precipitation and low summer soil moisture (more likely than not, >50%). In addition, Region 3, like the rest of Oregon is projected to experience an increase in the frequency of summer drought conditions as summarized by the standard precipitation-evaporation index (SPEI) due largely to projected decreases in summer precipitation and increases in potential evapotranspiration (Dalton, Dello, Hawkins, Mote, & Rupp, 2017).[25]

Recall Table DR-1 Significant Historic Drought Events. Drought is a normal, recurrent feature of climate. It is a temporary condition, but its effects can accumulate slowly and last from several months to several years, even well after the termination of the drought itself. Because of this characteristic of drought, it can be difficult to fully quantify the impact of drought upon communities. Additionally, estimating drought probability and frequency is difficult. Oregon lacks long historic databases for drought, many variables contribute to the weather behavior that causes drought, and different regions are affected to varying degrees of severity based on natural features and human infrastructure.

Winter droughts can have a profound impact on agriculture, particularly east of the Cascade Mountains. Also, below average snowfall in higher elevations has a far-reaching effect, especially in terms of hydroelectric power, irrigation, recreational opportunities and a variety of industrial uses. Drought is a significant risk in Umatilla County due to its limited annual rainfall and economic reliance on agriculture and ranching. Agriculture and ranching are heavily dependent on water supply and a complex network of irrigation systems and dams spread throughout the County.

Drought can affect all segments of a jurisdiction's population, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). Also, domestic water-users may be subject to stringent conservation measures (e.g., rationing) and could be faced with significant increases in electricity rates. Facilities affected by drought conditions include irrigation systems, storage systems for potable water, sewage treatment facilities, water storage for firefighting, and hydroelectric generating plants.

There also are environmental consequences. A prolonged drought in forests promotes an increase of insect pests, which in turn, damage trees already weakened by a lack of water. A moisture-

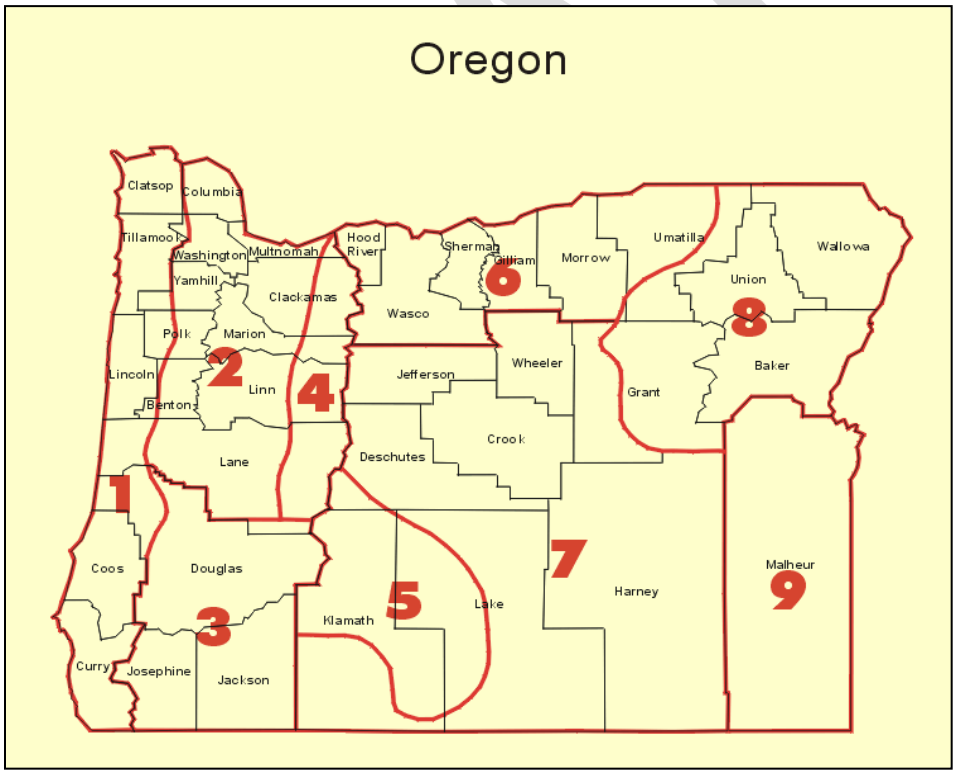
[25] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, 2020 Oregon NHMP

deficient forest or grassland constitutes a significant fire hazard (see the Wildland-Urban Interface Fires Hazard Annex). In addition, drought and water scarcity add another dimension of stress to species listed pursuant to the Endangered Species Act (ESA) of 1973.

There are multiple different sources of information that can provide more detailed information about the amount of rainfall and other climate related factors. The Severe Storms Hazard Annex and the Community Profile in Appendix B contain details about rainfall, snowfall, and temperature.[26]

Sometimes when describing climate in Oregon, people refer to the Oregon Climatic Divisions. These divisions are based on the Climate Divisional Dataset maintained by National Oceanic and Atmospheric Administration (NOAA). For many years the dataset was the "only long-term temporally and spatially complete dataset from which to generate historical climate analyses (1895-2013) for the contiguous United States. It was originally developed for climate division, statewide, regional, national, and population-weighted monitoring of drought, temperature, precipitation, and heating/cooling degree day values. Since the dataset was at the divisional spatial scale, it naturally lent itself to agricultural and hydrological applications."[27] Linn County is in Oregon Climate Zones 2 and 4. See Figure DR-2.

Figure DR-2 Map of Climatic Divisions



Source: NOAA, National Weather Service Climate Prediction Center, https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/CLIM_DIVS/oregon.gif

[26] U.S. Climate Data, Climate Oregon - Temperature, Rainfall and Averages (usclimatedata.com)

[27] NOAA National Centers for Environmental Information, *U.S. Climate Divisions*, https://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php, accessed 6/25/19.

Existing Hazard Mitigation Activities

Government Assistance when Droughts Occur

Once drought conditions have been established, Oregon communities may request government assistance. The mechanism to trigger federal or state assistance is contained in ORS 536.710.

> "1) The Legislative Assembly finds that an emergency may exist when a severe, continuing drought results in a lack of water resources, thereby threatening the availability of essential services and jeopardizing the peace, health, safety and welfare of the people of Oregon.
>
> (2) The Legislative Assembly finds it necessary in the event of an emergency described in subsection (1) of this section, to promote water conservation and to provide an orderly procedure to assure equitable curtailment, adjustment, allocation or regulation in the domestic, municipal and industrial use of water resources where more than one user is dependent upon a single source of supply."[28]

Locally, farmers may apply for assistance only when the state has declared the County a disaster area. The process for such a declaration is as follows: local County Court has passed a resolution declaring the County to be in a "State of Drought Emergency," which is sent to the Oregon Department of Agriculture for review. If the Department deems the County's production losses sufficient, it will request that the Governor designate the County a disaster area, making local farmers eligible for emergency loans and other assistance from the USDA Farm Service Agency. To receive assistance, farmers must provide documentation of crop losses and typical yields; additionally, they are only eligible for funds if this documentation reveals a 35% or greater loss in production due to drought.

Existing Hazard Mitigation Activities and Resources

National Drought Mitigation Center: Drought Monitor

On the National Drought Mitigation Center website there is a page called US Drought Monitor. It include a map and weekly summary of current drought conditions for each state in the US. There is an intensity and impacts scale that is used to indicate the severity level of conditions; there are five levels. There is also a section called data which provides a variety of statistics. You can select data each week such as percent of area, total area, percent of population and total population. Spatial scale choices include national, state, county and urban areas, and many more.

There is also a Drought Classification page on the website which includes the five levels of severity, and the types of systems used to classify and measure them: the Palmer Drought Severity Index, the CPC Soil Moisture Model, the USGS Weekly Streamflow, the Standardized Precipitation Index, and the Objective Drought Indicator Blends.

https://droughtmonitor.unl.edu/

[28] State of Oregon, ORS 536.710, https://www.oregonlaws.org/ors/536.710.

State Natural Hazard Risk Assessment: Drought

The risk assessment in the *2020 Oregon Natural Hazards Mitigation Plan* provides an overview of drought risk in Oregon and identifies the most significant droughts in Oregon's recorded history. It has overall state and regional information, and includes drought related mitigation actions for the entire state. The link included here is specific to the Risk Assessment for Region 3 Mid/Southern Willamette Valley. 2020 Oregon NHMP

Water Resources Commission, Water Supply Availability Committee, and the Drought Readiness Council

As described in the Oregon Drought Planning and Monitoring section, to trigger specific actions from the Water Resources Commission and the Governor, it must be likely that a severe and continuing drought will occur. There are two inter-agency groups that evaluate water supply conditions, and help assess and communicate potential drought-related impacts:

- The Water Supply Availability Committee (WSAC) is a technical committee chaired by the Oregon Water Resources Department (OWRD).
- The Drought Readiness Council is a coordinating body of state agencies co-chaired by the OWRD and the Office of Emergency Management (OEM).

See the State of Oregon's *Emergency Operations Plan, Incident Annex for Drought*, https://www.oregon.gov/oem/Documents/2015_OR_EOP_IA_01_drought.pdf.

Oregon Water Resources Department (ORWD)

OWRD has statutory authority (ORS and OAR) to implement special "drought rules" during times of surface water shortage. These rules allow higher use of supplemental groundwater rights and temporary, emergency water rights transfers to ensure that crops are not lost due to lack of water. While this program works during times of surface water shortages it allows the extended use of groundwater aquifers that are already depleted, some of which have declined over 400 feet.[29]

There is a Water Master for District 2 located in Eugene, Oregon. Eugene is 45 miles from Sweet Home. The Water Master communicates with the public during drought season and other times of the year about responsible water management best practices.

https://www.oregon.gov/OWRD/aboutus/contactus/Pages/RegionalOfficesandWatermastersDirectory.aspx

Natural Resources and Conservation Service -Linn County

The Natural Resource and Conservation Service (NRCS) has a service center located in Linn County, the Tangent Service Center. Also listed on the NRCS website is the Linn County Soil and Water Conservation District (Linn SWCD).

The NRCS offers voluntary technical and financial assistance to private landowners interested in natural resource conservation. The NRCS has historically focused on rangeland and irrigation

[29] *2014 Umatilla County NHMP*

upgrades to improve surface water quality, improve wildlife habitat, control invasive plants, and conserve groundwater.[30]

Of note,

> "NRCS Oregon uses a *Strategic Approach to Conservation* to address priority natural resource concerns in specific watersheds and landscapes across the state. It all begins with a *Long Range Plan*. Each county develops a Long Range Plan with input from landowners, agency partners and other stakeholders that identifies and prioritizes natural resource concerns in the community. Based on those plans, NRCS works with partners to develop local *Conservation Implementation Strategies* to help agricultural producers in those targeted areas implement conservation practices that address the resource concerns. *Long Range Plans* are updated to reflect the changing needs and objectives of the county's natural resources."[31]

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/contact/local/?cid=nrcs142p2_046140

Sweet Home Community and Economic Development Department

The Sweet Home Code of Ordinances (which includes zoning and other provisions) is located here: Sweet Home, OR Laws (amlegal.com)

Emergency Operations Plans

This description is excerpted from the *2012 Sweet Home Emergency Operations Plan*.

The Emergency Operations Plan is an all-hazard plan that describes how the City of Sweet Home and Sweet Home Fire and Ambulance District, known as the Sweet Home Area, will organize and respond to emergencies and disasters in the community. It is based on, and is compatible with, Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including Presidential Policy Directive 8, the National Response Framework, State of Oregon Emergency Management Plan, and Linn County Emergency Operations Plan.

Response to emergency or disaster conditions in order to maximize the safety of the public and to minimize property damage is a primary responsibility of government. It is the goal of the Sweet Home Area that responses to such conditions are conducted in the most organized, efficient, and effective manner possible. To aid in accomplishing this goal, the Sweet Home Area has, in addition to promulgating this plan, informally adopted the principles of the National Incident Management System, including the Incident Command System and the National Response Framework.

Consisting of a Basic Plan, Functional Annexes aligned with the Linn County Emergency Support Functions, and Incident Annexes, this Emergency Operations Plan provides a framework for coordinated response and recovery activities during a large-scale emergency. The plan describes

[30] USDA Natural Resources Conservation Service of Oregon, *Umatilla County,* https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/contact/local/?cid=nrcs142p2_046140, accessed 3/11/21.

[31] Ibid.

how various agencies and organizations in the City of Sweet Home and Sweet Home Fire and Ambulance District will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.

Linn County Watershed Councils

Watershed councils were established to promote environmental restoration along the tributaries and main stems of rivers, and other areas. These councils have completed projects ranging from recharge of alluvial aquifers to riparian planting and federal conservation projects. They often collaborate with partners such as the SWCD, local governments, and state government. An interesting report on forest and watershed restoration in Linn County, published in 2013, is called *Forest and Watershed Restoration in Linn County, Oregon: Economic Impacts, Trends, and Recommendations*, it can be found here: WP_44.pdf (uoregon.edu). Another interesting restoration effort is the All Lands Collaborative Approach which includes numerous partners. Information can be found here: Friends of the Forest Day – Sweet Home, Oregon - National Forest Foundation (nationalforests.org).

Future Changing Conditions/ Climate Change

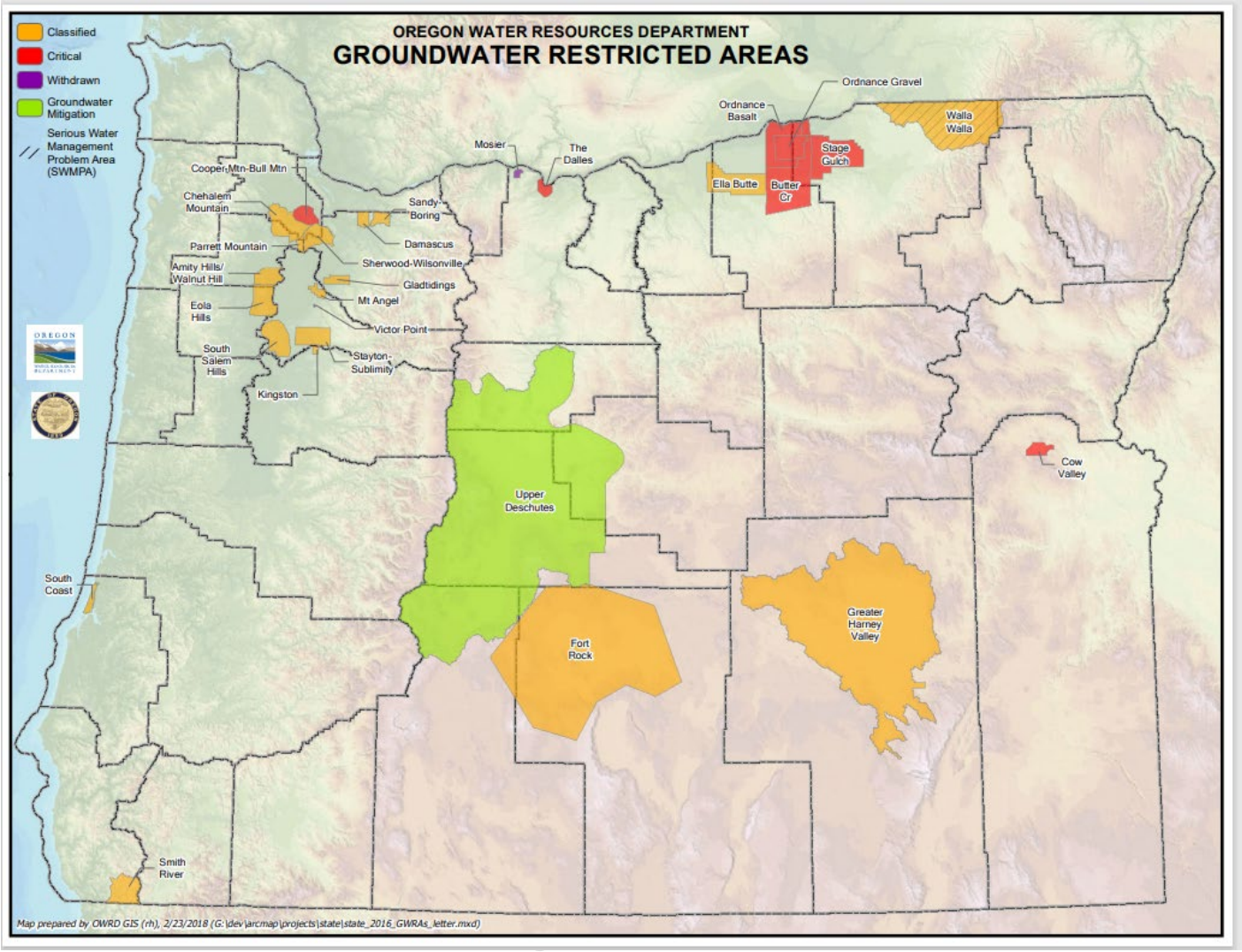
In the *2021 Sweet Home NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Sweet Home and the surrounding area. In the order of appearance in the NHMP it is in the Risk Assessment and the Hazards Annexes.

Drought Mitigation Actions

The drought mitigation actions have been identified by the Sweet Home NHMP Steering Committee. See Table 3-1, 2021 Sweet Home NHMP Mitigation Actions.

The NHMP Steering Committee agreed to use the HVA risk scores as the priority level for the mitigation actions. There are no drought-specific mitigation actions. The drought-specific mitigation actions have a low priority because the Hazard Vulnerability Assessment (HVA) resulted in drought having a low risk level. There are multi-hazard mitigation actions that relate to drought; multi-hazard mitigation actions are high priority. The risk scores and risk level rankings are in Table 2-4 in Section 2 Risk Assessment.

Figure DR-3 Oregon Water Resources Department Groundwater Restricted Areas



Source: ORWD, GWAdminAreasMap.pdf (oregon.gov), accessed 8/18/21

Landslides Hazard Annex

Risk Score: 24

Risk Level: Low

Causes and Characteristics of Landslides

Landslides are a geologic hazard in almost every state in America. Nationally, landslides cause 25 to 50 deaths each year.[1] In Oregon, economic losses due to landslides for a typical year are estimated to be over $10 million.[2] In years with heavy storms, such as in 1996, losses can be an order of magnitude higher and exceed $100 million.[3] In Oregon, a significant number of locations are at risk to dangerous landslides. While not all landslides result in private property damage, many landslides impact infrastructure such as transportation corridors, fuel and energy conduits, and communication facilities. They can also pose a serious threat to the lives of humans and animals, and to the environment.

In the *2015 Sweet Home NHMP*, landslides were ranked seventh in the list of hazards. In the *2021 Sweet Home NHMP*, landslides are again ranked seventh.

The *2015 Sweet Home NHMP* did not include specific events listed for natural hazards; the *2021 Sweet Home NHMP* includes a table of natural hazards events in each annex.

Types of Landslides

Landslides are downhill or lateral movements of rock, debris, or soil mass. Landslides vary greatly in the volumes of rock and soil involved, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Landslides are given different names depending on the type of failure and their composition and characteristics. All landslides can be classified into six types of movement: 1) falls, 2) topples, 3) slides, 4) spreads, 5) flows, and 6) complex. See Figure LS-1 for illustration of landslide types.[4]

Although the factors determining what type of movement will manifest for any given landslide are very complex, the topographic nature of the slope and the type of slope material often play dominant roles. Most slope failures are complex combinations of these distinct types, but the generalized groupings provide a useful means for framing discussion of the type of hazard and potential mitigation alternatives. Movement type should be combined with other landslide characteristics such as type of material, rate of movement, depth of failure, and water content in order to more fully understand the landslide behavior. For a more complete description of the different types of landslides, see U.S. Transportation Research Board *Special Report 247* (Turner and

[1] Mileti, Dennis. 1999. *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington D.C.: Joseph Henry Press.

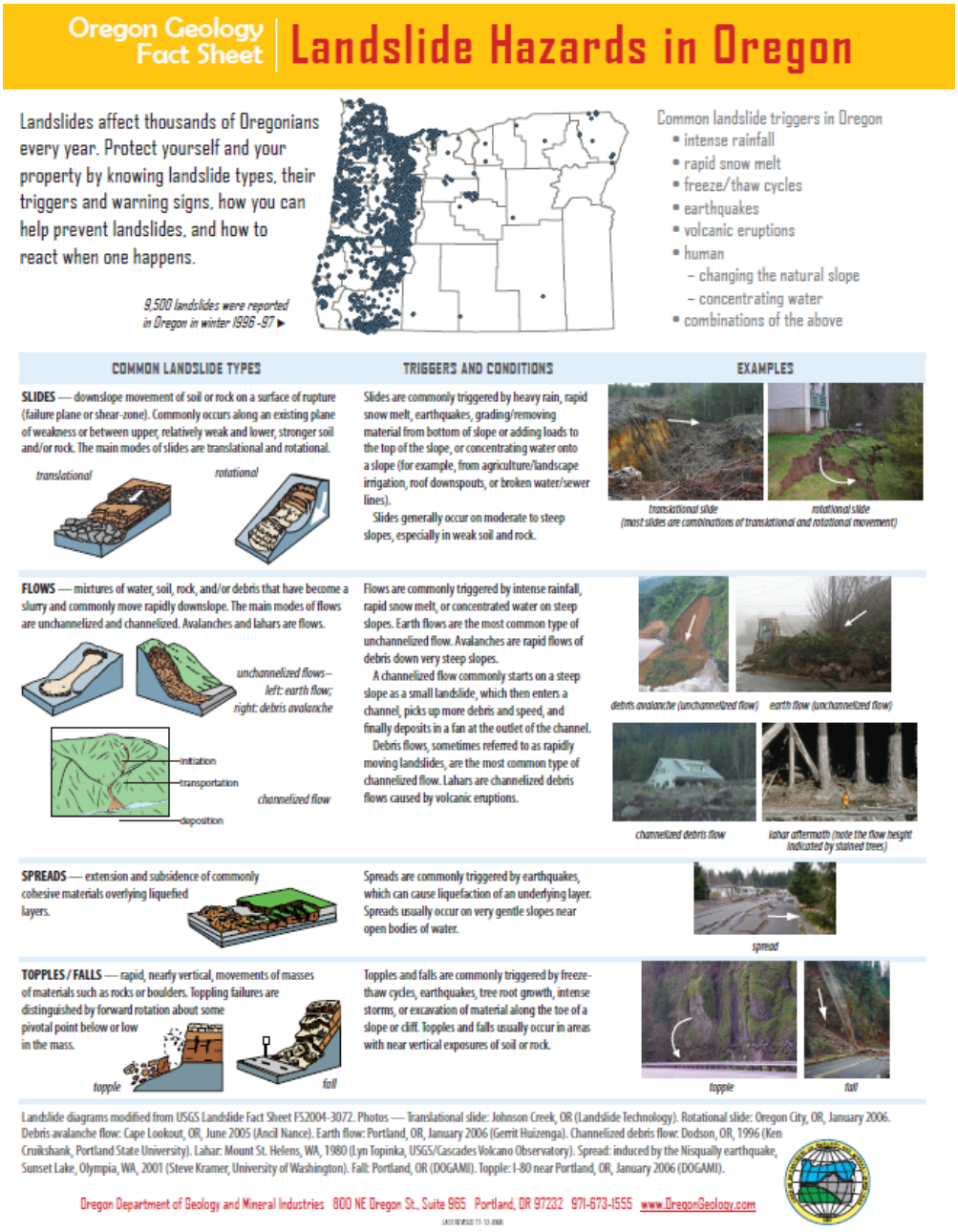
[2] Wang, Yumei, Renee D. Summers, R. Jon Hofmeister, and Oregon Department of Geology and Mineral Industries. 2002. *Open-File Report O-02-05: Landslide Loss Estimation Pilot Project in Oregon*. https://www.oregongeology.org/pubs/ofr/O-02-05.pdf, accessed February 14, 2010 and reaffirmed January 22, 2019.

[3] Ibid.

[4] Bill Burns, DOGAMI, personal communication, January 2019.

Schuster, 1996), which has an extensive chapter on landslide types and processes.[5] It is common for failures to reoccur where previous ones happened; this is true for all types of landslide movements and over periods much longer than human recorded history.

Figure LS-1 Landslide Types



DOGAMI, *Oregon Geology Fact Sheet: Landslide Hazards in Oregon*, https://www.oregongeology.org/pubs/fs/landslide-factsheet.pdf

[5] Turner, A. K., and Schuster, R. L., eds., 1996, *Landslides: Investigation and Mitigation*, National Research Council, Transportation Research Board Special Report 247, 673 p.

Slides

Slides move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface and translational slides where movement occurs along a flat surface. These slides are generally slow moving and can be deep. Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage, but are far less likely to result in serious injuries than rapidly moving landslides.[6]

Topples and Falls

Rock falls occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. They are fast moving with the materials free falling or bouncing down the slope.

In falls, material is detached from a steep slope or cliff. The volume of material involved is generally small, but large boulders or blocks of rock can cause significant damage. Rock falls have the potential to break off power poles located on hillsides.[7]

Spreads

Spreads are an extension and subsidence of commonly cohesive materials overlying layers. They are commonly triggered by earthquakes. Spreads usually occur on gentle slopes near open bodies of water.[8]

Flows

Flows are plastic or liquid movements in which land mass (e.g. soil and rock) breaks up and flows during movement. Earthquakes often trigger flows.[9] Flows can be channelized and unchannelized, and may also be called debris avalanches and earth flows. Debris flows normally occur when a landslide moves downslope as a semi-fluid mass scouring, or partially scouring soils from the slope along its path. Flows are typically rapidly moving and also tend to increase in volume as they scour out the channel. [10] Flows often occur during heavy rainfall, can occur on gentle slopes, and can move rapidly for large distances.

The channelized debris flow, which is sometimes referred to as “rapidly moving landslide” can be life threatening. They often initiate on a steep slope, move into a steep channel (or drainage), increase in volume by incorporating channel materials, and then deposit material, usually at the mouth of the channel on existing fans. Debris flows are commonly mobilized by other types of landslides that occur on slopes near a channel. They can also initiate within channels from accelerated erosion during heavy rainfall or snow melt (Bill Burns, personal communication, January 2019).

[6] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, 2020 Oregon NHMP

[7] Ernie, Eichorn, Field Representative, Chemawa District, Bonneville Power Authority, personal communication, November 10, 2004.

[8] DOGAMI, *Oregon Geology Fact Sheet: Landslide Hazards in Oregon*, https://www.oregongeology.org/pubs/fs/landslide-factsheet.pdf

[9] Robert Olson Associates, June 1999, *Metro Regional Hazard Mitigation Policy and Planning Guide*.

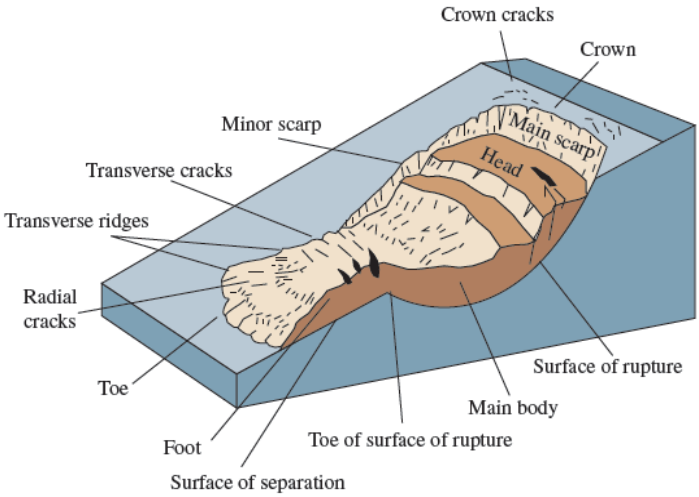
[10] Ibid.

Over time, ditches and culverts beneath hillside roads can become blocked with debris. If the ditches are blocked, run-off from the slopes is inhibited during periods of precipitation. This causes the run-off water to collect in soil, and in some cases, cause a slide. Usually the slides are small (100 – 1,000 cubic yards), but they can be quite large.

Complex

Complex landslides are the combinations of two or more types. A common complex landslide is a slump-earth flow, which usually exhibits slump features in the upper region and earth flow features near the toe.[11]

Figure LS-2 Landslide Features



Source: USGS, Landslide Factsheet, https://pubs.usgs.gov/fs/2004/3072/pdf/fs2004-3072.pdf

Conditions Affecting Landslides

Natural conditions and human activities can both play a role in causing landslides. Certain geologic formations are more susceptible to landslides than others. The incidence of landslides and their impact on people and property can be accelerated by development. Those who are uninformed about geologic conditions and processes may create conditions that can increase the risk of or even trigger landslides.

These are the principal factors that affect or increase the likelihood of landslides:

- Natural conditions and processes including the geology of the site, rainfall, rapid snow melt, freeze/thaw cycles, wave and water action, seismic tremors and earthquakes and volcanic activity.
- Excavation and grading on sloping ground for homes, roads and other structures.
- Drainage and groundwater alterations that are natural or human-caused can trigger landslides. Human activities that may cause slides include broken or leaking water or sewer lines, water retention facilities, irrigation and stream alterations, ineffective stormwater management and excess runoff due to increased impervious surfaces.

[11] Burns, Bill and Ian Madin, DOGAM, *Protocol for Inventory Mapping of Landslide Deposits from Light Detection and Ranging (LIDAR) Imagery*, Special Paper 42, 2009, https://www.oregongeology.org/pubs/dds/slido/sp-42_onscreen.pdf.

- Change or removal of vegetation on very steep slopes due to timber harvesting, land clearing and wildfire.
- Any combination of these factors.[12]

History of Landslides in Sweet Home & Linn County

Most of Oregon's landslide damage has been associated with severe winter storms where landslide losses can exceed $100 million in direct damage such as the February 1996 event. Annual average maintenance and repair costs for landslides in Oregon are over $10 million.[13] Eight deaths occurred during the 1996 and 1997 storm events, when heavier than normal rains caused thousands of landslides throughout Oregon. Those storm events resulted in the identification of roughly 9,500 landslides and those were added to a database. Some of these landslides were the reactivation of ancient and historically active landslides and some were new failures.

Table LS-1 Significant Historic Landslides

Date	Location	Description
Dec. 1964	Statewide	DR-184. Heavy rains and flooding, with landslides, on December 24, 1964.
Feb. 1996	Statewide	DR-1099. Heavy rains and rapidly melting snow contributed to hundreds of landslides / debris flows across the state; many occurred on clear cuts that damaged logging roads.
Dec. 2003-Jan. 2004	Statewide	DR-1510. Winter storms with landslides.
May 2006	Statewide	DR-1632. Statewide impacts from storms, floods, landslides, and mudslides.
Dec. 2008	Statewide	DR-1824. Severe winter storm, flooding, winds, record and near record snow, landslides and mudslides. Gresham received, 26" of snow. Many roads closed. Significant damages to public infrastructure, homes and businesses. Event occurred Dec. 20-26.
Jan. 2011	Statewide	DR-1956. Severe winter storm, flooding, mudslides, landslides, and debris flows.
Jan. 2012	W. Oregon	DR-4055. The incident was January 12-21, 2012. Severe winter storm with flooding, landslides, and mudslides. Declaration involves 12 counties including Benton, Columbia, Coos, Curry, Douglas, Hood River, Lane, Lincoln, Linn, Marion, Polk, and Tillamook.
Feb. 2014	W. Oregon	DR-4169. Severe winter storms. The event occurred February 6-10, 2014. Linn, Lane, Lincoln, and Benton Counties were part of the disaster declaration.
Dec. 2015	W. Oregon	DR-4258. Severe winter storms, straight-line winds, flooding, landslides, and mudslides. The event occurred December 6-23, 2015. Linn was many of many counties in Western Oregon that were part of the disaster declaration.
Apr. 2019	Statewide	DR-4452. Severe storms, flooding, landslides, and mudslides. The event occurred April 6-21, 2019. Counties that were part of the disaster declaration: Linn, Douglas, Curry, Wheeler, Grant, and Umatilla. Individual and Public Assistance money was approved.
Feb. 2021	W. Oregon	DR-4599. Oregon winter storm. The event occurred February 11-15, 2021. Counties that were part of the disaster declaration: Linn, Marion, Clackamas, Polk, Yamhill, and Benton. Public Assistance money was approved.

Source: DLCD, Oregon NHMP, 2020; FEMA, Disaster Declarations for Oregon, retrieved 2017 - 2021; Hazards and Vulnerability Research Institute (2007); the Spatial Hazard Events and Losses Database for the United States, Version 5.1 (online database), Columbia, S.C: University of South Carolina, available from http://www.shieldus.org/.

[12] *DOGAMI, Oregon Geology Fact Sheet: Landslide Hazards in Oregon*, https://www.oregongeology.org/pubs/fs/landslide-factsheet.pdf

[13] Wang and Chaker, DOGAMI, 2004, *Geological Hazards Study for the Columbia River Transportation Corridor*, Open File Report OFR 0-4-08, https://www.oregongeology.org/pubs/ofr/O-04-08.pdf.

DOGAMI maps the State Landslide Information Layer for Oregon (SLIDO). The database contains only landslides that have been located on these maps. Many landslides have not yet been located or are not on these maps and therefore are not in this database. This database does not contain information about relative hazards[14].

Compared to other natural hazards with the potential to affect Sweet Home and a proven history of past damages, landslides are not considered a major hazard.

The maps in Figure LS-3 Landslide Potential and Figure LS-4 Landslide Susceptibility show the majority of Sweet Home to be at low risk for landslide activity. Outside of the city limits, the landscape is primarily high and very high risk for landslide activity. The information is based on SLIDO and the *2016 Landslide Susceptibility Overview Map of Oregon* with its corresponding *Open File Report, O-16-02* (https://www.oregongeology.org/pubs/ofr/p-O-16-02.htm). Historically, no severe landslide events have occurred and been recorded in Sweet Home. Steering Committee members did not identify any events; see the Vulnerability Assessment below.

Risk Assessment

How are Hazards Identified?

Geologic and geographic factors are important in identifying landslide-prone areas. Stream channels, for example, have major influences on landslides, due to undercutting of slopes by stream erosion and long-term hillside processes. The severity or extent of landslides is typically a function of geology and the landslide triggering mechanism. Even small slides can cause property damage, result in environmental destruction, and cause injuries or death to people and animals.

The Oregon Department of Forestry (ODF) *Storm Impacts and Landslides of 1996: Final Report* conducted after the 1996-97 landslide events found that the highest probability for the initiation of shallow, rapidly moving landslides was on slopes of 70 to 80 percent steepness. A moderate hazard of shallow rapid landslide initiation can exist on slopes between 50 and 70 percent.[15]

Areas at risk to landslides do not always have steep slopes (25 percent or greater,) or a history of nearby landslides. As indicated by the DOGAMI *Open File Report O-16-02* and *Special Paper 42*, both previously mentioned, landslide hazards may be more effectively recognized using Light Detection and Ranging Imagery (LIDAR or lidar). Using lidar to craft inventory maps as well as shallow and deep susceptibility maps provides a substantial amount of information on the location and nature of the landslide hazards. Further mapping of Sweet Home and Linn County for landslides hazards is recommended.

[14] DOGAMI, Statewide Landslide Information Database for Oregon (SLIDO 3.4). https://www.oregongeology.org/slido/index.htm

[15] Oregon Department of Forestry, *Storm Impacts and Landslides of 1996: Final Report*, June 1999. https://digital.osl.state.or.us/islandora/object/osl%3A19728

Probability of Future Occurrence

Hazard Risk Analysis

The Sweet Home NHMP Steering Committee completed a Hazard Vulnerability Assessment/Analysis (HVA) during this NHMP update. This was described in Section 2 Risk Assessment. The method used for the HVA was developed from a Federal Emergency Management Agency (FEMA) tool that has been refined by the Oregon Office of Emergency Management (OEM). It addresses and weights (shown as percent within parentheses) probability (29%), vulnerability (21%), maximum threat (42%) and the history (8%) of each natural hazard and attributes a final hazard analysis score. The methodology produces scores that range from 24 to 240.

For local governments, conducting the HVA is a useful step in planning for hazard mitigation. The method provides the jurisdiction with a relative ranking from which to prioritize mitigation actions, but does not predict the occurrence of a particular hazard.

In the *2015 Sweet Home NHMP*, landslides were ranked seventh in the list of hazards. In the *2021 Sweet Home NHMP*, landslides are again ranked seventh.

For more information on all the risk scores and ranks of the natural hazards, see Volume I Basic Plan, Section 2 Risk Assessment of this NHMP.

Probability Assessment

As has been noted in this Annex already, many factors contribute to the probability of landslides. The probability of an area to have a landslide is increased depending on the factors that reduce the stability without causing failure. When several of these factors are combined, such as an area with steep slopes, weak geologic material, and previous landslide movement, the probability of future landslides is increased. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides (debris flows). The Oregon Department of Forestry tracks storms during the rainy season, monitors rain gauges and snow melt, and issues warnings as conditions warrant. Other agencies such as ODOT, DOGAMI, USGS, and National Weather Service also track weather conditions and potential landslide situations.

Vulnerability Assessment

To a large degree, landslides are very difficult to predict. Vulnerability assessments assist in predicting how different types of property and population groups will be affected by a hazard.[16] The optimum method for doing this analysis at the city or county level is to use parcel-specific assessment data on land use and structures.[17] Data that includes specific landslide-prone and debris flow locations in the county can be used to assess the population and total value of property at risk from future landslide occurrences.

Landslides can occur on their own or in conjunction with other hazards, such as flash flooding. Depending upon the type, location, severity and area affected, severe property damage, injuries and loss of life can be caused by landslide hazards. Landslides can damage or temporarily disrupt utility

[16] Burby, R., ed. 1998, *Cooperating with Nature.*

[17] Ibid.

services, block off or damage roads, critical lifeline services such as police, fire, medical, utility and communication systems, and emergency response.

While Sweet Home has rarely experienced major landslides, there are areas in Linn County that are potentially vulnerable such as road cuts and steeply sloped areas.

Community Hazard Issues

What is susceptible to damage during a hazard event?

Depending upon the type, location, severity and area affected, severe property damage, injuries and loss of life can be caused by landslide hazards. Landslides can damage or temporarily disrupt utility services, roads and other transportation systems and critical lifeline services such as police, fire, medical, utility and communication systems, and emergency response. In addition to the immediate damage and loss of services, serious disruption of roads, infrastructure and critical facilities and services may also have longer term impacts on the economy of the community and surrounding area.

These factors can increase the risk to people and property from the effects of landslides:

- Improper excavation practices, sometimes aggravated by drainage issues, can reduce the stability of otherwise stable slopes.

- Allowing development on or adjacent to existing landslides or known landslide-prone areas raises the risk of future landslides, regardless of excavation and drainage practices. Homeowners and developers should understand that in many potential landslide areas, there are no development practices that can completely assure slope stability from future landslide events.

- Building on fairly gentle slopes can still be subject to landslides that begin a long distance away from the development. Sites at greatest risk are those situated against the base of very steep slopes, in confined stream channels (small canyons), and on fans (rises) at the mouth of these confined channels. Home siting practices do not cause these landslides, but rather put residents and property at risk of landslide impacts. In these cases, the simplest way to avoid such potential effects is to locate development out of the impact area, or construct debris flow diversions for the structures that are at risk.

- Certain forest practices can contribute to increased risk of landslides. Forest practices may alter the physical landscape and its vegetation, which can affect the stability of steep slopes. Physical alterations can include slope steepening, slope-water effects, and changes in soil strength. Of all forest management activities, roads have the greatest effects on slope stability, although changing road construction and maintenance practices are reducing the effects of forest roads on landslides.

- High rainfall accumulation in a short period of time increases the probability of landslide. An extreme winter storm can produce inches of rainfall in a 24 hour period; if the storm occurs well into the winter season, when the ground is already saturated, the hydraulic overload effect is heightened.

