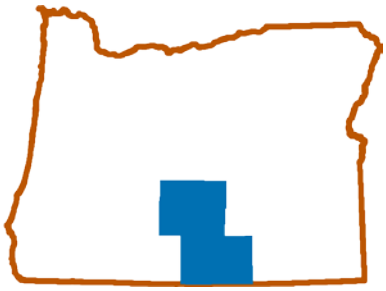







Lake County

MULTI-JURISDICTION NATURAL HAZARDS MITIGATION PLAN



- Lake County
- Lakeview
- Paisley

FEMA

Effective Month x, 2020 through Month x, 2025

The *2020 Lake County Multi-Jurisdictional 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:

Daniel Tague, Emergency Services Coordinator
Lake County Sheriff's Office
513 Center St.
Lakeview, OR 97630
Phone 541-947-6027 x 1204 office
Phone 541-905-6955 mobile
Email: dtague@co.lake.or.us

The **mission** of the Lake County NHMP is to:

To create a disaster-resilient Lake County

Lake County developed this Multi-Jurisdictional Natural Hazards Mitigation Plan through a partnership funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation Grant Program. In 2017, the Department of Land Conservation and Development (DLCD) received two Pre-Disaster Mitigation Grants (PDMC-PL-OR-2016-003 and PDMC-PL-10-OR-2016-005) from FEMA through the Oregon Office of Emergency Management (OEM) to assist Lake County and seven other counties with their NHMPs.

Volume I: Basic Plan

Source: Tricia Sears, DLCD, downtown, Lakeview, OR, 4/10/18

Source: Tricia Sears, DLCD, Welcome to Lakeview signs, Lakeview, OR, 4/10/18

Special Thanks & Acknowledgements

Source: Tricia Sears, DLCD, May 2019

Lake County developed this Multi-Jurisdictional Natural Hazards Mitigation Plan (NHMP) through a partnership funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation (PDM) Grant Program. In 2017, the Department of Land Conservation and Development (DLCD) received two Pre-Disaster Mitigation grants (PDMC-PL-10-OR-2016-003 and PDMC-PL-10-OR-2016-005) from FEMA through the Oregon's Office of Emergency Management (OEM) to assist Lake County and seven other counties with their NHMPs.

Partners include:

Lake County
Town of Lakeview
City of Paisley
Oregon Office of Emergency Management (OEM)
Oregon Department of Land Conservation and Development (DLCD)
Federal Emergency Management Agency (FEMA) Region X

Project Managers:

Daniel Tague, Emergency Services Coordinator, Lake County

Tricia Sears, Natural Hazards Planner, DLCD

Project Steering Committee

Representatives from the following organizations served as steering committee members for the Lake County Natural Hazards Mitigation Plan update process.

Department of Land Conservation & Development Staff

Tricia Sears, Natural Hazards Planner, DLCD

Lake County

Daniel Tague	Lake County Emergency Services Coordinator, Convenor
Kevin Hock	Road Superintendent, Lake County Road Department
Christy Horn	Office Manager, Lake County Road Department
Darwin Johnson	Planning Director, Lake County Planning Department
Ken Cooper	Building Official, Lake County Building Dept.
Jennifer Stephens	Asst. Building Director, Lake County Building Dept.
Ken Kestner	County Commissioner (former)
Dan Shoun	County Commissioner (former)
Mark Albertson	County Commissioner
Jill Harlan	Lake County Public Health
Michael Taylor	Sheriff

Town of Lakeview

Michele Parry	Town Manager
Roberta Vanderwall	Town Manager (former)
Jeff Marshall	Public Works Director, Lakeview Public Works
Scott Utley	911 Director
Janine Cannon	Town Planner

City of Paisley

Dustin Withers	Volunteer Fire Fighter, Paisley Volunteer Fire Dept.
Melissa “Missy” Waters	City Recorder
Ralph Paull	Mayor

Other Participants

Will Cahill	Superintendent, Lake County School District #7
Paul Hauder	Superintendent, Paisley School District
Darryl Anderson	President, Anderson Engineering & Surveying, Inc.
Carmen Tague	Business Manager, Anderson Engineering & Surveying, Inc.
Jason Jaeger	Program Coordinator, Lake County Cooperative Weed Management Area
Mike Warren	Lake County Radio (KCLR 95.3 FM)
Scott Hill	Sergeant, Oregon State Police
Peter Brewer	Air Quality Attainment Coordinator/Wildfire Smoke Response Coordinator, Oregon Dept. Environmental Quality
Dustin Gustaveson	Unit Forester, Oregon Dept. Forestry

Clint Albertson	Fire Planner, Fremont-Winema National Forest and BLM
Brian Mayer	Lake County Water Master, Oregon Water Resources Dept.
Barry Shullanberger	Interagency Fire Chief Staff Officer for Fremont-Winema national Forest and Lake District BLM, USFS
Mike Cuff	Interagency Safety Manager, Lakeview Interagency Offices USFS and BLM, USFS
Kristin Hill	EMS Manager, Lakeview Disaster Unit (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]

Plan Format Disclaimer

The *2020 Lake County Natural Hazards Mitigation Plan* update is based in part on a NHMP template developed by the University of Oregon's Institute for Policy Research and Engagement (IPRE) - Oregon Partnership for Disaster Resilience (OPDR) and used in the *2013 Lake County NHMP*. At that time, OPDR provided copies of the plan templates to communities for use in developing or updating their NHMPs. The template is structured to address the requirements contained in 44 CFR 201.6. The basic format of the *2013 Lake County NHMP* has been retained for this *2020 Lake County NHMP* update, but considerable modifications have been made. Emphasis is placed on identifying and describing the unique attributes of the County and Cities.

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

Lake County
Multi-Jurisdictional
Natural Hazards Mitigation Plan

Table of Contents

Executive Summary

Lake County developed and updated this *2020 Lake County Multi-jurisdictional Natural Hazards Mitigation Plan* (*2020 Lake County NHMP*) to prepare for 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 - it is possible to create a resilient community that benefits from mitigation planning and short- and long-term recovery planning efforts.

> *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 Lake County, the Town of Lakeview, and the City of Paisley will remain eligible for pre- and post-disaster mitigation grants.

Who Participated in Developing the Plan?

The *2019 Lake County NHMP* is the result of a collaborative effort between Lake County, the Town of Lakeview, the City of Paisley, DLCD, school districts, citizens, public agencies at the local, state, and federal level, non-profit organizations, and the private sector. DLCD lead the NHMP Steering Committee through the NHMP update process.

The Lake County NHMP Steering Committee included representatives from the following organizations:

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.

- Lake County Commissioners
- Lake County, Sheriff's Office
- Lake County, Planning Department
- Lake County, Roads Department
- Lake County, Building Department
- Lake County, Public Health
- Town of Lakeview, Public Works
- Town of Lakeview, 911
- Town of Lakeview, Town Manager
- Lake County Radio
- City of Paisley, Mayor
- City of Paisley, Volunteer Fire Department
- Lak County School district #7
- Paisley School District
- Lake County Cooperative Weed Management Area
- Oregon State Police
- Oregon Department of Environmental Quality
- Oregon Department of Forestry
- Oregon Water Resources Department
- Anderson Engineering & Surveying
- United States Forest Service
- United States Bureau of Land Management

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

In collaboration with DLCD, the Lake County Emergency Manager convened the planning process. The Lake County Emergency Manager will take the lead in implementing, maintaining, and updating the NHMP. Lake County is dedicated to directly involving the public in the continual review and update of the NHMP. The County will post the *2020 Lake County Multi-jurisdictional Natural Hazards Mitigation Plan* on the County's website. The Cities will also post the NHMP on their websites.

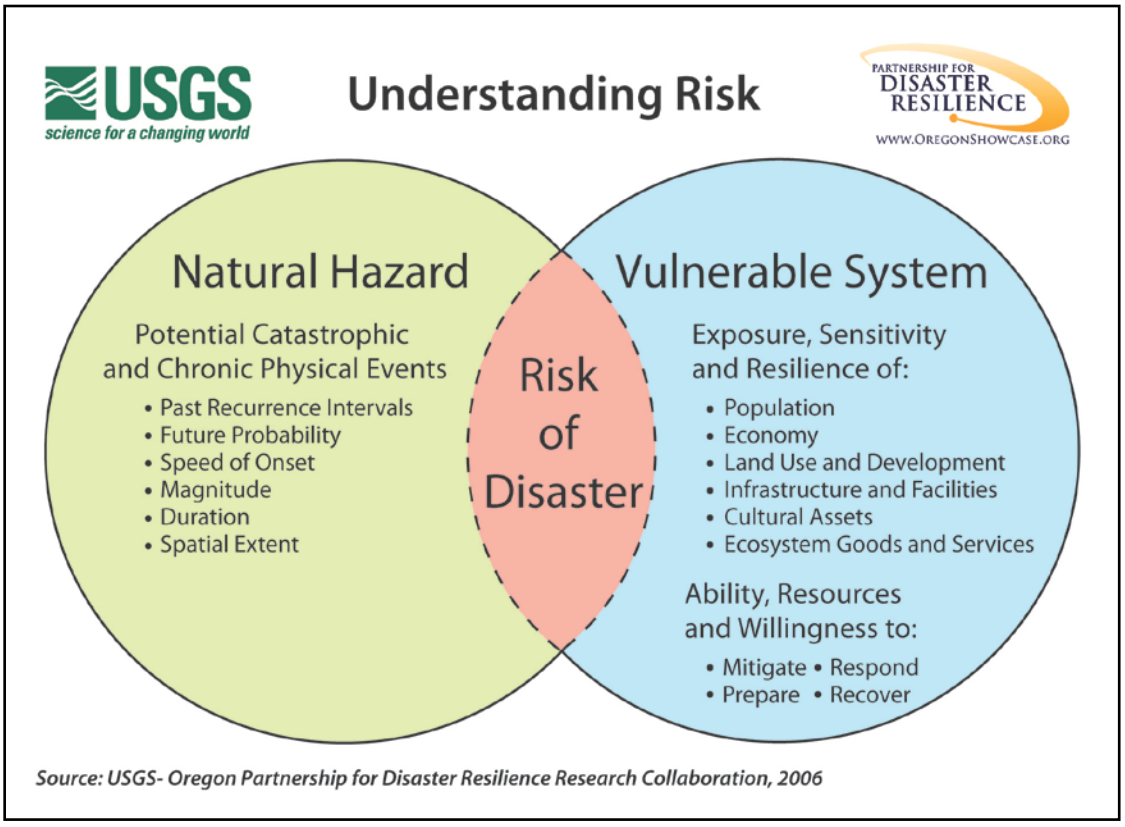
How Does this Mitigation Plan Reduce Risk?

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 Lake County 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 Lake County. A key part of the NHMP is the risk assessment. It consists of three phases: hazard

identification, vulnerability assessment, and risk analysis. In Figure ES-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.

Figure ES-1 Understanding Risk



Source: *2013 Lake County NHMP*, Oregon Partnership for Disaster Resilience, 2006.

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

What is the County's Overall Risk to Hazards?

Lake County, along with the Town of Lakeview and the City of Paisley, 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 Hazard Vulnerability Assessment (HVA) at the April 11, 2018 meeting. It was discussed again at the May 23, 2018 meeting. Table ES-1 summarizes the risk score and risk level for each hazard as determined by the Lake County NHMP Steering Committee. See also Volume I Section 2 Risk Assessment and Volume II Hazard Annexes for additional hazard information.

Table ES-1 Natural Hazards, Risk Scores, and Risk Levels

HAZARD	RISK SCORE	RISK LEVEL (H-M-L)
Droughts	240	High
Air Quality	240	High
Winter Storms	236	High
Floods	236	High
Wildfire	210	High-Medium
Earthquakes	201	High-Medium
Wind Storms	193	High-Medium
Volcanic Events	129	Medium
Landslides	97	Low

Source: Lake County NHMP Steering Committee. 2018-2020.

What is the Plan's Mission?

The mission of the Lake County Multi-jurisdictional Natural Hazards Mitigation Plan is to:

Mission: *To create a disaster-resilient Lake County*

What are the Plan Goals?

The plan goals describe the overall direction that the participating jurisdiction's agencies, organizations, and citizens can take toward mitigating risk from natural hazards.

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

Goal 1: *Protect Human Welfare, Property, Cultural and Natural Resources: Develop mitigation actions to lessen the impact from natural disasters on human welfare, infrastructure and property, and the cultural and natural resources of Lake County*

Goal 2: *Safeguard Economy: Develop mitigation actions to lessen the economic impacts from natural disasters on the region's economic development and local businesses.*

Goal 3: *Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase public awareness of hazards and risk-reduction practices.*

Goal 4: *Strengthen Community Capacity: Sustain and build upon community partnerships, resources, and collective knowledge to implement mitigation actions.*

Goal 5 (new): *Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase internal staff awareness and knowledge of hazards and risk reduction practices.*

How are the Action Items 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. Full descriptions of each mitigation action are provided in Appendix A Mitigation Action Forms. The Steering Committee agreed to use the risk level scores and rankings from the Hazard Vulnerability Assessment (HVA) - shown in summary in Table ES-1 - as a way to prioritize the mitigation actions. As a result of this, the high priority actions are all of the multi-hazard (MH) actions and the hazard-specific actions for drought, floods, winter storms, and air quality. Droughts and air quality are the two hazards with the highest risk scores, obtaining 240 out of 240 points. Wildfire, earthquakes, and wind storms have a risk level of high-medium and thus the mitigation actions are high-medium. Volcanic events and landslides do not have hazard-specific mitigation actions.

Data collection, research, Steering Committee discussion, and the public participation process resulted in the development of the mitigation actions.

The Lake County 2019 NHMP Mitigation Action for Lake County, the City of Paisley, and the Town of Lakeview is Table 3-1 and the Lake County and Cities Mitigation Actions 2013 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 and an x marks the applicability of the goals to that action.

There are **55 total mitigation actions** in the *2020 Lake County NHMP*. By natural hazard, the totals are as follows: multi-hazard (MH) = 13; drought (DR) = 2; earthquake (EQ) = 9; flood (FL) = 16; wind storms and winter storms (WWS) = 1; wildfire (WF) = 8; and air quality (AQ) = 6. There are no mitigation actions for landslides and volcanic events.

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 *2020 Lake County NHMP* remains an active and relevant document. The plan will be implemented, maintained and updated by a designated convener. The Lake County Emergency Services Coordinator 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 Lake County NHMP is locally reviewed and ready, the Lake County NHMP Convener (the Emergency Manager) 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 Lake County called the "Approved Pending Adoption" (APA), the County will then adopt the NHMP via resolution. Following County adoption, the other participating jurisdictions – the Town of Lakeview and the City of Paisley - will need to adopt the NHMP. The Lake County NHMP Convener and the DLCD Natural Hazards Planner will then provide both OEM and FEMA with the resolutions from the three jurisdictions.

Once FEMA is provided with final resolution documentation from all three jurisdictions, they will formally approve the *2020 Lake County NHMP*. At that point Lake County will maintain their eligibility for the Hazard Mitigation Assistance (HMA) pre- and post- disaster funds. These funds are distributed through the Pre-Disaster Mitigation (PDM) program, the Hazard Mitigation Grant Program (HMGP), and the Flood Mitigation Assistance (FMA) program.

The accomplishment of the *2020 Lake County NHMP* goals and mitigation actions depends upon regular NHMP Steering Committee participation and support from County, Town, and City 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.

Section I: Introduction

This section provides a general introduction to natural hazard mitigation planning in Lake County. 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?

Lake County developed this Natural Hazards Mitigation Plan (NHMP), along with the Town of Lakeview and the City of Paisley in an effort to reduce future loss of life and damage to property resulting from natural hazards. The current Lake County NHMP Steering Committee is doing an update to the existing NHMP that was approved on September 11, 2013 by FEMA and valid through September 11, 2018.

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.

[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.

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 in order to receive federal funds for pre- and post-disaster mitigation funds. Local and federal approval of this plan ensures that Lake County, the Town of Lakeview and the City of Paisley will remain eligible for pre- and post-disaster mitigation funding.

Local and federal approval of this plan ensures that the county and listed cities will remain eligible for pre- and post-disaster mitigation project grants.

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 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 *2020 Lake County 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.

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

[4] ibid, subsection (b). 2010

- Subsection (d) outlines the steps and agencies required for proper review of the plan before finished plans are adopted by their respective communities.[5]

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 2020 Lake County Natural Hazards Mitigation Plan (NHMP) Steering Committee with the collaboration of DLCD staff is updating the *2013 Lake County NHMP*. The *2020 Lake County NHMP* was approved by FEMA on September 11, 2013 and is valid through is September 11, 2018. Lake County adopted the NHMP on Jul7 30, 2013. The Town of Lakeview Addendum was adopted on August 13, 2013; the City of Paisley Addendum was adopted on August 13, 2013.

The Lake County NHMP Steering Committee includes the Town of Lakeview and the City of Paisley. A roster of the Steering Committee is included in the Acknowledgements section of this NHMP. The

[5] ibid, subsection (c). 2010

[6] ibid, subsection (d). 2010

Lake County NHMP Steering Committee formally convened at four meetings (April 11, 2018; May, 23 2018; October 10, 2018; and May 22, 2019) with the DLCD Natural Hazards Planner, in person, to discuss and revise the plan. In addition, the DLCD Natural Hazards Planner called and emailed with the Emergency Manager for continued discussion 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, as well as, private and non-profit entities to comment on the plan during review.[7] Lake County, the Town of Lakeview and the City of Paisley 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 B 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. The Town of Lakeview and the City of Paisley participated in the process along with Lake County and the other organizations on the NHMP Steering Committee, including several state and federal agencies. See the Acknowledgements for a list of participating organizations and their representatives. See Appendix B Planning and Public Process for more information about outreach.

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 countywide 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 C, Community Profile, which contains an overall description of Lake County, the Town of Lakeview, and the City of Paisley.

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

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, the Hazard Annexes, and Appendix F.

The Risk Assessment allows readers to gain an understanding of Lake County's, and other jurisdictions', sensitivities – those community assets and characteristics that may be impacted by natural hazards, as well as the County's, and other jurisdictions', resilience – the ability to manage risk and adapt to hazard event impacts. Information on the jurisdictions' 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 three tables related to mitigation actions: Table 3-1 2020 Lake County NHMP Mitigation Actions for Lake County, City of Paisley, and the Town of Lakeview and Table 3-2 Lake County and Cities Mitigation Actions 2013 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 plan are the following:

- Drought;
- Earthquake;
- Flood;
- Landslide;
- Volcanic Event;
- Wildfire;
- Wind Storm;
- Winter Storm, and
- Air Quality.

Volume III: Mitigation Resources

The resource appendices are designed to provide the users of the *2020 Lake County Natural Hazards Mitigation Plan* with additional information to assist them in understanding the contents of the mitigation plan, and provide them with potential resources to assist with plan implementation.

Appendix A: Mitigation Action Forms

The detailed mitigation action forms for each of the mitigation actions identified in this NHMP are here.

Appendix B: Planning and Public Process

This appendix includes documentation of all the countywide 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 C: Community Profile

The community profile describes the Lake County and participating cities from a number of perspectives in order 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).

Appendix D: 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. The Oregon Partnership for Disaster Resilience (OPDR) developed this appendix in the previous NHMP. It has been retained and slightly modified.

Appendix E: Grant Programs and Resources

This appendix lists state and federal resources and programs by hazard.

Appendix F: Future Climate Projections Reports

This appendix includes two reports provided by the Oregon Climate Change Research Institute (OCCRI): *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports* and *Future Climate Projections Lake County: A Report to the Oregon Land Conservation and Development*. Both reports are dated August 2018. These reports were funded by DLCD using a small portion of the PDM 16 grant funds obtained by DLCD.

Appendix G: Lake County NHMP Success Stories

These are stories that illustrate when a community in Lake County identifies a problem or concern and then works to solve it. These stories were identified and provided by the members of the Lake County NHMP Steering Committee.

Appendix H: Lake County HAZUS Global Reports for Crustal and Probabilistic Scenarios

This report was prepared by DOGAMI in 2007. It was never published but it was included in the *2013 Lake County NHMP*. It contains scenarios for crustal and probabilistic earthquakes including maps and descriptions of the impacts. HAZUS is an earthquake loss estimation model that was developed by FEMA and the National Institute of Building Sciences. Using HAZUS, the described impacts are to buildings, critical facilities, transportation, and utilities. It describes the social impacts and economic loss. Also, it describes fires that can follow earthquakes, and debris generation. A similar report was produced for Harney County and Malheur County.

Appendix I: Lake County Natural Hazards Mitigation Plan (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 multi-hazard mitigation action #2 in the *2020 Lake County NHMP*. See Table 3-1, 202 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview.

Appendix J: Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR and the Emergency Action Plan Bullard Dam

These two key documents are part of a PDF entitled Bullard Canyon Debris Basin Documents. The documents describe the operation and maintenance of Bullard Creek Floodwater Retarding Structure, a structure designed to retard floodwater flows in Bullard Canyon and release the water at a controlled rate. The documents relate to flood mitigation action #3 in the *2020 Lake County NHMP*. See Table 3-1, 202 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview.

Appendix K: Lakeview Access Right-of-Way Agreement

This appendix includes a sample of the agreement the Town of Lakeview has with landowners along Bullard and Deadman Creeks (Darryl Anderson, Anderson Engineering and Surveying, personal communication, 8/9/19). The agreement grants the right of the Town of Lakeview to go onto the landowner's property "for the sole and limited purpose of cleaning, clearing, repairing and maintaining the stream, stream bed and adjacent banks of Deadman Creek for flood, erosion and\or water flow control."

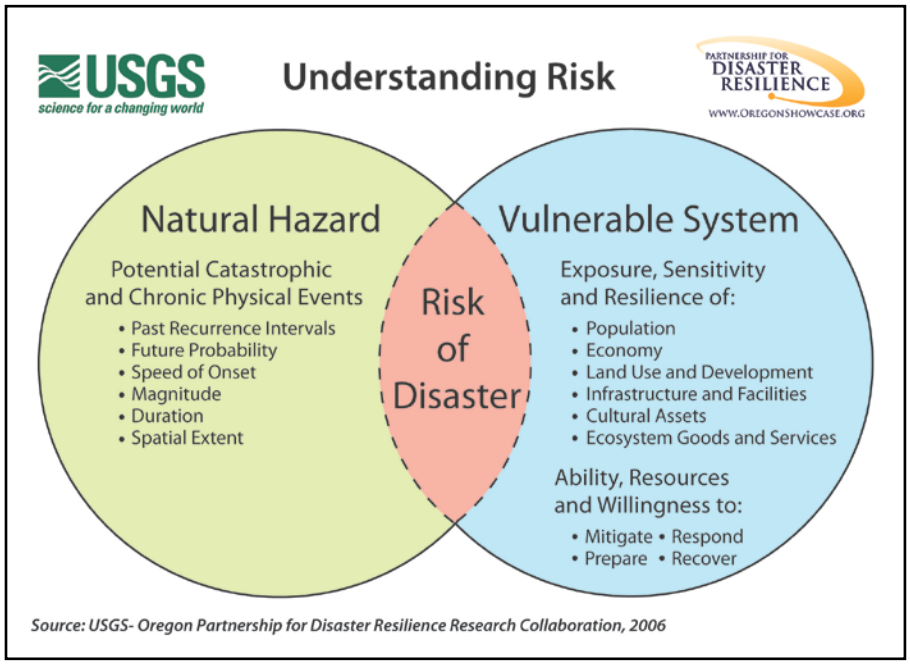
Section 2:
Risk Assessment

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

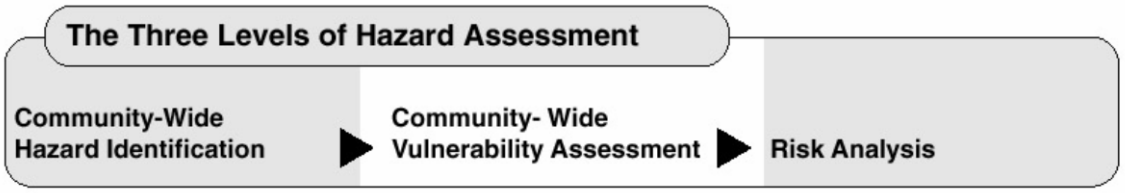


Source: USGS and Oregon Partnership for Disaster Resilience, 2006.

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

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

The planning area for the *2020 Lake County NHMP* is Lake County, both unincorporated and incorporated areas. The jurisdictions of Lake County, the Town of Lakeview, and the City of Paisley are included. In the *2013 Lake County NHMP*, the Town of Lakeview and the City of Paisley had separate jurisdictional addenda. In the *2020 Lake County NHMP*, information from the jurisdictions is integrated and included in the main body of the NHMP; there are no separate addenda. Information provided in this Risk Assessment section is supplemented by the Hazard Annexes, Appendix F Future Climate Projections Reports, and Appendix H Lake County HAZUS Global Reports for Crustal and Probabilistic Scenarios. A lengthier description of the contents of the Future Climate Projections Reports is included in the Hazard Identification section below and in the Introduction to the Hazard Annexes.

Hazard Identification

Lake County identifies nine natural hazards that could have an impact on the County. These hazards include drought, earthquake, flood, landslide, volcano, wildfire, wind storm, winter storm and air quality. At the Lake County NHMP Steering Committee meeting on April 11, 2018, the DLCD Natural Hazards Planner led the group in an exercise called the Hazard Vulnerability Analysis or Assessment (HVA). The HVA results are discussed later in this Risk Assessment.

Table 2-1 categorizes the hazards identified by Lake County and compares it to the regional hazards identified in the *2015 Oregon Natural Hazard Mitigation Plan* for Central Oregon (Region 6). Region 6 includes Lake, Klamath, Deschutes, Crook, Wheeler, and Jefferson Counties. Notably, the *2015 Oregon NHMP* does not include air quality as a natural hazard.

Table 2-1 Lake County Hazard Identification

Hazard Identified in Lake County NHMP*	Hazard identified in Oregon NHMP**
Winter Storms	Winter Storms
Wind Storms	Wind Storms
Earthquakes	Earthquakes
Droughts	Droughts
Floods	Floods
Volcanic Events	Volcanoes
Wildfire	Wildfire
Landslides	Landslides
Air Quality	NA

Source: *Lake County NHMP Steering Committee, 2018-19, and ***2015 Oregon NHMP*, Region 6: Central Oregon

This Hazard Identification section includes descriptions for each natural hazard in the following ways: significant changes since the *2013 Lake County 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 and Appendix F.

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]

In Appendix F Future Climate Projections Reports, the Oregon Climate Change Research Institute's (OCCRI) *Future Climate Projections Lake County: A Report to the Oregon Department of Land Conservation and Development* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports*, 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, cold waves, wildfire, and air quality. The overview discusses all eight of the counties while the respective individual county reports are specific to each county. OCCRI's research and analysis focuses on how climate change is expected to influence natural hazards. The overview describes results for the natural hazards using climate metrics in summary and as a comparison.

Each county report describes county-specific projected changes in climate metrics related to selected natural hazards. The reports present future climate projections for the 2020s (2010-2039 average) and the 2050s (2040-2069 average) compared to the 1971-2000 average historical baseline. Each hazard in the report has a box highlighting "key messages" that call out the main points of the research and analysis for that hazard. There is a very useful table that is a "summary of projected direction of changes in climate change-related risk of natural hazard occurrence across eight Oregon Counties." The Introduction of the Hazard Annexes also has climate change information in the "Predicted Climate Variability**"** section. The Lake County specific summary of expected climate change impacts is in Table HA-2 in the Introduction to the Hazards Annexes.

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 Facilities, Critical Infrastructure, and Lifelines, identifies the critical facilities, critical infrastructure, and lifelines of Lake County, the Town of Lakeview, and the City of Paisley. For a more detailed assessment of the hazard-specific vulnerability, see Volume II Hazard Annexes.

Lake County is part of Region 6 Central Oregon, as described in the *2015 Oregon Natural Hazards Mitigation Plan*, along with Crook, Deschutes, Klamath, Jefferson, and Wheeler Counties.

> Region 6 is mostly rural, with the majority of development occurring in communities along I-97. Mobile homes are inherently vulnerable to natural hazard events, and there are a significant number of mobile homes in Jefferson, Lake, and Wheeler Counties. Roughly half the homes in Klamath, Lake, and Wheeler Counties were built before 1970 and floodplain

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

management and seismic building standards, making them especially vulnerable. With the exception of Crook and Deschutes Counties, the region's Flood Insurance Rate Maps (FIRMs) are not as up to date as those of other areas of the state.[4]

Federal Disaster and Emergency Declarations

Looking at the past events that have occurred in Lake 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 December 2019, FEMA has approved a total of 35 federal major disaster (DR) declarations, two emergency (EM) declarations and 41 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 114 as identified in the FEMA "Disaster Declarations by State/Tribal Government" list on their website[5]

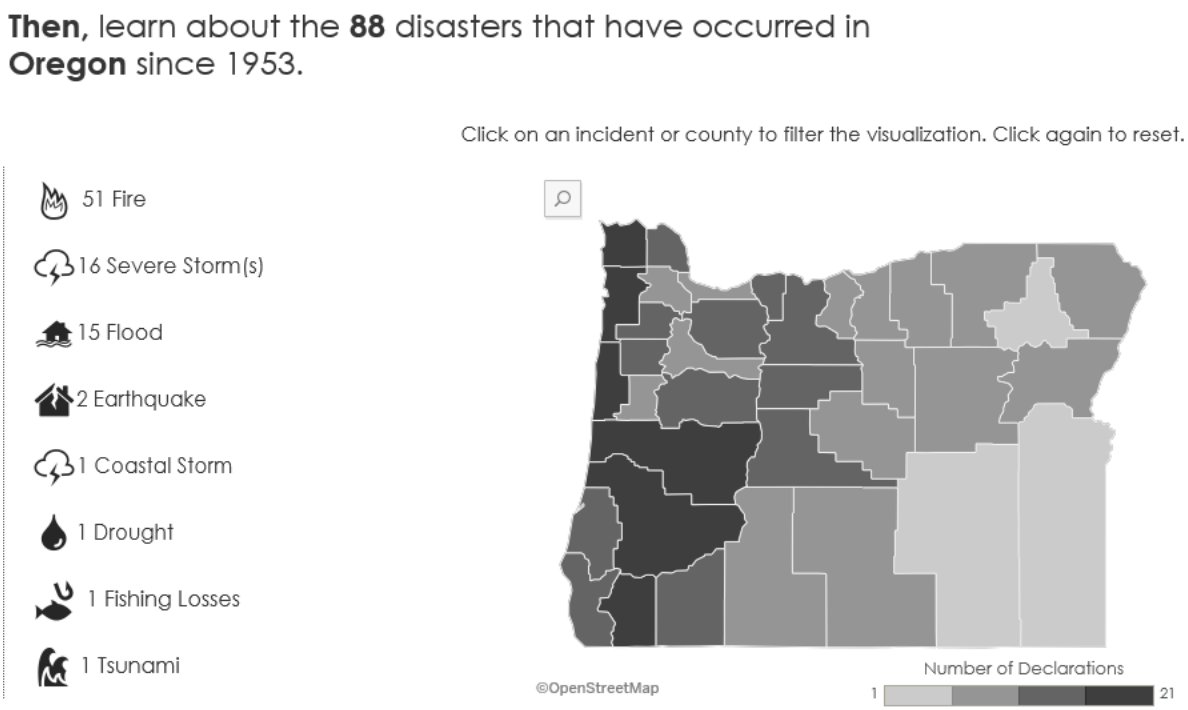
However, this contrasts with the 88 declared disasters that FEMA has listed for Oregon on their state by state "Historical Disaster Data" website. The "Historical Disaster Data" website includes the graphic shown in Figure 2-3, illustrating the types of disasters and the location, by county, of the disasters.[6] DLCD staff are not able to explain this discrepancy in the FEMA data.

[4] DLCD, *2015 Oregon Natural Hazards Mitigation Plan*, Region 6 Risk Assessment, https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_12_RA6.pdf.

[5] FEMA, *Declared Disasters by Year or State*, https://www.fema.gov/disasters/grid/state-tribal-government/88. Accessed November 20, 2018, December 19, 2018, March 22, 2019, July 29, 2019, and December 20, 2019.

[6] FEMA, *Historical Disaster Data*, https://recovery.fema.gov/state-profiles/HistoricalDisasterData, accessed November 20, 2018, December 19, 2018, March 22, 2019, July 29, 2019, and December 20, 2019.

Figure 2-3 Disaster Declarations in Oregon Since 1953



Source: FEMA, https://recovery.fema.gov/state-profiles/HistoricalDisasterData, most recently accessed 12/20/19

Table 2-2 summarizes the FEMA disaster declarations declared in Oregon that have directly affected Lake County since 1953. There have been three major disaster (DR) declarations, two emergency declarations (EM), and one fire management assistance (FM) declaration for Lake County. [7]

[7] FEMA, *Declared Disasters by Year or State*, https://www.fema.gov/disasters/grid/state-tribal-government/88., accessed November 20, 2018, December 19, 2018, March 22, 2019, July 29, 2019, and December 20, 2019.

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

Declaration Number	Declaration Date	Incident Period	Incident	Individual Assistance	Public Assistance Categories
DR-1510	Feb. 19, 2004	Feb. 26, 2003 to Jan. 14, 2004	Severe winter storm	None	A, B, C, D, E, F, G
DR-1160	Jan. 23, 1997	Dec. 25, 1996 to Jan. 6, 1997	Severe winter storm/flooding	None	A, B, C, D, E, F, G
DR-184	Dec. 24, 1964	Dec. 24, 1964	Heavy rains and flooding	Yes	A, B, C, D, E, F, G
EM-3228	Sep. 7, 2005	Aug. 29, to Oct. 1, 2005	Hurricane Katrina evacuation	None	B
EM-3039	Apr. 29, 1977	Apr. 29, 1977	Drought	None	A, B
FM 2444	Jul. 16, 2002	Jul 15 to July 25, 2002.	Winter Fire	None	B

Source: FEMA, *Oregon Disaster History. Major Disaster Declarations*, https://www.fema.gov/disasters, accessed March 22, 2019, July 29, 2019, and December 20, 2019; reaffirms and adds to the data in the *2013 Lake County NHMP*.

Drought

Significant changes since 2013 NHMP

In the *2013 Lake County NHMP*, drought was ranked in third place for the risk scores of the nine natural hazards. In the Hazard Vulnerability Analysis (HVA) for the *2020 Lake County NHMP*, the Steering Committee awarded 240/240 possible points for drought, making it the number one ranked natural hazard for Lake County. Drought tied with air quality for first place, both had 240 points.

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 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). Highlights of the survey findings indicate that the 1977 drought affected 80% of ranches in eastern Oregon (including Lake County), decreased forage, increased purchase of feed,

reduced rate of gain of cattle, delayed breeding, herd health problems and increased water hauling and equipment investments[8]. In the present, droughts remain as impactful events.

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. Lake County is susceptible to droughts because of its location east of the Cascades and within the high desert. The region experiences dry conditions annually during the summer months from June to September.

Lake County has a history of many drought events, dating back to 1904 according to the Significant Historic Hazard Events Tables in Table DR-1 within the Volume II Drought Annex of this NHMP. From this table it could be said that the incidence of drought in Oregon is between three and six years. 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.

According to OCCRI's *Future Climate Projections* report, "Drought conditions, as represented by low spring snowpack, is projected to become more frequent whereas drought conditions represented by low summer soil moisture and low summer runoff are projected to occur with the same or slightly greater frequency in Lake County by the 2050s compared to the historical baseline." See Appendix F for more information.

Earthquake

Significant changes since 2013 NHMP

In the *2013 Lake County NHMP*, earthquakes were ranked in fifth place and in the HVA for the *2020 Lake County NHMP*, they were ranked in fourth place.

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.[9]

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.[10] The last such event occurred in January of 1700, causing a tsunami in Japan. See the Earthquake Annex in Volume II.

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

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

[10] 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

Lake County 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.

Southeastern and Central Oregon have experienced multiple earthquakes of an estimated magnitude of four and greater since recorded history, with larger earthquakes in 1906, 1920, 1923, 1958, 1968, and 1993.

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 Lake County see the Earthquake Annex in Volume II Hazard Annexes.

Earthquake was not one of the identified climate change metrics therefore OCCRI's *Future Climate Projections* report does not include information about earthquakes. See the Earthquake Annex for more information.

Flood

Significant changes since 2013 NHMP

In the *2013 Lake County NHMP*, floods were ranked in sixth place. In the *2020 Lake County NHMP*, floods are tied with winter storms and both are ranked in second place.

Characteristics

The principal types of flood that occur in Lake County include riverine floods, local flash floods and playa floods.[11] The Chewaucan River is the predominant source of flooding in the county. There are numerous streams and lakes throughout the North Goose Lake Basin that also contribute to the flood hazard.[12]

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.

[11] Lake County Flood Insurance Study, FEMA, December 5, 1989; [City] of Lakeview Flood Insurance Study, FEMA, September 5, 1990; City of Paisley Flood Insurance Study, FEMA, September 15, 1989; and Oregon Natural Hazards Mitigation Plan (2012) Region 6: Regional Profile

[12] Oregon Natural Hazards Mitigation Plan (2012) Region 6: Central Oregon Regional Profile

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. Flash floods are most common to Eastern Oregon and pose a great threat to Lake County.[13] 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.

Playa Flooding

Many parts of Lake County are characterized by interior drainage or closed basins. Some of the basins (playas) contain lakes that grow and diminish with the seasons and from year to year. Alkali lake (located within the Summer Lake Basin watershed) is a good example. At times, they are almost dry, but this condition changes. These large lakes also have a long history of flooding. Most of the lake water originates from high mountain snow pack above the basin. Flooding follows winters with deep snow accumulation.

Location/Extent

The most significant of the FEMA-determined floodplains and floodways surround the Chewaucan River.[14] Properties in and near the floodplains in the cities of Lakeview and Paisley are subject to flooding events. Lakeview and Paisley are also potentially affected by flood runoff from the relatively steep mountains immediately surrounding the cities.

The Chewaucan River is the largest river flowing through Lake County. The Chewaucan's source is in the mountains of the Fremont-Winema National Forest southeast of the City of Paisley. The river arches north to flow through Paisley and then curves southwest to eventually drain into Lake Abert. The Chewaucan's waters are greatly depended upon by the farmers and ranchers that are near its banks. There are multiple diversions located in the vicinity of Paisley along the Chewaucan that divert river water for irrigation and for stock watering. Each of these diversions is privately owned.

The Chewaucan has a history of flooding the City of Paisley. Heavy rains and snow melt inundation are the primary culprits for flow increase. An earthen levee was created by the Army Corps of Engineers in the early 1900's as a means of channeling the river for irrigation uses, as the river naturally overflowed its banks creating seasonal marshes. The levee exists today on the south bank of the river through the City of Paisley. Efforts by local citizens have been made throughout the years to maintain the levee and protect the city from further flood issues. In 2006, a weir located on the river and upstream of the City of Paisley that was owned by the city was removed. The removal of the city weir lowered the standard flow of the river by approximately five feet. This has created a generous buffer for river flow increase and in protecting the city from further flooding on regular flood years.

[13] Ibid

[14] Ibid.

There are many small streams and tributaries in Lake County as well. These streams, like the Chewaucan, become inundated with excess flow from heavy rains and snow runoff. Because the population density is so low in Lake County, the flooding from these creeks rarely affects population and infrastructure.

There are also numerous large lakes that give Lake County its name. Each lake has a considerable sized flood plain, although historically the lakes have dried up more often than they have flooded. As in the same case as the streams in the county, there is little to no infrastructure or population within the flood plains of these lakes. The exception to this is the Goose Lake flood plain. The north end of Goose Lake is located seven (7) miles south of Lakeview near the border of Oregon and California in central Lake County. The Goose Lake Basin has a 100-year flood plain that stretches north of the Town of Lakeview by approximately ten (10) miles. The flood plain extends this far north because there are a few tributary creeks that feed Goose Lake that begin north of Lakeview. There have been no recorded issues with these tributaries flooding and affecting infrastructure or population.

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 Lake County see the Flood Annex in Volume II Hazard Annexes.

Flood is one of the identified climate change metrics therefore OCCRI's *Future Climate Projections* report. See the Introduction to the Hazard Annexes and Appendix H for more information on climate change. See the Flood Annex for more information about floods.

Landslide

Significant changes since 2013 NHMP

In the *2013 Lake County NHMP*, landslides were ranked ninth. In the *2020 Lake County NHMP*, the Steering Committee ranked landslides in seventh place. Due to several risk score ties, seventh place is effectively last place in the risk score rankings.

Characteristics

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 transportation corridors, fuel and energy conduits, and communication facilities. They can pose a serious threat to human life.

All landslides can be classified into one of the following six types of movements: (1) slides, (2) flows, (3) spreads, (4) topples, (5) falls, or (6) complex[15]. In addition, landslides may be broken down into the following two categories: (1) rapidly moving; and (2) slow moving[16]. Rapidly moving landslides are typically "off-site" (debris flows and earth flows) and present the greatest risk to human life. Rapidly moving landslides have caused most of the recent landslide-related injuries and deaths in

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

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

Oregon, including eight deaths in 1996 following La Niña storms[17]. Slow moving landslides tend to be "on-site" (slumps, earthflows, and block slides) and can cause significant property damage, but are less likely to result in serious human injuries[18].

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.[19]

Location/Extent

In general, areas at risk to landslides have steep slopes (25 percent or greater,) or a history of nearby landslides. In otherwise gently sloped areas, landslides can occur along steep river and creek banks, and along ocean bluff faces. At natural slopes under 30 percent, most landslide hazards are related to excavation and drainage practices, or the reactivation of preexisting landslide hazards.[20]

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]

Lake County has rarely experienced major landslides. The Steering Committee noted that road cuts can be problematic but they did not identify specifc areas in the County that are potentially vulnerable.

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 Lake County see the Landslide Annex in Volume II Hazard Annexes.

Landslide was not one of the identified climate change metrics therefore OCCRI's *Future Climate Projections* report does not include information about landslides.

Volcanic Event

Significant changes since 2013 NHMP

In the *2013 Lake County NHMP*, volcanic events were ranked eighth. In the *2020 Lake County NHMP*, volcanic events ranked sixth.

[17] Ibid

[18] Ibid.

[19] Ibid.

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

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

Characteristics

Lake 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. 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 Lake County directly.

Location/Extent

Active volcanoes that could impact Lake County include composite volcanoes within the Cascades; Crater Lake and Mount Shasta, and the broad field of shield volcanoes in the southern Cascades. 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 Lake County. 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, Lake County and the cities will be isolated from the rest of the state. See the Volcanic Events Annex for additional information about volcanoes.

Volcanic events were not a climate change metric so OCCRI's *Future Climate Projections* report does not include volcanic events.

Wildfire

Significant changes since 2013 NHMP

Wildfire was ranked seventh in the *2013 Lake County NHMP*. In the *2020 Lake County NHMP* it is ranked third.

Characteristics

Wildfires are common to the arid areas of central and eastern 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 Lake County can be divided into four categories: interface, wildland, firestorms, and prescribed burns. These are described in more detail in the Wildfire 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 eastern 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.[22]

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. [23]

The extent of damage to Lake County 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.

Lake County has a Community Wildfire Protection Plan (CWPP), the *2011 Lake County Community Wildfire Protection Plan (2011 Lake County CWPP)*. The *2011 Lake County CWPP* includes detailed analysis of every area under threat of wildfire, an assessment of the risk posed to each area, the state of wildfire prevention, and protection in Lake County, and finally, protection action items.

The following communities were issued hazard ratings in the *2011 Lake County CWPP*: Adel, Ana Estates, Christmas Valley, Drews Reservoir, Fort Rock, Plush, Quartz Mountain/Drews Gap, Alkali Lake, Silver Lake, and Summer Lake. Alkali Lake is rated low hazard and Silver Lake is rated moderate hazard while the other eight communities are rated high hazard.[24]

The high hazard ratings were due to issues with hazard fuels proximity, the use of combustible construction material, inadequate emergency ingress and egress, the lack of defensible space around structures, and proximity to slopes greater than 31 percent.[25]

The Wildfire Significant Historic Hazard Events Table notes the dates, locations, and a description of the event, identifying if there was a disaster declaration related to it. See Table WF-1 in the Wildfire Annex in Volume II Hazard Annexes.

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 Lake

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

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

[24] *2011 Lake County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

[25] *2011 Lake County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

County when there are wildfires. Roads close because of smoke visibility issues, animals on the rangelands can be affected, and people have respiratory issues.

For more information on the air quality hazard, which often relates to wildfire, in Lake County see the Air Quality section in this Risk Assessment, and see the Air Quality Annex in Volume II Hazard Annexes.

OCCRI's *Future Climate Projections* report states, "Wildfire risk, as expressed through the frequency of very high fire danger days, is projected to increase under future climate change. In Lake County, the frequency of very high fire danger days per year is projected to increase on average by about 38% (with a range of -10 to +90%) by the 2050s under the higher emissions scenario compared to the historical baseline." See Appendix F.

Wind Storm

Significant changes since 2013 NHMP

In the *2013 Lake County NHMP*, wind storms were ranked fourth. In the *2020 Lake County NHMP*, wind storms are ranked fifth.

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.[26] 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", are fairly common in Lake County 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 and two of those have been in Lake County. There have been six fatalities from the 113 tornadoes.[27]

Location/Extent

The damaging effects of windstorms may extend for distances of 100 to 300 miles from the center of storm activity. Windstorms in Lake County usually occur from October to March, and their extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain. While all of Lake County is susceptible to high winds and strong wind gusts Summer Lake and Christmas Valley are particularly susceptible to high winds and strong wind gusts.

[26] Taylor, George H. & Chris Hannan, *The Climate of Oregon*, OSU Press, 1999.

[27] The Tornado Project, *Tornadoes in Oregon*, http://www.tornadohistoryproject.com/tornado/Oregon.

Wind is nearly constant in Lake County. The county is subject to continental-influenced weather systems that tend to produce extreme weather, including wind gusts and windstorms. Local topography in Lake County consists of vast sage land with nothing to obstruct wind gusts and north/south oriented mountain ranges and canyons that funnel winds. Goose Lake, just seven miles south of Lakeview, is a primary producer of wind for the southern portion of the county. 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 windstorms can also damage roof beams or break shingles. Windstorms 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. Windstorms 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.[28]

For more information on the wind storm hazard in Lake County see the Wind Storms and Winter Storms Annex in Volume II Hazard Annexes. The Significant Historic Hazard Events Table, Table WWS-4, includes winter storms and wind storms. The list is substantial, revealing a long history of events. The table notes the dates, locations, and a description of the event, identifying if there was a disaster declaration related to it.

In OCCRI's *Future Climate Projections* report, "Limited research suggests very little, if any, change in the frequency and intensity of wind storms in the Pacific Northwest as a result of climate change."

Winter Storm

Significant changes since 2013 NHMP

In the *2013 Lake County NHMP*, winter storms were ranked first and in the *2020 Lake County NHMP,* they are ranked second in a tie with floods. The current risk score is the same (236) as it was in 2013.

Characteristics

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 Lake County typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.[29] Winter storm events are relatively common in eastern Oregon, where the air is generally cold enough for snow and ice, when a Pacific storm is associated with an air mass from the Gulf of Alaska, a major snowstorm may ensue.

[28] 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

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

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 within a community. Ice buildup can bring down trees, communication towers, and wires creating hazards for property owners, motorists, and pedestrians alike.

Location/Extent

All of Lake County is vulnerable to winter storms and impacts typically extend region-wide. Lakeview is particularly vulnerable to cold-air inversions and the resulting increases in poor air quality due to wood smoke. Varied elevations and topography of the County mean that the impact of a storm is variable depending on the location. The mountains and buttes scattered throughout the County generally receive the highest amounts of rainfall and snowfall. Large snow packs built during winter months can lead to potentially increased flooding risk in the spring. State Highways 31, 140 and 305 are primary transportation routes that have historically been closed due to severe winter weather. The senior population in Lake County is particularly vulnerable to winter cold, air quality (wood smoke), and the potential results of severe winter storms.

For more information on the winter storm hazard in Lake County see the Wind Storms and Winter Storms Annex in Volume II Hazard Annexes. The Significant Historic Hazard Events Table, Table WWS-4, includes winter storms and wind storms. The list is substantial, revealing a long history of events. The table notes the dates, locations, and a description of the event, identifying if there was a disaster declaration related to it.

In OCCRI's *Future Climate Projections* report, winter storms was not a metric. Therefore the report does not include winter storms.

Air Quality

Significant changes since 2013 NHMP

In the *2013 Lake County NHMP*, air quality was ranked second. In the *2020 Lake County NHMP*, air quality was ranked first, tying with droughts with 240/240 points, out of the nine natural hazards.

Characteristics

Lake County experiences periods of air stagnation and atmospheric temperature inversions that trap pollution. Although past air quality issues typically arose from use of wood stoves for winter heating, and that continues to some extent, there are also issues related to summer and fall smoke from wildfires. There have been and there continue to be air quality alerts. Particulate matter counts sometimes run close to the Oregon DEQ limits.

Location/ Extent

Air quality issues can occur widely across Lake County, affecting the unincorporated rural areas and the incorporated cities. Wildfires tend to provide a wide ranging source of smoke that can blanket large areas and be detrimental to health of people, animals, and plants. Wood burning stoves tend be a more concentrated, point source type of pollution that decreases air quality. Diesel emissions also contribute to lower air quality. If a volcano were to erupt, ashfall could inundate the areas sufficiently to impact transportation and cause widespread health concerns.

For more information on the air quality hazard in Lake County see the Air Quality Annex in Volume II Hazard Annexes. The Significant Historic Air Quality Events Table, Table AQ-3, notes the dates, locations, and a description of the event.

In OCCRI's *Future Climate Projections* report, air quality is a metric. The report notes that poor air quality is Lake County is expected to be increasing in risk, but the level of confidence in that direction of change is low (out of low, medium, and high confidence). The report also states that wildfires are primarily responsible for days when air quality standards for PM2.5 are exceeded in western Oregon and parts of eastern Oregon (Liu *et al.*, 2016), although woodstove smoke and diesel emissions are also main contributors (Oregon DEQ, 2016).

Hazard Probability

Lake County's Hazard Analysis was last completed on February 20, 2013 as part of the *2013 Lake County Natural Hazards Mitigation Plan*. The *2020 Lake County NHMP* update provided a good opportunity to revisit the hazards, update the analysis, and reestablish the mitigation action priorities as necessary. The DLCD Natural Hazards Planner and the Steering Committee performed a Hazard Vulnerability Analysis on April 11, 2018 and revisited it on May 23, 2018.

Lake County's natural hazards in 2020 are the same as in 2013:

- Winter Storms
- Wind Storms
- Earthquakes
- Droughts
- Floods
- Volcanic Events
- Wildfire
- Landslides
- Air Quality

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.
- **Probability** endeavors to reflect how physical changes in the jurisdiction and scientific research modify the historical record for each hazard.

Vulnerability accounts for approximately 60% of the total score, and probability accounts for approximately 40%.

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. Noting the location of more than half of the population in Lake County is outside the Town of Lakeview and the City of Paisley, the highest percentage of population would be impacted outside the population centers. Property damages could be substantial everywhere. Estimating the appropriate percentage for vulnerability and maximum threat provided some challenge.

Table 2-4 includes the 2020 NHMP Hazard Vulnerability Analysis scores for Lake County as well as the full list of natural hazards and their sub-scores for the components that comprise the risk score.

Table 2-4 2020 NHMP Hazard Vulnerability Analysis scores for Lake County

HAZARD	HISTORY WF = 2	VULNERABILITY WF = 5	MAX THREAT WF = 10	PROBABILITY WF = 7	RISK SCORE
Winter Storms	2 x **8**	5 x **10**	10 x **10**	7 x **10**	**236**
Wind Storms	2 x **10**	5 x **9**	10 x **6**	7 x **10**	**193**
Earthquakes	2 x **1**	5 x **10**	10 x **10**	7 x **7**	**201**
Droughts	2 x **10**	5 x **10**	10 x **10**	7 x **10**	**240**
Floods	2 x **8**	5 x **10**	10 x **10**	7 x **10**	**236**
Volcanic Events	2 x **1**	5 x **10**	10 x **10**	7 x **1**	**129**
Wildfire	2 x **10**	5 x **8**	10 x **8**	7 x **10**	**210**
Landslides	2 x **3**	5 x **1**	10 x **3**	7 x **8**	**97**
Air Quality	2 x **10**	5 x **10**	10 x **10**	7 x **10**	**240**

Source: Lake County NHMP Steering Committees, 2018.

To begin the discussion, DLCD staff asked the SC what they thought were their most common and impactful hazards are. The SC said winter storms, droughts, and floods. The risk score results supported that: droughts and air quality tied with 240 as their risk score (out of 240) taking the #1 spot and floods and winter storms tied at 236 taking the #2 in spot the rankings. Wildfire came in third with a risk score of 210. The risk score for wildfire was revised during the SC meeting on May 23, 2018 because the SC determined that wildfires had more impacts than previously discussed. The score for vulnerability was changed from 5 to 8 and the score for maximum threat was changed from 5 to 8. This put the overall risk score as 210 instead of 165. This changed wildfire in rank in the list of risk level scores for the Lake County natural hazards. The group came to consensus on the ratings for each of the four measures, as well as the total score, for each hazard.

Wind storms were noted as having a more frequent occurrence in the past 2-3 years and possibly longer time, and being stronger on a regular basis. Winds impact power lines and poles, and trees.

Earthquakes were noted as a local concern. The SC members described the difference in concerns for how a Cascadia Subduction Zone (CSZ) earthquake would impact them and how a more localized earthquake might impact them. They described that there are sometimes swarms of smaller earthquakes that happen at the end of the Sierra Nevada Mountains and the northwest corner of Nevada. They noted Abert Rim is nearby. Some of earthquake swarms are documented in the table "Recent Earthquake History Greater than 3.2" that was in the *2013 Lake County NHMP* and in the Significant Historic Hazard Events Tables used for the Hazard Vulnerability Analysis. One SC member noted that according to the earthquake tracker that the USGS has online (Pacific Northwest Seismic Network "Earthquake Map" at http://www.pnsn.org/earthquakes/recent), there were 48 earthquakes in the past 365 days in this area.

Air quality was noted as a big issue in Lakeview but not as much in Paisley. This is due to the geographic and topographic differences in the locations. There is more air movement in Paisley. Lakeview is in a valley. Scott said he called the air quality specialist to find out how many red days per year they have. The SC members noted they have street sweepers and those clean out the particulates that can cause air quality issues.

Landslides were noted as occurring most frequently on Hwy 140 and Adel.

Flooding was a big concern, especially rain on snow events. For flooding, rain on snow events are the main events that impact these jurisdictions. There is a stream under the Paisley School. Bullard Creek is in a culvert in Lakeview. Deadman Creek is located outside of Lakeview.

The total risk scores from the HVA are listed in Table 2-5 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 2-5.

Table 2-5 Natural Hazards, Risk Scores, and Risk Levels

HAZARD	RISK SCORE	RISK LEVEL (H-M-L)
Droughts	240	High
Air Quality	240	High
Winter Storms	236	High
Floods	236	High
Wildfire	210	High-Medium
Earthquakes	201	High-Medium
Wind Storms	193	High-Medium
Volcanic Events	129	Medium
Landslides	97	Low

Source: Lake County NHMP Steering Committee, 2018-2019.

As background, it should be noted that in addition to the Hazard Analysis done in 2013 for Lake County, a Hazard Analysis was also prepared specifically for the Cities of Lakeview and Paisley.

For the current NHMP update, it should be noted that the Hazard Analysis involves the same jurisdictions: Lake County and the Cities of Lakeview and Paisley. The SC agreed that one Hazard Analysis could be performed together with all the jurisdictions participating. This would be efficient and demonstrate collaboration. The group recognized that it would be very important to capture all the comments, as well as similarities and differences between the jurisdictions.

Table 2-6 2019 Total Risk Scores and Rankings with 2013 Total scores and Rankings for Comparison

HAZARD	2018 SCORES	2018 RANKING	2013 SCORES	2013 RANKING
Droughts	**240**	**1**	**210**	**3**
Air Quality	**240**	**1**	**230**	**2**
Winter Storms	**236**	**2**	**236**	**1**
Floods	**236**	**2**	**186**	**6**
Wildfire	**210**	**3**	**175**	**7**
Earthquakes	**201**	**4**	**187**	**5**
Wind Storms	**193**	**5**	**201**	**4**
Volcanic Events	**129**	**6**	**129**	**8**
Landslides	**97**	**7**	**66**	**9**

Source: Tricia Sears, DLCD, January 3, 2018

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 Indexes and Appendix C 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.[30] 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 2016, Lake County has 24.5% of the population over the age of 65. Harney County has 23.6% of the population over the age of 65. Malheur County has 17.4% of the population over the age of 65.[31]
- 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.[32]
- Rural counties tend to have a lower per capita personal income than metro counties.[33]
- Lake County has a per capita personal income of $36,944, which is ranked 25th out of 36 counties, in the Per Capita Personal Income for Oregon Counties.[34]

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

- According to the Oregon Employment Department, the Lake County unemployment rate was 6.5% in April 2019.[35] It was 5.5% in November 2019.[36]
- In the event of a large-scale disaster, unemployment has the potential to rise when businesses and companies are unable to overcome the hazard event.

[30] Hazards Workshop Session Summary #16, *Disasters, Diversity, and Equity*, (July 2000). University of Colorado, Boulder.

[31] Oregon Employment Department, *Employment Landscape of Rural Oregon*. May 2017, https://www.qualityinfo.org/documents/10182/13336/The+Employment+Landscape+of+Rural+Oregon?version=1.0

[32] Ibid.

[33] Ibid.

[34] Ibid.

[35] Oregon Employment Department, *April 2019 Employment and Unemployment in Oregon's Counties*, https://www.qualityinfo.org/documents/10182/73818/Labor+Force+and+Unemployment+by+Area?version=1.65 accessed December 24, 2019.

[36] 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 December 24, 2019.

- Job growth in Oregon is projected at 12% for 2017-2027. Lake County is listed in the growth category of 6 to 9%.[37]

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.[38] 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

- Lake County is 8,138 square miles in size and the population per square mile is 1.0. [39]
- Lake County is within the Northern Basin and Range ecoregion as described by the Oregon Conservation Strategy.[40]
- Oregon's Department of Land Conservation and Development contracted with the Oregon Climate Change Research Institute to perform and provide analysis of the influence of climate change on natural hazards. The report is provided in Appendix F.

For further consideration of environmental vulnerabilities, see Appendix F. In Appendix F Future Climate Projections Reports, the Oregon Climate Change Research Institute's (OCCRI) *Future Climate Projections Lake County: A Report to the Oregon Department of Land Conservation and Development* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports*, 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, cold waves, wildfire, and air quality.

National Flood Insurance Program (NFIP)

The Lake County Flood Insurance Rate Maps (FIRMs), like much of eastern Oregon, are not modernized. However, this work is in process. Below is a recap of current information related to the

[37] State of Oregon Employment Department, *Oregon's Current Workforce Gaps & Future Workforce Needs,* https://www.qualityinfo.org/documents/10182/79531/091719+-+Oregon%E2%80%99s+Current+Workforce+Gaps+%26+Future+Workforce+Needs?version=1.0, accessed December 24, 2019.

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

[39] United States Census, *Quick Facts, Lake County, Oregon*, https://www.census.gov/quickfacts/lakecountyoregon

[40] Oregon Fish and Wildlife, *Oregon Conservation Strategy*, https://www.oregonconservationstrategy.org/ecoregion/northern-basin-and-range/

NFIP in Lake County, the Town of Lakeview, and the City of Paisley. For more details see the Flood Annex section of the Hazard Annexes and Table FL-2 Flood Insurance Details, which shows information as of January 6, 2020 for Lake County, the Town of Lakeview, and the City of Paisley. Additional information about the NFIP maps and floods is included in the Flood Annex.

A brief recap of Table FL-2 and some additional information, all provided by DLCD staff Celinda Adair and Katherine Daniel:

- Lake County (including the Town of Lakeview and the City of Paisley) has 30 National Flood Insurance Program (NFIP) policies in force.[41]
- Private insurance has become an option. As of January 16, 2020, there are five private flood insurance policies in Lake County; three are within Lakeview and two are in the valley in the unincorporated areas.[42]
- There have been 11 paid claims: 6 in unincorporated areas, 4 in Lakeview, and 1 in Paisley.
- There has been one repetitive loss and no severe repetitive losses.
- There are 26 residential flood insurance policies and all are for single-family homes.
- There are 4 non-residential flood insurance policies.
- Lake County has never had a Community Assistance Visit (CAV) or Community Assistance Contact (CAC) according to the FEMA Community Information System database and DLCD's records.[43]
- Lakeview has never had a CAV. Their last CAC was 06/27/1991 and it is closed. Paisley has never had a CAV or CAC.
- The County, the Town of Lakeview, and the City of Paisley are not members of the Community Rating System (CRS).

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.

Critical Infrastructure, Critical Facilities, and Lifelines: Definitions

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

[41] Katherine Daniel, Natural Hazards Planner, DLCD, January 6, 2020.

[42] Krista Smith, Insurance Agent, Favell-Utley Corporation, personal communication, January 16, 2020, http://www.favell-utley.com/employees.htm.

[43] Celinda Adair, National Floodplain Insurance Program Coordinator, DLCD, January 8, 2020.

debilitating impact on security, national economic security, national public health or safety, or any combination of those matters"[44]

A definition of **critical facilities**: **"**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." [45]

A definition of **lifelines**: "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."[46]

From the *2013 Lake County NHMP*, "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."

Table 2-7, includes the critical or essential facility, critical infrastructure, and lifelines (also called assets) for Lake County, the Town of Lakeview, and the City of Paisley. The exact location of the asset is not identified in Table 2-7.

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

[45] 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.

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

Table 2-7 Critical Facilities, Critical Infrastructure, and Lifelines for Lake County, the Town of Lakeview, and the City of Paisley and the Natural Hazard that May Impact Them

Lake County Natural Hazards Mitigation Plan - Critical Infrastructure, Critical Facilities, and Lifelines									
Lake County Asset Identification	**Drought**	**Air Quality**	**Earthquake**	**Flood**	**Landslide**	**Volcanic Event**	**Wildfire**	**Wind Storm**	**Winter storm**
Lake County									
BPA transmission lines (BPA owns) – there is a line that goes to Bly and Adel.			x		x	x	x	x	x
Natural gas pipeline (Ruby owns) across the lake 5 miles away.			x	x	x				
Pacific Power, Midstate, Harney Electric Cooperative, and Surprise Valley Electric Cooperative provide electricity			x	x	x	x	x	x	x
CenturyLink, US Cellular, and Verizon provide telco and cell service. TMobile is coming.			x	x	x	x	x		
Communication towers for Verizon on the hill top in Paisley and ATT by the airport on Red House Lane.			x		x	x	x	x	x
FAA Instrument Site at Round Mountain Pass			x		x	x	x	x	x
National Security Site at Dead Indian Mountain			x		x	x	x	x	x
Lake County road bridges (all)			x	x	x				
Lake County Airport (back-up generator)		x	x	x		x	x	x	x
Grocery stores (they have generators)			x	x		x	x	x	x
Howards Pharmacy (medication)			x	x		x	x	x	x
Locations of chlorine gas storage in Lakeview.			x	x			x		
Lake District Hospital (only hospital in the county, level 4 trauma center, they have an emergency plan and back-up generators)			x	x		x	x	x	x
Radio communication sites on Black Cap Mountain, Grizzly Mountain, Drakes Peak, Fish Creek Rim, Dead Indian, Round Pass, Morgan Butte, Bald Mountain, and Green Mountain			x		x	x	x	x	x
Lakeview Emergency Services/ Police/ Dispatch Building			x			x	x	x	x
Lake County Sheriff's Office/ Courthouse/ Emergency Services Dispatch Building			x	x		x	x	x	x
Lakeview Interagency Fire Center			x			x		x	x
Oregon DMV Lakeview office			x			x	x	x	x
Lake County Sheriff Search and Rescue, ham radio			x	x		x	x	x	x
Lake County Public Health Department			x	x	x	x	x	x	x
ODOT office in Adel			x		x	x	x	x	x
ODOT office in Alkali Lake			x			x	x	x	x

Lake County Natural Hazards Mitigation Plan - Critical Infrastructure, Critical Facilities, and Lifelines									
Lake County Asset Identification	**Drought**	**Air Quality**	**Earthquake**	**Flood**	**Landslide**	**Volcanic Event**	**Wildfire**	**Wind Storm**	**Winter storm**
Lake County Fairgrounds			x			x	x	x	x
Lake County School District			x			x	x	x	x
Plush School District 18			x			x		x	x
Adel School District 21			x			x	x		x
Warner Creek Correctional Facility Geothermal Heating System (It is the heat exchanger building for the prison geothermal system. It is a direct use geothermal system and the hot water provides heating only – no power generation.)			x			x	x	x	x
Town of Lakeview Geothermal Heating System (It is providing heating to the hospital and school buildings with the hot water but no power is generated. This system is fed from a production well south of Lakeview.									
Bureau of Land Management (BLM) office			x		x	x	x	x	x
Oregon Department of Forestry (ODF) office			x			x	x	x	x
Thomas Creek Westside Rural Fire Protection District			x			x	x	x	x
New Pine Creek Rural Fire Protection District			x					x	x
Warner Valley Rangeland Fire Protection Association (RFPA)			x			x	x	x	x
High Desert Rangeland Fire Protection Association (RFPA)			x			x	x	x	x
Ed Staub & Sons (propane tanks, diesel and unleaded fuel)			x			x	x	x	
Warner Creek Correctional Facility (geothermal, gas pumps, back-up generators)			x		x	x	x	x	x
Christmas Valley (unincorporated)									
Lake County Public Health Department			x			x	x	x	x
Christmas Valley Rural Fire Protection District			x						
North Lake EMS building									
Silver Lake (unincorporated)									
USFS Ranger Station			x		x	x	x	x	x
Silver Lake Rural Fire Protection District			x			x	x	x	x
Lake County Sheriff's Office in Silver Lake			x			x	x	x	x
ODOT office in Silver Lake			x			x	x	x	x
North Lake School District (one building in the district, located in Silver Lake)			x			x	x	x	x

Lake County Natural Hazards Mitigation Plan - Critical Infrastructure, Critical Facilities, and Lifelines									
Lake County Asset Identification	**Drought**	**Air Quality**	**Earthquake**	**Flood**	**Landslide**	**Volcanic Event**	**Wildfire**	**Wind Storm**	**Winter storm**
Town of Lakeview									
Municipal water system			x	x	x	x	x	x	x
Wastewater treatment plant			x	x		x	x	x	x
ODOT office and Oregon State Police office			x		x	x	x	x	x
Lakeview Rural Protection Fire District			x			x	x	x	x
City of Paisley									
Municipal water system			x	x	x	x	x	x	x
Wastewater treatment plant			x	x	x	x	x	x	x
USFS Ranger Station			x	x	x	x	x	x	x
Surprise Valley Electrification Cooperative (SVE) Geothermal Plant			x	x	x	x	x	x	x
Paisley School District #11 (one building in the district, located in Paisley)			x	x	x	x	x	x	x
City of Paisley/ Paisley Volunteer Fire Department			x	x	x	x	x	x	x
Fire Department Building & Paisley Disaster Unit Ambulance Building			x	x	x	x	x	x	x

Source: Lake County NHMP Steering Committee 2018-2020

Vulnerabilities of Critical Infrastructure, Critical Facilities, and Lifelines

- It is critical to maintain the quality of built capacity (transportation networks, critical facilities, utility transmission, communication, etc.) throughout the area, especially since the Town of Lakeview and the City of Paisley would be isolated from much of the state if service on Highways 395, 31, and 140 were interrupted for an extended period of time.
- Some roads and bridges in the County are highly vulnerable to hazards. Because roads bridges vary in size, materials, siting, and design, any given hazard will affect them differently. 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 3,522 housing units, with 2,097 owner-occupied and 1,425 renter-occupied in Lake County. Of those, the bulk were built many years ago, before seismic and flood requirements. See Table 2-8 included below.[47]
- Current seismic building standards began in 1990 and the local implementation of the flood elevation requirements began in the 1970's. The Lake County Flood Insurance Rate Maps (FIRMs) are dated 1989.[48]
- Work on Memorandums of Understanding or Memorandums of Agreement with other agencies and organizations to have access to their radio communication. One example, ODOT has a radio tower east of Adel, but the Lake County agencies don't have access.[49]
- Identify ambulance service coverage for all of Lake County – who provides it and where; and map it. Lakeview Disaster Unit provides ambulance service in Lakeview. Lake District Hospital may take over this service. Warner Valley First Responders operates two ambulances, one in Adel and one in Plush. There is also the North Lake EMS, and the ambulance services in Paisley and Silver Lake.[50]
- Continue to consider impacts to vulnerable communities throughout Lake County.

Table 2-8 Housing Units in Lake County

Period of Time	Number of Units Constructed
2014 or later	42
2010 to 2013	20
2000 to 2009	443
1980 to 1999	718
1960 to 1979	964
1940 to 1959	918
1939 and before	417
Total	3,522

Source: U.S. Census Bureau, 2013-2017, American Community Survey, Table S2504, *Physical Housing Characteristics for Occupied Housing Units*, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF

[47] U.S. Census Bureau, 2013-2017, American Community Survey, Table S2504, *Housing Characteristics for Occupied Housing Units*, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF

[48] Celinda Adair, National Floodplain Insurance Program Coordinator, DLCD, January 8, 2020.

[49] Jason Jaeger, Lake County Cooperative Weed Management Agency, personal communication, 2/20/20.

[50] Ibid.

Section 3: Mitigation Strategy

Section 3 outlines Lake County'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 Lake County Natural Hazards Mitigation Plan (NHMP) Steering Committee reviewed and retain the mission and goals, and reviewed and updated mitigation actions. Additional planning process documentation is in Appendix B.

Mitigation Plan Mission

The plan mission states the purpose and defines the primary functions of Lake County'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 Lake County NHMP is to:

To create a disaster-resilient Lake County

The 2020 Lake County NHMP Steering Committee reviewed the existing NHMP mission statement and agreed it accurately describes the overall purpose and intent of this NHMP; therefore the mission statement was retained as is. The Steering Committee believes the concise nature of the mission statement allows for a comprehensive approach to mitigation planning.

Mitigation Plan Goals

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

Public participation was a key aspect in developing the NHMP goals. In the past, meetings with the Steering Committee, stakeholder interviews, surveys, and public workshops all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss for natural hazards in Lake County.

Public participation was also a key aspect in this update to the NHMP. The 2020 Lake County NHMP Steering Committee reviewed the four existing NHMP goals and determined they would keep the same goal and add one goal for this update; all the goals are of equal importance.

The **goals** of Lake County NHMP are:

Goal 1: Protect Human Welfare, Property, Cultural and Natural Resources: Develop mitigation actions to lessen the impact from natural disasters on human welfare, infrastructure and property, and the cultural and natural resources of Lake County

Goal 2: Safeguard Economy: Develop mitigation actions to lessen the economic impacts from natural disasters on the region's economic development and local businesses.

Goal 3: Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase public awareness of hazards and risk-reduction practices.

Goal 4: Strengthen Community Capacity: Sustain and build upon community partnerships, resources, and collective knowledge to implement mitigation actions.

Goal 5 (new): Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase internal staff awareness and knowledge of hazards and risk reduction practices.

Existing Mitigation Activities

Existing mitigation actions include current mitigation programs and activities that are being implemented by Lake County in an effort 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 1 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview and Table 3-2 Lake County and Cities Mitigation Actions 2013 Status. For details on each natural hazard see Volume II Hazard Annexes.

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 C, 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 the county and participating cities can be found in Appendix C, Community Profile.

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] A list documenting plans and policies already in place in Lake County and the Cities can be found in Section 4 Implementation Table 4-1 and Appendix C Community Profile in Table C-23.

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 Lake County's 2020 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, 2020 Lake County NHMP Mitigation Actions for Lake County, the city of Paisley, and the Town of Lakeview shows the mitigation actions to move forward.
- Table 3-2, Lake County's Mitigation Actions 2013 Status provides an update on the status of each mitigation action from the *2013 Lake County NHMP*.

Mitigation Action Forms

Each mitigation action has a corresponding Mitigation Action Form describing the activity, identifying the rationale for the project, identifying potential ideas for implementation, and assigning coordinating and partner organizations. The Mitigation Action Forms assist the community in pre-packaging potential projects for grant funding. The components of these Mitigation Action Forms are described below; the forms are in Appendix A Mitigation Action Forms.

Proposed Action Title

Each mitigation action item includes a title and a brief description of the proposed action.

[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

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.

Alignment with Existing Plans/ Policies

Identify any existing community plans and policies where the action item can be incorporated. Incorporating the mitigation action into existing plans and policies, such as comprehensive plans, will increase the likelihood that it will be implemented.

Affected Jurisdiction

Many of the mitigation actions within this plan apply to both the Cities and Lake County; some mitigation actions are specific to one jurisdiction. The list of affected jurisdictions is identified in the lead and partner organizations columns. Appendix A provides more detailed information.

Rationale or Key Issues Addressed

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 Section 2 Risk Assessment and Volume II Hazard Annexes.

Implementation through Existing Programs

For each mitigation action, the Mitigation Action Form asks for some ideas for implementation, which serve as the starting point for taking action. This information offers a transition from theory to practice. Ideas for implementation could include: (1) collaboration with relevant organizations, (2) alignment with the community priority areas, (3) applications to new grant programs, (4) tax incentives, (5) human resources, (6) education and outreach, (7) research, and (8) physical manipulation of buildings and infrastructure. This component of the mitigation action is dynamic, since some ideas may prove to not be feasible, and new ideas may be added during the plan maintenance process. When a mitigation action is implemented, more work may be needed to determine the exact course of action.

The Lake County NHMP includes a range of mitigation actions that, when implemented, will reduce loss from hazard events in the County. Within the NHMP, FEMA requires the identification of existing programs that might be used to implement these action items. Lake County, Town of Lakeview, and City of Paisley 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. The jurisdictions will work to incorporate the mitigation actions into existing programs and procedures.

Lake County, Lakeview, and Paisley will continue to coordinate and implement the *2020 Lake County 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

Emergency Management Team (EMT). Mitigation actions refer to the NHMP Steering Committee and the Emergency Management Team.

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 Lake County and the main contact is Daniel Tague, Emergency Services Coordinator.

Internal and External Partners

The internal and external partner organizations are listed in all three of the mitigation actions tables included below and in the Mitigation Action Forms, located in Appendix A. 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.

Internal partner organizations are departments within the County or other participating jurisdiction that may be able to assist in the implementation of action items by providing relevant resources to the coordinating organization.

External partner organizations can assist the coordinating organization in implementing the action items in various functions and may include local, regional, state, or federal agencies, as well as local and regional public and private sector organizations.

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), Pre-Disaster Mitigation (PDM) 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 funding sources are identified general as short- or long-term (see below) and includes an element of funding capacity of the jurisdiction for that action. Appendix A Action Item Forms includes the more detailed description of each mitigation action; funding sources are included there. See Appendix E Grant Programs and Resources for additional information on funding opportunities.

Estimated Cost

Where possible, an estimate of the cost for implementing the action item is included.

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.

- *Ongoing* 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 Action Development Process

Development of mitigation actions was a multi-step, iterative process that involved brainstorming, discussion, review, and revisions. The bulk of this work occurred during the second, third, and fourth Steering Committee meetings which were held on May 23, 2018, October 10, 2018, and May 22, 2019. Additional conversation occurred with the Emergency Manager and DLCD's Natural Hazards Planner.

One of the first steps was to discuss the status of the mitigation actions from the *2013 Lake County NHMP*. The Steering Committee went through each mitigation action 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 *2020 Lake County NHMP*; see Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview. It includes the mitigation actions that the Steering Committee supports.

Table 3-2 is the Lake County and Cities Mitigation Actions 2013 Status; it provides an update on the status of each mitigation action from the *2013 Lake County NHMP*.

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. Refer to Appendix A Mitigation Action Forms for detailed information about each mitigation action.

Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview, shows all nine of the natural hazards - winter storms, wind storms, earthquakes, droughts, floods, volcanic events, wildfire, landslides, and air quality - impacting Lake County and

the Cities have mitigation actions. Volcanic events and landslides do not have hazard-specific mitigation actions but they are included in the multi-hazard mitigation actions.

There are 55 total mitigation actions in the *2020 Lake County NHMP*. By natural hazard, the totals are as follows: multi-hazard (MH) = 13; drought (DR) = 2; earthquake (EQ) = 9; flood (FL) = 16; wind storms and winter storms (WWS) = 1; wildfire (WF) = 8; and air quality (AQ) = 6.

Table 3-2, Lake County and the Cities Mitigation Actions 2013 Status, includes the status and explanation of the *2013 Lake County NHMP* mitigation actions as provided by the Lake County NHMP Steering Committee (SC) at NHMP meetings in 2018-2019. 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. There is a column entitled "Priority" which identifies the priority of the mitigation actions in the *2013 Lake County NHMP*. In that NHMP, several of them were listed with a priority rating of "highest" and highlighted in green.

The NHMP Steering Committee finalized the mitigation actions for the *2020 Lake County 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 as a way 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, high-medium, and low. The risk level rankings are found in Section 2 Risk Assessment in Table 2-5 and the rankings are further described in the Risk Assessment section.

Table 3-1 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
Multi-Hazard (MH)													
MH#1	High	Re-establish communication and relationship between Lake County, Lakeview, Paisley, and the Chamber of Commerce. Focus on small business hazard and continuity of operations planning in Lake County.	Lake County Emergency Manager, Lake County Chamber of Commerce	Lake County, Lakeview, Paisley, Rotary, Soroptomist, Lakeview Business Association, South Central Economic Development District (SCOEDD), Lake County Resource Initiative (LCRI), OSU Extension Service, Lake District Hospital	On-going	X	X	X		X	X	X	Retain and modify. Re-establish relationships and reach out to businesses to assist them with hazard planning.

MH#2	High	Establish and maintain a community hazard awareness and mitigation campaign as seasonally appropriate to each hazard aiming mitigation actions at households, businesses and vulnerable populations. Develop a calendar that identifies the natural hazards focus for outreach each month. Identify outreach actions that will be done each month. The Lake County Natural Hazards Mitigation Plan (NHMP) Natural Hazards Outreach Calendar is included in the 2020 Lake County NHMP in the appendix.	NHMP Steering Committee, Emergency Preparedness Group	Lake Co. Emergency Manager, Lake Co. Building Dept, Lake Co. Planning Dept, Lake Co. Public Health, Lakeview, Paisley, Lake Co. Chamber of Commerce, SCOEDD, LCRI, Lakeview Crisis Center, OSU Extension, Lake Co. Senior Citizen's Assoc., Lake District Hospital, Klamath Co. Head Start, Lake County Education Service District (ESD), Oregon Department of Human Services (DHS), Veterans Services, Lake County School District #7, Soil & Water Conservation District,	On-going	X	X	X	X	X	X	X	Retain and modify. Establish more specific actions.
MH#3	High	Include broader citizen representation on the NHMP Steering	NHMP Steering Committee,	Lake Co. Planning, Lake Co. Public	Short-term	X		X	X	X			Retain

		Committee to oversee facilitation and implementation of community hazard awareness campaigns.	Emergency Preparedness Group	Health, Lake Co. Sheriff, Lakeview Police Department, Lakeview Fire Department, Oregon Department of Fish and Wildlife, U.S. Forest Service, Oregon Department of Forestry, Bureau of Land Management, Lake County Senior Citizens Association, Lake County Disaster Preparedness Group, Lions, Elks, Soroptomists, Lake District Hospital, Lake Co. Resource Initiative, Lakeview School District. Lakeview Crisis Center, Warner Creek Correctional Facility, Harney Electric Cooperative,									
MH#4	High	Shorten spans and anchor poles on utility	Mid-state Electric Cooperative,	Lake County, Lakeview, Paisley, Mid-	On-going	X	X			X	X	X	Retain

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
		lines in high wind or heavy icing areas.	PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative	state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative, Harney Electric Cooperative									

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH#5	High	Convert primary electrical overhead lines to mountaintop communication services with underground lines.	Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative	Lake County, Lakeview, Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative, Harney Electric Cooperative, companies which are served by the utility and the utility company	On-going	X	X			X	X	X	Retain

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH #6	High	Have all internal staff get Incident Command Training that is appropriate for their position.	Lake County Emergency Manager	All Lake County Departments, City of Paisley, Town of Lakeview	Long-term	x	x	x	x	x	x		New action. The Steering Committee stated this would be a good action.
MH #7	High	Have a GIS person on staff and located in Lake County.	Lake County Planning/Planning Director and Lake County Emergency Manager	Lake County Public Works and Transportation, City of Paisley, Town of Lakeview	Long-term	x	x	x	x	x	x		New action. The Steering Committee stated this would be a good action.
MH #8	High	Make maps of natural hazard areas identified in the NHMP. Collect data about hazard events and critical infrastructure to use in planning, transportation, emergency operations, search & rescue and other disciplines.	Lake County Planning/Planning Director and Lake County Emergency Manager	Lake County Public Works and Transportation, City of Paisley, Town of Lakeview, BLM, American Red Cross, DOGAMI	Long-term	x	x	x	x	x	x		New action. The Steering Committee stated this would be a good action.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH #9	High	Acquire and set up an emergency alert notification system so that emergency messages can be sent via text message or phone call.	Lake County Emergency Manager	Town of Lakeview, City of Paisley, OEM, FEMA, Lake District Hospital	Long-term	x	x	x	x	x	x		New action. Discussed at the Flood After Action Report (AAR) meeting on 4/18/19.
MH #10	High	Set up and conduct specialized training about leadership in emergency situations. E.g. how to feel comfortable leading teams of staff and volunteers. Perhaps have staff train with or shadow each other and volunteers have a buddy to do tasks together.	Lake County Emergency Manager, South Central Oregon Fire Management Partnership (SCOFMP)	Town of Lakeview, City of Paisley, OEM, FEMA, ODF, BLM, NPS, USFS, USFW, Lake District Hospital	Long-term	x		x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.
MH #11	High	Establish a method and system of signing in and out and tracking the emergent/spontaneous volunteers. Distribute this information to Lake County staff and to external partners.	Lake County Emergency Manager	Town of Lakeview, City of Paisley, OEM, FEMA, South Central Oregon Fire Management Partnership (SCOFMP)	Short-term	x		x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH #12	High	Establish mutual aid agreement(s) for lead roles and responsibilities, and sharing material resources.	Lake County Emergency Manager	Town of Lakeview, City of Paisley, Lake District Hospital	Long-term	x	x	x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.
MH #13	High	Establish an Emergency Operations Checklist that blends Incident Command System (ICS) and Emergency Support Functions (ESF) for the Emergency Operations Center. Distribute the information to Lake County staff and to external partners.	Lake County Emergency Manager	Town of Lakeview, City of Paisley, Lakeview District Hospital, South Central Oregon Fire Management Partnership (SCOFMP)	Short-term	x		x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.
Drought (DR)													

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
DR #1	High	Research the opportunity to obtain funds from Oregon Water Resources Department (OWRD) for a feasibility study for water storage for Lake County, the Town of Lakeview, and the City of Paisley. Identify options for the location of the water storage and what it would look like (e.g. above or below ground). Prepare the application for the Water Project Grants and Loans. https://www.oregon.gov/OWRD/programs/FundingOpportunities/WaterProjectGrantAndLoans/Pages/default.aspx	Lake County Emergency Manager, Lake County Planning Manager, Town of Lakeview Public Works, City of Paisley, Lake County Water Master, OWRD	Lake County Cooperative Weed Management Area, BLM, USFW, DSL, ODFW	Short-term	x	x	x	x	x	x	x	Proposed new mitigation action drafted by Tricia after talking with Brian Mayer, the Lake County Water Master.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
DR #2	High	Prepare and distribute water conservation information. Engage these organizations in a collaborative effort: the Lake County Umbrella Watershed Council, the Natural Resources Conservation Service (NRCS), Lake County Water Master, OWRD, Lake County, the Town of Lakeview, and the City of Paisley.	Lake County Umbrella Watershed Council, Lake County Water Master, OWRD, Lake County Emergency Manager, Oregon Department of Agriculture, NRCS	Lake County, Town of Lakeview, City of Paisley, BLM, USFW, ODFW, DSL, Lake County Cooperative Weed Management Area	Short-term	x	x	x	x	x	x	x	Proposed new mitigation action drafted by Tricia after talking with Brian Mayer, the Lake County Water Master.
Earthquake (EQ)													
EQ #1	High-medium	Finish seismic retrofit and restoring Daly Middle School to reduce the building's vulnerability to seismic hazards. The south side is not done with the retrofit and the third floor and basement remain to be restored.	Lake County School District #7	Lake County, Lakeview, DOGAMI, OEM, FEMA, ODE, American Red Cross	Long-term	X			X	X	X		Retain and modify.
EQ #2	High-medium	Seismically retrofit Arthur D. Hay Elementary School to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options.	Lake County School District #7	Lake County, Lakeview, DOGAMI, OEM, FEMA, ODE	Long-term	X			X	X	X		Retain.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
EQ #3	High-medium	Seismically assess and determine retrofit options for Union Elementary School to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options.	Lake County School District #7	Lake County, DOGAMI, OEM, FEMA, ODE	Long-term	X			X	X			Retain.
EQ #4	High-medium	Seismically retrofit Lakeview Fire and Emergency Services Department building (245 N F St) to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Town of Lakeview and Lake County	DOGAMI, OEM, FEMA	Long-term	X	X		X	X	X		Retain and modify.
EQ #5	High-medium	Seismically retrofit Lake County Courthouse/Sheriff's Office (513 Center St) and the Lake County Emergency Services Dispatch building (245 N. F St.) to reduce the buildings vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Lake County	Lake County, Lakeview, DOGAMI, OEM, FEMA	Long-term	X	X		X	X	X		Retain and modify.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
EQ #6	High-medium	Seismically retrofit Silver Lake Rural Fire Protection District (RFPD) building to reduce vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Silver Lake RFPD	Lake County (Silver Lake), DOGAMI, OEM, FEMA	Long-term	X	X		X	X			Retain and modify.
EQ #7	High-medium	Update the existing Historical Inventory list that identifies historic structures, critical facilities and other public structures that represent a significant resource for the community. Focusing especially on unreinforced masonry building to protect them from seismic natural hazards. Index and digitize the list so that it can be uploaded to GIS as a layer.	Lake County Historic Society, Lake County Building and Planning Departments	Lakeview and Paisley Building and Planning Departments, Lake County Emergency Management, State Historic Preservation Office	Long-term	X			X	X	X		Retain and modify

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
EQ #8	High-medium	Seismically assess and determine retrofit options for Paisley Disaster Unit/Ambulance Unit building (1009 and 1011 Cottonwood St, Paisley) and the Fire Department building (1007 Cottonwood St, Paisley) to reduce vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	City of Paisley	Lake County Emergency Services Coordinator, DOGAMI, OEM, FEMA, Oregon Department of Education (ODE)	Long-term	x	x	x	x	x		x	New action. Suggested by Steering Committee.
EQ #9	High-medium	Seismically assess and determine retrofit options for North Lake EMS building (87345 Holly Lane, Christmas Valley) to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Lake County Emergency Manager	DOGAMI, OEM, FEMA, ODE	Long-term	x	x	x	x	x			New action. Suggested by Steering Committee.
Flood (FL)													

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #1	High	Replace insufficient drainage culverts with bridge over Crane Creek at Hwy 395 and County Road 1-15.	Lake County Roads Dept.	OWEB, ODFW, ODOT, Lake County Watershed Councils, Ranchers with water rights to the creek, U.S. Army Corps of Engineers Silver Jackets	Long - term and on-going	X			X	X			Retain
FL #2	High	Establish a County culvert list that assesses and prioritizes which culverts need to be modified or replaced throughout Lake County. Map this information.	Lake County Roads Department	Lake County Planning Department, OWEB, ODFW, Lake County Watershed Councils, ODOT, USFW, BLM	Long-term	X			X	X	X		Retain and modify

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #3	High	Revisit the maintenance procedures and responsibilities described in the Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR. Implement maintenance program on drainage channels from Deadman and Bullard Canyon through Lakeview. The Manual is included in the *2020 Lake County NHMP* as an appendix.	Town of Lakeview, Lake County, and Lake County Soil and Water Conservation District	ODFW, Lake County Watershed Councils,	On-going	X	X		X	X	X		Retain. Revise the action because the maintenance has not occurred as described in the Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR.
FL #4	High	Replace to enlarge and properly construct storm drain at Hwy 31 and Mill Street in Paisley.	City of Paisley	Paisley, Lake County Roads Department, ODOT	Long-term	X			X	X		X	Retain

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #5	High	Ensure continued compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.	Lake County Planning	Town of Lakeview, City of Paisley, FEMA, OEM, DLCD, State NFIP Coordinator	On-going	X			X	X			Retain
FL #6	High	Assess the types and numbers of existing buildings (including repetitive loss structures), infrastructure, and critical facilities located in the identified flood hazard areas.	Lake County Planning	Lakeview, Paisley , Lake County Assessor's Office, DLCD	Long-term	X				X	X	X	Retain and modify
FL #7	High	Connect and establish a relationship with the U.S. Army Corps of Engineers Silver Jackets Program, which is able to provide timely assistance to requests from Lake and all rural counties.	Lake County Emergency Manager	Lake County, Lakeview, Paisley, OEM, DLCD, IHMT, U.S. Army Corps of Engineers Silver Jackets, State of Oregon NFIP Coordinator	Short-term	X	X	X	X	X	X	X	Retain

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #8	High	Levees and canals need to be revamped in Warner Valley. Have discussions to identify: what needs to be accomplished, who are the responsible parties, what is the timeline, and what resources are needed.	Adel Water Improvement District, Plush Water Users, Lake County Emergency Manager, Lake County Water Master, Lake County Cooperative Weed Management Area	Water users in Warner Valley	Long-term	x	x	x	x	x			New action. Daniel identified this and Tricia drafted the action.
FL #9	High	Identify three or four places in Lakeview to keep sandbags at around the County. Have the Warner Creek Correctional Facility make at least one sandbag machine and install it in the identified place.	Lake County Emergency Manager and Lake County Roads Department	Town of Lakeview, City of Paisley, Warner Creek Correctional Facility	Short-term	x	x	x	x	x	x	x	New action. Discussed at the Flood AAR meeting on 4/18/19.
FL #10	High	Identify which culverts need to be replaced and other relevant work to improve drainage on Roberta Street in Lakeview.	Lake County Emergency Manager, Town of Lakeview	U.S. Army Corps of Engineers Silver Jackets	Short-term	x	x	x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #11	High	Explore the option to: put up NO DUMPING signs at locations near Deadman and Bullard Creeks; and to send letters to each property owner in the area to remind them to trim willows, clear culverts, and not dump into water. Include information about removing and burning vegetation and other materials.	Lake County Emergency Manager, Lake County Road Department, Town of Lakeview Public Works	Lake County Tax Assessor	Short-term	x	x		x	x	x	x	New action. Discussed at the Flood AAR meeting on 4/18/19.

FL #12	High	Initiate, plan, and accomplish a collaborative effort to remove vegetation (primarily willows) at the north end of Crump Lake in the "Narrows." Consider also doing vegetation removal at 20 Mile Creek. The lake contain the Warner sucker (*Catostomus warnerensis*) which is a rare species of freshwater ray-finned fish in the family *Catostomidae*. The fish is a native to Oregon found only in the Warner Basin. It is a federally listed threatened species. The purpose of the removal of vegetation is to remove impediments to water flow (which ultimately causes flooding). The vegetation removal work would occur in a seasonally appropriate timeframe. Maintenance of the area identified for vegetation removal would continue in subsequent years as needed. Possible methods of removal include 1) pesticide application and	Lake County Cooperative Weed Management Area, Adel Water Improvement District, Plush Water Users	Lake County Emergency Manager, ODFW, DSL, USFW, BLM	Long-term	x	x	x	x	x			New action. Discussed at the Flood AAR meeting on 4/18/19. DSL (email dated 10/8/19 from Randy Wiest) states they would be willing to offer a letter of support as long as all the issues are addressed.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
		burning vegetation, 2) mechanical removal such as use of a backhoe, and 3) constructing a spillway. At this time, the pesticide application and burning vegetation is identified as the cheapest and most effective means to use.											
FL #13	High	Redesign stream crossing on road to Warner Shooting Range. Design it in a fashion that will allow water to pass over the road in a designated, armored location that will prevent the road from washing out in the event the stream crossing becomes blocked or compromised by debris.	Lake County Emergency Manager, Lake County Road Department, Town of Lakeview	USFS, ODF	Long-term	x	x	x	x	x			New action. Discussed at the Flood AAR meeting on 4/18/19.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #14	High	Install at least one continuous monitoring device at Bullard Dam and Reservoir which would provide an alarm in the event a catastrophic failure of the structure occurred.	Lake County Emergency Manager, Town of Lakeview Public Works, Lake County Soil and Water Conservation District.	Lake District Hospital	Long-term	x	x	x	x	x	x		New action. The Emergency Action Plan Bullard Dam (signed in 1998) says there are no continuous monitoring devices at Bullard Dam and Reservoir.
FL #15	High	Install a radio telemetered staff gage at the Bullard Creek Flood Conduit at the mouth of the canyon. It would be designed to alert the Town of Lakeview Department of Public Works that there is an unusual rise in the downstream water surface and monitoring for a potentially hazardous condition should be initialized.	Lake County Emergency Manager, Town of Lakeview Public Works, Lake County Soil and Water Conservation District.	Lake District Hospital	Long-term	x	x	x	x	x	x		New action. In the Emergency Action Plan Bullard Dam (signed in 1998) it says there are plans to install one.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #16	High	Work with ODOT to accomplish storm drain maintenance and clean out culverts.	Lakeview Public Works	ODOT	Long-term	x	x		x				This mitigation action was suggested by the NHMP Steering Committee on 5/22/19.
Landslide/Debris Flow (LS)													
LS #1	Low	No mitigation actions identified											
Wind Storm (WWS)													
WWS #1	High	Install reader boards along Highway 31 between Summer Lake and Paisley.	Oregon State Police	Lake County Board of Commissioners, Paisley, Summer Lake, ODOT	Short-term	X		X		X		X	Retain. It was noted that a dozen trucks have turned over in the past eight years along the road. There are small signs on the highway.
Volcanic Event (VE)													

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
VE#1	Medium	No mitigation actions identified.											The Steering Committee mentioned an Idaho State volcanologist. No new action suggested.
Wildfire (WF)													
WF #1	High-Medium	Establish fuel breaks to the south and west of Christmas Valley as recommended by the Lake County Community Wildfire Protection Plan Phase II.	Community Wildfire Protection Plan (CWPP) Committee	BLM, ODF, USFS, Lakeview Interagency Fire Center, Lake County Resource Initiative, Lake County Planning Department, Rural Fire Protection Districts, Rangeland Fire Protection Associations	Short-term	X		X	X	X			Retain. BLM has made fuel breaks along the road but additional work needs to be done.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #2	High-Medium	Determine appropriate location; establish fuel reduction projects and implement landscape scale forest restoration to reduce wildfire risk in and around Drews Gap, Lakeview, Paisley, and Summer Lake.	Klamath Lake Forest Health Partnership	BLM, ODF, USFS, OSU Extension, Lake County Umbrella Watershed Council, Lakeview Interagency Fire Center, Lake County Resource Initiative, Lake County Planning Department, Rural Fire Protection Districts, Rangeland Fire Protection Associations, Lake County CWMA, NRCS, Lake County SWCD	Short-term	X		X	X	X			Retain. Build upon past successful efforts and continue to work comprehensively with watershed and forest restoration efforts.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #3	High-Medium	Develop management plan and actively manage the Town of Lakeview's municipal watershed to reduce wildfire risk.	Town of Lakeview and ODF	USFS, Lake County Resource Initiative, Lake County Umbrella Watershed Council, OSU Extension, ODFW, Lake County CWMA	On-going	X		X	X	X	X		Retain. Expand upon past success. Coordinate with landscape scale restoration on adjacent public and private lands.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #4	High-Medium	Construct barriers on pole power transformers to prevent birds from building nests on them, thereby reducing the chance of wildfires from transformer shorts.	Harney Electric Cooperative, Inc. (covers Lake, Harney, and Malheur Counties)	Lake County, Lakeview, Paisley, Audubon Society, Nature Conservancy, USFW, , Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative	On-going	X	X		X	X	X	X	Retain. The Steering Committee noted that poles are constructed differently such that nests cannot be established on the poles. This remains a priority for the Harney Electric Cooperative and it is regularly budgeted item.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #5	High-Medium	Manage weeds and vegetation growth at base of poles in fire prone regions.	Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative, Harney Electric Cooperative, Inc.	Lake County, Lakeview, Paisley, BLM, USFW,	On-going	X	X		X	X	X	X	Retain. This remains a priority for the Harney Electric Cooperative and it is regularly budgeted item.
WF #6	High-Medium	The Community Wildfire Protection Plan (CWPP) group will be convened within three months from the FEMA approval of the NHMP (if it hasn't yet begun convening already).	Lake County Emergency Manager, Lake County Commissioners, Oregon Department of Forestry	CWPP Committee, Fire Defense Board, BLM, Town of Lakeview, City of Paisley, volunteer fire departments, RFPAs	Long-term	x	x	x	x	x	x	x	New action. Identified during the conversation with Dan Shoun and Dustin Gustaveson. Tricia drafted it.
WF #7	High-Medium	Review the fire events that have occurred, pre-planning and response actions, and note the successes and areas in need of improvement.	Lake County Emergency Manager, Oregon Department of Forestry, Fire Defense Board	CWPP Committee, Fire Defense Board, BLM, Town of Lakeview, City of Paisley, volunteer fire departments, RFPAs, ODF, USFS, USF&W	Long-term	x	x	x	x	x	x	x	New action. Identified during the conversation with Dan Shoun and Dustin Gustaveson. Tricia drafted it.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #8	High-Medium	Explore the option to stablish a provision in the local building code that limits or prohibits the use of wood shingles on buildings in certain areas as determined appropriate.	Lake County Emergency Manager, Lake County Planning Department, Lake County Building Department	Town of Lakeview, City of Paisley, State or Oregon Building Codes Division	Long-term	x	x	x		x	x	x	New action. Daniel talked with Darwin and sent Tricia a text message on 4/21/19 suggesting this be included as a mitigation action in the NHMP.
Air Quality (AQ)													

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
AQ #1 (formerly MH #6)	High	Complete the EPA Advance Program's "Path Forward" for Lakeview and implement the regulatory programs developed within the document in order to meet EPA PM 2.5 requirements.	Town of Lakeview	Lake County Public Health, Lake County Building, Lake County Emergency Manager, Oregon DEQ, Oregon Health Authority, US EPA, BLM, USFS, ODF	On-going	x	x		x	x	x		Retained. Moved from MH #6 to Air Quality. There is an existing Lakeview Area Particulate Matter (PM 2.5) Advance Plan dated Septembe r 2014 and a Lakeview Area PM Advance Program Action Plan Update dated October 2018.
AQ #2	High	Upgrade the air quality monitor owned by North Lake School District in Silver Lake.	Lake County Emergency Manger and North Lake School District/Superi ntendent	DEQ, Lake District Hospital	Long-term	x x		x	x	x			New action. Suggested by Peter Brewer at DEQ and drafted by Tricia.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
AQ #3	High	Evaluate the options of air quality monitors, then purchase and install an air quality monitor in the City of Paisley. Maintain it.	Lake County Emergency Manager and City of Paisley	Paisley School District, DEQ, Lake District Hospital	Long-term	x		x	x	x		x	New action. Suggested by Peter Brewer at DEQ and drafted by Tricia.
AQ #4	High	Reinstall education in the school districts about air quality: impacts of it, steps to take, and so forth.	Lake County Emergency Manager, Lake County School District, North Lake School District, Paisley School District, Lake District Hospital,	DEQ, City of Paisley, Town of Lakeview, SCOFMP	Long-term	x		x	x	x	x	x	New action. Suggested by Peter Brewer at DEQ and drafted by Tricia.
AQ #5	High	Expand outreach efforts to the community about air quality: impacts of it, steps to take, advice for air filters, and so forth.	Lake County Emergency Manger, City of Paisley, Town of Lakeview, Lake District Hospital	DEQ, SCOFMP	Long-term	x		x	x	x	x		New action. Suggested by Peter Brewer at DEQ and drafted by Tricia.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
AQ #6	High	Lake County NHMP Steering Committee / Emergency Preparedness Group read and discuss the Lakeview Area – Particulate Matter (PM 2.5) Advance Action Plan (September 2014) and the most current edition of the Lakeview Area PM Advance Program Action Plan – Update (currently dated October 2019) each year at an NHMP maintenance meeting.	Lake County Emergency Manager, NHMP Steering Committee/Emergency Preparedness Group	DEQ, City of Paisley, Town of Lakeview, Lake District Hospital, ODF, Paisley School District, Lake County School District, North Lake School District, Adel School District 21, Plush School District 21	On-going	x		x	x	x		x	New action. Drafted by Tricia.

Source: Lake County NHMP Steering Committee, 2018-2019

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Table 3-2 Lake County and Cities NHMP Mitigation Actions 2013 Status

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
Multi-Hazard (MH)													
MH#1	High	Re-establish communication and relationship between Lake County, Lakeview, Paisley, and the Chamber of Commerce. Focus on small business hazard and continuity of operations planning in Lake County.	Lake County Emergency Manager, Lake County Chamber of Commerce	Lake County, Lakeview, Paisley, Rotary, Soroptomist, Lakeview Business Association, South Central Economic Development District (SCOEDD), Lake County Resource Initiative (LCRI), OSU Extension Service, Lake District Hospital	On-going	X	X	X		X	X	X	Retain and modify. Re-establish relationships and reach out to businesses to assist them with hazard planning.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH#2	High	Establish and maintain a community hazard awareness and mitigation campaign as seasonally appropriate to each hazard aiming mitigation actions at households, businesses and vulnerable populations. Develop a calendar that identifies the natural hazards focus for outreach each month. Identify outreach actions that will be done each month. The Lake County Natural Hazards Mitigation Plan (NHMP) Natural Hazards Outreach Calendar is included in the 2019 Lake County NHMP in the appendix.	NHMP Steering Committee, Emergency Preparedness Group	Lake Co. Emergency Manager, Lake Co. Building Dept, Lake Co. Planning Dept, Lake Co. Public Health, Lakeview, Paisley, Lake Co. Chamber of Commerce, SCOEDD, LCRI, Lakeview Crisis Center, OSU Extension, Lake Co. Senior Citizen's Assoc., Lake District Hospital, Klamath Co. Head Start, Lake County Education Service District (ESD), Oregon Department of Human Services (DHS), Veterans Services, Lake County School District #7, Soil & Water Conservation District,	On-going	X	X	X	X	X	X	X	Retain and modify. Establish more specific actions.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH#3	High	Include broader citizen representation on the NHMP Steering Committee to oversee facilitation and implementation of community hazard awareness campaigns.	NHMP Steering Committee, Emergency Preparedness Group	Lake Co. Planning, Lake Co. Public Health, Lake Co. Sheriff, Lakeview Police Department, Lakeview Fire Department, Oregon Department of Fish and Wildlife, U.S. Forest Service, Oregon Department of Forestry, Bureau of Land Management, Lake County Senior Citizens Association, Lake County Disaster Preparedness Group, Lions, Elks, Soroptomists, Lake District Hospital, Lake Co. Resource Initiative, Lakeview School District. Lakeview Crisis Center, Warner Creek Correctional Facility, Harney Electric Cooperative,	Short-term	X		X	X	X			Retain
MH#4	High	Shorten spans and anchor poles on utility lines in high wind or heavy icing areas.	Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative	Lake County, Lakeview, Paisley, Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative, Harney Electric Cooperative	On-going	X	X			X	X	X	Retain

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH#5	High	Convert primary electrical overhead lines to mountaintop communication services with underground lines.	Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative	Lake County, Lakeview, Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative, Harney Electric Cooperative, companies which are served by the utility and the utility company	On-going	X	X			X	X	X	Retain
MH #6	High	Have all internal staff get Incident Command Training that is appropriate for their position.	Lake County Emergency Manager	All Lake County Departments, City of Paisley, Town of Lakeview	Long-term	x	x	x	x	x	x		New action. The Steering Committee stated this would be a good action.
MH #7	High	Have a GIS person on staff and located in Lake County.	Lake County Planning/Planning Director and Lake County Emergency Manager	Lake County Public Works and Transportation, City of Paisley, Town of Lakeview	Long-term	x	x	x	x	x	x		New action. The Steering Committee stated this would be a good action.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH #8	High	Make maps of natural hazard areas identified in the NHMP. Collect data about hazard events and critical infrastructure to use in planning, transportation, emergency operations, search & rescue and other disciplines.	Lake County Planning/Planning Director and Lake County Emergency Manager	Lake County Public Works and Transportation, City of Paisley, Town of Lakeview, BLM, American Red Cross, DOGAMI	Long-term	x	x	x	x	x	x		New action. The Steering Committee stated this would be a good action.
MH #9	High	Acquire and set up an emergency alert notification system so that emergency messages can be sent via text message or phone call.	Lake County Emergency Manager	Town of Lakeview, City of Paisley, OEM, FEMA, Lake District Hospital	Long-term	x	x	x	x	x	x		New action. Discussed at the Flood After Action Report (AAR) meeting on 4/18/19.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH #10	High	Set up and conduct specialized training about leadership in emergency situations. E.g. how to feel comfortable leading teams of staff and volunteers. Perhaps have staff train with or shadow each other and volunteers have a buddy to do tasks together.	Lake County Emergency Manager, South Central Oregon Fire Management Partnership (SCOFMP)	Town of Lakeview, City of Paisley, OEM, FEMA, ODF, BLM, NPS, USFS, USFW, Lake District Hospital	Long-term	x		x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.
MH #11	High	Establish a method and system of signing in and out and tracking the emergent/spontaneous volunteers. Distribute this information to Lake County staff and to external partners.	Lake County Emergency Manager	Town of Lakeview, City of Paisley, OEM, FEMA, South Central Oregon Fire Management Partnership (SCOFMP)	Short-term	x		x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.
MH #12	High	Establish mutual aid agreement(s) for lead roles and responsibilities, and sharing material resources.	Lake County Emergency Manager	Town of Lakeview, City of Paisley, Lake District Hospital	Long-term	x	x	x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
MH #13	High	Establish an Emergency Operations Checklist that blends Incident Command System (ICS) and Emergency Support Functions (ESF) for the Emergency Operations Center. Distribute the information to Lake County staff and to external partners.	Lake County Emergency Manager	Town of Lakeview, City of Paisley, Lakeview District Hospital, South Central Oregon Fire Management Partnership (SCOFMP)	Short-term	x		x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.
Drought (DR)													

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
DR #1	High	Research the opportunity to obtain funds from Oregon Water Resources Department (OWRD) for a feasibility study for water storage for Lake County, the Town of Lakeview, and the City of Paisley. Identify options for the location of the water storage and what it would look like (e.g. above or below ground). Prepare the application for the Water Project Grants and Loans. https://www.oregon.gov/OWRD/programs/FundingOpportunities/WaterProjectGrantAndLoans/Pages/	Lake County Emergency Manager, Lake County Planning Manager, Town of Lakeview Public Works, City of Paisley, Lake County Water Master, OWRD	Lake County Cooperative Weed Management Area, BLM, USFW, DSL, ODFW	Short-term	x	x	x	x	x	x	x	Proposed new mitigation action drafted by Tricia after talking with Brian Mayer, the Lake County Water Master.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
DR #2	High	Prepare and distribute water conservation information. Engage these organizations in a collaborative effort: the Lake County Umbrella Watershed Council, the Natural Resources Conservation Service (NRCS), Lake County Water Master, OWRD, Lake County, the Town of Lakeview, and the City of Paisley.	Lake County Umbrella Watershed Council, Lake County Water Master, OWRD, Lake County Emergency Manager, Oregon Department of Agriculture, NRCS	Lake County, Town of Lakeview, City of Paisley, BLM, USFW, ODFW, DSL, Lake County Cooperative Weed Management Area	Short-term	x	x	x	x	x	x	x	Proposed new mitigation action drafted by Tricia after talking with Brian Mayer, the Lake County Water Master.
Earthquake (EQ)													
EQ #1	High-medium	Finish seismic retrofit and restoring Daly Middle School to reduce the building's vulnerability to seismic hazards. The south side is not done with the retrofit and the third floor and basement remain to be restored.	Lake County School District #7	Lake County, Lakeview, DOGAMI, OEM, FEMA, ODE, American Red Cross	Long-term	X			X	X	X		Retain and modify.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
EQ #2	High-medium	Seismically retrofit Arthur D. Hay Elementary School to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options.	Lake County School District #7	Lake County, Lakeview, DOGAMI, OEM, FEMA, ODE	Long-term	X			X	X	X		Retain.
EQ #3	High-medium	Seismically assess and determine retrofit options for Union Elementary School to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options.	Lake County School District #7	Lake County, DOGAMI, OEM, FEMA, ODE	Long-term	X			X	X			Retain.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
EQ #4	High-medium	Seismically retrofit Lakeview Fire and Emergency Services Department building (245 N F St) to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Town of Lakeview and Lake County	DOGAMI, OEM, FEMA	Long-term	X	X		X	X	X		Retain and modify.
EQ #5	High-medium	Seismically retrofit Lake County Courthouse/Sheriff's Office (513 Center St) and the Lake County Emergency Services Dispatch building (245 N. F St.) to reduce the buildings vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Lake County	Lake County, Lakeview, DOGAMI, OEM, FEMA	Long-term	X	X		X	X	X		Retain and modify.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
EQ #6	High-medium	Seismically retrofit Silver Lake Rural Fire Protection District (RFPD) building to reduce vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Silver Lake RFPD	Lake County (Silver Lake), DOGAMI, OEM, FEMA	Long-term	X	X		X	X			Retain and modify.
EQ #7	High-medium	Update the existing Historical Inventory list that identifies historic structures, critical facilities and other public structures that represent a significant resource for the community. Focusing especially on unreinforced masonry building to protect them from seismic natural hazards. Index and digitize the list so that it can be uploaded to GIS as a layer.	Lake County Historic Society, Lake County Building and Planning Departments	Lakeview and Paisley Building and Planning Departments, Lake County Emergency Management, State Historic Preservation Office	Long-term	X			X	X	X		Retain and modify

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
EQ #8	High-medium	Seismically assess and determine retrofit options for Paisley Disaster Unit/Ambulance Unit building (1009 and 1011 Cottonwood St, Paisley) and the Fire Department building (1007 Cottonwood St, Paisley) to reduce vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	City of Paisley	Lake County Emergency Services Coordinator, DOGAMI, OEM, FEMA, Oregon Department of Education (ODE)	Long-term	x	x	x	x	x		x	New action. Suggested by Steering Committee.
EQ #9	High-medium	Seismically assess and determine retrofit options for North Lake EMS building (87345 Holly Lane, Christmas Valley) to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Lake County Emergency Manager	DOGAMI, OEM, FEMA, ODE	Long-term	x	x	x	x	x			New action. Suggested by Steering Committee.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
Flood (FL)													
FL #1	High	Replace insufficient drainage culverts with bridge over Crane Creek at Hwy 395 and County Road 1-15.	Lake County Roads Dept.	OWEB, ODFW, ODOT, Lake County Watershed Councils, Ranchers with water rights to the creek, U.S. Army Corps of Engineers Silver Jackets	Long - term and on-going	X			X	X			Retain
FL #2	High	Establish a County culvert list that assesses and prioritizes which culverts need to be modified or replaced throughout Lake County. Map this information.	Lake County Roads Department	Lake County Planning Department, OWEB, ODFW, Lake County Watershed Councils, ODOT, USFW, BLM	Long-term	X			X	X	X		Retain and modify

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #3	High	Revisit the maintenance procedures and responsibilities described in the Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR. Implement maintenance program on drainage channels from Deadman and Bullard Canyon through Lakeview. The Manual is included in the 2019 Lake County NHMP as an appendix.	Town of Lakeview, Lake County, and Lake County Soil and Water Conservation District	ODFW, Lake County Watershed Councils,	On-going	X	X		X	X	X		Retain. Revise the action because the maintenance has not occurred as described in the Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR.
FL #4	High	Replace to enlarge and properly construct storm drain at Hwy 31 and Mill Street in Paisley.	City of Paisley	Paisley, Lake County Roads Department, ODOT	Long-term	X			X	X		X	Retain

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #5	High	Ensure continued compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.	Lake County Planning	Town of Lakeview, City of Paisley, FEMA, OEM, DLCD, State NFIP Coordinator	On-going	X			X	X			Retain
FL #6	High	Assess the types and numbers of existing buildings (including repetitive loss structures), infrastructure, and critical facilities located in the identified flood hazard areas.	Lake County Planning	Lakeview, Paisley , Lake County Assessor's Office, DLCD	Long-term	X				X	X	X	Retain and modify
FL #7	High	Connect and establish a relationship with the U.S. Army Corps of Engineers Silver Jackets Program, which is able to provide timely assistance to requests from Lake and all rural counties.	Lake County Emergency Manager	Lake County, Lakeview, Paisley, OEM, DLCD, IHMT, U.S. Army Corps of Engineers Silver Jackets, State of Oregon NFIP Coordinator	Short-term	X	X	X	X	X	X	X	Retain

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #8	High	Levees and canals need to be revamped in Warner Valley. Have discussions to identify: what needs to be accomplished, who are the responsible parties, what is the timeline, and what resources are needed.	Warner Valley Water District, Lake County Emergency Manager, Lake County Water Master, Lake County Cooperative Weed Management Area	Water users in Warner Valley	Long-term	x	x	x	x	x			New action. Daniel identified this and Tricia drafted the action.
FL #9	High	Identify three or four places in Lakeview to keep sandbags at around the County. Have the Warner Creek Correctional Facility make at least one sandbag machine and install it in the identified place.	Lake County Emergency Manager and Lake County Roads Department	Town of Lakeview, City of Paisley, Warner Creek Correctional Facility	Short-term	x	x	x	x	x	x	x	New action. Discussed at the Flood AAR meeting on 4/18/19.
FL #10	High	Identify which culverts need to be replaced and other relevant work to improve drainage on Roberta Street in Lakeview.	Lake County Emergency Manager, Town of Lakeview	U.S. Army Corps of Engineers Silver Jackets	Short-term	x	x	x	x	x	x		New action. Discussed at the Flood AAR meeting on 4/18/19.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #11	High	Explore the option to: put up NO DUMPING signs at locations near Deadman and Bullard Creeks; and to send letters to each property owner in the area to remind them to trim willows, clear culverts, and not dump into water. Include information about removing and burning vegetation and other materials.	Lake County Emergency Manager, Lake County Road Department, Town of Lakeview Public Works	Lake County Tax Assessor	Short-term	x	x		x	x	x	x	New action. Discussed at the Flood AAR meeting on 4/18/19.