Existing Hazard Mitigation Activities

Existing Hazard Mitigation Activities and Resources

State Natural Hazard Risk Assessment

The risk assessment in the *2020 Oregon Natural Hazards Mitigation Plan* provides an overview of landslide risk in Oregon and identifies the most significant landslides in Oregon's recorded history. It has overall state and regional information, and includes landslide mitigation actions for the entire state. 2020 Oregon NHMP

Planning for Natural Hazards: Oregon Technical Resource Guide

This guide describes basic mitigation strategies and resources related to landslides and other natural hazards, including examples from communities in Oregon.
https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

Oregon Department of Forestry (ODF)

According to the *Forest Facts: Landslides and Debris Flows* handout on their website, "the Oregon Department of Forestry regulates forest practices to manage landslide risk in order to protect the public's safety. Forest Practices Act rules for timber harvesting and constructing roads help minimize surface erosion and the potential for landslides, which provides protection for natural resources. ODF's geotechnical specialists assist foresters and landowners by providing guidance and assessing the landslide hazards and risks. Protections include such measures as prohibiting timber harvest, specifying how trees should be replanted or roads should be constructed, leaving trees and vegetation undisturbed along streams, and requiring that trees be harvested with a skyline cable logging system, rather than using ground-based equipment"
https://www.oregon.gov/ODF/Documents/AboutODF/LandslidesDebrisFlowsFactsheet.pdf.

The ODF debris flow maps include locations subject to naturally occurring debris flows and include the initiation sites and locations along the paths of potential debris flows (confined stream channels and locations below steep slopes). These maps neither consider the effects of management-related slope alterations (drainage and excavation) that can increase the hazard, nor do they consider very large landslides that could possibly be triggered by volcanic or earthquake activity. Areas identified in these maps are not to be considered "further review areas" as defined by Senate Bill 12 (1999).[18]

Oregon Department of Geology and Mineral Industries (DOGAMI)

The Oregon Department of Geology and Mineral Industries (DOGAMI) "works to increase understanding of Oregon's geologic resources and hazards through science and stewardship" (https://www.oregongeology.org/default.htm) and has many landslide related resources. https://www.oregongeology.org/Landslide/landslidehome.htm. Resources previously mentioned such as the *Landslide Hazards Fact Sheet*, SLIDO, and the *Landslide Susceptibility Overview Map* of Oregon with its corresponding *Open File Report, O-16-02*, are just a few of the items found on their

[18] ODF, *Western Oregon Debris Flow Hazard Maps: Methodology and Guidance for Map Use*, 1999 and DOGAMI, IMS-22, *GIS Overview Map of Potential Rapidly Moving Landslide Hazards in Western Oregon*, 2002.

website. DOGAMI also has the Oregon HazVu: Statewide Geohazard Viewer where you can type in an address and discover the geohazards impacting *that site.* https://www.oregongeology.org/hazvu/

In October 2019, DOGAMI and DLCD published the *Preparing for Landslide Hazards: A Land Use Guide for Oregon Communities* document, along with a Quick Reference version of it, and a webinar. This information can be found on DLCD's website and DOGAMI's website.

Debris Flow Warning System

The debris flow warning system was initiated in 1997 and involves collaboration between ODF, DOGAMI, the Oregon Department of Transportation (ODOT), local law enforcement, and National Oceanic and Atmospheric Administration (NOAA) Weather Radio and other media. ODF is primarily engaged with the lands it owns while the other agencies have a broader scope of engagement.

DOGAMI's website states, "Throughout the rainy season, the National Weather Service highlights the potential for debris flows and landslides as part of a flood watch, for areas included in the flood watch" (https://www.oregongeology.org/Landslide/debrisflow.htm). The information is provided by the National Weather Service (NWS) and broadcast via the NOAA Weather Radio, and on the Law Enforcement Data System. The information provided does not include the Debris Flow Warning System as originally designed. NWS provides the following language in their flood watches that highlights the potential for landslides and debris flows[19]:

> *A flood watch means there is a potential for flooding based on current forecasts. Landslides and debris flows are possible during this flood event. People, structures and roads located below steep slopes, in canyons and near the mouths of canyons may be at serious risk from rapidly moving landslides.*

DOGAMI provides information on debris flows through the media. ODOT provides warning signs to motorists in landslide prone areas during high-risk periods.

Oregon State Building Code Standards

The Oregon Building Codes Division adopts statewide standards for building construction that are administered by the state and local municipalities throughout Oregon. The *2017 Oregon Residential Special Code* (*ORSC*) contains requirements for one- and two-family dwellings (https://codes.iccsafe.org/content/document/1018?site_type=public) and the *2019 Oregon Structural Special Code* (*OSSC*) (https://codes.iccsafe.org/content/OSSC2019P1) contains provisions for grading and site preparation for the construction of building foundations.

Both codes contain requirements for cut, fill and sloping of the lot in relationship to the location of the foundation. There are also building setback requirements from the top and bottom of slopes. The codes specify foundation design requirements to accommodate the type of soils, the soil bearing pressure, and the compaction and lateral loads from soil and ground water on sloped lots.

The building official has the authority to require a soils analysis for any project where it appears the site conditions do not meet the requirements of the code, or that special design considerations must be taken. ORS 455.447 and the *OSSC* require a seismic site hazard report for projects that include essential facilities such as hospitals, fire and police stations and emergency response

[19] NOAA, NWS. Letter dated December 20, 2010 from Stephen K. Todd, Meteorologist-in-Charge.

facilities, and special occupancy structures, such as large schools and prisons. This report includes consideration of any potentially unstable soils and landslides.[20]

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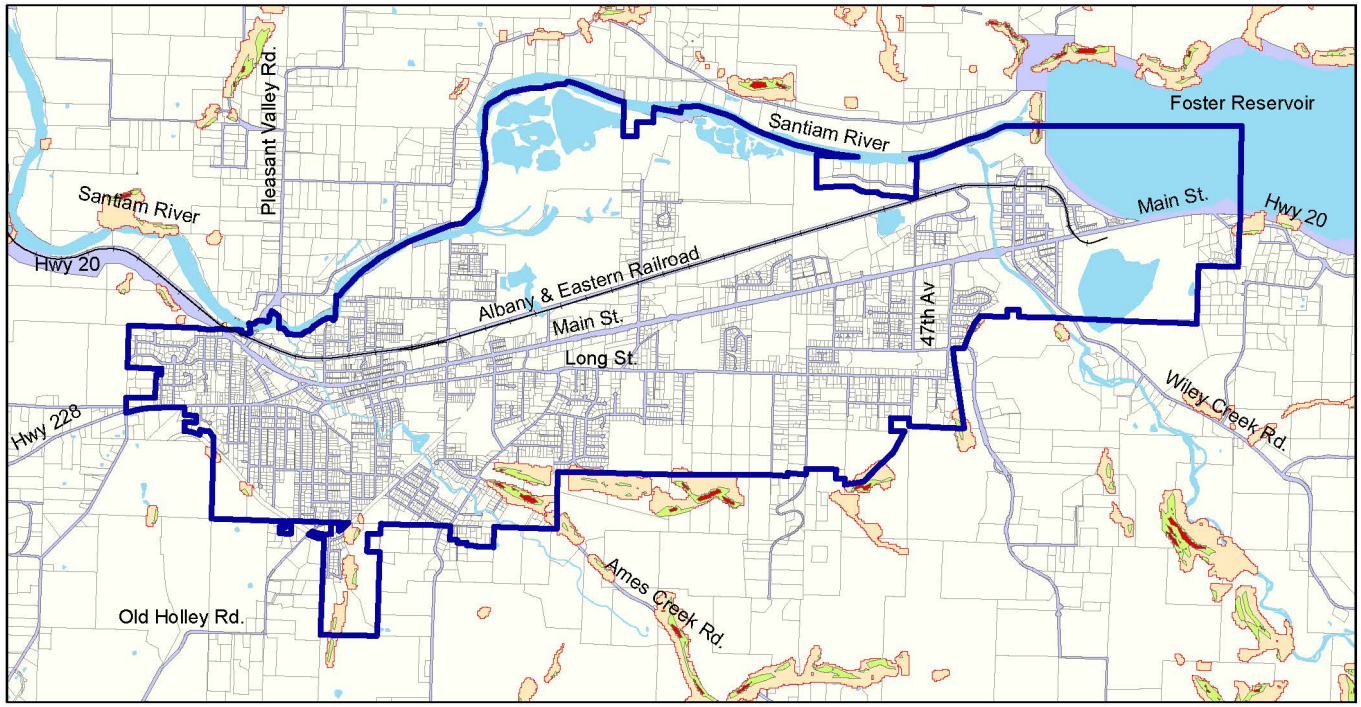
In the *2021 Sweet Home NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Sweet Home and the surrounding area. In the order of appearance in the NHMP it is in the Risk Assessment and the Hazards Annexes.

Landslide Mitigation Actions

There are three landslide specific mitigation actions that have been identified by the Sweet Home NHMP Steering Committee. Landslide hazards are low priority because the Hazard Vulnerability Assessment (HVA) resulted in landslides having a low risk level. In discussion with the NHMP Steering Committee, it was agreed that the risk level rankings from the HVA would be used as the way to prioritize the multi-hazard and hazard-specific mitigation actions. The risk level rankings are in Table 2-4 in Section 2 Risk Assessment. There are multi-hazard mitigation actions for the NHMP and those include landslide related mitigation actions, in conjunction with the other hazards. The multi-hazard mitigation actions are a high priority. See Table 3-1, Sweet Home NHMP Mitigation Actions for a more detailed description of the mitigation actions in this NHMP.

[20] DLCD and OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, Chapter 5. https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

Figure LS-3 Sweet Home Landslide Potential



City of Sweet Home
Natural Hazards Mitigation Plan
Landslide Potential

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Right-of-Way
- Water & Ponds
- Sweet Home Tax Lots

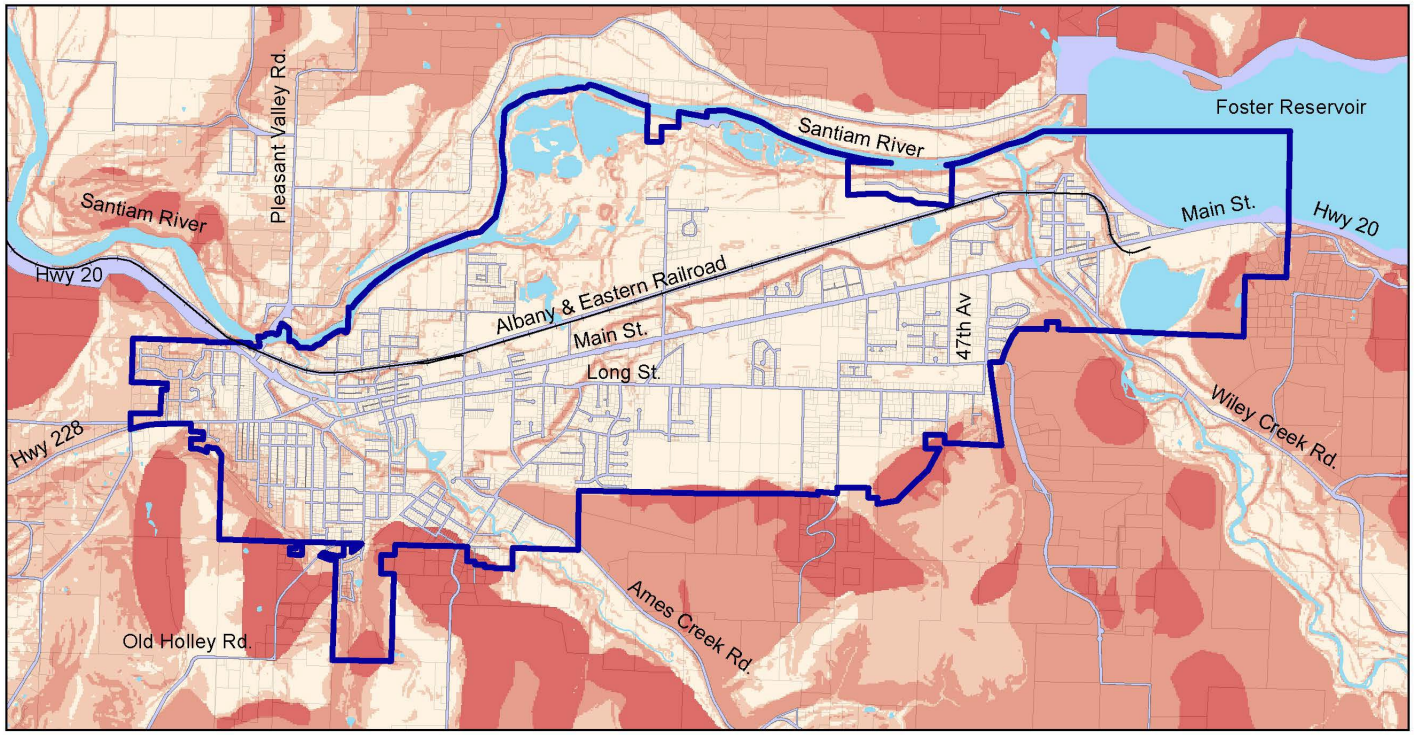
Natural Hazard Legend
- Landslide Potential
- 60 - 80% Slope
- Over 80% Slope

The Topography High Landslide Hazard Location (HLHL) display areas of steep slopes that help identify areas with an increased the likelihood of landslide occurrences. The feature class was developed to show the following slope percent ranges in (0-60%,60-80% and 80+%).

Source:
Oregon Department of Forestry..
The original source of the data was a ESRI grid built from USGS 10 Meter Digital Elevation Models. The grid was exported to vector format.

Source: Joe Graybill, Sweet Home, 8/30/21

Figure LS-4 Sweet Home Landslide Susceptibility



City of Sweet Home
Natural Hazards Mitigation Plan
Landslide Susceptibility

September 2, 2021

0 0.125 0.25 0.5 0.75 1 Miles

City of Sweet Home
3225 Main Street
Sweet Home OR 97386

City Infrastructure Legend
- Railway
- City Limits
- Water & Ponds
- Right-of-Way
- Sweet Home Tax Lots

Natural Hazard Legend
Landslide Susceptibility
- Very High
- High
- Moderate
- Low

The data in this raster depicts landslide susceptibility at a 10 meter resolution, across the state of Oregon. This elevation data was converted into slopes, and a multi pronged analysis process used these slopes, geology and mapped existing landslides to create this 10 meter raster. There are 4 classes of landslide susceptibility: Low, Moderate, High and Very High.

Source:
Oregon Department of Geology and Mineral Industries. The data was created using Oregon Lidar Consortium (OLC) data, and USGS NED data where OLC data was not present.

Source: Joe Graybill, Sweet Home, 9/8/21

Volume III: Mitigation Resources

Hail storm tree damage, 4/22/14

Credit: New Era Newspaper

Source: Lagea Mull, Sweet Home, personal communication, 8/30/21

Storm damage with power line and truck, 4/7/17

Storm damage with tree and house, 4/7/17

Credit: New Era Newspaper

Source: Lagea Mull, Sweet Home, personal communication, 8/30/21

APPENDIX A:
PLANNING AND PUBLIC PROCESS

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Purpose

This Appendix describes the changes made to the *2015 Sweet Home Natural Hazards Mitigation Plan (NHMP)* during the plan update process that resulted in the *2021 Sweet Home NHMP*.

Project Background

Sweet Home developed this Natural Hazards Mitigation Plan (NHMP) through a partnership funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation Grant Program (PDM). In 2018, the Department of Land Conservation and Development (DLCD) applied for and received the grant from FEMA through the Oregon Office of Emergency Management (OEM) to assist Sweet Home.

Sweet Home collaborated with DLCD and developed this Natural Hazards Mitigation Plan (NHMP) with contributions from Sweet Home Fire and Ambulance District and Linn County to reduce future loss of life and damage to property resulting from natural hazards. With the FEMA approval of the *2021 Sweet Home NHMP*, which updates the *2015 Sweet Home NHMP,* Sweet Home will then maintain their eligibility for the Hazard Mitigation Assistance (HMA) pre- and post- disaster funds. In addition to establishing a comprehensive community-level mitigation strategy, the Disaster Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions maintain an approved NHMP to receive federal funds for pre- and post- disaster mitigation funds. See the NHMP's Table of Contents, and the information below, for details on the contents of the NHMP.

As has been described, briefly in the Executive Summary and in more detail in the Introduction, the Disaster Mitigation Act of 2000 requires communities to update their mitigation plans every five years to remain eligible for Building Resilient Infrastructure and Cities (BRIC), Flood Mitigation Assistance (FMA) program funding, and Hazard Grant Mitigation Program (HMGP) funding.

DLCD Natural Hazards Planner, Tricia Sears, met with members of the Sweet Home NHMP Steering Committee, led by Blair Larsen, Community and Economic Development Director, and Brandon Neish, Finance Director, for this update to the *2015 Sweet Home NHMP*. A roster of the NHMP Steering Committee is included in the Acknowledgements section of this NHMP and in this Appendix.

2021 NHMP Changes and Integration of Information

The entire *2015 Sweet Home NHMP* has been revised and updated. In Table A-1, the sections of the *2015 NHMP* are compared to the *2021 Sweet Home NHMP*. A more complete description of each of the sections is provided in the text after Table A-1.

Table A-1 Changes to Sweet Home NHMP Organization

2015 Sweet Home NHMP	2021 Sweet Home NHMP
Cover, Acknowledgements, FEMA Approval Letter, Table of Contents	Cover, FEMA APA and Approval Letters, Acknowledgements, Table of Contents
Executive Summary	Executive Summary
1.0 Introduction	Volume I: Basic Plan

2.0 Community Profile: City of Sweet Home	Section 1: Introduction
3.0 Community Involvement and Public Process	Section 2: Risk Assessment
4.0 Mission Statement, Goals, Objectives, and Action Items	Section 3: Mitigation Strategy
5.0 Mitigation Plan Adoption, Implementation and Maintenance	Section 4: Plan Implementation and Maintenance
6.0 Flood Hazards	Volume II: Hazard Annexes with Introduction
7.0 Severe Storms	Severe Storms
8.0 Landslides	Wildland-Urban Interface Fires
9.0 Wildland-Urban Interface Fires	Floods
10.0 Earthquakes	Earthquakes
11.0 Volcanic Hazards	Volcanic Events
12. Dam Failures	Droughts
13.0 Disruption of Utility and Transportation Systems	Landslides
14.0 Hazardous Materials	Volume III: Mitigation Resources
15.0 Terrorism	Appendix A: Planning and Public Process
Appendices	Appendix B: Community Profile
Appendix 1: Synopsis of FEMA Grant Programs	Appendix C: Economic Analysis of Natural Hazards Mitigation Projects
Appendix 2: Principles of Benefit-Cost Analysis	Appendix D: Grant Programs and Resources
Appendix 3: Community Involvement Documentation	Appendix E: Sweet Home NHMP Success Stories
	Appendix F: Sweet Home NHMP Natural Hazards Outreach Calendar
	Appendix G: Linn County Community Wildfire Protection Plan

Source: Tricia Sears, DLCD, June 2021

The entire *2015 Sweet Home NHMP* was reviewed, revised, and updated. The *2021 Sweet Home NHMP* is based on information that has been researched, and the information is integrated into the NHMP. The sources of information are documented as footnotes and in the "source" listed under each table and figure. The Information used ranges includes the local jurisdiction's existing plans, studies, and policies, state and federal information, and non-agency studies, plans and resources; all of which helped to inform the Steering Committee and provide a basis for decisions made during the NHMP update process.

For example, linking existing plans and policies to the *2021 Sweet Home NHMP* helps identify what resources already exist that can be used to implement the mitigation actions in the NHMP. Implementing the natural hazards mitigation plan's action items through existing plans and policies increases their likelihood of being supported and getting updated and maximizes the City's resources. In addition to the plans listed in Tables 4-1 and B-14, the City also has zoning ordinances

(including floodplain development regulations) and building regulations. Identifying and finding the wide range of plans, studies, policies, agreements and the like is important.

The above provides a short description of how information in the NHMP was incorporated into the NHMP. The following descriptions of each section in the NHMP also provides details on the changes that have been made during the update process. Besides updating the NHMP with an extensive amount of new and more current information, the goals for the DLCD Natural Hazards Planner and the Sweet Home NHMP Steering Committee were to make the NHMP more user friendly and more integrated with other plans and policies used by Sweet Home.

Cover and Front Pages

The cover and the front pages orient the reader of the NHMP to what the NHMP contains.

- A new NHMP cover was created. The photos for the cover were provided by City of Sweet Home staff, from various sources. The NHMP cover pages include staff contacts for and the mission statement of the *2021 Sweet Home NHMP.*
- Photos were added to the Volume I, II, and III covers.
- The FEMA Approval Pending Adoption (APA) and final approval letter as well as the City's resolution of adoption are included (when available).
- The Acknowledgements have been updated to include the 2019-2021 Sweet Home NHMP Steering Committee members. The Table of Contents has been updated.

Volume I: Basic Plan

Executive Summary

The executive summary provides an overview of the FEMA requirements plans process and highlights the key elements of the risk assessment, mitigation strategy, and implementation and maintenance strategy.

Section 1: Introduction

The Introduction briefly describes the City's mitigation planning efforts and the methodology used to develop the plan.

Section 2: Risk Assessment

Section 2 provides the factual basis for the mitigation strategies contained in Section 3. Additional information is included within Appendix B, Community Profile, which contains an overall description of Sweet Home.

The Risk Assessment section includes a brief description of community sensitivities and vulnerabilities and an overview of the natural hazards further addressed in Volume II Hazard Annexes. Climate change is discussed in the Risk Assessment and the Hazard Annexes.

The Risk Assessment allows readers to gain an understanding of Sweet Home's, sensitivities – those community assets and characteristics that may be impacted by natural hazards, as well as the City's, resilience – the ability to manage risk and adapt to hazard event impacts. Information on the participation in the National Flood Insurance Program (NFIP) is included, with additional details in the Flood Annex.

Section 3: Mitigation Strategy

This section documents the plan vision, mission, goals, and actions and describes the components that guide implementation of the identified mitigation strategies. Mitigation actions are based on community sensitivity and resilience factors and the hazard assessments in Section 2 Risk Assessment and Volume II Hazard Annexes. In Section 3, there are two tables related to mitigation actions: Table 3-1 Sweet Home 2021 NHMP Mitigation Actions and Table 3-2 Sweet Home Mitigation Actions 2015 Status.

Section 4: Plan Implementation and Maintenance

This section provides information on the implementation and maintenance of the plan. It describes the process for prioritizing projects and includes a suggested list of tasks for updating the plan to be completed at the semi-annual and five-year review meetings. There is a five-year update cycle for the NHMP. As part of this NHMP process, the NHMP will be reviewed and discussed twice per year at plan maintenance meetings. This will help ensure the NHMP is used and stays connected to the plans, policies, and programs of the involved jurisdictions and other Steering Committee members. The Emergency Management Performance Grant (EMPG) requires NHMP review twice per year.

Volume II: Hazard Annexes

The hazard annexes describe the risk assessment process and summarize the best available local hazard data. A hazard summary is provided for each of the hazards addressed in the plan. The summary includes hazard history, location, extent, vulnerability, impacts, and probability.

The hazard specific annexes included with this NHMP are the following:

- Severe Storms;
- Wildland-Urban Interface Fires;
- Floods (includes dams);
- Earthquakes;
- Volcanic Events;
- Drought; and
- Landslides.

Volume III: Mitigation Resources

The resource appendices are designed to provide the users of the *2021 Sweet Home Natural Hazards Mitigation Plan* with additional information to assist them in understanding the contents of the mitigation plan, and to share potential resources to assist with plan implementation.

Appendix A: Planning and Public Process

This appendix includes documentation of all the public processes utilized to update the plan. It includes invitation lists, meeting agendas, sign-in sheets, screen shots from websites, and copies of flyers, as well as any other public involvement methods.

Appendix B: Community Profile

The community profile describes Sweet Home from numerous perspectives to help define and understand the regions sensitivity and resilience to natural hazards. The information in this section represents a snapshot in time of the current sensitivity and resilience factors in the region when the

plan was updated. Sensitivity factors can be defined as those community assets and characteristics that may be impacted by natural hazards, (e.g., special populations, economic factors, and historic and cultural resources). Community resilience factors can be defined as the community's ability to manage risk and adapt to hazard event impacts (e.g., governmental structure, agency missions and directives, and plans, policies, and programs). This appendix has been greatly updated from the *2015 Sweet Home NHMP*.

Appendix C: Economic Analysis of Natural Hazard Mitigation Projects

This appendix describes FEMA's requirements for benefit/cost analysis in natural hazards mitigation, and two other approaches: the cost effectiveness and the STAPLE/E.

Appendix D: Grant Programs and Resources

This appendix lists state and federal resources and programs by hazard. It has been greatly updated from the *2015 Sweet Home NHMP*.

Appendix E: Sweet Home Success Stories

These are stories that illustrate when Sweet Home identifies a problem or concern and then works to solve it. These stories were identified and provided by the members of the Sweet Home NHMP Steering Committee. This is a new appendix.

Appendix F: Sweet Home NHMP Natural Hazards Outreach Calendar

This calendar will be used each year to focus outreach and education efforts on natural hazards on a month-by-month basis. It relates to short-term multi-hazard mitigation action #3 in the *2021 Sweet Home NHMP*. See Table 3-1, 2021 Sweet Home NHMP Mitigation Actions for the mitigation actions. This is a new appendix.

Appendix G: Linn County Community Wildfire Protection Plan

To reduce the impact of wildfire, Linn County has a Community Wildfire Protection Plan (CWPP) called *the Linn County Community Wildfire Protection* Plan (*Linn County CWPP*) and it is dated November 2007. Sweet Home does not have a city specific CWPP. The *Linn County CWPP* provides detailed information on the vulnerability and history of wildfire in Linn County and provides mitigation actions Linn County can implement to reduce the impact of wildfire. This *2021 Sweet Home NHMP* links to the CWPP as it also contains wildfire information and mitigation actions. See Table 3-1, Sweet Home NHMP Mitigation Actions.

Of note, the mission of the *Linn County CWPP* aligns with the mission for the *Linn County Natural Hazards Mitigation Plan*. The mission is: To reduce the impact of natural hazards on the community through planning, communication, coordination, and partnership development.

The *Linn County CWPP* identifies five County-wide goals that could be effectively addressed by a CWPP. These goals are the product of input from community members through the FireWise workshop and are also coordinated with the *Linn County Natural Hazards Mitigation Plan*.[1]

• Goal #1: Enhance wildfire response capabilities;

• Goal #2: Increase stakeholder knowledge about wildfire risk through education and outreach Linn County Community Wildfire Protection Plan;

• Goal #3: Encourage the treatment of structural ignitability;

• Goal #4: Prioritize fuel reduction projects; and

• Goal #5: Increase opportunities for collaboration and coordination to implement wildfire projects.

[1] *Linn County Community Wildfire Protection Plan*, November 2007, file:///J|/Shared/Scholars%20bank%20local%20docs/County/Hazard%20mitigation%20plans/Linn_County_Wildfire_Plan_Appendices.pdf (uoregon.edu)

2021 NHMP Update

Sweet Home developed this Natural Hazards Mitigation Plan (NHMP) through a partnership funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation Grant Program (PDM). In 2018, the Department of Land Conservation and Development (DLCD) applied for and received the grant from FEMA through the Oregon Office of Emergency Management (OEM) to assist Sweet Home. This *2021 Sweet Home NHMP* is the result of a substantial collaborative effort between DLCD, Sweet Home, and the Sweet Fire and Ambulance District (SHFAD). The *2021 Sweet Home NHMP* is structured to address the requirements contained in 44 CFR 201.6. Emphasis is placed on identifying and describing the unique attributes of the City of Sweet Home and the SHFAD (Special District).

All Partners and Participants Include:

City of Sweet Home
Sweet Home Fire and Ambulance District
Linn County
Oregon Office of Emergency Management (OEM)
Oregon Department of Land Conservation and Development (DLCD)
Federal Emergency Management Agency (FEMA) Region X

Project Managers:

Tricia Sears, Natural Hazards Planner, DLCD
Blair Larsen, Community and Economic Development Director

All Participants / Partners on the NHMP Steering Committee

Representatives from the following organizations served as steering committee members for the *2021 Sweet Home NHMP* update process. Partners that are plan holders are those organizations or jurisdictions that signed IGAs with DLCD for the work on the NHMP. These plan holders are: the City of Sweet Home. All participants on the NHMP Steering Committee are listed below.

Department of Land Conservation & Development Staff

Tricia Sears, Natural Hazards Planner, DLCD

City of Sweet Home

Blair Larsen	Community and Economic Development Director, Convenor
Lagea Mull	Communication Specialist
Brandon Neish	Finance Director
Greg Springman	Public Works Director
Joe Graybill	Engineer
Jeff Lynn	Police Chief

Ray Towry	City Manager
Tommy Mull	Emergency Management Program Director (former)

Sweet Home Fire and Ambulance District

Dave Barringer	Fire Chief

Linn County

Joe Larsen	Emergency Management Coordinator (former)

Summary of Participation and Outreach

The Sweet Home NHMP Steering Committee formally convened at thirteen Steering Committee meetings in person and via Zoom: December 3, 2019 (pre-award) (in person); December 4, 2020; January 8, 2021; February 5, 2021; March 5, 2021; April 2, 2021; May 7, 2021; June 4, 2021; June 21, 2021; July 12, 2021; July 19, 2021; August 9, 2021; and September 8, 2021. There was a gap in the meetings from the December 3, 2019 meeting (pre-award) to the December 4, 2020 meeting (post-award) due to the wait for FEMA to obligate the funds for the NHMP update. The DLCD Natural Hazards Planner continued to work with Sweet Home staff on many tasks. However, pre-award work is limited to certain tasks, so we had to wait to have funds obligated to enter the post-award phase and continue much of the update process.

These Steering Committee meetings were with and lead by the DLCD Natural Hazards Planner, Tricia Sears, to discuss and revise the NHMP. In addition, the DLCD Natural Hazards Planner called and emailed with the Sweet Home NHMP Steering Committee members for continued discussion and collaboration throughout the process. Steering Committee members contributed data and information, did outreach and advocacy for the NHMP, and reviewed and updated the NHMP in collaboration with DLCD.

The NHMP update occurred before and during the Covid-19 pandemic, which forced most all jurisdictions not only locally, but globally, to use internet-based technologies to conduct meetings. Most participants wear many hats, so to speak. In addition, addressing multiple disasters at once, with a pandemic, floods, and wildfires, most jurisdictions have found themselves operating in overwhelming and truly extraordinary times. Regardless of meeting attendance, NHMP update information was being shared and people were engaged.

The following pages include Table A-2 Sweet Home NHMP Important Dates and copies of meeting agendas and sign-in sheets from NHMP Steering Committee meetings, website screenshots, flyers, and other information that demonstrates the outreach that has been done during this NHMP update process.

Table A-2 Sweet Home NHMP Important Dates

August 30, 2019	Tricia Sears, Natural Hazards Planner, DLCD and Blair Larsen, Community and Economic Development Director, Sweet Home phone conversation.
October 16, 2019	Tricia Sears, Blair Larsen, and Tommy Mull phone conversation.
October 23, 2019	Tricia sends Tommy the drafts of the IGA, SOW, and Project Schedule.
November 14, 2019	Tricia and Tommy phone conversation. Tricia sends a recap email with revised copies of the IGA, SOW, and Project Schedule. Tricia also sends the Sweet Home Timeline of NHMP Work/Outreach.
November 26, 2019	Tricia and Tommy phone conversation. Tricia sends all the documents we will use at the 12/3/19 NHMP SC meeting to Tommy today. He will email the Steering Committee (SC).
December 3, 2019	Sweet Home NHMP Organizational Steering Committee meeting (pre-award). Tricia attends in person. Tricia facilitates the meeting. Agenda items included a background on why we are here and what the NHMP update process entails, review of the project schedule and establishment of Steering Committee meeting dates, cost share forms and tracking, and a preview of upcoming topics. We discussed public outreach noting the draft NHMP Flyer. We also agreed to make decisions by consensus with acknowledgements of comments.
December 10, 2019	Tricia sent meeting notes from the 12/3/19 Steering Committee meeting and the updated roster to Tommy Mull. He will email the SC.
December 18, 2019	Revised NHMP outreach flyer received from Sweet Home.
January – Sept. 2020	Pre-award communications between Tricia and Tommy. We wait for FEMA to award/obligate PDM 18 funds so that we can begin post-award work.
October 8, 2020	DLCD Project Manager notified that FEMA obligated the PDM 18 funds and the post-award period began 9/2/20. Tricia emails Tommy Mull and Blair Larsen.
October 15, 2020	Tricia receives an email from Blair Larsen stating that Tommy Mull is no longer with the City of Sweet Home. Blair states he will be the contact for the Sweet Home NHMP update.
October 30, 2020	Tricia and Blair discuss the strategy for starting the post-award NHMP Steering Committee meetings.
October 30, 2020	Tricia sends meeting invitation to the Sweet Home NHMP Steering Committee for the NHMP Steering Committee meeting on 12/4/20.
November 12, 2020	Tricia sends the memo with request for NFIP information on repetitive loss (RL) and severe repetitive loss (SRL) to Scott Van Hoff of FEMA Region 10. She sends a copy of the memo to Blair Larsen.

November 30, 2020	Tricia sends the materials for NHMP Steering Committee meeting on 12/4/20.
December 4, 2020	The first post-award meeting of the Sweet Home NHMP Steering Committee is held by Zoom. Tricia facilitates the meeting. Agenda items include: a refresher about cost share; revising the project schedule including setting meeting dates and times; updating the NHMP Steering Committee roster; discussing the need to update the NHMP flyer; and discussion of the Hazard Vulnerability Analysis (HVA).
December 7, 2020	Tricia sends the meeting notes and other materials from the 12/4/20 NHMP Steering Committee meeting.
December 8, 2020	Lagea Mull sends the revised Sweet Home NHMP flyer to Tricia. Tricia thinks it looks great and Blair Larsen agrees. Tricia sends it to the Sweet Home NHMP Steering Committee, invites all to distribute it and post on the website etc.
January 4, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 1/8/21.
January 8, 2021	The second post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include continued discussion of the Hazards Vulnerability Analysis.
January 11, 2021	Tricia sends the May and June electronic NHMP Steering Committee meeting invitations. Note that February, March, and April are already out.
January 12, 2021	Tricia sends the meeting notes, the HVA Summary, and the cost share form (reminder!) from the 1/8/21 NHMP Steering Committee meeting.
Throughout the NHMP work	Tricia works with each NHMP Steering Committee member to obtain their fully completed cost share forms and supporting documentation to be used as match in the grant funds that DLCD has (HMGP) to support this NHMP update.
February 1, 2021	Tricia receives payroll documentation from Brandon Neish, Sweet Home's Finance Director.
February 3, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 2/5/21. These include the meeting agenda, the HVA Summary, and the Sweet Home NHMP Mitigation Actions Status.
February 5, 2021	The third post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include the discussion of Hazard Vulnerability Analysis Summary, and the status of existing mitigation actions from the *2015 Sweet Home NHMP* and whether the actions will be retained as is, retained and modified, or deleted, and crafting new mitigation actions.

February 11, 2021	Tricia sends the meeting notes, the revised HVA Summary, and the Sweet Home NHMP Mitigation Actions status from the 2/5/21 NHMP Steering Committee meeting.
March 1, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 3/5/21. These include: the meeting agenda, the revised HVA Summary, and the Sweet Home NHMP Mitigation Actions Status.
March 5, 2021	The fourth post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include the mitigation actions, the revised HVA Summary, the potential information forthcoming from the USACE about Lake Foster and Lake Greenpeter, and cost share forms.
March 8, 2021	Tricia sends the meeting notes and other materials from the 3/5/21 NHMP Steering Committee meeting. Tricia sends the two examples of outreach calendars from Lake County and Umatilla County with the meeting notes and the Sweet Home NHMP Mitigation Actions Status.
March 19, 2021	Tricia emails the NHMP Steering Committee to let them know that she has confirmed that Ross Hiner, Dam Safety Program Manager, USACE - Portland District (CENWP-ENC-HC), will join us at the May 7th Sweet Home NHMP Steering Committee meeting. He will present information on the Lake Foster and Lake Greenpeter dams and inundation maps. We have allocated at least 30 minutes for that and if we need to take more time we can do so.
March 29, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 4/2/21. These include: the meeting agenda and the Sweet Home NHMP Mitigation Actions Status.
April 2, 2021	The fifth post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include the Sweet Home NHMP Mitigation Actions Status, identification of new mitigation actions, and the next Sweet Home NHMP Steering Committee with Ross Hiner from USACE on 5/7/21.
April 2, 2021	Tricia sends the meeting notes from the 4/2/21 NHMP Steering Committee meeting.
April 22, 2021	Tricia emailed Lagea to check on the Sweet Home NHMP Outreach Calendar and the vulnerable population information and see if these items could be ready for discussion at the May NHMP Steering Committee meeting.
April 27, 2021	Tricia emailed the Sweet Home NHMP Steering Committee to share information about a free NOAA workshop on risk communication and a Smart Growth America contest/grant opportunity.
April 29, 2021	Tricia emailed Lagea again to check on the Sweet Home NHMP Outreach Calendar and the vulnerable population information and see if these items

	could be ready for discussion at the May NHMP Steering Committee meeting.
May 4, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 5/7/21. These include the agenda and the Sweet Home NHMP Mitigation Actions Status.
May 4, 2021	Tricia emailed Jeff Lynn and Dave Barringer re: the *2015 Sweet Home NHMP* mitigation action regarding back-up generators for emergency shelters in Sweet Home. Tricia emailed the NHMP Steering Committee to remind them to submit cost share forms.
May 7, 2021	The sixth post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include a presentation and conversation with Ross Hiner, USACE, about Lake Foster and Lake Greenpeter dams and inundation maps. Tom Voldback, Operations Manager, USACE, for Lake Foster and Lake Greenpeter also joins us for the meeting.
May 12, 2021	Tricia sends the meeting notes and Ross Hiner's presentation from the 5/7/21 NHMP Steering Committee meeting. Tricia also sends information about a resiliency workshop to be held on 6/4/21, hosted by Energy Trust of Oregon and Sustainable Northwest.
May 19, 2021	Tricia sends the NHMP Steering Committee information about FEMA's National Dam Safety Awareness Day, which is May 31.
May 26, 2021	Tricia sends the NHMP Steering Committee information about FEMA's Dam Safety Collaborative Technical Assistance webinar, which will be held on May 26 at 10 am PCT. The goal of this webinar and the series is to help communities at risk of dam-related flooding to better understand their risk and prepare for dam-related emergencies.
May 27, 2021	Tricia checks in via email with the NHMP Steering Committee regarding the "homework" assignments which are to be discussed at the 6/4/21 NHMP Steering Committee meeting.
June 2, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 6/4/21. These include the agenda and a reminder of the homework assignments to be discussed.
June 4, 2021	The seventh post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include the homework assignments and the mitigation actions; however, the discussion instead focused on the timeline for the NHMP and the need for NHMP Steering Committee input into the NHMP that Tricia is writing.
June 4, 2021	Tricia sends the meeting notes from the 6/4/21 NHMP Steering Committee meeting. Tricia states that the NHMP Steering Committee needs to make

	the NHMP a priority from now through the end of September so that we can put together a comprehensive NHMP to submit to OEM and FEMA.
June 4, 2021	Tricia sends a revised meeting invitation to move the July 2 NHMP Steering Committee meeting to July 12. Tricia sends new meeting invitations to add a NHMP Steering Committee on June 21 and July 19 to the schedule.
June 4, 2021	Tricia sends a list of tasks to Brandon Neish that we need to accomplish for the NHMP. Tricia sends a list of maps that are needed for the NHMP to Brandon Neish and Joe Graybill; she includes examples of maps from other NHMPs.
June 17, 2021	Tricia and Brandon meet to discuss the list of tasks that we need to accomplish for the NHMP. After the meeting, Tricia sends that same list of tasks with timelines and actions, to Brandon Neish. Tricia also sends updated meeting invitations to the NHMP Steering Committee, revising the date and time for the August and September meetings. Tricia updates the Project Schedule and the NHMP Steering Committee roster. Tricia sends several follow up emails with information for Brandon to assist in accomplishing our tasks.
June 17, 2021	Tricia sends the materials for the NHMP Steering Committee meeting. She sends the agenda again; it was initially sent on 6/4/21 with the meeting invitation. In addition, Tricia sends the mitigation actions, the updated Steering Committee roster, the updated Project Schedule, the NHMP Outreach Calendar, and the HVA Summary. Of note, the City Manager, Ray Towry, has been added to the roster.
June 21, 2021	The eighth post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include the NHMP timeline and tasks, homework assignments (e.g. Natural Hazards Outreach Calendar etc.), and mitigation actions.
June 21, 2021	Tricia sends the meeting notes from the 6/21/21 NHMP Steering Committee meeting and the revised Natural Hazards Outreach Calendar.
June 25, 2021	Tricia sends Table 4-1 from Vol 1 Section 4 to Brandon and Blair with a request for input by July 8 about the plans, policies, and programs.
July 8, 2010	Tricia and Brandon meet via Zoom to discuss NHMP tasks and prep for the July 12 NHMP Steering Committee meeting. We talked about the July 12 agenda and future NHMP Steering Committee meeting agendas; the tasks and timelines of the NHMP; cost share; and reviewed the NHMP draft table of contents which contains my comments on the status of each section.
July 8, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 7/12/21. The materials include: the agenda; the Critical Infrastructure List with Natural Hazards (the vulnerable populations and locations list from the 2020 wildfires is integrated into this), the critical infrastructure map, and the Sweet Home NHMP Mitigation Actions Status 2-3-21.