FL #12	High	Initiate, plan, and accomplish a collaborative effort to remove vegetation (primarily willows) at the north end of Crump Lake in the "Narrows." Consider also doing vegetation removal at 20 Mile Creek. The lake contain the Warner sucker (Catostomus warnerensis) which is a rare species of freshwater ray-finned fish in the family Catostomidae. The fish is a native to Oregon found only in the Warner Basin. It is a federally listed endangered species. The purpose of the removal of vegetation is to remove impediments to water flow (which ultimately causes flooding). The vegetation removal work would occur in a seasonally appropriate timeframe. Maintenance of the	Lake County Cooperative Weed Management Area, Adel Water Improvement District, Plush Water Users	Lake County Emergency Manager, ODFW, DSL, USFW, BLM	Long-term	x	x	x	x	x			New action. Discussed at the Flood AAR meeting on 4/18/19. DSL (email dated 10/8/19 from Randy Wiest) states they would be willing to offer a letter of support as long as all the issues are addressed.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
		area identified for vegetation removal would continue in subsequent years as needed. Possible methods of removal include 1) pesticide application and burning vegetation, 2) mechanical removal such as use of a backhoe, and 3) constructing a spillway. At this time, the pesticide application and burning vegetation is identified as the cheapest and most effective means to use.											
FL #13	High	Redesign stream crossing on road to Warner Shooting Range. Design it in a fashion that will allow water to pass over the road in a designated, armored location that will prevent the road from washing out in the event the stream crossing becomes blocked or compromised by debris.	Lake County Emergency Manager, Lake County Road Department, Town of Lakeview	USFS, ODF	Long-term	x	x	x	x	x			New action. Discussed at the Flood AAR meeting on 4/18/19.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #14	High	Install at least one continuous monitoring device at Bullard Dam and Reservoir which would provide an alarm in the event a catastrophic failure of the structure occurred.	Lake County Emergency Manager, Town of Lakeview Public Works, Lake County Soil and Water Conservation District.	Lake District Hospital	Long-term	x	x	x	x	x	x		New action. The Emergency Action Plan Bullard Dam (signed in 1998) says there are no continuous monitoring devices at Bullard Dam and Reservoir.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
FL #15	High	Install a radio telemetered staff gage at the Bullard Creek Flood Conduit at the mouth of the canyon. It would be designed to alert the Town of Lakeview Department of Public Works that there is an unusual rise in the downstream water surface and monitoring for a potentially hazardous condition should be initialized.	Lake County Emergency Manager, Town of Lakeview Public Works, Lake County Soil and Water Conservation District.	Lake District Hospital	Long-term	x	x	x	x	x	x		New action. In the Emergency Action Plan Bullard Dam (signed in 1998) it says there are plans to install one.
FL #16	High	Work with ODOT to accomplish storm drain maintenance and clean out culverts.	Lakeview Public Works	ODOT	Long-term	x	x		x				This mitigation action was suggested by the NHMP Steering Committee on 5/22/19.
Landslide/Debris Flow (LS)													
LS #1	Low	No mitigation actions identified											
Windstorm (WS)													

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WS #1	High	Install reader boards along Highway 31 between Summer Lake and Paisley.	Oregon State Police	Lake County Board of Commissioners, Paisley, Summer Lake, ODOT	Short-term	X		X		X		X	Retain. It was noted that a dozen trucks have turned over in the past eight years along the road. There are small signs on the highway.
Volcanic Event (VE)													
VE#1	Medium	No mitigation actions identified.											The Steering Committee mentioned an Idaho State volcanologist. No new action suggested.
Severe Weather / Winter Storms (SW)													

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
SW #1	High-Medium	No mitigation actions identified.											Severe weather and wind storms cause powerlines to go down. No new action suggested.
Wildfire (WF)													
WF #1	High-Medium	Establish fuel breaks to the south and west of Christmas Valley as recommended by the Lake County Community Wildfire Protection Plan Phase II.	Community Wildfire Protection Plan (CWPP) Committee	BLM, ODF, USFS, Lakeview Interagency Fire Center, Lake County Resource Initiative, Lake County Planning Department, Rural Fire Protection Districts, Rangeland Fire Protection Associations	Short-term	X		X	X	X			Retain. BLM has made fuel breaks along the road but additional work needs to be done.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #2	High-Medium	Determine appropriate location and establish fuel breaks in and around Drews Gap as recommended by the Lake County Community Wildfire Protection Plan Phase II.	Community Wildfire Protection Plan CWPP Committee	BLM, ODF, USFS, Lakeview Interagency Fire Center, Lake County Resource Initiative, Lake County Planning Department, Rural Fire Protection Districts, Rangeland Fire Protection Associations	Short-term	X		X	X	X			Retain. ODF has been working with private property owners to take steps to establish fuel breaks. Fuel breaks need to be maintained. Additional work needs to be done, including work on federal lands.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #3	High-Medium	Establish fuel breaks east of Lakeview along Deadman and Bullard Canyons as recommended by the South Central Lake County Wildfire Protection Plan (CWPP).	Community Wildfire Protection Plan (CWPP) Committee	BLM, ODF, USFS, Lakeview Fire Department, Lakeview Interagency Fire Center, Lake County Resource Initiative, Lake County Planning Department, Rural Fire Protection Districts, Rangeland Fire Protection Associations	On-going	X		X	X	X	X		Retain. The work has been completed by ODF. Fuel breaks need to be maintained so the action should be ongoing.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #4	High-Medium	Construct barriers on pole power transformers to prevent birds from building nests on them, thereby reducing the chance of wildfires from transformer shorts.	Harney Electric Cooperative, Inc. (covers Lake, Harney, and Malheur Counties)	Lake County, Lakeview, Paisley, Audubon Society, Nature Conservancy, USFW, , Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative	On-going	X	X		X	X	X	X	Retain. The Steering Committee noted that poles are constructed differently such that nests cannot be established on the poles. This remains a priority for the Harney Electric Cooperative and it is regularly budgeted item.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #5	High-Medium	Manage weeds and vegetation growth at base of poles in fire prone regions.	Harney Electric Cooperative, Inc.	Lake County, Lakeview, Paisley, BLM, USFW, Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative	On-going	X	X		X	X	X	X	Retain. This remains a priority for the Harney Electric Cooperative and it is regularly budgeted item.
WF #6	High-Medium	The Community Wildfire Protection Plan (CWPP) group will be convened within three months from the FEMA approval of the NHMP (if it hasn't yet begun convening already).	Lake County Emergency Manager, Lake County Commissioners, Oregon Department of Forestry	CWPP Committee, Fire Defense Board, BLM, Town of Lakeview, City of Paisley, volunteer fire departments, RFPAs	Long-term	x	x	x	x	x	x	x	New action. Identified during the conversation with Dan Shoun and Dustin Gustaveson. Tricia drafted it.
WF #7	High-Medium	Review the fire events that have occurred, pre-planning and response actions, and note the successes and areas in need of improvement.	Lake County Emergency Manager, Oregon Department of Forestry, Fire Defense Board	CWPP Committee, Fire Defense Board, BLM, Town of Lakeview, City of Paisley, volunteer fire departments, RFPAs, ODF, USFS, USF&W	Long-term	x	x	x	x	x	x	x	New action. Identified during the conversation with Dan Shoun and Dustin Gustaveson. Tricia drafted it.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
WF #8	High-Medium	Explore the option to stablish a provision in the local building code that limits or prohibits the use of wood shingles on buildings in certain areas as determined appropriate.	Lake County Emergency Manager, Lake County Planning Department, Lake County Building Department	Town of Lakeview, City of Paisley, State or Oregon Building Codes Division	Long-term	x	x	x		x	x	x	New action. Daniel talked with Darwin and sent Tricia a text message on 4/21/19 suggesting this be included as a mitigation action in the NHMP.
Air Quality (AQ)													

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
AQ #1 (formerly MH #6)	High	Complete the EPA Advance Program's "Path Forward" for Lakeview and implement the regulatory programs developed within the document in order to meet EPA PM 2.5 requirements.	Town of Lakeview	Lake County Public Health, Lake County Building, Lake County Emergency Manager, Oregon DEQ, Oregon Health Authority, US EPA, BLM, USFS, ODF	On-going	x	x		x	x	x		Retained. Moved from MH #6 to Air Quality. There is an existing Lakeview Area Particulate Matter (PM 2.5) Advance Plan dated September 2014 and a Lakeview Area PM Advance Program Action Plan Update dated October 2018.
AQ #2	High	Upgrade the air quality monitor owned by North Lake School District in Silver Lake.	Lake County Emergency Manger and North Lake School District/Superintendent	DEQ, Lake District Hospital	Long-term	x x		x	x	x			New action. Suggested by Peter Brewer at DEQ and drafted by Tricia.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
AQ #3	High	Evaluate the options of air quality monitors, then purchase and install an air quality monitor in the City of Paisley. Maintain it.	Lake County Emergency Manager and City of Paisley	Paisley School District, DEQ, Lake District Hospital	Long-term	x		x	x	x		x	New action. Suggested by Peter Brewer at DEQ and drafted by Tricia.
AQ #4	High	Reinstall education in the school districts about air quality: impacts of it, steps to take, and so forth.	Lake County Emergency Manager, Lake County School District, North Lake School District, Paisley School District, Lake District Hospital,	DEQ, City of Paisley, Town of Lakeview, SCOFMP	Long-term	x		x	x	x	x	x	New action. Suggested by Peter Brewer at DEQ and drafted by Tricia.
AQ #5	High	Expand outreach efforts to the community about air quality: impacts of it, steps to take, advice for air filters, and so forth.	Lake County Emergency Manger, City of Paisley, Town of Lakeview, Lake District Hospital	DEQ, SCOFMP	Long-term	x		x	x	x	x		New action. Suggested by Peter Brewer at DEQ and drafted by Tricia.

Hazard Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Plan Goals				Jurisdictions			Comments and Discussion
						1	2	3 and 5	4	Lake County	Lake-view	Paisley	
AQ #6	High	Lake County NHMP Steering Committee / Emergency Preparedness Group read and discuss the Lakeview Area – Particulate Matter (PM 2.5) Advance Action Plan (September 2014) and the most current edition of the Lakeview Area PM Advance Program Action Plan – Update (currently dated October 2018) each year at an NHMP maintenance meeting.	Lake County Emergency Manager, NHMP Steering Committee/Emergency Preparedness Group	DEQ, City of Paisley, Town of Lakeview, Lake District Hospital, ODF, Paisley School District, Lake County School District, North Lake School District, Adel School District 21, Plush School District 21	On-going	x		x	x	x		x	New action. Drafted by Tricia.

Source: Lake County Steering Committee, 2018-2019

Section 4: Plan Implementation and Maintenance

The Plan Implementation and Maintenance section details the formal process that will ensure that the *2020 Lake County 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 Lake County, the Town of Lakeview, and the City of Paisley will integrate public participation throughout the plan maintenance and implementation process.

Implementing the Plan

The success of the *2020 Lake County 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 will be taken: the plan 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 Lake County NHMP is locally reviewed and ready, the Lake County NHMP Convener (the Emergency Manager) 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 Lake County called the "Approved Pending Adoption" (APA), the County will then adopt the NHMP via resolution. Following County adoption, the other participating jurisdictions – the Town of Lakeview and the City of Paisley - will need to adopt the NHMP. The Lake County NHMP Convener and the DLCD Natural Hazards Planner will then provide both OEM and FEMA with the resolutions from the three jurisdictions.

Once FEMA is provided with final resolution documentation from all three jurisdictions, they will formally approve the *2020 Lake County NHMP*. At that point Lake County will maintain their eligibility for the Hazard Mitigation Assistance (HMA) pre- and post- disaster funds. These funds are distributed through the Pre-Disaster Mitigation (PDM) program, the Hazard Mitigation Grant Program (HMGP), and the Flood Mitigation Assistance (FMA) program.

The accomplishment of the *2020 Lake County NHMP* goals and mitigation actions depends upon regular NHMP Steering Committee participation and support from County, Town, and City 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.

Copies of the resolutions of approval from Lake County, the Town of Lakeview, and the City of Paisley will be included in the Lake County NHMP once they are received. Copies of the FEMA APA and final approval letters will also be included in the Lake County NHMP when they are received. The DLCD Natural Hazards Planner will provide the final copy of the 2020 Lake County NHMP in Word and PDF.

Convener

The Lake County Emergency Services Coordinator will take responsibility for plan implementation. The Lake County Emergency Manager is the designated convener of the NHMP Steering Committee and the maintenance meetings. The Emergency Services Coordinator 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 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.

Coordinating Body

The Lake County Emergency Services Coordinator will take responsibility for plan implementation. The Lake County Emergency Services Coordinator is the designated convener of the NHMP Steering Committee and the maintenance meetings. The Emergency Services Coordinator 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 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 Lake County Natural Hazards Mitigation Plan Steering Committee which includes Lake County, the Town of Lakeview, the City of Paisley, and others. A roster of the Steering Committee is included in the Acknowledgements section of this NHMP. It is anticipated the Lake County Steering Committee will continue so as to provide the implementation and evaluation of the progress of the NHMP. 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 other Steering Committee members. In addition, the Emergency Management Performance Grant (EMPG) grant requires review of the NHMP twice per year.

To make the coordination and review of the Lake County NHMP as broad and useful as possible, the Lake County Emergency Services Coordinator will engage the stakeholders to implement the identified mitigation actions. Specific organizations have been identified as either internal or external partners for the mitigation actions listed for the *2020 Lake County NHMP*; these are identified in Table 3-1 and described in the more detailed Mitigation Action Forms found in Appendix A.

Implementation through Existing Programs

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

Lake County, the Town of Lakeview, and the City of Paisley currently address Oregon's Statewide Planning Goals and legislative requirements through their comprehensive land use plans, capital improvement plans, mandated standards, and building codes. Lake County, the Town of Lakeview, and the City of Paisley 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 C-23 in Appendix C 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 C Community Profile, the 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview in Table 3-1, and the Appendix A Mitigation Action Forms.

Table 4-1 Existing Plans for Lake County, the Town of Lakeview, and the City of Paisley

Jurisdiction	Document	Year
Lake County	Community Wildfire Protection Plan	2005 and 2006, Revised and approved in 2011
Lake County	Comprehensive Plan	1980, amended in 1981, 1982, 1985, 1989
Lake County	Emergency Operations Plan	2013
Lake County	Lake County Ordinance 31 "In the matter of establishing emergency procedures for Lake County"	1999
Lake County, Town of Lakeview, City of Paisley	Natural Hazards Mitigation Plan	2020 in process 2013 existing
Lake County	Transportation Systems Plan	2002
Lake County	Zoning Ordinance	1980, amended in 1981, 1982, 1984, 1985, 1989
Lake County	Land Development Ordinance of 1980	1980, amended in 1981, 1982, 1984, 1989
Eastern Oregon Coordinated Care Organization (EOCCO)	EOCCO Community Health Plan (CHP) Lake County	2019
Lake County, Town of Lakeview, and Lake County Soil and Water Conservation District	Bullard Canyon Debris Basin Documents (PDF) which includes *Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR* and *Emergency Action Plan Bullard Dam*	1998
Lake County	*Emergency Action Plan Drews Creek Dam (D-3) and Cottonwood Creek Dam (C-6) Lake County, Oregon Prepared for Lakeview Water Users* with support from the Oregon Water Resources Department Dam Safety Program	No information
Town of Lakeview and City of Paisley	Memorandum of Understanding Between the Oregon Dept. of Land Conservation and Development and the Cities of Lakeview and Paisley – Oregon Housing Project Housing Needs Analysis	2018
Town of Lakeview and City of Paisley	Town of Lakeview and City of Paisley Housing Needs Analyses, Final Report (will be adopted into the Comprehensive Plan)	June 2019

Jurisdiction	Document	Year
Town of Lakeview and City of Paisley	Economic Opportunities Analysis for Lakeview and Paisley in Lake County, Final Report (will be adopted into the Comprehensive Plan)	June 2019
Town of Lakeview	Comprehensive Plan	1980, as amended
Town of Lakeview	Development Code	2001, as amended
Town of Lakeview	Emergency Operations Plan	2012
Town of Lakeview	Municipal Code	Various dates
Town of Lakeview	Community Response Plan for Air Quality	In process 2020
City of Paisley	Comprehensive Plan	1980
City of Paisley	Zoning Code	1980, revised in November 1988
City of Paisley	Municipal Code	No information
U.S. Air Force and Air National Guard	*173rd Fighter Wing Kingsley Field, Klamath Falls, Oregon Full Spectrum Threat Response Plan 10-2*	April 2006
Oregon Department of Energy	*Oregon Fuel Action Plan*	October 2017

Source: 2013 Lake County NHMP; Lake County Ordinance 31, https://www.lakecountyor.org/county_ordinances/docs/Ordinance%2031%20Declaring%20a%20State%20of%20Emergency.pdf; 2011 Lake County Community Wildfire Protection Plan, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf; Comprehensive Land Use Plan, Lake County, https://www.lakecountyor.org/government/docs/Comp%20Plan%20-%20June%201989.pdf; Lake County Zoning Ordinance, https://www.lakecountyor.org/government/docs/Lake_County_Zoning_Ordinance__Entire_Document_.pdf; Lake County Transportation System Plan, https://scholarsbank.uoregon.edu/xmlui/handle/1794/4116; EOCCO Community Health Plan (CHP) Lake County, https://www.eocco.com/eocco/~/media/eocco/pdfs/chip/chip_lake.pdf; Memorandum of Understanding Between the Oregon Dept. of Land Conservation and Development and the Cities of Lakeview and Paisley – Oregon Housing Project Housing Needs Analysis, https://static1.squarespace.com/static/5a95c820b10598aee241a43f/t/5c5b52fce5e5f0051af1018b/1549488893496/HNA+MOU+Lakeview+Paisley+DLCD.pdf; Lakeview Development Code, https://www.lakeview-oregon.com/planning; Darwin Johnson, Lake County, personal communication, 1/7/20; Janine Cannon, Town of Lakeview, personal communication 1/14/20; Melissa "Missy" Walton, City of Paisley, personal communication, 1/17/20; Daniel Tague, Lake County, personal communication, 1/30/20 and 3/5/20.

Plan Maintenance

Plan Maintenance

Plan maintenance is a critical component of the NHMP. Proper maintenance of the plan ensures that this plan will maximize Lake County, the Town of Lakeview, and the City of Paisley's efforts to reduce the risks posed by natural hazards. The coordinating body and local staff are responsible for implementing this process, in addition to maintaining and updating the plan in meetings described below.

Meetings

The coordinating body is composed of members of the NHMP Steering 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 Lake County and the NHMP Steering Committee on progress that has been made towards their components and mitigation actions of the NHMP.

The convener is the Lake County Emergency Services Coordinator and he/she will be responsible for documenting the outcome of the semi-annual meetings. The process the coordinating body, which is the NHMP Steering Committee, 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 Lake County 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 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 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 *2020 Lake County NHMP* is the risk level rankings from the Hazard Vulnerability Assessment. Of the nine natural hazards, four were identified as high risk level, three at the high-medium risk level, one as medium risk level, and one as 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 drought, floods, winter storms, and air quality mitigation actions. The high-medium hazards are wildfire, earthquakes, and wind storms. Volcanic events are medium and landslides

are low priority mitigation actions. See Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview.

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.

The project prioritization process that was written by the Oregon Partnership for Disaster Resilience (OPDR) and included in the *2013 Lake County NHMP* is provided below. The process includes four steps and is a more general description of the process. It has been slightly modified for inclusion in this *2020 Lake County NHMP*. It is not the process that Lake County used to establish priorities for the mitigation actions. In Appendix D 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.

Four General Steps for Project Prioritization

Step 1: Examine funding requirements

The first step in prioritizing the plan's mitigation actions is to determine which funding sources are open for application. Several funding sources may be appropriate for a county's proposed mitigation projects. Examples of mitigation funding sources include but are not limited to: FEMA's Pre-Disaster Mitigation program (PDM), Flood Mitigation Assistance (FMA) program, Hazard Mitigation Grant Program (HMGP), National Fire Plan (NFP), Community Development Block Grants (CDBG), local general funds, and private foundations, among others. Please see Appendix E Grant Programs and Resources for a more comprehensive list of potential grant programs.

Because grant programs open and close on differing schedules, the coordinating body will examine upcoming funding streams' requirements to determine which mitigation activities would be eligible. The coordinating body may consult with the funding entity, Oregon's Office of Emergency Management (OEM), or other appropriate state or regional organizations about project eligibility requirements. This examination of funding sources and requirements will happen during the coordinating body's twice yearly maintenance meetings.

Step 2: Complete risk assessment evaluation

The second step in prioritizing the plan's mitigation actions is to examine which hazards the selected actions are associated with and where these hazards rank in terms of community risk. The coordinating body will determine whether or not the plan's risk assessment supports the implementation of eligible mitigation activities. This determination will be based on the location of the potential activities, their proximity to known hazard areas, and whether community assets are at risk. The coordinating body will additionally consider whether the selected actions mitigate hazards that are likely to occur in the future, or are likely to result in severe / catastrophic damages.

Step 3: Committee Recommendation

Based on the steps above, the coordinating body will recommend which mitigation actions should be moved forward. If the coordinating body decides to move forward with an action, the coordinating organization designated on the mitigation action item form will be responsible for taking further action and documenting success upon project completion. The coordinating body will convene a meeting to review the issues surrounding grant applications and to share knowledge and/or resources. This process will afford greater coordination and less competition for limited funds.

Step 4: Complete quantitative and qualitative assessment, and economic analysis

The fourth step is to identify the costs and benefits associated with the selected natural hazard mitigation actions which may include measures or projects. This is discussed in more detail for three potential approaches to economic analysis- benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E approach - in Appendix D Economic Analysis of Natural Hazard Mitigation Projects.

The recommended approaches are benefit/cost for structural projects and either cost-effectiveness or STAPLE/E for the non-structural projects.

If the activity requires federal funding for a structural project, the Committee will use a FEMA-approved cost-benefit analysis tool to evaluate the appropriateness of the activity. A project must have a benefit/cost ratio of greater than one in order to be eligible for FEMA grant funding.

For non-federally funded or nonstructural projects, a qualitative assessment will be completed to determine the project's cost effectiveness. The committee could use a multivariable assessment technique called STAPLE/E to prioritize these actions. STAPLE/E stands for Social, Technical, Administrative, Political, Legal, Economic, and Environmental. Assessing projects based upon these seven variables can help define a project's qualitative cost effectiveness. ODPR has tailored the STAPLE/E technique for use in natural hazard mitigation action prioritization.

Appendix D includes a diagram, Economic Analysis Flowchart, to illustrate the process.

Continued Public Involvement & Participation

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

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

- Post copies of the *2020 Lake County NHMP* on the County and Cities websites;
- 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.

The *2020 Lake County NHMP* will be on the Lake County Sheriff's web pages at: https://www.lakecountyor.org/natural_hazards_mitigation_plan.php. The NHMP will 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 2020, the Lake County NHMP would be due to be updated in 2025.** The convener, the Lake County Emergency Services Coordinator will be responsible for organizing the coordinating body, which is the NHMP Steering Committee, to address plan update needs. These people are responsible for updating deficiencies found in the plan, and for meeting the Disaster Mitigation Act of 2000's plan update requirements. Table 4-2 is a toolkit that can assist determining which NHMP actions might be discussed during-scheduled plan maintenance meetings, and which might require additional meeting time and/or the formation of sub-committees.

Table 4-1 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

Source: Tricia Sears, DLCD, Lake County Emergency Services Building, 4/10/18; Emergency Services staff and fire truck, 2018, provided by Daniel Tauge, Lake County Emergency Services Coordinator

Introduction

Lake County identifies nine natural hazards that could impact the County, the Town of Lakeview, and the City of Paisley, as described in Section 2 Risk Assessment and within these Hazard Annexes. Table HA-1 below is the same as Table 2-5 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 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 Lake County, the Town of Lakeview, and the City of Paisley are in Section 3 Mitigation Strategy, Table 3.1. Details for each of the mitigation actions is provided in the mitigation action forms in Appendix A.

Table HA-1 Natural Hazards, Risk Scores, and Risk Levels

HAZARD	RISK SCORE	RISK LEVEL (H-M-L)
Droughts	240	High
Air Quality	240	High
Winter Storms	236	High
Floods	236	High
Wildfire	210	High-Medium
Earthquakes	201	High-Medium
Wind Storms	193	High-Medium
Volcanic Events	129	Medium
Landslides	97	Low

Source: Lake County NHMP Steering Committee, 2018-2019.

These Hazard Annexes describe the characteristics, location, extent, history, and probability for each hazard addressed in the *2020 Lake County NHMP*. Probability and vulnerability are described and uses the OEM Methodology; see the full description of the OEM Methodology in Volume I, Section 2 Risk Assessment. The Risk Assessment and these Hazard Annexes comprise and provide a risk analysis and vulnerability assessment for the natural hazards identified by Lake County. Additional information pertaining to the types and characteristics of each natural hazard is available in the *2015 Oregon Natural Hazards Mitigation Plan,* Region 6 Central Oregon Risk Assessment.

The Hazard Annexes and Volume I Section 2 Risk Assessment are further supplemented by the climate change information provided by the Oregon Climate Change Research Institute (OCCRI).

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.

The state climate change information in the *2015 Oregon NHMP* indicates that hazards projected to be impacted by climate change in Lake County include drought and wildfire. Climate models project warmer drier summers and a decline in mean summer precipitation for Oregon. Winter storms and wind storms also affect Lake County. There is an increasing amount of research on how climate change influences these and other hazards in the Pacific Northwest.

As part of the PDM 16 grants, the Department of Land Conservation and Development (DLCD) contracted with the Oregon Climate Change Research Institute (OCCRI) to provide an analysis of climate change influences on natural hazards. The collaboration resulted in products which provide information regarding the influence and impacts of climate change on existing natural hazards events such as heavy rains, river flooding, droughts, heat waves, cold waves, wildfire, and air quality.

The products include:

- *Future Climate Projections: Lake County (see Appendix F);*
- *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports (see Appendix F);*
- *Climate Change One-Pager;* and
- *Future Climate Change Projections to Support County Natural hazard Mitigation Planning in Oregon* (webinar).

All of those products are available on DLCD's website: https://www.oregon.gov/lcd/CL/Pages/Climate-Change-Resources.aspx.

The basis of the research prepared by OCCRI uses future climate projections that are derived from 10–20 global climate models and have been "downscaled"—made locally relevant. Several climate metrics that relate to natural hazards are being calculated for historical and mid-21st century periods under two future emissions scenarios that result in varying future temperature increases for the State of Oregon.

Each county report describes county-specific projected changes in climate metrics related to the selected natural hazards. The reports present future climate projections for the 2020s (2010-2039 average) and the 2050s (2040-2069 average) compared to the 1971-2000 average historical baseline. Each hazard in the report has a box highlighting "key messages" that call out the main points of the research and analysis for that hazard.

Table HA-2 provides an overview of expected climate change impacts for Lake County. The table shows the direction of change (increasing, decreasing, unchanging) and indicates the level of confidence in direction of change (high, medium, low).

According to the OCCRI reports:

- There is high confidence that heat waves will increase and that cold waves will decrease.
- There is medium confidence that heavy rains, wildfire, droughts, prevalence of invasive species, and loss of wetland ecosystems will increase.
- There is low confidence that wind storms will remain unchanged, dust storms will decrease, and poor air quality and river flooding will increase.

The overview describes results for the natural hazards using climate metrics in summary and as a comparison. For more information see the OCCRI reports in Appendix F. Of note, the climate metrics used by OCCRI do not exactly match the natural hazards identified by Lake County.

After Table HA-2 Overview of Expected Climate Change Impacts for Lake County, there is a list of changes from the *2013 Lake County NHMP* to the *2020 Lake County NHMP*, and a list of maps included in the Hazard Annexes.

Table HA–2 Overview of Expected Climate Change Impacts for Lake County

Heat Waves	↑↑	Heavy Rains	↑↑	Poor Air Quality	↑↑
Cold Waves	↓↓	Wildfire	↑↑	River Flooding	↑↑
		Droughts	↑↑	Dust Storms	↓↓
		Increased Invasive Species	↑↑	Wind Storms	==
		Loss of Wetlands	↑↑		
Level of Confidence in Direction of Change			Expected Direction of Change		
	High Confidence		Risk Increasing		↑↑
	Medium Confidence		Risk Decreasing		↓↓
	Low Confidence		Risk Unchanging		=

Source: OCCRI, *Climate Change Influence on Natural Hazards in Eight Oregon Counties*, August 2018.

Notable Changes to the Risk Assessment and Hazard Annexes from the 2013 NHMP to the 2020 NHMP

Notable changes from the *2013 Lake County NHMP* to the *2020 Lake County 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 were updated. Extraneous information was removed and links to technical reports, studies, and data were added.

- Hazard Annexes include information for Lake County, Town of Lakeview, and the City of Paisley together (previously the Cities were in separate addenda).
- 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 supplemental report from OCCRI (described below) was researched and written, and information has been integrated into the NHMP.

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

- EQ-4 Earthquake Hazard: Expected Shaking,
- EQ-5 Earthquake Hazard: Ground Motion,
- EQ-6 Earthquake Hazard: Liquefaction,
- FL-4 Lake County Flood Hazard,
- LS-3 Lake County Landslide Hazard,
- WF-10 Wildfire Hazard: History,
- WF-11 Wildfire Hazard: Burn Probability by Watershed,
- WF-12 Wildfire Hazard: Wildfire Risk by Watershed,
- WF-13 Wildfire Hazard: Risk to Assets by Watershed, and
- WF-14 Overall Wildfire Risk Lake County, Oregon.

There are additional maps included as figures in the Hazards Annexes.

Drought Hazard Annex

Risk Score: 240

Risk Level: High

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]

Drought ranked first in the risk score in the Hazard Vulnerability Assessment (HVA) for the *2020 Lake County NHMP*, out of the nine natural hazards that the Lake County NHMP Steering Committee identified.

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 *2015 Oregon Natural Hazards Mitigation Plan* (*2015 Oregon NHMP*) also includes all the drought types except ecological.

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.

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

[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.

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]

[6] National Drought Mitigation Center, *Types of Drought*, https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx, accessed July 31, 2019.

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)[8]. 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.[9] 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.[10]

[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] *2013 Lake County NHMP.*

[9] Barry Norris, Administrator, Technical Services Division, Water Resources Department, Planning for Drought, 2001.

[10] 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 *2015 Oregon Natural Hazards Mitigation Plan* (*2015 Oregon NHMP*), it states "Oregon has not undertaken a comprehensive statewide analysis to identify which communities are most vulnerable to drought."[11] Since 1991, Lake County has been under an emergency drought declaration from the Governor of Oregon on fourteen occasions: 1991, 1992, 1993, 1994, 2001, 2002, 2003, 2005, 2007, 2010, 2012, 2014, 2015, and 2018. These drought declarations generally included multiple other counties in the region or across Oregon in addition to Lake County. See Table DR-1 for details.

Ranching, farming, and other agricultural activities greatly contribute to the economy of Lake County. The economic analysis shows that Region 6 is particularly vulnerable during a hazard event for a number of reasons, including consistently higher unemployment and lower regional wages."[12] Region 6 includes Lake, Jefferson, Crook, Deschutes, Klamath, and Wheeler Counties according to the *2015 Oregon NHMP*. Besides the economy, the *2015 Oregon NHMP* also describes impacts of droughts on the environment, population, infrastructure, critical/essential facilities, and state-owned and operated facilities. Drought can have a significant impact on the agricultural community and associated businesses that rely on this industry. See the History of Drought in Lake County and Table DR-1 Significant Historic Drought Events for more details on how many drought events have occurred.

History of Drought in Lake County 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 *2015 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."[13]

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 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.[14]

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

[11] DLCD, *2015 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_12_RA6.pdf

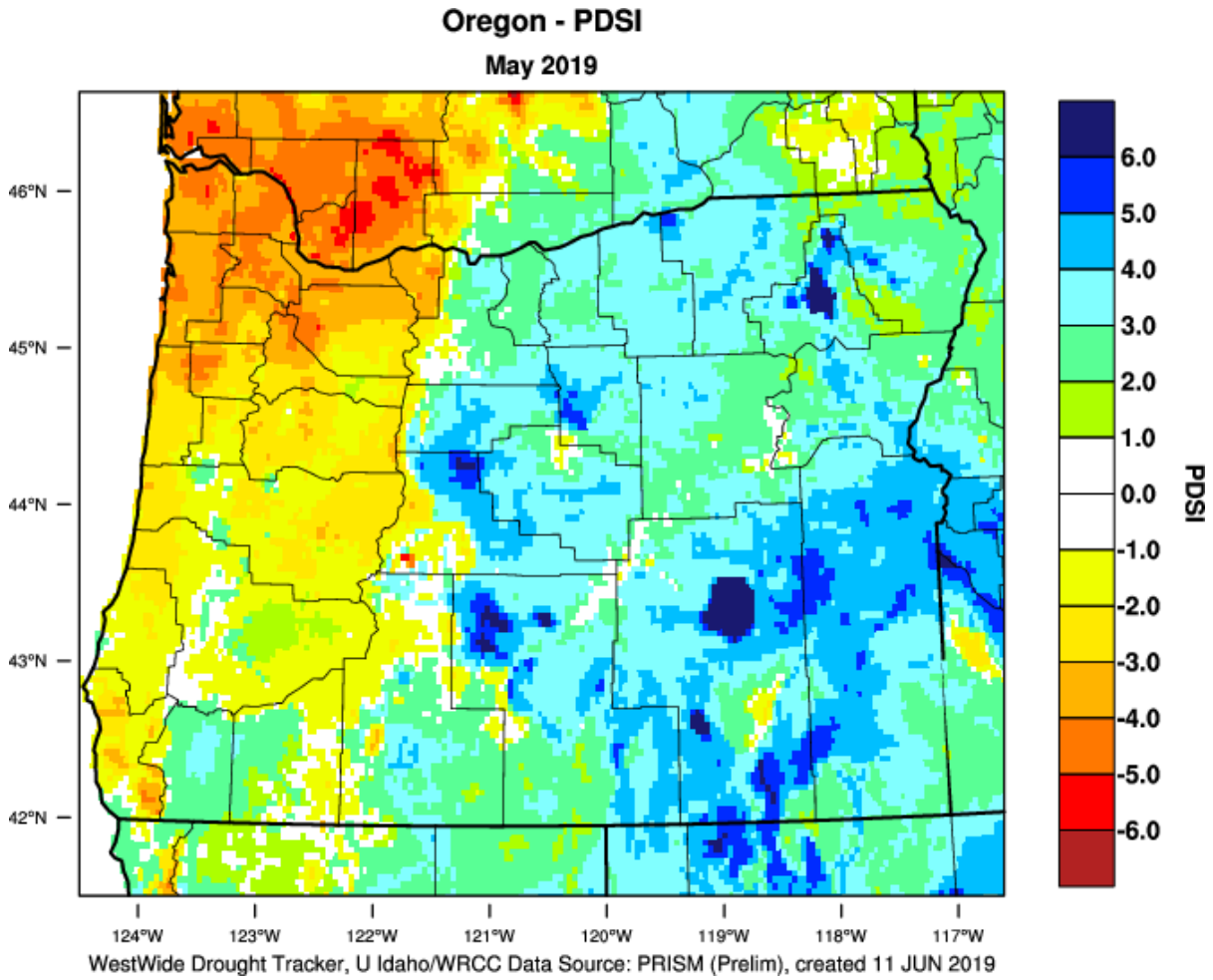
[12] DLCD, *2015 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_12_RA6.pdf

[13] Ibid.

[14] Oregon Drought Conditions Map – May 13, 2017, https://www.plantmaps.com/interactive-oregon-drought-conditions-map.php

in potential evapotranspiration. Monthly PDSI values do not capture droughts on time scales less than about 12 months;[15] 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.[16] See Figure DR-1.

Figure DR-1 Oregon Counties Palmer Drought Severity Index Map for May 2019



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 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.[17]

[15] 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

[16] *2013 Lake County NHMP.*

[17] *2013 Lake County NHMP*.

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.

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.[18] In 2001, 2002, and 2003 Oregon experienced drought conditions. 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.[19]

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.
1959-1964	Eastern Oregon	Streamflows were low throughout eastern Oregon.
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, including Lake (Executive Order 91-05).
1992	Statewide	Governor declared drought (Executive Order 92-21) in many counties, including Harney, Lake and Malheur, for the period of September through October.
1993	Lake County	Disaster loans made available for drought in Lake County.
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 and 03-05) in 18 counties including: Malheur, Harney, Lake, Hood River, Wasco, Sherman, and Gilliam. Lake County named a Contiguous County through Klamath County Secretarial Drought Declaration in 2001. Lake County names a Contiguous County from State of Nevada through Secretarial Declaration in 2002. Lake County named a Contiguous County from Harney County Drought Declaration by Executive Order 03-05 and Secretarial Declaration for Lake County in 2001.
2004	Eastern Oregon	Governor declared drought (Executive Orders) for Morrow, Baker, Klamath, and Malheur Counties.
2005	Several counties	Governor declared drought (Executive Orders) for Baker, Crook, Deschutes, Gilliam, Hood River, Klamath, Lake (Executive Order 05-06), Morrow, Sherman, Umatilla, Wallowa, Wasco, and Wheeler Counties. Lake

[18] Ibid.

[19] Ibid.

Date	Location	Description
		County named a Contiguous County from Klamath County Drought Declaration by Secretarial Natural Disaster Determination.
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). Lake County named a Contiguous County from Harney County.
2010	Region 6	Governor declared drought (Executive Order 10-03) for Klamath County and contiguous counties such as Lake County
2012	Region 6	Governor declared drought (Executive Order 12-15) for Lake and Klamath Counties, specific to the Lost River Basin. Federal Secretary of Agriculture Drought Declaration.
2013	Eastern Oregon	Five counties affected by drought declarations (Executive Orders 13-05, 13-06, 13-09): Gilliam, Morrow, Klamath, Baker, and Malheur.
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 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, Morrow, Umatilla, Union, Wallowa and Wheeler counties.
2015	Statewide	Governor declared drought for Harney County (Executive Order 15-03), Lake and Malheur Counties (Executive Order 15-02), and others (via other Executive Orders) in 2015.
2018	Lake County	Governor declared drought for Lake County (Executive Order 18-07).

Sources: University of Oregon, Lake County NHMP, May 2013; DLCD, Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017. The Oregonian, http://www.oregonlive.com/weather/index.ssf/2014/09/oregon_drought_not_much_relief.html; Oregon Water Resources Department Public Declaration Report http://apps.wrd.state.or.us/apps/wr/wr_drought/declaration_status_report.aspx, 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.

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 one city and county. In severe droughts, environmental and economic consequences can be significant.

How are Hazards Identified?

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Hazard Risk Analysis

The Lake County 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 *2013 Lake County NHMP* drought hazards had a risk score of 210 and a rank of third out of nine natural hazards. In the *2020 Lake County NHMP* drought hazards had a risk score of 240 and a rank of first out of nine 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

Oregon's drought history reveals many short-term and a few long-term events. The average recurrence interval for severe droughts in Oregon is somewhere between 8-12 years.[20] According to the Probability section for drought that is within the *2015 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."[21]

Vulnerability Assessment

Droughts are common throughout Region 6. When droughts occur they can be problematic, impacting community water supplies, wildlife refuges, fisheries, and recreation. Klamath and Lake Counties are especially vulnerable.[22]

Droughts have effects on lake and river levels, which harms wildlife, farmers and ranchers. Its effect on forest is less obvious and can have a tremendous impact. 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 poses a risk for 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).[23] In

[20] *2013 Lake County NHMP*

[21] DLCD, *2015 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP.pdf

[22] DLCD, *2015 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_12_RA6.pdf

[23]Water availability and precipitation are not always correlated; drought conditions affect regions differently than others due to available water supplies.

droughts, environmental, infrastructure, critical/essential facilities, state-owned and operated facilities, population, and economic consequences can be significant.

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 the Hazard Vulnerability Assessment as possibly resulting from drought, losses from a drought could be extensive and far-reaching. As described in Appendix F Future Climate Projections Reports, drought conditions represented by low spring snowpack are projected to become more frequent whereas drought conditions represented by low summer soil moisture and low summer runoff may become less frequent in Lake County by the 2050s as compared to the historical baseline.

Recall Table DR-1 Significant Historic Drought Events. Drought is a normal, recurrent feature of climate, one experienced frequently in the arid high desert of southeastern Oregon. 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 Lake 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-deficient forest or grassland constitutes a significant fire hazard (see the Wildfire 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 average amount of rainfall per year in Lakeview is 14.73 inches and the average amount of snowfall is 54 inches per year. The Wind Storms and Winter Storms Hazard Annex and the Community Profile in Appendix C contains details

about rainfall, snowfall, and temperature.[24] Note that Appendix F Future Climate Projections Reports describe scenarios for the future climate of Lake County based on past data and present models.

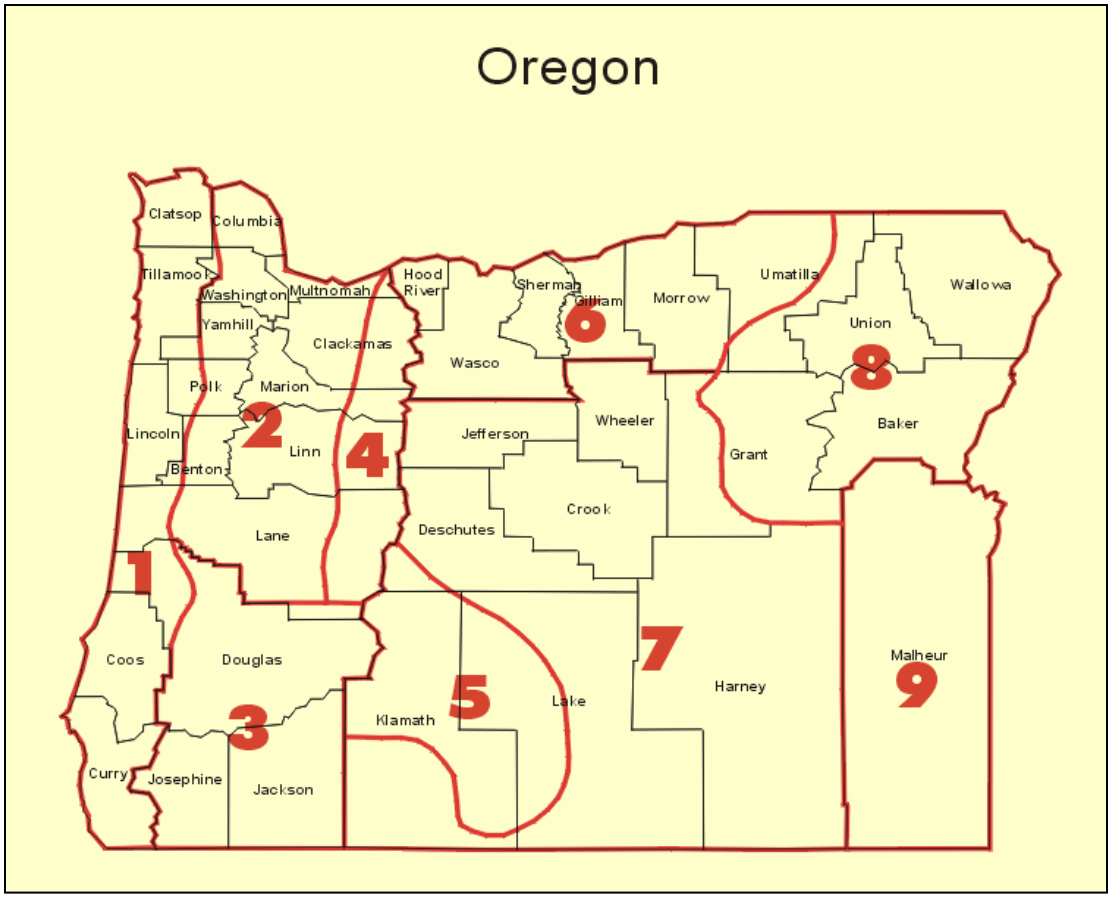
Sometimes when describing climate in Oregon, people refer to the Oregon Climatic Divisions. These divisions are based on the Climate Divisional Dataset maintained by National Oceanic and Atmospheric Administration (NOAA). For many years the dataset was the "only long-term temporally and spatially complete 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."[25]

Oregon climate Zone 7 occupies the southeast corner and the middle part of the state. It comprises the entirety of Harney County and portions of Lake, Crook, Deschutes, Jefferson, Wheeler, and Grant Counties. See Figure DR-2. Lake County is in Oregon Climate Zones 5 and 7.

[24] U.S. Climate Data, https://www.usclimatedata.com/climate/lakeview/oregon/united-states/usor0192.

[25] 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.

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

Existing Hazard Mitigation Activities

City Specific Damage

Town of Lakeview and the City of Paisley

Droughts impact farm owners and the agricultural industry as a whole, as well as ranchers and other businesses and industry. The unincorporated and incorporated areas of Lake County will be impacted by droughts in ways such as a lack of water availability, potential fires, lack of food, and other. The economic impacts of a drought could be substantial.

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."[26]

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 passes 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.[27]

Comprehensive cost estimates for droughts in Lake County are not kept on record, but a county-wide drought declaration can incur $500,000 – 5,000,000 dollars in disaster assistance payments for farmers from the USDA. Most farmers in the County do not carry drought insurance, according to the USDA Farm Service Agency.[28]

Existing Hazard Mitigation Activities and Resources

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.

Natural Resources and Conservation Service (Lake County)

The Natural Resource and Conservation Service (NRCS) has a service center located in Lakeview. They offer voluntary technical and financial assistance to private landowners interested in natural resource conservation. The NRCS has historically focused on rangeland and irrigation upgrades to

[26] State of Oregon, ORS 536.710, https://www.oregonlaws.org/ors/536.710.

[27] *2013 Lake County NHMP.*

[28] Ibid.

improve surface water quality, improve wildlife habitat, control invasive plants, and conserve groundwater.[29]

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."[30]

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/programs/?cid=nrcs142p2_044031

Outreach

Lake County has a Water Master, Brian Mayer, who communicates with the public during drought season and other times of the year about responsible water management best practices. Mr. Mayer, an Oregon Water Resources Department employee, participated in the Lake County NHMP update process and contributed to the creation of the drought mitigation actions.

https://www.lakecountyor.org/government/water_master.php

Lake County Emergency Services and the Planning Department

The Sheriff's Office includes the Emergency Management Services and has information about wildfires and other hazards which often have drought as a contributing factor. The Lake County Planning Department also has hazard information. Contact them for details.

https://www.lakecountyor.org/natural_hazards_mitigation_plan.php

https://www.lakecountyor.org/government/land_use_planning.php

USDA Farm Service Agency in Lake County

The United States Department of Agriculture (USDA) Service Centers are designed to be a single location where customers can access the services provided by the Farm Service Agency (FSA), Natural Resources Conservation Service, and the Rural Development agencies. The FSA in Lake County is located in Lakeview.

[29] USDA Natural Resources Conservation Service of Oregon, *Lake County High Desert Basin,* https://www.nrcs.usda.gov/wps/portal/nrcs/detail/or/programs/?cid=nrcs142p2_044031, accessed 12/26/19.

[30] Ibid.

https://www.nrcs.usda.gov/wps/portal/nrcs/site/or/home/

State Natural Hazard Risk Assessment: Drought

The risk assessment in the *2015 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 6 Central Oregon.

https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_12_RA6.pdf

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/

Emergency Operations Plans

The *Lake County Emergency Operations Plan* (*EOP*), dated April 2013, is an all-hazard plan that describes how Lake County will organize and respond to emergencies and disasters in the community. It is based on, and is consistent with Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including the Presidential Policy Directive 8, the National Response Framework, and State of Oregon Emergency Operations Plan. The *Lake County EOP* is one component of the County's emergency management program and is designed to be compliant with the National Incident Management System.

The *Lake County EOP* consists of a Basic Plan, Emergency Support Function Annexes that complement the Federal and State Emergency Support Functions, Support Annexes, and Incident Annexes. The *Lake County EOP* provides a framework for coordinated response and recovery activities during an emergency. It describes how agencies and organizations in Lake County will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.[31]

[31] Ecology and Environment, Inc., *Lake County Emergency Operations Plan*, April 2013.

Future Changing Conditions/ Climate Change

In the *2020 Lake County NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Lake County. In the order of appearance in the NHMP: the Risk Assessment, the Hazards Annexes, and Appendix F contain this information. Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.*

Drought Mitigation Actions

The drought mitigation actions have been identified by the Lake County NHMP Steering Committee which includes the Town of Lakeview and the City of Paisley. See Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the Town of Lakeview, and the City of Paisley and the mitigation action forms in Appendix A for a more detailed description of the mitigation actions.

As a result of discussion between the Emergency Services Coordinator, DLCD staff, 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 scores and risk level rankings are in Table 2-5 in Section 2 Risk Assessment.

The multi-hazard mitigation actions are applicable to all of the identified natural hazards, including drought. All multi-hazard actions are high priority.

In the HVA, drought had a risk score of 240 out of 240 points and is listed as a high risk level. It tied with air quality as the #1 ranked natural hazard for Lake County. With the high ranking, drought mitigation actions are identified as a high priority. There are two specific mitigation actions related to drought.

DR #1: Research the opportunity to obtain funds from Oregon Water Resources Department (ORWD) for a feasibility study for water storage for Lake County, the Town of Lakeview, and the City of Paisley. Identify options for the location of the water storage and what it would look like (e.g. above or below ground). Prepare the application for the Water Project Grants and Loans.

https://www.oregon.gov/OWRD/programs/FundingOpportunities/WaterProjectGrantAndLoans/Pages/default.aspx

DR #2: “Prepare and distribute water conservation information. Engage these organizations in a collaborative effort: the Lake County Umbrella Watershed Council, the Natural Resources Conservation Service (NRCS), Lake County Water Master, OWRD, Lake County, the Town of Lakeview, and the City of Paisley.”

Earthquake Hazard Annex

Risk Score: 201

Risk Level: High-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 Lake County, 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 Lake County.[2]

Earthquake ranked fourth out of the nine natural hazards in the Hazard Vulnerability Assessment that the Lake County NHMP Steering Committee performed for the *2020 Lake County NHMP*.

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[3]; and 4) earthquakes related to volcanic activity can also affect the region.[4]

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

[3] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, p. 8-9, https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

[4] 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.[5] 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.[6]

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.[7] 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.[8] 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.[9]

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[10]. 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.[11] 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.[12]

[5] Madin, Ian P. and Zhenming Wang, *Relative Earthquake Hazard Maps Report*, DOGAMI, 1999.

[6] DOGAMI, *Earthquakes in Oregon*, https://www.oregongeology.org/earthquakes/earthquakehome.htm.

[7] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, p. 8-8, https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

[8] OPDR and OEM, *2012 Oregon Natural Hazards Mitigation Plan*, https://oregonexplorer.info/content/oregon-natural-hazard-mitigation-plan-2012

[9] Hill, Richard, *Geo Watch Warning Quake Shook Portland 40 Years Ago*, The Oregonian. October 30, 2002.

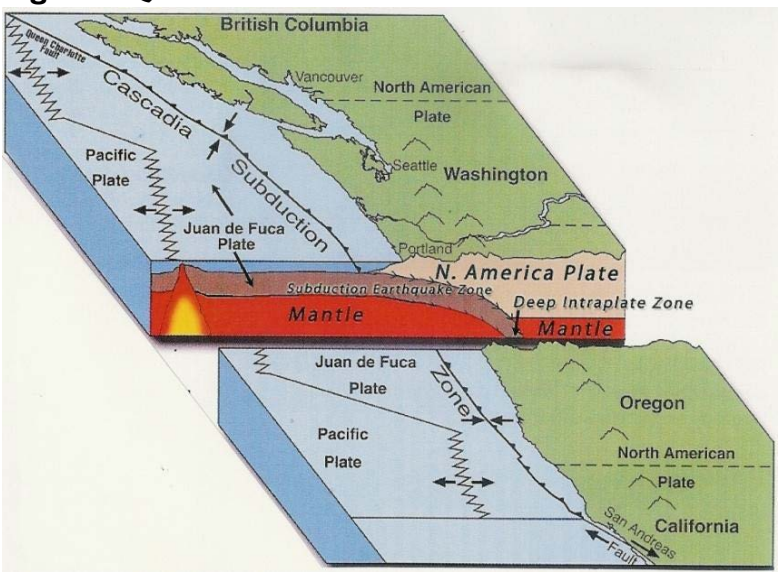
[10] OPDR and OEM, *2012 Oregon Natural Hazards Mitigation Plan*, https://oregonexplorer.info/content/oregon-natural-hazard-mitigation-plan-2012

[11] Riley, Colleen M., *A Basic Guide to Volcanic Hazards*, Michigan Technological University, http://www.geo.mtu.edu/volcanoes/vc_web/overview/o_health.html.

[12] 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.[13] 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. Lake County is unlikely to be directly affected by a subduction zone earthquake; however, it could be

[13] OPDR and OEM, *2012 Oregon Natural Hazards Mitigation Plan*, https://oregonexplorer.info/content/oregon-natural-hazard-mitigation-plan-2012

affected as populations of refugees flee eastward and supplies are staged in the area. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes.[14]

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.

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.

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.

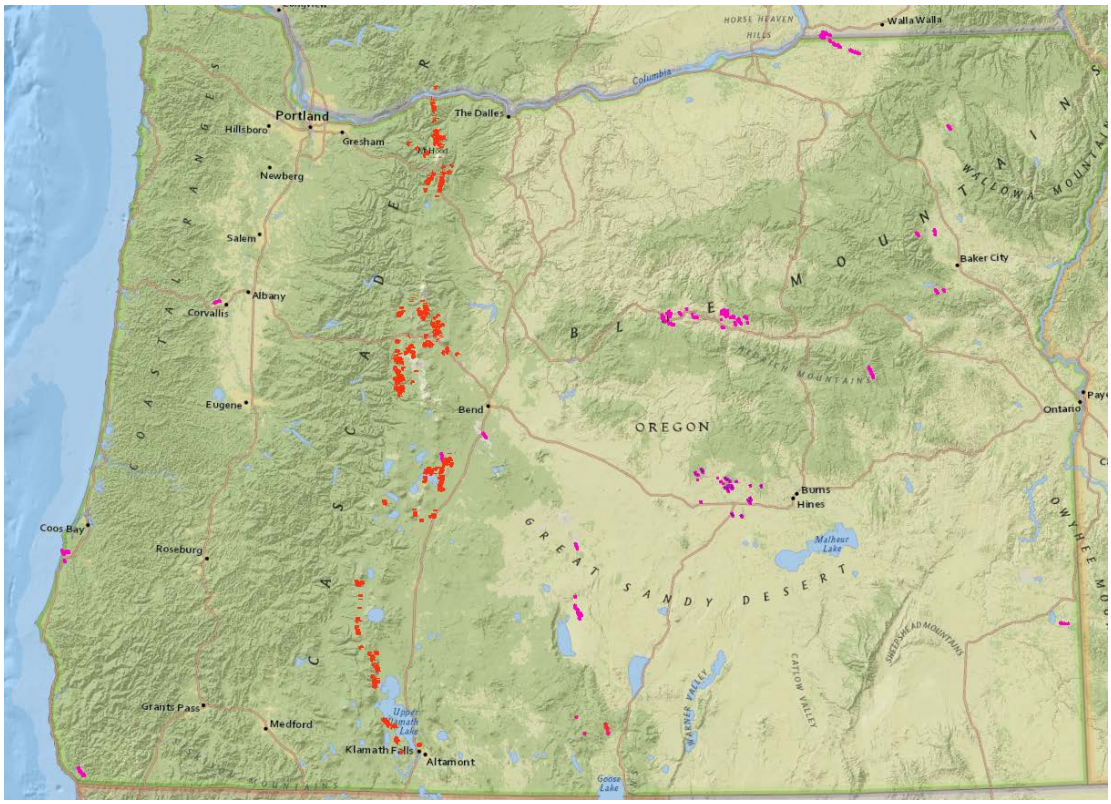
An article published by DOGAMI and others in September 2018 describes a newly discovered fault zone on Mount Hood. The fault zone includes two faults, the Blue Ridge and the Twin Lakes Faults. The discovery of "this active fault system is important for understanding the potential seismic threat for nearby communities." Based on the estimates of the earthquake capability, which are based on

[14] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, p. 8-9, https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909.

observations of average displacement and surface rupture, the fault could produce an earthquake of 6.5 or greater.[15]

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 Portland's drinking water system in Bull Run. Impacts of an earthquake along this fault could readily impact Malheur, Lake, and Harney Counties.[16]

Figure EQ-2 Map of Faults in Oregon Identified with Lidar



Source: Ian Madin, DOGAMI, personal communication, October 30, 2018

Liquefaction and Subsidence

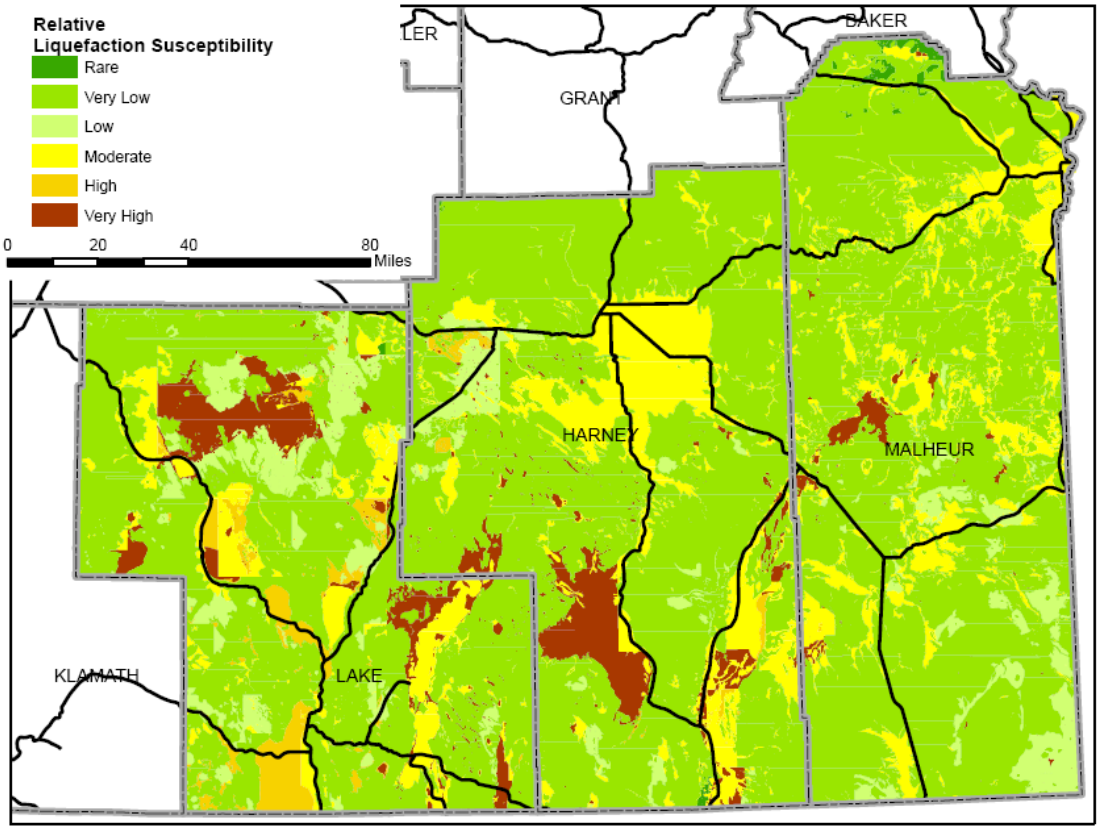
Liquefaction occurs when ground shaking causes wet, granular soils to change from a solid state into a liquid state. This results in the loss of soil strength and the soil's ability to support weight. When the ground can no longer support buildings and structures (subsidence), buildings and their occupants are at risk.

[15] 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*.

[16] Ibid.

In Figure EQ-3, the most current information about the susceptibility of soils to liquefaction is shown for Malheur, Harney, and Lake Counties.[17] In Figure EQ-6, included later in this Earthquake Hazard Annex, the liquefaction susceptibility of Lake County is shown with categories of high, moderate, and low.

Figure EQ-3 Map of Relative Liquefaction Susceptibility Hazard



Source: Burns, et al, 2007. Unpublished Report. Geologic Hazards, Earthquake 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.

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 Lake 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

[17] Bill Burns, DOGAMI, personal communication, December 13, 2018.

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 and Lake County

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.

The 6.0 earthquake from Klamath Falls in 1993 posed a threat to Lake County and is the largest regional earthquake in the last 30 years. Within Lake County, historically seismic events have occurred in the Christmas Valley area, SE of Lakeview near the Warner Mountains, and Adel. The largest recorded earthquake was in May-July of 1968 when Adel experienced a swarm of earthquakes; the highest magnitude quake was 5.1. There are also numerous identified faults in the region that have been active in the last 20,000 years. The region has been shaken historically by crustal and intraplate earthquakes and prehistorically by subduction zone earthquakes centered outside the area.[19]

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.

[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.

[19] OPDR and OEM, *2012 Oregon Natural Hazards Mitigation Plan*, https://oregonexplorer.info/content/oregon-natural-hazard-mitigation-plan-2012

Date	Location	Size (M)	Description
1906	Lakeview, OR	unrecorded	Lakeview area experienced an earthquake.
May 1916	Richland, WA	5.7	Earthquake on May 13, 1916 centered on Richland, WA.
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; University of Oregon, Lake County NHMP, April 2013; DLCD, Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017.

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 staff performed a search, with the parameter of recorded earthquakes between magnitude 3.0 and 10 that have occurred from January 1, 1960 to December 11, 2019, the results identified 3,282 earthquakes that have occurred. The location, date and time, magnitude, depth, and other

information related to each earthquake is provided. The interactive map provides options to vary the search parameters.

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.

DLCD and Lake County collaborated with the Harney County GIS staff and used the DOGAMI Statewide Geohazards Viewer to create maps of:

- Figure EQ-4 Lake County Earthquake Hazard: Expected Shaking,
- Figure EQ-5 Lake County Earthquake Hazard: Ground Motion, and
- Figure EQ-6 Lake County Earthquake Hazard: Liquefaction.

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. As the maps indicate, and has been stated previously, the southeastern part of Oregon is the least seismically active in the state.

Hazard Risk Analysis

The Lake County 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 *2013 Lake County NHMP*, earthquake hazards had a risk score of 187. In the *2020 Lake County NHMP*, earthquake hazards have a risk score of 201. Earthquakes are ranked of 4th out of 9 natural hazards identified by the Lake County NHMP Steering Committee.

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.

See Appendix H Lake County HAZUS Global Reports for Crustal and Probabilistic Scenarios for details about simulated scenarios and the results. Some information below has been excerpted from this prepared by DOGAMI unpublished 2007 report and included here in this Earthquake Annex. The report includes two HAZUS-MH scenarios: Lake Arbitrary Crustal M6.9 and 2500 Year Probably

Scenario M6.5 Driving. The report includes inventories of: buildings; critical facilities; and transportation and utilities. The damage assessment is listed in the categories of direct damage, induced damage, social impact, and economic loss.

Probability Assessment

The 2007 DOGAMI report does not explain why these HAZUS-MH probabilistic scenarios were chosen. Nonetheless, the report from 2007 provides useful information, described briefly in the Vulnerability Assessment. Here, we turn to other sources for the probability of earthquake occurrence.

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.[20]

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.[21]

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.[22]

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

[20] DOGAMI, *Oregon Geology*, Volume 64, No. 1, Spring 2002, https://www.oregongeology.org/pubs/og/p-OG.htm

[21] 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

[22] Rojas-Burke, Joe, *Predicting the next Northwest mega-quake still a struggle for geologists*, The Oregonian. April 20, 2010.

within Washington and British Columbia, the chance of an event has increased to 10-17 percent from 8-14 percent."[23]

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."[24]

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.

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 the 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. The Cities of Lakeview and Paisley are particularly susceptible to being isolated given that Highways 31, 395, and 140 are the only major transportation routes connecting the cities with the rest of the state. Should an earthquake damage any of these transportation routes, communities in Lake County can find themselves isolated. Following an earthquake event, the cleanup of debris can be a huge challenge for the community.

As mentioned previously, Appendix H Lake County HAZUS Global Reports for Crustal and Probabilistic Scenarios has details about two simulated scenarios and the results: Lake Arbitrary Crustal M6.9 and 2500 Year Probable Scenario M6.5 Driving. Both are described below.

Lake Arbitrary Crustal M6.9: The damage assessment is listed in the categories of direct damage, induced damage, social impact, and economic loss. The information below is excerpted from the unpublished 2007 DOGAMI report, *Lake County HAZUS Global Reports for Crustal and Probabilistic Scenarios*.

In the direct damage category:

[23] 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

[24] Ibid.

HAZUS estimated that 301 buildings will be at least moderately damaged, with two being damaged beyond repair. That is over 8% of the buildings in the region. There will be an estimated zero buildings that will be damaged beyond repair. HAZUS estimated that before the earthquake there were 68 hospital beds available. There will be 0 beds in Lake County available for use after the earthquake. After one week the estimate is 3% of the beds and after 30 days 24% of the beds will be available. The transportation and utility lifeline damage is shown in multiple tables with damage to the transportation system, utility system, pipelines, potable water, and electric power.

In the induced earthquake damage category:

There are two categories: fire following earthquake and debris generation. Fires often occur after an earthquake. HAZUS estimated that fires will displace zero people and burn zero dollars of building value. HAZUS estimated the amount of two categories of debris: brick and wood, and concrete and steel. In the report, the total amount of debris is not listed but it does state that brick and wood will comprise 51% and the remainder will be concrete and steel.

In the social impact category:

HAZUS estimates that two households would be expected to be displaced from their homes. Of these, zero people out of a total population of 7,422 will seek temporary shelter in public shelters. HAZUS estimates the number of injuries and casualties from the earthquake in four levels of severity and at three times of day.

In the economic loss category:

HAZUS estimates the total economic loss from the earthquake to be 86.55 million dollars, which includes building and lifeline related losses. The building losses are described in two categories: direct building losses and business interruption losses. The total building related losses were 10.65 million dollars and 15% of the losses were related to business interruption; 58% of the total loss was from residential occupancies. Transportation system losses include those from highways, railways, light rail, bus, ferry, ports, and airports. Utility system losses include potable water, wastewater, natural gas, oil systems, electrical power, and communication. There is also a table about indirect economic impact with outside aid.

2500 Year Probably Scenario M6.5 Driving: The damage assessment is listed in the categories of direct damage, induced damage, social impact, and economic loss. The information below is excerpted from the unpublished 2007 DOGAMI report, *Lake County HAZUS Global Reports for Crustal and Probabilistic Scenarios*.

In the direct damage category:

HAZUS estimates that about 1,478 buildings will be at least moderately damaged. That's over 41% of the buildings in the region. There will be an estimated one building damaged beyond repair. The hospital will be damaged such that 5 of the 68 hospital beds will be available for use immediately. Within one week there will be 26% of the beds available, and after 30 days there will be 68% of the beds available. The transportation and utility lifeline damage is shown in multiple tables with damage to the transportation system, utility system, pipelines, potable water, and electric power.

In the induced earthquake damage category:

There are two categories: fire following earthquake and debris generation. Fires often occur after an earthquake. HAZUS estimated that fires will displace zero people and burn zero million dollars of building value. HAZUS estimated the amount of two categories of debris: brick and wood, and concrete and steel. In the report, the total amount of debris is not listed but it does state that brick and wood will comprise 51% and the remainder will be concrete and steel.

In the social impact category:

HAZUS estimates 43 households will be displaced from their homes. Of that, nine people out of a total population of 7,422 will seek temporary shelter in public shelters. HAZUS estimates the number of injuries and casualties from the earthquake in four levels of severity and at three times of day.

In the economic loss category:

HAZUS estimates the total economic loss from the earthquake to be 196.26 million dollars, which includes building and lifeline related losses. The building losses are described in two categories: direct building losses and business interruption losses. Building related losses were 60.06 million dollars with 11% of the total loss from business interruption. Over 66% of the losses came in residential occupancies. Transportation system losses include those from highways, railways, light rail, bus, ferry, ports, and airports. Utility system losses include potable water, wastewater, natural gas, oil systems, electrical power, and communication. There is also a table about indirect economic impact with outside aid.

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 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 surveyed twenty nine buildings that are in Lake County, Lakeview, and Paisley. 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.

[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.

Table EQ-3: DOGAMI Building Collapse Potential Scores

Facility	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Daly Middle School (2 buildings)				X, X
Fremont/Hay Elementary School (3 buildings)			X	X, X
Lakeview Senior High School (3 buildings)				X, X, X
North Lake School (3 buildings)	X, X, X			
Paisley School (5 buildings)	X	X	X, X	X
Christmas Valley RFPD (2 buildings)	X, X			
Silver Lake RFPD			X	
Thomas Creek/Westside RFPD (2 buildings)	X, X			
Lake County Search & Rescue	X			
Lake County Sheriff Department				X
Lakeview Fire Department				X
Lakeview Police Department	X			
Paisley VFD (2 buildings)	X, X			
Lake District Hospital - Lakeview	X			

Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment. http://www.oregongeology.org/sub/projects/rvs/OFR-O-07-02-SNAA-onscreen.pdf

Of the school facilities evaluated by DOGAMI using RVS, three buildings have high (greater than 10% chance) collapse potential; eight buildings have very high (100% chance) collapse potential. The Lake County Sheriff and the Lakeview Fire Department have buildings with a very high (100% chance) collapse potential. Fremont Elementary and Lakeview High School have since been awarded Seismic Rehabilitation Grants through the State of Oregon's competitive Seismic Rehabilitation Grant Program (SRGP; see below for more information). See end of this annex 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 and Home 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.

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.[28]

Damage to Lifelines

Lifelines are the connections between communities and critical services. They include 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. Lifelines need to be usable after an earthquake to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public. Section 2 Risk Assessment includes this information specific to Lake County and the Cities; see Table 2-7, Critical Facilities, Critical Infrastructure, and Lifelines.

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

[26] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, p. 8-9, https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909.

[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] 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.

response to be disrupted.[29] 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.

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.[30] More information about Lake County's critical infrastructure can be found in Section 2 Risk Assessment and in Appendix I.

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] 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.

[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, much time is spent cleaning up brick, glass, wood, steel or concrete building elements, office and home contents, and other materials.

City Specific Damage

The Town of Lakeview has many unreinforced masonry buildings. The City of Paisley also has unreinforced masonry buildings. Both cities are susceptible to isolation due to the fact that Highways 31, 395, and 140 are the only major transportation routes connecting them with the rest of the state.

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.[31]

Ordinances

Lake County's Planning and Development Department includes planning and building staff. The Town of Lakeview also has planning and building staff while Paisley does not. Information regarding the Lake County and Lakeview's Comprehensive Plans and other information are available at the County office and at Lakeview Town Hall.

- Lake County, https://www.lakecountyor.org/government/land_use_planning.php
  - Town of Lakeview, https://www.lakeview-oregon.com/
  - City of Paisley, http://www.cityofpaisley.net/

Studies/Reports

- The USGS *Open File Report for Quaternary Faults and Folds in Oregon* contains a list of documented faults in Lake County and their basic geologic properties. The report notes **"**This north-striking high-angle fault forms 150-m-high escarpments on Miocene volcanic rocks along the eastern margin of the Harney basin and the western margin of the Crane Creek Mountains in central Oregon. No detailed information on Quaternary offset is available, but regional geologic mapping and limited air photo and field reconnaissance suggests possible middle or late Quaternary displacement" (page 470). See https://pubs.usgs.gov/of/2003/ofr-03-095/

- In 2007, DOGAMI prepared *HAZUS Global Reports for Crustal and Probabilistic Scenarios for Lake County*. These reports provide a comprehensive cost assessment of two potential earthquake scenarios which could impact the county; but the reports were not published. The citation for the information is: Burns, et al, 2007. Unpublished Report. *Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake*

[31] OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 20001, p. 8-20. https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

Damage and Loss Estimates for three Counties in the southeastern Region Including Lake, Malheur, and Harney. DOGAMI Open File Report. See Appendix H.

- 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. See 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. Table EQ-, Rapid Visual Survey Scores, shows the results of the assessment for Lake County. 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 *2015 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. The link provided here is for the Risk Assessment for Region 6 Central Oregon. https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_12_RA6.pdf

- 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.[32] Strapping down heavy furniture, water heaters and expensive personal property as well as having earthquake insurance, is a step towards earthquake mitigation. The *2020 Lake County NHMP* includes Table 3-1, 2020 Lake County Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview. There are nine earthquake-specific

[32] Darienzo, Mark, Oregon Office of Emergency Management, personal communication, February 22, 2001.

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 *2014 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 http://ecodes.biz/ecodes_support/free_resources/Oregon/14_Structural/14_ORStructural_main.html.

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

The *Lake County Emergency Operations Plan* (*EOP*), dated April 2013, is an all-hazard plan that describes how Lake County will organize and respond to emergencies and disasters in the community. It is based on, and is consistent with Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including the Presidential Policy Directive 8, the National Response Framework, and State of Oregon Emergency Operations Plan. The *Lake County EOP* is one component of the County's emergency management program and is designed to be compliant with the National Incident Management System.

The *Lake County EOP* consists of a Basic Plan, Emergency Support Function Annexes that complement the Federal and State Emergency Support Functions, Support Annexes, and Incident Annexes. The *Lake County EOP* provides a framework for coordinated response and recovery activities during an emergency. It describes how agencies and organizations in Lake County will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.[33]

Future Changing Conditions/ Climate Change

Several locations in the Lake County NHMP describe future changing conditions or climate change as it relates to the natural hazards that impact Lake County. In the order of appearance in the NHMP: the Risk Assessment, the Hazards Annexes, and Appendix F contain this information. Appendix F has two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.*

Earthquake Mitigation Actions

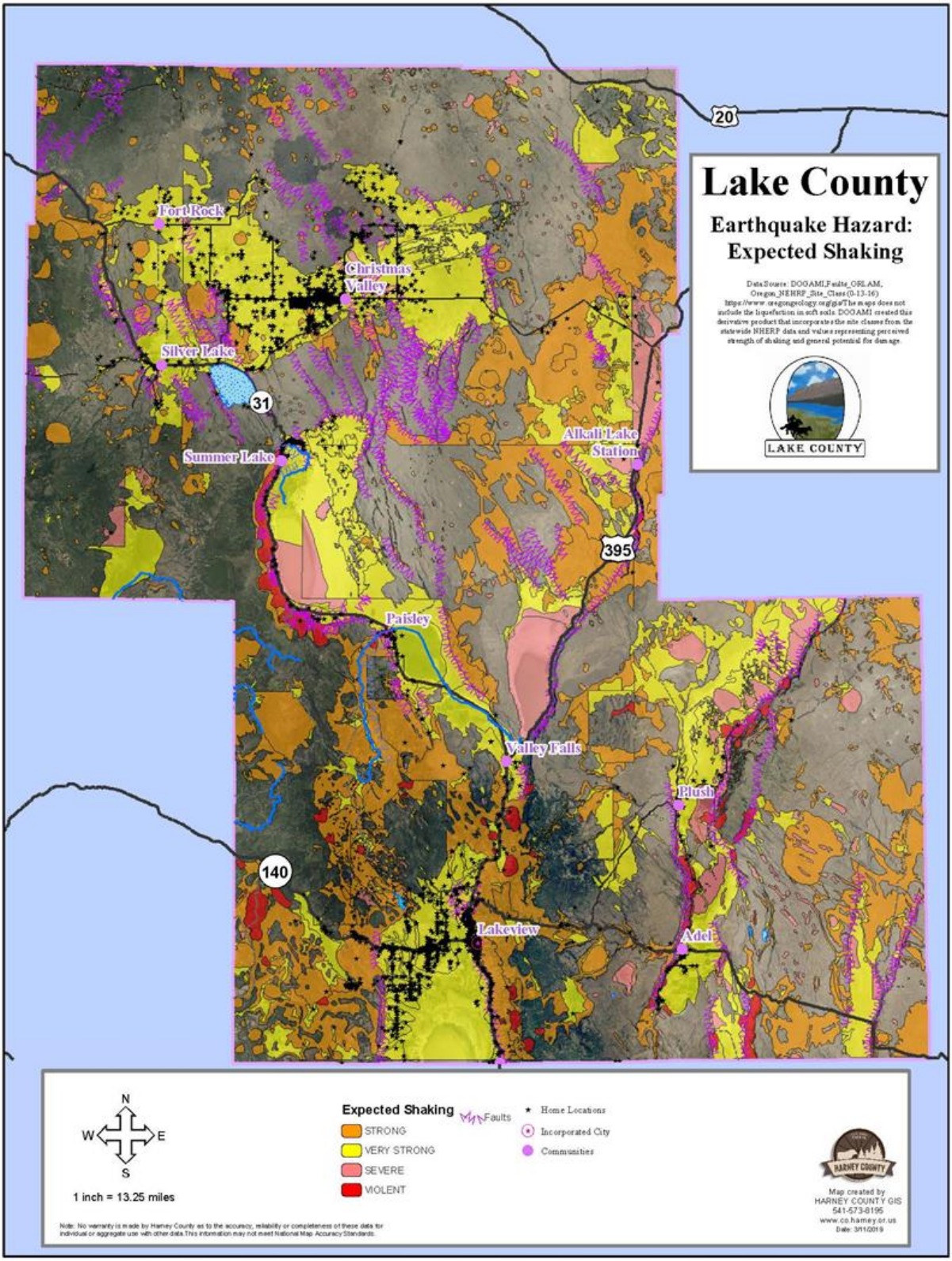
There are multi-hazard mitigation actions that include all hazards and earthquake-specific mitigation actions; all have been identified by the Lake County NHMP Steering Committee which includes the Town of Lakeview and the City of Paisley. See Table 3-1, 2020 Lake County Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview and the Mitigation Action Forms in Appendix A for a more detailed description of the mitigation actions.

There are nine earthquake-specific mitigation actions. The earthquake specific mitigation actions have a high-medium priority because the Hazard Vulnerability Assessment (HVA) resulted in earthquakes having a high-medium risk level.

The HVA, risk scores, and risk levels are also described in Section 2 Risk Assessment. The Critical Infrastructure List is included in Section 2 Risk Assessment.

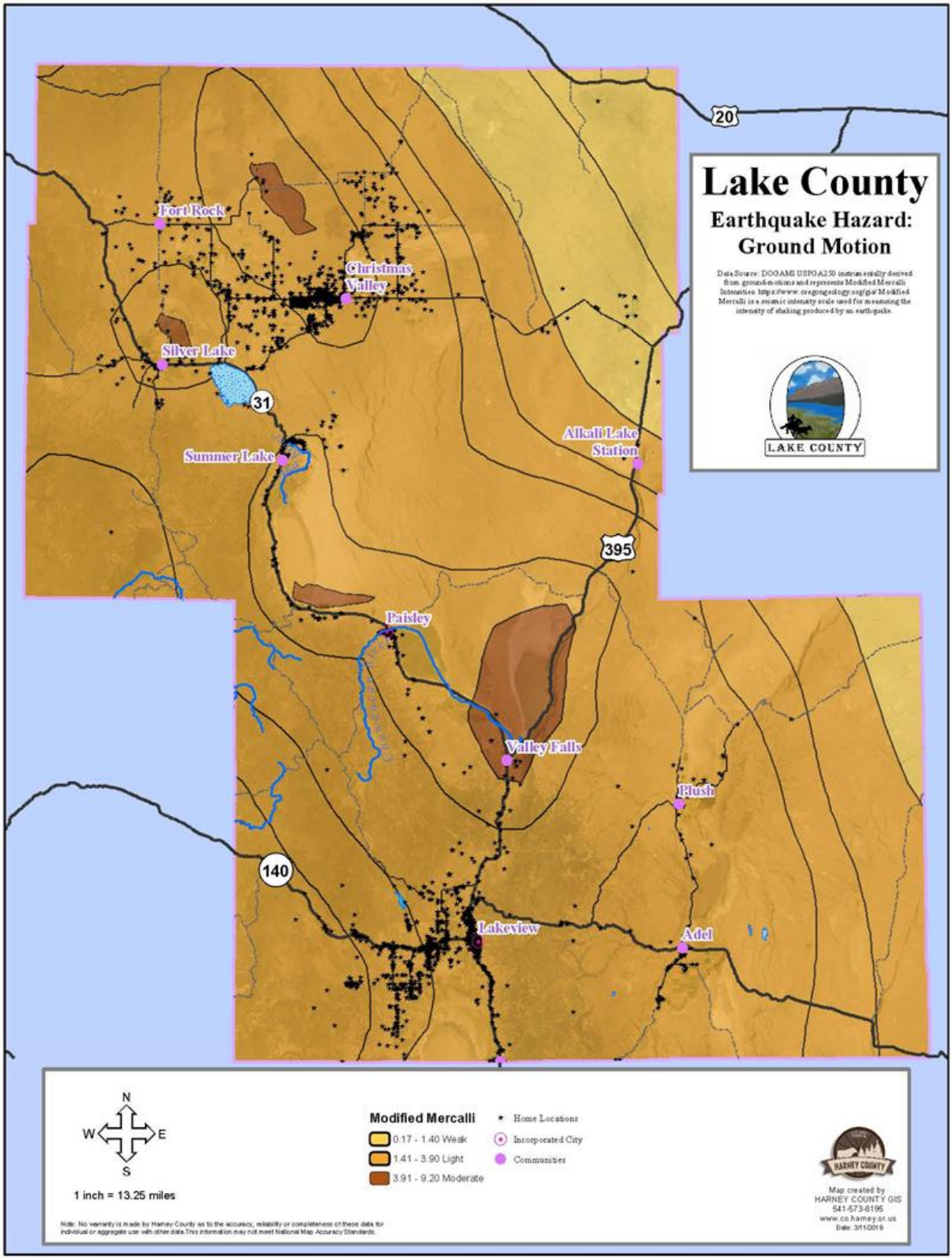
[33] Ecology and Environment, Inc., *Lake County Emergency Operations Plan*, April 2013.

Figure EQ-4 Lake County Earthquake Hazard: Expected Shaking



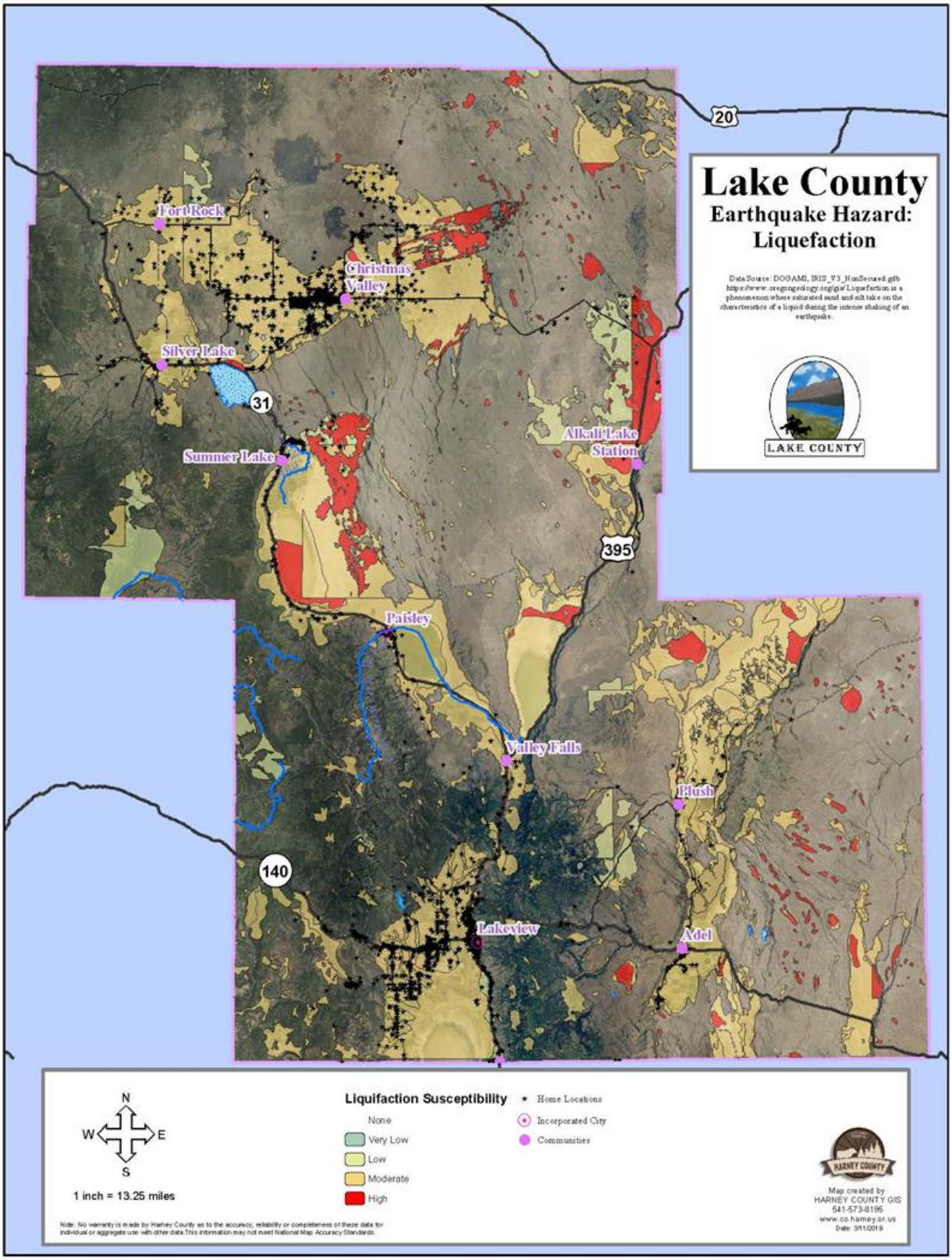
Source: Bryce Mertz, Harney County, March 11, 2019

Figure EQ-5 Lake County Earthquake Hazard: Ground Motion



Source: Bryce Mertz, Harney County, March 11, 2019

Figure EQ-6 Lake County Earthquake Hazard: Liquefaction



Source: Bryce Mertz, Harney County, March 11, 2019

FLOOD HAZARD ANNEX

Risk Score: 236

Risk Level: High

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 Lake County. 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 Grant Program (HMGP).

- The NFIP provides flood insurance and pays claims to policyholders who have suffered losses from floods.
- The HMGP provides grants to help mitigate flood hazards by elevating structures or relocating or removing them from flood hazard areas.

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 *2013 Lake County NHMP*, floods ranked sixth out of the nine natural hazards. In the *2020 Lake County NHMP*, floods ranked second out of the nine natural hazards that the Lake County NHMP Steering Committee identified in the Hazard Vulnerability Assessment. Floods tied with winter storms, both had a score of 236.

The principal types of flood that occur in Lake 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.

[1] Taylor, George H. and Chris Hannan, *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press, 1999.

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 and pose a great threat to Lake County. 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.

Playa Flooding

The major streams within the County are the Ana River, Chewaucan River, Rock Creek (Catlow Valley), Sprague River, and the Sycan River.

- The Ana River is a short, spring-fed river that empties into Summer Lake. It is on the northwestern edge of the Great Basin drainage.
- The Chewaucan River is part of the Great Basin drainage. It flows 53 miles through the Fremont-Winema Forests, BLM land, and private property in southern Oregon.
- Rock Creek is a 56-mile intermittent stream that flows in Lake and Harney Counties. Its source, Rock Creek, is at an elevation of 6,914 feet on Hart Mountain while the moth is at an elevation of 4,557 feet in the Catlow Valley.
- The Sprague Rivers is approximately 75 miles long. It drains an arid volcanic plateau region east of the Cascade Range in the Klamath River watershed.
- The Sycan River is about 75 miles long; the headwaters are in the highlands of the Fremont National Forest south of summer Lake. It runs northwest into the Sycan marsh in southern Lake County, from which it flows southwest to join the Sprague River in Klamath County[2]

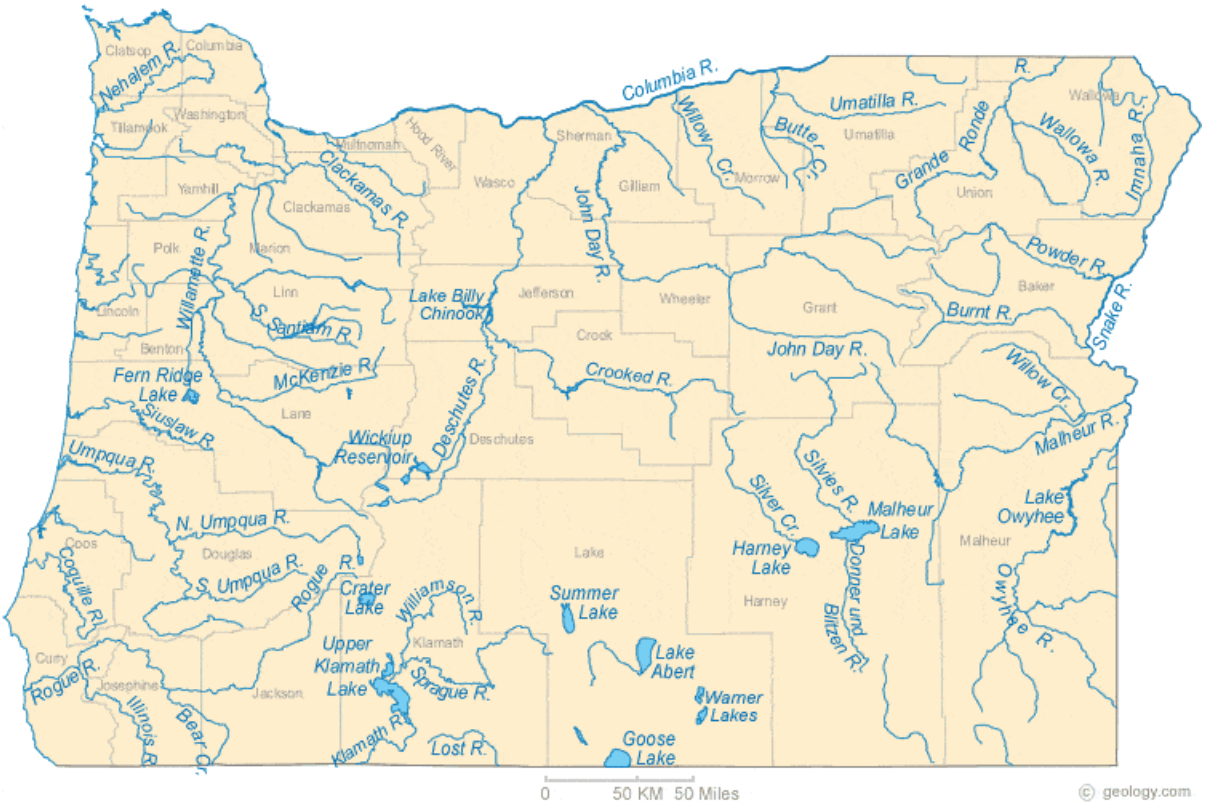
In looking at Figure 1, showing the major drainage basins, streams, rivers, and lakes in Oregon, Lake County appears to have less water flowing through it than other counties. Within Table FL-1 Significant Historic Floods provides details on the date, location, type of flood, and a description of the flood that occurred in Lake County. Some of the basins (playas) contain lakes that grow and diminish with the seasons and from year to year.

All Flooding

Local, state, and federal agencies as well as other organizations are actively involved in mapping flood hazard areas and working on flood hazard issues in Lake County. All involved mut 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.

[2] Wikipedia, Rivers of Lake County, OR, https://en.wikipedia.org/wiki/Category:Rivers_of_Lake_County,_Oregon, accessed December 27, 2019.

Figure FL-1 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

Dam Failure

Major flooding could result from partial or complete failure of man-made structures constructed to restrict the flow of water on Lake County's waterways, either impounding reservoirs or diversion dams. There are 67 dams located in Lake County that meet the statutory definition and are listed in the Oregon Water Resources Department's dam inventory datatabase (https://apps.wrd.state.or.us/apps/misc/dam_inventory/).The statutory 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.[3] See Table FL-3 for the categorization of those as high, medium, and low hazard level dams. Dams are further discussed in the Hazard Vulnerability section of this Flood Hazard Annex.

Factors that contribute to flooding in Lake County

Precipitation

Lake County climate is semi-arid with long, severe winters and short, warm summers. Average annual precipitation is 8 to 12 inches in the lower basins, 12 to 16 in some mountain valleys, and 16

[3] Keith Mills, Oregon Water Resources Department, personal communication, December 27, 2018.

to 28 in the forested uplands; most precipitation is in the form of snow.[4] Annual snowfall ranges from under 20 inches in the basin to over 60 inches in the mountain. Lake County receives less precipitation as the Cascades descend west to east. Eastern fringe communities such as Akali Lake receive only 8.4 inches of precipitation.[5] The area experiences a dry season from May through October, from September to April precipitation usually takes the form of rain showers with the occasional thunder storm. Communities west of the mountains receive additional precipitation.

A quick summary of countywide averages for Lake County: 13 inches of rain/year; 29 inches of snow/year; and 211 sunny days a year. Lake County gets some kind of precipitation, on average, 78 days per year. Precipitation is rain, snow, sleet, or hail that falls to the ground. In order for precipitation to be counted there has to be at least .01 inches on the ground to measure.[6]

Geography

Lake County is located in the south-central high desert of Oregon along the California border; it spans 8,275 square miles making it the third largest county in Oregon. There are two geographic and climatic divisions in Lake County, the northern part belonging to the High Plateau region; the southern half is the South Central region.[7] Most of the county is located in the High Plateau region. The remoteness and ruggedness of the High Plateau has resulted in low area population. Only a few small unincorporated towns, including Christmas Valley, Fort Rock, and Silver Lake, serve as population centers; none exceeds 1,000 residents. The majority of residents live in the southern half of the County where the incorporated communities of Paisley and Lakeview are located. Lakeview, the largest community in the County is the county seat, meets the merging highways of 140 and 395. The western part of Lake County features the Deschutes and Fremont National Forests. Lying parallel to these forests are the larger alkali lakes, Summer Lake and Goose Lake. The eastern part has the Hart Mountain Antelope Refuge, 270,000 acres.

Location of Development

Most of the County is very sparsely populated. Much of the land, 67.8% is owned by federal agencies.[8] The Bureau of Land Management, owns nearly half of county land, 48.6%, primarily in the north and eastern parts of the County. The U.S. Forest Service owns about one fifth of the land on the western border of the County. The Park Service, the military, and other are the three additional categories of federal land ownership.[9] State and other local agencies also have land holdings.

Most of Lake County's land is zoned Rangeland, Agriculture, or Forest with the sparse exceptions of the Lakeview urban growth area, the Paisley urban growth area, and scattered rural residential. About fifteen percent of the County is forested; approximately five percent is used for cropland or

[4] *2013 Lake County NHMP*, referenced as "OCS Climate of Lake County"

[5] Ibid.

[6] Best Places, *Lake County, OR*, https://www.bestplaces.net/climate/county/oregon/lake, accessed December 27, 2019.

[7] Ibid

[8] Lake County BLM Summary 12/27/19, created from this website, https://headwaterseconomics.org/tools/economic-profile-system/

9 Ibid.

hay production.[10] Lakeview is the most intensely populated community representing almost a third of the County population. Growth trends have been in Christmas Valley and Drews Reservoir.[11]

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. The Lake County Comprehensive Plan minimizes most development in the floodway; only under certain circumstances does it allow development in the floodplain.[12]

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 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-2 and FL-3.

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

10 *2013 Lake County NHMP*, referenced as "South Central Oregon Economic Development District (SCOEDD) p. 7.4."

11 *2008 Lake County NHMP*.

12 Lake County Comprehensive Plan 1982

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.[13]

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.[14] 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.[15]

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.

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 in order 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.[16]

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.

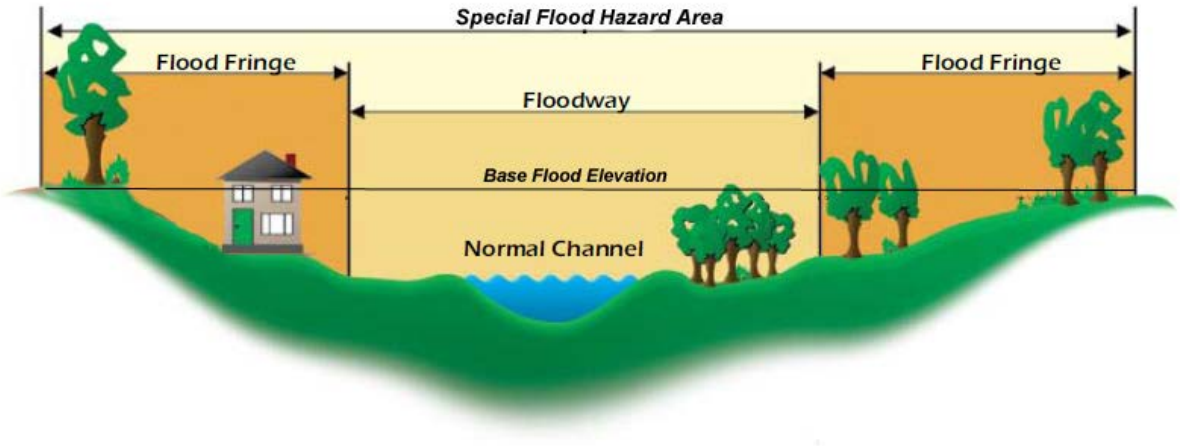
[13] Oregon Department of Land Conservation and Development, *National Flood Insurance Program (NFIP) in Oregon*, https://www.oregon.gov/lcd/NH/Pages/NFIP.aspx, accessed December 26, 2018.

[14] Ibid.

[15] DOGAMI, *Base Flood Elevation Determinations Fact Sheet*, https://www.oregongeology.org/pubs/fs/BFE-fact-sheet.pdf, accessed December 26, 2018.

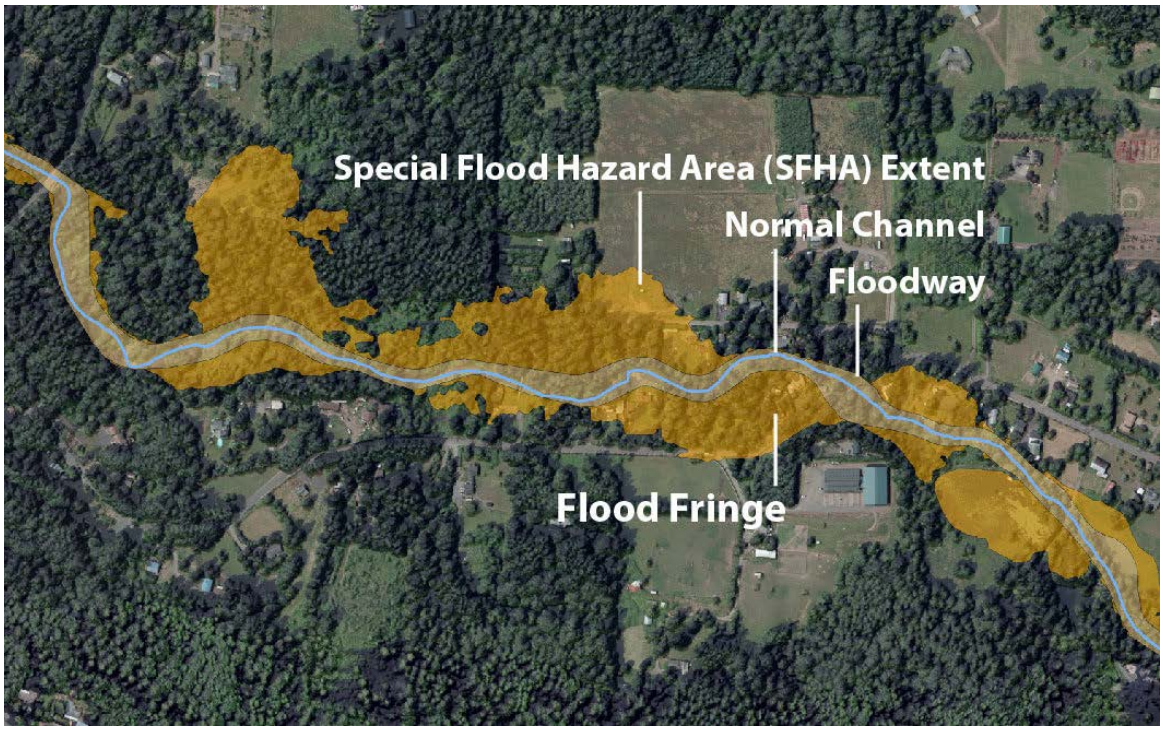
[16] FEMA, *Definition of Floodway*, https://www.fema.gov/floodway, accessed December 26, 2018.

Figure FL-2 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.

Figure FL-3 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 Lake County

The interior drainage of closed basin lakes and creeks and rivers in southeastern Oregon have a long history of flooding. Most of the lake water originates from high mountain snowpack above the basin. The Chewaucan River is the largest river flowing through Lake County. The Chewaucan's source is in the mountains of the Fremont-Winema National Forest southeast of the City of Paisley. The river arches north to flow through Paisley and then curves southwest to eventually drain into

Lake Abert. The Chewaucan's waters are greatly depended upon by the farmers and ranchers that are near its banks. There are multiple diversions located in the vicinity of Paisley along the Chewaucan that divert river water for irrigation and for stock watering. Each of these diversions is privately owned.

The Chewaucan has a history of flooding the City of Paisley. Heavy rains and snow melt inundation are the primary culprits for flow increase. An earthen levee was created by the Army Corps of Engineers in the early 1900's as a means of channeling the river for irrigation uses, as the river naturally overflowed its banks creating seasonal marshes. The levee exists today on the south bank of the river through the City of Paisley. Efforts by local citizens have been made throughout the years to maintain the levee and protect the city from further flood issues. In 2006, a weir located on the river and upstream of the City of Paisley that was owned by the city was removed. The removal of the city weir lowered the standard flow of the river by approximately five feet. This has created a generous buffer for river flow increase and in protecting the city from further flooding on regular flood years.

There are many small streams and tributaries in Lake County as well. These streams, like the Chewaucan, become inundated with excess flow from heavy rains and snow runoff. Because the population density is so low in Lake County, the flooding from these creeks rarely affects population and infrastructure.

There are also numerous large lakes that give Lake County its name. Each lake has a considerable sized floodplain, although historically the lakes have dried up more often than they have flooded. As in the same case as the streams in the county, there is little to no infrastructure or population within the floodplains of these lakes. The exception to this is the Goose Lake floodplain. The north end of Goose Lake is located seven (7) miles south of Lakeview near the border of Oregon and California in central Lake County. The Goose Lake Basin has a 100 year floodplain that stretches north of the Town of Lakeview by approximately 10 miles. The floodplain extends this far north because there are a few tributary creeks that feed Goose Lake that begin north of Lakeview. There have been no recorded issues with these tributaries flooding and affecting infrastructure or population.

Table FL-1 shows the history of major flood events within Lake County.

Table FL-1 Significant Historic Floods

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.
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.
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. Lake County was affected.
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 and neighboring counties. Warm rains caused extensive snowpack melt which occurred quickly; many rivers and creeks overflowed.

Date	Location	Type of Flood	Description
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.
Jan. 1993	Lake County	Flooding	Governor declaration for severe winter storms and flooding in Lake County on January 1st.
Jan. 1995	Lake County	Flooding	Governor declaration for severe flooding in Lake County on January 1st. On January 10 there was a presidential declared disaster for damages caused by flooding, landslides, mud and debris flows. DR #?
Feb. to Apr. 1995	Lake County	Flooding	Small Business Agency declaration. Severe flooding in County.
Jul. 1995	Statewide	Flooding	DR -1061. Event occurred July 8 to July 9, 1995.
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.
Apr. - May 1998	Malheur, Lake, and Harney Counties	Persistent rain on mountain snowpack	Numerous monthly rainfall records set. There was widespread flooding; mudslides in Malheur County. Secretarial Natural Disaster Determination for flooding in Lake County.
Jan.-Feb. 1999	NW Oregon	Rain, flooding, landslides, mudslides	Widespread flooding on smaller rivers and streams; numerous landslides and mudslides.
Jul. 2001	Lakeview, OR	Flooding	Flash flood throughout Lakeview. Lakeview Police reported rock and or mudslides on State Highway 140 at mileposts 22, 23.2, and 25.1. They reported .25 inch hail up to an inch deep and 2 feet of water in spots on the same highway.
Dec. 2005 to Jan. 2006	Statewide	Flooding	DR-1632. Severe storms, flooding, landslides, and mudslides 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. Approximately $500,000 in property damage in Klamath and Lake Counties, with $225,000 in Lake County.
Nov. 2006	Statewide	Severe storms, flooding, landslides, mudslides	DR-1962. The events occurred November 6-8, 2006. Total rainfall for November was 14.67 inches in Hood River County; the previous record was 11.09 in 1973. Total estimated damages: $27 million.
Dec. 2007-Jan. 2008	NW Oregon	Winter storms, heavy rain, flooding	DR-1824. Severe winter storm, flooding, winds, record and near record snow, landslides and mudslides. Gresham received, 26" of snow. Many roads closed. Significant damages to public infrastructure, homes and businesses.
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.
Jan. 2011	Statewide	Winter storm	DR-1956. Severe winter storm, flooding, mudslides, landslides, and debris flows.

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 Hood River 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.

Sources: University of Oregon, Lake County NHMP, May 2013; DLCD, Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017; Taylor and Hatton, 1999.

Risk Assessment

How are Hazards Identified?

Lake 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.[17] The two principal flood sources are along the Chewaucan River and its tributaries and in the Goose Lake Basin.[18] Flooding is usually caused by heavy rainfall and snowmelt when soil is near saturation.

Repetitive Flood Loss in Lake 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).[19]

The Lake County Flood Insurance Rate Maps (FIRMs), like much of eastern Oregon, are several decades old. The Lake County FIRMs are dated 1989.[20] Table FL-2 shows flood insurance data as of January 6, 2020 including the number of policies by building type.

A brief recap of Table FL-2 and some additional information, all provided by DLCD staff Celinda Adair and Katherine Daniel:

- Lake County (including the Town of Lakeview and the City of Paisley) has 30 National Flood Insurance Program (NFIP) policies in force.[21]

[17] FFEMA, *Lake County Flood Insurance Study NFIP*, 12/5/89.

[18] Ibid

[19] Celinda Adair, National Floodplain Insurance Program Coordinator, DLCD, July 22, 2019.

[20] Celinda Adair, National Floodplain Insurance Program Coordinator, DLCD, January 8, 2020.

[21] Katherine Daniel, Natural Hazards Planner, DLCD, January 6, 2020.

- Private insurance has become an option. As of January 16, 2020, there are five private flood insurance policies in Lake County; three are within Lakeview and two are in the unincorporated areas of the valley. All five policies are from Hartford Insurance.[22]
- There have been 11 paid claims: 6 in unincorporated areas, 4 in Lakeview, and 1 in Paisley.
- There has been two repetitive losses that were residential structures[23] and no severe repetitive losses.
- There are 26 residential flood insurance policies and all are for single-family homes.
- There are 4 non-residential flood insurance policies.
- Community Assistance Visits and Community Assistance Contacts are done to meet monitoring requirements for communities that participate in the National Flood Insurance Program (NFIP).
- Lake County has never had a Community Assistance Visit (CAV) or Community Assistance Contact (CAC) according to the FEMA Community Information System (CIS) database and DLCD's records.[24]
- Lakeview has never had a CAV. Their last CAC was 06/27/1991 and it is closed. Paisley has never had a CAV or CAC.
- The County, the Town of Lakeview, and the City of Paisley are not members of the Community Rating System (CRS).
- The NFIP and CRS are described below.

Conversations with staff from Lake County, Lakeview, and Paisley about development in the floodplain reveal that little if any development has occurred in the floodplain in the past nine years.

Darwin Johnson, the Planning Director and floodplain manager for Lake County, stated that he has been the floodplain manager for nine years and no development has occurred in the floodplain. He said that there has been limited development in Zone A 100-year flood zones, with elevation certificates being completed and some Letters of Map Revisions (LOMRs) completed. He noted the Red Rock Biofuels site has had a LOMR. He helps anyone in Lake County who has floodplain questions (Darwin Johnson, Lake County, personal communication, 3/5/20).

Janine Cannon, the Town Planner for Lakeview, stated that Lakeview has had no development in the floodplain that she was aware of (Janine Cannon, Lakeview, personal communication, 3/10/20).

Missy Walton, the City Recorder for Paisley, stated there has been no development in the floodplain in the five years she has been with the City of Paisley. She noted that the City Council reviews development proposals and approves or disapproves them. Then the proposals go to review by the Lake County Planning Department (Missy Walton, Paisley, personal communication, 3/10/20).

[22] Krista Smith, Insurance Agent, Favell-Utley Corporation, personal communication, January 16, 2020, http://www.favell-utley.com/employees.htm.

[23] Scott Van Hoff, Regional Flood Insurance Liaison, Mitigation Division, FEMA Region 10, via John Schelling, Regional Hazard Mitigation Planning Manager, FEMA Region 10, personal communication, 5/13/20.

[24] Celinda Adair, National Floodplain Insurance Program Coordinator, DLCD, January 8, 2020.

Table FL-2 Flood Insurance Detail

Jurisdiction	Effective FIRM and FIS	Initial FIRM Date	Total Policies	Pre-FIRM Policies	Policies by Building Type				Minus Rated A Zone	Minus Rated V Zone
					Single Family	2 to 4 Family	Other Residential	Non-Residential		
Lake County	-	-	30	18	26	0	0	4	2	0
Unincorporated	12/5/1989	12/5/1989	27	16	24	0	0	3	2	0
Lakeview	9/5/1990	11/16/1982	3	2	2	0	0	1	0	0
Paisley	9/15/1989	9/15/1989	0	0	0	0	0	0	0	0

Jurisdiction	Insurance in Force	Total Paid Claims	Pre-FIRM Claims Paid	Substantial Damage Claims	Total Paid Amount	Repetitive Loss Structures	Severe Repetitive Loss Properties	CRS Class Rating	Last Community Assistance Visit
Lake County	$ 4,518,400	11	5	1	$ 172,386	2	0	-	-
Unincorporated	4,101,400.00	6	4	1	157,582	1	0		none
Lakeview	417,000.00	4	1	0	14,411	1	0		none
Paisley	$0	1	0	0	393	0	0		none

NP - Not Participating , No FIRM

NA - Information not Available/ Not Applicable

-- none

CIS accessed 01/06/2020

Source: Katherine Daniel, Natural Hazards Planner, DLCD, January 6, 2020 and Scott Van Hoff, FEMA Region 10, May 13, 2020.

Hazard Risk Analysis

The Lake County 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 *2020 Lake County NHMP*, floods ranked second, tied with winter storms, of the nine natural hazards that the Lake County NHMP Steering Committee identified in the Hazard Vulnerability Assessment.

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 the area is the lack of accurate floodplain maps, an issue that has larger ramifications for development in Lake County. Lake County's FIRM floodplain maps have not been updated since 1989-1990 and the maps may not reflect current flood patterns. The lack of accurate maps prevents the County from making the most effect planning decisions in regards to flood management.

Areas that are most vulnerable to flooding events are near the Town of Lakeview and the City of Paisley. Floods causing damage elsewhere in the County has been minimal since the floodplains are sparsely developed. Near Paisley, the Chewaucan River has the capacity to overbank. The *2013 Lake County NHMP* states this was largely controlled with flood protection measures including dams and diversions along Chewaucan. The Town of Lakeview has potential flooding concerns from area streams that have been largely curtailed by flood protection projects including the Bullard Canyon Dam and the Deadman Canyon Holding Structures. See Appendix J for details in the *Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR*. Additional areas vulnerable to flooding are described below.

The Oregon Water and Resources Department (OWRD) has inventoried all dams located in Oregon. Of the high hazard dams in Lake County, those of special concern are Drews Reservoir, Cottonwood Reservoir, and Bullard Creek Dam. All three of those were last inspected in October 2019. Because

they are rated high hazard, they are inspected annually.[25] All high hazard dams are required to have an Emergency Action Plan.[26]

Table FL-3 Lake County Dam Inventory

Number of Dams	Hazard Level or Potential
3	High
5	Significant
59	Low

Source: Arden Babb, Oregon Water Resources Department, personal communication, 2/10/20; the OWRD Dam Inventory Query was not working, http://apps.wrd.state.or.us/apps/misc/dam_inventory/

Table FL-4 High Hazard Level Dams and Reservoirs in Lake County

High Hazard Dams and Reservoirs	Acre Feet Capacity	Location	Owner
Drews Dam	62,500 acre feet	15 miles southwest of Lakeview	Lakeview Water Users, Inc.
Cottonwood Dam	8,800 acre feet	9.2 miles northwest of Lakeview	Lakeview Water Users, Inc.
Bullard Creek Flood Retarding Structure (FRS)	50 acre feet	2 miles east of Lakeview	Town of Lakeview

Source: Cottonwood Reservoir, https://www.hookandbullet.com/fishing-cottonwood-reservoir-lakeview-or/; Arden Babb and Keith Mills, Oregon Water Resources Department, personal communication, 2/10/20

Oregon Water Resources Department, Dam Inventory Query was not working, accessed 2/10/20, http://apps.wrd.state.or.us/apps/misc/dam_inventory/,

These are the most significant vulnerabilities to flood in Lake County, Lakeview, and Paisley[27]:

- Blocked culverts buried from Center St. and T St. to S St. in Lakeview have resulted in flooding damage to properties.
- The intersection of Stockdrive Rd and Roberta Rd. in Lakeview has flooded during heavy rains and spring snowmelt when ditches have been clogged. This back up has overflowed the traffic intersection and resulted in high standing water.
- Along Hwy 31, between the town of Silver Lake and Silver Lake, often has high water.
- Crane Creek floods the intersection at County Road 1-15 and State Highway 395 near New Pine Creek during high flow periods due to insufficient culvert size and clogging. The *2020 Lake County NHMP* includes mitigation action FL#1 to address this situation.
- County Road 3-12 in Hart Mountain is subject to regular clogging and water back-up due to insufficient culvert size. This flooding has washed out the road in previous flood

[25] Arden Babb, Oregon Water Resources Department, personal communication, 2/10/20

[26] Oregon Water Resources Department, *Dam Safety Program*, accessed 2/10/20

[27] Daniel Tague, Lake County Emergency Services Coordinator, personal communication, 1/30/20.

events. The *2020 Lake County NHMP* includes mitigation FL#2 which is to establish a County culvert list that assesses and prioritizes which culverts need to be modified or replaced throughout Lake County.

- A storm drain at the intersection of Highway 31 and Mill Street in the City of Paisley chronically backs up with water every time it rains to a depth of up to 16 inches. The *2020 Lake County NHMP* includes mitigation action FL#4 to address this situation.

Community Hazard Issues

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, 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 Infrastructure, Critical Facilities, and Lifelines

The major regional hospital for Lake County is located in Lakeview and is noted in Table 2-7 as potentially being impacted by a flood. The Emergency Services Center in Lakeview is noted as not being potentially impacted by flood. Recognizing the history of flooding in the region, the location of critical facilities in the floodplain increases vulnerability. Critical infrastructure, critical facilities, and lifelines are described in detail in Section 2 Risk Assessment in Table 2-7 and have x's indicating which natural hazards may impact them.

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. Road networks in Lake County frequently 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 Lake County designed to mitigate the impacts of flooding. These programs range from federally funded national programs to individual projects by landowners.

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 maps are known as Flood Insurance Rate Maps (FIRMs). The Lake County Flood Insurance Rate Maps are dated 1989.[28]

Insurance is available to help recover from losses incurred from flooding events. As Table FL-2 indicates, there are 30 NFIP policies in Lake County. A significant number of property owners lack insurance coverage. As mentioned previously, there are five private flood insurance policies and it is noted that private insurance has become an increasingly popular option.

[28] Celinda Adair, National Floodplain Insurance Program Coordinator, DLCD, personal communication, January 8, 2020.

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.[29]

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.[30] 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 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.[31] Table FL-5 illustrates how the CRS point system is broken down. Lake County, the Town of Lakeview, and the City of Paisley do not participate in the CRS.