July 12, 2021	The ninth post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include mitigation actions, the Critical Infrastructure List with Natural Hazards, and the critical infrastructure map.
July 12, 2021	Tricia sends the meeting notes from the 7/12/21 NHMP Steering Committee meeting. Tricia notes the follow up aka homework tasks we discussed.
July 15, 2021	Tricia, Brandon, and Blair meet via Zoom to discuss NHMP tasks and prep for the July 19 NHMP Steering Committee meeting.
July 15, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 7/19/21. These include: the agenda, the Critical Infrastructure List with Natural Hazards, and draft maps of Critical Infrastructure, Critical Facilities, and Essential Facilities.
July 16, 2021	Tricia, Blair, Brandon, and Joe meet via Zoom to discuss the NHMP maps.
July 19, 2021	The tenth post-award Sweet Home NHMP Steering Committee meeting. Tricia facilities the meeting. Agenda items include the Critical Instructure List with Natural Hazards, natural hazards maps for the NHMP, the draft table of contents from the NHMP, and photos of natural hazards. The SC decides to extend the length of the 8/9/21 SC meeting.
July 19, 2021	Tricia sends the meeting notes from the 7/19/21 NHMP Steering Committee meeting. Tricia also sends the revised Critical Infrastructure List with Natural Hazards.
July 23, 2021	Tricia emailed the Sweet Home NHMP Steering Committee the two mitigation actions tables: the 2021 Sweet Home NHMP mitigation actions and the status of the 2015 Sweet Home NHMP mitigation actions. Tricia asked them to review and comment but did not give them a deadline for comments.
July 29, 2021	Tricia emailed the Sweet Home NHMP Steering Committee reminders for the information we talked about at the 7/19/21 Steering Committee meeting, and they said they would provide. She noted she has written a partial draft of the *2021 Sweet Home NHMP*.
August 3, 2021	Tricia sends the NHMP Steering Committee the information (received today from the Marion County EM) re: the USACE drought information session to be held on 8/5/21.
August 5, 2021	Tricia, Blair, and Brandon meet via Zoom to discuss NHMP tasks and prep for the August 9 NHMP Steering Committee meeting.
August 5, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 8/9/21. These include: the agenda, Critical Instructure List with Natural Hazards, the draft table of contents from the NHMP, the mission/goals/objectives from the *2015 Sweet Home NHMP,* and the

	Mitigation Actions Only document which contains the two tables of mitigation actions.
August 9, 2021	The eleventh post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include the Critical Infrastructure List with Natural Hazards, success stories, the *2021 Sweet Home NHMP* table of contents, the mitigation actions, and the mission/goals/objectives from the *2015 Sweet Home NHMP*.
August 9, 2021	Tricia emails Kevin Strong at Sweet Home Public Schools with questions regarding the public schools/critical facilities list and the seismic upgrades/success stories for the NHMP.
August 10, 2021	Tricia sends the Sweet Home NHMP Steering Committee the information about DLCD TA Grants.
August 11, 2021	Tricia sends the meeting notes and other materials from the 8/9/21 NHMP Steering Committee meeting. These include the Critical Infrastructure List with Natural Hazards and the draft Appendix E Sweet Home Success Stories.
August 20, 2021	Tricia sends the NHMP Steering Committee an email reminder for the tasks and information she has asked them to provide.
August 27, 2021	Tricia sends the NHMP Steering Committee an email reminder for the tasks and information she has asked them to provide (resending the 8/20/21 email).
September 1, 2021	Tricia, Blair, and Brandon meet to discuss NHMP tasks and prep for the September 8 NHMP Steering Committee meeting.
September 2, 2021	Tricia sends the materials for the NHMP Steering Committee meeting on 9/8/21. These include the agenda and the Critical Infrastructure List with Natural Hazards.
September 2, 2021	Tricia sends the draft *2021 Sweet Home NHMP* to the Steering Committee for their review, with a link to the DLCD FTP site in an email. She asks Lagea to post it on the Sweet Home website for public comment, and to let her know when it is there.
September 3, 2021	Lagea posts the draft *2021 Sweet Home NHMP* to the Sweet Home website. She also sent out a press release to 169 subscribers about the draft and posted on the Sweet Home Facebook page.
September 8, 2021	The twelfth post-award Sweet Home NHMP Steering Committee meeting. Tricia facilitates the meeting. Agenda items include the tasks that committee members have for providing information to Tricia for the NHMP; the Critical Facilities List with Natural Hazards, the Critical Facilities Map, and the Evacuation Map.

September 8, 2021	Tricia sends the meeting notes and the revised Critical Facilities List with Natural Hazards from the 9/8/21 NHMP Steering Committee meeting.
September 13, 2021	Tricia emails the NHMP Steering Committee as a reminder to provide the information she has asked for to put into the NHMP; she reminds them she is aiming to submit the NHMP to OEM and FEMA by 9/29/21.
September 14, 2021	Tricia emails the NHMP Steering Committee about three upcoming webinars they may be interested in.
September 17, 2021	Tricia emails the NHMP Steering Committee with introductions to Ric Lentz the Linn County Emergency Manager and Jennifer Cepello the Linn County Associate Planner. Both Ric and Jennifer have expressed interest in the *2021 Sweet Home NHMP*.
September 22, 2021	Tricia emails the NHMP Steering Committee with the flyer about the EPA technical assistance for Oregon wildfires.
September 23, 2021	Tricia emails the NHMP Steering Committee with the request again for the cost share forms for their required in-kind contributions.
October 1, 2021	Tricia emails the NHMP Steering Committee to let them know she has not yet submitted the *2021 Sweet Home NHMP* to OEM and that she still needs their cost share forms. She also asked Joe about the NHMP maps.
October 6, 2021	Tricia calls Brandon to ask for him to provide cost share forms for the NHMP Steering Committee members to me. Tricia emails the NHMP Steering Committee with a request (again) for their cost share. She includes a list of the 13 Steering Committee meetings we have had.
Sept-Nov 2021	Comments received and revisions made to the draft *2021 Sweet Home NHMP*.
November 30, 2021	The *2021 Sweet Home NHMP* is submitted to Oregon Emergency Management (OEM).
Month date, 2021	The *2021 Sweet Home NHMP* is submitted to Federal Emergency Management Agency (FEMA).
Month date year	If needed: A revised *2021 Sweet Home NHMP* is submitted to FEMA. The revised NHMP addresses the comments FEMA provided in the FEMA Local NHMP Review Tool in an email on month date year to DLCD and discussed in a phone call on month date year.
Month date year	The *2021 Sweet Home NHMP* receives the Approved Pending Adoption (APA) letter from FEMA.
Month date year	The *2021 Sweet Home NHMP* is approved by Sweet Home City Council.
Month date year	The resolution of approval from Sweet Home is sent to OEM and FEMA.

Month date year	The *2021 Sweet Home NHMP* receives the approval letter from FEMA. The dates of approval are from month date year to month date year.
Month date year	DLCD finalizes the *2021 Sweet Home NHMP* to include the FEMA APA letter, the Sweet Home approval resolution, and the FEMA approval letter. The final copy of the NHMP will have the draft watermark removed and the cover will include the NHMP approval dates.
Month date year	Sweet Home staff post the *2021 Sweet Home NHMP* to the city's website.

Source: Tricia Sears, DLCD, November 2021.

Sweet Home NHMP Steering Committee Meeting Agendas and Sign-in Sheets

Sweet Home NHMP Update

Organizational Steering Committee Meeting for Pre-Award Work

Tuesday, December 3, 2019
3:00 PM – 5:00 PM

City of Sweet Home
3225 Main St., Wiley Conference Room
Sweet Home, OR 97386

AGENDA

I. Welcome & Introductions (10 min) — Tommy Mull
- Make sure you sign your full signature on the meeting sign in sheet

II. NHMP Update Project (30 min) — Tricia Sears
- What is the Natural Hazards Mitigation Plan (NHMP)? (DLCD NHMP Info Sheet)
- FEMA Region X approved the existing Sweet Home NHMP on October 21, 2015. With approval Sweet Home is eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through October 20, 2020.
- NHMP Pre-Disaster Mitigation (PDM) 18 grant, pre-award and post-award work
- Cost share responsibilities [Cost Share Forms (3)]

III. Agreements between DLCD and Sweet Home (30 min) — Tricia and Tommy
- Intergovernmental Agreement (IGA) (copy provided)
- Scope of Work (SOW) (includes Allocation of Basic Responsibilities and Tasks) (copy provided)
- Project schedule (copy provided)
- Public outreach (NHMP Flyer)
- Success stories

IV. Steering Committee (30 min) — Tricia and Tommy
- Composition of the Committee (SC Roster)
- Roles and Participation
- Elect/Decide a Chairperson
- Ground Rules (e.g. Vote or Consensus)
- Meeting dates and locations

V. Upcoming NHMP SC Meeting Topics (10 min) — Tommy and Tricia
- Hazard Vulnerability Assessment/Analysis (HVA)
- Critical infrastructure, critical facilities, and lifelines (list and map)
- Mission statement, goals and objectives (copy provided)
- Mitigation actions: review 2015 actions, revise, delete, add new actions

VI. Next Steps (10 min) — Tricia
- Next NHMP SC meeting is January 7, 2020 at 3 pm, same location
- Meeting notes will be provided by Tricia

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; DLCD NHMP Info Sheet; Cost Share Forms (3); IGA; SOW; Project Schedule; NHMP Flyer; SC Roster; Mission Statement, Goals, and Objectives; and 2015 Sweet Home NHMP.

Sweet Home Natural Hazards Mitigation Plan
Organizational Steering Committee Meeting for Pre-Award Work

City of Sweet Home, Wiley Conference Rm, 3225 Main Street, Sweet Home , OR 97386

Tuesday, December 3, 2019 from 3 pm to 5 pm

PLEASE SIGN IN (Sign your name or add to the list)

Full Signature	Name	Title	Representing	Phone	Email
	Tommy Mull	Emergency Manager Program Director	Sweet Home	541-818-8043	tmull@sweethomeor.gov
	Jeff Lynn	Chief of Police	Sweet Home	541-367-5181	jlynn@sweethomeor.gov
	Dave Barringer	Fire Chief SHFAD	Sweet Home	541-367-5882	dbarringer@sweethomefire.org
absent due to illness	Greg Springman	Public Works Director	Sweet Home	541-367-6359	gspringman@sweethomeor.gov
remove from list	Patricia Rice	GIS Specialist	Sweet Home	541-367-6359	price@sweethomeor.gov
	Joseph Graybill	Engineer	Sweet Home	541-818-8039	jgraybill@sweethomeor.gov
	Brandon Neish	Finance Director	Sweet Home	541-367-5128	bneish@sweethomeor.gov
	Blair Larsen	Community and Economic Development Director	Sweet Home	541-818-8036 (office) 541-393-7409 (cell)	blarsen@sweethomeor.gov
	~~Leaga~~ Laura Mull	Communication Specialist	Sweet Home	541-818-8029	lmull@sweethomeor.gov
absent	Justin Peterson	Community Development Planner	Oregon Cascades West Council of Governments	541-924-8420	jpeterson@ocwcog.org
absent	Joe Larsen	Emergency Management Coordinator	Linn County	541-812-2272 (office) 541-619-8992 (cell)	jlarsen@linnsheriff.org
	Tricia Sears	Natural Hazards Planner	Oregon Department of Land Conservation & Development	503-934-0031 (office)	tricia.sears@state.or.us

Sweet Home NHMP Update

Steering Committee Meeting

Friday, December 4, 2020
9:00 – 10:00 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/83688503531?pwd=S0htSWFsemE4Z3Vld29ONStCeFRwUT09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. Where are we on the Sweet Home NHMP (10 min) — Tricia
- NHMP Pre-Disaster Mitigation (PDM) 18 grant, pre-award and post-award work
- Updated SC roster and project schedule/select meeting dates and times (Roster & Schedule)
- Cost share forms and documentation (Cost Share Form & Instructions)
- Public outreach (NHMP Flyer, Sweet Home website, SHFAD website)

III. Hazard Vulnerability Assessment/Analysis (HVA) (40 min) — Tricia
- Hazard Vulnerability Analysis Worksheet (copy provided)
- Hazard Vulnerability Analysis Significant Historic Hazard Events Tables (copy provided)

IV. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- Critical infrastructure, critical facilities, and lifelines (list and map)
- Mitigation actions: review 2015 NHMP mitigation actions: retain as is, retain and revise, delete, and add new actions

V. Next Steps (5 min) — Tricia
- Next NHMP SC meeting will focus on mission statement and goals, revisit the HVA, begin mitigation action review
- Next NHMP SC meeting is? Tricia will send a Zoom link
- Meeting notes will be provided by Tricia

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; SC Roster; Project Schedule; Cost Share Form & Instructions (three documents); NHMP Flyer; Hazard Vulnerability Analysis; Significant Historic Hazard Events Tables; and Hazard Vulnerability Analysis Worksheet

11/9/2020

City of Sweet Home NHMP Steering Committee

Attendance for 12/4/20 Sweet Home NHMP mtg ? See also photo screen shots

Name	Position	Email	Phone
		Sweet Home	
Jeff Lynn* not today	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer* no	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
Joseph Graybill no	Engineer	jgraybill@sweethomeor.gov	541-818-8039
Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
		Oregon Cascades West Council of Governments	
Justin Peterson won't be mtg today	Community Development Planner	jpeterson@ocwcog.org	541-924-8420
		Linn County	
Joe Larsen by phone then by Zoom	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
Tricia [illegible]	Natural Hazards Planner @ DLCD	tricia.sears@state.or.us	503-428-6426

*These folks are on the Emergency Management Committee (EMC).

The City Manager, Ray Towry, is on the EMC but not on the NHMP Steering Committee.

Sweet Home NHMP Update

Steering Committee Meeting

Friday, January 8, 2021
9:00 – 10:00 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/89015964296?pwd=ZTZlaFpEakdOc2R1SWxtYmtzQ1h3QT09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. Sweet Home NHMP Updates (10 min) — Tricia
- Updated SC roster and project schedule (Roster & Schedule)
- Check in about cost share forms and documentation
- Public outreach (NHMP Flyer, Sweet Home website, SHFAD website)

III. Hazard Vulnerability Assessment/Analysis (HVA) (40 min) — Tricia
- Hazard Vulnerability Analysis Worksheet (copy provided)
- Hazard Vulnerability Analysis Significant Historic Hazard Events Tables (copy provided)

IV. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- Review 2015 NHMP mission, goals, and objectives
- Critical infrastructure, critical facilities, and lifelines (list and map)
- Review 2015 NHMP mitigation actions: retain as is, retain and revise, delete, add new actions

V. Next Steps (5 min) — Tricia
- Next NHMP SC meeting will revisit the HVA/discuss summary; mission statement and goals
- Next NHMP SC meeting is 2/5/21
- Meeting notes will be provided by Tricia

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; SC Roster; Project Schedule; NHMP Flyer; Hazard Vulnerability Analysis; Significant Historic Hazard Events Tables; and Hazard Vulnerability Analysis Worksheet; Sweet Home Mission, Goals, Objectives from 2015 NHMP

NHMP Steering Committee meeting 1/8/21

Committee on January 2021

~~12/9/2019~~

City of Sweet Home NHMP Steering Committee

Attendance

See also Photos

Name	Position	Email	Phone
	Sweet Home		
~~Tommy Mull*~~	~~Emergency Management Program Coordinator~~	~~tmull@sweethomeor.gov~~	~~541-818-8043~~
Jeff Lynn*	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer*	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
Joseph Graybill	Engineer	jgraybill@sweethomeor.gov	541-818-8039
Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
	Oregon Cascades West Council of Governments		
~~Jodan Peterson~~	~~Community Development Planner~~	~~jpeterson@ocwcog.org~~	~~541-924-8420~~
	Linn County		
Joe Larsen	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
Tricia F. Sears Jr.	Natural Hazards Planner, DLCD,	tricia.sears@state.or.us	#503-428-0496

*These folks are on the Emergency Management Committee (EMC).

The City Manager, Ray Towry, is on the EMC but not on the NHMP Steering Committee.

Sweet Home NHMP Update

Steering Committee Meeting

Friday, February 5, 2021
9:00 – 10:00 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/81172304873?pwd=MWx0Rk9XTUxyUGVBSlQ5ZHRPUTFaUT09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. Hazard Vulnerability Assessment/Analysis (HVA) (10 min) — Tricia
- Hazard Vulnerability Analysis Summary (copy provided)

IV. Review 2015 NHMP Mitigation Actions (40 min) — Tricia
- Review 2015 NHMP mitigation actions: retain as is, retain and revise, delete, add new actions (Sweet Home NHMP Mitigation Actions Status)

VI. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- Critical infrastructure, critical facilities, and lifelines (list and map)
- Review 2015 NHMP mission, goals, and objectives (copy will be provided)

V. Next Steps (5 min) — Tricia
- Next NHMP SC meeting: continue mitigation actions
- Next NHMP SC meeting is 3/5/21
- Meeting notes will be provided by Tricia

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Hazard Vulnerability Analysis Summary; Sweet Home NHMP Mitigation Actions Status

Use for attendance for 2/5/21 meeting

12/7/2020

City of Sweet Home NHMP Steering Committee

Name	Position	Email	Phone
	Sweet Home		
Jeff Lynn*	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer*	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
Joseph Graybill	Engineer	jgraybill@sweethomeor.gov	541-818-8039
Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
Emailed 2/3/21 to say he would miss the meeting.			541-818-8036 (office) 541-393-7409 (cell)
Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	
Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
Emailed 2/4/21 to say she will miss the meeting.			
Patricia K. Learn, Tricia K. Sears, Natural Hazards Planner, DLCD 503-428-0496			
	Linn County		
Joe Larsen	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)

*These folks are on the Emergency Management Committee (EMC).

The City Manager, Ray Towry, is on the EMC but not on the NHMP Steering Committee.

Sweet Home NHMP Update

Steering Committee Meeting

Friday, March 5, 2021
9:00 – 10:00 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/88638384492?pwd=SHJTMzlzb1Yxc3Zaemg0R2toQTdwUT09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. General Discussion (5 min) — Tricia et al
- Lake Foster and Lake Greenpeter: dam safety action plans and inundation maps
- Cost share forms

III. Hazard Vulnerability Assessment/Analysis (HVA) (5 min) — Tricia et al
- Hazard Vulnerability Analysis Summary 2-11-21 (revised)(copy provided)

IV. Review *2015 Sweet Home NHMP* Mitigation Actions (40 min) — Tricia et al
- Review 2015 NHMP mitigation actions: retain as is, retain and revise, delete, add new actions (Sweet Home NHMP Mitigation Actions Status 2-3-21)
- Confirm that using the HVA risk scores as the priority level for the mitigation actions is ok

V. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- Critical infrastructure, critical facilities, and lifelines (list and map)
- Review 2015 NHMP mission, goals, and objectives (copy will be provided)

VI. Next Steps (5 min) — Tricia
- Next NHMP SC meeting: continue mitigation actions
- Next NHMP SC meeting is 4/2/21
- Meeting notes will be provided by Tricia

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Hazard Vulnerability Analysis Summary 2-11-21; Sweet Home NHMP Mitigation Actions Status 2-3-21

Attendance for the 3/5/21 Steering Comm meeting

12/7/2020			
City of Sweet Home NHMP Steering Committee			
Name	**Position**	**Email**	**Phone**
Sweet Home			
Jeff Lynn* weight ext acad	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer*	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
Joseph Graybill	Engineer	jgraybill@sweethomeor.gov	541-818-8039
Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
Linn County			
Joe Larsen	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
Tricia R. Sears	Natural Hazards Planner, DLCD	tricia.sears@State.or.us 503-428-6496	
*These folks are on the Emergency Management Committee (EMC).			
The City Manager, Ray Towry, is on the EMC but not on the NHMP Steering Committee.			

Sweet Home NHMP Update

Steering Committee Meeting

Friday, April 2, 2021
9:00 – 10:00 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/89182191361?pwd=YVRkR2tEZTB3cU92dktvWElnSEF5QT09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. General Discussion (5 min) — Tricia et al
- Updates, questions, comments from the NHMP SC

III. Review *2015 Sweet Home NHMP* Mitigation Actions (45 min) — Tricia et al
- Review 2015 NHMP mitigation actions: retain as is, retain and revise, delete, add new actions (Sweet Home NHMP Mitigation Actions Status 2-3-21)
- We are using the HVA risk scores as the priority level for the mitigation actions

VI. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- Critical infrastructure, critical facilities, and lifelines (list and map)
- Review 2015 NHMP mission, goals, and objectives (copy will be provided)
- Lake Foster and Lake Greenpeter: dam safety action plans and inundation maps

V. Next Steps (5 min) — Tricia
- Next NHMP SC meeting: Ross Hiner, Dam Safety Program Manager, USACE - Portland District talks about Lake Foster and Lake Greenpeter dam safety action plans and inundation maps
- Next NHMP SC meeting is 5/7/21
- Meeting notes will be provided by Tricia
- Remember to fill out and send your cost share forms to Tricia

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Sweet Home NHMP Mitigation Actions Status 2-3-21

✓ = Meeting attendance for 4/2/21 Steering Committee Meeting

12/7/2020

City of Sweet Home NHMP Steering Committee

Name	Position	Email	Phone
	Sweet Home		
Jeff Lynn*	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer*	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
✓ Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
✓ Joseph Graybill	Engineer	jgraybill@sweethomeor.gov	541-818-8039
✓ Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
✓ Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
✓ Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
	Linn County		
Joe Larsen	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
✓ Tricia Sears	Natural Hazards Planner, DLCD	tricia.sears@State.or.us	503-428-0496
*These folks are on the Emergency Management Committee (EMC).			
The City Manager, Ray Towry, is on the EMC but not on the NHMP Steering Committee.			

Sweet Home NHMP Update
Steering Committee Meeting

Friday, May 7, 2021
9:00 – 10:00 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/85890825989?pwd=Qm44VCs2djdHSEYrdEV5TkNLaVh4UT09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. Lake Foster and Lake Greenpeter Dams & Inundation Maps Discussion (30 min) — Ross Hiner
- Ross Hiner, Dam Safety Program Manager, USACE - Portland District (CENWP-ENC-HC)
- Lake Foster and Lake Greenpeter dam safety action plans and inundation maps
- Potential mitigation actions for the Sweet Home NHMP?

III Review *2015 Sweet Home NHMP* Mitigation Actions (20 min) — Tricia et al
- Review 2015 NHMP mitigation actions: retain as is, retain and revise, delete, add new actions (Sweet Home NHMP Mitigation Actions Status 2-3-21)
- Follow up on 4/2/21 Sweet Home NHMP Steering Committee meeting "homework"
  Sweet Home NHMP Outreach Calendar (Lagea)
  Critical locations, vulnerable populations list from 2020 wildfires, and other (Lagea)
  Plans for PPL upgrades to power infrastructure (Blair)
  List of shelters and back-up generators from Police & Fire (Tricia, Jeff, and Dave)

IV. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- Critical infrastructure, critical facilities, and lifelines (list and map)
- Review 2015 NHMP mission, goals, and objectives (copy will be provided)
- Review the Sweet Home NHMP Outreach Calendar (draft from Lagea)

V. Next Steps (5 min) — Tricia
- Next NHMP SC meeting: continue mitigation actions
- Next NHMP SC meeting is 6/4/21
- Meeting notes will be provided by Tricia
- Remember to fill out and send your cost share forms to Tricia

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Sweet Home NHMP Mitigation Actions Status 2-3-21

Attendance 5/7/21 NHMP Steering Committee meeting

12/7/2020

City of Sweet Home NHMP Steering Committee

Name	Position	Email	Phone
	Sweet Home		
✓ Jeff Lynn*	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer*	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
✓ Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
✓ Joseph Graybill	Engineer	jgraybill@sweethomeor.gov	541-818-8039
Brandon Neish*	Finance Director → Not attending due to family illness	bneish@sweethomeor.gov	541-367-5128
✓ Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
✓ Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
✓ Tom Voldseth, operations Manager @ Green Peter & Foster, USACE			
	Linn County		
Joe Larsen	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
✓ Tricia Sears, Natural Hazards Planner, DLCD, tricia.sears@state.or.us 503-428-0496			
✓ Ross Hiker, Dam Safety Program Manager, USACE, ross.d.hiker@usace.army.mil 503-819-1287			
*These folks are on the Emergency Management Committee (EMC).			
The City Manager, Ray Towry, is on the EMC but not on the NHMP Steering Committee.			

Sweet Home NHMP Update
Steering Committee Meeting

Friday, June 4, 2021
9:00 – 10:00 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/88352440811?pwd=bC9lL3N2a3J3Zm1BWUtic3IwWHJTdz09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

Attendance note: Blair, out of office until 6/7/21

II. 4/2/21 Sweet Home NHMP Steering Committee meeting "homework" (20 min) — Tricia et al
- Sweet Home NHMP Outreach Calendar (Lagea)
- Critical locations, vulnerable populations list from 2020 wildfires, and other (Lagea)
- Plans for PPL upgrades to power infrastructure (Blair) (Brandon)
- List of shelters and back-up generators from Police & Fire (Tricia, Jeff, and Dave)
- Consider having a longer meeting or schedule additional meetings to have more scheduled time to accomplish our tasks (Note, draft NHMP to OEM) (Tricia et al)

III. Review *2015 Sweet Home NHMP* Mitigation Actions (30 min) — Tricia et al
- Review *2015 NHMP* mitigation actions: retain as is, retain and revise, delete, add new actions (Sweet Home NHMP Mitigation Actions Status 2-3-21)

IV. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- Critical infrastructure, critical facilities, and lifelines (list and map)
- Review *2015 NHMP* mission, goals, and objectives (copy will be provided)

V. Next Steps (5 min) — Tricia
- Next NHMP SC meeting: continue mitigation actions
- Next NHMP SC meeting is 7/2/21 (reconfirm this works for everyone)
- Meeting notes will be provided by Tricia
- Remember to fill out and send your cost share forms to Tricia

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Sweet Home NHMP Outreach Calendar 5-x-21; Sweet Home NHMP Mitigation Actions Status 2-3-21

✓=present

Attendance list for 6/14/21 Steering Committee Meeting

12/7/2020			
City of Sweet Home NHMP Steering Committee			
Name	**Position**	**Email**	**Phone**
Sweet Home			
Jeff Lynn* no, out of office	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer*	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
Greg Springman* no, out of office	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
✓ Joseph Graybill maybe	Engineer	jgraybill@sweethomeor.gov	541-818-8039
✓ Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
Blair Larsen out of the office 6/14/21	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
Lagea Mull* no not able to attend	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
Linn County			
Joe Larsen	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
✓ Tricia Sears	DLCD	tricia.sears@state.or.us	503-428-0490
*These folks are on the Emergency Management Committee (EMC).			
The City Manager, Ray Towry, is on the EMC but not on the NHMP Steering Committee.			

Sweet Home NHMP Update

Steering Committee Meeting

Monday, June 21, 2021
8:30 – 9:30 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/86305782621?pwd=ek1KcHN3T3JkeHlDWU1sVys3SFF0UT09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. Strategy and Timeline for Sweet Home NHMP (5 min) — Tricia et al
- Meetings, tasks, note draft NHMP scheduled to be submitted to OEM by 9/30/21

III. 4/2/21 Sweet Home NHMP Steering Committee meeting "homework" (15 min) — Tricia et al
- Sweet Home NHMP Outreach Calendar (Lagea)
- Critical locations, vulnerable populations list from 2020 wildfires, and other (Lagea)
- Plans for PPL upgrades to power infrastructure (Blair) (Brandon)
- List of shelters and back-up generators from Police & Fire (Tricia, Jeff, and Dave)

III. Review *2015 Sweet Home NHMP* Mitigation Actions (30 min) — Tricia et al
- Review *2015 NHMP* mitigation actions: retain as is, retain and revise, delete, add new actions (Sweet Home NHMP Mitigation Actions Status 2-3-21)

IV. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- Critical infrastructure, critical facilities, and lifelines (list and map)
- Review *2015 NHMP* mission, goals, and objectives (copy will be provided)
- Maps for the NHMP

V. Next Steps (5 min) — Tricia
- Next NHMP SC meeting: continue mitigation actions, plus upcoming topics
- Next NHMP SC meetings are July 12 and July 19 at 8:30 am
- Meeting notes will be provided by Tricia
- Remember to fill out and send your cost share forms to Tricia!

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Steering Committee Roster 6-17-21; Project Schedule 6-17-21; Sweet Home NHMP Outreach Calendar 6-17-21; Sweet Home NHMP Mitigation Actions Status 2-3-21

Attendance for the 6/21/21 NHMP Steering Committee

6/17/2021			
City of Sweet Home NHMP Steering Committee			
Name	**Position**	**Email**	**Phone**
Sweet Home			
✓ Jeff Lynn*	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer*	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
✓ Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
✓ Joseph Graybill	Engineer	jgraybill@sweethomeor.gov	541-818-8039
✓ Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
✓ Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
✓ Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
Ray Towry*	City Manager	rtowry@sweethomeor.gov	541-367-8969
Linn County			
Joe Larsen	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
✓ Tricia Sears	Natural Hazards Planner, DLCD	tricia.sears@dlcd.oregon.gov	503-428-0490
*These folks are on the Emergency Management Committee (EMC).			

Sweet Home NHMP Update
Steering Committee Meeting

Monday, July 12, 2021
8:30 – 9:30 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/86778223254?pwd=c1p6MURJbFk1S3FyVnFjQVhvY0hWdz09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. Review *2015 Sweet Home NHMP* Mitigation Actions (30 min) — Tricia et al
- Review *2015 NHMP* mitigation actions: retain as is, retain and revise, delete, add new actions (Sweet Home NHMP Mitigation Actions Status 2-3-21)

III. Critical Infrastructure List and Map Discussion and Review (20 min) — Tricia et al
- Sweet Home Critical Infrastructure List with Natural Hazards 7-8-21
- Note, the Critical Infrastructure List includes the 7-8-21 info from Lagea re: vulnerable populations, critical facilities, and essential facilities
  Note, Lagea, for clarity, what is the difference of how you define critical vs essential facility?
- Sweet Home Critical Infrastructure Map 10-2-19

IV. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- Continue Sweet Home Critical Infrastructure List with Natural Hazards 7-8-21, July 19 meeting
- Natural hazards maps for the NHMP, July 19 meeting
- Photos of natural hazards for the NHMP, July 19 meeting
- Table of Contents for the NHMP, July 19 meeting
- Review *2015 NHMP* mission, goals, and objectives, August 9 meeting
- Success stories for the NHMP, August 9 meeting
- Continued mitigation actions discussion, all meetings

V. Next Steps (5 min) — Tricia
- Next NHMP SC meeting is July 19 at 8:30 am
- Meeting notes will be provided by Tricia
- Remember to fill out and send your cost share forms to Tricia!

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Sweet Home NHMP Mitigation Actions Status 2-3-21; Sweet Home Critical Infrastructure List with Natural Hazards 7-8-21; Sweet Home Critical Infrastructure Map 10-2-19;

Meeting attendance July 19, 2021 Sweet Home NHMP Steering Committee

6/17/2021

City of Sweet Home NHMP Steering Committee

Name	Position	Email	Phone
	Sweet Home		
✓ Jeff Lynn*	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer*	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
✓ Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
✓ Joseph Graybill	Engineer	jgraybill@sweethomeor.gov	541-818-8039
✓ Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
✓ Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
✓ Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
Ray Towry*	City Manager	rtowry@sweethomeor.gov	541-367-8969
	Linn County		
Joe Larsen	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
✓ Tricia Sears	Natural Hazards Planner, DLCD	tricia.sears@dlcd.oregon.gov	503-428-0490
*These folks are on the Emergency Management Committee (EMC).			

Sweet Home NHMP Update
Steering Committee Meeting

Monday, July 19, 2021
8:30 – 9:30 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/88246824499?pwd=OVBpYXZ5dkVoSUZtNU5CLzB5VFlFZz09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot
- Reminder, Lagea, Photos of natural hazards are due
- Reminder, Greg, Does the Sweet Home water treatment plant have an emergency operations plan specific to it, or is it part of the *Sweet Home Emergency Operations Plan*
- Note, NHMP maps discussed 7/16/23 with Tricia, Blair, Brandon, and Joe

II. Critical Infrastructure List and Map Discussion and Review (50 min) — Tricia et al
- Sweet Home Critical Infrastructure List with Natural Hazards 7-8-21 (includes the info from Lagea re: vulnerable populations, critical facilities, and essential facilities)
- Define critical vs essential facilities
- Sweet Home Critical Infrastructure Map 10-2-19
- Sweet Home Critical Facilities Map 7-1-21
- Sweet Home Essential Facilities Map 7-1-21

III. Next NHMP Steering Committee Meeting (5 min) — Tricia et al
- Currently set for August 9 at 8:30 am
- Propose new date and longer meeting (2 hours)

VI. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- NHMP Table of Contents, August 9 meeting
- Review *2015 NHMP* mission, goals, and objectives, August 9 meeting
- Success stories for the NHMP, August 9 meeting
- Continued discussion of NHMP maps, all meetings
- Continued discussion of NHMP mitigation actions, all meetings

V. Next Steps (FYI) — Tricia
- Next NHMP SC meeting is August 9 at 8:30 am unless rescheduled
- Meeting notes will be provided by Tricia
- Review the in process draft *2021 Sweet Home NHMP*
- Remember to fill out and send your cost share forms to Tricia!

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Sweet Home Critical Infrastructure List with Natural Hazards 7-8-21; Sweet Home Critical Infrastructure Map 10-2-19; Sweet Home Critical Facilities Map 7-1-21; Sweet Home Essential Facilities Map 7-1-21;

Meeting attendance July 19, 2021 Sweet Home NHMP Steering Committee

meeting attendance July 19, 2021 Sweet Home NHMP Steering committee

6/17/2021

City of Sweet Home NHMP Steering Committee

Name	Position	Email	Phone
	Sweet Home		
Jeff Lynn*	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer*	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
Joseph Graybill	Engineer	jgraybill@sweethomeor.gov	541-818-8039
Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
Ray Towry*	City Manager	rtowry@sweethomeor.gov	541-367-8969
	Linn County		
Joe Larsen	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
Tricia Sears	Natural Hazards Planner, DLCD	tricia.sears@dlcd.oregon.gov	503-428-0490
*These folks are on the Emergency Management Committee (EMC).			

Sweet Home NHMP Update

Steering Committee Meeting

Monday, August 9, 2021
8:30 – 10:30 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/86892675450?pwd=M0NRc2F3TGNoc0dMWjlQd2VJYnJYdz09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. Critical Infrastructure List and Map Discussion and Review (60 min) — Tricia et al
- Sweet Home Critical Infrastructure List with Natural Hazards 7-8-21

II. Review *2015 Sweet Home NHMP* mission, goals, and objectives (15 min) — Tricia et al
- See handout, review, discuss the mission, goals, & objectives: retain as is, retain & revise, delete

III. Table of Contents of the *2021 Sweet Home NHMP* (15 min) — Tricia et al
- Review what is in the NHMP, the status of the draft NHMP, timelines and tasks

IV. Success Stories for the NHMP Discussion and Review (10 min) — Tricia et al
- SHFAD water tender
- Sweet Home water treatment plant
- Seismic retrofits of city hall, police building, schools, and other structures?

V. Review *2021 Sweet Home NHMP* Mitigation Actions (5 min) — Tricia et al
- Review the two mitigation actions tables: Sweet Home NHMP 2015 Mitigation Actions Status 7-23-21 and Sweet Home 2021 NHMP Mitigation Actions 7-23-21

VI. Review *2021 Sweet Home NHMP* Maps (5 min) — Tricia et al
- Critical Infrastructure, Critical Facilities, Essential Facilities Map
- Natural Hazards Maps (composite and individual hazards)
- Evacuation Map
- Vicinity Map

VII. Upcoming NHMP SC Meeting Topics (FYI) — Tricia
- All topics and timelines

VIII. Next Steps (5 min) — Tricia
- Next NHMP SC meeting is September 8 at 8:30 am
- Meeting notes will be provided by Tricia
- Please follow up on your tasks!
- Remember to fill out and send your cost share forms to Tricia!

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Sweet Home Critical Infrastructure List with Natural Hazards 7-8-21; *2015 Sweet Home NHMP* Mission, Goals, and Objectives; *2021 Sweet Home NHMP* Table of Contents 8-5-21; Sweet Home NHMP Mitigation Actions Status 7-23-21; Sweet Home 2021 NHMP Mitigation Actions: *2021 Sweet Home NHMP* Maps

√= Attendance @ 8/9/21 NHMP Steering Committee Meeting

6/17/2021

City of Sweet Home NHMP Steering Committee

Name	Position	Email	Phone
Sweet Home			
√ Jeff Lynn*	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer* out	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
√ Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
Joseph Graybill out	Engineer	jgraybill@sweethomeor.gov	541-818-8039
√ Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
√ Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
√ Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
Ray Towry* out	City Manager	rtowry@sweethomeor.gov	541-367-8969
Linn County			
Joe Larsen out	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
√ Tricia Sears	Natural Hazards Planner @ DLCD	tricia.sears@dlcd.oregon.gov	503-428-0496
*These folks are on the Emergency Management Committee (EMC).			