Table FL-3 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.

[29] FEMA, National Flood Insurance Program: *Frequently Asked Questions, Repetitive Loss*, https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt

[30] Ibid.

[31] Ibid.

State Programs

State Natural Hazard Risk Assessment: Flood

The risk assessment in the *2015 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_2015ORNHMP_5_RAState.pdf

Planning for Natural Hazards: Oregon Technical Resource Guide

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

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.[32] One goal in particular focuses on land use planning and natural hazards.

Goal 7 Areas Subject to Natural Disasters and Hazards,[33] 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 communities of Lake County, Lakeview, and Paisley all have approved comprehensive plans that include information pertinent to Goal 7.

https://www.oregon.gov/lcd/OP/Pages/Goals.aspx

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:

[32] Oregon Department of Land Conservation and Development, https://www.oregon.gov/lcd/OP/Pages/History.aspx, accessed December 27, 2018.

[33] Oregon Department of Land Conservation and Development, https://www.oregon.gov/lcd/OP/Pages/Goals.aspx, accessed December 27, 2018.

- 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.[34]

https://silverjackets.nfrmp.us/State-Teams/Oregon.cfm

County and City Programs

Zoning Ordinance – Floodplain Standards

Community participation in the NFIP requires the adoption and enforcement of a local floodplain management ordinance that controls development in the floodplain. Lake County and the cities of Burns and Hines participate in the National Flood Insurance Program (NFIP). Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent.[35]

Lake County's Planning and Development Department includes planning and building staff. The Town of Lakeview also has planning and building staff while Paisley does not. Information regarding the Lake County and Lakeview's Comprehensive Plans and other information are available at the County office and at Lakeview Town Hall.

- Lake County, https://www.lakecountyor.org/government/land_use_planning.php
- Town of Lakeview, https://www.lakeview-oregon.com/
- City of Paisley, http://www.cityofpaisley.net/

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

[34] Silver Jackets, *Oregon Silver Jackets*, https://silverjackets.nfrmp.us/State-Teams/Oregon.cfm, accessed December 11, 2019.

[35] 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 fill, installation of riprap, and other bank stabilization techniques also require a floodplain development permit.[36]

Elevation Certificate Maintenance

Elevation certificates are administered by Planning and Development Services at Lake County, and also at the Town of Lakeview. 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). Lake County has elevation certificates on file for many developed properties.

Emergency Operations Plans

The *Lake County Emergency Operations Plan* (*EOP*), dated April 2013, is an all-hazard plan that describes how Lake County will organize and respond to emergencies and disasters in the community. It is based on, and is consistent with Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including the Presidential Policy Directive 8, the National Response Framework, and State of Oregon Emergency Operations Plan. The *Lake County EOP* is one component of the County's emergency management program and is designed to be compliant with the National Incident Management System.

The *Lake County EOP* consists of a Basic Plan, Emergency Support Function Annexes that complement the Federal and State Emergency Support Functions, Support Annexes, and Incident Annexes. The *Lake County EOP* provides a framework for coordinated response and recovery activities during an emergency. It describes how agencies and organizations in Lake County will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.[37]

Future Changing Conditions/ Climate Change

In the *2020 Lake County NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Lake County. In the order of appearance in the NHMP: the Risk Assessment, the Hazards Annexes, and Appendix F contain this information. Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.*

[36] 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

[37] Ecology and Environment, Inc., *Lake County Emergency Operations Plan*, April 2013.

Flood Mitigation Actions

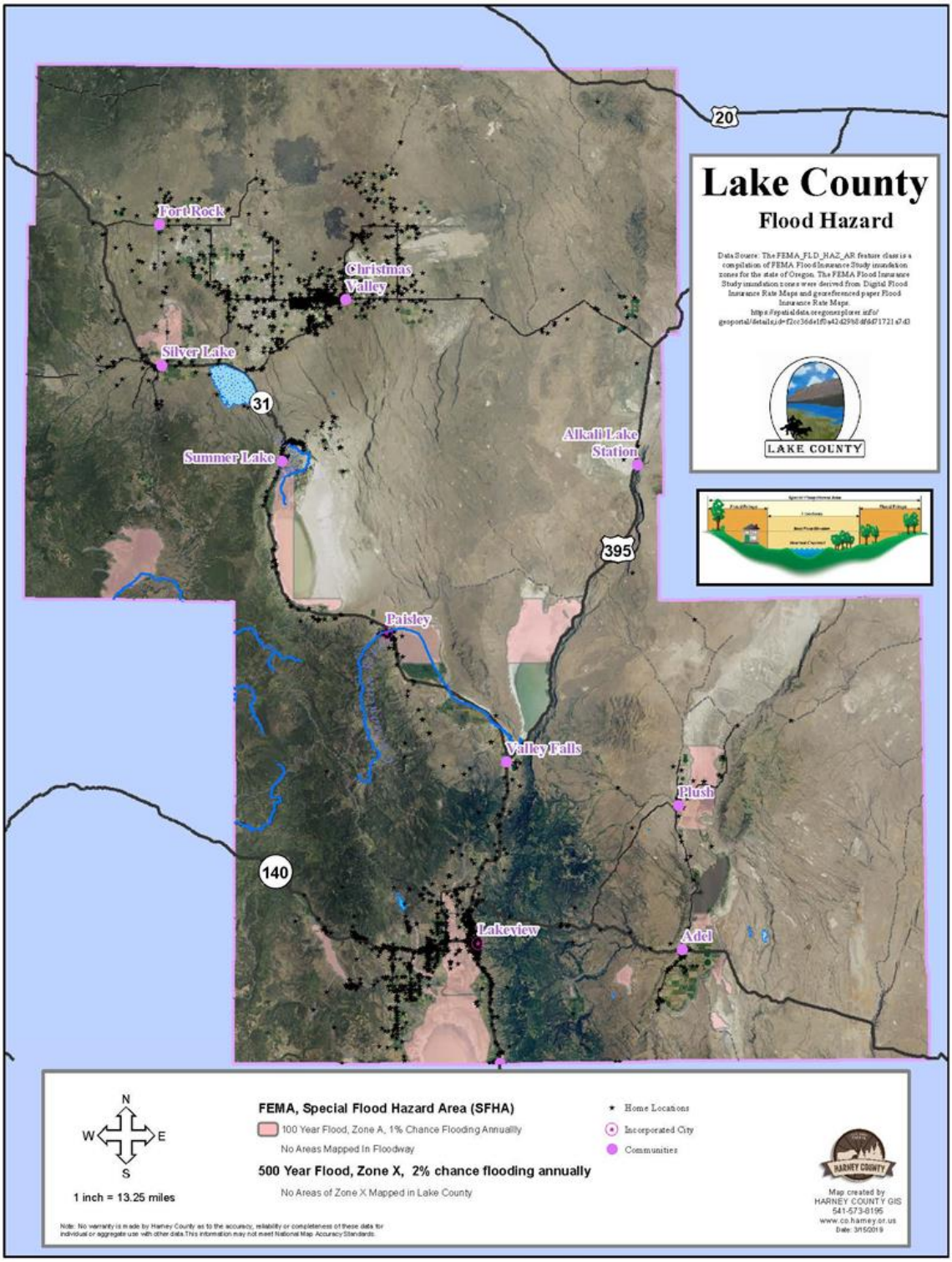
The flood mitigation actions have been identified by the Lake County NHMP Steering Committee which includes the Town of Lakeview and the City of Paisley. See Table 3-1, Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview and the Mitigation Action Forms in Appendix A for a more detailed description of the mitigation actions in this NHMP.

In discussion with the Emergency Services Coordinator 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 2-5 in Section 2 Risk Assessment.

In the *2020 Lake County NHMP*, there are sixteen flood specific mitigation actions. The flood mitigation actions have a high priority because the HVA resulted in floods having a high risk level.

There are thirteen 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-4 Lake County Flood Hazard



Source: Bryce Mertz, Harney County, March 11, 2019

Landslide Hazard Annex

Risk Score: 97

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.

Landslides ranked seventh out of the nine natural hazards that the Lake County NHMP Steering Committee identified in the Hazard Vulnerability Assessment (HVA) for this *2020 Lake County NHMP*. Due to ties for first and second place, being ranked seventh is effectively ranked last.

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

[6] DLCD, *2015 Oregon Natural Hazards Mitigation Plan*, https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP.pdf

[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.

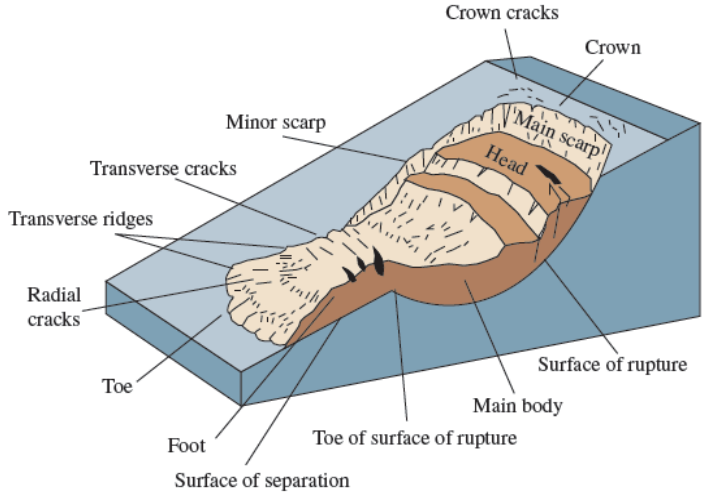
occur on slopes near a channel. They can also initiate within channels from accelerated erosion during heavy rainfall or snow melt (Bill Burns, personal communication, January 2019).

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.

[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.

- 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.
- 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 Lake 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] Five 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/Debris Flows

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.
Dec. 2005 to Jan. 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.

Source: University of Oregon, *2013 Lake County NHMP*, April 2013; DLCD, *Oregon NHMP*, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017; 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 Lake County and a proven history of past damages, landslides are not considered a major hazard.

The map in Figure LS-3 shows the vast majority of Lake County to be at low risk for landslide activity, though the map also shows a fair amount of moderate susceptibility. There are a few clusters of high and very high susceptibility. This information is based on SLIDO (version 3.4) 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 Lake County. Steering Committee members did not identify any events other than some small-scale chronic rock fall and areas with unstable ground; 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 Lake 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 Lake County 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 *2013 Lake County NHMP*, landslide hazards had a risk score of 66 and a rank of nine out of nine natural hazards. In the *2020 Lake County NHMP* landslide hazards had a risk score of 97 and a rank of seven out of nine natural hazards. Notably, this is effectively last place because of ties for first and second place.

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.

[16] Burby, R., ed. 1998, *Cooperating with Nature.*

[17] Ibid.

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 services, block off or damage roads, critical lifeline services such as police, fire, medical, utility and communication systems, and emergency response.

While Lake County has rarely experience major landslides, there are areas in the County that are potentially vulnerable. Community members identified the following areas as landslide prone:[18]

- US-140 from Lakeview to Adel,
- Highway 31 – from Valley Falls, and
- Highway 140 west of Lakeview Mile Posts 28-32.

Generally these areas are more prone to landslides during the end of May and June[19]

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 additional 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.

[18] 2013 NHMP Steering Committee

[19] Ibid

- 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.

City Specific Damage

The Town of Lakeview and the City of Paisley would be impacted by landslides that closed highways 31, 395, and 140. Lakeview sits below some slopes that, if they slid, would impact residences and businesses.

Existing Hazard Mitigation Activities

Existing Hazard Mitigation Activities and Resources

State Natural Hazard Risk Assessment

The risk assessment in the *2015 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. https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_5_RAState.pdf

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).[20]

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 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/

A historic example, after the 1996-1997 storm events, DOGAMI developed a landslide public outreach brochure in cooperation with several other state agencies. Forty thousand copies were printed in November 1997 and were distributed widely through building code officials, county planners, local emergency managers, natural resource agency field offices, banks, real estate companies, insurance companies, and other outlets.[21]

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.

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[22]:

> *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.

[20] *2013 Lake County NHMP* identifies the source as the *Western Oregon Debris Flow Hazard Maps: Methodology and Guidance for Map Use*, 1999.

[21] *2013 Lake County NHMP*.

[22] NOAA, NWS. Letter dated December 20, 2010 from Stephen K. Todd, Meteorologist-in-Charge.

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 *2014 Oregon Structural Special Code* (*OSSC*) (http://ecodes.biz/ecodes_support/free_resources/Oregon/14_Structural/14_ORStructural_main.html) 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 facilities, and special occupancy structures, such as large schools and prisons. This report includes consideration of any potentially unstable soils and landslides.[23]

Emergency Operations Plans

The *Lake County Emergency Operations Plan* (*EOP*), dated April 2013, is an all-hazard plan that describes how Lake County will organize and respond to emergencies and disasters in the community. It is based on, and is consistent with Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including the Presidential Policy Directive 8, the National Response Framework, and State of Oregon Emergency Operations Plan. The *Lake County EOP* is one component of the County's emergency management program and is designed to be compliant with the National Incident Management System.

The *Lake County EOP* consists of a Basic Plan, Emergency Support Function Annexes that complement the Federal and State Emergency Support Functions, Support Annexes, and Incident Annexes. The *Lake County EOP* provides a framework for coordinated response and recovery activities during an emergency. It describes how agencies and organizations in Lake County will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.[24]

Future Changing Conditions/ Climate Change

In the Lake County NHMP, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Lake County. In the order of

[23] DLCD and OPDR, *Planning for Natural Hazards: Oregon Technical Resource Guide*, July 2001, Chapter 5. https://scholarsbank.uoregon.edu/xmlui/handle/1794/1909

[24] Ecology and Environment, Inc., *Lake County Emergency Operations Plan*, April 2013.

appearance in the NHMP: the Risk Assessment, the Hazards Annexes, and Appendix F contain this information. Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.* In the *Future Climate Projections* document, it is noted that in Lake County, the frequency of days with at least ¾ inch of precipitation and the frequency of days exceeding a threshold for landslide risk is not projected to change substantially.[25]

Landslide Mitigation Actions

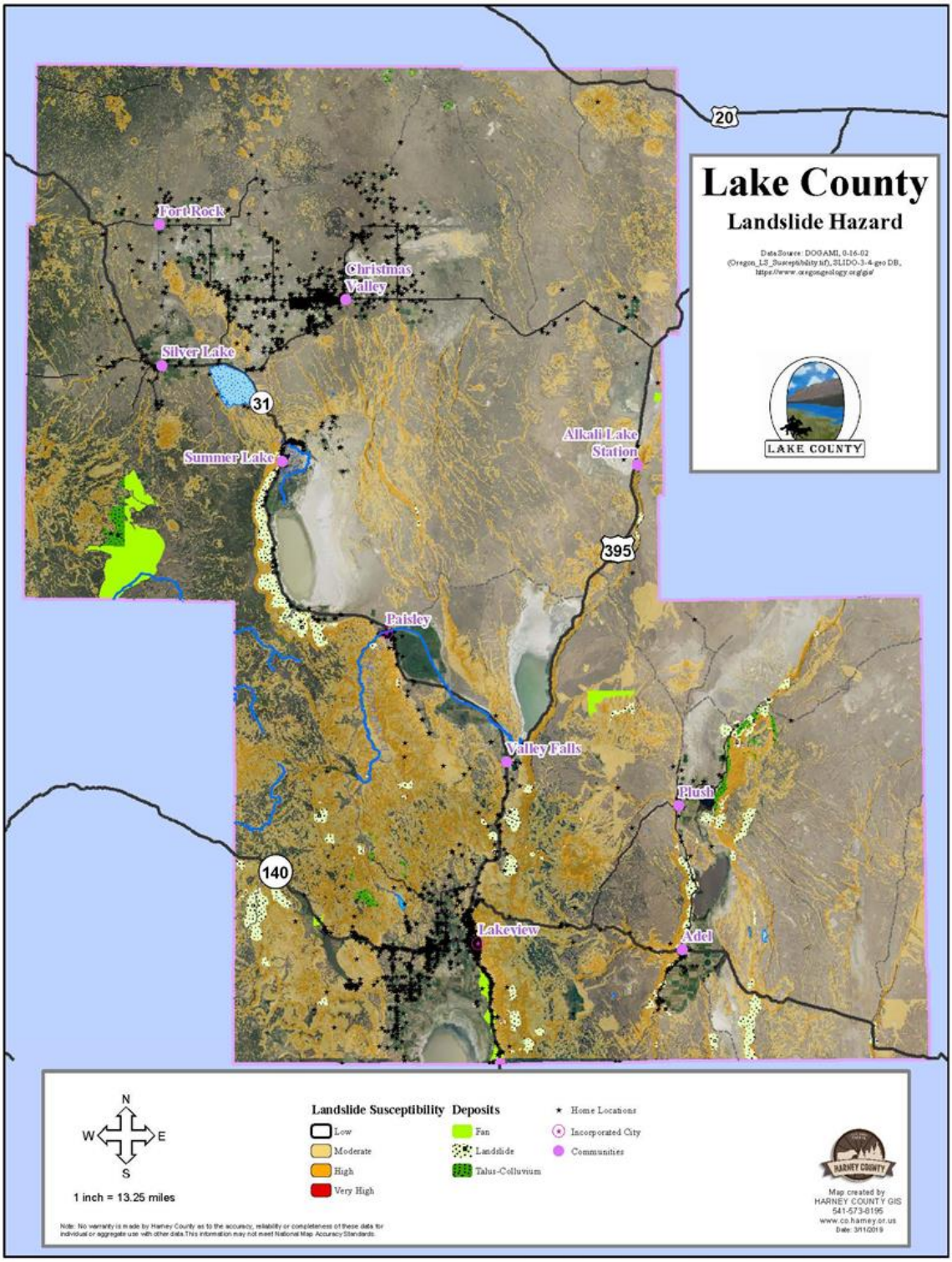
There are no landslide specific mitigation actions that have been identified by the Lake County NHMP Steering Committee. Landslide hazards are low priority because the Hazard Vulnerability Assessment (HVA) resulted in landslides having a low risk level.

In a discussion with the Lake County Emergency Services Coordinator, and shared 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 2-5 in Section 2 Risk Assessment. See Table 3-1, Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview and the mitigation action forms in Appendix A for a more detailed description of all the mitigation actions.

There are thirteen 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.

[25] OCCRI, *Future Climate Projections: Lake County*, August 2018.

Figure LS-3 Lake County Landslide Hazard



Source: Bryce Mertz, Harney County, March 11, 2019

Volcanic Event Hazard Annex

Risk Score: 129

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]

Volcanic events ranked sixth out of the nine natural hazards that the Lake County NHMP Steering Committee identified in the Hazard Vulnerability (HVA) for the *2020 Lake County NHMP*.

Causes and Characteristics of Volcanic Eruption

Lake 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.

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

[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

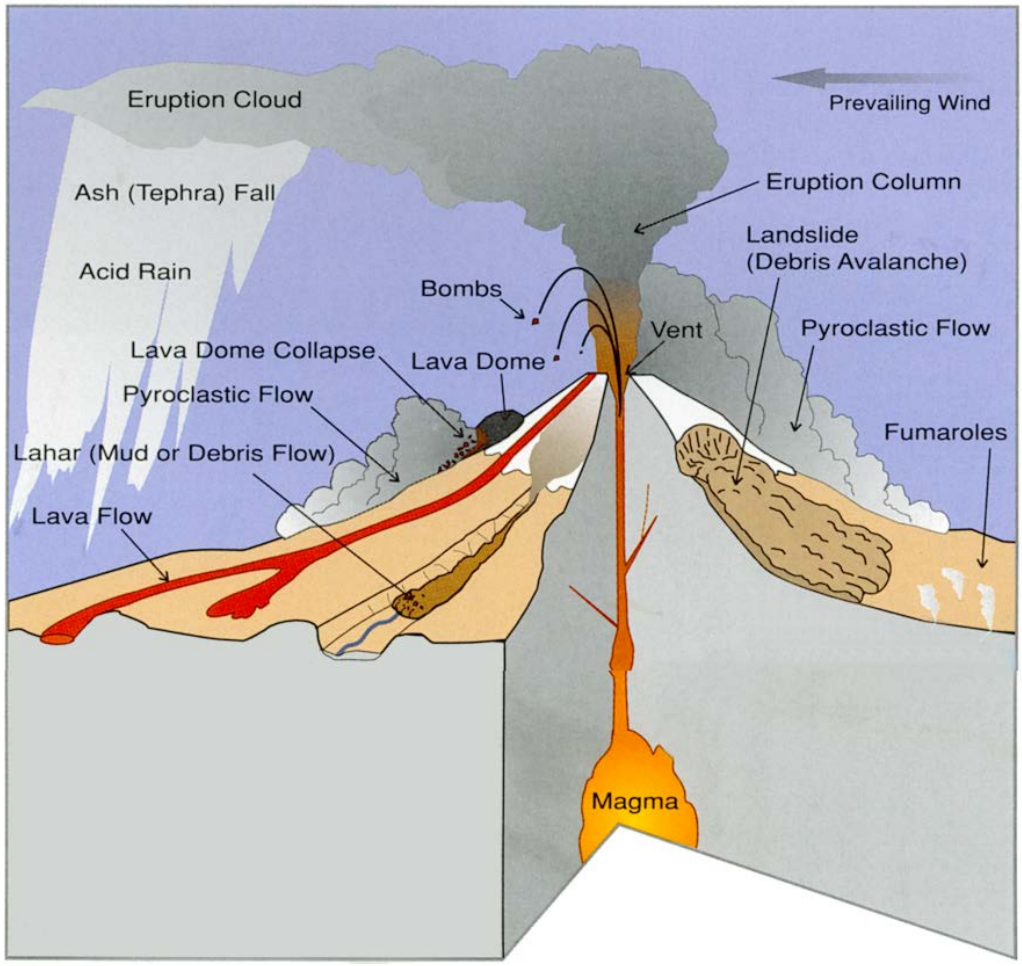
[3] USGS, *Volcano Hazards in the Cascade Range*, https://volcanoes.usgs.gov/observatories/cvo/hazards.html

[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

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 VE-1 diagrams the basic features of a volcano.

Figure VE-1 Volcanic Hazard from a Composite Type Volcano



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.,

[5] Tilling, Robert I., *Volcanoes*, USGS General Interest Publication, (1982), https://books.google.com/books/about/Volcanoes.html?id=5eVjblx7IC8C

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 anytime 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 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

[6] OPDR, *2012 Oregon State Natural Hazard Mitigation Plan*, Volcanic Hazards Chapter, https://oregonexplorer.info/content/oregon-natural-hazard-mitigation-plan-2012.

[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] OPDR, *2012 Oregon State Natural Hazard Mitigation Plan*, Volcanic Hazards Chapter, https://oregonexplorer.info/content/oregon-natural-hazard-mitigation-plan-2012.

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. 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.

[11] Ibid.

[12] USGS, Volcano Hazards Program, *Understanding Volcanoes Can Save Lives*, http://volcanoes.usgs.gov/Hazards/What/Lahars/lahars.html.

[13] Ibid.

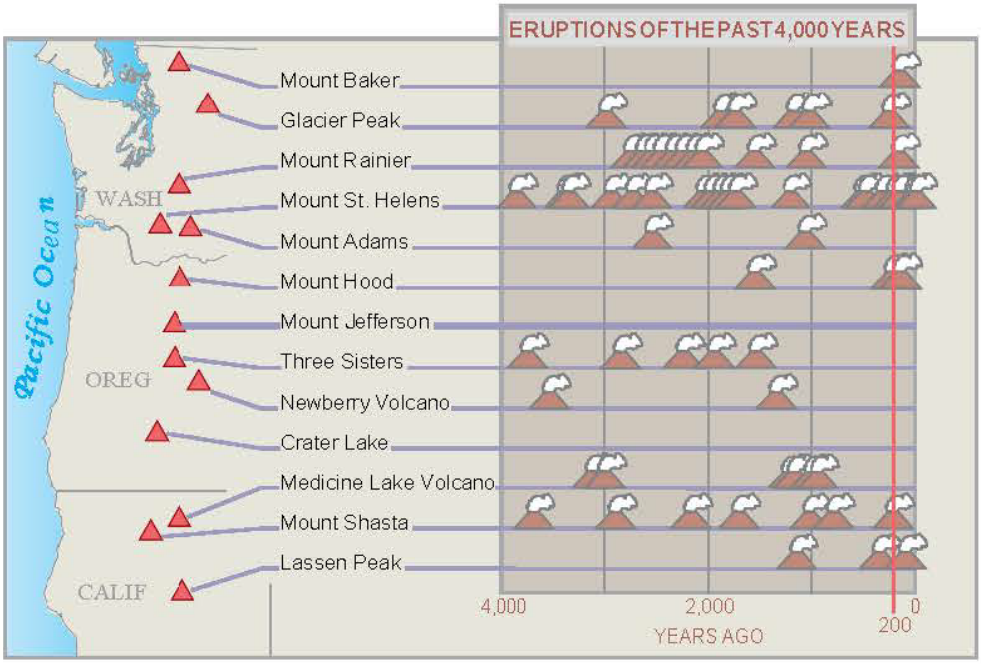
[14] Ibid.

[15] Wright and Pierson, Living With Volcanoes, USGS Volcano Hazards Program Circular 1973, (1992).

History of Volcanic Events in Lake County

Although there have been no recent volcanic events in the Lake 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 VE-2 displays the potentially active volcanoes of the western United States as identified by the USGS.

Figure VE-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

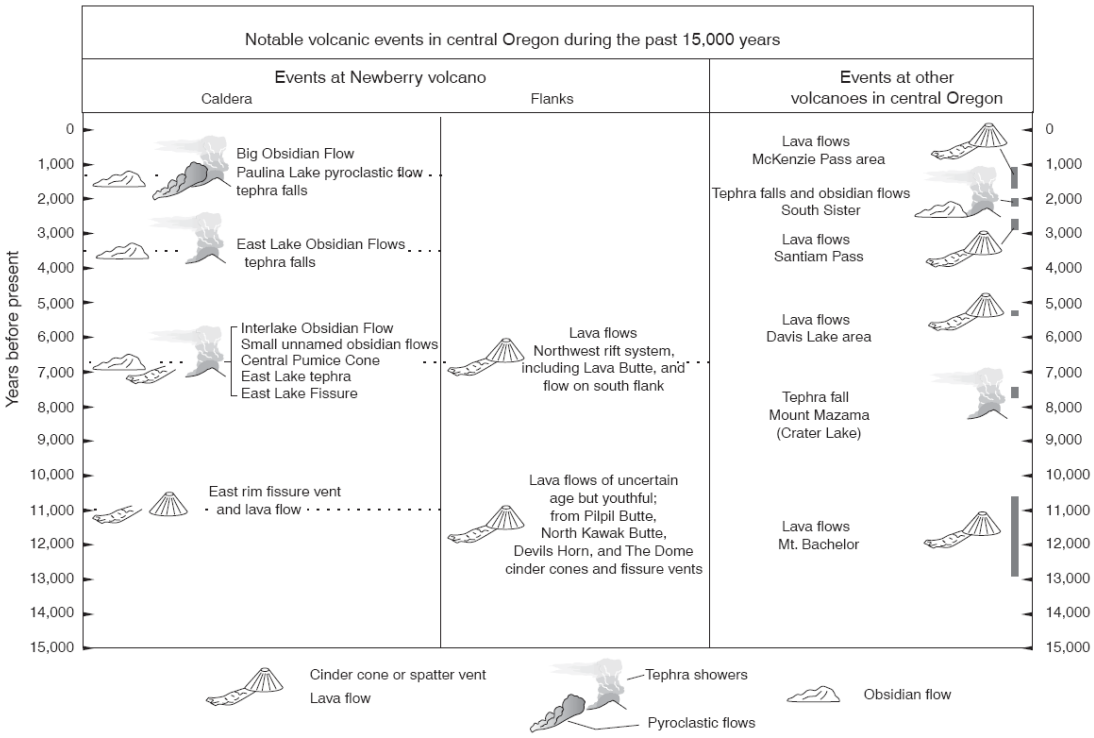
There are six active volcanic areas that could potentially impact Lake County and the broader region. These include: Mt. Saint Helens, Mt. Hood, Newbery Volcano, Mt. Bachelor, Three Sisters and Mt. Broken Top, and Mt. Mazama/ Crater Lake. All of these are in the very high threat category except Mt. Bachelor 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 VE-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. Some of the most recent events include Big Obsidian Flow at Newberry Volcano. All of the Cascade

[16] USGS, *2018 Update to the U.S. Geological Survey National Volcanic Threat Assessment*, https://pubs.usgs.gov/sir/2018/5140/sir20185140.pdf.

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 VE-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 VE-1 describes volcanic events in Oregon and Washington.

Table VE-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, *2013 Lake County NHMP*, April 2013; DLCD, *Oregon NHMP*, 2015; 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]

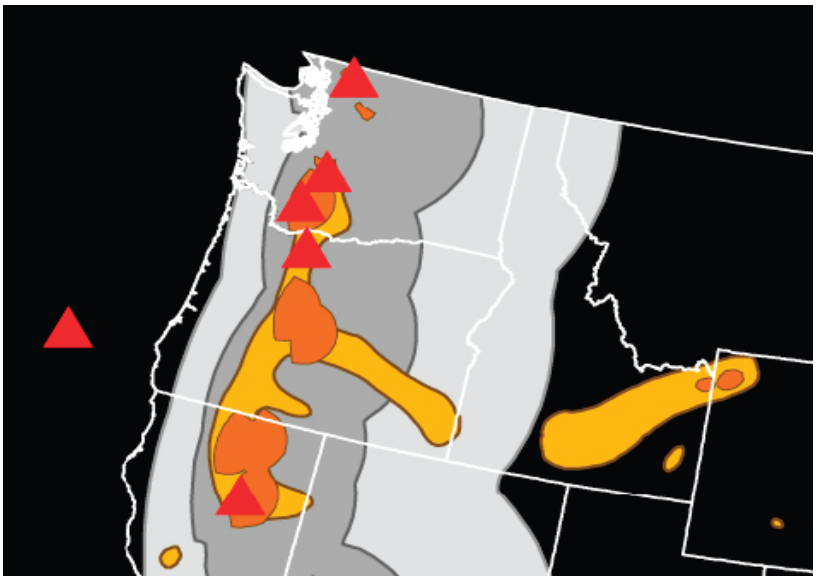
Risk Assessment

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 VE-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 VE-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.

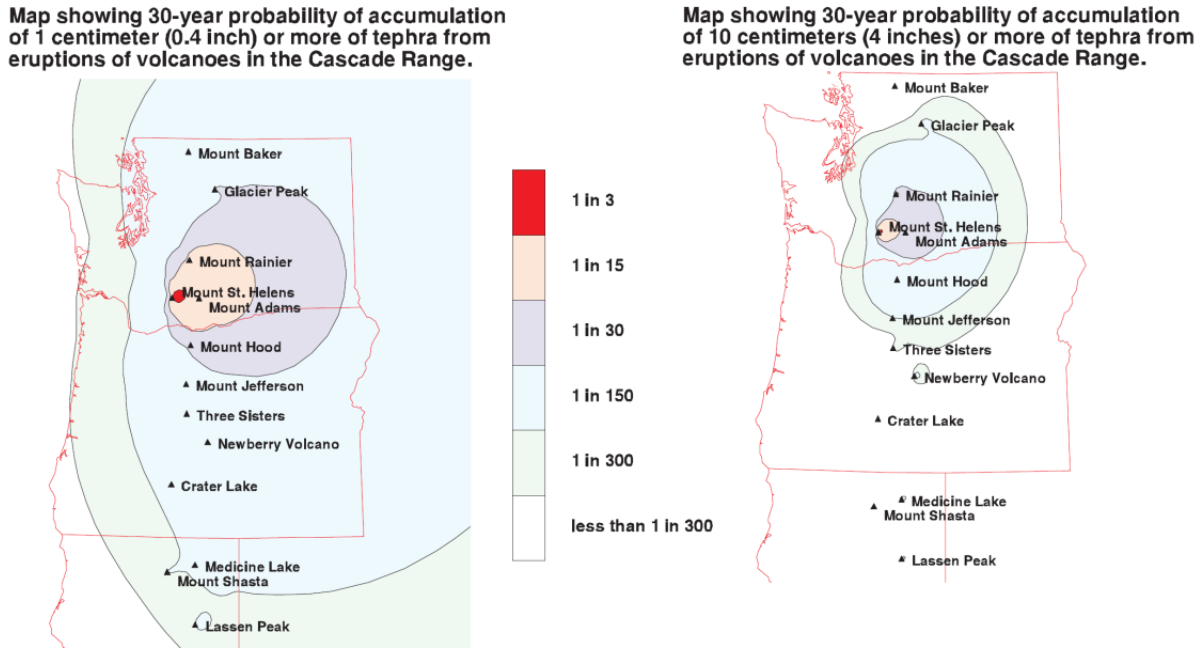
Source: Image modified from USGS, *Volcano Hazards – A National Threat, Fact Sheet 2006-3014*, https://pubs.usgs.gov/fs/2006/3014/2006-3014.pdf

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 VE-5 depicts the potential and geographic extent of volcanic ash fall from several volcanoes in the Pacific Northwest.

Figure VE-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

A useful resource has been 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 found 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

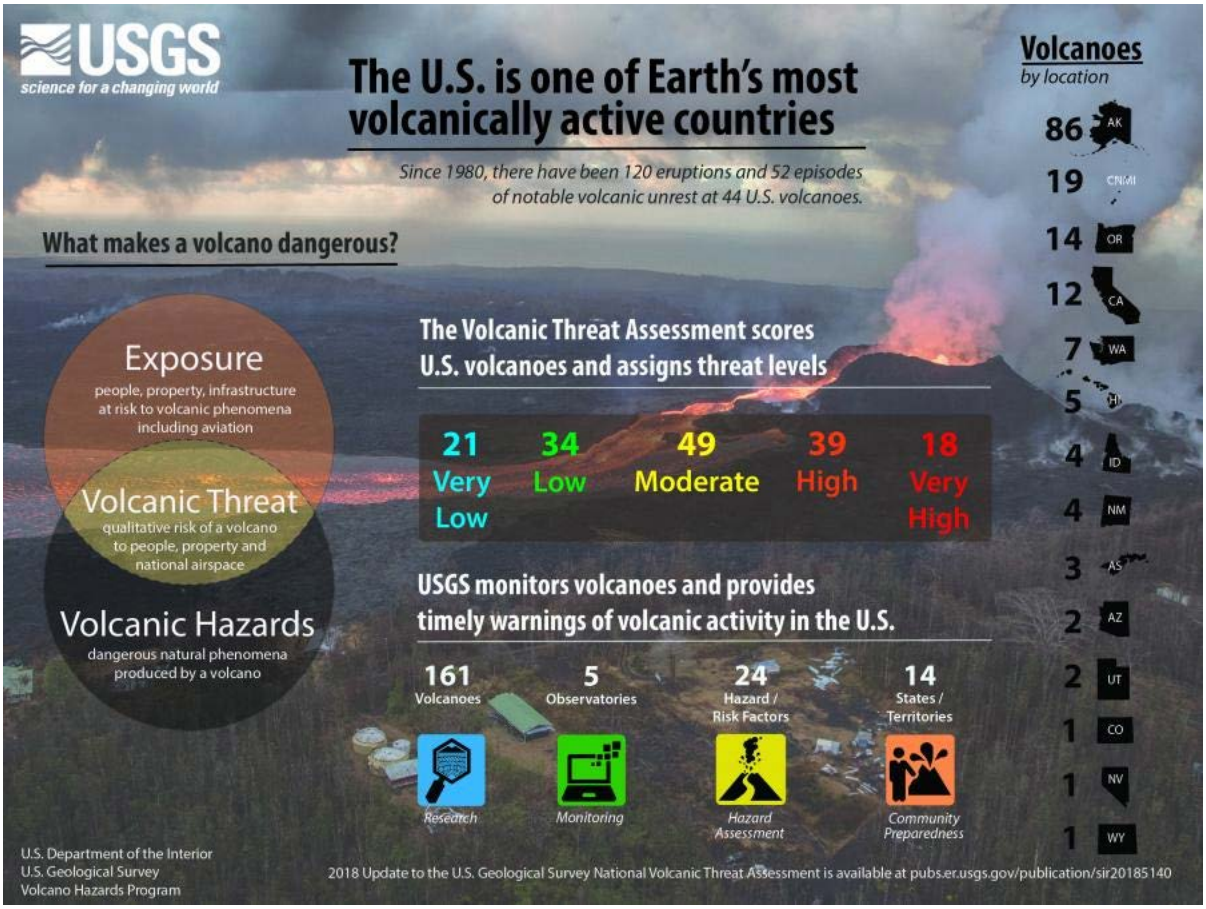
[18] USGS, *The U.S. is one of Earth's most Volcanically Active Countries*, https://volcanoes.usgs.gov/index.html.

[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 VE-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 Lake County NHMP Steering Committee completed a Hazard Vulnerability Assessment/Analysis (HVA) on April 11, 2018. 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

[20] Ibid.

[21] Ibid.

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.

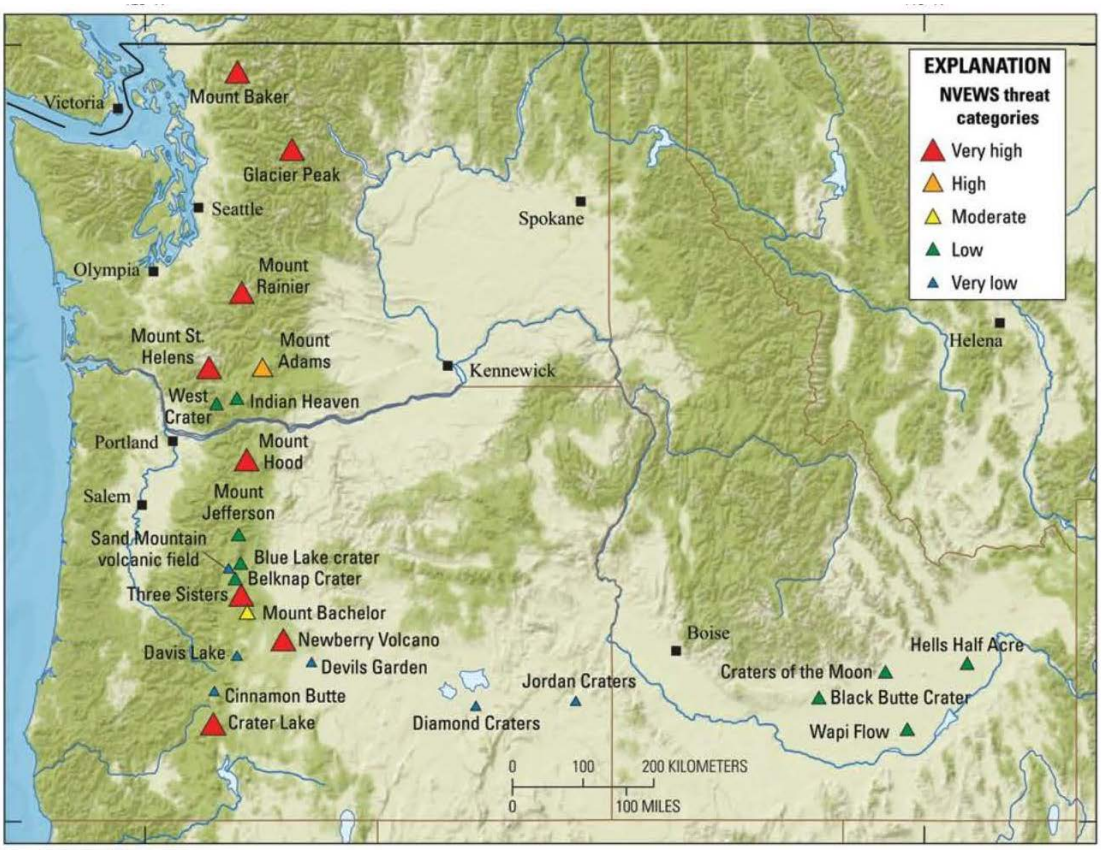
In 2013 volcanic hazards had a risk score of 129 and ranked eighth out of nine natural hazards. In the *2020 Lake County NHMP*, volcanic hazards had a risk score of 129 again and are ranked sixth out of nine natural hazards.

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 six active volcanic areas that could potentially impact Lake County 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 VE-7.

Figure VE-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 Lake County NHMP Steering Committee noted that the area is not highly 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 Eastern Oregon, Lake County 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, Malheur County is not at risk for proximal hazards such as lava flows. 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 Lake County volcanic eruption events, there are many qualitative factors - issues relating to what is in danger within a community - that point to potential vulnerability.

[22] *2013 Lake County Natural Hazards Mitigation Plan*.

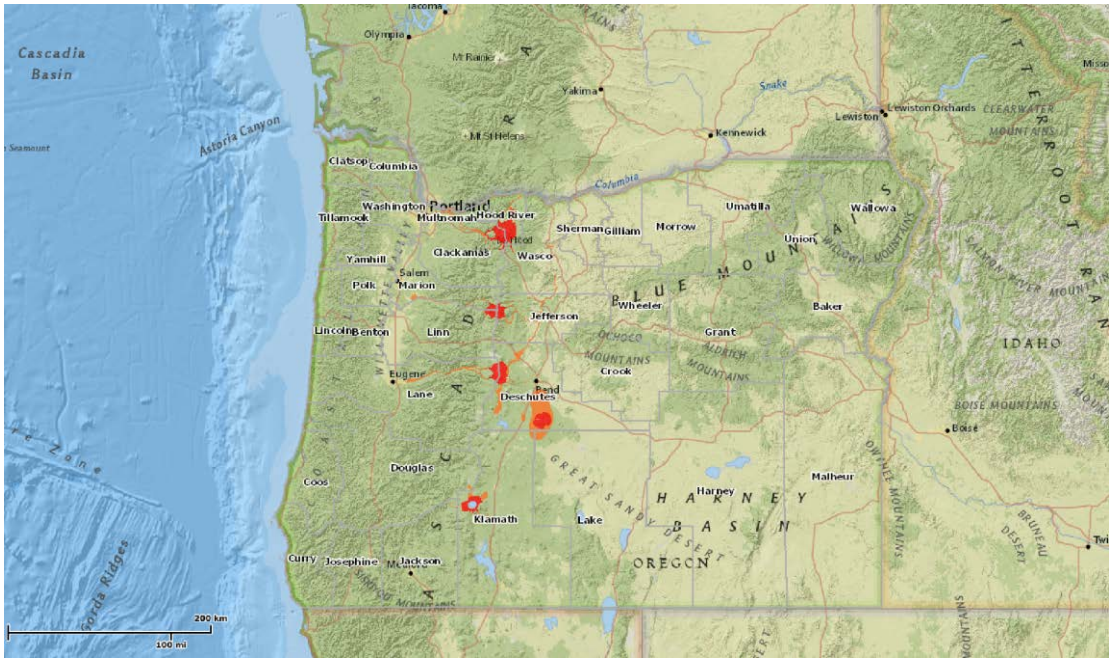
[23] Ibid.

[24] Ibid.

Figure VE-8 shows that that Lake County 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 Lake County, 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. However, while Lake County may not be directly affected by a volcanic event, should an event force Highways 31, 395, and 140 to close, the County will be isolated from the rest of the state.[28]

Figure VE-8 Map of Generalized Vulnerability of the Region



Source: DOGAMI HazVu: Statewide Geohazards Viewer

The northwestern portion of Lake County faces the greatest threat of volcanic eruption -- its proximity to a number of Cascade Range volcanoes places the County at risk from ash fallout originating from such an event.

[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 other information such as the *Emergency Operations Plan*, and collective memory, the Lake County NHMP Steering Committee determined the overall risk score of 129. 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 129. See the Hazard Vulnerability Analysis in the Risk Assessment in Section 2 of Volume I of this *2020 Lake County NHMP*.

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 Lake County Airport would need to close to prevent the detrimental effect of fine ash on jet engines

[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.

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 Lake County and nearby communities and trade centers could be deterred or halted. Subsequent 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 facilities such as the regional highways (HWY 20 and HWY 395).

Death and Injury

Inhalation of volcanic ash can cause respiratory discomfort, damage or result in death for sensitive individuals 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.

City Specific Damage

Town of Lakeview and City of Paisley

While a volcanic event may not have a direct impact on the Town of Lakeview and the City of Paisley, the ash fallout from an event in the Cascades could potentially affect people. People with respiratory issues may be particularly hard hit.

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 near Lake County: 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. Lake County is only at risk for tephra (ash) fall from these volcanoes, should these volcanoes become active enough to raise concerns.

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 *2015 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.
https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_5_RAState.pdf

Emergency Operations Plans

The *Lake County Emergency Operations Plan* (*EOP*), dated April 2013, is an all-hazard plan that describes how Lake County will organize and respond to emergencies and disasters in the community. It is based on, and is consistent with Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including the Presidential Policy Directive 8, the National Response Framework, and State of Oregon Emergency Operations Plan. The *Lake County EOP* is one component of the County's emergency management program and is designed to be compliant with the National Incident Management System.

The *Lake County EOP* consists of a Basic Plan, Emergency Support Function Annexes that complement the Federal and State Emergency Support Functions, Support Annexes, and Incident Annexes. The *Lake County EOP* provides a framework for coordinated response and recovery activities during an emergency. It describes how agencies and organizations in Lake County will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.[31]

Future Changing Conditions/ Climate Change

In the *2020 Lake County NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Lake County. In the order of appearance in the NHMP: the Risk Assessment, the Hazards Annexes, and Appendix F contain this information. Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.*

Volcanic Event Mitigation Actions

There are no volcanic events specific mitigation actions that have been identified by the Lake County NHMP Steering Committee. The mitigation actions would have a medium priority because the

[31] Ecology and Environment, Inc., *Lake County Emergency Operations Plan*, April 2013.

Hazard Vulnerability Assessment (HVA) resulted in volcanic events having a medium risk score and medium risk level. There are thirteen 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 conversation with the Emergency Manager and 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 2-5 in Section 2 Risk Assessment. See Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview and the mitigation action forms in Appendix A for a more detailed description of all the mitigation actions.

WILDFIRE HAZARD ANNEX

Risk Score: 210

Risk Level: High-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 (see Table WF-1 Significant Historic Wildfires) of wildfire in both wildlands and in wildland-urban interface (WUI) areas. 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 in this region grows, development in the WUI increases, posing a larger threat to life and property.

Wildfire ranked third in the risk score in the Hazard Vulnerability Analysis (HVA) for the *2020 Lake County NHMP* out of the nine natural hazards that the NHMP Steering Committee identified.

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 vast private rangelands within Lake County. The Town of Lakeview has a fire department and the City of Paisley has a volunteer fire department. There are many agreements between local, state, and federal organizations to assist one another throughout Lake County.

To reduce the impact of wildfire, Lake County adopted the *Lake County Community Wildfire Protection Plan* (CWPP) in 2006; the most recent version is dated 2011. The 2011 *Lake County CWPP* provides detailed information on the vulnerability and history of wildfire in the County, and provides mitigation actions the County can implement to reduce the impact of wildfire. This *2020 Lake*

[1] Oregon Wildfire Risk Explorer, *County Summary Report for Harney County*, December 2018.

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

County NHMP links to the *2011 Lake County CWPP* as it also contains wildfire information and mitigation actions. See Table 3-1, Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview and the detailed mitigation action forms in Appendix A.

Communities located in areas near rangeland or forests or a WUI may be at risk to wildfire hazards. The *2011 Lake County CWPP* identified the level of risk and hazard to ten communities within Lake County[3]. It rates eight of the ten communities as high-hazard: Adel, Ana Estates, Christmas Valley, Drews Reservoir, Fort Rock, Plush, Quartz Mountain/Drews Gap, and Summer Lake. Alkali Lake is low hazard and Silver Lake is moderate hazard.[4] See the Risk Assessment section in this hazard annex and Table WF-5 2011 Lake County CWPP Communities and Hazard Rating with Contributing Factors.

The impact on communities from wildfire can be huge and has been estimated at 3 times the cost of suppression.[5] 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.[6] Wildfires in Lake County affect other counties. The History of Wildfires in Lake County section in this Wildfire Hazard Annex includes a description of documented wildfires in Lake County in Table WF-1; not all the wildfires that have occurred in Lake County are included on this list. Lake County averages over 120 wildland fires per year with only a small fraction becoming of significance.[7]

See Figures WF-10 through WF-17 for countywide maps illustrating wildfire hazards In Lake County. Through an agreement, the Harney County GIS has created four maps with wildfire information for this *2020 Lake County NHMP*. Each map identifies the source of the information used and are included at the end of this Hazard Annex. Figures WF-15 through WF-17 are from USFS.

- Figure WF-10 Lake County Wildfire Hazard: Local Fire History
- Figure WF-11 Lake County Wildfire Hazard: Burn Probability by Watershed
- Figure WF-12 Lake County Wildfire Hazard: Wildfire Risk by Watershed
- Figure WF-13 Lake County Wildfire Hazard: Risk to Assets by Watershed
- Figure WF-14 Lake County Overall Wildfire Risk
- Figure WF-15 Lake County Rural Fire Protection Associations (RFPAs)
- Figure WF-16 Lake County Rural Fire Protection Associations (RFPAs)with Aerial Photo
- Figure WF-17 Lake County Rural Fire Protection Associations (RFPAs) with Aerial Photo and Fire Location with Fire Cause

[3] Lake County, *2011 Lake County CWPP* and *2009 South Central Lake County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

[4] Lake County, *2011 Lake County CWPP* and *2009 South Central Lake County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

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

[6] 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/.

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

Wildfire can be divided into four categories: interface fires, wildland fires, firestorms, and prescribed fires.[8] 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.

- The **occluded wildland-urban interface** where islands of wildland vegetation exist within a largely urbanized area.[9]

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. [10] 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.[11] Another term of use is mega-fire which is a fire that is more than 100,000 acres in size.[12] There are fires greater than 100,000 acres listed in Table WF-1. The Lakeview Complex Fire and the Toolbox Complex fire occurred in Lake County. The Long Draw Fire, The Egley Fire Complex, the Hollaway Fire, the Buzzard Complex Fire, and the Miller Homestead Fire occurred in Harney County. Fires outside of Lake County are also included in the table to

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

[9] Ibid.

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

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

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

demonstrate that large or mega-fire wildfires can and do occur in Oregon. Harney County abuts Lake County and fires in adjacent counties can have substantial impacts on both counties.

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 stated that over the long term approximately 20% of fires are caused by humans. This is a similar statistic in Lake County[13] Many of the equipment caused fires occur as a result of transportation or creation.[14] See Figures WF-10 and WF-17 for a map of fire locations and an indication of the fire's origins as either human or lightning caused. Table WF-4 Acres Burned in Lake County and Cause of Fire from 1992-2017 includes the information shown via the map in Figure WF-10. The data from USFS, used in Figures WF-15 through WF-17, have not yet been provided.

Additional data provided by the BLM shows some variability and uncertainty in the identification of the cause of fire starts. BLM staff noted that some of the human starts are under investigation until legal issues are resolved. So while those fires are under investigation, they are placed in the unknown category of fire starts.

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[15] 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

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

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

[15] Ibid.

moisture, soil temperature, and amount of and nature of grass there varies. Vegetation such as agricultural lands and rangelands also provides fuel for wildfires.[16] Many agencies are finding it cheaper and more effective to reduce fuels than to fight large grassland or rangeland fires. Currently there is a partnership working to thin forests north of Lakeview with the goal of improving forest health and to use prescribed fire to reduce the risk of catastrophic wildfire. The project involves the BLM, the Lake County Umbrella Watershed Council, the USFS, the NRCS, and others.[17]

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. Figure WWS-2 shows the average annual precipitation in Lakeview and WWS-4 shows the average annual precipitation in Summer Lake, these figures also show the mean annual precipitation and the geographic distribution in Lake County.

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-10 Local Fire History shows the fire locations from 1992-2017 and the cause as either human or lightning; Figure WF-17 also shows fire locations with the cause as either human or lightning with data from 1995-2019.

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 these wildland and WUI fires are increasing in severity and size.[18] Looking at the future climate projections described in Appendix F, it is likely these situations are already and will continue to be

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

[17] Jason Jaeger, Lake County Cooperative Weed Management Association, personal communication 2/20/20.

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

exacerbated by changes in the climate. In the Wind and Winter Storms Hazard Annex, see Figure WWS-2 which shows the Lakeview average annual precipitation and WWS-4 which shows the same information for Summer Lake. It is clear that mean annual precipitation is low and this contributes to wildfire impacts and other natural hazards impacts in Lake County.

History of Wildfire in Lake County

South-central Oregon contains large tracts of ponderosa pine and mixed conifer forests, primarily in the Western part of Lake County. These areas are highly vulnerable to wildfire because of natural aridity and the frequency of lightning strikes. Grasslands and brush lands, which naturally cover most of the region, 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.

Recall that Lake County is largely comprised of forestland, grasslands, rangelands, agricultural lands, and primarily small communities, with a few larger cities. Recognizing the economic, human, and environmental impacts, federal agencies have typically sought to alleviate fire-related problems through a controlled burning program. Controlled burning is extensively used on federal ownership in Lake County along with other fuels reduction techniques including mechanical treatment.[19]

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.

A list of fires in Lake County is included in Table WF-1 below.

Table WF-1 Significant Historic Wildfires

Date	Location	Description	Evacuations
2001	Lake County	The Lakeview Complex Fire was a cluster of 5 fires that burned near Lakeview. It burned 179,400 acres.	NA
2002	Lake County	Grizzly fire west of Lakeview 5975 acres July 12th.	NA
2002	Lake County	Winter Fire July 12th with 35,779 acres burned. Winter Fire and Toolbox Fire grew together into one fire.	Evacuation in Summer Lake. A shelter was opened at North Lake School. One person went to it.
2002	Lake County	The Toolbox Complex Fire started in Lake County and scorched the Fremont National Forest. It burned 120,085 acres. Winter Fire and Toolbox Fire grew together into one fire.	Same as Winter Fire.
2006	Harney County	The South End Complex burned 117,553 acres between Frenchglen and Fields in Harney County. It started by lightning.	NA

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

Date	Location	Description	Evacuations
2007	Lake County	Fletcher Fire, burned into OR from CA. Threatened several ranch structures, one lost.	Did not have time to evacuate Point Ranch.
2007	Harney County	FM-2712. The Egley Fire Complex burned 140,360 acres from July 8 through July 25. It was started by lightning; threatened Hines and Burns.	NA
2010	Lake County	Poker Jim, August 6th, burned 3151 acres	NA
2011	Lake County	Ana Fire, August 8th, 300 acres burned, threatened community of Summer Lake.	NA
2011	Lake County	Garden Fire, September 8th, 6140 acres burned.	NA
2011	Lake County	Buffalo Fire September 14, burned 1400 acres.	NA
2012	Harney County	The Miller Homestead Fire burned 160,801 acres. It started on July 8 by lightning. The location was ½ mile west of Frenchglen.	NA
2012	Harney County	The Long Draw Fire burned 560,627 acres. It started on July 14.	NA
2012	Lake County	Hickey Fire, May 16th, burned 411 acres.	NA
2012	Lake County	Blue Joint, March 22, 3,435 acres burned.	NA
2012	Lake County	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.	NA
2012	Harney County	The Hollaway Fire burned 75,000 acres. It started on August 5 by lightning. It burned 245,000 acres in OR and 215, 000 acres in NV.	NA
2012	Lake County	The lightning caused Lava 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.	NA
2012	Lake County	The Barry Point Fire burned 71,289 acres in Oregon and 21,688 acres in Modoc County, CA. Started August 5th from lightning	There were evacuations at Drews Reservoir.
2013	Lake County	Riffle Fire, Sept 17th, 1,007 acres burned.	NA
2016	Lake County	Withers, August 17th, 3,424 acres burned, threatened town of Paisley.	Paisley was evacuated.
2017	Lake County	Jade Creek, August 10th, burned 782 acres.	Evacuations at Dairy Point, Happy Camp, and general campgrounds.
2017	Lake County	July Complex, July 29th, 45,690 acres burned in CA, spread stopped ½ mile before reaching Oregon.	NA
2017	Lake County	Crane fire, July 26th, 603 acres burned.	NA
2017	Lake County	Ana Fire, July 8th, 5,874 acres burned, one cabin lost, threatened communities of Summer Lake and Ana Estates	Summer Lake was evacuated.
2018	Lake County	Watson Cr Fire, 58,753 acres burned including 14000 acres of industrial forestland. August 19th. Threatened town of Paisley	Evacuations at Lakeview Estates, Happy Camp, Dairy Point, and south end of Summer Lake. Paisley evacuation discussed, not implemented.
2019	Lake County	The Poker Fire was reported on 8/15/19 on Hart Mountain, near Plush, OR. It started by lightning. It was 24,000 acres.	NA

Sources: University of Oregon, Lake County NHMP, May 2013; DLCD, Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017; InciWeb, retrieved 10/10/17, 5203, https://inciweb.nwcg.gov/incident/5584/; Burns Times Herald, September 6, 1996; Burns Times Herald, August 27, 1997; NICC Incident Management Report, August 11, 2005, http://cidi.org/wildfire/0508/ixl10.html, accessed August 8, 2007; Poker Fire, KOBI5.com, https://kobi5.com/news/wildfire-in-lake-county-grow-to-15000-acres-110943/; Dustin Gustaveson, ODF, personal communication, 2/24/20; Evacuation information from Daniel Tague, Lake County, personal communication, 3/5/20.

The wildfires reported in Lake County from 1993 to 2012 are described in Table WF-2 below. The

table, previously included in the *2013 Lake County NHMP*, shows that 77% of the reported wildfires were less than 0.25 acres in size, while the six largest wildfires burned a total of more than 243,000 acres. It also shows that the vast majority of wildfires are lightning caused.

Table WF-2 Wildfire History for the Years 1993-2012

Fire Size Class (Acres)	Acres Burnt	Percent Total Acres	Number of Fires	Percent Total Fires	Fire Ignition Source	
					Lightning	Human
0 – 0.249	161	0.05%	1,460	77.3%	1,257	203
0.25 – 9.9	437	0.14%	326	17.3%	241	85
10.0 – 99.9	1,718	0.55%	45	2.4%	28	17
100 - 299.9	3,337	1.07%	18	1.0%	13	5
300 - 999.9	7,287	2.33%	14	0.7%	10	4
1,000 – 4,999.9	40,019	12.78%	16	0.8%	13	3
5,000 – 9,999.9	16,977	5.42%	3	0.2%	2	1
> 10,000	243,173	77.66%	6	0.3%	5	1
Total	313,108	100%	1,888	100%	1,569	319

Source: Lake County, *2011 Lake County CWPP* and *2009 South Central Lake County CWPP*, Table WF-1, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

Table WF-3 shows the acres burned, ownership, ignition source, and discovery date of the fires that occurred during the years of 1993-2004 that are over 1,000 acres; this table was previously included in the *2013 Lake County NHMP*. The table shows far more fires are caused by lightning than by humans. Note that many fires after 2000 in Table WF-3 are much larger than the largest fire size class (10,000 acres) listed in Table WF-2.

Two large fires, Barry Point and Lava, occurred in 2012 were lightning ignited and burned more than 114,000 acres combined. The 2002 fire season 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 as documented in the *2009 South Central Lake County CWPP*.

Table WF-3 Wildfire History (>1,000 Acres) for the Years 1993-2004

Fire Name	Ownership	Discovery Date	Acres Burned	Ignition Source
Barry Point	USFS	8/6/12	92,977	Lightning
Lava	BLM	7/23/12	21,546	Lightning
Blue Joint	NOMANS	3/22/12	3,435	Human (Misc.)
Garden	BLM	9/8/11	6,140	Lightning
Buffalo	BLM	9/8/11	1,400	Lightning
Poker Jim	FWS	8/5/10	3,153	Human (Misc.)
Jug	NOMANS	7/23/06	2,671	Lightning
Grassy	ODF	8/13/04	4,443	Lightning
Toolbox	USFS	7/12/02	59,970	Lightning
Winter	ODF	7/13/02	33,951	Lightning
Silver	USFS	7/13/02	24,564	Lightning
Grizzly	USFS	7/12/02	5,837	Lightning
Lava	BLM	7/13/02	2,353	Lightning
Tucker	BLM	7/12/02	1,824	Lightning
Johnson	USFS	8/8/01	2,691	Lightning
Jump	NOMANS	8/8/01	2,383	Lightning
South Warner	USFS	8/8/01	1,702	Lightning
Abert	BLM	8/3/00	10,165	Human (Misc.)
Lugnut	BLM	6/22/00	2,010	Lightning
Degarmo Cy	FWS	11/7/99	5,000	Human (recreationist)
Crump	BLM	8/3/99	3,433	Lightning
Thomas	USFS	7/6/99	1,821	Human (recreationist)
Alder Ridge	USFS	8/12/96	3,573	Lightning
Owen	ODF	9/16/95	1,176	Lightning
Spaulding	BLM	7/20/94	1,951	Lightning

Source: Lake County, *2011 Lake County CWPP* and *2009 South Central Lake County CWPP*, Table WF-2, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

Figure WF-10 Local Fire History is a map that shows the fire locations from 1992-2017 and the cause as either human (red dot) or lightning (yellow dot). The map data used to create the Local Fire History map includes statistics (see data sources listed on the map)[20] for fires from 1992-2017.

Table WF-4 Acres Burned in Lake County and Cause of Fire from 1992-2017 Based on Information Used in Creating Figures WF-1 to WF-13

Year	Human Caused	Lightning Caused	Unknown Caused	Total Acres
1992	1,237.65	2,767.57	NA	4,005.22
1993	7.66	6.97	NA	14.63
1994	89.71	10,074.44	NA	10,164.15
1995	6,721.56	1,747.50	NA	8,469.06

[20] Bryce Mertz, Harney County GIS, personal communication, provided wildfire maps in Figures WF-10 through WF-13 using the data sources identified on the maps.

1996	79.25	5,145.95	NA	5,225.20
1997	840.92	80.39	NA	921.31
1998	1,425.22	44.79	NA	1,470.01
1999	6,956.91	4,188.61	NA	11,145.52
2000	10,219.10	1,970.85	NA	12,189.95
2001	35.71	8,176.68	NA	8,212.39
2002	7.42	124,428.22	NA	123,435.64
2003	86.41	94.94	NA	181.35
2004	4.62	4,264.51	NA	4,269.13
2005	5.16	1,528.15	NA	1,533.31
2006	152.20	3,370.60	NA	3,522.80
2007	9,892.35	263.40	NA	10,155.75
2008	6.80	536.73	NA	543.53
2009	18.80	413.20	NA	432.00
2010	3,409.37	9,535.45	NA	12,944.82
2011	16.25	7,930.47	NA	7,946.72
2012	4,100.41	115,411.08	NA	119,511.49
2013	1,198.69	71.06	NA	1,269.75
2014	256.61	119.02	NA	375.63
2015	285.45	75.63	NA	361.08
2016	4,170.50	9.05	NA	4,179.55
2017	5,874.10	2,617.02	54,256.00	62,747.12

Source: Bryce Mertz, Harney County GIS, personal communication, 3/11/19

1992-2017 Totals for Lake County Fire Data from Table WF-4:

- Lightning caused acres burned: 303,872.28 (73.18%)
- Human caused acres burned: 57,098.83 (13.75%)
- Unknown caused acres burned: 54,256(13.07%)
- Total acres burned: 415,227.11 (100%)

Clint Alberston of the U.S. Forest Service (USFS) provided several maps included in this Wildfire Annex: Figures WF-14, WF 15, WF-16, and WF -17. The datasets for those maps have not been provided and is not included in tables in this Wildfire Annex.

In looking through the history of wildfires in Oregon, and more specifically in Lake and Harney Counties, 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 Lake County. They are described here as examples of how fires can impact an area. 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.

Long Draw Fire (July 2012): This lightning caused wildfire ignited on July 8, 2012 and burned 582,313 acres primarily within Malheur County, but also affecting Nevada and an area south of

Burns Junction in Harney County.[21] It did not burn in Lake 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.[22]

Miller Homestead Fire (July 2012): This lightning caused wildfire burned approximately 160,850 acres near Frenchglen.[23] More than 450 personnel, including a dedicated structure protection division were deployed to this event. This was the largest Oregon wildfire since 2007 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[24].

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.[25]

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.[26] In Lake County, fire primary burned federal land (43,225 acres) though it also burned 11,452 acres of private land.[27] The fire required the mandatory evacuation of over 20 residences,[28] with nearly 1,300 people on the firelines.[29] The image in Figure WF-1 shows

21 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.

22 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.

23 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.

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

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

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

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

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

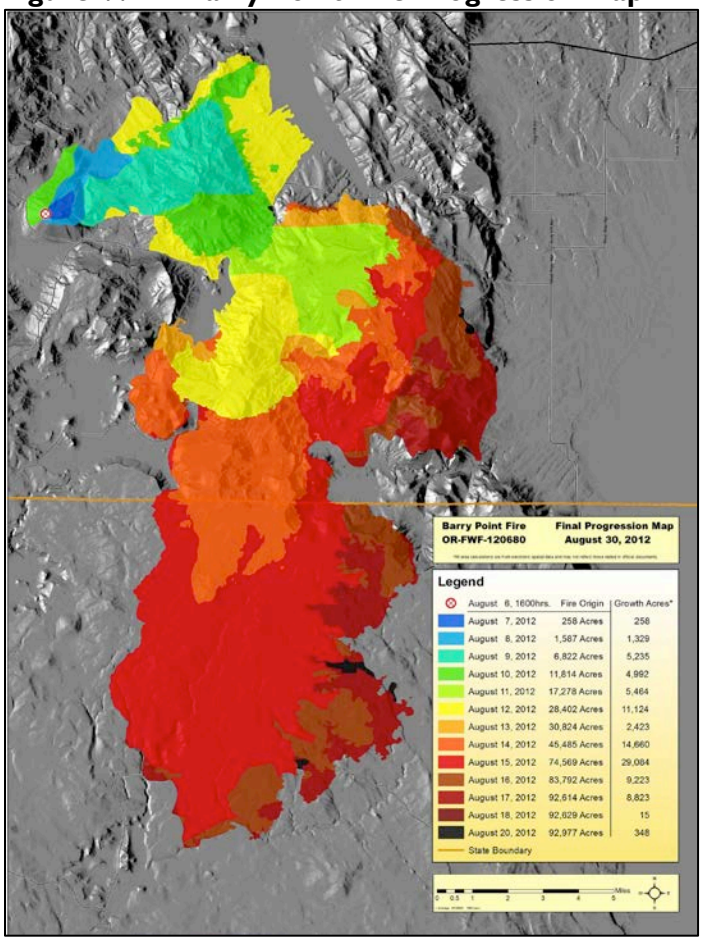
29 Oregon Live "Lightning ignites two new fire in Oregon, Washington" August 2012 http://www.oregonlive.com/pacific-northwest-news/index.ssf/2012/08/lightning_ignites_two_new_fire.html

firefighters from the Baker River Hot Shots conducting burnout operations around a structure on the edge of the Fremont-Winema National Forest.

Figure WF-1 Firefighters Performing Structure Protection Burnout Operation

Source: Kevin Abel, BLM Lakeview District

Figure WF-2 Barry Point Fire Progression Map



Source: InciWeb: Incident Information System, http://www.inciweb.org/incident/map/3105 (link no longer accessible)

Risk Assessment

Wildfire risk combines the likelihood of a fire occurring with the exposure and susceptibility of valued resources and assets on the landscape.[30] Lake County developed a Community Wildfire Protection Plan (CWPP) with the intention of addressing wildfires within the WUI boundaries and affecting the communities in the County.[31] The purpose of the CWPP is for communities to take advantage of opportunities offered under the Healthy Forests Restoration Act of 2003 (HFRA) legislation.[32]

The focus of the *2011 Lake County CWPP* is on Lake County with emphasis on the communities of Adel, Alkali Lake, Ana Estates, Christmas Valley, Drews Reservoir, Fort Rock, Quartz Mountain/Drews Gap, Silver Lake, and Summer Lake. The *2011 Lake County CWPP* updated the 2005 and 2006 CWPPs – there were two because one was created separately for the area of south-central Lake County, which included the communities of New Pine Creek, Westside, Lakeview, Valley Falls, Paisley, and Collins Timber properties.[33]

The *2011 Lake County CWPP* encourages 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. The *2011 Lake County CWPP* issued a hazard rating for ten communities in Lake County; the contributing factors for the hazard ratings included:

- Likelihood of fire occurring,
- Topographic hazard,
- Total fuel hazard,
- Overall fire protection capability,
- Weather factor, and
- Values at risk.

The following communities were issued hazard ratings in the *2011 Lake County CWPP*: Adel, Ana Estates, Christmas Valley, Drews Reservoir, Fort Rock, Plush, Quartz Mountain/Drews Gap, Alkali Lake, Silver Lake, and Summer Lake. Alkali Lake is rated low hazard and Silver Lake is rated moderate hazard while the other eight communities are rated high hazard. The high hazard ratings were due to issues with hazard fuels proximity, the use of combustible construction material, inadequate emergency ingress and egress, the lack of defensible space around structures, and proximity to slopes greater than 31 percent. [34]

[30] Oregon Wildfire Risk Explorer, *County Summary Report for Lake County*, 1/15/20.

[31] *2011 Lake County CWPP,* https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

[32] *2011 Lake County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

[33] *2011 Lake County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

[34] *2011 Lake County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

Table WF-5 2011 Lake County CWPP Communities and Hazard Rating with Contributing Factors

Community	Hazard Rating	Contributing Factors
Adel	High Hazard	• Sagebrush, dried grass and weeds around and within town; agricultural land with dried herbaceous vegetation during late summer and fall • Surrounding terrain • Lack of defensible space around structures • Combustible roof or siding on some structures • Presently no fire authority • Above-ground utilities
Alkali Lake	Low Hazard	• Terrain east of buildings • Combustible siding on structures • Above-ground utilities
Ana Estates	High Hazard	• Juniper, sagebrush and dried grasses around and within community • Lack of defensible space around structures • Limited ingress/egress with non-surface, narrow road • Surrounding terrain • Proximity of water • Above-ground utilities
Christmas Valley	High Hazard	• Sagebrush, dried grass and weeds around and within community; agricultural land with dried herbaceous vegetation during late summer and fall • Lack of defensible space around structures • Combustible roof and/or siding on some structures • Above-ground utilities
Drews Reservoir	High Hazard	• Tress, sagebrush, grass, within and around community • Lack of structure defensible space • Continuous fuels between public and private boundaries • Above-ground utilities • Lack of street signs and house numbers • Steep, narrow, non-surfaced private roads and driveways • Lack of local fire protection authority
Fort Rock	High Hazard	• Sagebrush and grass within and around community • Lack of defensible space around structures • Lack of non-combustible construction materials • Above-ground utilities • Lack of local fire protection authority
Plush	High Hazard	• Juniper, sagebrush, dried grass and weeds in proximity to structures; and, agricultural lands with dried herbaceous vegetation during late summer and fall • Lack of structure defensible space • Structures with combustible roofs and siding materials • Presently no fire authority • Above ground utilities
Quartz Moountain/ Drews Gap	High Hazard	• Overstocked timber, ladder fuels, sagebrush and dried grass on adjoining public land and on property • Lack of defensible space around structures • Limited ingress/egress on narrow, steep roads • Surrounding terrain • Limited water availability • Above-ground utilities

Silver Lake	Moderate Hazard	• Juniper, sagebrush and grass within and surrounding community • Agriculture fields with dry herbaceous vegetation during late-summer and fall • Structures within combustible roofs and siding materials • Surrounding terrain • Above-ground utilities
Summer Lake	High Hazard	• Juniper, sagebrush and grass in proximity of community • Agricultural fields with dry herbaceous vegetation during late-summer and fall • Lack of defensible space around structures • Surrounding terrain • Structures within combustible roofs and siding materials • Above-ground utilities

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

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 Lake County, there are scattered small communities and ranches with houses and out-buildings without structural fire protection because they are outside the Lakeview Fire Department and the Paisley Volunteer Fire Department districts. Other economic values at risk include businesses, farmland, ranchland, grazing land, hunting and other recreational land, historic and cultural sites, and critical infrastructure.

Lake County has mitigation actions for wildfire in the *2011 Lake 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 *2020 Lake County NHMP* has eight wildfire-specific mitigation actions that the Lake County Steering Committee has adopted. See Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview and the mitigation action forms in Appendix A.

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 Ignitiability: A CWPP must recommend measures that homeowners and communities can take to reduce the ignitability of structures throughout the area addressed by the plan.[35]

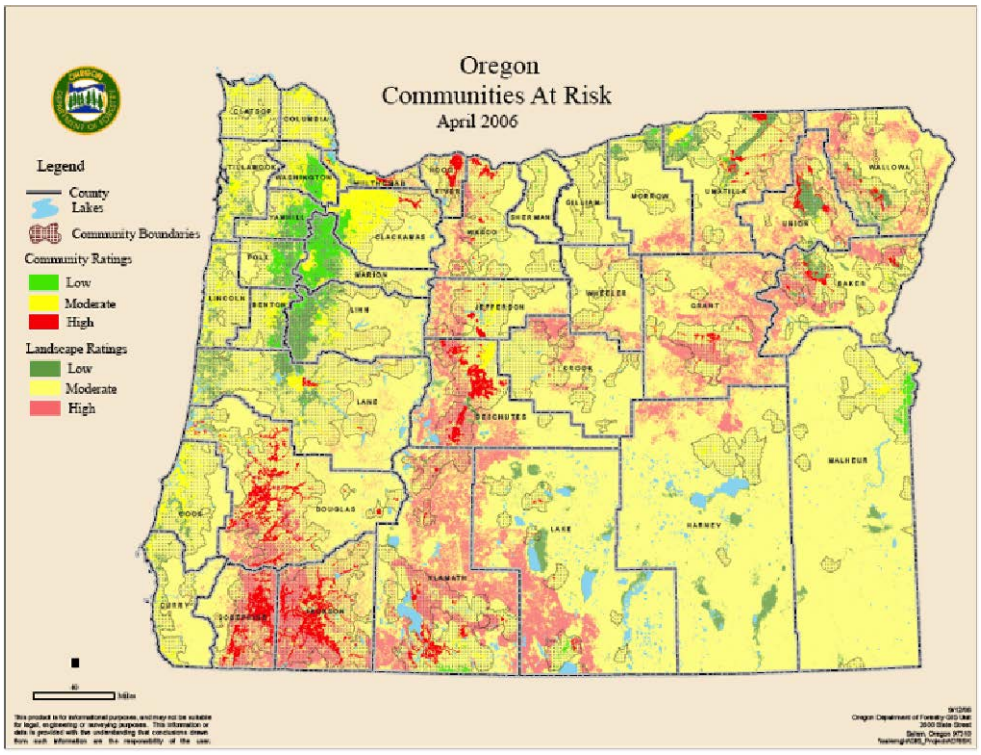
A community at risk is a geographic area within and surrounding permanent dwellings (at least one home per 40 acres) with basic infrastructure and services, under a common fire protection

[35] *2011 Lake Harney County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

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 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."[36]

Figure WF-3 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 Lake County 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

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

(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 *2013 Lake County NHMP*, wildfire hazards had a risk score of 186 and a rank of third out of eight natural hazards. In the *2020 Lake County NHMP,* wildfire hazards had a risk score of 208 and a rank of third out of nine natural hazards. Wildfires tied with winter and wind storms.

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 is a common occurrence in Lake County. 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.[37]

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-10 Wildfire Hazard: History shows fire locations in terms of human and lightning caused between 1992 and 2017.

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.

Figure WF-11 Wildfire Hazard: Burn Probability by Watershed shows Lake County's moderate to very high burn probability areas; there are no low probability areas. Burn probability shows the annual likelihood of occurrence of a large wildfire great than 250 acres, considering weather, topography, fire history and fuels (vegetation), including recently disturbed fuels from large Oregon wildfires in notable years 2013, 2014, 2015, and 2017.[38]

[37] Ibid.

[38] Oregon Wildfire Risk Explorer, *County Summary Report for Lake County*, 1/15/20.

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.

Wildfire information included in this *2020 Lake County NHMP* includes but is not limited to the *2011 Lake County Community Wildfire Protection Plan*, information from the BLM and ODF, information from the Oregon Wildfire Explorer and Harney County GIS (they prepared the maps in Figures WF-10 to WF-13), and other information. Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.*

The *2020 Lake County CWPP* measures fire regime condition class (FRCC) as one method to determine vulnerability to the wildfire hazard in the community. As described, the FRCC measures the degree of departure from a historic reference condition which may occur due to changes in ecosystem components (vegetation characteristics), fuels composition, fire frequency, severity, and pattern and other changes such as insect and disease mortality, grazing and drought[39]. The FRCC classes 1, 2 and 3 represent low-, moderate-, and high- hazardous fuel situations respectively[40]. For more information see the *2011 Lake County CWPP* which includes two maps with fire regime information: Map 4 Historic Fire Regime and Map 5 Fire Regime Condition Class.

The *2011 Lake County CWPP* included a risk assessment specific to the wildfire hazard that includes extensive research, evaluation, field surveys and public comment. The *2011 Lake County CWPP* contains important information, and yet is in need of updating to provide more current information. Using the CWPP in addition to other information as noted above, provides a blend of wildfire information in this NHMP from the past, present, and future.

Figure WF-12 Wildfire Hazard: Wildfire Risk by Watershed and Figure WF-13 Wildfire Hazard: Wildfire Risk to Assets by Watershed illustrate risk areas in Lake County.

Community Hazard Issues

What is susceptible to damage during a hazard event?

Air Quality

Air Quality is a concern for residents of the Lakeview basin, particularly within the Town of Lakeview due to cold air inversions (capping inversions) and wildfires that occur during summer months. In the 1990s, 2000, and 2010s, Lakeview experienced poor air quality. In the past, the sources of air

[39] Ibid.

[40] Ibid.

pollution in the region included 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 the valley or becomes trapped during inversions. Wood stove, industrial, and motor vehicle emissions continue to be a source of air (and other types of) pollution. See the Air Quality Annex for more information about wildfire impacts.

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.

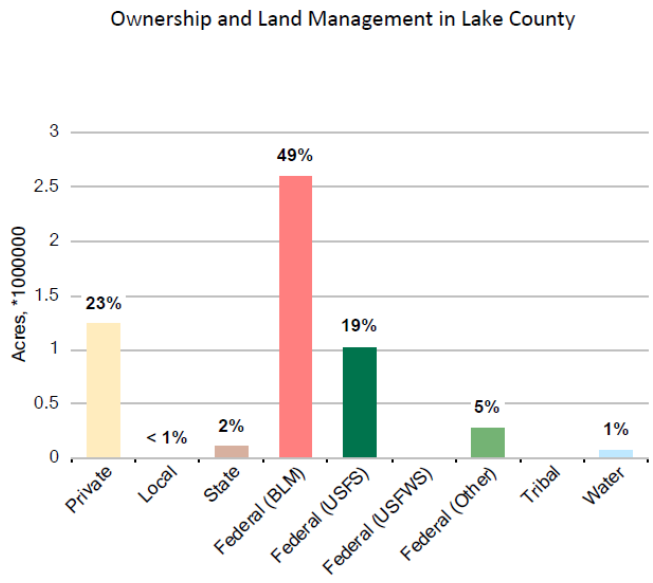
The total land base in Oregon is approximately 63 million acres, or just over 98,000 square miles. Lake County contains 5,350,506 acres (8,360 sq. miles). Within the entire state, the US Forest Service (USFS) manages just over 17 million acres, and US Bureau of Land Management (BLM) manages nearly 16 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.[41]

The federal government owns 73% of the land within Lake County, while the state of Oregon owns 2%. The two largest agencies with authority over federal lands are the Bureau of Land Management (BLM) with 49% and the U.S. Forest Service (USFS) with 19%. Tribal ownership is less than 1%. See Table WF-4 and Figure WF-5 for graphics about landownership within Lake County.[42]

[41] Source: Oregon Wildfire Risk Explorer, *Lake County Summary Report*, 1/15/20

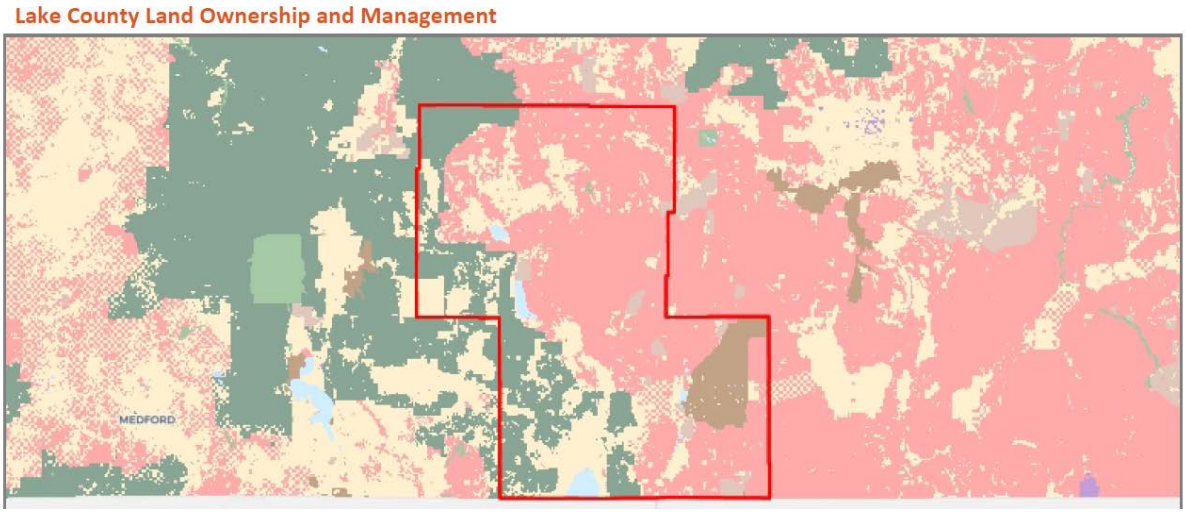
[42] Source: Oregon Wildfire Risk Explorer, *Lake County Summary Report*, 1/15/20

Figure WF-4 Landownership in Lake County, OR



Source: Oregon Wildfire Risk Explorer, *Lake County Summary Report*, 1/15/20

Figure WF-5 Landownership in Lake County, OR



Source: Oregon Wildfire Risk Explorer, *Lake County Summary Report*, 1/15/20

Personal Choices and Private Lands

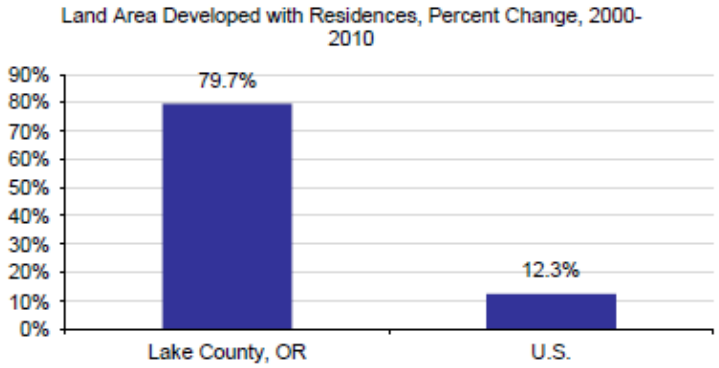
Many interface areas, found at lower elevations and drier sites, are also desirable real estate. More people in Oregon are becoming vulnerable to wildfire by choosing to live in wildfire-prone areas.[43]

[43] National Wildland/Urban Interface Fire Protection Program, *Fire protection in the Wildland/Urban Interface: Everyone's responsibility*,

Private development in Lake 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 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.

Figure WF-6 Development and the WUI: Land Developed with Residences

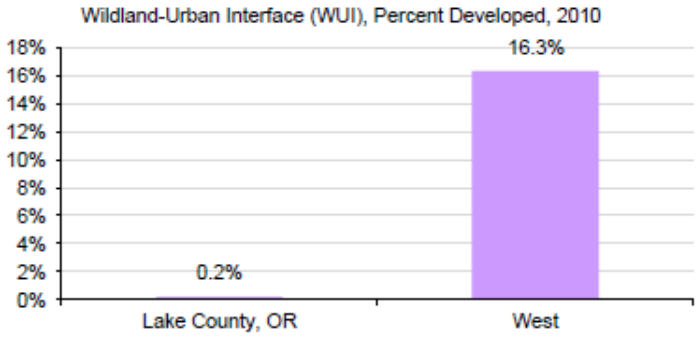
- Between 2000 and 2010, Lake County, OR had the largest percent change in residential land area developed (79.7%), and the U.S. had the smallest (12.3%).



Source: BLM Summary Profile, *Lake County, OR*, 1/15/20

Figure WF-7 Development and the WUI: WUI Percent Developed

- In 2010, the west had the largest proportion of the wildland-urban interface that is developed (16.3%), and Lake County, OR had the smallest (0.2%).



Source: BLM Summary Profile, *Lake County, OR*, 1/15/20

http://www.geosci.sfsu.edu/Geosciences/classes/e360/OaklandHillsFire/www.firewise.org/pubs/everyones_resp/pdf/resp.pdf

Drought

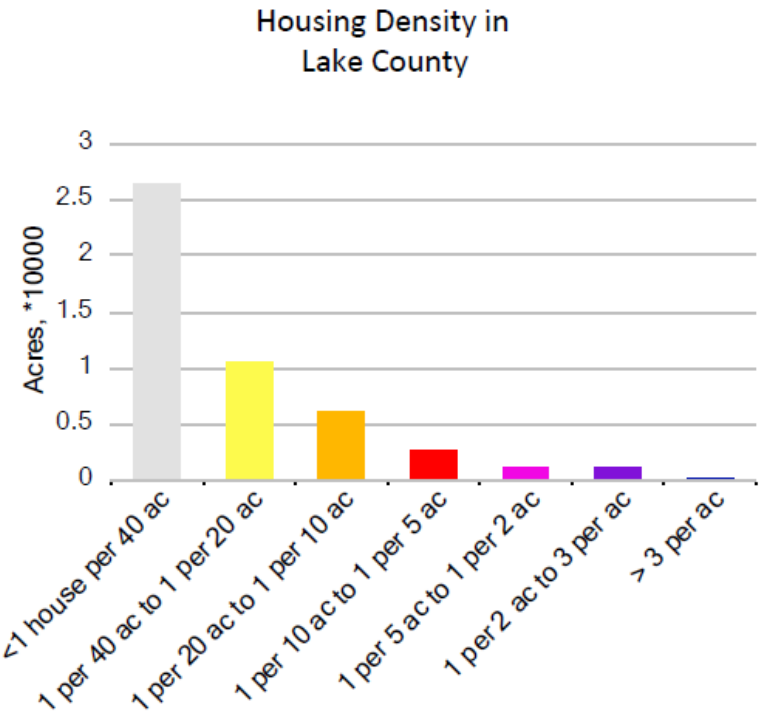
Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. Unusually dry winters and hot summers increase the likelihood of a wildfire event, and place importance on mitigating the impacts of wildfire before an event takes place.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

City Specific Damage

Town of Lakeview and City of Paisley

In the *2011 Lake County CWPP* the following communities were issued hazard ratings for wildfire: Adel, Ana Estates, Christmas Valley, Drews Reservoir, Fort Rock, Plush, Quartz Mountain/Drews Gap, Alkali Lake, Silver Lake, and Summer Lake. Alkali Lake is rated low hazard and Silver Lake is rated moderate hazard while the other eight communities are rated high hazard. Lakeview is not rated. Lakeview is the largest community in Lake County, and provides the majority of the resources for the entirety of Lake County. WUI areas are outside of urban core areas like Lakeview. WUI areas are major concern, with a close proximity of house and infrastructure to flammable wildland vegetation. Housing density in Lake County is low, with the most housing at the rate of less than one house per acre, as shown in Figure WF-8.

Figure WF-8 Housing Density in Lake County



Source: Oregon Wildfire Risk Explorer, *Lake County Summary Report*, 1/15/20

Existing Hazard Mitigation Activities and Resources

Ordinances

People proposing to construct new buildings in the WUI in Lake County, the Town of Lakeview, and the City of Paisley 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.

Lake County's Planning and Development Department includes planning and building staff. The Town of Lakeview also has planning and building staff while Paisley does not. Information regarding the Lake County and Lakeview's Comprehensive Plans and other information are available at the County office and at Lakeview Town Hall.

- Lake County, https://www.lakecountyor.org/government/land_use_planning.php
- Town of Lakeview, https://www.lakeview-oregon.com/
- City of Paisley, http://www.cityofpaisley.net/

State Natural Hazard Risk Assessment

The risk assessment in the *2015 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 state. https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_5_RAState.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

The *Lake County Emergency Operations Plan* (*EOP*), dated April 2013, is an all-hazard plan that describes how Lake County will organize and respond to emergencies and disasters in the community. It is based on, and is consistent with Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including the Presidential Policy Directive 8, the National Response Framework, and State of Oregon Emergency Operations Plan. The *Lake County EOP* is one component of the County's emergency management program and is designed to be compliant with the National Incident Management System.

The *Lake County EOP* consists of a Basic Plan, Emergency Support Function Annexes that complement the Federal and State Emergency Support Functions, Support Annexes, and Incident Annexes. The *Lake County EOP* provides a framework for coordinated response and recovery activities during an emergency. It describes how agencies and organizations in Lake County will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.[44]

[44] Ecology and Environment, Inc., *Lake County Emergency Operations Plan*, April 2013.

Existing Fire Authorities

The following are the existing fire suppression authorities within Lake 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. The USFS, BLM, USFWS, and ODF are jointly dispatched out of the Lakeview Interagency Fire Center (LIFC). Lake County has two municipal fire departments; City of Paisley and Town of Lakeview. The Rural Fire Districts (RFDs) include Silver Lake, Christmas Valley, Thomas Creek-Westside, New Pine Creek, and Lakeview Rural. The RFD's have both wildland and structural fire authority in their respective districts. For much of the remaining, less populated rangelands, Rangeland Fire Protection Associations (RFPA) provide wildland fire suppression. The High Desert RFPA covers an area from Valley Falls to Silver Lake to the north. Warner Valley RFPA covers the Warner Valley and surrounding area. Additionally, in the northwestern portion of Lake County, Walker Range Forest Patrol Association provides wildland fire protection to private and other public forestlands. [45]

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. Most all areas of Lake Co have a base level of wildland fire protection however only areas covered by RFD's and within the Town of Lakeview and City of Paisley have structural protection.

Lakeview Interagency Fire Center (LIFC)

The LIFC is comprised of the USFS Fremont/Winema National Forest, BLM Lakeview District, USFWS Hart Mountain National Antelope Refuge, and ODF Klamath-Lake forest protection district. The LIFC functions to manage wildland fire and fuels on public and some private lands within the County. These lands include federal land in the Fremont/Winema National Forests, BLM lands, and Oregon state lands. Firefighters are trained to National Wildfire Coordinating Group (NWCG) standards as appropriate. Fulltime and seasonal NWCG crews are available to operate equipment for initial wildfire attach. Extended attack would follow NWCG rules and guidelines.[46]

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

[45] *2011 Lake Harney County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

[46] Ibid.

has a memorandum of agreement with Oregon to provide support to the Rangeland Fire Protection Associations (RFPA).[47]

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.[48] See the descriptions of Rangeland Fire Protection Associations, Oregon Department of Forestry, and the US Forest Service for additional information.

Rangeland Fire Protection Associations (RFPA)

Rangeland Fire Protection Associations (RFPAs) provide wildfire protection of private rangeland within Lake County. 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)[49].

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.[50]

The following RFPAs are active within Lake County[51]:

- High Desert RFPA, and
- Warner Valley RFPA.

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.[52]

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

[48] Ibid.

[49] 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.

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

[51] *2011 Lake Harney County CWPP*, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

[52] 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/.

Rural Fire Districts (RFD)

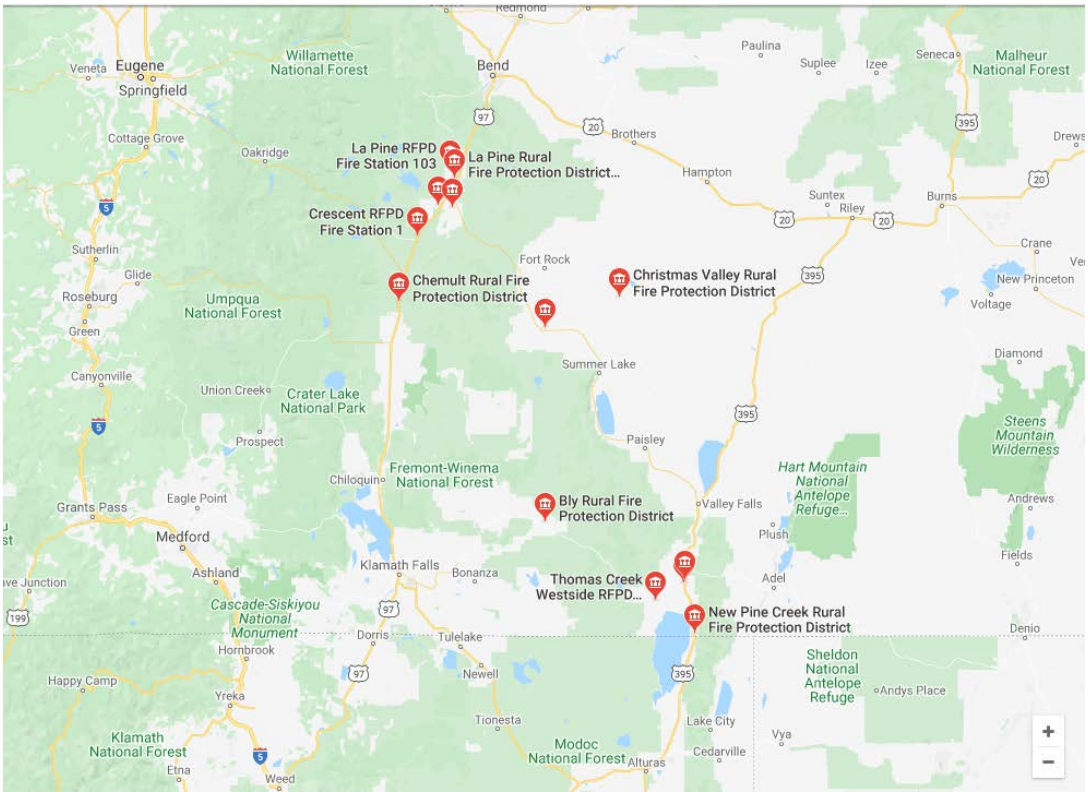
Rural Fire Districts in Oregon are formed under the Oregon State Fire Marshall and provide both structural and wildland fire protection. In Lake County, RFD's can be found mainly in the population centers of Lake County such as Silver Lake, Christmas Valley, and in the Gooselake Basin. The RFD's in Lake County are:

- Lakeview Rural,
- Thomas Creek-Westside Rural,
- New Pine Creek Rural,
- Silver Lake Rural, and
- Christmas Valley Rural.

Rural Fire Districts are dispatched in Lake County through the local 911 dispatch. Each agency has agreements with the State and Federal Wildland Agencies. RFD's are members of the Lake County Fire Defense Board.

Figure WF-9 displays the names and locations of the existing RFDs in Lake County.

Figure WF-9 Rural Fire Districts (RFDs) in Lake County



Source: Lake County, Oregon Rural Fire Protection Districts, https://www.google.com/search?rls=com.microsoft:en-US:IE-SearchBox&q=lake+county,+oregon+rural+fire+protection+districts&npsic=0&rflfq=1&rlha=0&rllag=42616348,-120672751,75694&tbm=lcl&ved=2ahUKEwisvOGMlInnAhXRqp4KHZVuBxMQtgN6BAgLEAQ&tbs=lrf:!1m4!1u2!2m2!2m1!1e1!2m1!1e2!3sIAE,lf:1,lf_ui:2&rldoc=1#rlfi=hd:;si:;mv:[[43.806203,-120.20859209999997],[41.8909498,-121.87472830000001]];tbs:lrf:!1m4!1u2!2m2!2m1!1e1!2m1!1e2!3sIAE,lf:1,lf_ui:2&spf=1579213344438

Oregon Department of Forestry (ODF)

ODF provides wildland fire protection to private and other public forestland within Lake County. ODF is a partner in LIFC and has connection with the RFPAs and agreements with the RFD's.

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 19% of the 73% federally owned land in Lake County.[53] 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[54].

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 *National Cohesive Wildland Fire Management Strategy* that has three key components: Resilient Landscapes, Fire Adapted Communities, and Safe and Effective Wildfire Response.[55]

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

[53] Oregon Wildfire Risk Explorer, *Lake County Summary Report*, 1/15/20

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

[55] Ibid.

Firewise

Related to wildfire risk, Lake County is not now nor has been a part of a formal Firewise program. The Firewise standards are promoted.[56] The County does not have information on about the Community Wildfire Protection Plan on their website.

https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf

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

Lake County Fire Defense Board and Community Wildfire Protection Plan Group

The Lake County Fire Defense board is made up of the fire chiefs for each structural department within the county. The members elect a chair or a chief of the chiefs. Other entities participate on the Fire Defense Board such as ODF, USFS, BLM, RFPA's, and emergency management. Oregon State Fire Marshall (OSFM) provides oversight and guidance to the fire defense board. Information about the fire defense boards can be found on page 24 of this document: https://www.oregon.gov/osp/SFM/docs/2017_MobPlanFinal.pdf.[57]

Members of the CWPP group can change based upon numerous factors. CWPP's can be developed for individual communities or a group of communities, or a county. Dependent upon the scale of the CWPP, participation will be vastly different. However, in each case, there are three mandatory decision makers: Local government, local fire department(s), and local state forestry.[58]

If the scale of the CWPP is at a community level, the three entities would be ODF, City government, and City Fire department. For Lake County, since the CWPP is at a county level as of current, the three entities are the County Commissioners, ODF, and the Fire Defense Board Chief. More information about CWPP's can be found at this link: https://www.oregon.gov/ODF/Fire/Pages/CWPP.aspx and the 2011 Lake County CWPP here: https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf.[59]

Both the Fire Defense Board and the CWPP Group have core participants, though the participants can fluctuate.

[56] Dustin Gustaveson, ODF, personal communication, 1/16/20.

[57] Dustin Gustaveson, ODF, personal communication 10/19/18 and 1/21/20.

[58] Ibid.

[59] Ibid.

Future Changing Conditions/ Climate Change

In the *2020 Lake County NHMP*, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Lake County. In the order of appearance in the NHMP: the Risk Assessment, the Hazards Annexes, and Appendix F contain this information. Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.*

Wildfire Mitigation Actions

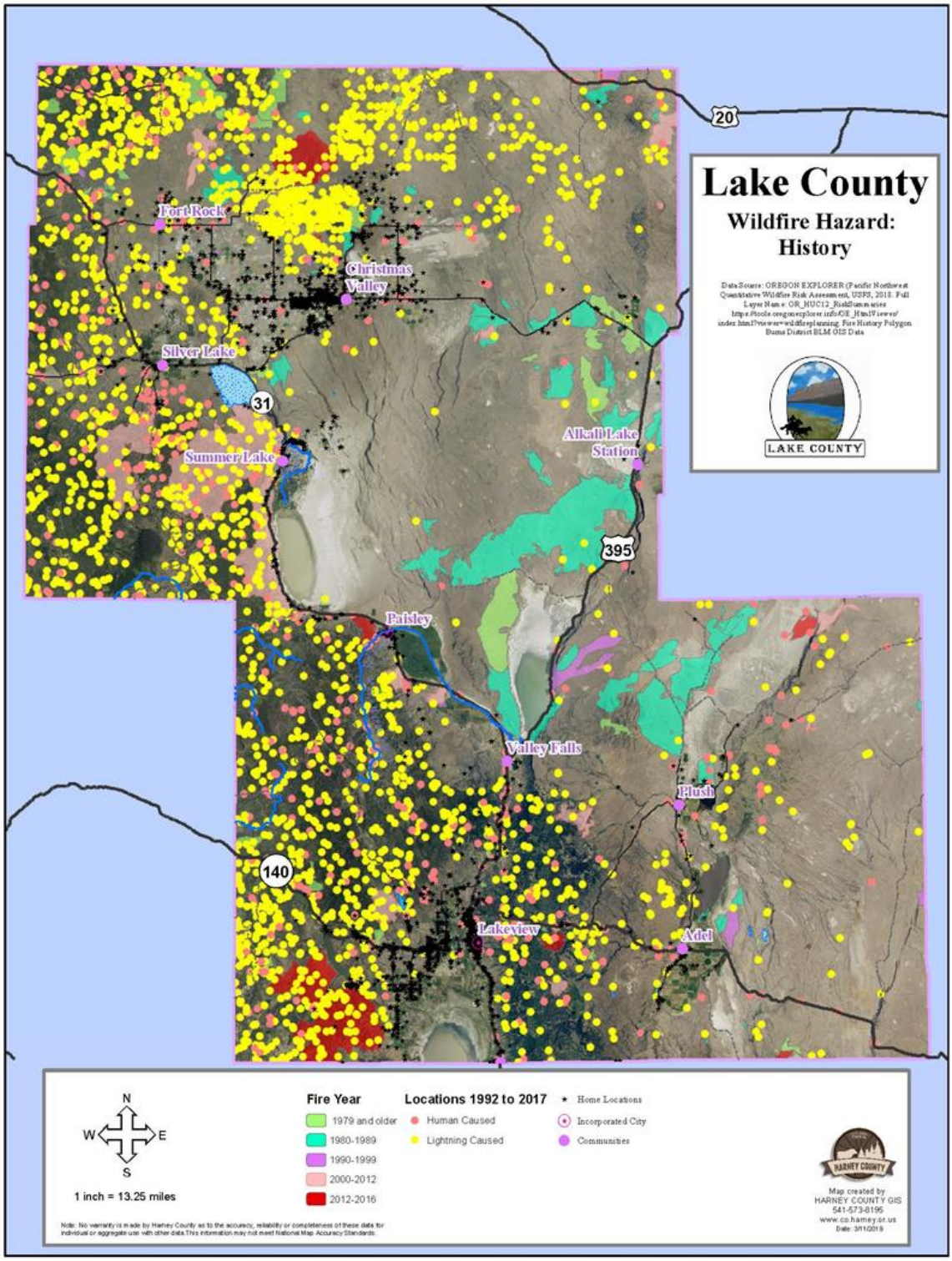
The wildfire mitigation actions have been identified by the Lake County NHMP Steering Committee which includes the Town of Lakeview and the City of Paisley. See Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview and the mitigation action forms in Appendix A for a more detailed description of the mitigation actions in this NHMP. These mitigation actions are separate from the mitigation actions in the 2011 *Lake County CWPP*. Together, the mitigation actions from these two plans form a strong approach to risk reduction of wildfire in Lake County.

In discussion with the Emergency Services Coordinator 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 2-5 in Section 2 Risk Assessment.

In the NHMP, there are eight wildfire specific mitigation actions. The mitigation actions have a high-medium priority because the HVA resulted in wildfires having a high-medium risk level.

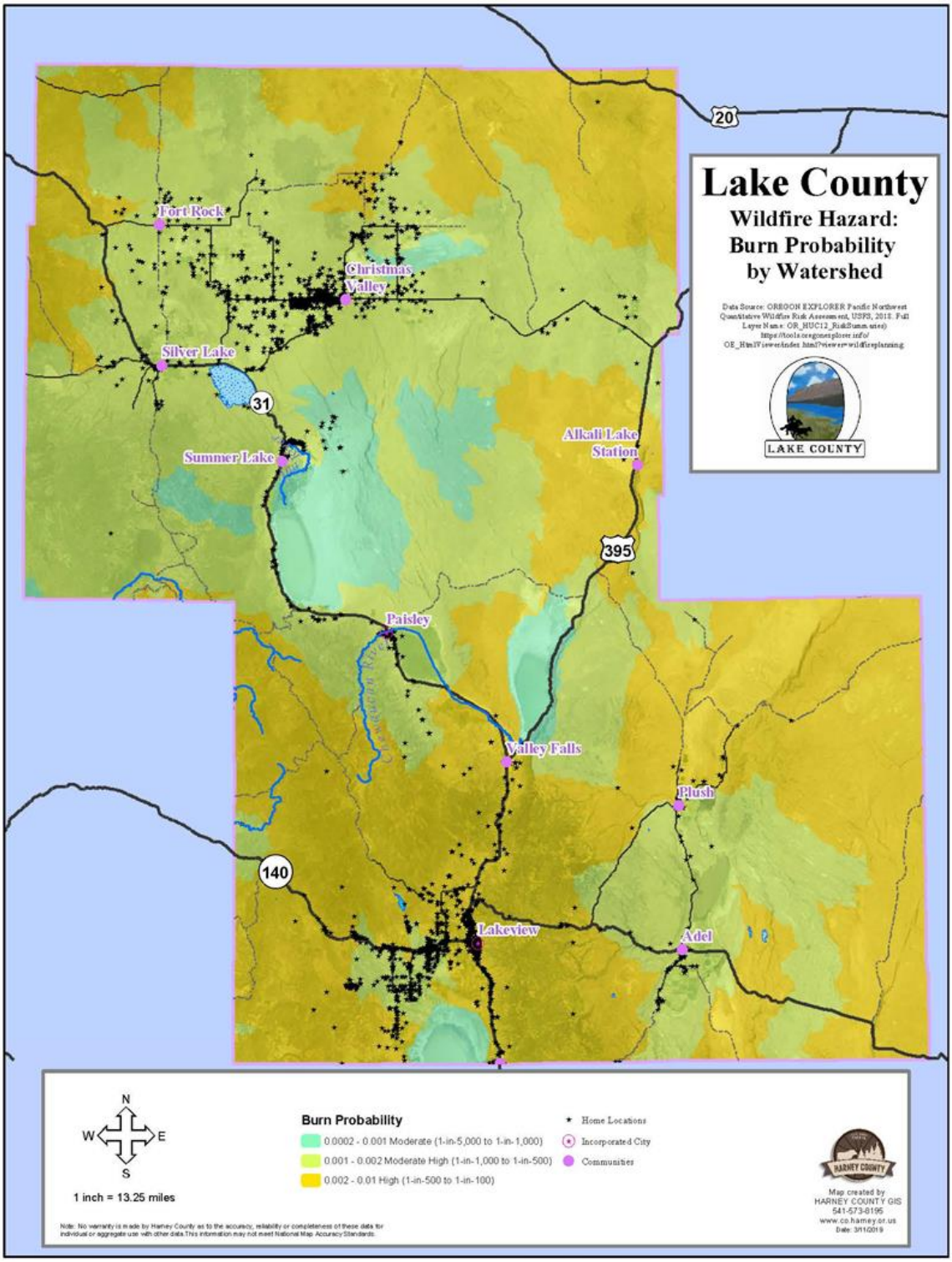
There are thirteen multi-hazard mitigation actions for the NHMP and several of those include wildfire related mitigation actions, in conjunction with the other hazards. The multi-hazard mitigation actions are a high priority.

WF-10 Wildfire Hazard: History



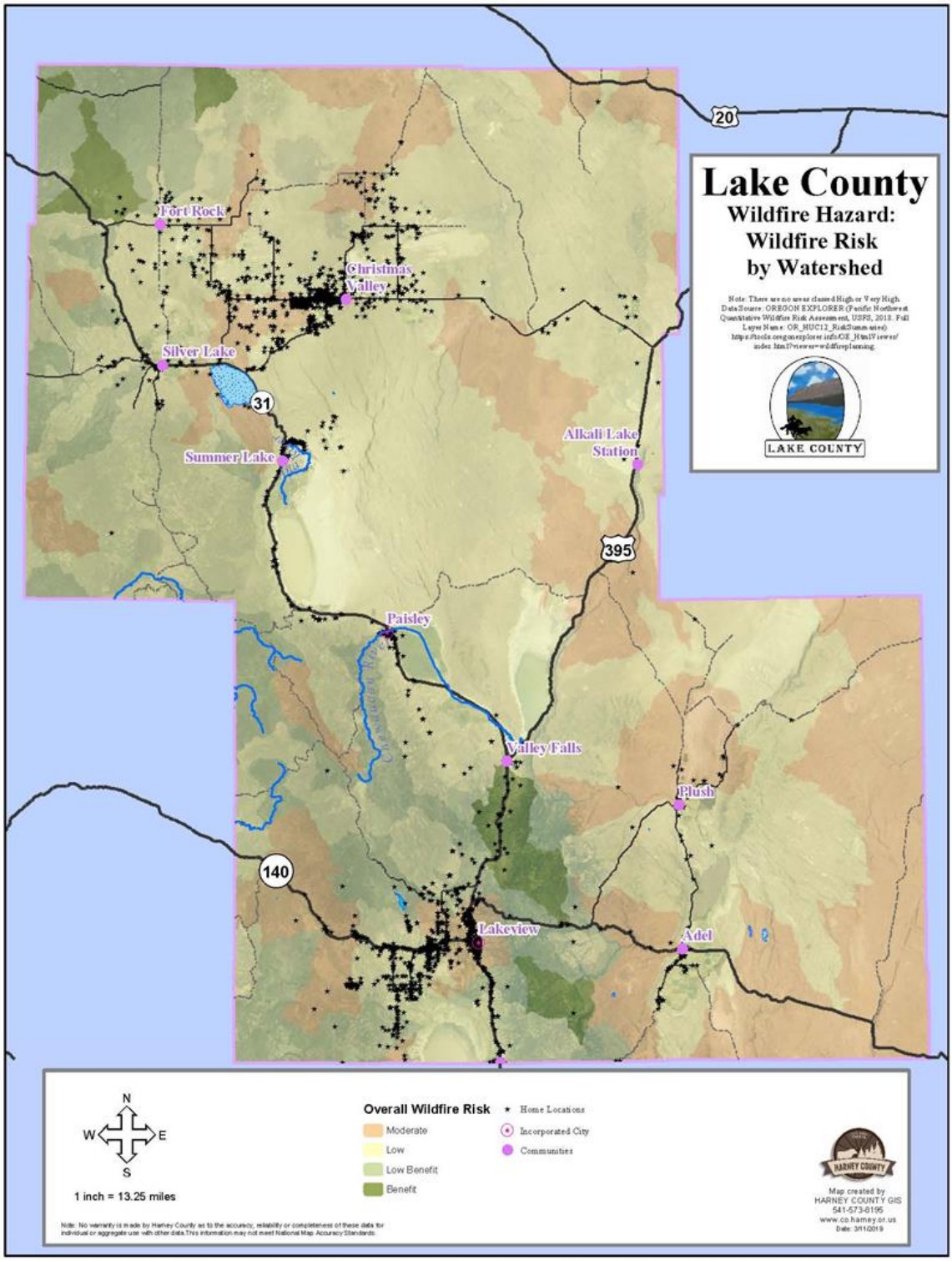
Source: Bryce Mertz, Harney County, March 11, 2019

Figure WF-11 Wildfire Hazard: Burn Probability by Watershed



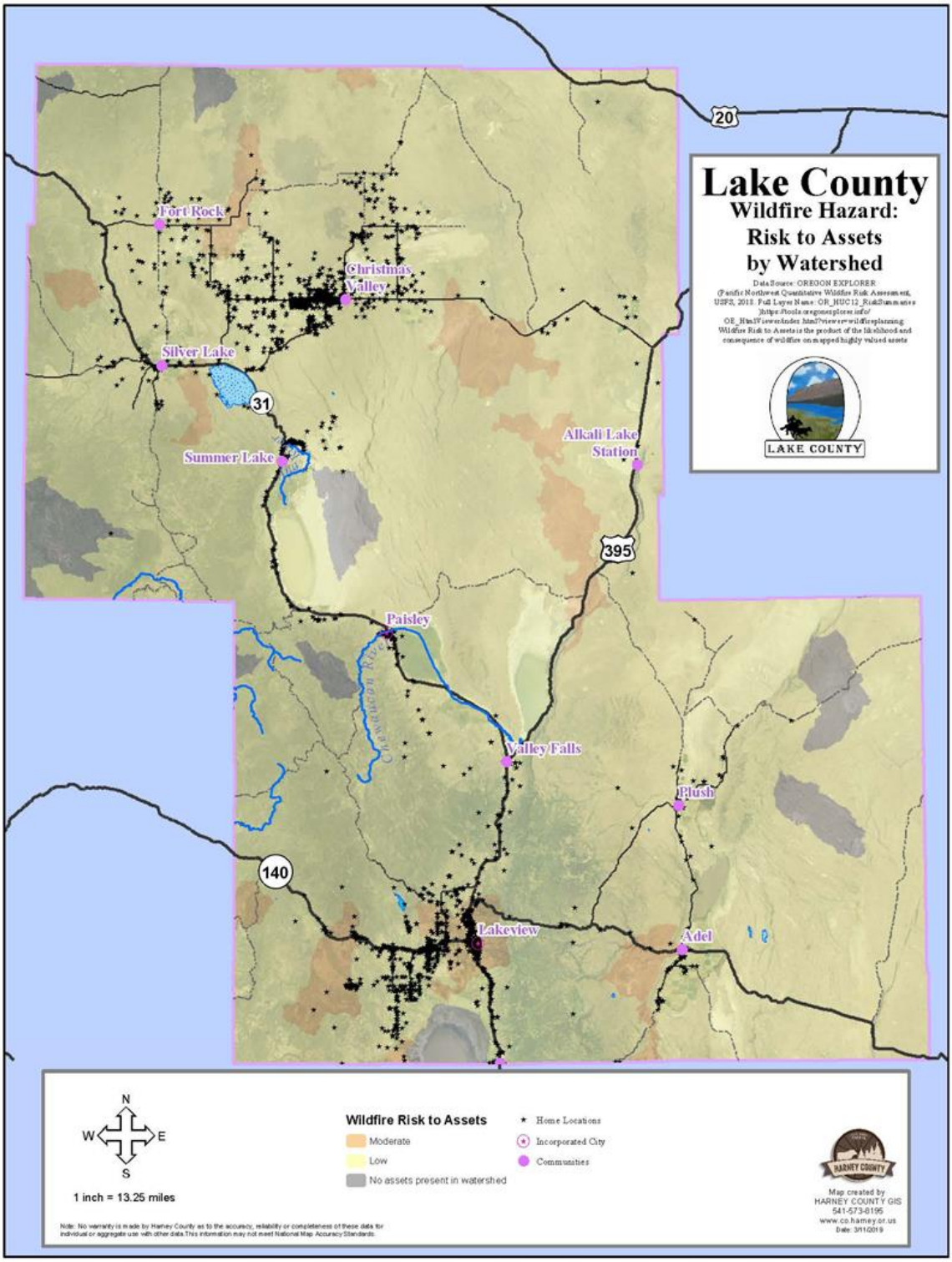
Source: Bryce Mertz, Harney County, March 11, 2019