Sweet Home NHMP Update
Steering Committee Meeting

Wednesday, September 8, 2021
8:30 – 9:30 AM

City of Sweet Home
3225 Main St.
Sweet Home, OR 97386

Join Zoom Meeting
https://us02web.zoom.us/j/88347965996?pwd=MFJVTTJXUWhKNkJsMWFQUWRQTEtBZz09

AGENDA

I. Welcome & Introductions (5 min) — Tricia Sears
- Make sure you sign the meeting sign in sheet/ mark attendance/ take screen shot

II. Success Stories for the NHMP, Discussion and Review (10 min) — Tricia et al
- SHFAD water tender (Brandon and Dave)
- Sweet Home wastewater treatment plant (Greg)
- City Hall and police building seismic retrofits (Brandon)

III. Critical Facilities List and Map, and Evacuation Map (15 min) — Tricia et al
- Review the Critical Facilities List with Natural Hazards
- Review the Critical Facilities Map
- Review the Evacuation Map

IV. Draft *2021 Sweet Home NHMP* Review (15 min) — Tricia et al
- Most flood prone areas of Sweet Home?
- No existing stormwater management master plan, it is funded for 2021-2022
- Stormwater fee was raised to provide funding for position and plan (study rec'd $4 fee per home but only $1 was adopted as fee), raised in 2021 to $2 for the plan, discussed that in future may raise it again to address the items in the plan/ maintenance
- On May 1, 2021 the stormwater system development charge went into effect for capital improvements in the stormwater system

IV. Tasks remaining to do (10 min) — Tricia et al
- Mitigation actions about shelters with Dave and Jeff (Brandon, Dave, and Jeff)
- Critical Facilities Map and Landslide Susceptibility Map (Joe)
- Additional revisions to maps and the draft *2021 Sweet Home NHMP* (all)

VI. Next Steps (5 min) — Tricia
- No NHMP SC meeting is currently scheduled after this one
- Complete your tasks!
- Meeting notes will be provided by Tricia
- Remember to fill out and send your cost share forms to Tricia!

Materials from DLCD and Sweet Home: DLCD will provide electronic copies and Sweet Home will provide printed copies: Meeting Agenda; Critical Facilities List with Natural Hazards 8-11-21; Critical Facilities Map; Evacuation Map 8-30-21

√ = Attendance for 9/8/21 NHMP Steering Committee meeting
√ = Attendance @ 8/9/21 NHMP Steering Committee Meeting

6/17/2021

City of Sweet Home NHMP Steering Committee

Name	Position	Email	Phone
Sweet Home			
√ Jeff Lynn*	Chief of Police	jlynn@sweethomeor.gov	541-367-5181
Dave Barringer* out	Fire Chief, Sweet Home Fire and Ambulance District (SHFAD)	dbarringer@sweethomefire.org	541-367-5882
√ Greg Springman*	Public Works Director	gspringman@sweethomeor.gov	541-367-6359
√ Joseph Graybill out	Engineer	jgraybill@sweethomeor.gov	541-818-8039
√ Brandon Neish*	Finance Director	bneish@sweethomeor.gov	541-367-5128
√ Blair Larsen	Community and Economic Development Director	blarsen@sweethomeor.gov	541-818-8036 (office) 541-393-7409 (cell)
√ Lagea Mull*	Communication Specialist	lmull@sweethomeor.gov	541-818-8029
Ray Towry* out	City Manager	rtowry@sweethomeor.gov	541-367-8969
Linn County			
Joe Larsen out	Emergency Management Coordinator	jlarsen@linnsheriff.org	541-812-2272 (office) 541-619-8992 (cell)
√ Tricia Sears	Natural Hazards Planner @ DLCD	tricia.searsedl@dlcd.oregon.gov	503-428-0496
*These folks are on the Emergency Management Committee (EMC).			

Sweet Home NHMP Flyer 2019 and 2020

What concerns you?

- Floods
- Winter Storms
- Earthquakes
- Wind Storms

About the Plan

The City of Sweet Home's existing Natural Hazards Mitigation Plan (NHMP) was updated in October of 2015. NHMPs must be updated every five years.

The City of Sweet Home is collaborating with the Oregon Department of Land Conservation and Development (DLCD) to update the NHMP. The updated NHMP will continue the City's eligibility for disaster-related funding.

A Steering Committee, chaired by the Sweet Home Community & Economic Development Director, Blair Larsen, works with DLCD staff to update the NHMP. The NHMP is targeted for completion by February 2022.

Why engage in natural hazard mitigation planning?

- **To avoid disasters** by reducing or eliminating long-term risk to people, property, and the environment from natural hazards.
- **To increase safety and resilience** by integrating hazard mitigation into the City's plans, programs, and policies.
- **To maintain eligibility** for disaster related funding.

DLCD

For more information and to provide comments, contact:

Blair Larsen, Community & Economic Development Director

541-818-8036 | blarsen@sweethomeor.gov | 3225 Main Street Sweet Home, OR

What concerns you?

- Floods
- Winter Storms
- Earthquakes
- Wind Storms

About the Plan

The City of Sweet Home's existing Natural Hazards Mitigation Plan (NHMP) was updated in October of 2015. NHMPs must be updated every five years.

The City of Sweet Home is collaborating with the Oregon Department of Land Conservation and Development (DLCD) to update the NHMP. The updated NHMP will continue the City's eligibility for disaster-related funding.

A Steering Committee, chaired by the Sweet Home Emergency Management Program Director Tommy Mull, is working with DLCD staff to update the NHMP. The NHMP is targeted for completion by October 2020.

Why engage in natural hazard mitigation planning?

- **To avoid disasters** by reducing or eliminating long-term risk to people, property, and the environment from natural hazards.
- **To increase safety and resilience** by integrating hazard mitigation into the City's plans, programs, and policies.
- **To maintain eligibility** for disaster related funding.

DLCD

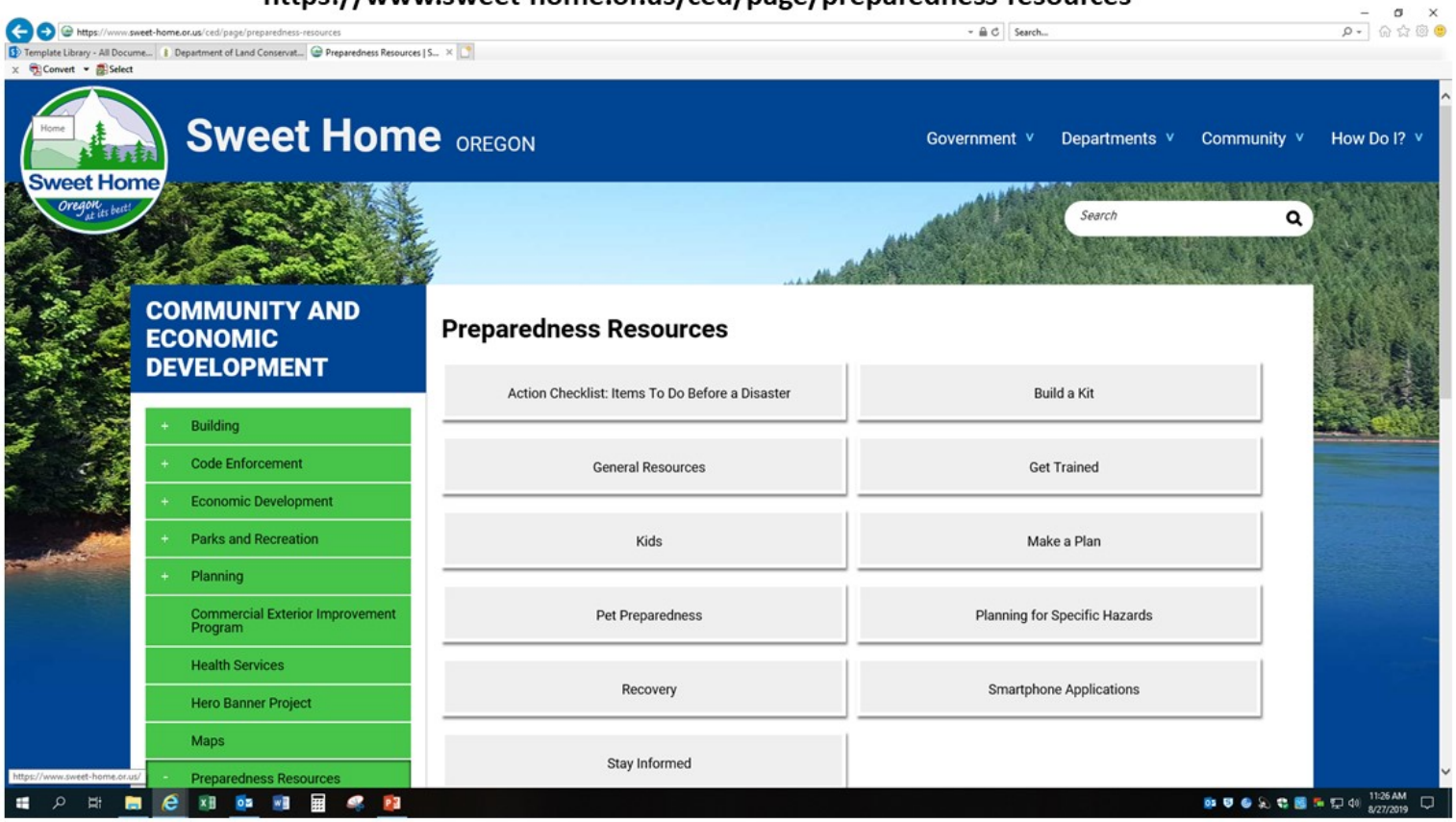
For more information and to provide comments, contact:

Tommy Mull, Sweet Home Emergency Management Program Director

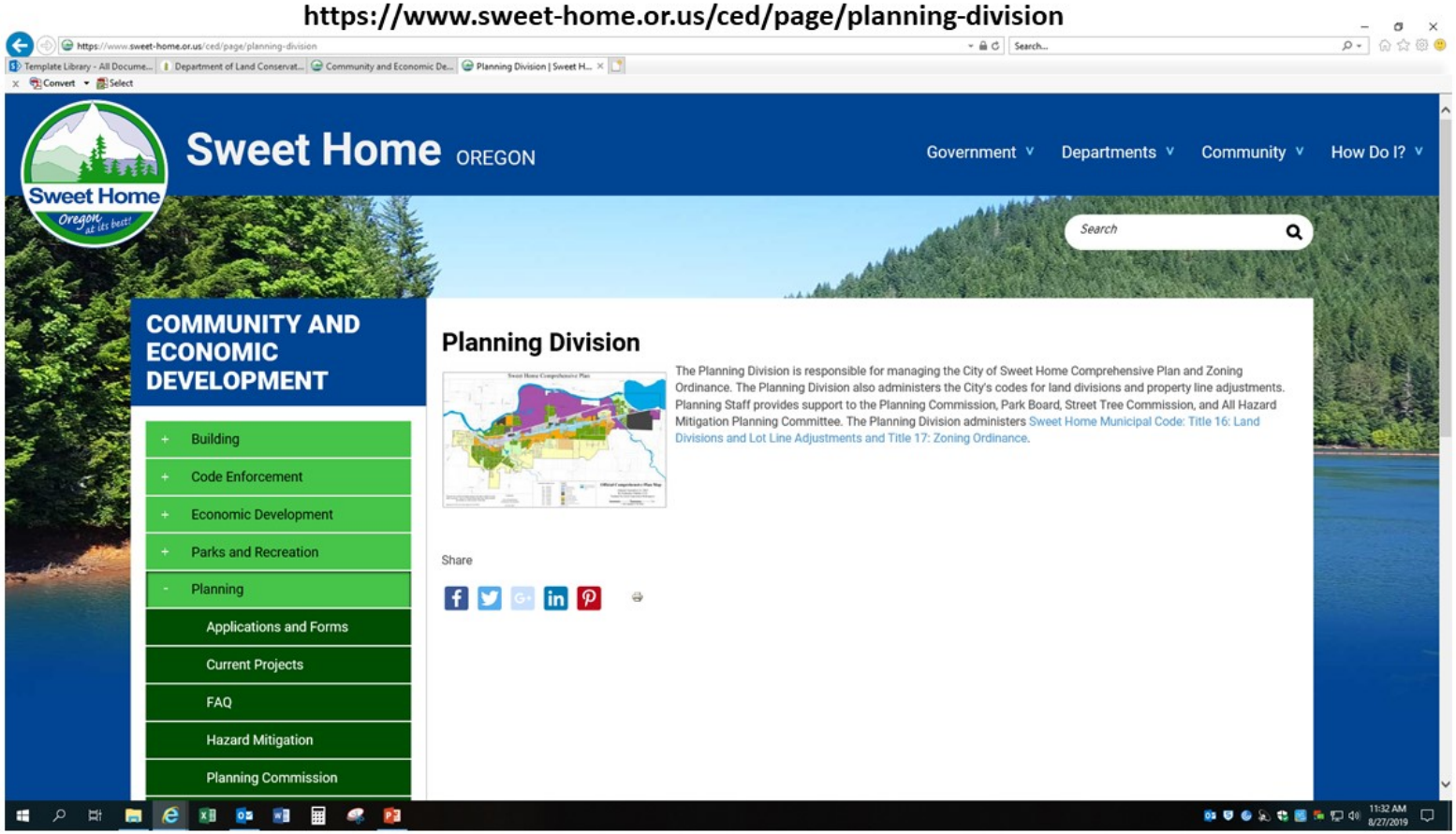
541-818-8043 | tmull@sweethomeor.gov | 3225 Main Street Sweet Home, OR

Website and Facebook Screen Shots, and Events

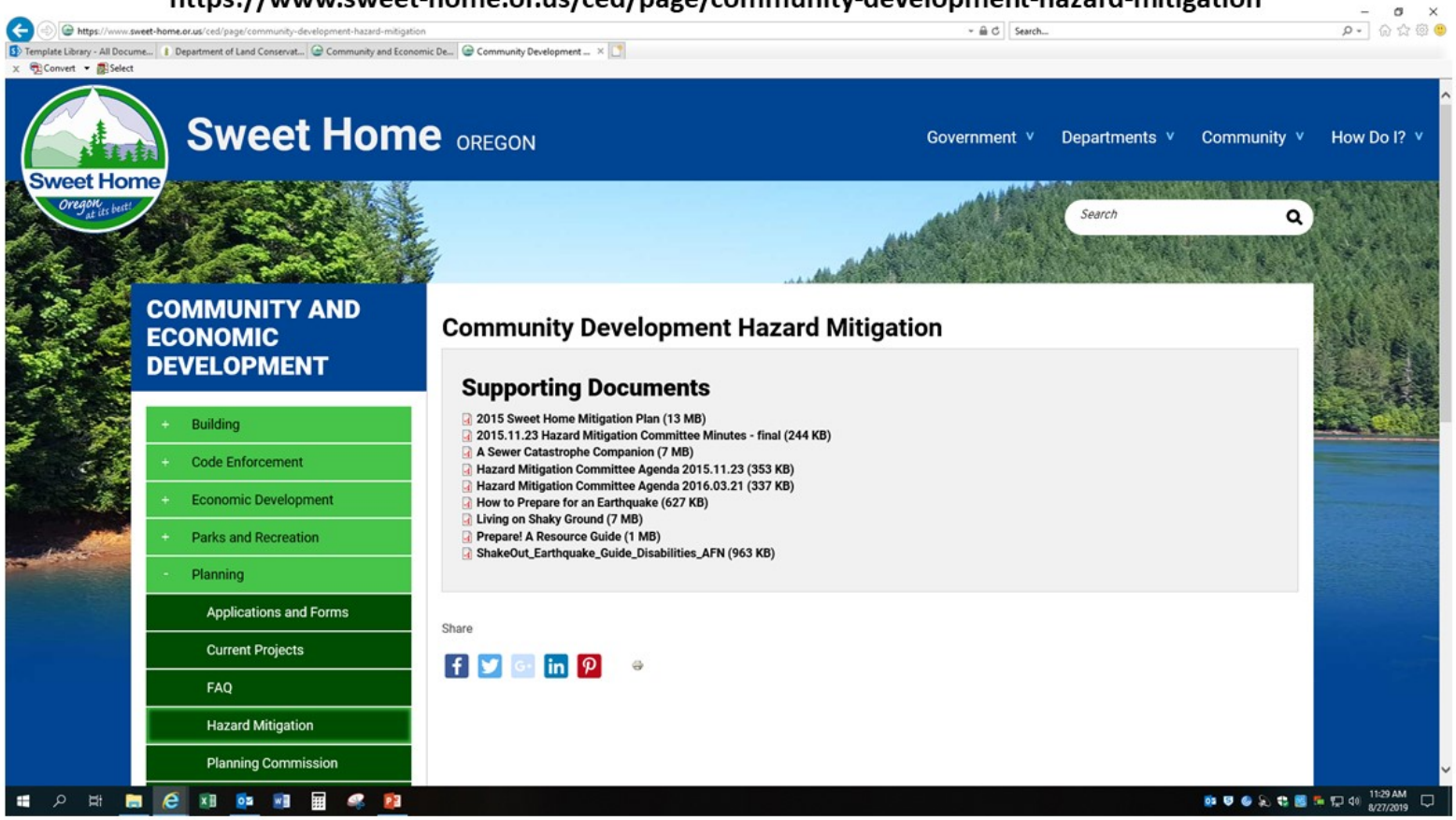
City of Sweet Home website 8-27-19
https://www.sweet-home.or.us/ced/page/preparedness-resources



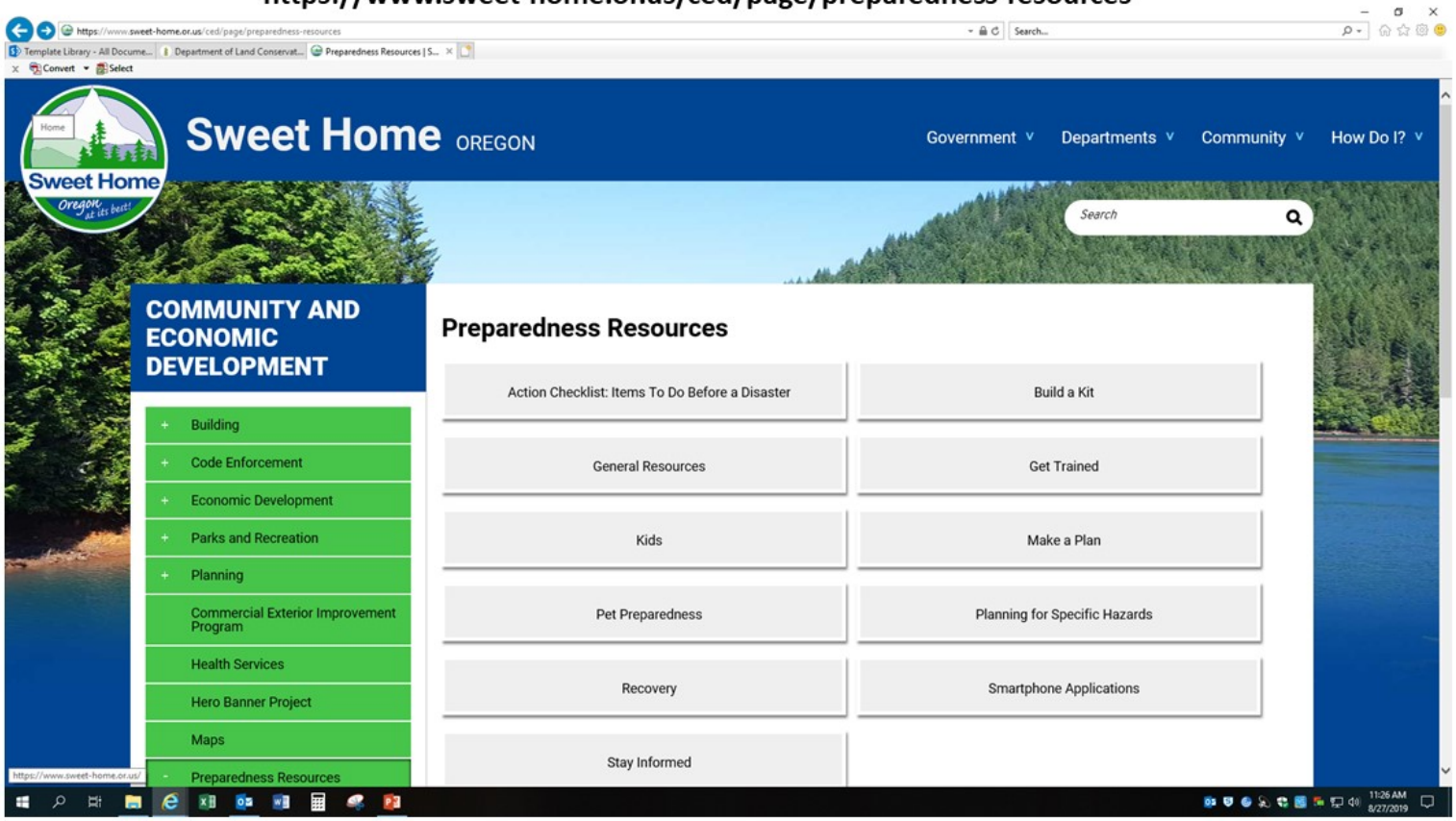
City of Sweet Home Website 8/27/19
https://www.sweet-home.or.us/ced/page/planning-division



City of Sweet Home Website 8-27-19
https://www.sweet-home.or.us/ced/page/community-development-hazard-mitigation

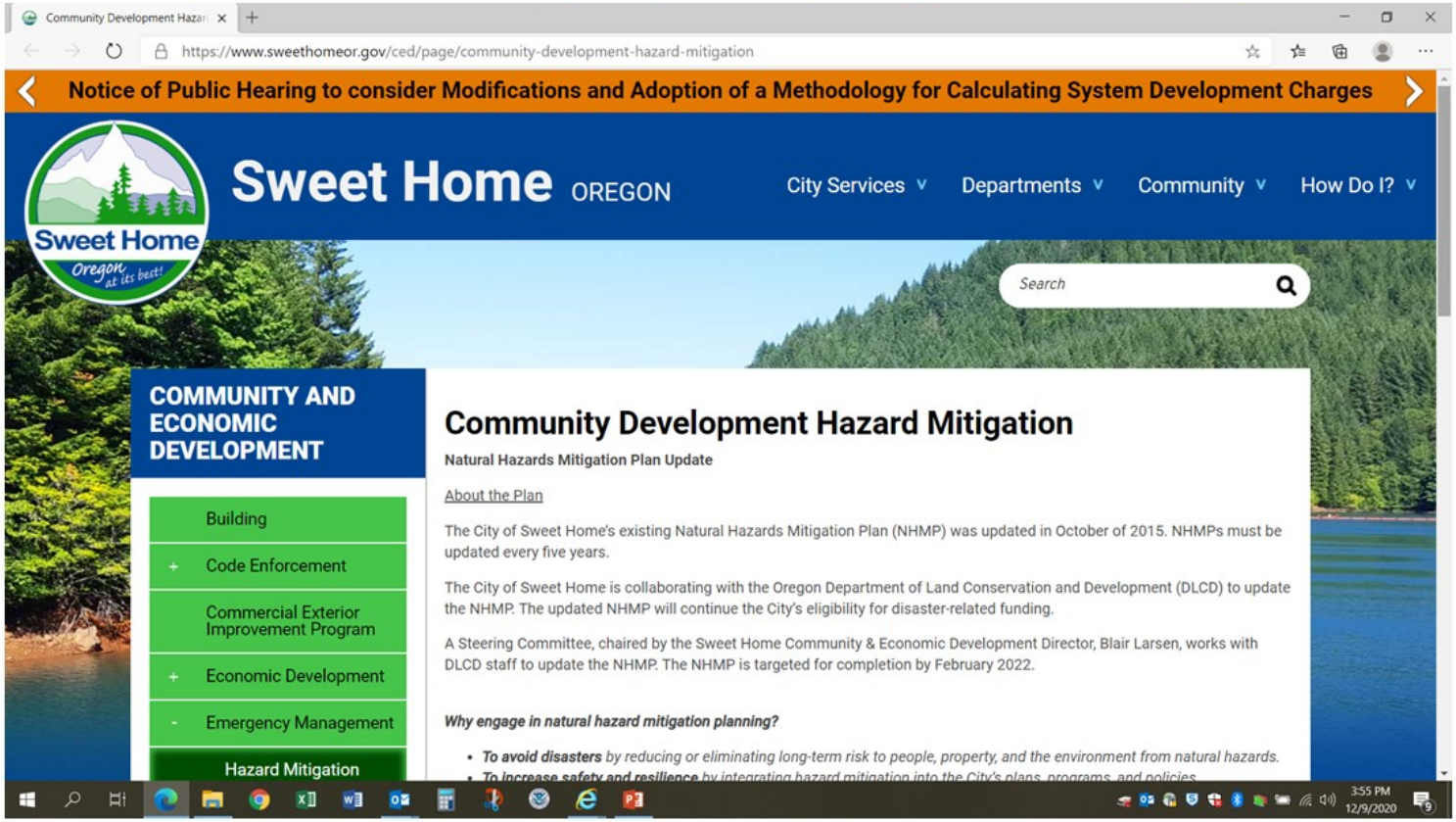


City of Sweet Home website 8-27-19
https://www.sweet-home.or.us/ced/page/preparedness-resources



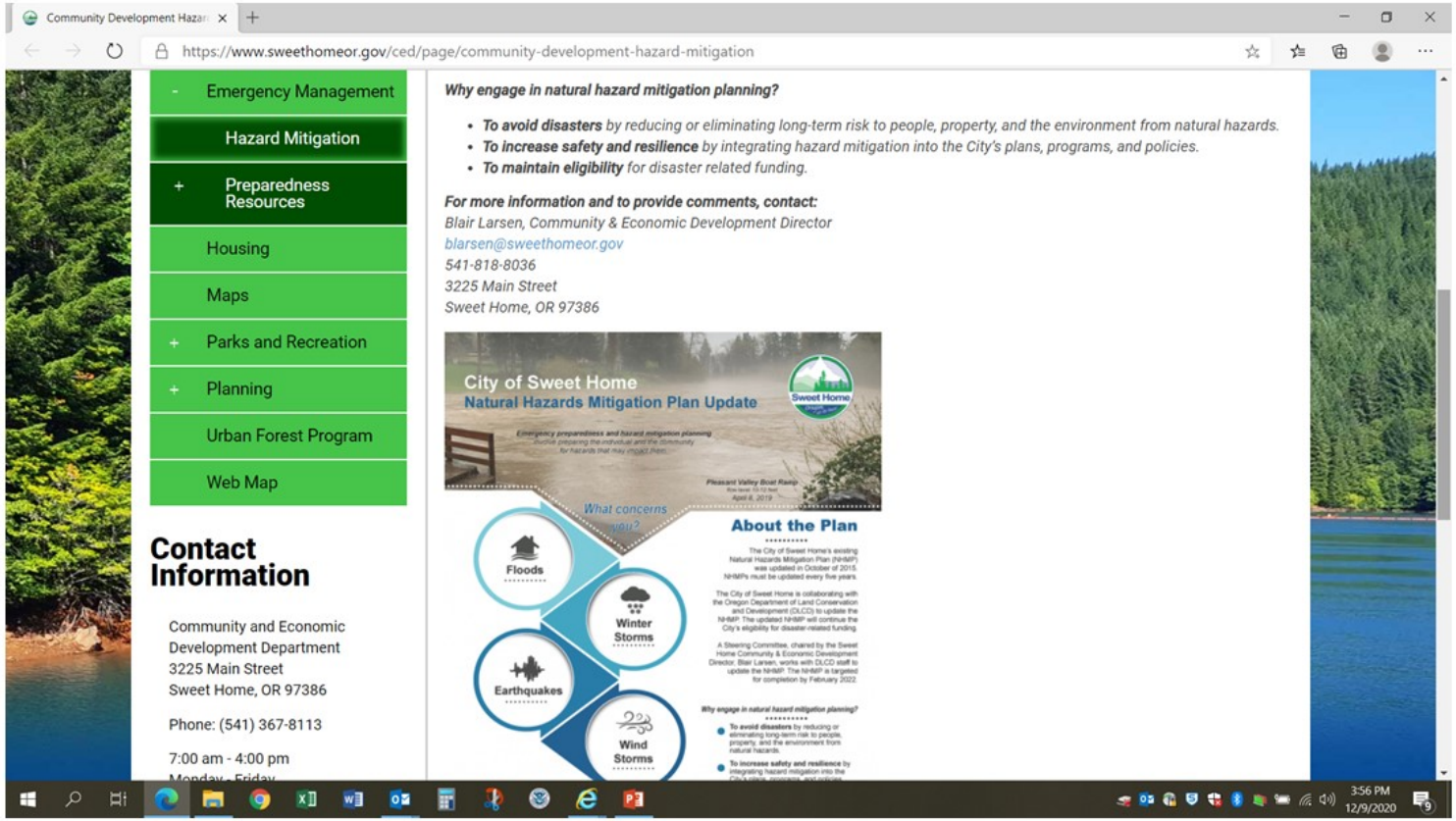
City of Sweet Home Website 12/9/20

https://www.sweethomeor.gov/ced/page/community-development-hazard-mitigation



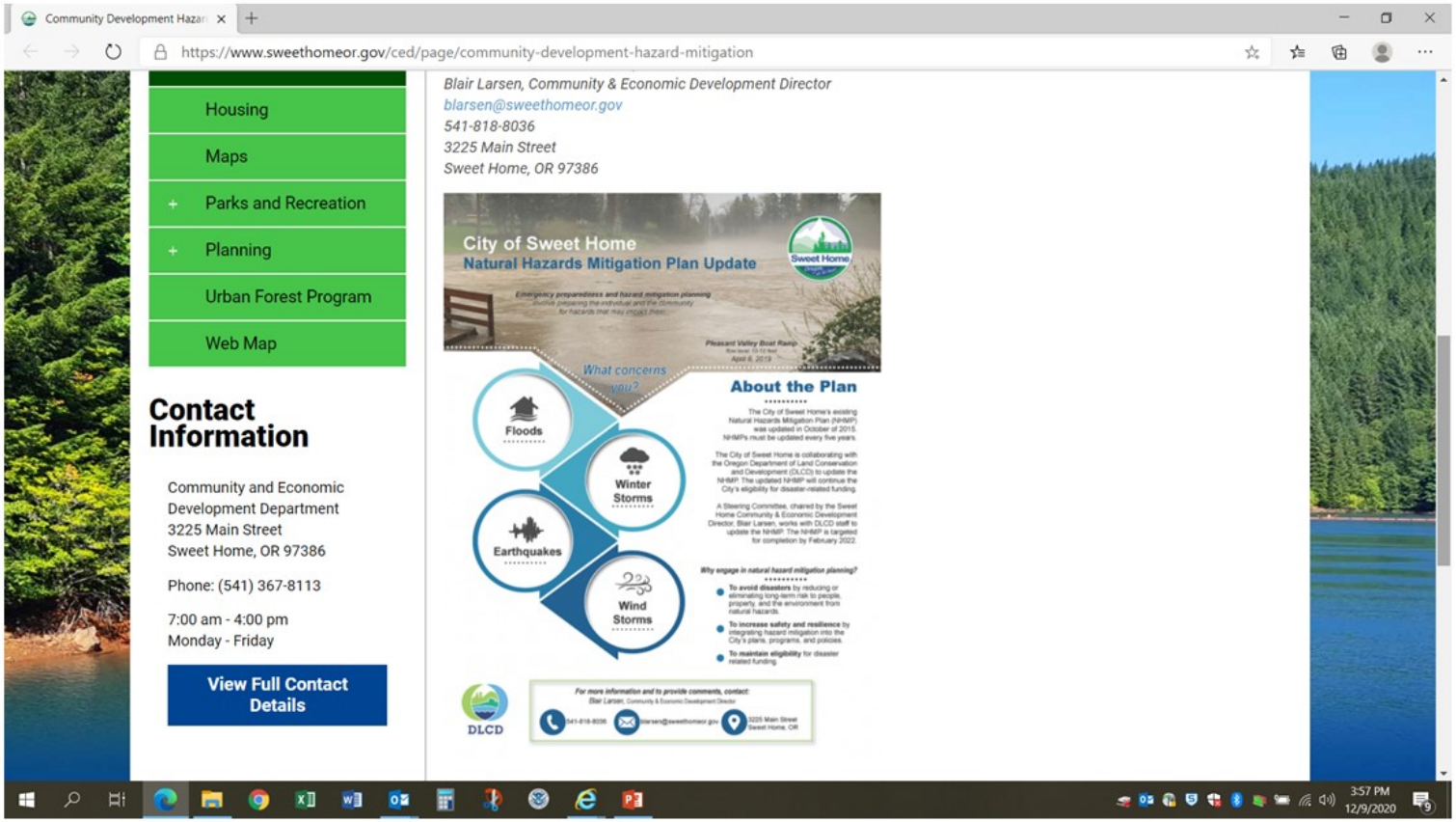
City of Sweet Home Website 12/9/20

https://www.sweethomeor.gov/ced/page/community-development-hazard-mitigation

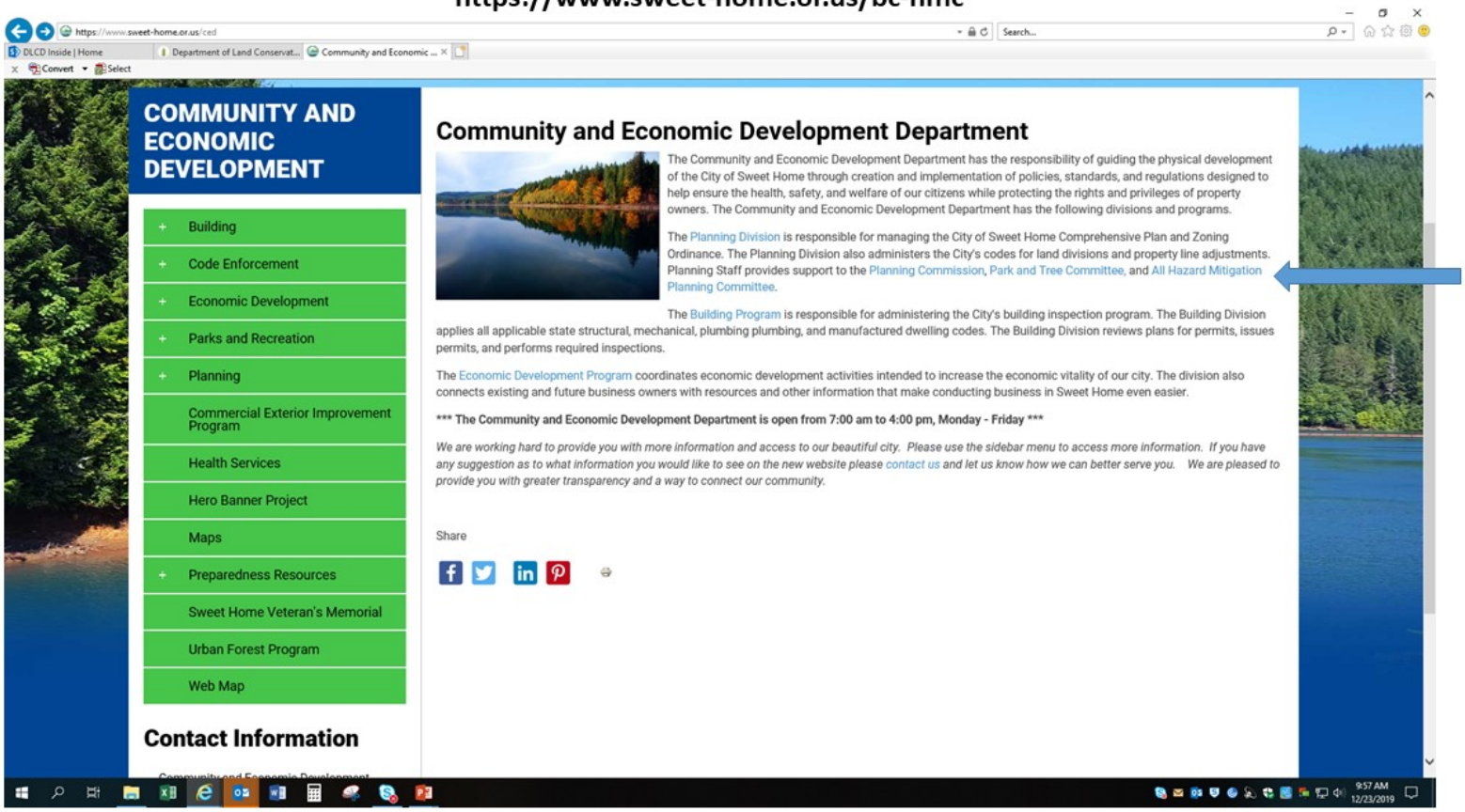


City of Sweet Home Website 12/9/20

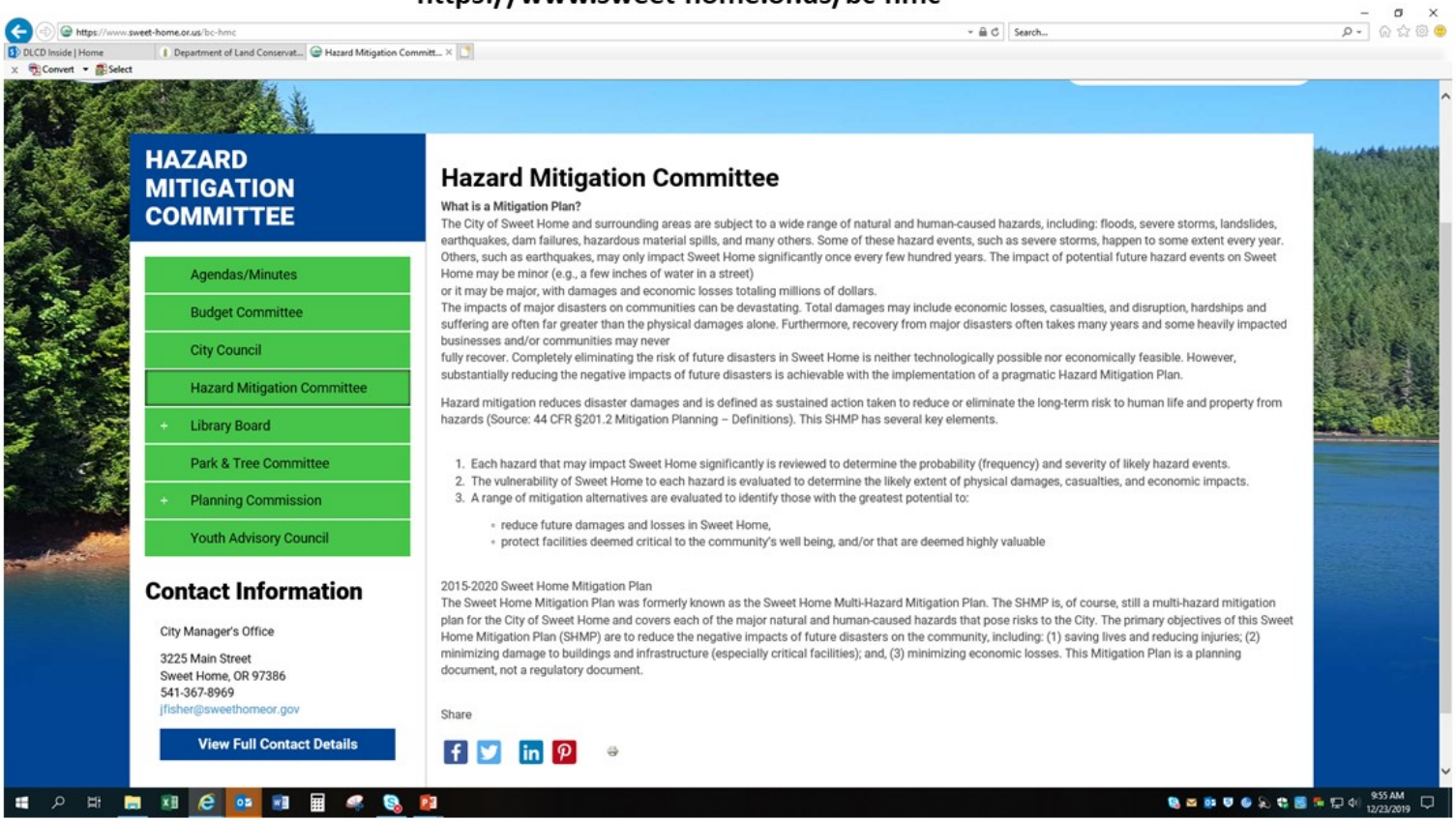
https://www.sweethomeor.gov/ced/page/community-development-hazard-mitigation



City of Sweet Home Website 12-23-19
https://www.sweet-home.or.us/bc-hmc

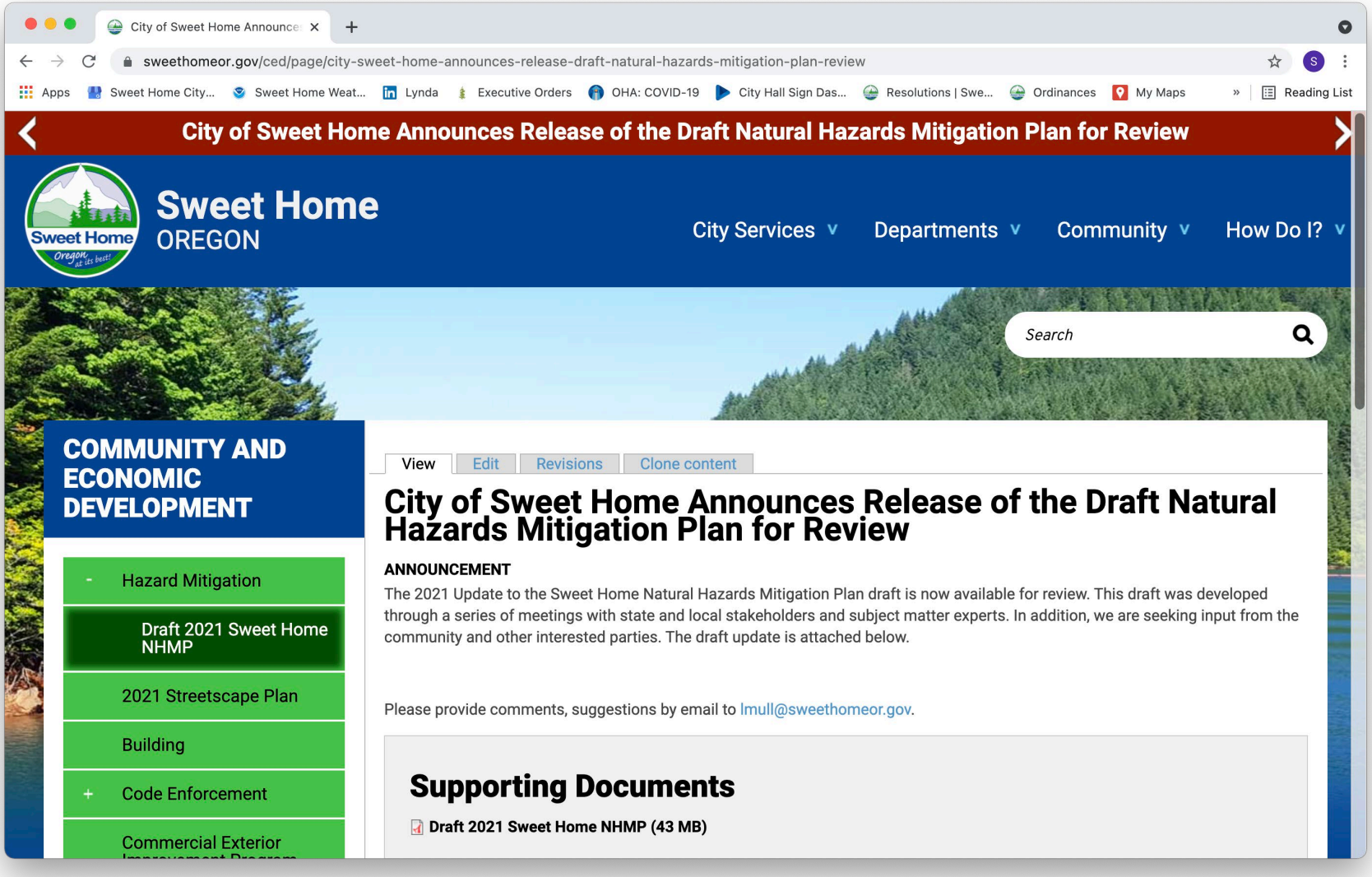


City of Sweet Home Website 12-23-19
https://www.sweet-home.or.us/bc-hmc



City of Sweet Home Website 9/2/21

[City of Sweet Home Announces Release of the Draft Natural Hazards Mitigation Plan for Review | Sweet Home Oregon]



City of Sweet Home Sign at City Hall 9/3/21

[City of Sweet Home Announces Release of the Draft Natural Hazards Mitigation Plan for Review | Sweet Home Oregon]

Source: Lagea Mull, Sweet Home, personal communication, 9/3/21

From: Lagea Mull
To: SEARS Tricia * DLCD
Subject: FW: [Communications: News & Information] City of Sweet Home Announces Release of the Draft Natural Hazards Mitigation Plan for Review
Date: Friday, September 3, 2021 10:25:43 AM
Attachments: image001.png
image002.png

This is the announcement I sent to 169 email subscribers & posted on the City of Sweet Home's Facebook page.