Figure WF-12 Wildfire Hazard: Wildfire Risk by Watershed



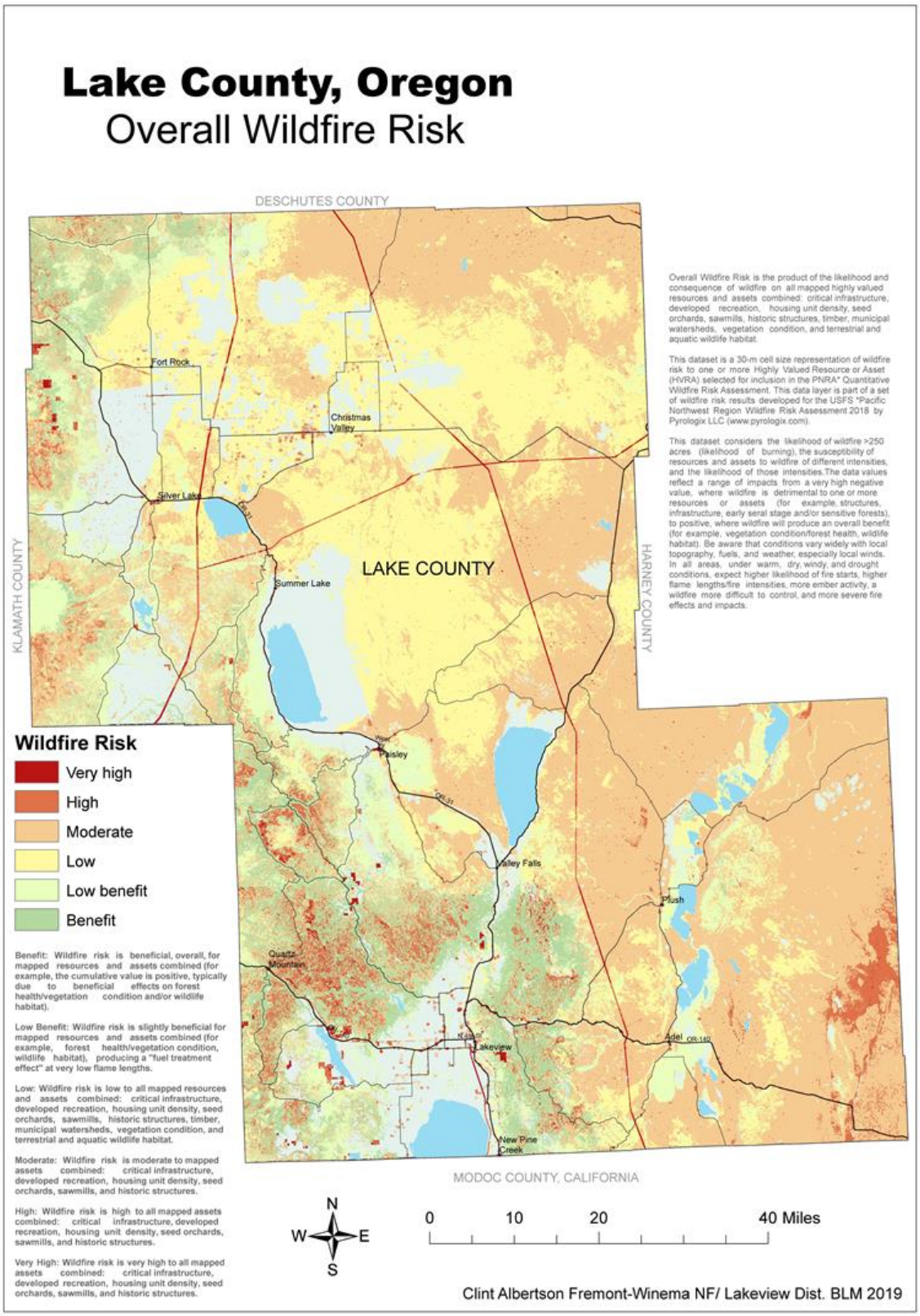
Source: Bryce Mertz, Harney County, March 11, 2019

WF-13 Wildfire Hazard: Risk to Assets by Watershed



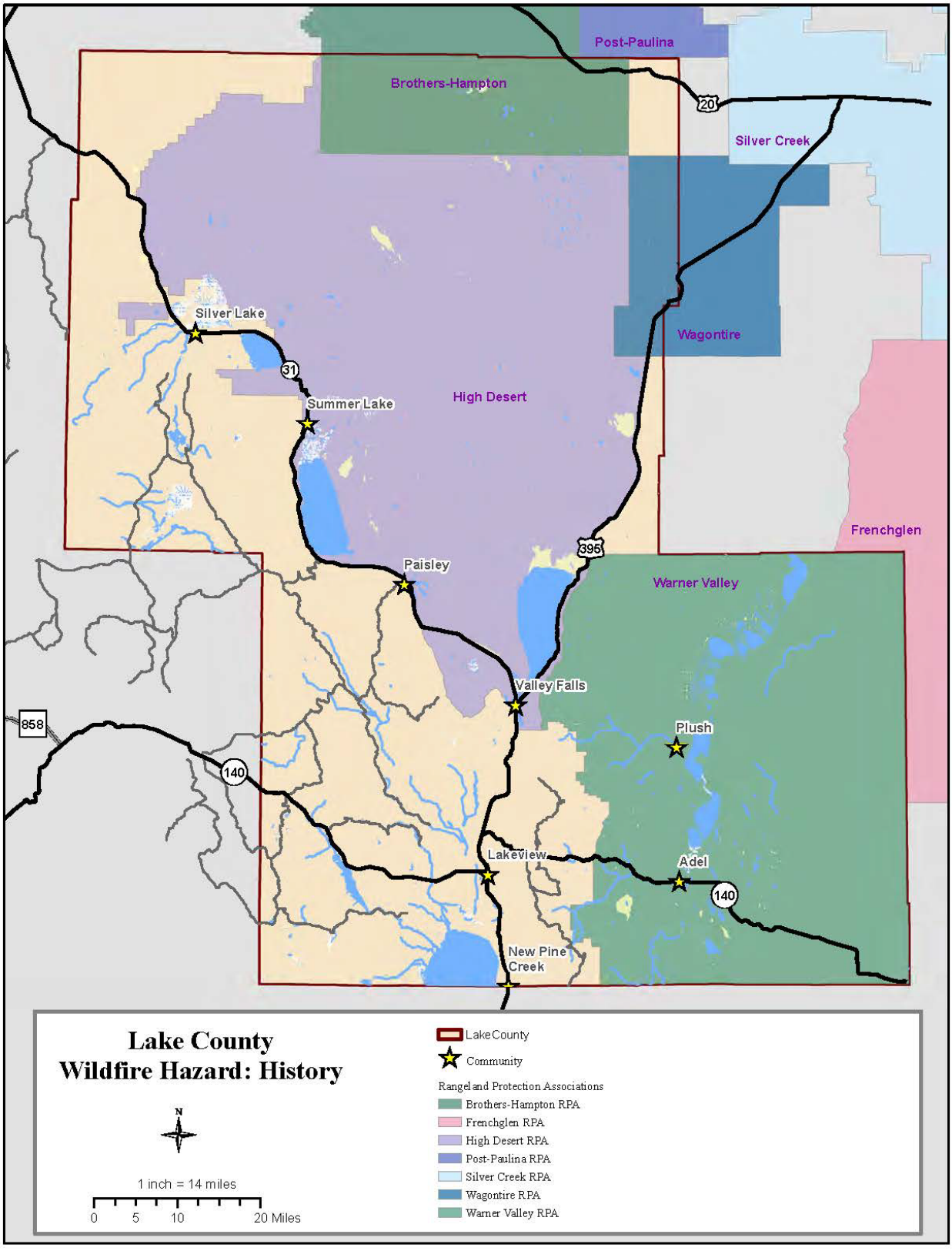
Source: Bryce Mertz, Harney County, March 11, 2019

WF-14 Lake County Overall Wildfire Risk



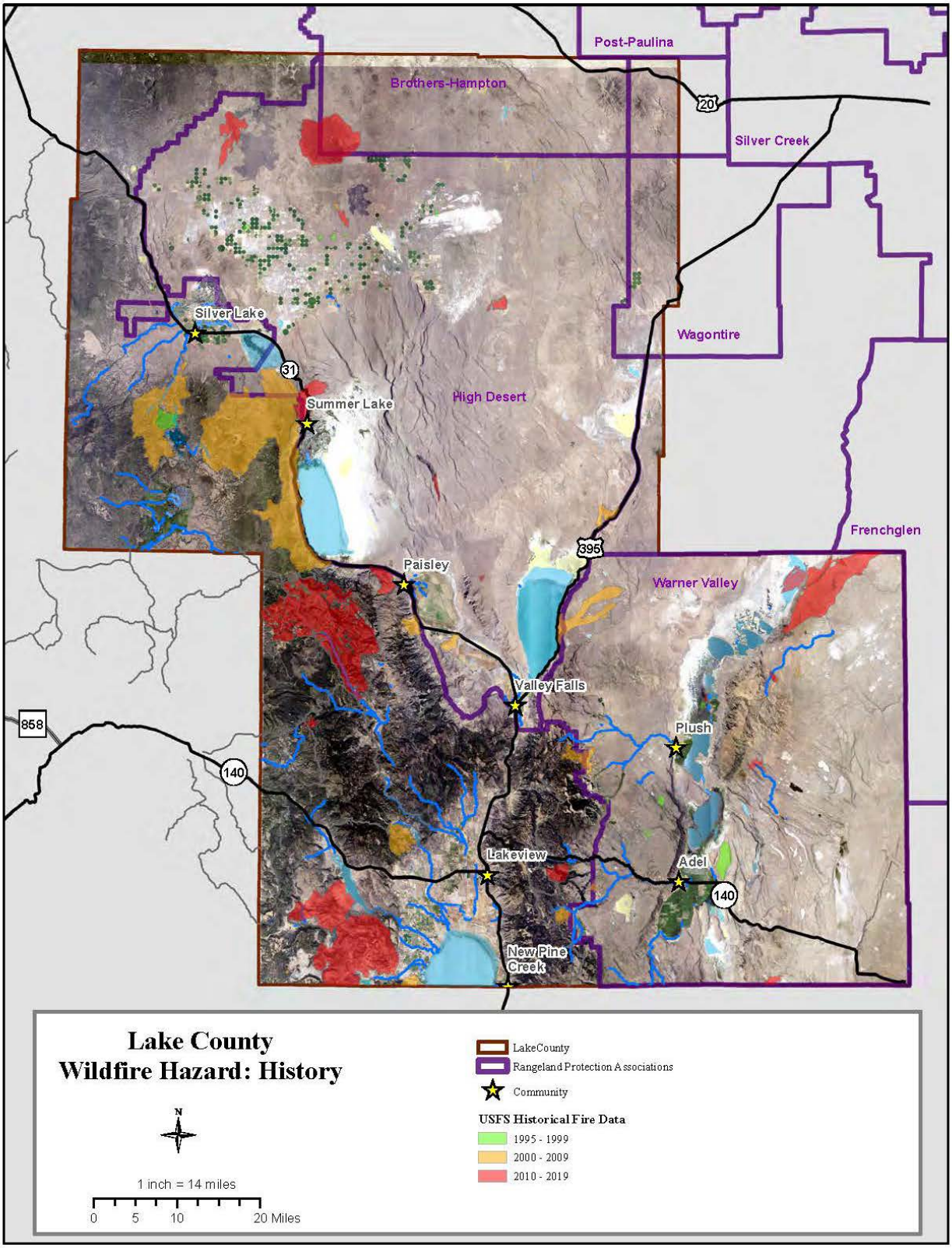
Source: Clint Albertson, Bureau of Land Management Fremont-Winema National Forest, Lakeview District, personal communication, 2/3/19

WF-15 Lake County Rural Fire Protection Associations (RFPAs)



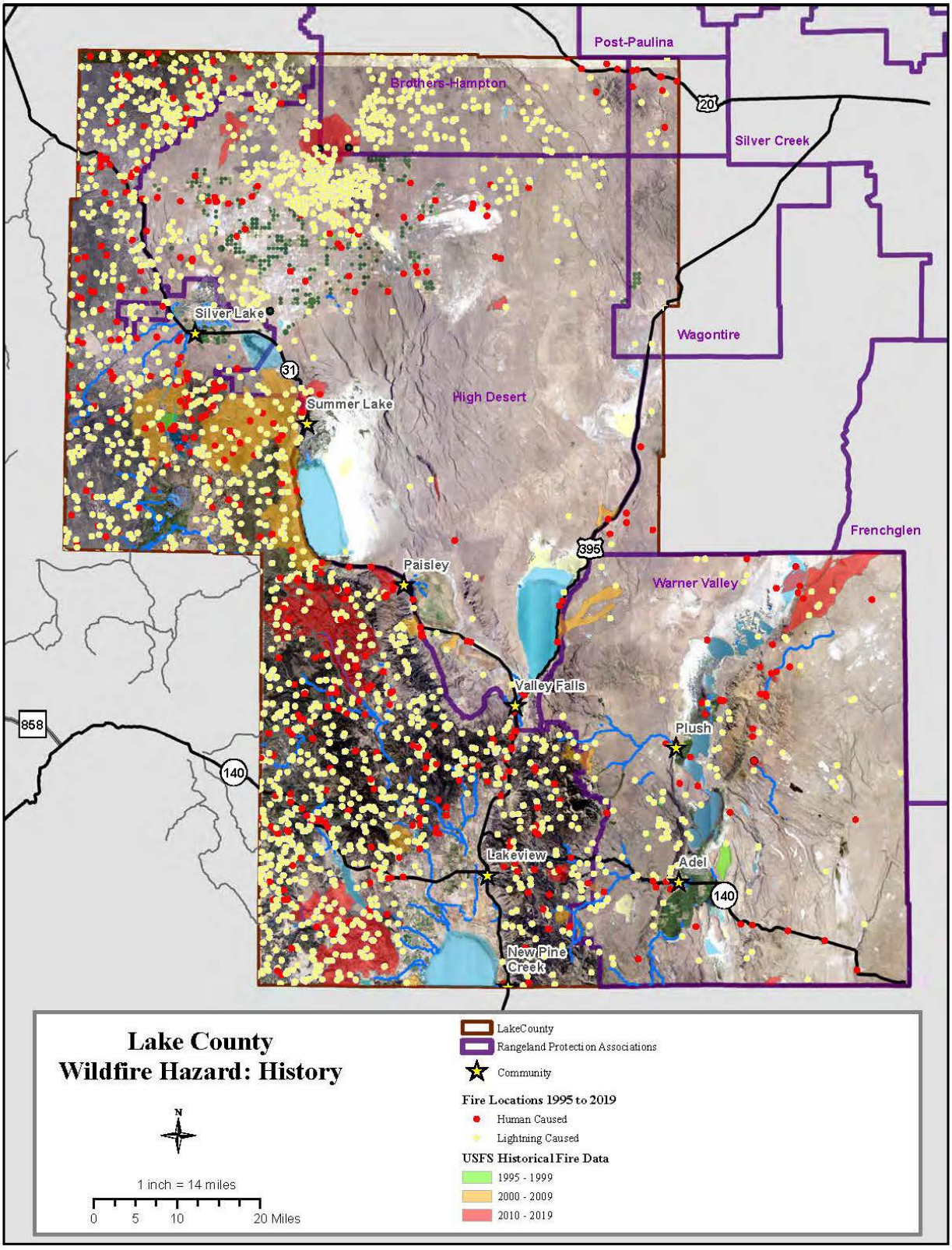
Source: Dacey Mercer and Clint Albertson, USFS in Lake County, personal communication, 3/18/20

WF-16 Lake County Rural Fire Protection Associations (RFPAs) with Aerial Photo



Source: Dacey Mercer and Clint Albertson, USFS in Lake County, personal communication, 3/18/20

Figure WF-17 Lake County Rural Fire Protection Associations (RFPAs) with Aerial Photo and Fire Location with Fire Cause



Source: Dacey Mercer and Clint Albertson, USFS in Lake County, personal communication, 3/18/20

WIND STORMS AND WINTER STORMS HAZARD ANNEX

Wind Storm Risk Score: 193

Wind Storm Risk Level: High-Medium

Winter Storm Risk Score: 236

Winter Storm Risk Level: High

Causes and Characteristics of Wind Storms and Winter Storms

The purpose of this annex is to describe the natural hazards of wind storms and winter storms; provide their hazards history; identify probability and vulnerability, and list the risk score and risk level for each hazard. Climate data is included. The Lake County 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 wind storms and winter storms. These weather related hazards have significant impacts on the County and Cities.

Wind storms ranked fifth out of the nine natural hazards that the Lake County NHMP Steering Committee identified and ranked in the HVA for the *2020 Lake County NHMP*.

Winter storms ranked second, tying with floods, out of the nine natural hazards that the Lake County NHMP Steering Committee identified and ranked in the HVA for the *2020 Lake County NHMP*.

Wind Storms

Extreme winds occur throughout Oregon. 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.[2] 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.[3]

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.

[1] OPDR, *2012 Oregon NHMP*, https://oregonexplorer.info/content/oregon-natural-hazard-mitigation-plan-2012.

[2] *2013 Lake County NHMP*, link not available.

[3] Statesman Journal, February 8, 2002.

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 October.[4] Central and Eastern Oregon's relatively low population may cause many tornadoes to go unreported.[5]

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.[6] Lake County is known for cold, snowy winters. Relative to western Oregon, Lake County receives a large amount of annual snowfall. This is advantageous in at least one respect: in general, the region is prepared, and those visiting the region during the winter, usually come prepared. However, there are occasions when preparation cannot meet the challenge.

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.[7]

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 Lake County [8]

Climate Data for Lake 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. Lake County is in Climate Divisions 5 and 7 as seen in Figure WWS-1.

4Taylor, George H., Holly Bohman, and Luke Foster, August 1996, *A History of Tornadoes in Oregon*, Oregon Climate Service. Corvallis, OR: Oregon State University.

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

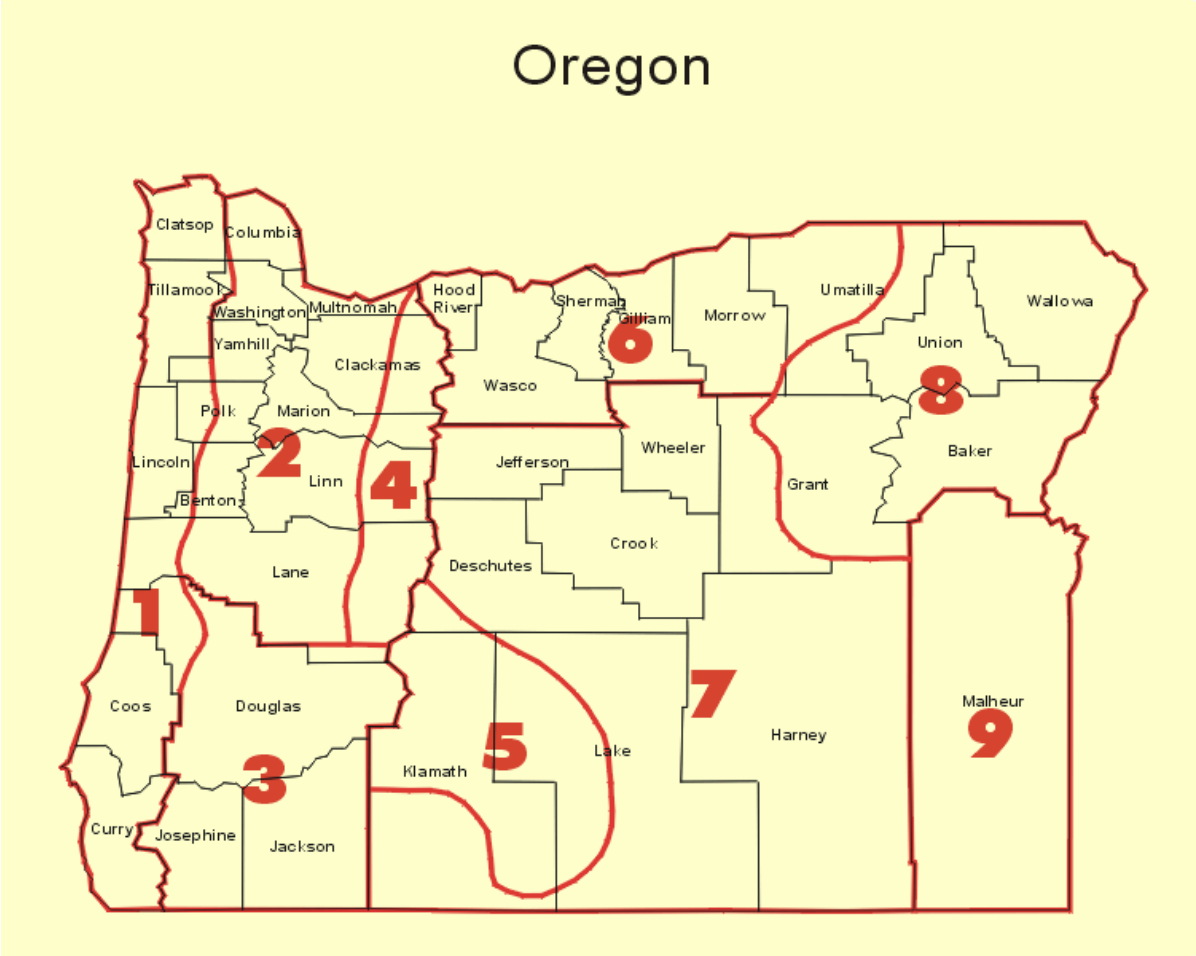
[6] OPDR, *2012 Oregon NHMP*, https://oregonexplorer.info/content/oregon-natural-hazard-mitigation-plan-2012.

[7] Ibid.

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

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)[9] which also houses the Oregon Climate Change Research Institute (OCCRI). OCCRI has provided climate change information for the *2020 Lake County NHMP*. In addition to the short description of climate change or future changing conditions in this Annex, see also Volume I Section 2 Risk Assessment and Appendix F for detailed information on climate change as it relates to natural hazards. Appendix C Community Profile also includes climate information for Lake County.

Figure WWS-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 sunshine provides a framework for understanding the climate in Lake County - information for Lakeview and Paisley is included - and how it relates to natural hazards and hazard events. Paisley is approximately 45 miles northwest of Lakeview. These are the two most populated incorporated cities in Lake County. Summer Lake is an unincorporated community approximately 74 miles northwest of Lakeview. Climate information is

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

included to provide climate information for a different location in Lake County. The U.S. Climate Data website is https://www.usclimatedata.com/. According to the website, Tables WWS-1 and 2, and Figure WWS-2 are based on the climate data for Lakeview, OR 97630 - 1981-2010 normals.

Table WWS-1 Lakeview Weather Averages by Month

Climate Lakeview - Oregon °C | °F

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F:	39	42	49	56	65	74
Average low in °F:	21	22	27	31	37	44
Av. precipitation in inch:	1.73	1.54	1.46	1.38	1.42	0.91
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-
Average snowfall in inch:	11	10	6	4	1	0

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F:	85	84	76	63	47	38
Average low in °F:	51	48	41	33	26	20
Av. precipitation in inch:	0.35	0.28	0.67	0.94	1.85	2.2
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-
Average snowfall in inch:	0	0	0	1	9	12

Source: U.S. Climate Data, https://www.usclimatedata.com/climate/lakeview/oregon/united-states/usor0192

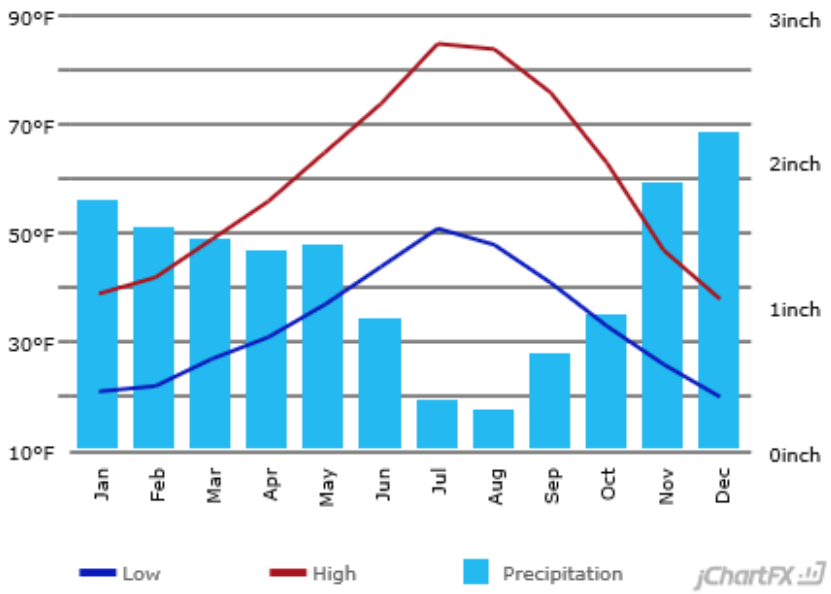
Table WWS-2 Lakeview Weather Averages by Year

Lakeview weather averages

Annual high temperature:	59.8°F
Annual low temperature:	33.4°F
Average temperature:	46.6°F
Average annual precipitation - rainfall:	14.73 inch
Days per year with precipitation - rainfall:	-
Annual hours of sunshine:	-
Av. annual snowfall:	54 inch

Source: U.S. Climate Data, https://www.usclimatedata.com/climate/lakeview/oregon/united-states/usor0192

Figure WWS-2 Lakeview Climate Graph



Source: U.S. Climate Data, https://www.usclimatedata.com/climate/lakeview/oregon/united-states/usor0192

Summer Lake climate data is included here to represent an unincoporated area and in a different area of Lake County. Tables WWS-3 and 4, and Figure WWS-3 are based on the data for Summer Lake, OR 97640 – 1981-2010 normals.

Table WWS-3 Summer Lake Weather Averages by Month

Climate Summer Lake - Oregon °C | °F

	Jan	Feb	Mar	Apr	May	Jun
Average high in °F:	44	47	54	60	69	78
Average low in °F:	25	26	31	34	41	47
Av. precipitation in inch:	1.46	1.26	1.14	1.14	1.3	0.91
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-
Average snowfall in inch:	3	2	1	1	0	0

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F:	88	88	79	66	50	42
Average low in °F:	52	50	43	35	29	24
Av. precipitation in inch:	0.51	0.51	0.55	0.87	1.73	1.93
Days with precipitation:	-	-	-	-	-	-
Hours of sunshine:	-	-	-	-	-	-
Average snowfall in inch:	0	0	0	0	2	4

Source: U.S. Climate Data, https://www.usclimatedata.com/climate/summer-lake/oregon/united-states/usor0334

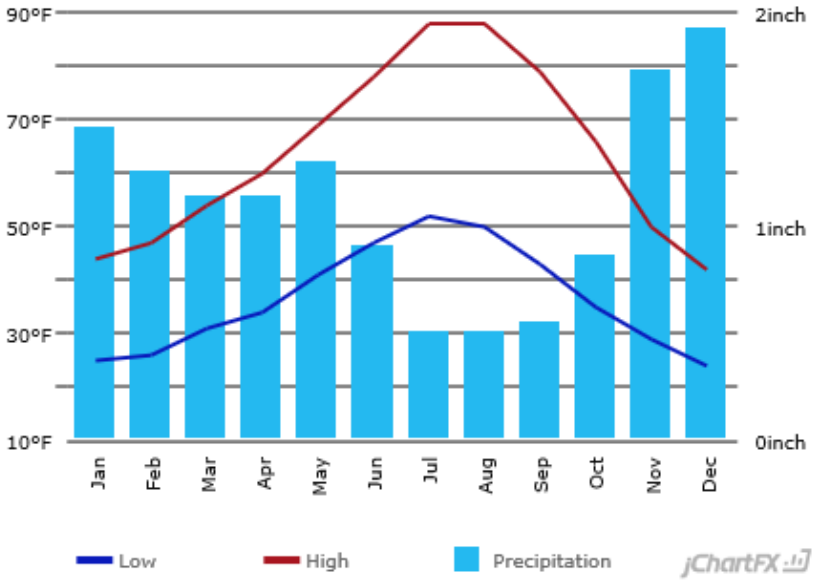
Table WWS-4 Summer Lake Weather Averages by Year

Summer Lake weather averages

Annual high temperature:	63.8°F
Annual low temperature:	36.4°F
Average temperature:	50.1°F
Average annual precipitation - rainfall:	13.31 inch
Days per year with precipitation - rainfall:	-
Annual hours of sunshine:	-
Av. annual snowfall:	13 inch

Source: U.S. Climate Data, https://www.usclimatedata.com/climate/summer-lake/oregon/united-states/usor0334

Figure WWS-3 Summer Lake Climate Graph



Source: U.S. Climate Data, https://www.usclimatedata.com/climate/summer-lake/oregon/united-states/usor0334

History of Wind Storms and Winter Storms in Lake County

All of Lake County is susceptible to severe weather. Table WWS-1 includes a list of wind storms, winter storms, tornadoes, and other natural hazard events that have occurred in Lake County.

Table WWS-4 Significant Wind Storms and Winter 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.

Date	Location	Type of Severe Weather	Description
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.
Sep. or Dec. 1973	Lake County	Tornado	No reported damage.
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.
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.

Date	Location	Type of Severe Weather	Description
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.
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.
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.
Jan. 1993	Lake County	Winter storm	On January 5-22, Lake County was named in the Governor Disaster Declaration due to severe winter storms.
Feb. 1993	W. Oregon	Snow	Record snowfalls.
May 1993	Lake County	Thunderstorms and wind	Thunderstorms moved across Central Oregon accompanied by high winds. On May 12, in Christmas Valley, two barns were blown off their foundations by high winds.
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.
May 1994	Eastern Oregon	Wind storm	Strong winds in Treasure Valley area (Ontario); blowing dust caused car accidents. Event occurred May 15.
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.
Jan. 2000	Lake County	Wind storm	On January 11 there were high winds reported near Lakeview. Minor damages sustained.
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.
Nov. 2001	Lake County	Wind storm	On November 22, there were reported gusts of 74 mph at Summer Lake. Wind Advisory was issued.
Nov. 2001	Lake County	Winter storm	On November 24-25 there was a snow storm. Snow advisory issued; now totals around the warning threshold.

Date	Location	Type of Severe Weather	Description
Dec. 2001	Lake County	Wind storm	On December 1, reported winds of 50 mph near Lakeview; a high wind warning was issued. A blizzard warning may have been more appropriate.
Dec. 2001	Lake County	Wind storm	On December 16 there were high winds reported at Summer Lake, gusting up to 64 mph.
Jan. 2002	Lake County	Wind storm	On January 7 there were reported sustained winds of 30-40 mph with a peak gust of 61 mph.
Feb. 2002	W. Oregon	Winter storm	Damages $6.14 million. Downed power lines and trees. Buildings damaged. Power outages caused some water supply problems.
Dec. 2002	Klamath Basin, Lake County	Wind storms	On December 13 there were recorded winds of 44-54 mph at Klamath Falls. High wind warning issued for south central Oregon zones.
Dec. 2002	Lake County	Wind storm	On December 30 there were high winds reported at Summer Lake of 50 mph gusting to 83 mph. high wind warning issued.
Mar. 2003	Lake County	Wind storm	On March 13 there was a high wind warning issued for Oregon zones in Lake County.
Dec. 2003	Lake County	Winter storm	On December 28-29 there was a snow storm. A winter storm warning was issued, an observer noted a 24 hour snow total of 15 inches.
Dec. 2003-Jan. 2004	Statewide	Snow and ice	DR-1510. Much of Portland area shut down. Twenty-six counties receive FEMA assistance. Lake County was included.
Feb. 2004	Lake County	Winter storm	On February 3 there was a snow storm with heavy snow waring. Summer Lake reported an 11 hour snow accumulation of 6 inches. Storm resulted in presidentially declared disaster.
Winter 2003-2004	Lake County	Winter storm	Severe winter storms and public disaster assistance declaration.
Jun 2004	Lake County	Dust storms	Blowing dust from a dry lake bed filled the sky in and near Summer Lake.
Oct. 2004	Lake County	Winter storm	6 inches of snow fell in 24 hours over Lake County.
Aug. 2005	Christmas Valley, OR	Tornado	No reported damage. This occurred on August 21.
Sep. 2005	Statewide	Evacuation	EM 3228. On September 7, there was a declaration for the Hurricane Katrina evacuation.
Jan. 2005	Lake County	Winter storm	A winter storm warning was issued; Summer Lake recorded 6 inches of snow in 8 hours.
Jan. 2006	Lake County	Wind storm	On January 13 there were high winds reported near Summer Lake.
Apr. 2006	Lake County	Winter storm	On April 14-16 there were no warnings or advisories issued; Lakeview reported 8 inches of snow in 24 hours; Lakeview Airport closed.
May 2006	Statewide	Storms, flooding, landslides, mudslides	DR-1632. Statewide impacts from storms, floods, landslides, and mudslides. The winds ranged from 70-80 mph.
Jun. 2006	Diamond and Wagontire, OR	Hail and Tornado	Hail up to nickel size (7/8/ inch) fell on June 12 in Diamond and a tornado touched down briefly on June 13 in Wagontire.
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.
Jan. 2007	Lake County	Winter storm	There was a snow storm on January 16. Unseasonably cold air masses over Oregon; icy roads blamed for accident that killed 2 people. Most snow totals were 1 to 3 inches.
Feb. 2007	Lake County	Winter storm	Fort Rock reported 13 inches of snow in 24 hours on February 21.
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.
Jan. 2008	Lake County	Winter storm	On January 27 there was a snow storm; Lakeview reported 6 inches of snow.
Jan. 2008	Lake County	Winter storm	On January 31 there were snow advisories issued; Lakeview reported 8 inches of snow.

Date	Location	Type of Severe Weather	Description
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.
Apr. 2009	Lake County	Winter storm	On April 8 there was a snow storm; Lakeview reported 8 inches of snow.
Aug. 2009	Lake County	Wind storm	On August 2 there were thunderstorms reported in Paisley, Summer Lake, and Fort Rock. Numerous afternoon and evening thunderstorms; many of which contained large hail and strong winds.
Nov. 2009	Lake County	Dust storm	An alkaline dust storm blew into Lakeview.
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.
Apr. 2010	Lake County	Winter storm	On April 20 there was a snow storm. An observer noted 5.5 inches of snow in a 9 hour period by Adel.
Nov. 2010	Statewide	Winter storm	Snow, freezing rain, and ice in Portland to Hood River. On November 21, Harney County had 4 in snow.
Dec. 2010	Lake County	Winter storm	On December 17 there was a snow storm.
Dec. 2010	Lake County	Winter storm	On December 28 there was a snow storm. Lake County law enforcement reported 6 inches of snow in a 4 hour period.
Jan. 2011	Statewide	Winter storm	DR-1956. Severe winter storm, flooding, mudslides, landslides, and debris flows.
Feb. 2011	Lake County	Winter storm	On February 15 there was 6 inches of snow at Summer Lake.
Feb. 2011	Lake County	Winter storm	On February 18 there was 12 inches of snow in 12 hours at Silver Lake.
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.
Aug. 2012	Lake County	Wind storm	On August 5 several thunderstorms developed across the Silver Lake area. A few achieved severe status. Estimated gusts of 74 mph.
Dec. 2012	Lake County	Wind storm	On December 12 there was a high wind warning issued for western Lake County and NE Klamath County, but winds were not as strong as expected.
Dec. 2015	Western Oregon	Winter storm	DR-4258. Severe winter storms, straight-line winds, flooding, landslides, and mudslides.
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.

Sources: University of Oregon, Lake County NHMP, May 2013; DLCD, Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017. 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 Lake County usually occur from October to March, and 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 windstorms, while monitoring

storms with weather stations in protected valley locations throughout Oregon.[10] Thunderstorms can bring high winds to Lake County during the warmer months (April to October). Tornadoes are the most violent of windstorms and are occasionally caused by intense local thunderstorms, which are more common during the warm season (April to October).

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 winter storms, is measured by gauging stations. The National Weather Service, Boise Bureau, monitors the stations and provides public warnings on storm, snow, and ice events as appropriate.[11] Table WWS-1, 2, and 4 display average precipitation in the form of rainfall and snowfall for Lakeview and Summer Lake in Lake County.

Hazard Risk Analysis

The Lake County 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 wind and winter storms hazards between the HVA done in 2013 and in 2019:

In 2013, **winter storms** had a risk score of 236 and a rank of first out of nine natural hazards. In the HVA for the *2020 Lake County NHMP*, winter storms had a risk score of 236, tying it with floods, and has a rank of second out of nine natural hazards.

In 2013, **wind storms** had a risk score of 201 and a rank of fourth out of nine natural hazards. In the HVA for the *2020 Lake County NHMP*, wind storms had a risk score of 193 and a rank of fifth out of nine natural hazards.

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

Probability of Future Occurrence

The hazard history section details numerous wind storm and winter storm events affecting Lake County and the Cities since 1861. Some of the report incidents are localized events that do not

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

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

affect large areas of the County or Cities. Specific probability rates have not been calculated for each of these hazards in Lake County.

The Lake County NHMP Steering Committee, during the HVA on April 11, 2018 scored wind storms with a probability of 10 and winter storms with a probability of 10. 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, 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 Central and North Coast of Region 1. See Table WWS-5, 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. The table shows that structures in Lake County, within Region 6, can expect to be exposed to lower wind speeds than most regions within the state.

Table WWS-5 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 the hazards of wind storms and 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 Lake County 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. Tree damage associated with windstorms is very place sensitive. For identifying the hazards posed to structures, Figure WWS-6, Effects of Wind Speed, shows the maximum wind speed that structures 33 feet above the ground would expect to be exposed to; for Lake County that expected wind speed is less than for much of the rest of the state at 85 mph.

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 the 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 WWS-6 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: *2013 Lake County NHMP* cites 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.

According to the *2013 Lake County NHMP*, the recurrence interval for severe winter storms throughout Oregon is about every 13 years; however, there can be many localized storms between these periods. While other storms could have been included with more background information available, those included average out to one winter storm every 2.5 years.

Community Hazard Issues

What is susceptible to damage during a wind storm hazard 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.

City Specific Damage

Town of Lakeview and the City of Paisley

Wind storms occur during the summer and the winter months, coming with cold air or with thunderstorms. Wind storms, as described previously, can inflict a lot of damage.

What is susceptible to damage during a winter storm hazard 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.

In Lake County, 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.

Town of Lakeview and City of Paisley

When Highways 31, 395, and 140 are closed due to ice or other storms, communities like Lakeview, Paisley, Summer Lake, and Christmas Valley are isolated. As has been described, winter storms can damage property and disrupt utilities.

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 *2015 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. https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_5_RAState.pdf

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 *2014 Oregon Structural Special Code* (*OSSC*) (http://ecodes.biz/ecodes_support/free_resources/Oregon/14_Structural/14_ORStructural_main.html) contains provisions for grading and site preparation for the construction of building foundations.

Street/ Road/ Highway Maintenance

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 various 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

The *Lake County Emergency Operations Plan* (*EOP*), dated April 2013, is an all-hazard plan that describes how Lake County will organize and respond to emergencies and disasters in the community. It is based on, and is consistent with Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including the Presidential Policy Directive 8, the National Response Framework, and State of Oregon Emergency Operations Plan. The *Lake County EOP* is one component of the County's emergency management program and is designed to be compliant with the National Incident Management System.

The *Lake County EOP* consists of a Basic Plan, Emergency Support Function Annexes that complement the Federal and State Emergency Support Functions, Support Annexes, and Incident Annexes. The *Lake County EOP* provides a framework for coordinated response and recovery activities during an emergency. It describes how agencies and organizations in Lake County will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.[12]

Future Changing Conditions/ Climate Change

In the Lake County NHMP, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Lake County. In the order of appearance in the NHMP: the Risk Assessment, the Hazards Annexes, and Appendix F contain this information. Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.*

Wind Storms and Winter Storms Mitigation Actions

The wind storms and winter storms mitigation actions (WWS) have been identified by the Lake County NHMP Steering Committee which includes the Town of Lakeview and the City of Paisley. See Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview in the wind and winter storms category and the mitigation action forms in Appendix A for a more detailed description.

There is one WWS specific mitigation actions. The WWS mitigation action has a high priority because the Hazard Vulnerability Assessment (HVA) resulted in winter storms having a high risk level and wind storms having a high-medium risk level.

There are nine multi-hazard mitigation actions for the NHMP and several of those include wind and winter storms related mitigation actions, in conjunction with the other hazards. The multi-hazard mitigation actions are a high priority.

In conversation with the Emergency Manager 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 2-5 in Section 2 Risk Assessment.

[12] Ecology and Environment, Inc., *Lake County Emergency Operations Plan*, April 2013.

Photos from the wind storm in Summer Lake, OR on January 19, 2012. All photos from Daniel Tague, Lake County Emergency Services Coordinator, personal communication, 3/5/20.

Photos from the wind storm in Summer Lake, OR on January 19, 2012. All photos from Daniel Tague, Lake County Emergency Services Coordinator, personal communication, 3/5/20.

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Photos from the wind storm in Summer Lake, OR on January 19, 2012. All photos from Daniel Tague, Lake County Emergency Services Coordinator, personal communication, 3/5/20.

AIR QUALITY HAZARD ANNEX

Risk Score: 240

Risk Level: High

Causes and Characteristics of Air Quality

The hazard of air quality is not a common one for inclusion in Natural Hazards Mitigation Plans. In this updated NHMP, Lake County recognizes the unique situations that factor into identification of air quality as a natural hazard for the area.

Given its valley-like shape, the Town of Lakeview experiences periods of air stagnation and atmospheric temperature inversions that trap pollution.

During these times, the temperature near the ground decreases rapidly toward sunset. As the surface air cools, it flows down the mountain slopes, forming a pool of cold air on the valley floor with the warmer air above acting as a lid. The cooling within this layer typically produces fog, and, as air pollutants are discharged, they become trapped. During stagnant conditions, the fog and trapped air can remain under this "lid" for several days, becoming increasingly polluted and unhealthy.

In the 1990s, 2000, and 2010s, Lakeview experienced poor air quality. In the past, the sources of air pollution in the region included 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 the valley or becomes trapped during inversions. See the Wildfire Hazard Annex for more information about wildfire impacts. Wood stove, industrial, and motor vehicle emissions continue to be a source of air (and other types of) pollution.

In 2014, the Town of Lakeview and Lake County submitted the *Lakeview Area PM Advance Program Action Plan* to DEQ to achieve emission reductions to help the area meet the daily and annual $PM_{2.5}$ standard. A single federal reference method sampler for $PM_{2.5}$ is sited in Lakeview at the corner of Center and M Street. DEQ has monitored at this site since 1991 for PM_{10} and since 2007 for $PM_{2.5}$.[1]

There is one air quality monitor at the North Lake County School; it is owned by the school. There are no air quality monitors in Paisley.[2]

Air quality was included in the *2013 Lake County NHMP*; however, the NHMP did not include an air quality annex. Air quality ranked first out of the nine natural hazards, tying with droughts as both received 240 points out of 240 points in the Hazard Vulnerability Analysis (HVA) that the Lake County NHMP Steering Committee identified for the *2020 Lake County NHMP*.

[1] DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

[2] Peter Brewer, DEQ, personal communication, 12/30/19.

Federal Regulations

The Clean Air Act of 1970 and the U.S. Environmental Protection Agency (EPA) established health-based National Ambient Air Quality Standards (NAAQS) for six air pollutants: carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and lead (Pb). The areas that fail to meet the standards are designated "non-attainment" and are required to develop plans to come into compliance with the standards. Once compliance with the standard is achieved, a maintenance plan is developed to ensure that air quality will not be compromised in the future. Lakeview is not an Air Quality Maintenance Area (AQMA).[3]

Oregon Regulations

The Oregon Department of Environmental Quality (DEQ) is a regulatory agency with the responsibility to protect and enhance the quality of Oregon's environment. DEQ is responsible for providing accurate scientific data concerning the State of Oregon's air quality "to ensure that the state meets the National Ambient Air Quality Standards (NAAQS) as required by the Federal Clean Air Act." [4]

Fine particulate matter ($PM_{2.5}$) is the biggest concern in the Lakeview area due to smoke impacts from woodstoves, fireplaces and other wood burning appliances besides wildfire smoke in the summer. Other sources of $PM_{2.5}$ include open burning, prescribed burning, wildfires, smoke from industrial stacks, and some road dust from vehicle travel.[5]

The Air Quality Index (AQI) provides a review of the health levels over the past year. The information in the *Oregon Air Quality Annual Report: 2017*, published in October 2018, displays the AQI health levels over the past year for all the areas where DEQ and Lane County Regional Air Protection Authority (LRAPA) monitor air quality. The AQI is computed hourly for $PM_{2.5}$ in ug/$m^3$and ozone in parts per million (ppm). A rating of good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy, and hazardous are designated for the AQI number and that provides an air quality rating. EPA provides all states with the AQI equation for national uniformity. DEQ and Lane County Regional Air Protection Authority (LRAPA) report the AQI for cities in Oregon.[6]

[3] Peter Brewer, DEQ, personal communication, 8/5/19.

[4]DEQ, *Air quality home*, retrieved September 1, 2016 from http://www.oregon.gov/DEQ/aq/Pages/default.aspx.

[5] DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

[6] DEQ, *Oregon Air Quality Annual Report: 2017*, https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf.

Table AQ-1 Air Quality Index Ranges and Episode Stages

Air Quality Rating	Air Quality Index (AQI)	$PM_{2.5}$ 24-hour Average ($\mu g/m^3$)	Ozone 8-hour Average (ppm)
GOOD	0 - 50	0.0 - 12.0	0.000 - 0.054
MODERATE	51 - 100	12.1 - 35.4	0.055 - 0.070
UNHEALTHY FOR SENSITIVE GROUPS	101 - 150	35.5 - 55.4	0.071 - 0.085
UNHEALTHY	151 - 200	55.5 - 150.4	0.086 - 0.105
VERY UNHEALTHY	201 - 300	150.5 - 250.4	0.106 - 0.200
HAZARDOUS	>300	>250.5	>0.200

Source: DEQ, *Oregon Air Quality Annual Report: 2017,* https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf.

For 2019, the air pollutants of greatest concern in Oregon are:

- Fine particulate matter (mostly from combustion sources) known as **$PM_{2.5}$** (2.5 micrometers and smaller diameter).
- **Air Toxics -** pollutants that cause or may cause cancer or other serious health effects.
- Ground-level **ozone**, a component of smog.
- **Greenhouse gas** (GHG) emissions and global climate change are also concerns in Oregon. Oregon state agencies track GHG emissions from a wide variety of products, services, utilities, and fuel providers. These emissions data are available on DEQ's web site under Air Quality/ AQ Programs / Greenhouse Gas Reporting Home.[7]

Here is a summary of Oregon's 2017 - 2019 ambient air quality[8]:

- **$PM_{2.5}$** was greatly elevated in 2017 due to widespread wildfire smoke in August and September. The winter time levels were about average. For 2018, air quality levels were much improved as primarily there were fewer wildfire impacts and the winter was milder and with more unstable air which moves wood stove smoke out of the area.

- In 2017 and 2018, some of the **air toxics** such as benzene and acetaldehyde, remain near or above the health benchmarks. Air toxics in the wildfire smoke were greatly elevated in

[7] Peter Brewer, DEQ, personal communication, 1/6/20 and the *Oregon Air Quality Annual Report: 2017*, https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf.

[8] Peter Brewer, DEQ, personal communication, 1/6/20 and the *Oregon Air Quality Annual Report: 2017*, https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf.

impacted areas. Health benchmarks are concentration levels at which, if exposed over a lifetime, an individual's risk of getting cancer is increased by one in a million, or non-cancer health effects could occur.

- In 2017 and 2018, the **ozone** (smog) levels violated the National Ambient Air Quality Standard in most of the communities impacted by wildfire smoke because of ozone precursors in the smoke such as nitrogen dioxide and volatile organic compounds. Actual ozone levels however are unknown due to not having the resources to locate a monitor in the area during the wildfire season. Ordinarily ozone levels are much lower than the National Ambient Air Quality Standard.

- In 2017 and 2018**, Carbon monoxide, nitrogen dioxide, sulfur dioxide** and **PM_{10}** are far below the criteria pollutant federal health standard. These pollutants have been trending mostly downward for most locations over the last ten years.
    -
- In 2019, air quality was improved all over Oregon due to weather patterns and very few wildfires.

Air Quality Pollutants

Oregon DEQ operates the ambient monitoring network for the entire state with the exception of Lane County which is operated by the Lane Regional Air Protection Authority (LRAPA). These air quality monitoring networks measure ambient concentrations of the criteria pollutants - ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, lead. The air quality pollutants are monitored at the locations shown on Figure AQ-1.[9]

Figure AQ-1 Oregon's 2019 Ambient Air Monitoring Network

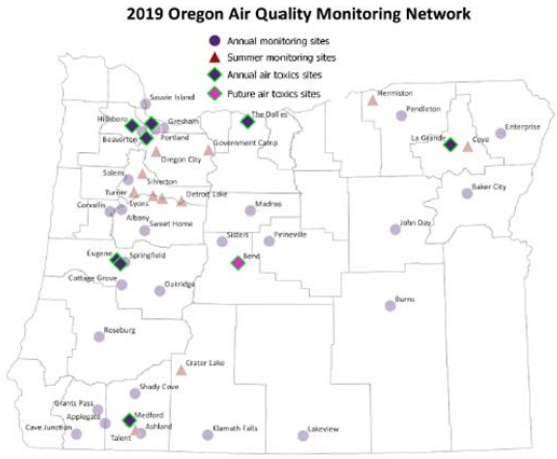


Figure 1. ODEQ and LRAPA Ambient Air Monitoring Network

Source: DEQ, 2019 *Oregon Annual Ambient Criteria Pollutant Air Monitoring Network Plan,* https://www.oregon.gov/deq/FilterDocs/AQmonitoringplan.pdf

[9] DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.* The *Future Climate Projects* report states that "Climate change is expected to result in a longer wildfire season with more frequent wildfires and greater area burned." This will impact air quality.

The Lakeview area nonattainment for the 24-hour $PM_{2.5}$ NAAQS in 2007 because there was not sufficient monitoring information available at the time of the designations. However, in 2013, prolonged winter inversions occurred causing a significant increase in ambient concentrations and caused Lakeview to violate the standard. Since 2013, the $PM_{2.5}$ has decreased. After a challenging year in 2017, Lakeview returned downward trend in $PM_{2.5}$ in 2018. In 2018, the Lakeview area met the daily standard (98th percentile) as shown in Figure AQ-2.

Figure AQ-2 The 2018 PM2.5 Yearly Monitoring Results in Lakeview

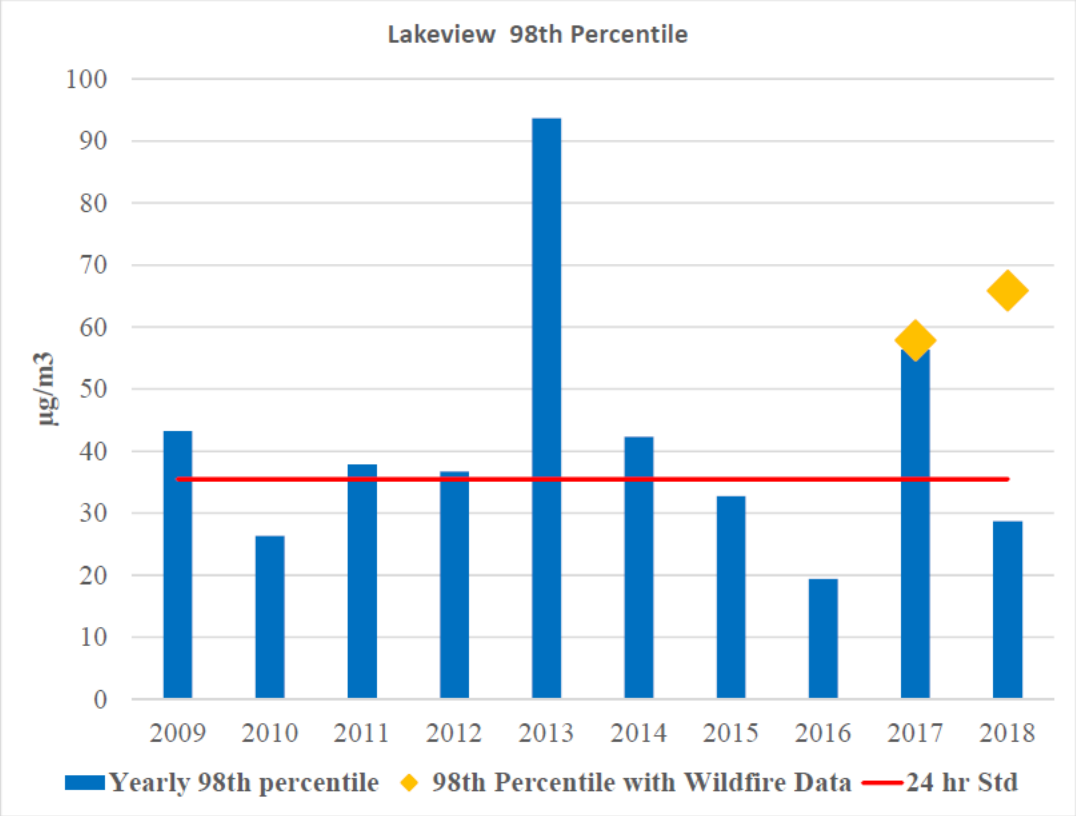


Figure 1: 24-hr 98th percentile concentrations measured at Center and M Street Monitor

Source: DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

Lakeview is currently meeting the standard – a three-year average of 98 percentile 24-hour data – based on the most recent data (2016-2018) at a level of 34.8 ug/m3. Figure AQ-3 shows the three-year averages over the past few years.

Figure AQ-3 The PM2.5 Three-Year Average Monitoring Results in Lakeview (2016-18)

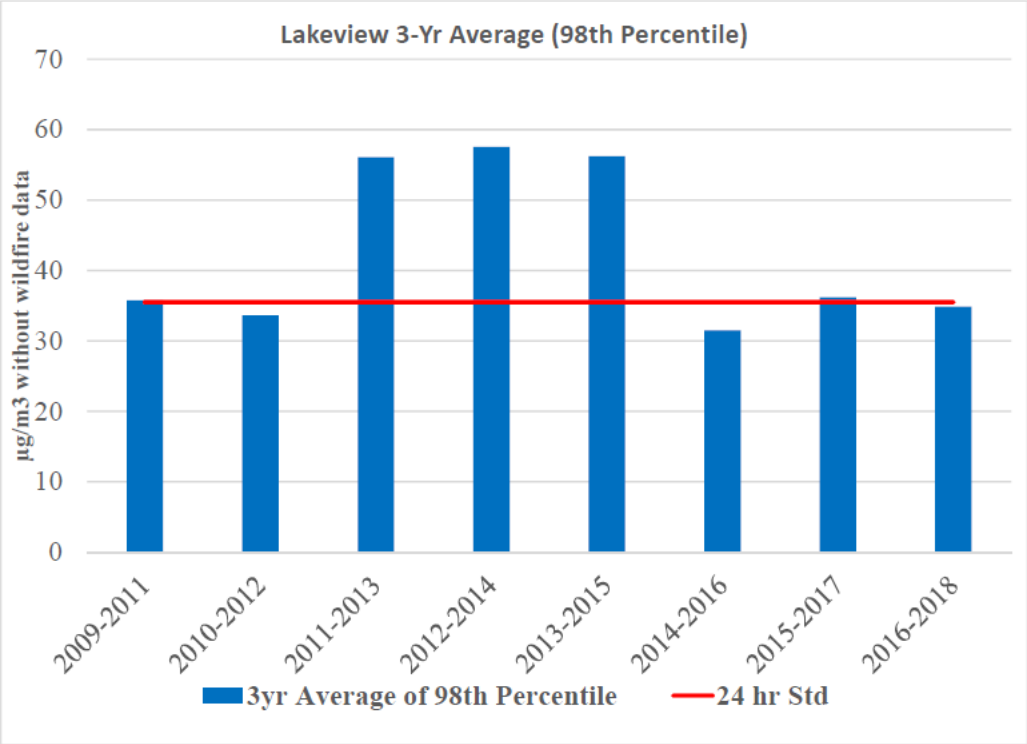


Figure 2: Three Year Average 98th Percentile Concentration Measured at Center and M Street without wildfire impacts.

Source: DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

DEQ looks at air quality pollutant trends for Ozone, $PM_{2.5}$, PM_{10}, carbon monoxide, sulfur dioxide, nitrogen dioxide, air toxics, and greenhouse gases. Each of these trends is described below.

Ozone

DEQ describes that

> "Ozone is a secondary pollutant formed when there are elevated levels of nitrogen dioxide and volatile organic compounds that undergo chemical reactions in high temperatures, and sunlight. In Oregon, elevated ozone occurs in the summer and can be formed by human-caused pollution from fossil fuel combustion and also by naturally caused pollution from wildfire smoke, which contains NO_2 and VOCs. In 2017, most of the state experienced elevated ozone because the wildfire smoke introduced natural precursors on top of the human-caused emissions. With global warming we expect more fires in the Northwest and higher temperature days; this will result in more elevated ozone days."[10]

[10] DEQ, *Oregon Air Quality Annual Report: 2017,* https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf.

DEQ states that "data with wildfire contributions is included because it is very difficult to determine if the ozone would have exceeded the NAAQS without the smoke from wildfires."[11]

DEQ notes that the wildfire smoke in 2017 contributed to the elevated ozone levels most likely caused Portland to violate the NAAQS. However, DEQ also stated that since high ozone occurs in the summer months precisely when wildfire smoke impacts occur, it is very difficult to determine what the ozone level would have been but for the wildfire smoke.

$PM_{2.5}$

Again, within Appendix F, the *Future Climate Projects* report states, "Wildfires are primarily responsible for days when air quality standards for $PM_{2.5}$ are exceeded in western Oregon and parts of eastern Oregon, although wood stove smoke and diesel emissions are also main contributors." The *Future Climate Projects* report further states that with the increasing wildfires and $PM_{2.5}$ levels, there is a greater risk of wildfire smoke exposure through increasing frequency, length, and intensity of smoke waves. Smoke waves are two or more consecutive days with high levels of $PM_{2.5}$ from wildfires. Measuring the number of smoke waves is one way to see the changes of the $PM_{2.5}$ levels.[12]

DEQ describes that wildfire smoke impacts air quality, and that it is useful to understand how much wildfire smoke contributed to particulate levels above the NAAQS standard. DEQ also notes that it is useful to understand how particulate levels in an airshed compare to the NAAQS without the wildfire emissions, because this shows the effectiveness of local air quality improvement in communities with particulate reduction plans.