Lagea Mull
Communications Specialist/PIO
City of Sweet Home
3225 Main Street
Sweet Home, OR 97386
p: 541-818-8029

CONNECT WITH US

From: Sweet Home Oregon <sweethome-or@municodeweb.com>
Date: Friday, September 3, 2021 at 10:23 AM
To: Lagea Mull <lmull@sweethomeor.gov>
Subject: [Communications: News & Information] City of Sweet Home Announces Release of the Draft Natural Hazards Mitigation Plan for Review

City of Sweet Home Announces Release of the Draft Natural Hazards Mitigation Plan for Review

ANNOUNCEMENT

The 2021 Sweet Home Natural Hazards Mitigation Plan draft is now available for review. This draft was developed through a series of meetings with state and local stakeholders and subject matter experts. In addition, we are seeking input from the community and other interested parties. The draft update is attached below.

Participants in the Sweet Home NHMP Steering Committee: Blair Larsen, Brandon Neish, Joe Graybill,

Lagea Mull, Greg Springman, Jeff Lynn, Dave Barringer, Ray Towry, and Joe Larsen.

Draft 2021 Sweet Home NHMP Preparation: This draft NHMP has been prepared by Tricia Sears, Natural Hazards Planner, Oregon Department of Land Conservation and Development (DLCD) in collaboration with the Sweet Home NHMP Steering Committee. This is the first draft provided for review and comment.

This draft contains all parts of the *2021 Sweet Home NHMP.* The Table of Contents describes the contents of the NHMP. Of note, the Linn County Community Wildfire Protection Plan (CWPP) is not attached but will be attached for the submittal to OEM and FEMA. Also, please note several places in the NHMP contain missing or unfinished information. These are in the process of being addressed.

The draft NHMP is a work in progress. Comments received will be integrated.

Please provide your comments to me by **September 23, 2021**.

Comments, questions, and concerns on this draft should be sent to:

Tricia Sears
Natural Hazards Planner
Oregon Department of Land Conservation and Development
Tricia.sears@state.or.us

Supporting Documents

Draft 2021 Sweet Home NHMP (43 MB)

Unsubscribe

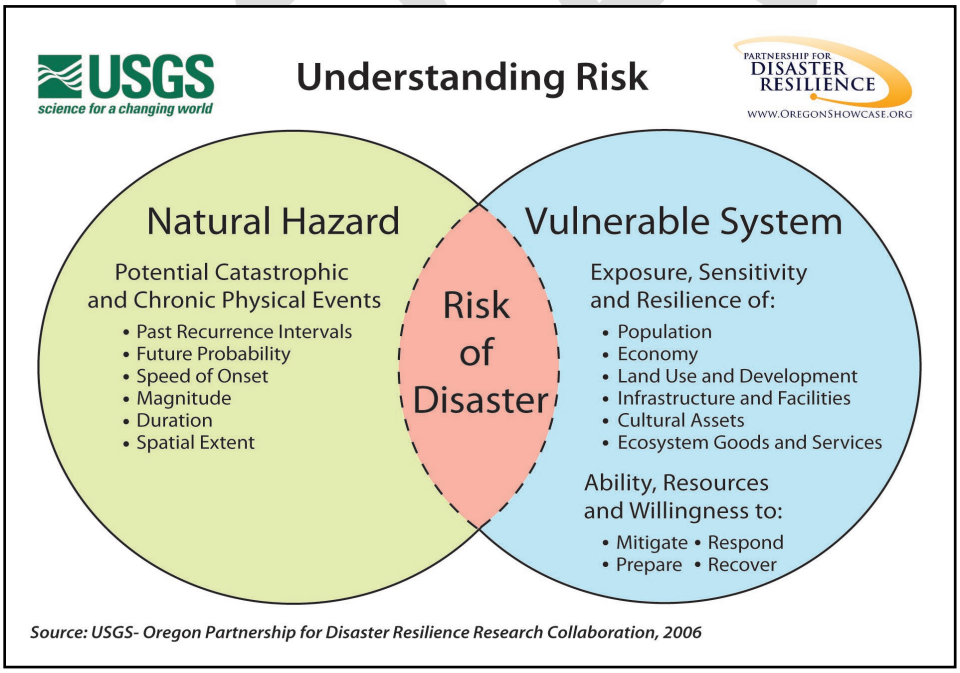
Appendix B:
Community Profile

Community resilience can be defined as the community's ability to manage risk and adapt to natural hazard impacts. It is the measure of the sustained ability of a community to use available resources to respond to, withstand, and recover from adverse situations.[1] The following capacities will be examined to help define and understand Sweet Home's resilience to natural hazards:

- Natural Environment
- Socio-Demographic Capacity
- Regional Economy
- Built (or Infrastructure)
- Community Connectivity
- Political Capital

The Community Profile provides a snapshot in time of the sensitivity and resilience factors in the county during the plan's most recent update. It assists in establishing mitigation actions and preparation for a more resilient community. The identification of mitigation actions that reduce sensitivity and exposure, and increase community resiliency, assists in reducing overall risk of disaster. See **Figure B-1**.

Figure B-1 Understanding Risk



Source: Oregon Partnership for Disaster Resilience

[1] Rand Corporation, *Community Resilience*, https://www.rand.org/topics/community-resilience.html

History and Present Day

This history and description of Sweet Home is directly excerpted from the City of Sweet Home's *FY2021-2022 Budget, Revised Version, 5/31/21*.

Settlers first arrived in the Sweet Home Valley in 1851. Early settlers shared the valley with the friendly Santiam band of the Kalapuyan tribe. The camas plant and antlered game were plentiful. The Native Americans occupied this part of Eastern Linn County until 1922 when Indian Lize, the last remaining member of the Kalapuyan tribe died.

This historic town began with two other names: the upper part of town was nicknamed Mossville, the lower part was called Buck Head. According to historians, Sweet Home was later named after the lovely green "Sweet Home Valley." The winding clear water of the South Santiam River finds its way through the edge of the city where high, tree covered mountains tower over the small community.

In 1893, Sweet Home became an incorporated city in Linn County, Oregon. A tollgate was built a few miles east of town, charging travelers wanting to cross over the Cascade Range. As recently as 1878, Sweet Home consisted of only four-square blocks, totaling 32 lots. Almost overnight, because of the demand of lumber created by the defense program of the 1940s, the "sleepy little village" was transformed into a pulsing boomtown with logging operations starting throughout the area. A second "shot in the arm" was given to the community in 1962 when construction work began on nearby Green Peter Dam and continued as construction began on the Foster Dam in 1966. Instead of Sweet Home being hidden away by itself, as it was for 80 years, it now became the gateway to recreation and industrial activities in eastern Linn County.

During the 1980s, Sweet Home experienced a major decline in population and industry as environmental issues forced the closure of sawmills and logging operations. During these tough times, the community banded together and rode through the changes, eventually turning the tide of recession into a wave of progression. Throughout the 1990s, using grant dollars provided by the Federal government, Sweet Home's downtown corridor was revitalized, small businesses were encouraged to come to Sweet Home, and assisted living facilities were built to accommodate a retiring community.

Today Sweet Home offers a unique and very livable location for families who prefer the small-town lifestyle. It provides the best of two worlds – far enough off the I-5 corridor to be a comfortable rural community, yet close enough for quick trips to metropolitan areas. Individuals from Sweet Home pride themselves on their self-sufficiency and community cooperation. Yet the residents from this beautiful area can drive less than sixty miles to access two major universities, two metropolitan areas with all of their cultural and shopping opportunities, the state capitol and endless recreational opportunities.

Sweet Home attracts visitors year-round to its undeveloped, hidden beauty. In winter, the snowcapped Cascade Mountains boast both downhill and cross-country skiing. There is excellent deer and elk hunting in the fall. During the spring and summer, water sport enthusiasts enjoy sailing and water skiing on Green Peter and Foster Lakes. Visitors enjoy fishing on Foster Lake and campers and hikers use the many available parks and campgrounds around the area.

A stop at the remarkable East Linn Museum is a must for all visitors. The building and surrounding grounds house generations of artifacts that depict the many phases of Sweet Home's rich heritage. Axes, mauls and cross-cut saws are surviving reminders of early logging methods.

The Weddle Covered Bridge, a community restoration project that adjoins historic Sankey Park, is not only a favorite location for weddings, anniversary parties, music and dances, but also the background for the annual Oregon Jamboree. The Northwest's premier three-day country music and camping festival, the Oregon Jamboree more than doubles the population of Sweet Home for three days in August with more than 25 shows and a whole lot of fun. [2]

Additional information about Sweet Home is provided from the City of Sweet Home's *FY2021-2022 Budget, Revised Version, 5/31/21*. This collection of current statistics paints a quick picture of the city and is useful for the discussion.

Table B-1 Sweet Home Community Statistics

Community Profile

Sweet Home has an estimated 9,340 residents. It is the third largest city in Linn County and the 66th largest in the state of Oregon. The City encompasses 6.5 square miles and is 537 feet above sea level. The largest employer in Sweet Home is the Sweet Home School District with over 300 full-time equivalent employees. The City of Sweet Home employs 66 people, including six City Councilors, one Mayor, one contracted Municipal Court Judge, and one contracted City Attorney.

Year founded	1851
Date of incorporation	February 10, 1893
Form of government	Council / Manager
Total Assessed Value/Real Market Value of property	$516,452,718.00 / $820,690,733

2020 Community Statistics

Community & Economic Development:	
Building inspections	1,521
Building valuations	$15,074,659
Code compliance cases cleared	352
Commercial Exterior Improvement Program grants funded	7
Planning actions	44
Sankey Park phase two project hours	1,054
Police Protections:	
Calls for service	8,272
Communications dispatchers	5
Sworn police officers	15
Traffic stops	1,056

[2] City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, City Profile | FY22 Approved Budget (cleargov.com), accessed 8/19/21

Library:	
Materials circulated	26,598
Programs hosted	20
Registered library patrons	2,141
Resource sharing savings (thru regional collaboration)	8,207
Streets:	
Leaves collected	1,130 cubic yards
Miles of city streets	44
Miles of state highways	5.6
Street sweeping miles	2,086
Potholes fixed	670
Sewage Collection:	
Miles of sanitary sewer	49.4
Water Distribution:	
Miles of water lines	54
Number of residential and commercial hookups	3,400
Water leaks fixed	120
Parks:	
Number of city parks	5
Size of park lands	336 acres
Number of time parks mowed	117
Parks bathroom and garbage services	597 visits

Source: City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

Natural Environment Capacity

Natural environment capacity is the geography, climate, and land cover of the area such as, urban, water and forested lands that maintain clean water, air, and a stable climate.[3] Natural resources such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from natural hazards such as flooding and landslides. However, natural systems are often impacted or depleted by human activities adversely affecting community resilience.

Geography

Sweet Home is located in Linn County, Oregon on the south side of the South Santiam River, at the southeastern edge of the Willamette Valley, in the foothills of the Cascade Mountain range. Figure EX-2 is the Vicinity Map which shows the location of Sweet Home within Oregon. Most of Sweet Home lies at elevations between 500 and 600 feet above sea level, with higher elevations in the hills at the southern edge of Sweet Home.

According to the United States Census Bureau, the city has a total area of 5.75 square miles (14.89 km^2), of which 5.30 square miles (13.73 km^2) is land and 0.45 square miles (1.17 km^2) is water. The intersection Oregon Route 228 and U.S. Route 20 occurs at the western end of Sweet Home. Sweet Home is built on a prehistoric petrified forest. In addition to fossil wood, the area includes a variety of agate, jasper, crystals and minerals.[4]

[3] Mayunga, J. 2007, *Understanding and Applying the Concept of Community Disaster Resilience: A capital-based approach. Summer Academy for Social Vulnerability and Resilience Building*. https://www.u-cursos.cl/usuario/3b514b53bcb4025aaf9a6781047e4a66/mi_blog/r/11._Joseph_S._Mayunga.pdf

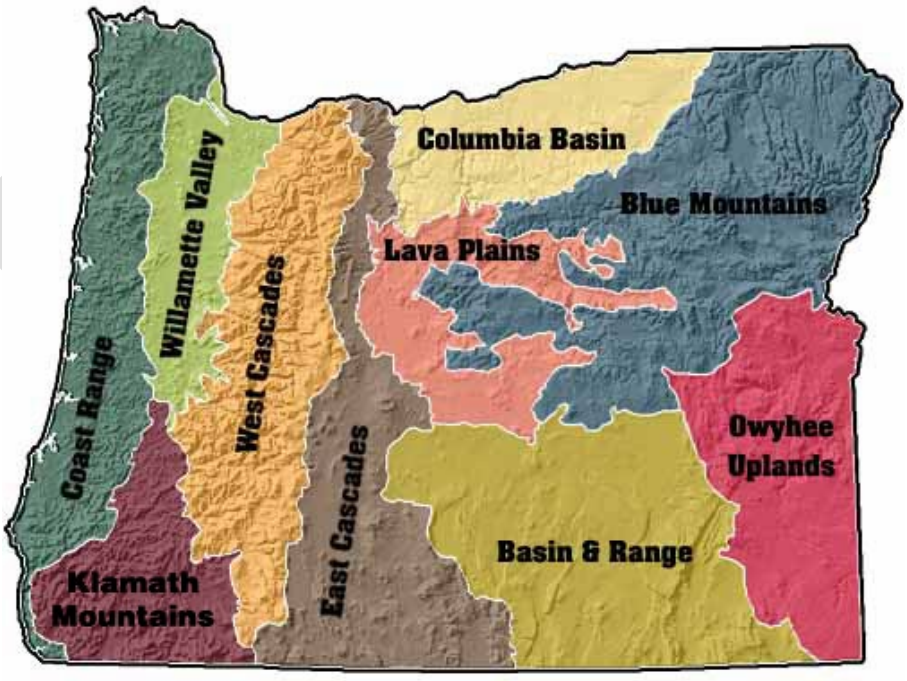
[4] Wikipedia, Sweet Home, Oregon, Sweet Home, Oregon - Wikipedia, accessed 8/19/21

In addition to the South Santiam River, there are several creeks running through Sweet Home, including Ames Creek, Taylor Creek, and Wiley Creek, and several smaller creeks. There are two large dams and reservoirs on the South Santiam River upstream from Sweet Home, the Foster and Green Peter Dams.[5] As described in the Flood Annex, the dams are owned and operated by the U.S. Army Corps of Engineers. Figure FL-3 is the Map of Major Drainage Basins, Lakes, Streams, and Rivers in Oregon and shows the ones in Linn County. Figures FL-8 and FL-9 are maps with topographic information showing the location of Sweet Home, Foster and Greenpeter Dams, and water bodies and waterways.

Physical Geography and Ecoregions

Figure B-2 is a map that shows the physiographic provinces of Oregon. Physiographic is the physical geography. What does the land look like here? Land is often described in terms of ecoregions. Ecoregions are areas where ecosystems (and the type, quality, and quantity of environmental resources) are generally similar.[6] "Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources; they are designed to serve as a spatial framework for the research, assessment management, and monitoring of ecosystem components. By recognizing the spatial differences in the capacities and potentials of ecosystems, ecoregions stratify the environment by its probable response to disturbance."[7]

Figure B-2 Physiographic Provinces of Oregon



Source: Physiographic Provinces, Oregon Habitat Joint Venture, http://www.ohjv.org/projects.html

[5] *2015 Sweet Home NHMP*

[6] Environmental Protection Agency, Ecoregions, Ecoregions | US EPA

[7] Environmental Protection Agency, *Ecoregions of Oregon*, ftp://ftp.epa.gov/wed/ecoregions/or/or_front.pdf.

Current and Projected Weather and Climate

Weather is how the atmosphere is behaving and its effects upon life and human activities. Weather can change from minute-to-minute. Most people think of weather in terms of temperature, humidity, precipitation, cloudiness, brightness, visibility, wind, and atmospheric pressure. Climate is the description of the long-term pattern of weather in a place. Climate can mean the average weather for a particular region and a time period of 30 years. Climate is the average of weather over time.[8]

The weather and climate of Sweet Home and Linn County was discussed in the Severe Storms Hazard Annex. Linn County is in Climate Divisions 2 and 4 as seen in Figure SS-1. Sweet Home is in Climate Division 2. Additional information is provided here.

Localized climate projections for the regions within Oregon must be developed; these localized assessments are essential for both the public and private sectors to respond to climate change.[9]

In the *2020 Oregon NHMP*, the U.S. EPA's ecoregions are used to describe areas of ecosystem similarity. Within the *2020 Oregon NHMP*, Oregon's Natural Hazard Regions are identified as 1 through 8. We refer to the *2020 Oregon NHMP* for climate change information about the Mid/Southern Willamette Valley Region (Region 3). Region 3 includes Linn, Lane (non-coastal), Marion, Polk, and Yamhill Counties. The hazards faced by Region 3 that are projected to be influenced by climate change include drought, wildfire, flooding, landslides, and extreme heat. The *Fourth Oregon Climate Assessment Report: State of Climate Science: 2019* provides a comprehensive assessment of the state of climate change as it pertains to Oregon. It covers the physical, biological, and social dimensions. In summary, it notes the following assessments:

- Oregon is already experiencing statewide impacts of a changing climate.
- Oregon continues to warm in all seasons, in part due to human activity.
- Warming is projected to continue in all seasons, dependent on global activity.
- Changes in rainfall will accentuate extremes.
- Sea level rise projections have not changed substantially through mid-century, though estimates of the maximum plausible sea level by the end of the century (2100) have increased to 8.2 feet.
- Hot days will become more frequent in Oregon in a changing climate.
- Nearly every location in Oregon has seen a decline in spring snowpack, and it will continue to significantly decline through mid-century, especially at lower elevations.
- Fire activity is strongly linked to summer climate, with the largest fires occurring exclusively in warm and dry summers.
- Climate change may also present a potential opportunity to adapt to a rapidly changing Oregon.[10]

Volume II: Hazard Annexes contains hazard-specific information. The Introduction to Volume II briefly includes climate information and describes the HVA; the full description of the HVA is in the Risk Assessment in Volume I Section 2. Climate data such as precipitation and temperature is

[8] Best Places, *Climate in Sweet Home, OR*, Sweet Home, Oregon Climate (bestplaces.net)

[9] The Governor's Climate Change Integration Group, *A Framework for Addressing Rapid Climate Change*, 2008, http://www.oregon.gov/ENERGY/gblwrm/docs/ccigreport08web.pdf, p 8.

[10] OCCRI, *Fourth Oregon Climate Assessment Report: State of Climate Science: 2019, http://www.occri.net/publications-and-reports/fourth-oregon-climate-assessment-report-2019/*.

presented below and provides a framework for understanding the weather and climate in Sweet Home and Linn County.

Precipitation, Rainfall, and Snowfall

As a summary and a comparison with the rest of the U.S., here are some statistics. Sweet Home, Oregon gets 51 inches of rain, on average, per year. The U.S. average is 38 inches of rain per year. Sweet Home averages 2 inches of snow per year. The U.S. average is 28 inches of snow per year. On average, there are 154 sunny days per year in Sweet Home. The U.S. average is 205 sunny days. Sweet Home gets a form of precipitation, on average, 165 days per year. Precipitation is rain, snow, sleet, or hail that falls to the ground. For precipitation to be counted there must be at least .01 inches on the ground to measure.

Summer High: The July high is around 82 degrees.
Winter Low: The January low is 34.
Rain: The average is 51 inches of rain a year.
Snow: The average is 2 inches of snow a year.

November is the wettest month in Sweet Home with 7.9 inches of rain, and the driest month is July with 0.7 inches. The wettest season is Spring with 40% of yearly precipitation and 8% occurs in Autumn, which is the driest season. The annual rainfall of 50.7 inches in Sweet Home means that it is wetter than most places in Oregon.[11]

December is the rainiest month in Sweet Home with 20.3 days of rain, and August is the driest month with only 3.6 rainy days. There are 164.7 rainy days annually in Sweet Home, which is rainier than most places in Oregon. The rainiest season is Spring when it rains 35% of the time and the driest is Autumn with only a 10% chance of a rainy day.[12]

An annual snowfall of 2.0 inches in Sweet Home means that it is less snowy than most places in Oregon. December is the snowiest month in Sweet Home with 0.7 inches of snow, and 2 months of the year have significant snowfall.[13]

Temperature

August is the hottest month for Sweet Home with an average high temperature of 82.7°, which ranks it as about average compared to other places in Oregon. In Sweet Home, there are 4 comfortable months with high temperatures in the range of 70-85°. The most pleasant months of the year for Sweet Home are September, July, and June.[14]

January has the coldest nighttime temperatures for Sweet Home with an average of 33.5°. This is about average compared to other places in Oregon. In Sweet Home, there are 15.0 days annually when the high temperature is over 90°, which is about average compared to other places in Oregon. In Sweet Home, there are 52.5 days annually when the nighttime low temperature falls below freezing, which is about average compared to other places in Oregon. In Sweet Home, there are 0.0

[11] Best Places, *Climate in Sweet Home, OR*, Sweet Home, Oregon Climate (bestplaces.net)

[12] Best Places, *Climate in Sweet Home, OR*, Sweet Home, Oregon Climate (bestplaces.net)

[13] Best Places, *Climate in Sweet Home, OR*, Sweet Home, Oregon Climate (bestplaces.net)

[14] Best Places, *Climate in Sweet Home, OR*, Sweet Home, Oregon Climate (bestplaces.net)

days annually when the nighttime low temperature falls below zero°, which is about average compared to other places in Oregon.[15]

Clouds and Sun

In Sweet Home, the average percentage of the sky covered by clouds experiences extreme seasonal variation over the course of the year. The clearer part of the year in Sweet Home begins around June 13 and lasts for 3.8 months, ending around October 8. On August 3, the clearest day of the year, the sky is clear, mostly clear, or partly cloudy 82% of the time, and overcast or mostly cloudy 18% of the time. The cloudier part of the year begins around October 8 and lasts for 8.2 months, ending around June 13. On November 30, the cloudiest day of the year, the sky is overcast or mostly cloudy 77% of the time, and clear, mostly clear, or partly cloudy 23%of the time.[16]

The length of the day in Sweet Home varies significantly over the course of the year. In 2021, the shortest day is December 21, with 8 hours, 50 minutes of daylight; the longest day is June 20, with 15 hours, 32 minutes of daylight. The earliest sunrise is at 5:25 AM on June 14, and the latest sunrise is 2 hours, 30 minutes later at 7:55 AM on November 6. The earliest sunset is at 4:31 PM on December 9, and the latest sunset is 4 hours, 28 minutes later at 8:59 PM on June 26. Daylight saving time (DST) is observed in Sweet Home during 2021, starting in the spring on March 14, lasting 7.8 months, and ending in the fall on November 7.[17]

Wind

This section discusses the wide-area hourly average wind vector (speed and direction) at 10 meters above the ground. The wind experienced at any given location is highly dependent on local topography and other factors, and instantaneous wind speed and direction vary more widely than hourly averages.

The average hourly wind speed in Sweet Home experiences mild seasonal variation over the course of the year. The windier part of the year lasts for 4.9 months, from November 1 to March 29, with average wind speeds of more than 4.5 miles per hour. The windiest day of the year is December 3, with an average hourly wind speed of 5.3 miles per hour. The calmer time of year lasts for 7.1 months, from March 29 to November 1. The calmest day of the year is August 1, with an average hourly wind speed of 3.8 miles per hour.[18]

The predominant average hourly wind direction in Sweet Home varies throughout the year. The wind is most often from the west for 2.7 months, from April 7 to June 27 and for 5.0 days, from September 4 to September 9, with a peak percentage of 45% on May 28. The wind is most often from the north for 2.2 months, from June 27 to September 4 and for 3.1 weeks, from September 9

[15] Best Places, *Climate in Sweet Home, OR*, Sweet Home, Oregon Climate (bestplaces.net)

[16] Weather Spark, *Average Weather in Sweet Home, OR*, Average Weather in Sweet Home, Oregon, United States, Year Round - Weather Spark

[17] Ibid.

[18] Ibid.

to October 1, with a peak percentage of 49% on July 21. The wind is most often from the south for 6.2 months, from October 1 to April 7, with a peak percentage of 50% on January 1.[19]

Hazard Severity

Typically, as part of the grant funds for a NHMP update, the Department of Land Conservation and Development (DLCD) contracts with the Oregon Climate Change Research Institute (OCCRI) to provide an analysis of climate change influences on natural hazards. The collaboration results in products which provide information regarding the influence and impacts of climate change on existing natural hazards events such as but not limited to heavy rains, river flooding, droughts, heat waves, cold waves, wildfire, and air quality. Unfortunately, for this NHMP, DLCD was not able to do that. Therefore, the typical products produced: a Future Climate Projections Report; a Climate Change Two-Pager; and a Future Climate Change Projections Change presentation are not available.

We refer to the *2020 Oregon NHMP* for climate change information about the Mid/Southern Willamette Valley Region (Region 3). Region 3 includes Linn, Lane (non-coastal), Marion, Polk, and Yamhill Counties. The following is excerpted from the *2020 Oregon NHMP*.

> The hazards faced by Region 3 that are projected to be influenced by climate change include drought, wildfire, flooding, landslides, and extreme heat.
>
> Climate models project warmer, drier summers for Oregon. Coupled with projected decreases in mountain snowpack due to warmer winter temperatures, Region 3 is expected to be affected by an increased incidence of drought and wildfire. In Region 3, climate change would result in increased frequency of drought due to low spring snowpack (very likely, >90%), low summer runoff (likely, >66%), and low summer precipitation and low summer soil moisture (more likely than not, >50%). It is very likely (>90%) that Region 3 will experience increasing wildfire frequency and intensity due to warmer, drier summers coupled with warmer winters that facilitate greater cold-season growth.
>
> It is extremely likely (>95%) that the frequency and severity of extreme heat events will increase over the next several decades across Oregon due to human-induced climate warming (very high confidence).
>
> Furthermore, flooding and landslides are projected to occur more frequently throughout western Oregon. It is very likely (>90%) that Oregon will experience an increase in the frequency of extreme precipitation events and extreme river flows (high confidence) that is more likely than not (>50%) to lead to an increase in the incidence and magnitude of damaging floods (low confidence). Because landslide risk depends on a variety of site-specific factors, it is more likely than not (>50%) that climate change, through increasing frequency of extreme precipitation events, will result in increased frequency of landslides.
>
> While winter storms and windstorms affect Region 3, there is little research on how climate change influences these hazards in the Pacific Northwest. For more information on climate

[19] Weather Spark, *Average Weather in Sweet Home, OR*, Average Weather in Sweet Home, Oregon, United States, Year Round - Weather Spark

drivers and the projected impacts of climate change in Oregon, see Section 2.2.1.2, Introduction to Climate Change.[20]

Synthesis

The physical geography, weather, climate, and land cover of an area are interrelated systems that affect overall risk and exposure to natural hazards. Climate change variability also has the potential to increase the effects of hazards. These factors combined with a growing population and development intensification can lead to increasing risk of hazards, threatening loss of life, property and long-term economic disruption if land management is inadequate. Climate change is further discussed as part of the Risk Assessment in Volume I Section2, and throughout Volume 2 in the Introduction and the Hazard Annexes.

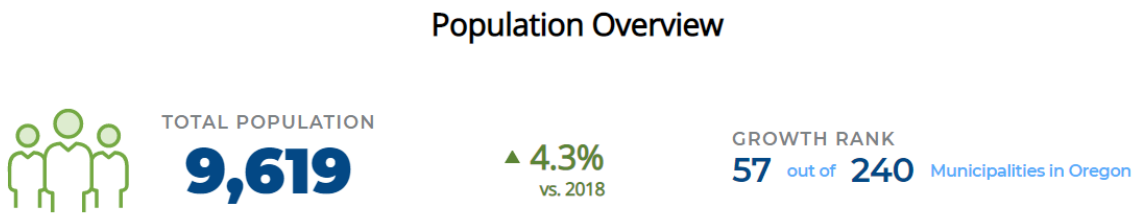
Socio Demographic Capacity

Socio demographic capacity characterizes the community population in terms of language, race and ethnicity, age, income, educational attainment, and health. These attributes can significantly influence the community's ability to cope, adapt to, and recover from natural disasters. In addition to those described, the current status of other socio demographic capacity indicators such as graduation rate, quality of schools, median household income can have long term impacts on the Sweet Home economy and stability of the community ultimately affecting future resilience. These factors that are vulnerabilities can be reduced with outreach and mitigation planning.

Population

Sweet Home's total population as of 2021 was 9,619 residents. That is up 4.3% since 2018. The growth rank for Sweet Home is 57 out of 240 cities in Oregon. [21] **Figure B-3** illustrates an overview of the population in Sweet Home and **Figure B-4** illustrates the number of people living in Sweet Home from 1990 to 2019.

Figure B-3 Population Overview

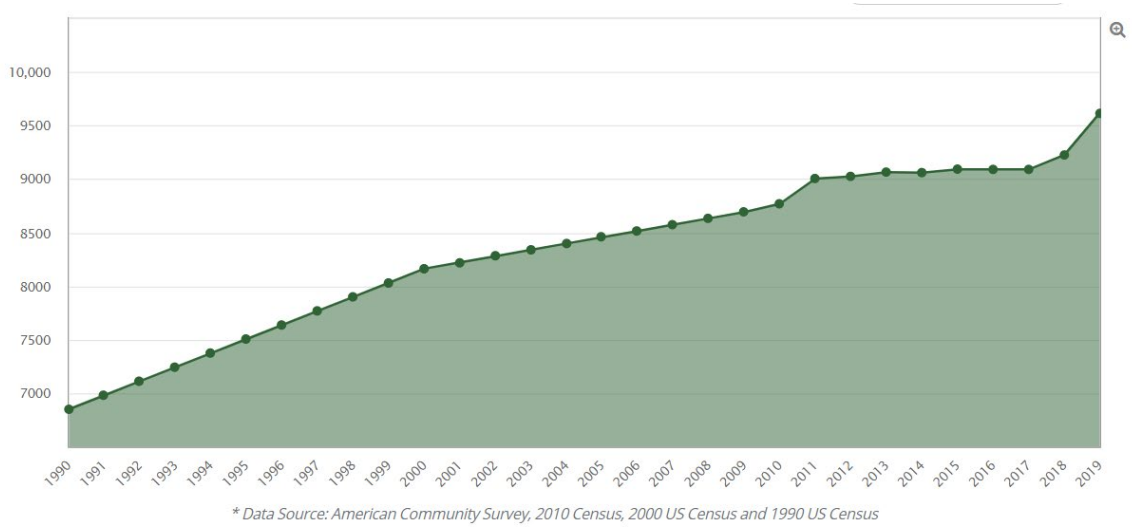


Source: City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

[20] *2020 Oregon NHMP,* Region 3: Mid/Southern Willamette Valley Region, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

[21]City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

Figure B-4 Population of Sweet Home



Source: City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

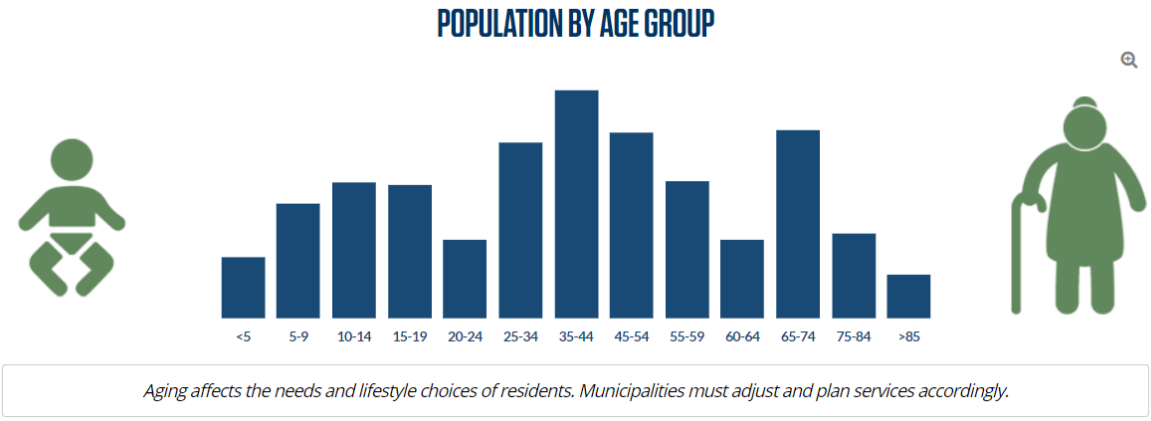
As shown above, Sweet Home's total population has grown steadily since 1990. Identifying the daytime population of the city is also important, especially in planning and emergency management efforts to mitigate hazards impacts on people, property, and the environment.

Figure B-4 Daytime Population in Sweet Home

Source: City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

The population by age is shown in the graphic in Figure B-5. The population in Sweet Home will likely continue to grow, based on the data described here, provided by the City of Sweet Home.

Figure B-5 Population By Age in Sweet Home



Source: City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

The age profile of an area has a direct impact on what actions are prioritized for mitigation and how response to hazards is carried out. School age children rarely make decisions about emergency management. Therefore, a larger youth population increases the importance of outreach to schools and parents on effective ways to teach children about fire safety, flood response, and evacuation plans. Children are more vulnerable to the heat and cold, have few transportation options, and require assistance to access medical facilities.[22] Older populations may have special needs prior to, during, and after a natural disaster. For example, they may require assistance in evacuation due to limited mobility or health issues. They may require special medical equipment or medication. They may lack the social and economic resources needed for post-disaster recovery.[23]

The most significant indicator that influences socio-demographic capacity in may be the age dependency ratio of the population. The dependency ratio is a generalized analytical tool that evaluates the population under the age of 15 and over the age of 64. The dependency ratio is derived by dividing the combined under 15 and 65-and-over populations by the 15-to-64 population and multiplying by 100. The dependency ratio indicates a higher percentage of dependent aged people to that of working age. The U.S. Census Bureau provides that information in searchable database at a county level but not at a city level.

Language

Special consideration should be given to populations who do not speak English as their primary language. Language barriers can be a challenge when disseminating hazard planning and mitigation resources to the general public, and it is less likely they will be prepared if special attention is not given to language and culturally appropriate outreach techniques.[24] The percentage of persons age

[22] DLCD, *2015 Oregon Natural Hazards Mitigation Plan*, Region 6 Central Oregon Regional Profile, https://www.oregon.gov/lcd/NH/Documents/Approved_2015ORNHMP_12_RA6.pdf (applicable to many regions)

[23] Wood, Nathan, *Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon*, U.S. Geological Survey, Reston, VA, 2007.

[24] DLCD, *2020 Oregon Natural Hazards Mitigation Plan*, Region 5 Risk Assessment, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_11_RA5.pdf

5 or more who speak a language other than English at home in Linn County, OR is 7.9% during the 2015-2019 timeframe.[25]

Race

The impact in terms of loss and the ability to recover may also vary among minority population groups following a disaster. Studies have shown that racial and ethnic minorities can be more vulnerable to natural disaster events. This is not reflective of individual characteristics; instead, historic patterns of inequality along racial or ethnic divides have often resulted in minority communities that are more likely to have inferior building stock, degraded infrastructure, or less access to public services. **Table B-2** describes Linn County's population by race and ethnicity.

Table B-2 Race and Ethnicity in Linn County, OR

Race and Hispanic Origin	
White alone, percent	92.5%
Black or African American alone, percent (a)	0.8%
American Indian and Alaska Native alone, percent (a)	1.7%
Asian alone, percent (a)	1.3%
Native Hawaiian and Other Pacific Islander alone, percent (a)	0.2%
Two or More Races, percent	3.6%
Hispanic or Latino, percent (b)	9.5%
White alone, not Hispanic or Latino, percent	84.3%

Source: U.S. Census Bureau, Linn County, OR, https://data.census.gov/cedsci/profile?g=0500000US41059, accessed 11/12/21

It will be important to identify specific ways to support the community, especially Hispanics and Latinos, through hazard preparedness and response.

Income

Household income and poverty status are indicators of socio demographic capacity and the stability of the local economy. Household income can be used to compare economic areas as a whole; however, it does not reflect how the income is divided among the area residents.[26]

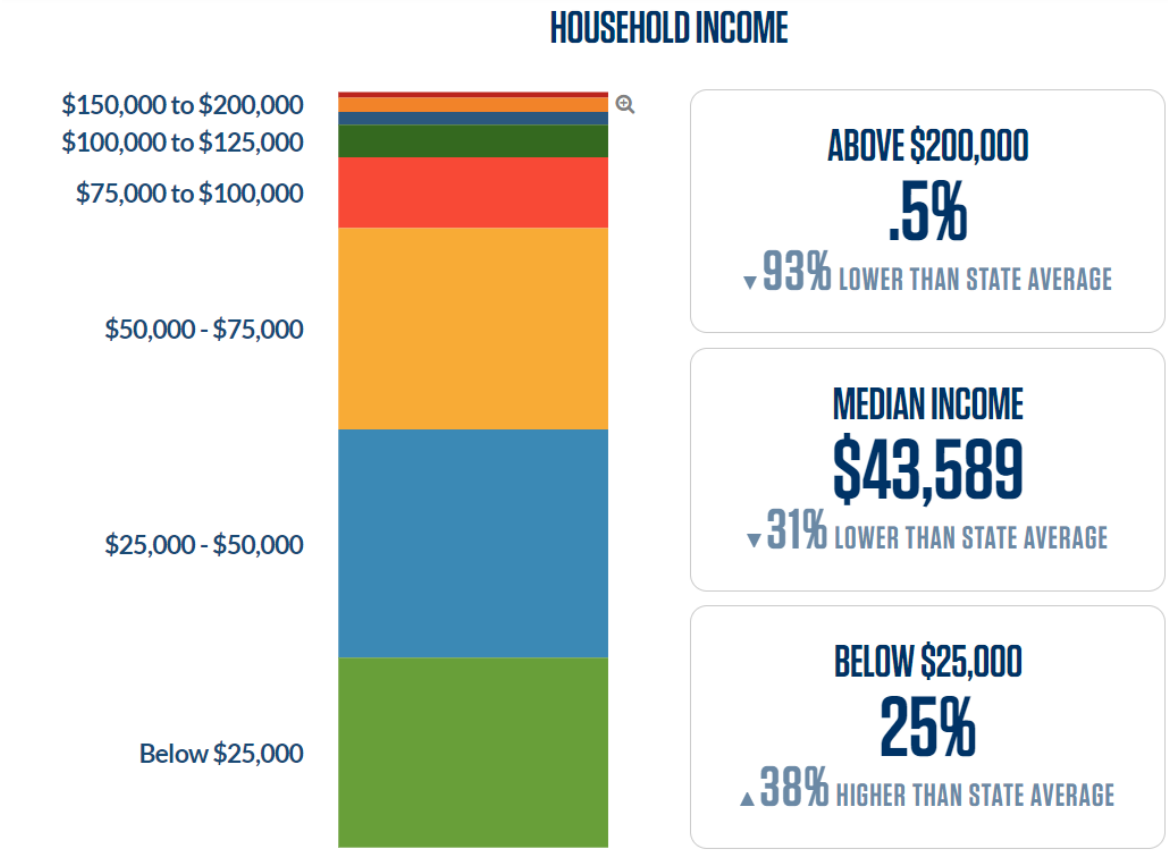
The median household income in Sweet Home is $43,589. This amount is about 31 percent lower than the average state median household income for Oregon. See **Figure B-6**. [27]

[25] U.S. Census Bureau, Linn County, OR, https://data.census.gov/cedsci/profile?g=0500000US41059, accessed 11/12/21

[26] *2020 Oregon NHMP,* Region 3: Mid/Southern Willamette Valley Region, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

[27] Source: City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

Figure B-6 Household Income in Sweet Home, OR



Source: City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

In Oregon, rural counties tend to have a lower per capita personal income (PCPI) than urban counties. The per capita income is the total personal income in an area divided by the population. Wages and salaries are typically the largest source of personal income. Area with large youth populations or large retirement populations have lower per capita income because a larger share of their population isn't working and earning income.[28]

[28] Source: Oregon Employment Department, *The Employment Landscape of Rural Oregon*, May 2017, https://www.qualityinfo.org/documents/10182/13336/The+Employment+Landscape+of+Rural+Oregon?version=1.0

Table B-3 Per Capita Personal Income in Metro and Non-Metro Areas in Oregon and the U.S. 2015

Per Capita Personal Income in Metro and Nonmetro Areas in Oregon and the U.S., 2015

	Total	Metro	Nonmetro
Per capita personal income			
United States	$48,112	$49,827	$37,866
Oregon	$43,783	$45,040	$37,332
Per capita net earnings			
United States	$30,729	$32,260	$21,584
Oregon	$26,467	$27,911	$19,058
Per capita transfer receipts			
United States	$8,334	$8,118	$9,624
Oregon	$8,861	$8,406	$11,196
Per capita dividends, interest, and rent			
United States	$9,049	$9,449	$6,658
Oregon	$8,455	$8,723	$7,078

Source: U.S. Bureau of Economic Analysis

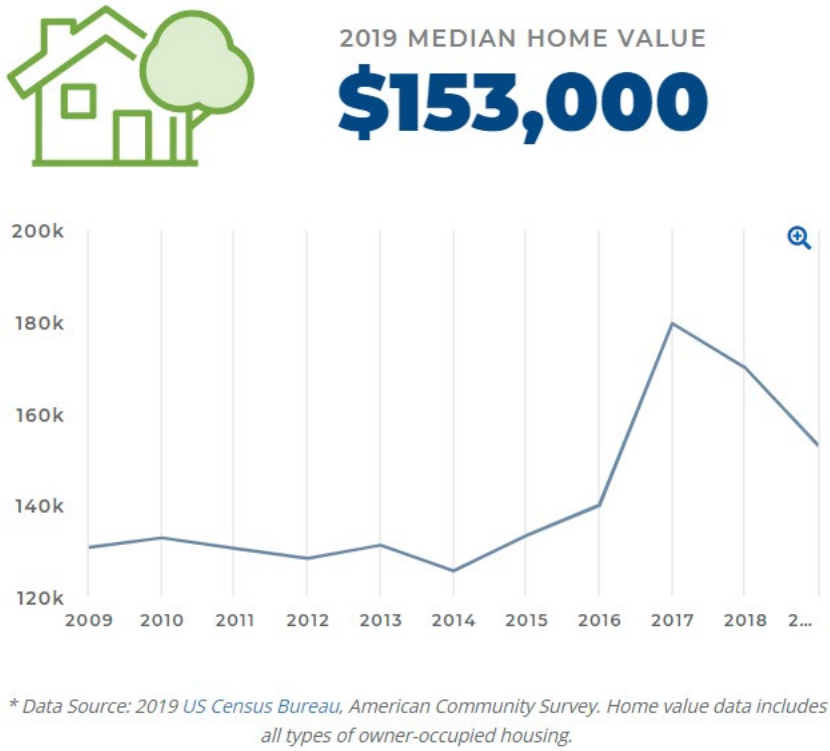
Source: Oregon Employment Department, *The Employment Landscape of Rural Oregon*, May 2017, https://www.qualityinfo.org/documents/10182/13336/The+Employment+Landscape+of+Rural+Oregon?version=1.0

Income is a resiliency indicator, as higher incomes are often associated with increased self-reliance, and ability to prepare oneself if an emergency does occur. The higher the poverty rate, the more assistance the community will likely need in the event of a disaster in the form of sheltering, medical assistance, and transportation. Higher income populations often have less mobility following significant hazard events because their assets may be rooted in the local community and lower income members of the population may find it easier to relocate.

Housing

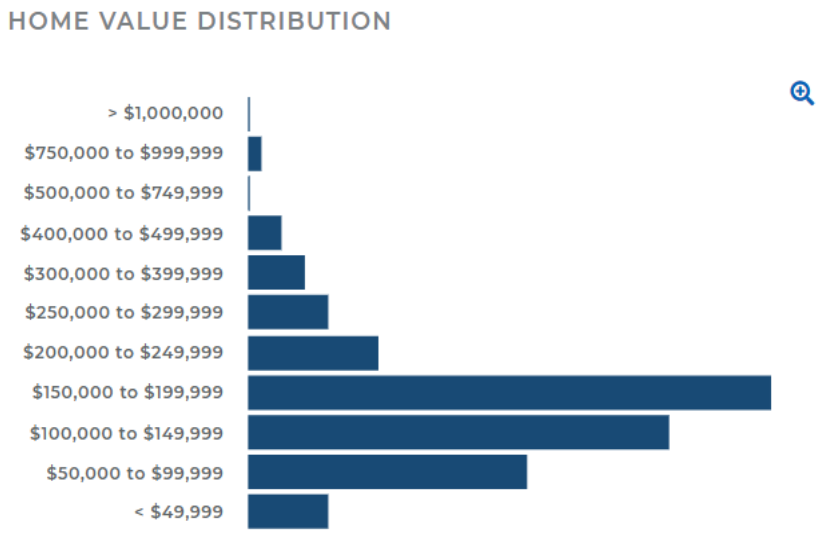
These next two graphics about housing are again from the City of Sweet Home and are quite useful in illustrating the housing information. Of note, 62% of the population owns a home while 38% rent in Sweet Home. This matches the homeownership and renters percentages in Oregon overall, according to the *City of Sweet Home FY 2021-2022 Budget, Revised Version*, 5/31/21.

Figure B-7 The 2019 Median Home Value in Sweet Home, OR



Source: City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

Figure B-8 The 2019 Home Value Distribution in Sweet Home, OR



Source: City of Sweet Home, *FY2021-2022 Budget, Revised Version, 5/31/21*, Demographics | FY22 Approved Budget (cleargov.com)

Education

Educational attainment of community residents is also identified as an influencing factor in socio demographic capacity. Educational attainment often reflects higher income and therefore higher self-reliance. Widespread educational attainment is also beneficial for the regional economy and employment sectors as there are potential employees for professional, service, and manual labor workforces. An oversaturation of either highly educated residents or low educational attainment can have negative effects on the resilience of the community.

Table B-4 Educational Attainment in Linn County, OR

Education	
High school graduate or higher, percent of persons age 25 years+, 2015-2019	89.5%
Bachelor's degree or higher, percent of persons age 25 years+, 2015-2019	19.3%

Source: U.S. Census Bureau, Linn County, OR, https://data.census.gov/cedsci/profile?g=0500000US41059, accessed 11/12/21

Health

Individual and community health play an integral role in community resiliency, as indicators such as health insurance, people with disabilities, dependencies, homelessness, and crime rate paint an overall picture of a community's well-being. These factors translate to a community's ability to prepare, respond, and cope with the impacts of a disaster.

It is recognized that those who lack health insurance or are impaired with sensory, mental, or physical disabilities, have higher vulnerability to hazards and will likely require additional community support and resources. On a similar note, a community with high percentages of drug dependency and violent crimes may experience increased issues with the disruption of normal social systems. It is likely that the continuity of services will be interrupted by a disaster.

Table B-5 Health in Linn County, OR

Health	
With a disability, under age 65 years, percent, 2015-2019	12.9%
Persons without health insurance, under age 65 years, percent	⚠ 8.4%

Source: U.S. Census Bureau, Linn County, OR, https://data.census.gov/cedsci/profile?g=0500000US41059, accessed 11/12/21

Synthesis

Sweet Home and Linn County need to consider both short- and long-term socio-demographic information and the implications it highlights related to hazard resilience. Immediate concerns such as the presence of a significant low-income population can result in a substantial reliance on public services and assistance. Another notable demographic is the county's Hispanic and Latino population, which may have less access to public outreach related to natural hazard preparedness and response. These factors and factors such as populations without health insurance and median household income, can have long-term impacts on the economy and stability of the community, ultimately affecting future resilience.

Economic Capacity

Regional economic capacity refers to the financial resources present and revenue generated in the community to achieve a higher quality of life. Income equality, housing affordability, economic diversification, employment, and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the components of the economy work and are interconnected in the existing economic picture. Once inherent strengths or systematic vulnerabilities are apparent, both the public and private sectors can take action to improve them, thereby increasing the resilience of the local economy.

Regional Affordability

The evaluation of regional affordability supplements the identification of socio demographic capacity indicators, i.e. median income, and is a useful analysis tool to understanding the economic status of a community. This information can capture the likelihood of individuals' ability to prepare for hazards, through retrofitting homes or purchasing insurance. If the community reflects high income inequality or housing cost burden, the potential for homeowners and renters to implement mitigation can be drastically reduced. Therefore, regional affordability is a mechanism for generalizing the abilities of communities to recover without federal, state, or local assistance.

In paragraphs above, statistics about income, housing, education, and so forth have been shared. Part of the economic well-being and affordability of an area includes looking at businesses and industry. In Table B-6, the U.S. Census based information for employment shows there are 2,688 total employer establishments in Linn County and 6,357 non-employer establishments. The table also shows categories of ownership for the businesses.

Table B-6 Statistics for Businesses in Linn County, OR

BUSINESSES	
Businesses	
Total employer establishments, 2019	2,688
Total employment, 2019	37,607
Total annual payroll, 2019 ($1,000)	1,686,799
Total employment, percent change, 2018-2019	1.6%
Total nonemployer establishments, 2018	6,357
All firms, 2012	7,057
Men-owned firms, 2012	3,135
Women-owned firms, 2012	2,446
Minority-owned firms, 2012	537
Nonminority-owned firms, 2012	6,157
Veteran-owned firms, 2012	604
Nonveteran-owned firms, 2012	5,832

Source: U.S. Census Bureau, Linn County, OR, https://data.census.gov/cedsci/profile?g=0500000US41059, accessed 11/12/21

Income Equality

Income equality is a measure of the distribution of economic resources, as measured by income, across a population. It is a statistic defining the degree to which all persons have a similar income.

The Gini Index is a summary measure of income inequality. The Gini coefficient incorporates the detailed shares data into a single statistic, which summarizes the dispersion of income across the entire income distribution. The Gini coefficient ranges from 0, indicating perfect equality (where everyone receives an equal share), to 1, perfect inequality (where only one recipient or group of recipients receives all the income). The Gini is based on the difference between the Lorenz curve (the observed cumulative income distribution) and the notion of a perfectly equal income distribution.[29]

Based on social science research, a region's cohesive response to a hazard event may be affected by the distribution of wealth in communities that have less income equality.[30]

An Oregon State University and The Oregon Community Foundation report from 2015 describes that compared to all other states, Oregon has average levels of income inequality. Nationally, Oregon ranks 22nd among the 50 states and Washington D.C., where ranking 1st means having the lowest inequality and ranking 51st means having the highest inequality. Oregon's level of inequality is slightly below the national average. [31]

According to an Oregon Employment Department article dated July 24, 2018, "The degree of wage inequality in Oregon has generally increased since 1990, though not steadily. The state's Gini coefficient for all year-round workers rose from 1991 through the mid-1990s, and then was largely flat before rising to a peak in 2000. Since 2000, the coefficient fell slightly in 2001 and 2002, during the first economic slowdown of the decade. Afterwards, it began a steady rise to a second peak in 2007, as the state's economy recovered from the recession earlier in the decade. The coefficient decreased a little again in 2008 and 2009 and subsequently rose to reach its highest point in 2015. It dropped slightly in 2016 and remained essentially unchanged in 2017".[32]

Housing Affordability

Housing affordability is a measure of economic security gauged by the percentage of a metropolitan area's households paying less than 35% of their income on housing.[33] Households spending more than 35% are considered housing cost burdened. In general, the population that

[29] U.S. Census Bureau*, Income Inequality, The Gini Index*, https://www.census.gov/topics/income-poverty/income-inequality/about/metrics/gini-index.html

[30] Susan Cutter, Christopher G. Burton, and Christopher T. Emrich. 2010, *Disaster Resilience Indicators for Benchmarking Baseline Conditions*, Journal of Homeland Security and Emergency Management 7, no.1: 1-22, http://resiliencesystem.com/sites/default/files/Cutter_jhsem.2010.7.1.1732.pdf

[31] Oregon State University and The Oregon Community Foundation, *TOP: Tracking Oregon's Progress: A Focus on Income Inequality*, https://www.oregoncf.org/Templates/media/files/reports/top_indicators_2015.pdf and *TOP: Tracking Oregon's Progress: Toward a Thriving Future: Closing the Opportunity Gap for Oregon's Kids,* https://oregoncf.org/Templates/media/files/research/top_report_2017.pdf

[32] Oregon Employment Department, *Wage Inequality in Oregon: The Widening Gap*, https://www.qualityinfo.org/-/wage-inequality-in-oregon-the-widening-gap

[33] University of California Berkeley, Building Resilient Regions, *Resilience Capacity Index*, http://brr.berkeley.edu/rci/

spends more of their income on housing has proportionally fewer resources and less flexibility for alternative investments in times of crisis.[34]

High incidence of housing cost burden can impose serious challenges for a community recovering from a disaster, as housing costs may exceed the ability of local residents to repair or move to a new location. These populations may live paycheck to paycheck and are extremely dependent on their employer. In the event their employer is also impacted, it will further the detriment experienced by these individuals and families.

Table B-7 Households Spending > 35% of Income on Housing

Jurisdiction	Owners		Renters
	With Mortgage	Without Mortgage	
Oregon	11.0%	40.0%	33.9%
United States	9.8%	39.4%	38.3%

Source: U.S. Census Bureau, American Fact Finder, Table DP04, Selected Housing Characteristics, 2013-2017, https://data.census.gov/cedsci/table?q=Selected%20Housing%20Characteristics&g=0100000US_0400000US41_0500000US41059&tid=ACSDP1Y2019.DP04&hidePreview=true

Economic Diversity

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times, but it is not a guarantor of economic vitality or resilience. [35]

One method for measuring economic diversity is through use of the Hachman Index, a formula that compares the composition of county and regional economies with those of states or the nation as a whole. Using the Hachman Index with the state of Oregon, a diversity ranking of 1 indicates the Oregon County with the most diverse economic activity compared to the state as a whole, while a ranking of 36 corresponds with the least diverse county economy.

Anticipated job growth in rural areas of Oregon, according to employment projections covering the 2014 to 2024 period, is muted compared with anticipated growth in metro areas. Between 2014 and 2024, statewide growth is anticipated to be about 14 percent.[36]

No matter what the size of the local economy, a certain level of demand for workers exists. Approaching opportunity through the lens of high-wage and high-demand jobs or the level of replacement openings in an area illustrates how varied job opportunities are in rural Oregon.[37]

[34] Ibid.

[35] Business Oregon, *Distressed Areas in Oregon*, https://www.oregon4biz.com/Publications/Distressed-List/

[36] Oregon Employment Department, *The Employment Landscape of Rural Oregon*, May 2017, https://www.qualityinfo.org/documents/10182/13336/The+Employment+Landscape+of+Rural+Oregon?version=1.0

[37] Ibid.

More than 40 percent of rural Oregon employment is concentrated in natural resources, leisure, and hospitality (tourism), and government. Together those three sectors make up around 27 percent of the employment in urban Oregon. Manufacturing employment in Oregon has decreased 8 percent between 1990 and 2016, and it has shifted with more happening in the Portland metro area and less in the rural counties. In addition, rural Oregon's historic reliance on resource extraction has shifted as timber harvest levels have declined.[38]

The Oregon Employment Department designates counties, cities, communities or other geographic areas experiencing high unemployment, poverty and job loss as economically distressed. The Distressed Counties List is used to highlight Oregon communities that may need additional support. The distressed designation may provide a community with an advantage if it applies for funds from state and federal sources. Business Oregon gives priority when funding technical assistance, programs and projects to geographic areas determined to be economically distressed as prescribed by Oregon law. Umatilla County is listed as a distressed area.[39]

Employment and Wages

Since 2005 the unemployment rate in Sweet-Home, Oregon has ranged from 3.4% in November 2019 to 15.4% in March 2009. The current unemployment rate for Sweet-Home is 5.7% as of June 2021.[40]

Industry

Major Regional Industry

Key industries are those that represent major employers and are significant revenue generators. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry specific discussions below. Identifying key industries in the region enables communities to target mitigation activities towards those industries' specific sensitivities. It is important to recognize that the impact that a natural hazard event has on one industry can reverberate throughout the regional economy.[41]

This is of specific concern when the businesses belong to basic sector industries. Basic sector industries are those that are dependent on sales outside of the local community. The farm and ranch, information, and wholesale trade industries are all examples of basic industries. Non-basic sector industries are those that are dependent on local sales for their business, such as retail trade, construction, and health and social assistance.[42]

[38] Oregon Employment Department, *The Employment Landscape of Rural Oregon*, May 2017, https://www.qualityinfo.org/documents/10182/13336/The+Employment+Landscape+of+Rural+Oregon?version=1.0

[39] Business Oregon, *Distressed Areas in Oregon*, https://www.oregon4biz.com/Publications/Distressed-List/

[40] Home Facts, *Sweet Home, OR Unemployment Rate Report,* Sweet Home, OR Unemployment | Homefacts, accessed 11/12/21

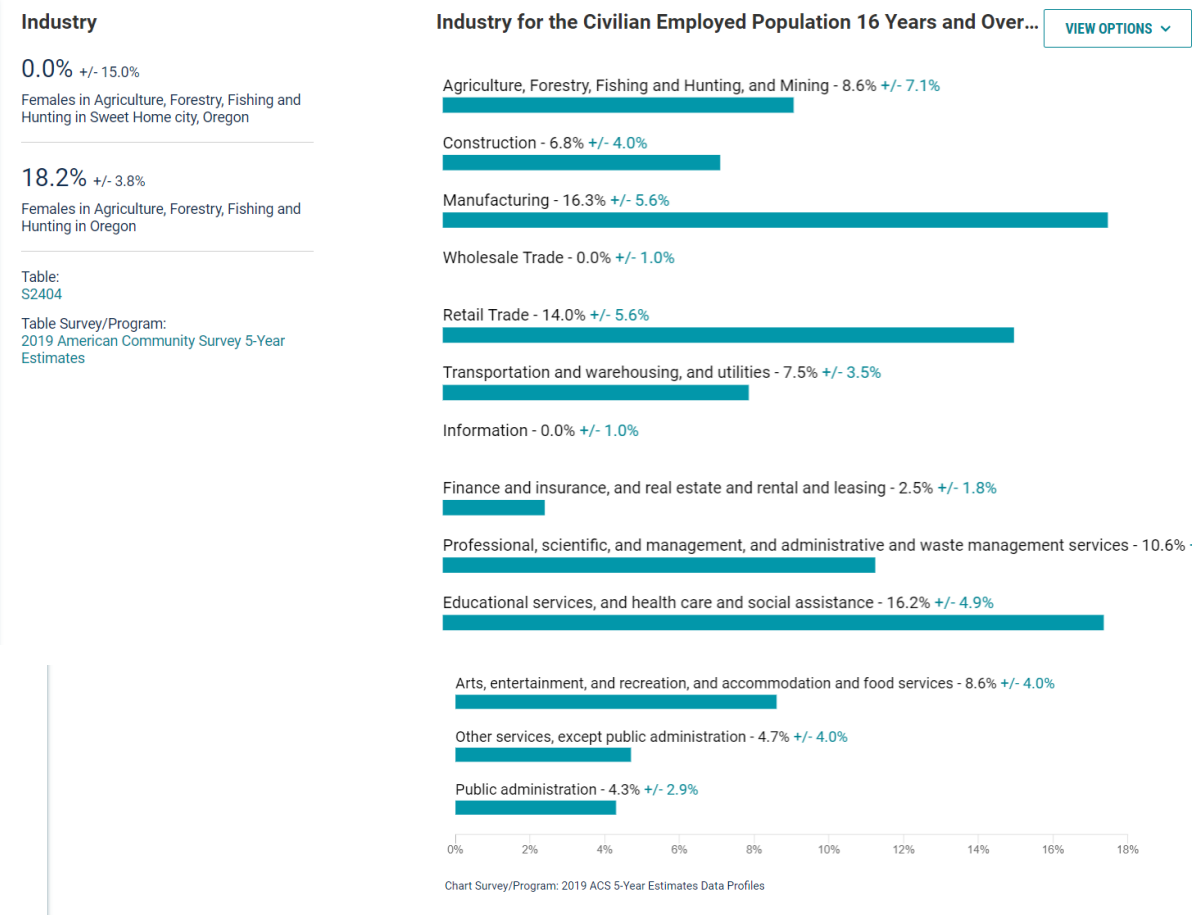
[41] *2020 Oregon NHMP,* Region 3: Mid/Southern Willamette Valley Region, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

[42] Ibid

Employment by Industry

Economic resilience to natural disasters is particularly important for the major employment industries in the region. If these industries are negatively impacted by a natural hazard, such that employment is affected, the impact will be felt throughout the regional economy.[43] Thus, understanding and addressing the sensitivities of these industries is a strategic way to increase the resiliency of the entire regional economy.

Figure B-9 Industry for the Civilian Population 16 Years and Over in Sweet Home, OR



Source: U.S. Census, Sweet Home, OR, Census - Geography Profile, accessed 11/12/21

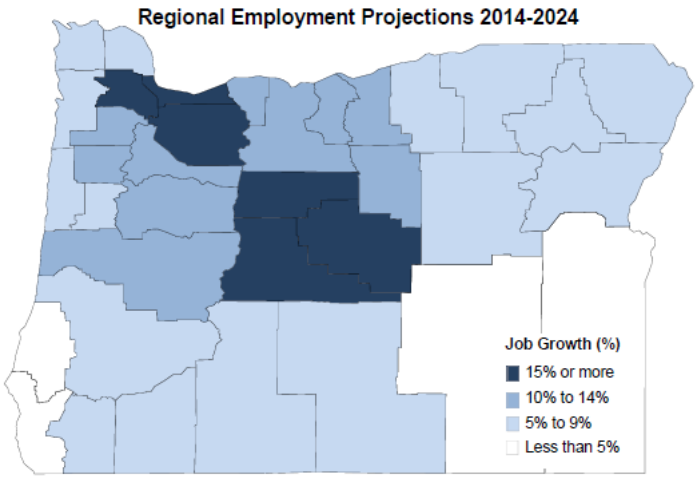
Future Employment in Industry

According to the *The Employment Landscape of Rural Oregon*, anticipated job growth in rural areas of Oregon, according to employment projections covering the 2014 to 2024 period, is muted compared with anticipated growth in metro areas. Between 2014 and 2024 statewide growth is anticipated to be about 14 percent. [44]

[43] Ibid.

[44] Oregon Employment Department, *The Employment Landscape of Rural Oregon*, May 2017, https://www.qualityinfo.org/documents/10182/13336/The+Employment+Landscape+of+Rural+Oregon?version=1.0

Figure B-9 Regional Employment Projections



Source: Oregon Employment Department, *The Employment Landscape of Rural Oregon*, May 2017, https://www.qualityinfo.org/documents/10182/13336/The+Employment+Landscape+of+Rural+Oregon?version=1.0

Synthesis

The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families and the community to absorb disaster impacts for a quick recovery. It is important to consider what might happen to the Sweet Home and Linn County economy if some of the largest revenue generators and employers (retail, manufacturing, and health care and social assistance industries), were heavily impacted by a disaster. It is important to have strategies to reduce vulnerability and have risk management for the dominant industries.

Built Capacity

Built capacity refers to the built environment and infrastructure that supports the community. The various forms, quantity, and quality of built capital mentioned above contribute significantly to community resilience. Physical infrastructures, including utility and transportation lifelines, are critical during a disaster and are essential for proper functioning and response. The lack or poor condition of infrastructure can negatively affect a community's ability to cope, respond and recover from a natural disaster. Following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediately available resources.

Housing Building Stock

Housing characteristics are an important factor in hazard mitigation planning, as some housing types tend to be less disaster resistant than others, and therefore warrant special attention. Of particular interest are mobile homes and other non-permanent housing structures (including boats, RVs, vans, etc.). Mobile structures are particularly vulnerable to certain natural hazards,

such as windstorms, and special attention should be given to securing the structures as they are typically more prone to damage than wood-frame construction.[45]

It is also important to consider multi-unit structures, as they are more vulnerable to the impacts from natural disasters due to the increased number of people living in close proximity. In short, a structural weakness in a multiunit structure will have an amplified impact on the population.

In preparing this *2021 Sweet Home NHMP*, DLCD staff found that searching U.S. Census Bureau, American Fact Finder information, usually found in Table DP04, Selected Housing Characteristics, was not located at the city level. So data showing the housing type in terms of number of units, or as a mobile home, boat, RV, or other, is not available. DLCD staff did not ask the Sweet Home staff to provide that data. Therefore, the data in Table B-13 is limited to what was found on the U.S. Census Bureau website.

Table B-13 Linn County and Sweet Home, OR Data on Housing Occupancy

Housing Occupied or Vacant	Linn County, OR	Sweet Home, OR
Occupied	49,344	3,807
Vacant	2,577	230
Total	**51,921**	**4,037**

Source: U.S. Census Bureau, American Fact Finder, Table H1, Selected Housing Characteristics, Decennial Census 2020 and 2010, Census - Table Results Accessed 11/23/21

Age of housing is another characteristic that influences a structure's vulnerability to hazards. Generally, the older a home is, the greater the risk of damage from natural disasters. This is because stricter building codes have only been implemented in recent decades, following improved scientific understanding of plate tectonics and earthquake risk. In Oregon, many structures built after the late 1960's began utilizing earthquake resistant designs and construction. Similarly, communities in the northwest began implementing flood elevation ordinances in the 1970's.[46] In 1990, Oregon again upgraded to stricter seismic standards that included earthquake loading in the building design.[47] So housing stock built after 1990 had more stringent building codes in place. The construction dates of housing in Sweet Home, OR is shown in Table 2-8 in Section 2 Risk Assessment.

[45] *2020 Oregon NHMP,* Region 3: Mid/Southern Willamette Valley Region, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

[46] Ibid.

[47] Wang Yumei and Bill Burns, *Case History on the Oregon GO Bond Task Force: Promoting Earthquake Safety in Public Schools and Emergency Facilities*, National Earthquake Conference. January 2006.

Commercial Building Stock

Critical Infrastructure, Critical Facilities, and Lifelines

Critical infrastructure, critical facilities, and lifelines are those systems, structures, and facilities that are essential to government response and recovery activities (e.g., hospitals, police, fire and rescue stations, utilities, communications lines, sewer and water lines, dams, levees, school districts, and higher education institutions). The interruption of service or destruction of any of these would have a debilitating effect on the community.

Critical infrastructure, critical facilities, and lifelines in Sweet Home are identified in Volume I Section 2 Risk Assessment in the Critical Infrastructure, Critical Facilities, and Lifelines section. Rather than repeat the information, go to the other section for details. This information provides the basis for informed decisions that can be used to reduce the vulnerability of Sweet Home to natural hazards. It is not necessary to repeat it here.

Dependent Facilities

In addition to the critical facilities mentioned above in Volume I Section 2 Risk Assessment, there are other vital services delivered in the county that must be accounted for when planning for natural disaster response and recovery. Assisted living centers, nursing homes, residential mental health facilities, and psychiatric hospitals are important to identify within the community because of the dependent nature of the residents. Such facilities can also serve as secondary medical facilities during an emergency, as they are equipped with nurses, medical supplies and beds.

Correctional Facilities

Correctional facilities are incorporated into physical infrastructure as they play an important role in everyday society by maintaining a safe separation of the public from potentially dangerous human elements. While correctional facilities are built to code to resist structural failure and typically have back up power to sustain regulation of inmates following the immediate event of an emergency, logistical planning becomes more of a challenge when the impacts of the event continue over a long duration.

Physical Infrastructure

Physical infrastructure such as dams, levees, roads, bridges, railways and airports support Sweet Home. Due to the fundamental role that physical infrastructure plays both in pre and post-disaster, they deserve special attention in the context of creating resilient communities.

Dams and Levees

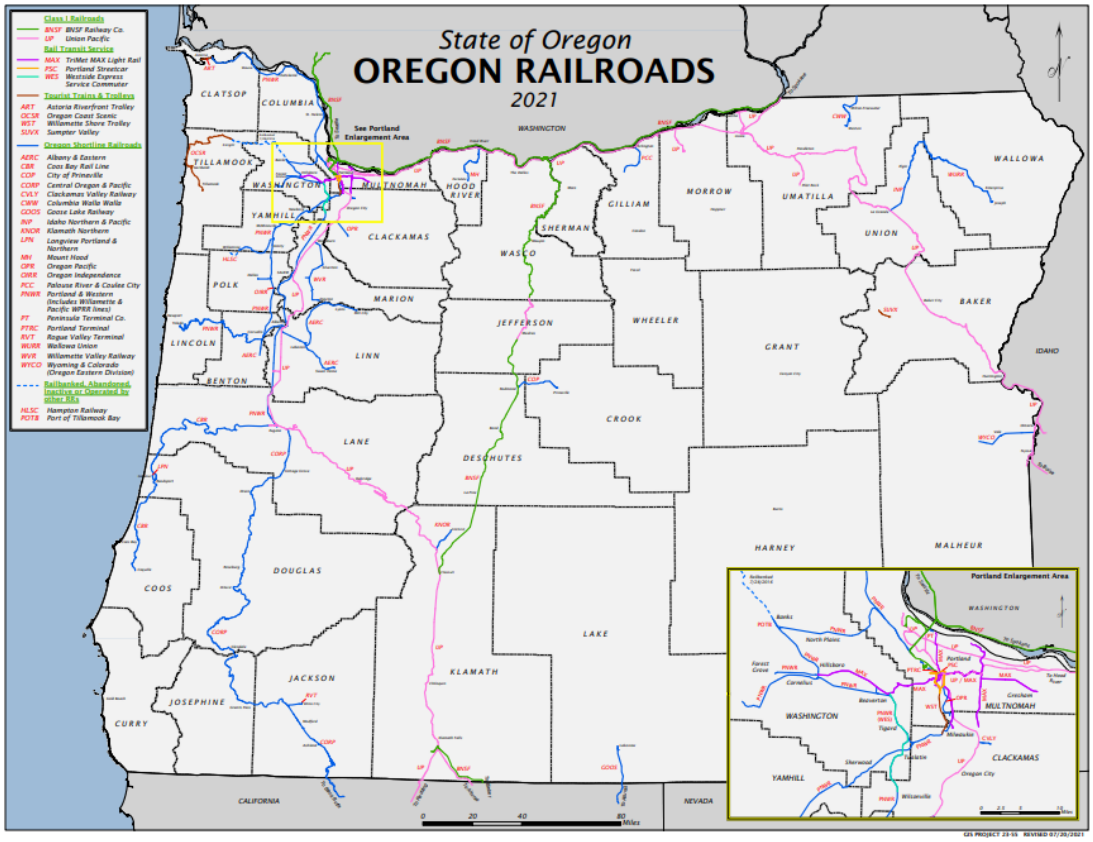
Dam failures can occur rapidly and with little warning. Fortunately, most failures result in minor damage and pose little or no risk to life safety.[48] However, the potential for severe damage still exists and should be considered in mitigation planning efforts. Dams and levees are described in the Flood Annex of the *2021 Sweet Home NHMP*.

[48] Federal Emergency Management Agency, *Dam Failure Information*, https://www.fema.gov/dam-failure-information, accessed March 12, 2019.

Railways

Railroads are major providers of regional and national cargo trade flows. The *State of Oregon, Oregon Railroads 2021* map shows the Oregon Shortline Railroads run through Sweet Home. See Figure B-10. Rails are sensitive to icing from winter storms that can occur. For industries in the region that utilize rail transport, these disruptions in service can result in economic losses. The potential for rail accidents caused by natural hazards can also have serious implications for the local communities, especially if hazardous materials are involved.[49] Sparks from rails have also been known to start wildfires.

Figure B-10 State of Oregon, Oregon Railroads 2021



Source: Oregon Department of Transportation, State of Oregon Railroads, Railroads.pdf (oregon.gov)

Airports

Sweet Home Langmack Airport was a private airport located two miles east of Sweet Home. The airport was founded by pilot Dr. Robert Langmack, who founded the town's hospital in the 1940s. The airport is closed and the former location of the airport is now being redeveloped for housing.[50] The nearest airport to Sweet Home is the Corvallis Municipal Airport.

[49] *2020 Oregon NHMP,* Region 3: Mid/Southern Willamette Valley Region, https://www.oregon.gov/lcd/NH/Documents/Approved_2020ORNHMP_09_RA3.pdf

[50] Sweet Home Airport, Sweet Home Airport (Oregon) - Wikipedia, accessed 11/23/21

Roads and Bridges

The major routes in and out of Sweet Home are identified as the Primary Evacuation Routes on the Sweet Home Evacuation Map, Figure 2-6.

Daily transportation infrastructure capacity can be stressed by maintenance, congestion, and oversized loads. Peak loads and congestion can materialize during major construction projects, but can also fluctuate by season. Natural hazards tend to further disrupt automobile traffic and create gridlock; this is of specific concern in periods of evacuation during an emergency.

The existing condition of bridges in the region is also a factor that affects risk from natural hazards. Bridge failure can have immediate and long-term implications in the response and recovery of a community. Incapacitated bridges can disrupt traffic and exacerbate economic losses due to the inability to transport products and services in and out of the area.

Oregon Department of Transportation (ODOT) provides an interactive mapping program, TransGIS, which provides updated information on structures (such as bridges), highways, traffic data and more. Bridge information is available for ODOT managed bridges, such as locations and their status (structurally deficient, closures, etc.).

Structurally Deficient is defined as: "*A bridge condition rating used by the Federal Highway Administration to indicate deteriorated physical conditions of the bridge's structural elements (primarily deck, superstructure, and substructure) and reduced load capacity. Some of these bridges are posted and may require trucks of a certain weight to detour. A classification of "structurally deficient" does not imply that bridges are unsafe. When an inspection reveals a safety problem, the bridge is posted for reduced loads, scheduled for repairs, or in unusual situations, closed until repairs can be completed. Structural deficiency is one of the many factors that are used in the ODOT State Bridge Program for project ranking or selection.*" [51]

Utility Lifelines

Utilities are the resources that the public relies on daily, (i.e., electricity, fuel and communication lines). If these lines fail or are disrupted, the essential functions of the community can become severely impaired. Utilities are closely related to physical infrastructure, (i.e., dams and power plants) as they transmit the power generated from these facilities.

Power Generation

Power sources in Sweet Home, OR include electricity, natural gas, and solar. Prices paid for power by residents are noted as lower in Sweet Home than the average U.S. price.[52]

Telecommunications

There are many telecommunication providers in Sweet Home and Linn County.

[51] ODOT, *2020 Bridge Condition Report and Tunnel Data*, *https://www.oregon.gov/odot/Bridge/Documents/Final_2020BridgeConditionReport.pdf*

[52] Utilities Local, *Sweet Home, OR*, Sweet Home, OR Utilities - Electricity, Natural Gas, Solar | Utilities Local

Sewer, Landfill and Industrial Waste

Sweet Home Sanitation[53] provides sanitation services, including recycling and hazardous waste, for business and residences. The City of Sweet Home provides sewer and water services to business and residences. According to the City's website, "The City operates and maintains a Water Treatment facility and appropriate distribution systems in such a way as to meet strict governmental requirements while providing safe drinking water and protecting the health and environment. Our goal is to continue to produce superior quality potable water that resulted in the City earning the Overall Best Drinking Water in Oregon award in 2016."[54]

Synthesis

Built capacity refers to the built environment and infrastructure that supports a community. The various forms of built capital mentioned throughout this section play significant roles in the event of a disaster. Physical infrastructure, including utility and transportation lines, is critical to maintain as these are essential for proper functioning and response during a disaster. Community resilience is directly affected by the quality and quantity of built capital and lack of or poor condition of infrastructure can negatively affect a community's ability to cope, respond and recover from a natural disaster. Initially following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediate resources.

Community Connectivity Capacity

Community connectivity capacity places strong emphasis on social structure, trust, norms, and cultural resources within a community. In terms of community resilience, these emerging elements of social and cultural capital will be drawn upon to stabilize the recovery of the community. Social and cultural capitals are present in all communities; however, it may be dramatically different from one city to the next as these capitals reflect the specific needs and composition of the community residents.

Social Systems

Social systems include community organizations and programs that provide social and community-based services, such as employment, health, senior and disabled services, professional associations and veterans' affairs for the public. In natural hazard mitigation planning, it is important to know what social systems exist within the community because of their existing connections to the public.

Often, mitigation actions identified in the NHMP involve communicating with the public or specific subgroups within the population (e.g. elderly, children, low income, etc.). The County can use existing social systems as resources for implementing such communication-related activities because these service providers already work directly with the public on a number of issues. The presence of these services are more predominantly located in urbanized areas of Linn County.

There are five essential elements for communicating effectively to a target audience:

- The source of the message must be credible,
- The message must be appropriately designed,

[53] Sweet Home Sanitation, Sweet Home Sanitation - Services, accessed 11/23/21.

[54] City of Sweet Home, Utility Billing, Utility Billing | Sweet Home Oregon, accessed 11/23/21.

- The channel for communicating the message must be carefully selected,
- The audience must be clearly defined, and
- The recommended action must be clearly stated and a feedback channel established for questions, comments and suggestions.

A few methods that social organizations throughout Sweet Home can use to become involved in hazard mitigation.

- Education and Outreach – Organizations can partner with the community to educate the public or provide outreach assistance and materials on natural hazard preparedness and mitigation.
- Information Dissemination – Organizations can partner with the community to provide and distribute hazard-related information to target audiences.
- Plan/Project Implementation – Organizations may have plans and/or policies that may be used to implement mitigation activities or the organization can serve as the coordinating or partner organization to implement mitigation actions.

Civic Engagement

Civic engagement and involvement in local, state, and national politics are important indicators of community connectivity. Those who are more invested in their community may have a higher tendency to vote in political elections. Other indicators such as volunteerism, participation in formal community networks, and community charitable contributions are examples of civic engagement that may increase community connectivity. Residents who want to become involved in their community through volunteering have opportunities available to them throughout the region.

Cultural Resources

Historic Places

Historic and cultural resources such as historic structures and landmarks can help to define a community and may also be sources for tourism revenue. Protecting these resources from the impact of disasters is important because they have a role in defining and supporting the community.

According to the National Register Bulletin, "a contributing resource is a building, site, structure, or object adds to the historic associations, historic architectural qualities, or archeological values for which a property is significant because it was present during the period of significance, related to the documented significance of the property, and possesses historical integrity or is capable of yielding important information about the period; or it independently meets the National Register criteria."[55] If a structure does not meet these criteria, it is considered to be non-contributing.

Libraries and Museums

Libraries and Museums are other facilities which a community can use to stay connected. These facilities serve a critical function in maintaining a sense of community, however library buildings should also be considered as a common place for members of communities to gather during a disaster or hazard event.

[55] U.S. Department of the Interior, National Park Service, Cultural Resources, *National Register Bulletin 16A: How to Complete the National Register Registration Form*, https://www.nps.gov/nr/publications/bulletins/nrb16a/

Museums can also function in maintaining a sense of community as they provide residents and visitors with the opportunity to explore the past and develop cultural capacity.

As with public libraries, it is important to consider museums in the mitigation process for community resilience. These structures should be protected in critical times to preserve cultural heritage and may also serve as a place of refuge for community members during a disaster event.

Cultural Events

Other such institutions that can strengthen community connectivity are the presence of festivals and organizations that engage diverse cultural interests. These places and events bring some revenue into the community; they also improve cultural competence and enhance the sense of place. Cultural connectivity is important to community resilience, as people may be more inclined to remain in the community because they feel part of the community and local culture.

Community Stability

Community stability is a measure of rootedness in place. It is hypothesized that resilience to a disaster stems in part from familiarity with place, not only for navigating the community during a crisis, but also accessing services and other supports for economic or social challenges.[56]

Often homeownership is associated with greater resilience as it is a measure of place attachment and commitment. Homeownership is an indicator that residents will return to a community post-disaster, as these people are economically and socially invested in the community. Similar to communities with higher median household income, homeownership can reflect an increased resource capacity to prepare, respond, and cope with a crisis situation.

Synthesis

Sweet Home has social and cultural resources that work in favor to increase community connectivity and resilience. Sustaining these social and cultural resources through events and awareness campaigns helps to preserve community cohesion and a sense of place. All of the communities have social systems that could help raise awareness of available resources and services for the public. It may be of specific interest to these communities to evaluate social and cultural resources periodically so as to get a sense of what exists, what is needed, and who can provide it.

Political Capacity

Political capacity is recognized as the government and planning structures established within the community. In terms of natural hazard mitigation planning and resilience, it is essential for political capital to encompass diverse government and non-government entities in collaboration. Disaster losses stem from a predictable result of interactions between the physical environment, social and demographic characteristics and the built environment.[57] Resilient political capital involves stakeholders in hazard planning and works towards integrating the Natural Hazard Mitigation Plan with other community plans, so that all planning approaches are consistent.

[56] Cutter, Susan, Christopher Burton, Christopher Emrich, *Disaster Resilience Indicators for Benchmarking Baseline Conditions*, Journal of Homeland Security and Emergency Management, http://resiliencesystem.com/sites/default/files/Cutter_jhsem.2010.7.1.1732.pdf

[57] Mileti, D. 199, *Disaster by Design: a Reassessment of Natural Hazards in the United States,* https://www.researchgate.net/publication/293178738_Disasters_by_Design_A_Reassessment_of_Natural_Hazards_in_the_United_States

Government Structure

Sweet Home is governed by the City Council and the City Manager. See the Executive and Legislative section below for more information on the structure of the government. Departments in the Sweet Home government that have a role in hazard mitigation are the following as listed and described in the *City of Sweet Home FY 2021-2022 Budget, Revised Version*, 5/31/21.

Non-Departmental

This "department" is used for city-wide expenditures, which would be difficult to charge to individual departments. Items such as the City's Communications Specialist, labor relations and the City Attorney's retainer are contained in this budget. Additionally, this budget includes funding for tourism programs and streetlights among other essential functions of the city government.

Executive and Legislative

The Executive department includes the City Council and the City Manager's Office. The City Council is the governing body for the City of Sweet Home and consists of six Councilors elected at-large across the city and one Mayor who is elected as a Councilor by the citizens and selected by the Council to serve for a two-year term. The City Manager manages the day-to-day operations of the organization. The Manager is responsible for all personnel, risk management, purchasing and property management as well as overseeing the work plans of all city departments in conformance with the vision, goals and objectives established by the City Council.

Community and Economic Development

The Community & Economic Development Department has the responsibility of facilitating the physical development of the City through creation and implementation of policies, standards and regulations designed to promote the health, safety and welfare of the citizens while protecting the rights and privileges of property owners.

Finance

The Finance Department is responsible for the fiscal management of the City of Sweet Home. This includes accounts payable, payroll, general accounting, preparing the annual budget and the city's annual audit. The Finance Department also administers the city's assessment docket, coordinates employee's benefits and maintains financial records relating to grants and contracts.

A part of the Finance Department, the Municipal Court division is responsible for the processing of citations and complaints issued by the Sweet Home Police Department, the City's Code Enforcer, the City Attorney and by private citizens within the City of Sweet Home. The Court processes over 3,000 court case per year and is a valuable cog in the efforts to promote the health, safety, and welfare of the citizens.

Library Services

The mission of the Sweet Home Public Library is to obtain, organize and make available to all people of the community education, informational and recreational materials. The Sweet Home Public Library recently celebrated 75 years of service but it has not been the easiest years on record. Through economic ups and downs, the Library has adapted to survive and thrive to become the Library it is today. Prior to the coronavirus pandemic, nearly 3,500 patrons visited the Library and that does not include those from the community who come in to browse the offerings, make copies or utilize the various services offered.

Police

The Sweet Home Police Department is responsible for all law enforcement within the city limits of Sweet Home. The department provides a complete range of law enforcement services as well as a wide variety of community services from neighborhood watch groups, Seniors and Law Enforcement Together (SALT) and Peer Court.

The mission statement of the department is "to work in partnership with our Community, to protect the public and prevent crime while providing the highest quality police services to all." The motto is simple: "Honor ~ Integrity ~ Service."

Public Works

The Public Works department is the largest department in terms of total budget. Within the department are five divisions that impact the livability in Sweet Home. The five divisions are:

- Parks & Facilities
- Water
- Wastewater
- Storm Water
- Street Maintenance

Parks

The Parks division is a component of Public Works. The City of Sweet Home has an established city-wide park system that provides a variety of recreational opportunities to all citizens and visitors. Currently, the City maintains six parks (including a skate park) and the Hobart Natural Area. The 2017 Budget Committee and City Council both made the parks program a priority for the city and added a crew leader to the budget to oversee maintenance of those parks and city facilities. For the 2021-2022 approved budget, the City is continuing to focus on Sankey Park after being awarded a $242k grant from the Oregon Parks and Recreation Department. The grant allows the City to move forward with the park's master plan and leverage its own funds to restore the park to its former glory.

Water

The City operates and maintains a Water Treatment Facility and appropriate distribution systems in such a way as to meet strict governmental requirements while providing safe drinking water and protecting the health of the environment. Several activities are associated with the production of potable water. Equipment operation and maintenance is accomplished on pumps, valves, motors, compressors, chemical feed machines, flow meters, pressure meters and filters. Production averages approximately 1 million gallons per day with peak days in excess of 2.5 million gallons. To accomplish the feat, the plant runs seven days a week, 365 days a year.

Our goal is to continue to produce superior quality potable water that resulted in the city earning the Overall Best Drinking Water in Oregon award for 2016.

Wastewater and Stormwater

The City operates and maintains a Wastewater Treatment Facility and appropriate collections systems in such a way as to meet strict governmental requirements for wastewater collections and reclamation, while protecting the health of the environment. This facility consists of six unit processes, including influent pumping, aeration, clarification, sludge dewatering and disposal, disinfections and two gravity filters that

are operated during certain periods throughout the year. Laboratory facilities which support the operations and comply with state and federal mandates are also associated with the overall operation and maintenance, cleaning of grounds and facilities, sludge dewatering and disposal activities, process operation, monitoring and reporting.

The monitoring activities are composed of effluent flow monitoring and lab testing. The City maintains a water quality lab for the purpose of meeting state and federal regulations for treatment and discharge of municipal sewage. In-house analysis includes daily, weekly and monthly testing for Biological Oxygen Demand (BOD), fecal coliforms, suspended solids, volatile solids and total solids as well as chlorine concentration and pH. Certified private laboratories perform annual and periodic testing for inorganic toxic chemicals (heavy metals), organic toxic chemicals (pesticides) and radioactive contamination. All data from these monitoring activities are collected, correlated and entered into appropriate report formats for submittal to the regulatory agencies (DEQ and EPA).

Other objectives are to try to meet discharge permit requirements within feasible limits set forth under our new NPDES Discharge Permit; continue operations with effluent recycling and sludge watering improvements; and continue replacement reserve.

Streets

Our mission is to build, maintain, operate and manage city facilities while being responsible, accountable stewards of the city's facilities. Additionally, we strive to provide timely, cost-effective, preventive maintenance of public infrastructure and equipment and assist other departments and divisions to jointly provide a safe, convenient and healthy environment for the City of Sweet Home.

Participating Special Districts: Sweet Home Fire and Ambulance District

The following information is excerpted from the Sweet Home Fire and Ambulance District (SHFAD) website, Department History (sweethomefire.org)c, accessed on 11/12/22.

Sweet Home Fire Department began in October 1938, with the acceptance by the City of Sweet Home of an offer of Aid By Way of Loan and Grant from the U.S. Government. Soon thereafter, plans for a City Water Supply and establishment of a Fire Department were approved and set into motion. The bid included a Fire Department building and "necessary operating equipment".

The Department provides Fire and Ambulance protection to approximately 7,300 people and 300 buildings in the 6.5 square miles comprising the City of Sweet Home. The Department also has an agreement with the Sweet Home Rural Fire Board to provide protection to approximately 5,560 people and 2,500 buildings in the District's 55 square mile rural district. Ambulance coverage includes and extends outside of these boundaries to cover approximately 1,000 square miles primarily to the East of Sweet Home. Mountainous terrain, multiple waterways, and two large lakes dictate the responders be able to manage many different types of rescue techniques.

The Sweet Home Fire & Ambulance District was formed in November 2000. This consolidated the Rural Fire District, City Fire Department and Ambulance District into one entity. With the District formation, Fire District boundaries increased from 63 square miles to 159 square miles. The "Ambulance Service Area" remains at 1,000 square miles. The growth of our new District expanded into some previously unprotected areas of East Linn County for structural fire protection. Station 24 was built in December of 2002 to serve the citizens in the community of Cascadia, Oregon 15 miles East of Sweet Home.

The Sweet Home Fire and Ambulance District currently serves over 16,000 citizens throughout the district. These citizens are served by a combined staff of 11 full-time personnel and 55 volunteers responding out of 4 stations. Fire Chief Dave Barringer was appointed June 27, 2014 and is currently working in that capacity.

Existing Plan & Policies

In Section 4 Plan Implementation and Maintenance, under "Implementing through Existing Program" there is a description noting that Umatilla County and the participating cities and districts have plans, programs, policies, procedures and agencies that may be used to implement mitigation actions. This section and the previous section "Government Structure" provide more detail on that information.

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports or studies. Plans and policies already in existence have support from local residents, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs.[58]

The *2021 Sweet Home NHMP* includes mitigation action items that, when implemented, will reduce the City's vulnerability to natural hazards. These mitigation actions are consistent with the goals and objectives of the City's existing plans and policies.

Linking existing plans and policies to the *2021 Sweet Home NHMP* helps identify what resources already exist that can be used to implement the mitigation actions in the NHMP. Implementing the natural hazards mitigation plan's actions through existing plans and policies increases their likelihood of being supported and getting updated, and maximizes the City's resources. In addition to the plans listed in **Table B-14**, the City also has zoning ordinances (including floodplain development regulations) and building regulations.

Table B-14 Existing Plans for Sweet Home (Same as Table 4-1)

Jurisdiction	Document	Year
Sweet Home	Natural Hazards Mitigation Plan	2021 in process, 2015 existing
Sweet Home and Sweet Home Fire and Ambulance District	Emergency Operations Plan	Pandemic Response added in 2020 to existing January 2013
Sweet Home	Sweet Home Code of Ordinances (includes Development Code, Code Compliance, etc.)	Updated 2021, typically annually
Sweet Home	Development Code (Title 16 and 17 of the Sweet Home Code of Ordinances)	Updated 2021, typically annually

[58] Burby, Raymond J., ed. 1998. *Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities*, https://www.nap.edu/catalog/5785/cooperating-with-nature-confronting-natural-hazards-with-land-use-planning

Jurisdiction	Document	Year
Sweet Home	Comprehensive Plan	August 27, 2010
Sweet Home	Sweet Home Transportation System Plan	May 2005
Sweet Home	Emergency Action Site Specific Plan for CH2M Hill Sweet Home, OR	October 2017
Sweet Home	Emergency Response Plan: Sweet Home Wastewater and Water Treatment Plants	November 2014
Sweet Home	Sweet Home City Council Vision Statement, Mission Statement, and Goals Resolution	February 2021
Sweet Home	2021 Sweet Home Streetscape Plan	Draft 2021
Sweet Home and Linn County	Community Development Block Grant #H19012 Linn County Housing Rehabilitation Partnership Program	April 2020
Sweet Home	Sweet Home Fair Housing Resolution	2014
Sweet Home	Sweet Home Capital Improvement Plan	Adopted 2021 copy dated March 1, 2019
Sweet Home	Sweet Home Park System Master Plan	January 2014
Sweet Home	Sweet Home Downtown Retail Market Analysis	2010
Sweet Home	Sweet Home Livability Assessment	2014
Sweet Home	Sweet Home Housing and Economic Analysis	May 2001
Sweet Home	2003 Oregon Downtown Development Association Report	2003
Sweet Home	1994 Sweet Home Downtown Redevelopment Assessment Report	1994
Linn County	Linn County Community Wildfire Protection Plan	November 2007
State of Oregon	ORS 401.305 - Emergency management agency of city, county or tribal government - 2020 Oregon Revised Statutes (oregonlaws.org)	2020

Source: Tricia Sears, DLCD; 2015 Sweet Home Natural Hazards Mitigation Plan, https://www.sweethomeor.gov/sites/default/files/fileattachments/community_and_economic_development/page/4031/2015_sweet_home_mitigation_plan.pdf; Sweet Home Code of Ordinances, SWEET HOME, OREGON CODE OF ORDINANCES (amlegal.com); TITLE 16: LAND DIVISIONS AND LINE ADJUSTMENTS (amlegal.com); TITLE 17: ZONING (amlegal.com); Sweet Home Comprehensive Plan, sh_comprehensive_plan_2010_201408151818255696.pdf (sweethomeor.gov); Sweet Home Transportation System Plan, tsp_complete_except_app_g.pdf (sweethomeor.gov); Sweet Home City Council Vision Statement, Mission Statement, and Goals Resolution, SKM_C65821022509200 (sweethomeor.gov); Community Development Block Grant #H19012 Linn County Housing Rehabilitation Partnership Program, final_sweet_home_h19012_err.pdf (sweethomeor.gov), 2021 Sweet Home Streetscape Plan, 2021 Streetscape Plan | Sweet Home Oregon; Sweet Home Fair Housing Resolution, KMBT_C654-20140115083236 (sweethomeor.gov); City of Sweet Home Capital Improvement Plan, March 1, 2019, from Brandon Neish and Blair Larsen, Sweet Home, personal communication 7/8/21; Sweet Home Park System Master Plan, sweet_home_parks_master_plan_2014_201408151834432446.pdf (sweethomeor.gov); Sweet Home Downtown Retail

Market Analysis, Microsoft Word - Sweet Home Draft Report 02.12.10.doc (sweethomeor.gov); Sweet Home Livability Assessment, Microsoft Word - SWH Intro & Transpo_11-12.doc (sweethomeor.gov); Sweet Home Housing and Economic Analysis, KMBT_C654-20141010073606 (sweethomeor.gov); 2003 Oregon Downtown Development Association Report, 2003_oregon_downtown_development_association_report.pdf (sweethomeor.gov); 1994 Sweet Home Downtown Redevelopment Assessment Report, KMBT_C654-20150903071406 (sweethomeor.gov); Linn County Community Wildfire Protection Plan, file:///J|/Shared/Scholars%20bank%20local%20docs/County/Hazard%20mitigation%20plans/Linn_County_Wildfire_Plan_Appendices.pdf (uoregon.edu); Greg Springman, Sweet Home, personal communication, 8/5/21.

Synthesis

As addressed above, many governmental entities are responsible for work relevant to hazards planning. It is challenging to decipher whether these governmental entities work collaboratively in practice towards strengthening natural hazard mitigation. On a similar note, in short of reviewing each of the relevant policy documents it is questionable whether the documents effectively integrate hazard initiatives into implementation policy. Further analysis is needed to evaluate the effectiveness of political capital in terms of community resilience.

APPENDIX C: ECONOMIC ANALYSIS OF NATURAL HAZARD MITIGATION PROJECTS

This appendix was originally developed by the Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Community Service Center (now the Institute for Policy Research and Engagement or IPRE) and included in many of the NHMPs that ODPR/IPRE did with local jurisdictions. It has been reviewed and accepted by the Federal Emergency Management Agency (FEMA) as a means of documenting how the prioritization of mitigation actions includes a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and associated costs. In the *2015 Sweet Home NHMP*, there is an appendix titled Principles of Benefit-Cost Analysis. Portions of that appendix have been included here.

This appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects:

- the benefit/cost analysis,
- the cost-effectiveness analysis, and
- the STAPLE/E Approach.

The appendix describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies.

Information in this section is derived in part from the Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon's Office of Emergency Management, 2000), and FEMA Publication 331, *Report on Costs and Benefits of Natural Hazard Mitigation*. This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation actions reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs. Evaluating possible natural hazard mitigation actions provides decision-makers with an understanding of the potential benefits and costs, as well as a basis upon which to compare alternative projects.

Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables such as these three:

- Natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, police, utilities, and schools.
- While some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars.
- Many of the impacts of such events produce "ripple-effects" throughout the community, greatly increasing the disaster's social and economic consequences.

While not easily accomplished, there is value in assessing the positive and negative impacts from mitigation actions, and obtaining an instructive benefit/cost comparison.

What are some Economic Analysis Approaches for Evaluating Mitigation Strategies?

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into three general categories: benefit/cost analysis, cost-effectiveness analysis and the STAPLE/E approach.

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by OEM, FEMA, and other state and federal agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

Benefit/cost analysis is used in natural hazards mitigation to show if the benefits to life and property protected through the mitigation action exceed the cost of the mitigation action. A benefit/cost analysis for a mitigation action can assist communities in determining whether a project is worth undertaking now to avoid disaster-related damages later.

Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoiding future damages, and risk. In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented. A project must have a benefit/cost ratio greater than 1 (the net benefits will exceed the net costs) to be eligible for FEMA funding.

From the *2015 Sweet Home NHMP*,

> Benefit/cost analysis is the tool that provides answers to a central question for hazard mitigation projects: **"Is it worth it?"** If hazard mitigation were free, individuals and communities would undertake mitigation with robust enthusiasm and the risks from hazards would soon be greatly reduced. Unfortunately, mitigation is not free, but often rather expensive. For a given situation, is the investment in mitigation justified? Is the owner (public or private) better off economically to accept the risk or invest now in mitigation to reduce future damages? These are hard questions to answer! Benefit-cost analysis can help a community answer these difficult questions.

Cost-Effectiveness Analysis

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

Investing in Public Sector Mitigation Actions

Evaluating mitigation strategies in the public sector is complicated because it involves estimating all of the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. Some benefits cannot be evaluated monetarily, but still

affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions which involve a diverse set of beneficiaries and non-market benefits.

Investing in Private Sector Mitigation Actions

Private sector mitigation projects may occur on the basis of one or two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether a private entity or a public agency, required to conform to a mandated standard may consider the following options:

- Request cost sharing from public agencies;
- Dispose of the building or land either by sale or demolition;
- Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
- Evaluate the most feasible alternatives and initiate the most cost effective hazard mitigation alternative.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to prospective purchases. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of a sale regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

STAPLE/E Approach

Considering detailed benefit/cost or cost-effectiveness analysis for every possible mitigation action could be time consuming and impractical. There are approaches for conducting a quick evaluation of the proposed mitigation actions which could be used to identify those that merit more detailed assessment. One of those methods is the STAPLE/E approach.

Using STAPLE/E criteria, mitigation actions can be evaluated quickly. This set of criteria requires the assessment of the mitigation actions based on the Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLE/E) constraints and opportunities of implementing the particular mitigation action in your community.

The second chapter in FEMA's *How-To Guide Developing the Mitigation Plan – Identifying Mitigation Actions and Implementation Strategies* as well as the *State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process* outline some specific considerations in analyzing each aspect. The following are suggestions for how to examine each aspect of the STAPLE/E approach from the *State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process*.

Social: Community development staff, local non-profit organizations, or a local planning board can help answer these questions.

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly?

- Will the action cause social disruption?

Technical: The city or county public works staff, and building department staff can help answer these questions.

- Will the proposed action work?
- Will it create more problems than it solves?
- Does it solve a problem or only a symptom?
- Is it the most useful action in light of other community goals?

Administrative: Elected officials or the city or county administrator, can help answer these questions.

- Can the community implement the action?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political: Consult the mayor, city council or city board of commissioners, city or county administrator, and local planning commissions to help answer these questions.

- Is the action politically acceptable?
- Is there public support both to implement and to maintain the project?

Legal: Include legal counsel, land use planners, risk managers, and city council or county planning commission members, among others, in this discussion.

- Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
- Are there legal side effects? Could the activity be construed as a taking?
- Is the proposed action allowed by the comprehensive plan, or must the comprehensive plan be amended to allow the proposed action?
- Will the community be liable for action or lack of action?
- Will the activity be challenged?

Economic: Community economic development staff, civil engineers, building department staff, and the assessor's office can help answer these questions.

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs taken into account?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private?)
- How will this action affect the fiscal capability of the community?
- What burden will this action place on the tax base or local economy?
- What are the budget and revenue effects of this activity?
- Does the action contribute to other community goals, such as capital improvements or economic development?

- What benefits will the action provide? (This can include dollar amount of damages prevented, number of homes protected, credit under the CRS, potential for funding under the HMGP or the FMA program, etc.)

Environmental: Watershed councils, environmental groups, land use planners and natural resource managers can help answer these questions.

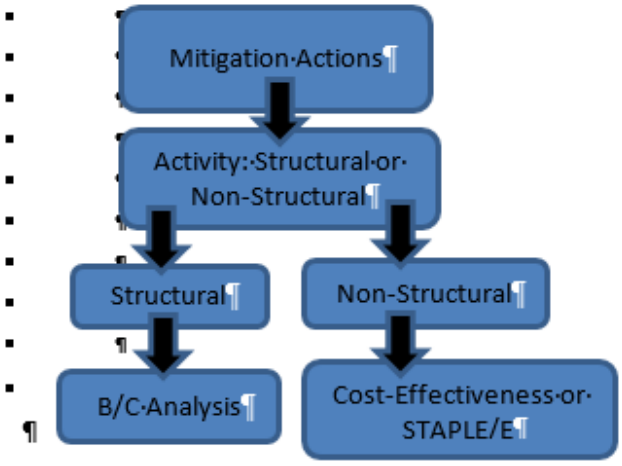
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

The STAPLE/E approach is helpful for doing a quick analysis of mitigation projects. Most projects that seek federal funding and others often require more detailed benefit/cost analyses.

When to use the Various Approaches

It is important to realize that various funding sources require different types of economic analyses. The following figure is to serve as a guideline for when to use the various approaches.

Figure C-1 Economic Analysis Flowchart



Source: Tricia Sears, DLCD, November 2018, based on OPDR 2005.

Implementing the Approaches

Below is a framework that could be used in further analyzing the feasibility of implementing prioritized mitigation actions after determining – through the use of one of the economic analysis approached described above – whether or not to implement the mitigation action.

1. Identify the Activities

Activities for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among

others. Different mitigation projects can assist in minimizing risk to natural hazards, but do so at varying economic costs.

2. Calculate the Costs and Benefits

Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate activities. Potential economic criteria to evaluate alternatives include:

- ***Determine the project cost***. This may include initial project development costs, and repair and operating costs of maintaining projects over time.

- ***Estimate the benefits***. Projecting the benefits, or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment. This is difficult to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.

- ***Consider costs and benefits to society and the environment***. These are not easily measured, but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.

- ***Determine the correct discount rate***. Determination of the discount rate can just be the risk-free cost of capital, but it may include the decision-maker's time preference and also a risk premium. Including inflation should also be considered.

3. Analyze and Rank the Activities

Once costs and benefits have been quantified, economic analysis tools can rank the possible mitigation activities. Two methods for determining the best activities given varying costs and benefits include net present value and internal rate of return.

- ***Net present value***. Net present value is the value of the expected future returns of an investment minus the value of the expected future cost expressed in today's dollars. If the net present value is greater than the projected costs, the project may be determined feasible for implementation. Selecting the discount rate, and identifying the present and future costs and benefits of the project calculates the net present value of projects.

- ***Internal rate of return***. Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the

internal rate of return is greater than the total costs of the project. Once the mitigation projects are ranked on the basis of economic criteria, decision-makers can consider other factors, such as risk, project effectiveness, and economic, environmental, and social returns in choosing the appropriate project for implementation.

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owners as a result of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of mitigation should consider reductions in physical damages and financial losses. A partial list follows:

- Building damages avoided,
- Content damages avoided,
- Inventory damages avoided,
- Rental income losses avoided,
- Relocation and disruption expenses avoided, and
- Proprietor's income losses avoided.

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period of time.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These are usually termed "indirect" effects, but they can have a very direct effect on the economic value of the owner's building or land. They can be positive or negative, and include changes in the following:

- Commodity and resource prices,
- Availability of resource supplies,
- Commodity and resource demand changes,
- Building and land values,
- Capital availability and interest rates,
- Availability of labor,
- Economic structure,
- Infrastructure,
- Regional exports and imports,
- Local, state, and national regulations and policies, and
- Insurance availability and rates.

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts

of changes in an economy. Decision-makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. With this in mind, opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

As noted in the *2015 Sweet Home NHMP*,

> Although benefit-cost analysis is a powerful tool for helping to evaluate and prioritize mitigation projects, and a requirement for all FEMA hazard mitigation grants, benefit-cost analysis should not be considered the sole determinant for mitigation actions. In some cases, the potential for negative effects from a particular natural hazard may simply be deemed unacceptable, such as the potential for deaths and injuries, and thus mitigation may be undertaken without benefit-cost analysis.

Resources

These resources were identified in the *2014 Umatilla County NHMP* with this section, and in other NHMPs during 2014-2015; these may not be widely available at this time.

CUREe Kajima Project, *Methodologies for Evaluating the Socio-Economic Consequences of Large Earthquakes*, Task 7.2 Economic Impact Analysis, Prepared by University of California, Berkeley Team, Robert A. Olson, VSP Associates, Team Leader; John M. Eidinger, G&E Engineering Systems; Kenneth A. Goettel, Goettel and Associates, Inc.; and Gerald L. Horner, Hazard Mitigation Economics Inc., 1997

Federal Emergency Management Agency, *Benefit/Cost Analysis of Hazard Mitigation* Projects, Riverine Flood, Version 1.05, Hazard Mitigation Economics, Inc., 1996

Federal Emergency Management Agency, *Report on the Costs and Benefits of Natural Hazard Mitigation*. Publication 331, 1996.

Goettel & Horner Inc., *Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in the City of Portland*, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

Goettel & Horner Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects* Volume V, Earthquakes, Prepared for FEMA's Hazard Mitigation Branch, October 25, 1995.

Horner, Gerald, *Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures*, Robert Olsen Associates, Prepared for Oregon Military Department – Office of Emergency Management, July 1999.

Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon State Police – Office of Emergency Management, 2000.)

Risk Management Solutions, Inc., *Development of a Standardized Earthquake Loss Estimation Methodology*, National Institute of Building Sciences, Volume I and II, 1994.

VSP Associates, Inc., *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings*, Volumes 1 & 2, Federal Emergency management Agency, FEMA Publication Numbers 227 and 228, 1991.

VSP Associates, Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects*, 1993.

VSP Associates, Inc., *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model*, Volume 1, Federal Emergency Management Agency, FEMA Publication Number 255, 1994.

APPENDIX D:
GRANT PROGRAMS AND RESOURCES

Introduction

There are numerous local, state, and federal funding sources available to support natural hazard mitigation projects and planning. The following section includes an abbreviated list of the most common funding sources and resources utilized by local jurisdictions in Oregon. Because grant programs often change, it is important to periodically review available funding sources for current guidelines and program descriptions.

Note that FEMA administers three programs that provide funding for eligible mitigation planning and projects that reduces disaster losses and protect life and property from future disaster damages. The three programs are the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) Program, and the Building Resilient Infrastructure and Communities (BRIC) (formerly the Pre-Disaster Mitigation (PDM) Program).
https://www.fema.gov/hazard-mitigation-assistance

Post-Disaster Federal Programs

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP involves a paper application which is first offered to the counties with declared disasters within the past year, then becomes available statewide if funding is still available.
http://www.fema.gov/hazard-mitigation-grant-program

Disaster Loan Assistance

There are four types of loans available from the U.S. Small Business Administration (SBA): home and personal property loans; business physical disaster loans; economic injury loans; and military reservist injury loans. When physical disaster loans are made to homeowners and businesses following disaster declarations by the SBA, up to 20% of the loan amount can go towards specific measures taken to protect against recurring damage in similar future disasters.
http://www.sba.gov/category/navigation-structure/loans-grants/small-business-loans/disaster-loans

Pre-Disaster Federal Programs

Building Resilient Infrastructure and Communities (BRIC)

The Pre-Disaster Mitigation (PDM) grant transitioned to the Building Resilient Infrastructure and Communities (BRIC) program for applications in FY 2020. The Pre-Disaster Mitigation (PDM) Program provided funds to state, local, and Tribal entities for hazard mitigation planning and the implementation of mitigation projects before a disaster.

As described on FEMA's website, "Building Resilient Infrastructure and Communities (BRIC) will support states, local communities, tribes and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards…The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency."

The website also describes, "The Building Resilient Infrastructure and Communities (BRIC) program aims to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience. FEMA anticipates BRIC funding projects that demonstrate innovative approaches to partnerships, such as shared funding mechanisms, and/or project design. For example, an innovative project may bring multiple funding sources or in-kind resources from a range of private and public sector stakeholders or offer multiple benefits to a community in addition to the benefit of risk reduction."

https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

Flood Mitigation Assistance Program

The overall goal of the Flood Mitigation Assistance (FMA) Program is to fund cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other National Flood Insurance Program (NFIP) insurable structures. This specifically includes:

- Reducing the number of repetitively or substantially damaged structures and the associated flood insurance claims;
- Encouraging long-term, comprehensive hazard mitigation planning;
- Responding to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development activities; and
- Complementing other federal and state mitigation programs with similar, long-term mitigation goals.

http://www.fema.gov/flood-mitigation-assistance-program

Detailed program and application information for federal post-disaster and pre-disaster programs can be found in the *Hazard Mitigation Assistance Guidance*, dated February 27, 2015, available at: Hazard Mitigation Assistance Guidance Feb 27, 2015 (fema.gov). Note that guidance regularly changes. Verify that you have the most recent edition. Flood mitigation assistance is usually offered annually; applications are submitted online. Applicants need a user profile approved by the State Hazard Mitigation Officer (SHMO), which should be garnered well before the application period opens.

For Oregon Military Department, Office of Emergency Management (OEM) grant guidance on Federal Hazard Mitigation Assistance, visit:
https://www.oregon.gov/OEM/emresources/Grants/Pages/HMA.aspx

Contact: Amie Bashant, State Hazard Mitigation Officer (SHMO), amie.bashant@state.or.us

State Programs

State Preparedness and Incident Response Equipment (SPIRE)

Oregon House Bill 2687 became effective in August 2017. It established a grant program to distribute emergency preparedness equipment to local governments and other recipients to be used to decrease risk of life and property resulting from an emergency. Items purchased must qualify as capital assets, meaning individual items must cost at least $5,000. A total of $5,000,000 is available to procure emergency preparedness equipment to help Oregon communities prepare, respond, and recover from emergencies.

The deadline for this grant program, as listed on the OEM website, is March 1, 2019. Jim Jungling is the contact for the SPIRE program, jim.jungling@state.or.us. According to Jim Jungling, this was the only opportunity the SPIRE grant was offered. The equipment procurement and distribution should be complete by the end of 2021. It is possible that the grant could be funded again in the future by the Oregon Legislature.[1] https://www.oregon.gov/oem/emresources/Grants/Pages/Spire.aspx

Seismic Rehabilitation Grant Program

The Seismic Rehabilitation Grant Program (SRGP) provides state funds to strengthen public schools and emergency services buildings so they will be less damaged during an earthquake. Reducing property damage, injuries, and casualties caused by earthquakes is the goal of the SRGP.
http://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/

Community Development Block Grant Program

The Community Development Block Grant (CDBG) Program provides annual grants on a formula basis to states, cities, and counties to develop viable urban communities by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for low- and moderate-income persons. The program is authorized under Title 1 of the Housing and Community Development Act of 1974, Public Law 93-383, as amended 42 U.S.C. 5301 et seq. The program was designed to reinforce several important values and principles of community development.

CDBG funds may be used for activities which include, but are not limited to:

- Acquisition of real property
- Relocation and demolition

[1]Jim Jungling, Grants Coordinator, OEM, personal communication, 7/2/21.

- Rehabilitation of residential and non-residential structures
- Construction of public facilities and improvements, such as water and sewer facilities, streets, neighborhood centers, and the conversion of school buildings for eligible purposes
- Public services, within certain limits
- Activities relating to energy conservation and renewable energy resources
- Provision of assistance to profit-motivated businesses to carry out economic development and job creation/retention activities.

Each activity must meet one of the following national objectives for the program: benefit low- and moderate-income persons, prevention or elimination of slums or blight, or address community development needs having a particular urgency because existing conditions pose a serious and immediate threat to the health or welfare of the community for which other funding is not available. Generally, the following types of activities are ineligible:

- Acquisition, construction, or reconstruction of buildings for the general conduct of government
- Political activities
- Certain income payments
- Construction of new housing (with some exceptions).

Community Development Block Grant Program | HUD.gov / U.S. Department of Housing and Urban Development (HUD)

Oregon Watershed Enhancement Board

The Oregon Watershed Enhancement Board is a state agency that provides grants to help Oregonians take care of local streams, rivers, wetlands, and natural areas. Community members and landowners use scientific criteria to decide jointly what needs to be done to conserve and improve rivers and natural habitat in the places where they live. OWEB grants are funded from the Oregon Lottery, federal dollars, and salmon license plate revenue. The agency is led by an 18-member citizen board drawn from the public at large, tribes, and federal and state natural resource agency boards and commissions. The mission statement is "To help protect and restore healthy watersheds and natural habitats that support thriving communities and strong economies." There are numerous programs, grants, and technical assistance options available.

Oregon Watershed Enhancement Board : About Us : About Us : State of Oregon

Oregon Watershed Enhancement Board : OWEB Index : State of Oregon

Federal Mitigation Programs, Activities & Initiatives

Basic & Applied Research/Development

National Earthquake Hazard Reduction Program (NEHRP), National Science Foundation

Through broad based participation, the NEHRP attempts to mitigate the effects of earthquakes. Member agencies in NEHRP are the US Geological Survey (USGS), the National Science Foundation (NSF), the Federal Emergency Management Agency (FEMA), and the National Institute for Standards and Technology (NIST). The agencies focus on research and development in areas such as the science of earthquakes, earthquake performance of buildings and other structures, societal impacts, and emergency response and recovery. There are grants available. http://www.nehrp.gov/

Decision, Risk, and Management Science Program, National Science Foundation

Supports scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society. Disciplinary and interdisciplinary research, doctoral dissertation research, and workshops are funded in the areas of judgment and decision making; decision analysis and decision aids; risk analysis, perception, and communication; societal and public policy decision making; management science and organizational design. The program also supports small grants for exploratory research of a time-critical or high-risk, potentially transformative nature. http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423

Hazard ID and Mapping

National Flood Insurance Program: Flood Mapping; FEMA

Flood maps are one tool that communities use to know which areas have the highest risk of flooding. FEMA maintains and updates data through flood maps and risk assessments. Flood insurance rate maps and flood plain management maps for all NFIP communities. http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping

Cooperating Technical Partners (CTP) Program

The Cooperating Technical Partners Program is an innovative approach to create partnerships between FEMA and communities participating in the NFIP**.** Other partners include regional and state agencies, tribes, territories and universities that have the interest and capability to become more active participants in the FEMA flood hazard mapping program. The purpose of the CTP Program is to provide, through a Cooperative Agreement, funds to ensure that partners can perform program management and technical mapping-related activities.

Cooperating Technical Partners Program | FEMA.gov

The National Map, USGS

The National Map is a suite of products and services that provide access to base geospatial information to describe the landscape of the United States and its territories. The National Map embodies 11 primary products and services and numerous applications and ancillary services. The National Map supports data download, digital and print versions of topographic maps, geospatial data services, and online viewing.

The National Map (TNM) supporting themes include boundaries, elevation, geographic names, hydrography, land cover, orthoimagery, structures, and transportation. Other types of georeferenced or mapping information can be added within TNM Viewer or brought in with TNM data into a GIS to create specific types of maps or map views and (or) to perform modeling or analyses. The National Map (usgs.gov)

National Cooperative Geologic Mapping Program, USGS

The National Cooperative Geologic Mapping Program (NCGMP) is the primary source of funds for the production of geologic maps in the United States and provides accurate geologic maps and three-dimensional framework models that help to sustain and improve the quality of life and economic vitality of the Nation and to mitigate natural hazards. The National Cooperative Geologic Mapping Program (NCGMP) is the primary source of funds for the production of geologic maps in the United States and provides accurate geologic maps and three-dimensional framework models that help to sustain and improve the quality of life and economic vitality of the Nation and to mitigate natural hazards. National Cooperative Geologic Mapping Program - About (usgs.gov)

Soil Survey, USDA-NRCS

The Soils section is part of the National Cooperative Soil Survey, an effort of Federal and State agencies, universities, and professional societies to deliver science-based soil information. Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation or related purposes. http://soils.usda.gov/survey/printed_surveys/

Oregon Coastal Atlas

The Oregon Coastal Atlas is a multi-group project that has the ambitious goal of being a useful resource for the various audiences that make up the management constituency of the Oregon Coastal Zone. The project is a depot for traditional and digital information which can be used to inform decision-making relating to the Oregon Coastal Zone. We provide background information for different coastal systems, access to interactive mapping, online geospatial analysis tools, and direct download of various planning and natural resource data sets. http://www.coastalatlas.net/

Oregon Geospatial Data Clearinghouse

Hosted by the Oregon Geospatial Enterprise Office, this is an electronic library of Oregon geographic information including Geographic Information System (GIS) data, orthophotography, Digital Elevation Models, and more. The Geospatial Enterprise Office (GEO) coordinates with government agencies to develop and manage geographic information. It communicates about Geographic Information Systems (GIS) issues with users. It guides development of Oregon's GIS data standards. Working together, state, federal, and local governments are improving the geographic information they share. GEO is also the State's point of contact for other organizations about geographic information and GIS. GEO also hosts the Oregon Geospatial Data Clearinghouse, an electronic library of geographic information. http://www.oregon.gov/DAS/CIO/GEO/Pages/sdlibrary.aspx

Oregon Explorer

The Oregon Explorer – maintained by the Institute for Natural Resources at Oregon State – provides several portals developed to provide background information about many topics relevant to Oregon natural hazards. Tools include the Hazards Reporter, an interactive map viewer created to provide

current detailed information for hazards such as flood, tsunami, earthquake, volcano, and landslides for a variety of users including planners.

http://oregonexplorer.info/hazards/OregonsNaturalHazards

Oregon HazVu: Statewide Geohazards Viewer

HazVu provides a way to view many different geohazards in Oregon. You can enter the address for your home, school, business, or public buildings in your area to see what hazards might affect you. You can print the map you create. Geohazards include 100-year flooding; Cascadia Subduction Zone earthquake shaking and tsunami; coastal erosion; volcano; landslide; active faults; earthquake soft soil; and more. Assets include state-owned/leased facilities and public buildings such as schools, police and fire stations, and hospitals, as well as links to seismic assessment reports for these public buildings. https://www.oregongeology.org/hazvu/

Oregon Risk MAP

Oregon is part of FEMA Region X which covers four states: Alaska, Idaho, Oregon, and Washington. FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) program represents a flood hazard mapping and risk analysis process with planning and mitigation considerations woven throughout. Risk MAP involves: (1) discovering local needs, (2) mapping with better base data, and (3) working with community representatives in assessing risk and vulnerability.

Risk MAP concerns the community, making maps and information available in a way that that makes sense, is understandable, and is usable. Risk MAP is a national program to work with states, tribes, territories, and local communities to evaluate and better understand their current flood risk, as well as the actions that can be taken to mitigate and become more resilient against future risk. More details about the Risk MAP program can be found here, and specific project information can be found by entering your community information into the Projects page.

https://www.fema.gov/risk-map-region-x

RAPTOR - Real Time Assessment and Planning Tool for Oregon

The State of Oregon initiated RAPTOR in 2010 to share information on a common operating picture (COP) as part of the US Department of Homeland Security's Virtual USA Northwest Pilot Project program. RAPTOR enables users access to live data in combination with traditional map layers to create a comprehensive picture anywhere, anytime.

RAPTOR is a web mapping application that allows users to display data from various resources onto a single map. RAPTOR supports our Emergency Operations Plan by sharing information before, during and after an event. RAPTOR allows us to develop, implement and operate data sharing with our community. RAPTOR enhances our overall readiness because as we all know, incidents do not stop at our borders. http://www.oregon.gov/oem/emops/Pages/RAPTOR.aspx

Project Support

Coastal Zone Management Program, NOAA.

The National Coastal Zone Management Program comprehensively addresses the nation's coastal issues through a voluntary partnership between the federal government and coastal and Great

Lakes states and territories. Authorized by the Coastal Zone Management Act of 1972, the program provides the basis for protecting, restoring, and responsibly developing our nation's diverse coastal communities and resources.

Currently 34 coastal states participate. While state partners must follow basic requirements, the program also gives states the flexibility to design unique programs that best address their coastal challenges and regulations. By leveraging both federal and state expertise and resources, the program strengthens the capabilities of each to address coastal issues.

Provides grants for planning and implementation of non-structural coastal flood and hurricane hazard mitigation projects and coastal wetlands restoration. https://coast.noaa.gov/czm/

Community Development Block Grant Entitlement Communities Program, US Department of Housing and Urban Development

The Community Development Block Grant (CDBG) Entitlement Program provides annual grants on a formula basis to entitled cities and counties to develop viable urban communities by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for low- and moderate-income persons. The program is authorized under Title 1 of the Housing and Community Development Act of 1974, Public Law 93-383, as amended; 42 U.S.C.-530.1 et seq. CDBG Entitlement Program - HUD Exchange

National Cohesive Wildland Fire Management Strategy (USDA, USFS)

The Forest Service has been managing wildland fire on National Forests and Grasslands for more than 100 years. But the Forest Service doesn't do it alone. Instead, the agency works closely with other federal, tribal, state, and local partners. Over the last few decades, the wildland fire management environment has profoundly changed. Longer fire seasons; bigger fires and more acres burned on average each year; more extreme fire behavior; and wildfire suppression operations in the wildland urban interface (WUI) have become the norm.

To address these challenges, the Forest Service and its other federal, tribal, state, and local partners have developed and are implementing a *National Cohesive Wildland Fire Management Strategy* that has three key components: Resilient Landscapes, Fire Adapted Communities, and Safe and Effective Wildfire Response. National Cohesive Wildland Fire Management Strategy (fs.fed.us)

Assistance to Firefighters Grant Program, FEMA

Fire safety grants fund critically needed resources to equip and train emergency personnel, enhance efficiencies, and support community resilience. Three types of grants are available: Assistance to Firefighters Grant (AFG), Fire Prevention and Safety (FP&S), and Staffing for Adequate Fire and Emergency Response (SAFER). FEMA AFG grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. Fire Prevention & Safety (FP&S) grants support projects that enhance the safety of the public and firefighters from fire and related hazards. SAFER grants fund fire departments and volunteer firefighter interest organizations directly to help them increase capacity in their communities.

http://www.fema.gov/welcome-assistance-firefighters-grant-program

Emergency Watershed Protection Program, USDA-NRCS

The Emergency Watershed Protection (EWP) Program, a federal emergency recovery program, helps local communities recover after a natural disaster strikes. The program offers technical and financial assistance to help local communities relieve imminent threats to life and property caused by floods, fires, windstorms and other natural disasters that impair a watershed.

The EWP Program allows communities to quickly address serious and long-lasting damages to infrastructure and to the land. The EWP Program authorities offer NRCS the flexibility to act quickly to help local communities cope with adverse impacts resulting from natural disasters. EWP does not require a disaster declaration by federal or state government officials for program assistance to begin. The NRCS State Conservationist can declare a local watershed emergency and initiate EWP program assistance in cooperation with an eligible sponsor (see the "Eligibility" section below). NRCS will not provide funding for activities undertaken by a sponsor prior to the signing of a cooperative agreement between NRCS and the sponsor.

If funding becomes available, all funded projects must demonstrate they reduce threats to life and property; be economically, environmentally and socially sound; and must be designed to acceptable engineering standards, if applicable.

http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp

Rural Development Assistance – Utilities, USDA

USDA's Rural Utilities Service (RUS) provides much-needed infrastructure or infrastructure improvements to rural communities. These include water and waste treatment, electric power, and telecommunications services. These services help to expand economic opportunities and improve the quality of life for rural residents.
https://www.rd.usda.gov/about-rd/agencies/rural-utilities-service

Rural Development Assistance – Housing, USDA.

USDA Rural Development Assistance (RDA) operates over fifty financial assistance programs for a variety of rural applications. Select a category that best describes your situation. The RDA program provides grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster is necessary.
https://www.rd.usda.gov/programs-services

Public Assistance Grant Program, FEMA.

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide assistance to State, Tribal and local governments, and certain types of Private Nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.

http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

National Flood Insurance Program, FEMA

The NFIP makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements. Flood insurance is available to anyone living in one of the 23,000 participating NFIP communities. Homes and businesses in high-risk flood areas with mortgages from government-backed lenders are required to have flood insurance.

http://www.fema.gov/national-flood-insurance-program

HOME Investments Partnerships Program (IPP), HUD

The HOME IPP provides grants to states, local government and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons. HOME provides grants to state and local governments to create affordable housing for low-income households. HOME: HOME Investment Partnerships Program - HUD Exchange

Disaster Recovery Initiative, HUD

HUD provides flexible grants to help cities, counties, and states to recover from Presidentially declared disasters, especially in low-income areas, subject to the availability of supplemental appropriations. In response to Presidentially declared disasters, Congress may appropriate additional funding for the Community Development Block Grant (CDBG) Program as Disaster Recovery grants to rebuild the affected areas and provide crucial seed money to start the recovery process. Since CDBG Disaster Recovery (CDBG-DR) assistance may fund a broad range of recovery activities, HUD can help communities and neighborhoods that otherwise might not recover due to limited resources. The DRI provides grants to fund gaps in available recovery assistance after disasters (including mitigation).

CDBG-DR: Community Development Block Grant Disaster Recovery Program - HUD Exchange

Emergency Management Performance Grants, FEMA

The purpose of the Emergency Management Performance Grant (EMPG) program is to make grants available to states to assist state, local, territorial and tribal governments in preparing for all hazards, as authorized by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5121 et seq.). EMPG grants help state and local governments to sustain and enhance their all-hazards emergency management programs.

DHS: Emergency Management Performance Grant (in.gov)

Partners for Fish and Wildlife, DOI – FWS

The Partners for Fish and Wildlife Program provides technical and financial assistance to landowners interested in restoring and enhancing wildlife habitat on their land. Projects are custom designed to meet landowners' needs. Since the program's start in 1987, some 50,000 landowners have worked with Partners staff to complete 60,000 habitat restoration projects on 6 million acres. Partners projects are voluntary. Participating landowners continue to own and manage their land to serve their needs while they improve conditions for wildlife. The PFW program provides financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats. http://www.fws.gov/partners/

North American Wetland Conservation Fund, DOI-FWS

NAWC fund provides cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats. The grant funds projects for wetlands conservation in the United States, Canada, and Mexico.

https://www.grants-gov.net/cfda.php?CFDANumber=15.623

Federal Land Transfer / Federal Land to Parks Program, DOI-NPS

Identifies, assesses, and transfers available federal real property for acquisition for state and local parks and recreation, such as open space. The NPS's Federal Lands to Parks Program gives surplus federal land, usually at no cost, to communities for public parks and recreational areas. Surplus properties are properties held by the federal government that it no longer needs. Since its inception in 1949, this program has transferred about 178,000 acres to state and local governments.

This program exists to help communities get land from the federal government. We advocate for communities that want to acquire land and ensure those properties stay open for public recreational use and taken care of. We are engaged with every step of the process, from applying for properties to securing ownership.

What We Do - Federal Lands to Parks Program (U.S. National Park Service) (nps.gov)

Wetlands Reserve program, USDA-NCRS

The Wetlands Reserve Program (WRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. WRP offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.

Wetlands Reserve Program (WRP) | Conservation Program Maps | NRCS (usda.gov)

Secure Rural Schools and Community Self-Determination Act of 2000, US Forest Service.

It was originally enacted in 2000 to provide five years of transitional assistance to rural counties affected by the decline in revenue from timber harvests on federal lands. Funds have been used for improvements to public schools, roads, and stewardship projects. Money is also available for maintaining infrastructure, improving the health of watersheds and ecosystems, protecting communities, and strengthening local economies. The Further Consolidated Appropriations Act, 2020, reauthorized payments for fiscal years 2019 and 2020. http://www.fs.usda.gov/pts/

The Oregon Climate Change Adaptation Framework

The 2010 report provides a framework for the continued development of strategies and plans to address future climate conditions in the state. It is the result of a collaborative effort between Oregon's state agencies, and with support from the Oregon Climate Change Research Institute. The 2010 report is being completely updated, through a process led by DLCD, with 24 participating agencies, in 2019-2021. The *2021 State Agency Climate Change Adaptation Framework* was published in January 2021.

https://www.oregon.gov/lcd/Publications/Climate_Change_Adaptation_Framework_2010.pdf

https://www.oregon.gov/lcd/CL/Documents/2021_Climate_Change_Adaptation_Framework_with_Blueprint.pdf

Oregon Climate Assessment Report

The Oregon State Legislature established the Oregon Climate Change Research Institute (OCCRI) within the Department of Higher Education in 2007. OCCRI is a network of over 150 researchers at Oregon State University (OSU), the University of Oregon, Portland State University, Southern Oregon University, and affiliated federal and state labs. OCCRI is administered by OSU. The *Fifth Oregon Climate Assessment Report* was released on January 5, 2021. OCAR5.pdf | Powered by Box

Oregon Health Authority (OHA)

Environmental public health works to identify, assess and report on threats to human health from exposure to environmental and occupational hazards, and advise Oregon communities on potential risks where they live, work and play to remain healthy and safe. OHA's Climate and Health Program is working with partners to study, prevent, and plan for the health effects of climate change.

The *Climate and Health Resilience Plan* offers a selection of strategies and policy priorities for state, local, and tribal public health practitioners and partners.

http://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Pages/resilience-plan.aspx

Oregon's *Public Health Hazard Vulnerability Assessment* summarizes public health consequences of Oregon's likely hazards based on the input from local health jurisdictions, tribal health agencies, and emergency management partners.

http://www.oregon.gov/oha/PH/Preparedness/Partners/Documents/OHA%208584%20PH%20Hazard%20Vulnerability.pdf

Oregon Silver Jackets

The Oregon Silver Jackets Team is a subcommittee to the State Interagency Hazard Mitigation Team. It is an interagency team dedicated to establish and strengthen intergovernmental partnerships at the state level as a catalyst in developing comprehensive and sustainable solutions to state flood hazard challenges. Silver Jackets Website > State Teams > Oregon (nfrmp.us)

USGS Natural Hazards

The USGS Natural Hazards Mission Area includes six science programs: Coastal & Marine Geology, Earthquake Hazards, Geomagnetism, Global Seismographic Network, Landslide Hazards, and Volcano Hazards. Through these programs, the USGS provides alerts and warnings of geologic hazards and interactive maps and data.

http://www.usgs.gov/natural_hazards/

State Interagency Hazard Mitigation Team (IHMT) website

Find IHMT meeting dates and locations, agendas, minutes and meeting materials. The State IHMT is comprised of about 18 state agencies involved with natural hazards. The State IHMT meets quarterly to understand losses arising from natural hazards, coordinate recommended strategies to mitigate loss of life, property, and natural resources, and maintain the Oregon Natural Hazards Mitigation Plan. http://www.oregon.gov/oem/Councils-and-Committees/Pages/IHMT.aspx

Oregon Natural Hazards Mitigation Plan (NHMP)

The Oregon NHMP identifies and prioritizes potential actions throughout Oregon that would reduce our vulnerability to natural hazards. In addition, the plan satisfies the requirements of the Federal Emergency Management Agency (FEMA) to ensure that Oregon is eligible to receive hazard mitigation and disaster assistance funds from the federal government. The current version of the plan was approved in September 2020 and is valid through September 2025. NHMPs must be updated and reapproved every five years by FEMA - so as to remain valid.

https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

Oregon Department of Land Conservation and Development (DLCD) Technical Assistance (TA) Grants

DLCD's General Fund grants are used primarily for Oregon communities' comprehensive planning and plan updates. The fund is divided into functional categories and made available for specific types of projects. During 2019-2021, the categories included Population Forecasting, Technical Assistance, Columbia River Gorge National Scenic Area, Grant Young Memorial Planning Assistance, and a Dispute Resolution grant to the Oregon Consensus Program.

Grant categories have, from time to time, been designated in DLCD's budget notes, in which the Legislature gives direction on how monies should be spent that is applicable only for that particular biennium. DLCD's *2021-2023 General Fund Grants Allocation Plan* provides the guidance for DLCD's decision-making for the upcoming opportunities for DLCD Technical Assistance Grants. The TA Grants use General Fund money appropriated by the Oregon Legislature for each two-year budgetary period. As of 7/2/21, the Oregon Legislature allocation of funds for DLCD TA Grants for the 2021-2023 biennium is $600,000 to $700,000.[2]

https://www.oregon.gov/lcd/CPU/Pages/Community-Grants.aspx

Lindbergh Grants Program

The Lindbergh Foundation is the grant administrator. The purpose is to balance the advance of technology and the preservation of the natural human environment. It can be used for the conservation of natural resources and public outreach/education projects. Grants are awarded to specific projects as they are identified. http://lindberghfoundation.org/

Energy Trust of Oregon

Energy Trust of Oregon is a nonprofit organization committed to delivering clean, affordable energy to 1.7 million utility customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista, and NW Natural customers. Energy Trust can provide technical support and cash incentives for new construction projects starting at the early design stage to help identify opportunities for improving the energy performance and resilience of the building. Energy Trust also provides information, cash incentives, technical support and resources to support energy investments in existing residential, commercial, municipal, nonprofit, tribal, or institutional sites

[2] Gordon Howard, Community Services Division Manager, DLCD, personal communication, 7/2/21.

across the state. Energy Trust has resources to support communities who are addressing potential risks to their energy systems, including aging infrastructure, natural disasters and severe weather events. Complete this form on the website to find out how they can support your project: https://www.energytrust.org/communities/community-contact-us-form/ and www.energytrust.org

APPENDIX E:
SWEET HOME SUCCESS STORIES

Introduction

There are many times when a community ascertains a problem or an issue and then works to troubleshoot or problem solve. That takes recognition and commitment.

One illustration of this commitment to increase resilience is that mitigation actions identified in the NHMPs can become integrated into the regular activities that a community does. For example, these activities may be something like a yearly trimming of roadside vegetation to reduce fuel load for wildfires or a public outreach campaign each winter to alert and remind people of winter hazards. In the mitigation actions tables, communities often mark these activities or actions as "on-going." These on-going activities have become well accepted activities the community continues to prioritize each year. This is a very good accomplishment to have mitigation integrated as a priority.

Mitigation actions can also be achieved through specific projects.

Below, there are examples from the Sweet Home NHMP Steering Committee of success stories.

Sweet Home Wastewater Treatment Plan

This success story, including the photos, was provided by Lagea Mull, Communications Specialist/PIO, City of Sweet Home, via personal communication, 9/8/21.

In November 2017, Sweet Home City Council approved a rate increase to plan to construct a new Wastewater Treatment Plant. These efforts have assisted the City in building up wastewater fund reserves in anticipation of a multi-million-dollar plant expansion. We also went before the State of Oregon Infrastructure Committee to request a variety of grants. Since then, the State of Oregon has appropriated lottery funds to the City of Sweet Home for $2 million for design and another $7 million for construction.

Photos of the Wastewater Treatment Plant were provided by Lagea Mull.

Wastewater Treatment Plant Aerial View

Source: Lagea Mull, Sweet Home, personal communication, 9/8/21

Wastewater Treatment Plant

Source: Lagea Mull, Sweet Home, personal communication, 9/8/21

Sweet Home Police Building

This success story was provided by the Sweet Home NHMP Steering Committee members during September 2021. The photo of the police building was provided by Lagea Mull, Communications Specialist/PIO, City of Sweet Home, via personal communication, 9/8/21.

During the Hazard Vulnerability Analysis and mitigation action discussions, the Sweet Home NHMP Steering Committee talked about the impacts of earthquakes on critical infrastructure. Regarding the police building, Brandon Neish, Finance Director at Sweet Home, ascertained that "The Police Department was built to 1999 seismic standards. In reviewing the documentation submitted by the engineering firm prior to construction, various building materials such as sheer walls and metal columns/posts were used, and meticulous calculations were run to ensure the building would withstand a seismic event. Additional reinforcement was added to the roof to ensure viability."

Jeff Lynn, the current Sweet Home Police Chief, and Brandon noted that there are six HVAC units on the roof. That could be the cause of having additional reinforcement added to the roof. After discussing this information with the NHMP Steering Committee, the NHMP Steering Committee agreed that Joe Graybill would look at the building code. Joe described that "the building construction code in effect at the time of the Justice Facility construction was during the transition from the *1998 Oregon Structural Specialty Code* and the *1997 Uniform Building Code*, effective from October 1, 1998, to the *2004 Oregon Structural Specialty Code* and the *2003 International Building Code*, effective October 1, 2004."

Joe described that the current code is the *2019 Oregon Structural Specialty Code* (OSSC) including *2018 International Building Code* (IBC) and *2018 International Fire Code* (IFC), effective since October 1, 2019.

Sweet Home Police Building

Source: Lagea Mull, Sweet Home, personal communication, 9/8/21

Seismic Upgrades with Sweet Home School District

This description of the successful implementation of seismic upgrades to schools in the Sweet Home School District is provided by Kevin Strong, Sweet Home School District, via personal communication, 8/10/21. Mr. Strong also provided the photos that accompany the text.

As described by Kevin Strong, the seismic projects at Foster Elementary (2019), Hawthorne Elementary (2018), Holley Elementary (2019) and the Sweet Home High School auditorium (2017) were largely funded with grants from the state seismic rehabilitation grant program. The junior high project (2020) was not a seismic project, but seismic improvements were included. It was funded with a bond, a state school facility matching grant and district long term maintenance funds.

FOSTER ELEMENTARY

These are the changes made to the Foster Elementary School.

• Verify diaphragm sheathing and nailing over skip sheathing. Strengthen as required.

• Install plywood sheathing over the decking present in the addition at the northwest corner of the building.

• To limit the aspect ratio of the roof diaphragm to code prescribed limits the existing interior cross walls will be sheathed with plywood on the existing wall framing. Existing gypsum interior finish will be removed and replaced over the plywood sheathing. The walls will be adequately attached to the existing slab on grade utilizing post installed anchors and attached to the roof framing using structural screws.

• Additional connection hardware will be added to strengthen the connection between the roof diaphragms and shear walls.

• Windows will be removed and in-filled in strategic locations to provide new plywood shear walls and establish a shear transfer between the upper and lower roof diaphragms and shear walls below.

• New shear panels shall be frames or full height blocking between joists shall be installed to properly transfer the in-plane seismic force into the shear walls from the roof diaphragm.

• The existing glass block openings found around the perimeter of the building shall be strategically in-filled to provide adequate in-plane shear resistance.

• Remove remaining glass block in perimeter walls and replace with glazing • Where new shear walls are to be located, provide additional anchors to transfer lateral loads from the wall base plates to the concrete stem walls.

• All wood posts to beam or foundation element connections shall have new post installed connection hardware.

• All piping and HVAC equipment found throughout the building shall be properly braced and attached to the structure to limit the potential damage.

• Any mechanical equipment weighing over 20 pounds shall be attached and properly braced.

• Provide proper attachment and bracing for all non-structural components and equipment.

Foster Elementary School

Source: Kevin Strong, Sweet Home School District, personal communication, 8/10/21

Sweet Home High School Auditorium

These are the changes made to Sweet Home High School

• The tops of the concrete walls need to be properly attached to the roof and floor diaphragms for both in-plane and out-of-plane loading.

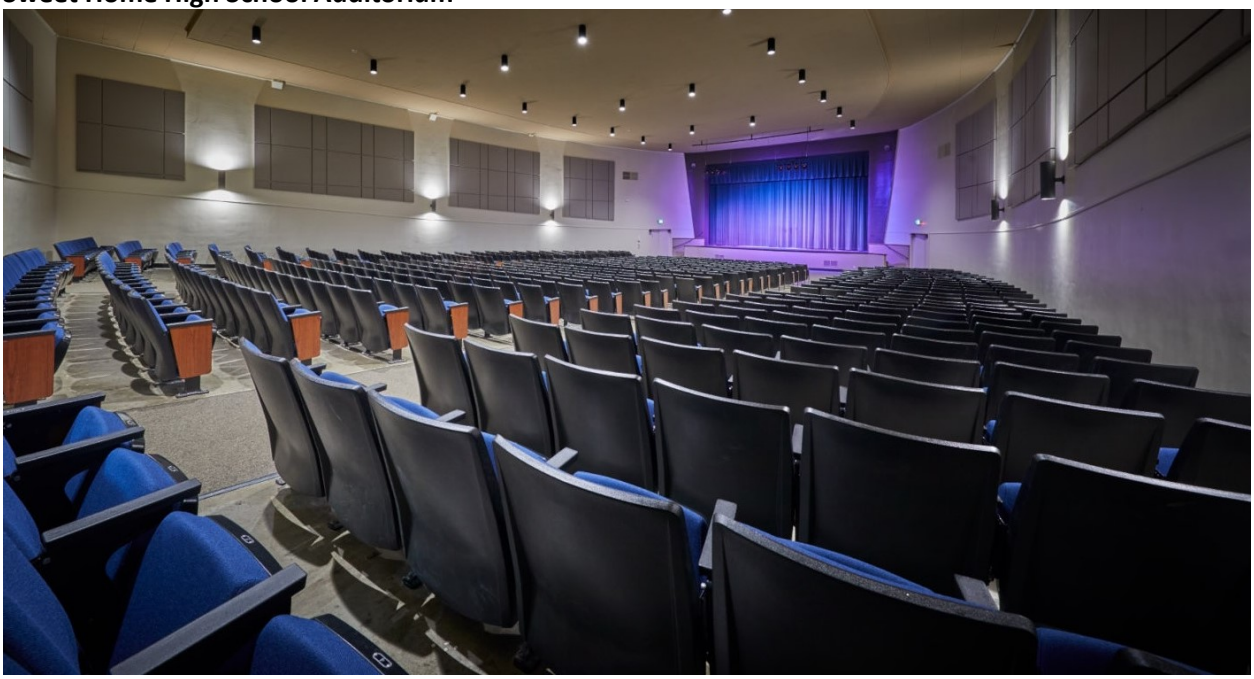
• Given our extensive knowledge of bowstring truss roofs and their lack of structural redundancy, it is our recommendation that the existing roof structure be strengthened. Strengthening would consist of establishing properly detailed connections using steel side plates and additional through bolts. Additional bottom chord and top chord elements may be added. In the event that strengthening is performed rather than replacement the repairs will also address the diaphragm deficiencies with the installation of a plywood diaphragm over the top of the existing straight sheathing.

• Reinforce concrete pilasters with steel columns for combined axial and bending loads

• Provide seismic isolation between adjacent buildings

• Provide proper attachment and bracing for all non-structural components and equipment • All piping and HVAC equipment found throughout the building shall be properly braced and attached to the structure to limit the potential damage.

Sweet Home High School Auditorium



Source: Kevin Strong, Sweet Home School District, personal communication, 8/10/21

Holley Elementary

These are the changes made to Holley Elementary School.

- Replace exterior CMU walls to provide lateral support. These locations would consist of the removal of windows in each classroom.

- Provide plywood shear walls along the top of the existing CMU shear walls along the corridor to connect the roof diaphragm for in-plane shear.

- Provide new drag tie beams between the beam lines in the transverse direction over the corridor to complete cross ties.

- Remove the roofing material and re-nail the roof sheathing to complete the diaphragm connection. Provide plywood roof sheathing over west classroom pod.

- Provide blocking, clipping and nailing connections along top of CMU walls to establish adequate connection between top of wall and diaphragm

- To limit the aspect ratio of the roof diaphragm to code prescribed limits the existing interior cross walls will be extended through the attic space using plywood sheathed shear walls to the

underside of the roof. The walls will be adequately attached to the existing CMU utilizing post installed anchors and be properly nailed to the roof sheathing.

- Along the perimeter of the classroom wings and corridors, new 2x walls will be installed to provide secondary gravity support of the roof framing in the event of wall collapse. These walls will be attached to the walls to provide support for out-of-plane buckling forces. • New shear panels or full height blocking between joists shall be installed to properly transfer the in plane seismic force into the shear walls from the roof diaphragm.

- All piping and HVAC equipment found throughout the building shall be properly braced and attached to the structure to limit the potential damage.

- All piping found within the building that is greater than 12" from structure shall be properly attached and braced.

Holley Elementary School

Source: Kevin Strong, Sweet Home School District, personal communication, 8/10/21

Hawthorne Elementary

These are the changes made to Hawthorne Elementary School.

• A new layer of plywood sheathing will be added over the top of the existing 2x T&G decking to increase the allowable shear capacity of the roof diaphragm to acceptable levels.

• Where the existing plywood shear walls are not adequate either additional nailing will be provided, or an additional layer of plywood will be added on the inside face to provide the necessary strength

• The existing gypsum wall board will be removed in strategic locations and new plywood sheathing wall be installed to increase the shear capacity to resist the prescribed in-plane seismic forces. Where required, additional anchor bolts shall be installed using post installed concrete anchors.

• New shear panels shall be frames or full height blocking between joists shall be installed to properly transfer the in-plane seismic force into the shear walls from the roof diaphragm.

• Selective windows should be in-filled and new wall sheathing installed on the inside face of the wall framing to provide adequate shear capacity for in-plane loading.

• Provide seismic isolation between adjacent buildings.

• To limit the aspect ratio of the roof diaphragm to code prescribed limits the existing interior cross walls will be sheathed with plywood on the existing wall framing. The existing gypsum interior finish will be removed and replaced over the plywood sheathing. The walls will be adequately attached to the existing slab on grade utilizing post installed anchors and attached to the existing slab on grade utilizing post installed anchors and attached to the roof framing using structural screws.

• Where required new hold down devices shall be installed to resist overturning forces.

• Where new shear walls are to be located, provide additional anchors to transfer lateral loads from the wall base plates to the concrete stem walls.

• All piping and HVAC equipment found throughout the building shall be properly braced and attached to the structure to limit the potential damage.

• Any mechanical equipment weighing over 20 pounds shall be attached and properly braced

• Provide proper attachment and bracing for all non-structural components and equipment

• All piping found within the building that is greater than 12” from structure shall be properly attached and braced.

Hawthorne Elementary School

Source: Kevin Strong, Sweet Home School District, personal communication, 8/10/21

Sweet Home Junior High School

These are the changes made to Sweet Home Junior High School.

The glulam beams that support the school's roof structure were manufactured in the early 1960s before engineers fully understood how the beams performed when subjected to excessive bending stresses.

When the school was renovated in 2020, there was concern that bending stress could cause the beams to fail. As an example, a beam supporting a roof at Thurston High School in Springfield cracked and failed during a major snowstorm in 2019 due to bending stress caused by the weight of the snow.

To reinforce the beams, a post-tensioning system was added. Steel cables were anchored underneath each beam and pulled tight in opposite directions. The tension in the cable pulls the anchors toward each other, effectively shortening the bottom of the beam's length. The compression force from the anchors reduces the tension force in the bottom of the beam allowing the beam to withstand the bending stress from the weight above. Without the post-tensioning system, the bottom of the beam is the weak point where the beam is most likely to crack and fail.

Sweet Home Junior High

Source: Kevin Strong, Sweet Home Public Schools, personal communication, 8/10/21

APPENDIX F: SWEET HOME NATURAL HAZARDS OUTREACH CALENDAR

Introduction

This calendar will be used each year to focus on outreach and education efforts on natural hazards each month. It includes lead contacts and partners to collaborate with on outreach efforts. It relates to **short-term multi-hazard mitigation action #3 (MH#3)** in the *2021 Sweet Home NHMP*.

Media tools to use for outreach: newspapers, websites, Facebook, Twitter, Instagram, utility bill inserts, newsletters, flyers and other materials.

The outreach will be accomplished as a collaboration of partners, with lead contacts and subject matter experts that can provide updated and informative materials. A list of partners will be established for outreach efforts for each of the hazards.

It is recommended that the outreach efforts be tracked and reported on at each *2021 Sweet Home NHMP* maintenance meeting. The **conveners or lead contacts** for the *2021 Sweet Home NHMP* are Sweet Home staff: Blair Larsen, Community and Economic Development Director, and Lagea Mull, Communication Specialist.

Table F-1 Sweet Home Natural Hazards Outreach Calendar

MONTH	NATURAL HAZARD	LEAD CONTACTS
January	Severe storms, floods, landslides, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
February	Severe storms, floods, landslides, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
March	Severe storms, floods, landslides, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
April	Severe storms, floods, landslides, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
May	Severe storms, wildland-urban interface fires, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager

June	Drought, wildland-urban interface fires, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
July	Drought, wildland-urban interface fires, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
August	Drought, wildland-urban interface fires, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
September	Drought, wildland-urban interface fires, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
October	Drought, wildland-urban interface fires, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
November	Severe storms, floods, landslides, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager
December	Severe storms, floods, landslides, volcanic events, earthquakes, dam failure	Sweet Home Police Chief, Sweet Home Fire and Ambulance District Chief, Sweet Home City Manager

Source: DLCD Natural Hazards Planner, Tricia Sears, and the Sweet Home NHMP Steering Committee, 2020-2021.

In the table below, the hazards, risk scores, and risk level are listed in order (high to low) as ascertained by the Steering Committee during the *2021 Sweet Home NHMP* update.

Table F-2 Natural Hazards, Risk Scores, and Risk Levels for Sweet Home (same as Table 2-4 in the Risk Assessment)

HAZARD	RISK SCORE	RISK LEVEL (H-M-L)
Severe Storms	221	High
Wildland-Urban Interface Fires	166	Medium
Floods	156	Medium
Earthquakes	149	Medium
Volcanic Events	147	Medium
Droughts	94	Low
Landslides	24	Very Low

Source: DLCD Natural Hazards Planner, Tricia Sears, and the Sweet Home NHMP Steering Committee, 2020-2021.

In the table below, the natural hazards identified in the *2021 Sweet Home NHMP* are listed with the partner organizations at the local, state, and federal level related to those natural hazards.

Table F-3 Sweet Home Natural Hazards Outreach Calendar Partners

NATURAL HAZARD	PARTNER CONTACTS
Severe Storms	Linn County Road Department, Sweet Home Fire and Ambulance District, Oregon State Police, ODOT, ODFW, OEM, FEMA, BLM, USFS, NWS, USACE, Pacific Power, Samaritan Hospital, assisted living facilities
Wildland-Urban Interface Fires	Sweet Home Fire and Ambulance District, Linn County Sheriff, Sweet Home school districts, local timber companies, ODF, Oregon State Fire Marshal, Oregon State Police, OEM, USFS, USF&W, FEMA, BLM, Pacific Power, Samaritan Hospital, assisted living facilities
Floods	Linn County Road Department, Linn County Sheriff, Sweet Home Fire District, ODOT, Oregon State Police, DOGAMI, OEM, FEMA, NWS, BLM, USFS, USACE, American Red Cross, Pacific Power, Samaritan Hospital, assisted living facilities
Earthquakes	Linn County Sheriff, Sweet Home Fire and Ambulance District, Pacific Power, Oregon State Police, OEM, ODOT, DOGAMI, NWS, FEMA, BLM, USFS, Pacific Power, Samaritan Hospital, assisted living facilities
Volcanic Events	Linn County Sheriff, Sweet Home Fire and Ambulance District, USGS, Oregon State Police, DOGAMI, OEM, FEMA, BLM, USFS, USACE, Pacific Power, Samaritan Hospital, assisted living facilities
Droughts	Soil & Water Conservation District, ORWD, ODA, OEM, BLM, USFS, FEMA, USACE, Pacific Power, Samaritan Hospital, assisted living facilities
Landslides	Linn County Road Department, Linn County Sheriff, local timber companies, ODOT, Oregon State Police, OEM, DOGAMI, BLM, USFS, FEMA, USACE, Pacific Power, Samaritan Hospital, assisted living facilities

Source: DLCD Natural Hazards Planner, Tricia Sears, and the Sweet Home NHMP Steering Committee, 2020-2021.

APPENDIX G: LINN COUNTY COMMUNITY WILDFIRE PROTECTION PLAN

Introduction

To reduce the impact of wildfire, Linn County has a Community Wildfire Protection Plan (CWPP) called *the Linn County Community Wildfire Protection* Plan (*Linn County CWPP*) and it is dated November 2007. Sweet Home does not have a city-specific CWPP. The *Linn County CWPP* provides detailed information on the vulnerability and history of wildfire in Linn County, and provides mitigation actions Linn County can implement to reduce the impact of wildfire. This *2021 Sweet Home NHMP* links to the CWPP as it also contains wildfire information and mitigation actions. See Table 3-1, Sweet Home NHMP Mitigation Actions.

Of note, the mission of the *Linn County CWPP* aligns with the mission for the *Linn County Natural Hazards Mitigation Plan*. The mission is: To reduce the impact of natural hazards on the community through planning, communication, coordination, and partnership development.

The *Linn County CWPP* identifies five County-wide goals that could be effectively addressed by a CWPP. These goals are the product of input from community members through the FireWise workshop, and are also coordinated with the *Linn County Natural Hazards Mitigation Plan*.[1]

- Goal #1: Enhance wildfire response capabilities;
- Goal #2: Increase stakeholder knowledge about wildfire risk through education and outreach Linn County Community Wildfire Protection Plan;
- Goal #3: Encourage the treatment of structural ignitability;
- Goal #4: Prioritize fuel reduction projects; and
- Goal #5: Increase opportunities for collaboration and coordination to implement wildfire projects.

[1] *Linn County Community Wildfire Protection Plan*, November 2007, file:///J|/Shared/Scholars%20bank%20local%20docs/County/Hazard%20mitigation%20plans/Linn_County_Wildfire_Plan_Appendices.pdf (uoregon.edu)