PM_{10}

The PM_{10} trend chart shows the values in the city with the highest concentration, the average, concentration, and the lowest concentration. All cities are well below the standard, but EPA requires DEQ to continue monitoring in PM_{10} maintenance areas and in cities over 500,000 people.[13] Lakeview has successfully worked with DEQ to manage PM_{10} pollution from the 1990s through the present. In 2014, with the *Lakeview Area PM Advance Program Action Plan* submitted to DEQ, Lakeview and Lake County began implementing strategies to address residential wood heating smoke, put restrictions on open burning, and engage in public education.[14]

Carbon Monoxide, Sulfur Dioxide, Nitrogen Dioxide

The carbon monoxide, sulfur dioxide, and nitrogen dioxide trends for cities in Oregon as compared to the federal standards are measured. These are not a hazard concern for Lakeview or other portions of Lake County at this time.

[11] DEQ, *Oregon Air Quality Annual Report: 2017,* https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf.

[12] OCCRI, *Future Climate Projections: Lake County,* August 2018, https://www.oregon.gov/lcd/CL/Documents/OCCRI_PDM16_LakeCoFutureProjections2018.pdf

[13] DEQ, *Oregon Air Quality Annual Report: 2017,* https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf

[14] Source: DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

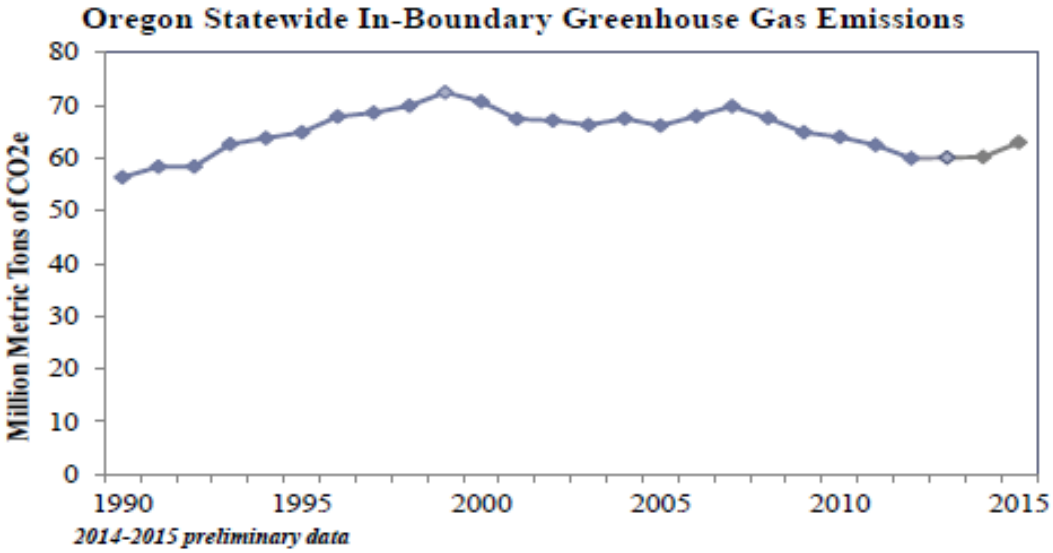
Air Toxics

Oregon DEQ and LRAPA began sampling for air toxics in Oregon in 1999. This section of the *Oregon Air Quality Annual Report: 2017* describes data for the toxics of concern: benzene, acetaldehyde, arsenic, cadmium, lead, and manganese. These are not a hazard concern for Lakeview or other portions of Lake County at this time. Also, the information is for neighborhood monitoring only; it does not include monitoring next to industrial facilities. That information is presented in separate reports issued by the Oregon Health Authority, specific to the monitoring project and facility.[15]

Greenhouse Gases

Information about greenhouse gas emissions in Oregon from 1990 to 2014 are presented on DEQ's website at http://www.oregon.gov/DEQ/AQ/Pages/Greenhouse-Gas-Inventory-Report. Figure AQ-4 shows Oregon's total greenhouse gas emissions from 1990 through 2015. Greenhouse gases and climate change have a relationship that is described in Appendix F.

Figure AQ-4 Oregon Statewide Total Greenhouse Gas Emissions 1990-2015



Source: DEQ, *Oregon Air Quality Annual Report: 2017,* https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf

Wood stove emissions from residential wood combustion are still prominent, but emissions seems to be on a downward trajectory compared to the original emissions inventory estimates. Significant improvements to air quality continue to be implemented since the original emission estimates were made for 2011 and 2019. They include implementation of the mandatory woodstove curtailment program and the ongoing uncertified woodstove replacement program. [16]The difference between

[15] DEQ, *Oregon Air Quality Annual Report: 2017,* https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf

[16] DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

the predicated 2019 emission inventory in the original plan and current estimates is shown in Table AQ-2.

Table AQ-2 Emission Inventory Projection for 2019 Compared to Estimated Actual Emissions in 2017

Source	Original Future Year 2019 lbs/day	Estimated Current Year 2017 lbs/day
Residential Wood Combustion	588	415
Permitted Sources	238	66
Residential Open Burning	24	24
Prescribed Fire	0	0
Fugitive Dust	0.1	8
Other Area Sources	16	9
Nonroad	3	3
Onroad	2	6
Total	871	531

Source: DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

In 2014, with the PM Advance Plan submitted to DEQ, Lakeview and Lake County began implementing strategies to address residential wood heating smoke, put restrictions on open burning, and engage in public education. Each year, the PM Advance Plan is updated. There are eleven "Future Efforts" steps identified in the *Lakeview Area PM Advance Program Action Plan* – Update, October 2019.

Lakeview and Lake County changed their wood burning ordinance in 2015 to a mandatory curtailment program; as a result, considerable reductions have been observed. The Town of Lakeview and Lake County inside the urban growth boundary require residents to curtail their residential wood combustion on red days (high pollution, high health risk days) and curtail their uncertified woodstove use on yellow days (moderate pollution days).[17]

In November 2016, the exemption program that allowed low income and sole source homeowners to burn even on yellow and red days, was no longer offered within the town limits. Residents with sole source of heat or low income were prioritized for the woodstove changeout program to provide them with a new, cleaner heating device. 2019 is the third year of implementing the program without exemptions; local residents are observing the curtailment advisory determinations.[18]

The air quality advisory information is available to the public every day during the wood heating season, which is November 1 – February 28. One part-time Air Quality program staff person, employed by Lakeview, is responsible for providing the advisory calls, educating the public, and conducting patrols to see if there is compliance with the advisory. Implementation and enforcement of the advisory will continue to occur through letters and home visits.[19]

[17] DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

[18] Ibid.

[19] Ibid.

Continued enforcement of the curtailment program, increased public awareness as a result of the program, and better compliance shows the change in public behavior towards addressing wood smoke. The 2018-19 winter heating season had this many advisory calls: 87 green advisory calls, 9 yellow advisory calls, and 2 red advisory calls.[20]

Lakeview has a history of conducting woodstove changeouts by replacing old uncertified stoves with cleaner burning units. In 2014, House Bill 5201, appropriated $750,000 in funding for a regional solutions air quality project in Lake County. Since 2014, the regional solutions air quality project has changed out stoves in 119 homes in additional to weatherizing 21 of those homes in the Lakeview area. Overall: 63 woodstoves and fireplaces were replaced with non-wood heating alternatives such as ductless heat pumps, and 56 woodstoves and fireplaces were replaced with either pellet stoves or very low emitting stoves (less than 1 g/hr).[21]

For those residents who received a very low emitting woodstove or pellet stove they were also required to install a non-wood burning alternative such as a ductless heat pump to heat homes on red days. The homeowner is required to sign a paper stating they will use the alternative to burning on predicted poor air quality days in the winter. Funding for the program ended in December 2017.

For the 2018 year there was no funding available for the changeout of woodstoves, however approximately $20,000 from the past-loan program and related reimbursement for woodstove changeouts has been identified and should be made available to residents for additional woodstove changeouts in 2019-2020.[22] In 2019, Lakeview received a $75,000 grant for wood smoke reduction efforts primarily through the change out of old wood stoves to newer technology.[23]

Lakeview and Lake County established an ordinance prohibiting outdoor open burning that extends to the urban growth boundary limits between November 1 and February 28th of each year. The ban has been effective in controlling open burning in the critical winter months when potential $PM_{2.5}$ exceedances might occur.[24]

Lake County will work in coordination with Lakeview to reach out on education and outreach efforts within the UGB. DEQ has provided funding Lakeview, through an interagency agreement, to conduct ongoing and enhanced education efforts in the Lakeview community about proper use of woodstoves and how to reduce wood smoke. Although difficult to quantify, the enhanced educational efforts include:

- Improved education on burning properly, wood storage, seasoned wood, and types of wood to burn,
- Public education in schools and service groups, and

[20] DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

[21] Ibid.

[22] Ibid.

[23] DEQ, Peter Brewer, personal communication, 1/6/20.

[24] DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

- Installation of reader board (in a high visibility spot) to inform residents of curtailment call.[25]

Daily advisories were available to the public by 11:30AM each day, seven days a week between November 1 and March 1 of the 2018-2019 season. The advisories were available to the public by the following media outlets:

- Local Radio Stations
- Town Website
- Stoplight in the second story window at Town Hall
- Local reader board located in front of the fire hall and the Fairgrounds
- 24-hour hotline
- Email to those who sign up, and
- Facebook.[26]

The advisories were prepared based on information from the National Weather Service, Oregon Department of Forestry forecasts and local knowledge of the weather patterns. DEQ generally will also work through a forecast and be available to Town Staff to call and discuss the advisory determination for that day.

Figure AQ-5 Lakeview Town Hall Advisory Posting

Source: Tricia Sears, DLCD, October 10, 2018

[25] Ibid.

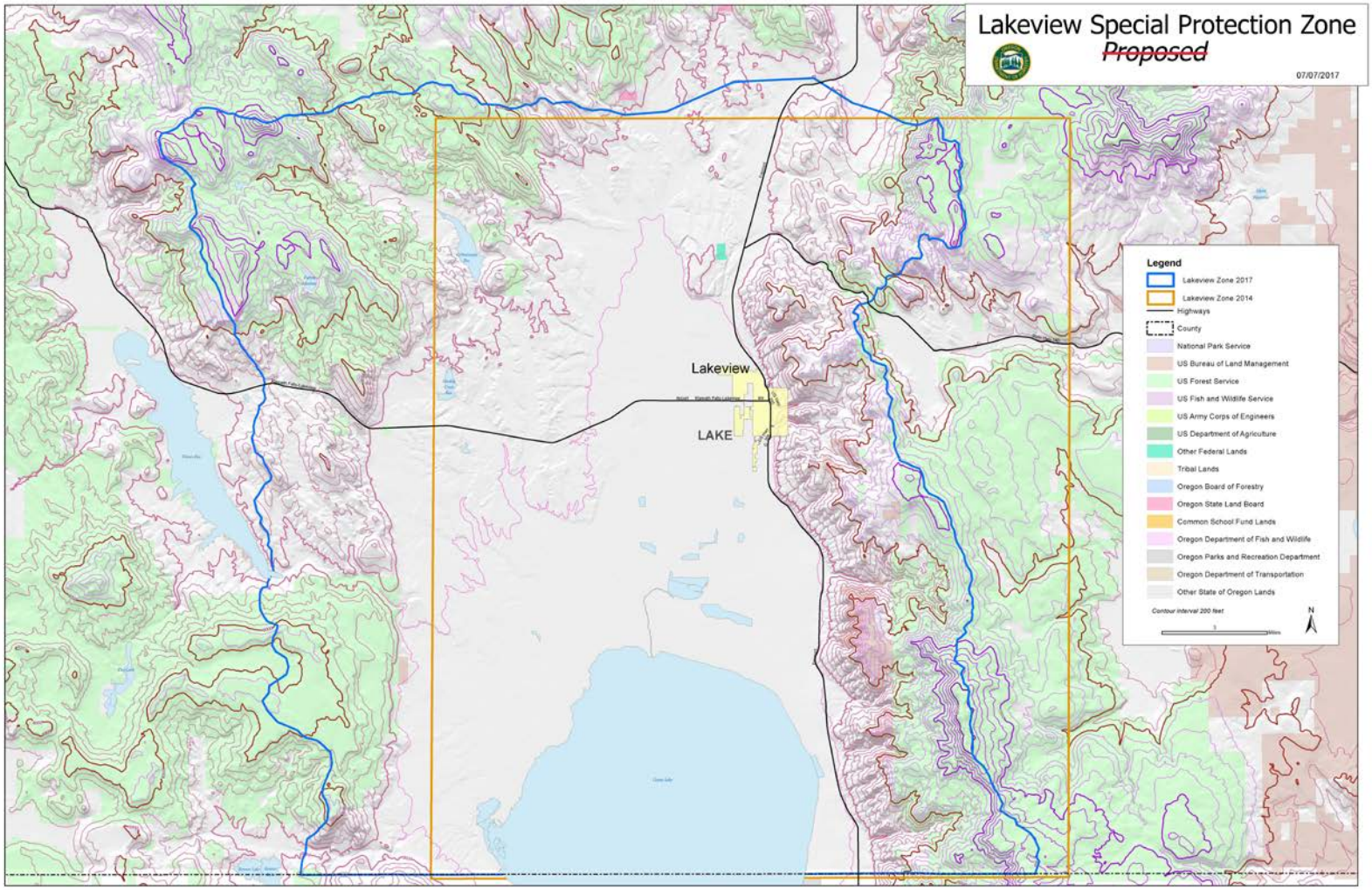
[26] DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

Figure AQ-6 Air Quality Information Announcement in the Lake County Examiner

Source: Tricia Sears, DLCD, October 11, 2018

The U.S. Forest Service continues to maintain its agreement with the Town of Lakeview and Lake County to not burn within the Lakeview Special Protection Zone (LSPZ or Goose Valley airshed) an area surrounding the Town of Lakeview, during poor air quality days. The Collins Pine Company also has a similar agreement. This helps prevent smoke impacts from prescribed burning entering into Lakeview's airshed. The USFS and DEQ along with the Air Quality Committee are reviewing the agreement to renew it, work with the signatories, and gain concurrence this year. Figure AQ-7 is the Lakeview Special Protection Zone map.

Figure AQ-7 Lakeview Special Protection Zone



Source: Peter Brewer, DEQ, personal communication, 5/23/19

History of Air Quality in Lake County

The Steering Committee recognized that wildfires can cause poor air quality and that people and animals can suffer detrimental impacts as a result. Wood stoves also contribute to poor air quality. They determined, after discussion at the April 11, 2018 Steering Committee meeting, that air quality should continue as a natural hazard for Lake County. A list of air quality events in Lake County is included in Table AQ-3.

Table AQ-3 Significant Historic Air Quality Events

Date	Location	Description
1987	Nationwide	In 1987 the national PM_{10} levels were revised to a 24-hour concentration of 150 ug/m3 and an annual concentration of 50 ug/m3.
1993-94	Lakeview Area	The *Lakeview Area PM Advance Program Action Plan Update* for Lake Co notes that PM_{10} used to be monitored in the 1990s in the Lakeview area. PM_{10} monitoring began in Lakeview in 1991 and ended in 2006. $PM_{2.5}$ monitoring began in 2007 and continues to the present.
1996	Lakeview Area	Air quality monitoring continued in 1996 with a PM_{10} sampler for 129 days and has continued to the present. Initially monitoring was conducted during the winter months only to characterize the emissions and PM_{10} concentrations primarily from wood stoves.
1996	Nationwide	In 1996 the national $PM_{2.5}$ 24-hour NAAQS was established at 65 ug/m3, and the annual average NAAQS set at 15 ug/m3. The daily standard is measured by the 98% of official monitoring data collected per year, and averaged over a 3-yr rolling period.
1999	Lakeview Area	The first monitoring for $PM_{2.5}$ in Lakeview in 2000 through 2002, then recommenced in 2007.
2006	Nationwide	In 2006 the national $PM_{2.5}$ 24-hour standard was set at 35 ug/m3.
2006	Lakeview Area	The more recent trend, with a NAAQS of 35 ug/m3, and with wildfire smoke removed (to a level above 15 ug/m3) shows a 24-hr average range from a little above the NAAQS at 37.5 ug/m3 to 22.4 ug/m3, with an average of 28.5 ug/m3. The long term trend has been a slow lowering of the daily exposure to $PM_{2.5}$ (excluding wildfire smoke).
2012	Nationwide	In 2012 the national: the $PM_{2.5}$ annual average NAAQS was reduced to 12 ug/m3.
2012	Lakeview Area	The annual average for the area continues in a similar trend ranging between 8.2 and 11.1 ug/m3, and with a 2018 annual average without forest fire influences of 9.2 ug/m3. This is comfortably below the NAAQS of 12 ug/m3 and in line with many other communities in Central and Eastern Oregon.
2013	Lakeview Area	The Lakeview Area had an Air quality Committee off and on from the 1990's and into the 2000's, resuming again in 2013 when high PM2.5 levels were documented and the area decided to join EPA's PM Advance Program. The committee continues to meet about 8 times per year to address air quality issues and opportunities such as grant applications.
2014	Lakeview Area	In 2014 Lake County submitted a PM Advance Plan to DEQ, with actions to achieve emission reductions to help the area meet the daily and annual $PM_{2.5}$ standard. The Plan is updated every year with an evaluation of the strategies employed and any new strategies to work on in the next year. In 2014 Oregon House Bill 5201 appropriated $750,000 in funding for a regional solutions air quality project in Lake County.
2015	Lake County	Lakeview and Lake County established an ordinance prohibiting outdoor burning that extends to the urban growth boundary limits between November 1 and February 28th of each year.
2019	Lake County	The *Lakeview Area PM Advance Program Action Plan – Update* dated October 2019. In 2019, Lakeview received a $75,000 grant for wood smoke reduction efforts primarily through the change out of old wood stoves to newer technoclogy.

Source: Peter Brewer, DEQ, personal communication, 8/30/19 and 1/6/20; DEQ, *Lakeview Area PM Advance Program Action Plan* – Update, October 2019, obtained from Peter Brewer, DEQ, personal communication 12/30/19.

Risk Assessment

How are Hazards Identified?

The natural hazards that impact the community are identified during the update of the NHMP. See the next section, Hazard Risk Analysis for the *2020 Lake County NHMP* update process that identified air quality as a new natural hazard for the community.

With air quality, there are multiple air pollutants that the federal government requires the state to monitor. As described previously, the air pollutants of $PM_{2.5}$, air toxics, ozone, and greenhouse gases are the most concerning to DEQ in 2019. Other air pollutants that are monitored are carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM_{10}. The Air Quality Index (AQI) is calculated.

The AQI is computed hourly for $PM_{2.5}$ and ozone. A rating of good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy, and hazardous are designated for the AQI number and that provides an air quality rating. See Table AQ-1 which shows the six AQI air quality ratings.

Hazard Risk Analysis

The Lake County NHMP Steering Committee completed a Hazard Vulnerability Assessment/Analysis (HVA) during this NHMP update. The HVA was performed at the April 11, 2018 Lake County NHMP Steering Committee meeting. Air quality was retained as a natural hazard from the *2013 Lake County NHMP*. 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 *2013 Lake County NHMP*, air quality was the second ranked natural hazard. In the *2020 Lake County NHMP*, air quality was ranked first, tying with droughts. Both had a HVA score of 240 points out of 240 points. The risk level is high.

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 mentioned earlier, the Lakeview area can experience air stagnations. Depending upon climate conditions, these stagnations can be infrequent or numerous in any given year, which can have a potential impact to air quality levels for both $PM_{2.5}$ and ozone in the area.[27] Prevailing wind direction and strength can influence the location and extent of the air quality impacts. The probability of air quality at one level or another varies, as air quality is a range based on multiple factors such as those measured for CO, $PM_{2.5}$ and others described in this Air Quality Hazard Annex.

[27] Rachel Sakata, DEQ, personal communication, March 1, 2017.

The sources of air pollution in the region include wood stove, industrial, and motor vehicle emissions. Industry and residential wood stoves emit particulate matter and carbon monoxide. Concerns for air quality arise when smoke from regional wildfires either blows through the valley or becomes trapped during inversions. See the Wildfire Hazard Annex and Section 2 Risk Assessment for more information about wildfire impacts. In addition, climate change has a relationship with natural hazards. For details on the climate change impacts, see Appendix F.

Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.* Information from these two documents is woven throughout the *2020 Lake County NHMP*.

Several key points from the *Future Climate Projections* report are shared here:

- Wildfire risk, as expressed through the frequency of very high fire danger days, is projected to increase under future climate change in Lake County.
- The frequency of very high fire danger days per year is projected to increase on average by about 38% (with a range of -10 to +90%) by the 2050s under the higher emissions scenario compared to the historical baseline.
- With air quality, under future climate change, the risk of wildfire smoke exposure is projected to increase in Lake County.
- In Lake County, there is projected to be four more "smoke wave" days during 2046-2051 under a medium emissions scenario compared with 2004-2009.
- In Lake County, the number of "smoke wave" days is projected to increase by 33% by 2046-2051 under a medium emissions scenario compared with 2004-2009.

With increased wildfire risk, which is described and illustrated in the *Future Climate Projections* report as very high fire danger days per year, the risk of poor air quality, expressed in smoke wave days, is increased too. 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, but over the years there have been more numerous, bigger fires and a wildfire season that extends beyond the past years' typical timeframes. The wood stove, industrial, and motor vehicle emissions can occur during any month of the year.

Vulnerability Assessment

Poor air quality puts the health of all persons at risk. The effects of poor air quality are long-term, chronic, and often difficult to trace. Those persons most at risk tend to be the elderly, very young children, and people with pre-existing respiratory problems. As noted above, according to DEQ, particulate matter in smoke poses a serious air pollution threat to public health.[28]

The increase in wildfires that produce smoke and impact air quality exacerbates people with underlying medical conditions such as, respiratory diseases.[29]

Oregon Smoke Information is a website put together by city, county, tribal, state, and federal agencies to coordinate and aggregate information for Oregon communities that are affected by

[28] Rachel Sakata, DEQ, personal communication, March 1, 2017.

[29] Beth DePew, Oregon Health Authority, personal communication, September 21, 2016.

wildfire smoke. The information on the website is posted by the agencies, but the site was built and is maintained by volunteers.[30]

One NASA study noted that "Researchers believe recent fire seasons give a taste of the more active wildfires of the future. Such fires are likely to increase air pollution, even as emissions from industry and motor vehicles have fallen in recent decades." Furthermore, "The U.S. has really made great strides in reducing man-made particles," said study co-author Loretta Mickley of Harvard University. Now, she said, "wildfires dominate poor air quality in the West." The study identifies that wildfires contribute roughly 18 percent of the total particulate emissions in the U.S.[31]

That same study noted,

> "Globally, fine particles have been linked to more than 3.3 million premature deaths Particulate pollution, one of the results of burning matter, can cause a slew of health problems, including chronic obstructive pulmonary disease, acute lower respiratory illness, asthma, ischemic heart disease, and lung cancer.
>
> Using atmospheric and climate models, the research team found that more than 82 million people are likely to experience an increase in the frequency and duration of smoke waves. Northern California, western Oregon, and the Great Plains are among areas that researchers estimate will be hit hardest by particulate matter ($PM_{2.5}$) in the atmosphere.
>
> Wildfires are difficult to predict because they're variable one day to the next and one year to the next, said Jason West, a professor of environmental science at the University of North Carolina. The new research is valuable, he said, because it places the fires into a health context. What's interesting [about the study] is that it shows that climate change can have a direct impact on public health, said Mickley. We're used to thinking of climate change as affecting temperatures and rising sea levels. This is something different that requires a lot of resources to control, affects millions of people, and it has been overlooked."[32]

Carbon monoxide (CO) can cause harmful health effects by reducing oxygen delivery to the body's organs, especially the heart, brain, and tissues. At extremely high levels, CO can cause death. Exposure to CO can reduce the oxygen-carrying capacity of the blood. People with several types of heart disease already have a reduced capacity for pumping oxygenated blood to the heart, which can cause them to experience myocardial ischemia (reduced oxygen to the heart), often accompanied by chest pain (angina), when exercising or under increased stress. For these people, short-term CO exposure further affects their body's already compromised ability to respond to the increased oxygen demands of exercise or exertion.[33]

[30] Oregon Blog Spot, *Oregon Smoke Information*, http://oregonsmoke.blogspot.com, accessed 7/24/19.

[31] National Aeronautics and Space Administration (NASA) Earth Observatory, *Increased fire comes with increased health risks*, retrieved September 2, 2016 from http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=88611&eocn=home&eoci=nh

[32] Ibid.

[33] U.S. Environmental Protection Agency, *Carbon monoxide (CO) pollution in outdoor air*, retrieved from https://www.epa.gov/co-pollution.

Ozone reacts with molecules in the lining of our airways. Chemical bonds break and reform in different ways with the addition of oxygen atoms (the process of oxidation) from ozone, and this causes acute inflammation. The lining of our airways loses some of its ability to serve as a protective barrier to microbes, toxic chemicals, and allergens. Our airways respond by covering the affected areas with fluid and by contracting muscles. Breathing becomes more difficult.

Shortness of breath, dry cough or pain when taking a deep breath, tightness of the chest, wheezing, and nausea are common responses to ozone. Ozone also triggers asthma and may aggravate other respiratory illnesses such as pneumonia and bronchitis. Ozone concentrations can make the small bands of muscles that help control breathing more sensitive to dry air, cold or dust, so ozone exposure may increase allergic responses in susceptible people.

While the effects of acute, short-term episodes of ozone exposure are reversible, the human body's response to long-term exposure may not be reversible. Exposure to ozone at levels we commonly encounter in our own communities permanently scars the lungs of experimental animals, causing long-term impairment of lung capacity, or the volume of air that can be expelled from fully inflated lungs. Ozone may have similar effects on human lungs. Studies in animals suggest ozone may reduce the human immune system's ability to fight bacterial infections in the respiratory system.

Ozone damage to people can occur without any noticeable signs. Even when initial symptoms appear, they can disappear while ozone continues to cause harm. Otherwise healthy people can expect to experience acute but reversible effects if they exercise regularly outdoors when ozone levels are high. The National Institute of Environmental Health Sciences (NIEHS) considers such people to be especially susceptible as a group.[34]

Particulate matter is also known as particular pollution; it is a complex mixture of extremely small particles and liquid droplets that get into the air. Once inhaled, these particles can affect the heart and lungs, and cause serious health effects.[35] The size of particles is directly linked to their potential for causing health problems. Small particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into lungs and the bloodstream. Exposure to such particles can affect both the lungs and heart. People with heart or lung diseases, children, and older adults are the most likely to be affected by particle pollution exposure.[36]

[34] National Aeronautics and Space Administration Earth Observatory, *The Ozone we Breathe*, retrieved September 1, 2016 from http://earthobservatory.nasa.gov/Features/OzoneWeBreathe/ozone_we_breathe2.php.

[35] U.S. Environmental Protection Agency, *Ozone Pollution*, retrieved September 1, 2016 from https://www.epa.gov/ozone-pollution.

[36] Ibid.

Numerous scientific studies have linked particle pollution exposure to problems, including:
• premature death in people with heart or lung disease,
• nonfatal heart attacks,
• irregular heartbeat,
• aggravated asthma,
• decreased lung function, and
• increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.[37]

Fine particles ($PM_{2.5}$) are the main cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas. Particles can be carried over long distances by wind and then settle on ground or water. Depending on their chemical composition, the effects of this settling may include:
• making lakes and streams acidic,
• changing the nutrient balance in coastal waters and large river basins,
• depleting the nutrients in soil,
• damaging sensitive forests and farm crops,
• affecting the diversity of ecosystems, and
• contributing to acid rain effects.[38]

PM can stain and damage stone and other materials, including culturally important objects such as statues and monuments. Some of these effects are related to acid rain effects on materials.[39]

Community Hazard Issues

What is susceptible to damage during a hazard event?

Threat to Life and Property

Humans breathe and the quality of the air they breathe, both indoor and outdoor, is essential to their well-being. As has been described, the air can be contaminated with air pollutants at any time of the year in both large and small geographies. Impacts to humans can range widely, but is especially impactful to vulnerable populations such as the elderly and those that are ill. It has also been noted that buildings can be stained and deteriorate due to air pollutants. Transportation routes may be limited or closed due to air that has ashfall in it.

Personal Choices

Humans can make choices to not use wood stoves, to drive less, to follow rules and advisories that are provided by agencies such as DEQ.

[37] U.S. Environmental Protection Agency, *Particulate Matter (PM) Pollution*, retrieved from https://www.epa.gov/pm-pollution.

[38] Ibid.

[39] Ibid.

Private and Public Lands

Both private and public lands are both subject to air quality and impacts.

City Specific Damage

Town of Lakeview and the City of Paisley

With a valley-like location like that of Lakeview, the Town is subjected to air stagnation and inversion which can decrease the air quality. As has been described, the impacts can be substantial to life, the environment, and property.

Existing Hazard Mitigation Activities and Resources

Additional

For information on resources related to wildfires, see the Existing Hazard Mitigation Activities and Resources section in the Wildfire Hazard Annex in this NHMP.

Ordinances

The Town Hall in Lakeview has the air quality level posted for all to see; the air quality advisory number is painted on the front window. Lake County's Planning and Development Department includes planning and building staff. The Town of Lakeview also has planning and building staff while Paisley does not. Information regarding the Lake County and Lakeview's Comprehensive Plans and other information are available at the County office and at Lakeview Town Hall.

- Lake County, https://www.lakecountyor.org/government/land_use_planning.php
- Town of Lakeview, https://www.lakeview-oregon.com/
- City of Paisley, http://www.cityofpaisley.net/

Emergency Operations Plan

The *Lake County Emergency Operations Plan* (*EOP*), dated April 2013, is an all-hazard plan that describes how Lake County will organize and respond to emergencies and disasters in the community. It is based on, and is consistent with Federal, State of Oregon, and other applicable laws, regulations, plans, and policies, including the Presidential Policy Directive 8, the National Response Framework, and State of Oregon Emergency Operations Plan. The *Lake County EOP* is one component of the County's emergency management program and is designed to be compliant with the National Incident Management System.

The *Lake County EOP* consists of a Basic Plan, Emergency Support Function Annexes that complement the Federal and State Emergency Support Functions, Support Annexes, and Incident Annexes. The *Lake County EOP* provides a framework for coordinated response and recovery activities during an emergency. It describes how agencies and organizations in Lake County will coordinate resources and activities with other Federal, State, local, tribal, and private-sector partners.[40]

[40] Ecology and Environment, Inc., *Lake County Emergency Operations Plan*, April 2013.

State Natural Hazard Risk Assessment

The risk assessment in the *2015 Oregon Natural Hazards Mitigation Plan* provides an overview of natural hazards risk in Oregon but it does not include air quality. It has overall state and regional information and mitigation actions for the entire state.
https://www.oregon.gov/LCD/NH/Documents/Approved_2015ORNHMP_5_RAState.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

Oregon DEQ

Oregon's Department of Environmental Quality oversees the air, land, and water quality in Oregon. The website divides information into four categories: air, land, and water; hazards and cleanup; vehicle inspection; and residential.

https://www.oregon.gov/deq/Pages/index.aspx

Future Changing Conditions/ Climate Change

In the Lake County NHMP, there are several locations that describe future changing conditions or climate change as it relates to the natural hazards that impact Lake County. In the order of appearance in the NHMP: the Risk Assessment, the Hazards Annexes, and Appendix F contain this information. Within Appendix F there are two documents, the *Future Climate Projections: Lake County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.* Documents such as the DEQ *Oregon Air Quality Annual Report: 2017 (*https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf) describe that with climate change we expect more fires in the Northwest and higher temperature days; resulting in more elevated ozone days.

Air Quality Mitigation Action Items

The air quality (AQ) mitigation actions have been identified by the Lake County NHMP Steering Committee which includes the Town of Lakeview and the City of Paisley. See Table 3-1, 2020 County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview and the mitigation action forms in Appendix A for a more detailed description of the mitigation actions in this NHMP.

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

In discussion with the Emergency Manager 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 2-5 in Section 2 Risk Assessment.

Volume III: Mitigation Resources

Source: Tricia Sears, DLCD, Lake District Hospital, 10/10/18.

Source: Tricia Sears, DLCD, Lake Abert, unincorporated Lake County, OR, 5/22/18

Appendix A:
Mitigation Action Forms

Mitigation actions are described in Volume I Section 3 Mitigation Strategy and listed in two tables: **Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview**, and **Table 3-2, Lake County and the Cities Mitigation Actions 2013 Status.**

Each mitigation action in Table 3-1 has a corresponding Mitigation Action Form. The Form describes the activity, identifying the rationale for the project, identifying potential ideas for implementation, and assigning coordinating and partner organizations.

There are 55 total mitigation actions in the *2020 Lake County NHMP*. By natural hazard, the totals are as follows: multi-hazard (MH) = 13; drought (DR) = 2; earthquake (EQ) = 9; flood (FL) = 16; wind storms and winter storms (WWS) = 1; wildfire (WF) = 8; and air quality (AQ) = 6.

Table A-1 Summary of Mitigation Action Item Timelines, Priority and Related Hazards

Action Item	Timeline	Priority (High, Medium, Low)	Drought	Earthquake	Flood	Landslide	Volcanic Event	Wildfire	Winter Storms	Wind Storms	Air Quality
MH#1	On-going	High	x	x	x	x	x	x	x	x	x
MH#2	On-going	High	x	x	x	x	x	x	x	x	x
MH#3	Short-term	High	x	x	x	x	x	x	x	x	x
MH#4	On-going	High	x	x	x	x	x	x	x	x	x
MH#5	On-going	High	x	x	x	x	x	x	x	x	x
MH#6	Long-term	High	x	x	x	x	x	x	x	x	x
MH#7	Long-term	High	x	x	x	x	x	x	x	x	x
MH#8	Long-term	High	x	x	x	x	x	x	x	x	x
MH#9	Long-term	High	x	x	x	x	x	x	x	x	x
MH#10	Long-term	High	x	x	x	x	x	x	x	x	x
MH#11	Short-term	High	x	x	x	x	x	x	x	x	x
MH#12	Long-term	High	x	x	x	x	x	x	x	x	x
MH#13	Short-term	High	x	x	x	x	x	x	x	x	x
DR#1	Short-term	High	x								
DR#2	Short-term	High	x								
EQ#1	Long-term	High-Medium		x							
EQ#2	Long-term	High-Medium		x							
EQ#3	Long-term	High-Medium		x							
EQ#4	Long-term	High-Medium		x							
EQ#5	Long-term	High-Medium		x							
EQ#6	Long-term	High-Medium		x							
EQ#7	Long-term	High-Medium		x							
EQ#8	Long-term	High-Medium		x							
EQ#9	Long-term	High-Medium		x							

Action Item	Timeline	Priority (High, Medium, Low)	Drought	Earthquake	Flood	Landslide	Volcanic Event	Wildfire	Winter Storms	Wind Storms	Air Quality
FL#1	Long-term and on-going	High			x						
FL#2	Long-term	High			x						
FL#3	On-going	High			x						
FL#4	Long-term	High			x						
FL#5	On-going	High			x						
FL#6	Long-term	High			x						
FL#7	Short-term	High			x						
FL#8	Long-term	High			x						
FL#9	Short-term	High			x						
FL#10	Short-term	High			x						
FL#11	Short-term	High			x						
FL#12	Long-term	High			x						
FL#13	Long-term	High			x						
FL#14	Long-term	High			x						
FL#15	Long-term	High			x						
FL#16	Long-term	High			x						
WWS#1	Short-term	High							x	x	
WF#1	Short-term	High-Medium						x			
WF#2	Short-term	High-Medium						x			
WF#3	On-going	High-Medium						x			
WF#4	On-going	High-Medium						x			
WF#5	On-going	High-Medium						x			
WF#6	Long-term	High-Medium						x			
WF#7	Long-term	High-Medium						x			
WF#8	Long-term	High-Medium						x			

Action Item	Timeline	Priority (High, Medium, Low)	Drought	Earthquake	Flood	Landslide	Volcanic Event	Wildfire	Winter Storms	Wind Storms	Air Quality
AQ#1	On-going	High									x
AQ#2	Long-term	High									x
AQ#3	Long-term	High									x
AQ#4	Long-term	High									x
AQ#5	Long-term	High									x
AQ#6	On-going	High									x

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #1 –High –Re-establish communication and relationship between Lake County, Lakeview, Paisley, and the Chamber of Commerce. Focus on small business hazard and continuity of operations planning in Lake County.	Goals 1, 2, 3, 5
Alignment with Existing Plans/Policies:	
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action:	
• The Disaster Mitigation Act of 2000 requires communities to identify actions that reduce the impacts of natural hazards [201.6(c)(3)(ii)]. • All businesses in Lake County are considered small businesses. • Most small businesses are financially fragile and may not be able to recover losses if a hazardous event should prevent business for even a few days or if there was damage to the assets of the business as determined by stakeholders • Resources may be available from South Central Economic Development District (SCOEDD), Lake District Hospital, and other places. • Business continuity plans assist businesses in determining appropriate insurance coverage, review lease stipulations, mitigate against potential risks, and plan for future recovery efforts (Source: Alesch, Daniel J. et al. 2001. "Organizations at Risk: What Happens When Small Businesses and Not-for-Profits Encounter Natural Disasters," The Public Entity Risk Institute). • Research has shown that most small businesses are unable to recover after a disaster. (Source: Wood, N., in preparation,, Variations in the community vulnerability to tsunami hazards on the Oregon coast, U.S. Geological Survey research project 9861-B5C, unpublished data) • Business continuity plans allow businesses and their employees to be better prepared for a disaster. Having plans in place may reduce the impact on the business, allowing employees to continue to work or get back to work faster. (Source: ONHW, Cannon Beach Case Study Report, University of Oregon, July 2006)	
Ideas for Implementation:	

- Hold community workshops on business hazard preparation and business continuity planning.
- Provide information on small business hazard planning such as the Institute for Business and Home Safety's (IBHS).
- Utilize Chamber's monthly mailings to promote hazard awareness, mitigation activities/ projects and business hazard mitigation planning

Coordinating Organization:	Lake County Emergency Manager, Lake County Chamber of Commerce

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	Lake County, Lakeview, Paisley, Rotary, Soroptomist, Lakeview Business Association, South Central Economic Development District (SCOEDD), Lake County Resource Initiative (LCRI), OSU Extension Service, Lake District Hospital

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		On-going

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	On-going

Proposed Action and Priority	**Alignment with Plan Goals:**
MH #2 –High - Establish and maintain a community hazard awareness and mitigation campaign as seasonally appropriate to each hazard aiming mitigation actions at households, businesses and vulnerable populations. Develop a calendar that identifies the natural hazards focus for outreach each month. Identify outreach actions that will be done each month. The Lake County Natural Hazards Mitigation Plan (NHMP) Natural Hazards Outreach Calendar is included in the 2020 Lake County NHMP in the appendix.	Goals 1-5

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action:

- The more educated and aware the public is of natural hazards, the more risk can be reduced.
- The Disaster Mitigation Act of 2000 requires that communities continue to involve the public beyond the original planning process [201.6(c)(4)(ii)]. Developing a public awareness campaign for hazard risk mitigation will help to keep the public informed of, and involved in, awareness of natural hazards and potential mitigation activities the public can implement.
- Public education and outreach can be inexpensive and provide information which results in safer households, work places, and other public areas. Some outreach materials include: informational brochures about community seismic risks and mitigation techniques, public forums, newspaper articles, training classes and television advertisements.
- Mitigation is a shared responsibility between local, state, and federal government; citizens; businesses; non-profit organizations; and others. Informing the public of their role in a

community's mitigation efforts not only increases the public's awareness of a community's hazard risks, but also helps a community reduce its risk to the hazards addresses by the Natural Hazard Mitigation Plan.

Ideas for Implementation:

- Create mailing packet and other materials with hazard-specific information on impacts of hazards, mitigation activities and preparedness. See the Outreach Calendar in the *2020 Lake County NHMP* Appendix.
- Emphasize prevention of excessive snow load on structures during times of heavy snow.
- Determine which media avenue is most effective for local outreach; mailings, posters, flyers, radio, local TV, Facebook, twitter, newspaper, presentations by local officials, etc.
- Have informational brochures and packets available at identified partner's office locations.
- Firewise brochures can be used to address wildfire.
- Institute for Business and Home Safety (IBHS) offers materials that address winter storms, flooding, wind storms, wildfire and earthquake for homes and businesses.
- Lake County Watershed Councils and Natural Resource Conservation District have drought information/water conservation information.
- Distribute IBHS Homeowner's Guide to Non-Structural Retrofit to homes, businesses and medical and care facilities to encourage mitigation actions for earthquake.

Coordinating Organization:	NHMP Steering Committee, Emergency Preparedness Group

Internal Partners:	**External Partners:**
Lake Co. Building Dept, Lake Co. Planning Dept, Lake Co. Public Health, Lakeview, Paisley	Lake Co. Emergency Manager, Lake Co. Building Dept, Lake Co. Planning Dept, Lake Co. Public Health, Lakeview, Paisley, Lake Co. Chamber of Commerce, SCOEDD, LCRI, Lakeview Crisis Center, OSU Extension, Lake Co. Senior Citizen's Assoc., Lake District Hospital, Klamath Co. Head Start, Lake County Education Service District (ESD), Oregon Department of Human Services (DHS), Veterans Services, Lake County School District #7, Soil & Water Conservation District,

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		On-going

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	Ongoing

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #3 – High - Include broader citizen representation on the NHMP Steering Committee to oversee facilitation and implementation of community hazard awareness campaigns	Goals 1, 3, 4, 5

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action:

- The Disaster Mitigation Act of 2000 requires that communities continue to involve the public beyond the original planning process [201.6(c)(4)(ii)].
- Mitigation is a shared responsibility between local, state, and federal government; citizens; businesses; non-profit organizations; and others.
- Help Lake County residents prepare and reduce loss from natural hazard events by having a broad range of people engaged.

Ideas for Implementation:

- Solicit representatives from a variety of government agencies and departments, local businesses, community organizations and groups to form diverse representation
- Form as a subcommittee of the NHMP Steering Committee and have commissioners recognize the subcommittee. The subcommittee will report to the NHMP Steering Committee on progress of outreach accomplished
- Have group create an outreach strategy with timeline, resource list and implementation ideas

Coordinating Organization:	NHMP Steering Committee and Emergency Preparedness Group

Internal Partners:	**External Partners:**
Lake Co. Planning Department, Lake Co. Public Health, Lake Co. Sheriff Department, Lakeview Police Department, Lakeview Fire Department	Lake Co. Planning, Lake Co. Public Health, Lake Co. Sheriff, Lakeview Police Department, Lakeview Fire Department, Oregon Department of Fish and Wildlife, U.S. Forest Service, Oregon Department of Forestry, Bureau of Land Management, Lake County Senior Citizens Association, Lake County Disaster Preparedness Group, Lions, Elks, Soroptomists, Lake District Hospital, Lake Co. Resource Initiative, Lakeview School District. Lakeview Crisis Center, Warner Creek Correctional Facility, Harney Electric Cooperative

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Short-Term

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	Short-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #4 – High- Shorten spans and anchor poles on utility lines in high wind or heavy icing areas.	Goals 1 and 2

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

This action was developed for the Harney County NHMP and incorporated into the Lake County NHMP since the Harney Electric Cooperatives service area includes a portion of Lake County.

Rationale for Proposed Action Item:

• High windstorms or winter icing storms can cause damage to long spans between power poles and create power outages during storms. If poles are inserted between spans this reduces the risk of outages. Also by anchoring certain poles this can reduce the amount of line, which would go down in a storm. Both items reduce the cost of repair and replacement. • Winter storms have a significant impact on the Harney Electric Cooperative, causing power outages when ice forms on the power lines. This is especially a problem with older power lines constructed in the 1950s that have a larger line span between poles. Placing intermediary poles between these spans cuts the span in half and reduces the likelihood of a power line breaking. • The Disaster Mitigation Act of 2000 requires communities to develop comprehensive actions to reduce the impacts of natural hazards, with an emphasis on new and existing buildings and infrastructure.[201.6(c)(3)(ii)] • This action is considered to be a multi-jurisdictional action since it benefits both the County and all the participating cities.
Ideas for Implementation:
•The utility company would be responsible to identify high wind and icing areas from previous outages and apply for grants to strengthen the areas by pole inserts and anchoring.

Coordinating Organization:	Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative

Internal Partners:	**External Partners:**	
Lake County, Lakeview, Paisley	Lake County, Lakeview, Paisley, Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative, Harney Electric Cooperative	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		On-going

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	On-going

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #5 – High - Convert primary electrical overhead lines to mountaintop communication services with underground lines.	Goals 1 and 2
Alignment with Existing Plans/Policies:	
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans This action was developed for the Harney County NHMP and incorporated into the Lake County NHMP since the Harney Electric Cooperatives service area includes a portion of Lake County.	
Rationale for Proposed Action Item:	

•Overhead electrical lines are subject to high winds and winter storm damage. The risk is higher on the lines going to a mountaintop or peak. Most of the services at the top are communication sites. The communication sites are used by ODOT, State Police, county sheriff, emergency services, telephone utilities and cell phone companies. During a disaster the sites are vital for communication. During winter storm access to the line by the utility is difficult and this difficulty delays the time for restoration of power to the services. The utility company has experienced costs each year to repair and maintain the lines. Converting the lines to underground would remove the risk of damage from wind and winter storm. •The Disaster Mitigation Act of 2000 requires communities to develop comprehensive actions to reduce the impacts of natural hazards, with an emphasis on new and existing buildings and infrastructure.[201.6(c)(3)(ii)] •This action is considered to be a multi-jurisdictional action since it benefits both the County and all the participating cities.
Ideas for Implementation:
•The utility company would be responsible to identify all the mountaintops and apply for grants to convert the lines to underground service. •Priority projects include Jack Mountain (Harney County) and Glass Butte (Lake County).

Coordinating Organization:	Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	Lake County, Lakeview, Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative, Harney Electric Cooperative, companies which are served by the utility and the utility company

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Ongoing

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	Ongoing

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #6 – High - Have all internal staff get Incident Command Training that is appropriate for their position.	Goas 1-5

Alignment with Existing Plans/Policies:
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans
Rationale for Proposed Action Item:
• Having staff be aware of and understand the Incident Command System (ICS) is very important for a prompt and efficient response to an incident. • The Disaster Mitigation Act of 2000 requires communities to develop comprehensive actions to reduce the impacts of natural hazards, with an emphasis on new and existing buildings and infrastructure.[201.6(c)(3)(ii)]

Ideas for Implementation:			
• Collaborate with nearby counties to bring in the training and offer several options for staff. • Provide refresher courses and practice sessions to keep the information familiar to staff. • Have a buddy system and train people for multiple roles in ICS.			
Coordinating Organization:	Lake County Emergency Manager		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		All Lake County Departments, City of Paisley, Town of Lakeview	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2013 NHMP Steering Committee; Revised and confirmed in 2020.		
Action Item Status:	Long-Term		

Proposed Action and Priority:	Alignment with Plan Goals:
MH #7 – High - Have a GIS person on staff and located in Lake County.	Goals 1-5
Alignment with Existing Plans/Policies:	
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action Item:	
• Mapping land use areas, natural hazards, environmental areas and so forth is essential for making decisions that promote life safety. • Maps are visuals that are often easier for people to understand and relate to when sharing information with the public. • Maps can provide "at a glance" views of information that can be quicker to use in daily events as well as in emergency situations. • Having the GIS capability in house can save time and money rather than using a contractor or relying on other counties or agencies to provide the information.	
Ideas for Implementation:	
• Have the County fund at least a part time, but preferably full time GIS person on staff.	

Coordinating Organization:	Lake County Planning/Planning Director and Lake County Emergency Manager		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		Lake County Public Works and Transportation, City of Paisley, Town of Lakeview	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2020 NHMP Steering Committee		

Action Item Status:	Long-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #8 – High - Make maps of natural hazard areas identified in the NHMP. Collect data about hazard events and critical infrastructure to use in planning, transportation, emergency operations, search & rescue and other disciplines.	Goals 1-5

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Lake County, Lakeview, Paisley and other jurisdictions have limited resources.
- Maps and data are essential parts of effective decision-making.
- Mapping land use areas, natural hazards, environmental areas and so forth is essential for making decisions that promote life safety.
- Maps are visuals that are often easier for people to understand and relate to when sharing information with the public.
- Maps can provide "at a glance" views of information that can be quicker to use in daily events as well as in emergency situations.
- Having the GIS capability in house can save time and money rather than using a contractor or relying on other counties or agencies to provide the information.

Ideas for Implementation:

- There is no end to the number of ways the information could be used.

Coordinating Organization:	Lake County Planning/Planning Director and Lake County Emergency Manager

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	Lake County Public Works and Transportation, City of Paisley, Town of Lakeview, BLM, American Red Cross, DOGAMI

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Long Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #9 – High - Acquire and set up an emergency alert notification system so that emergency messages can be sent via text message or phone call.	Goals 1-5

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:		
• Lake County, Lakeview, Paisley and other jurisdictions have limited resources. • Sharing information quickly is an essential part of effective decision-making and reducing risk to people and property. • Lake County is a large geographic area and providing information to people in this manner would be an excellent tool for increasing life safety.		
Ideas for Implementation:		
• There is no end to the number of ways the information could be used on a year round basis.		
Coordinating Organization:	Lake County Emergency Manager	
Internal Partners:	**External Partners:**	
Lake County, Lakeview, Paisley	Town of Lakeview, City of Paisley, OEM, FEMA, Lake District Hospital	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term
Form Submitted by:	2020 NHMP Steering Committee	
Action Item Status:	Long-Term	

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #10 – High - Set up and conduct specialized training about leadership in emergency situations. E.g. how to feel comfortable leading teams of staff and volunteers. Perhaps have staff train with or shadow each other and volunteers have a buddy to do tasks together.	Goals 1, 3, 4, 5
Alignment with Existing Plans/Policies:	
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action Item:	
• Lake County, Lakeview, Paisley and other jurisdictions have limited resources. • Having people trained and comfortable in tasks related to emergency situations is essential to reducing risk to people and property, and improves the ability of people to respond effectively.	
Ideas for Implementation:	
• There is no end to the number of ways the information could be used.	
Coordinating Organization:	Lake County Emergency Manager, South Central Oregon Fire Management Partnership (SCOFMP)
Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	Town of Lakeview, City of Paisley, OEM, FEMA, ODF, BLM, NPS, USFS, USFW, Lake District Hospital
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Long-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #11 – High - Establish a method and system of signing in and out and tracking the emergent/spontaneous volunteers. Distribute this information to Lake County staff and to external partners.	Goals 1, 3, 4, 5

Alignment with Existing Plans/Policies:
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans
Rationale for Proposed Action Item:
• Lake County, Lakeview, Paisley and other jurisdictions have limited resources. • Knowing where and who the volunteers are in the disaster is important.
Ideas for Implementation:
• Have the Emergency Manager, the NHMP Steering Committee, and other relevant committees discuss the method and system that would most effectively work in Lake County.

Coordinating Organization:	Lake County Emergency Manager

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	Town of Lakeview, City of Paisley, OEM, FEMA, South Central Oregon Fire Management Partnership (SCOFMP)

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Short-Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Short-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #12 – High - Establish mutual aid agreement(s) for lead roles and responsibilities, and sharing material resources.	Goals 1-5

Alignment with Existing Plans/Policies:
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans
Rationale for Proposed Action Item:
• Lake County, Lakeview, Paisley and other jurisdictions have limited resources. • Sharing resources is efficient. Relationships are established and strengthened. Collaboration benefits everyone.
Ideas for Implementation:
• There is no end to the number of ways the information could be shared.

Coordinating Organization:	Lake County Emergency Manager		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		Town of Lakeview, City of Paisley, Lake District Hospital	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2020 NHMP Steering Committee		
Action Item Status:	Long-Term		

Proposed Action and Priority:	**Alignment with Plan Goals:**
MH #13 – High - Establish an Emergency Operations Checklist that blends Incident Command System (ICS) and Emergency Support Functions (ESF) for the Emergency Operations Center. Distribute the information to Lake County staff and to external partners.	Goals 1, 3, 4, 5
Alignment with Existing Plans/Policies:	
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action Item:	
• Lake County, Lakeview, Paisley and other jurisdictions have limited resources. • Having staff be aware of the information and understand it will be beneficial to all. This will in turn reduce risk to people and property, and will increase the effective and efficient response to emergency situations.	
Ideas for Implementation:	
• Have the Emergency Manager, the NHMP Steering Committee, and other relevant committees discuss the method and system that would most effectively work in Lake County.	

Coordinating Organization:	Lake County Emergency Manager		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		Town of Lakeview, City of Paisley, Lakeview District Hospital, South Central Oregon Fire Management Partnership (SCOFMP)	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Short-Term
Form Submitted by:	2020 NHMP Steering Committee		
Action Item Status:	Short-Term		

Proposed Action and Priority:	**Alignment with Plan Goals:**
DR #1 – High - Research the opportunity to obtain funds from Oregon Water Resources Department (OWRD) for a feasibility study for water storage for Lake County, the Town of	Goals 1-5

Lakeview, and the City of Paisley. Identify options for the location of the water storage and what it would look like (e.g. above or below ground). Prepare the application for the Water Project Grants and Loans. https://www.oregon.gov/OWRD/programs/FundingOpportunities/WaterProjectGrantAndLoans/Pages/default.aspx	

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Drought is a frequent problem in Lake County, and residents should be informed about the risks that drought poses, such as the increase in wildland fire risk. In addition, homeowners should be aware of controlling water use during drought conditions to conserve water.
- Work with county and cities to develop strategies to reduce water consumption for residential gardening during times of drought.
- Work with the irrigation districts, water resources division and watershed councils to develop strategies to reduce water consumption for agricultural and other commercial purposes during times of drought.
- Promote the use of drought resistant vegetation for commercial and residential development.
- The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that reduce the effects of a hazard on the community [201.6(c)(3)(ii)], such as actions protecting natural resources. This action is considered to be a multi-jurisdictional action since it benefits both the County and all the participating cities.

Ideas for Implementation:

- Conduct a collaborative investigation as to what water storage needs are and where the storage would be most effective.
- Engage a broad spectrum of residents, business, industry, farmers, ranchers, agencies, and others to identify needs and concerns.

Coordinating Organization:	Lake County Emergency Manager, Lake County Planning Manager, Town of Lakeview Public Works, City of Paisley, Lake County Water Master, OWRD

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	Lake County Emergency Manager, Lake County Planning Manager, Town of Lakeview Public Works, City of Paisley, Lake County Water Master, OWRD

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Short-Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Short-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**

DR #2 – HIGH - Prepare and distribute water conservation information. Engage these organizations in a collaborative effort: the Lake County Umbrella Watershed Council, the Natural Resources Conservation Service (NRCS), Lake County Water Master, OWRD, Lake County, the Town of Lakeview, and the City of Paisley.	Goals 1-5

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Drought is a frequent problem in Lake County, and residents should be informed about the risks that drought poses, such as the increase in wildland fire risk. In addition, homeowners should be aware of controlling water use during drought conditions to conserve water.
- Work with county and cities to develop strategies to reduce water consumption for residential gardening during times of drought.
- Work with the irrigation districts, water resources division and watershed councils to develop strategies to reduce water consumption for agricultural and other commercial purposes during times of drought.
- Promote the use of drought resistant vegetation for commercial and residential development.
- The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that reduce the effects of a hazard on the community [201.6(c)(3)(ii)], such as actions protecting natural resources. This action is considered to be a multi-jurisdictional action since it benefits both the County and all the participating cities.

Ideas for Implementation:

- Engage a broad spectrum of residents, business, industry, farmers, ranchers, agencies, and others to identify needs and concerns.
- Outreach and education is a focus already noted in MH#2. See also the Natural Hazards Mitigation Plan Outreach Calendar in the Appendix of this *2020 Lake County NHMP*.

Coordinating Organization:	Lake County Umbrella Watershed Council, Lake County Water Master, OWRD, Lake County Emergency Manager, Oregon Department of Agriculture, NRCS

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	Lake County, Town of Lakeview, City of Paisley, BLM, USFW, ODFW, DSL, Lake County Cooperative Weed Management Area

Potential Funding Sources:	**Estimated cost:**

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Short-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**

EQ #1 – High-Medium - Finish seismic retrofit and restoring Daly Middle School to reduce the building's vulnerability to seismic hazards. The south side is not done with the retrofit and the third floor and basement remain to be restored.	Goals 1 and 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Daly Middle school was built in 1910 and has buildings constructed of un-reinforced masonry and concrete shear wall with very high collapse potential.
- Occupants of the school are primarily middle school children, aged 10-14 and are vulnerable to potential injury should an event occur.
- Seismic vulnerability studies have shown that un-reinforced masonry buildings perform very poorly in earthquakes.
- Daly Middle School has been identified as a critical facility by the Natural Hazard Mitigation Steering Committee.
- The Statewide Seismic Needs Assessment Study conducted by DOGAMI identifies Daly Middle School as having high risk to seismic activity.
- Daly Middle School has been prioritized by the Steering Committee as a community icon.
- Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities, including schools. Careful review of this data will assist in developing a strategy to seismically retrofit Daly Middle School.
- Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Advisory Service Report Number 483/484).
- Retrofitting Daly Middle School will significantly reduce the school's vulnerability to seismic hazards and improve the safety of students, teachers, and community members that use the school
- The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6 (c)(3)(ii)].

Ideas for Implementation:

- Apply for additional grant funding through the Oregon Seismic Rehabilitation Grant Program, FEMA, or other sources to ensure the retrofit and restoration work is completed.
- Align project with School District Maintenance Plan.

Coordinating Organization:	Lake County School District #7

Internal Partners:	**External Partners:**
Lake County, Lakeview	Lake County, Lakeview, DOGAMI, OEM, FEMA, ODE, American Red Cross

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	In process

Proposed Action and Priority:	**Alignment with Plan Goals:**
EQ #2 – High-Medium - Seismically retrofit Arthur D. Hay Elementary School to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options.	Goals 1 and 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Arthur D. Hay Elementary was built ca. 1920 and has buildings constructed of light wood-frame that have high collapse potential.
- Occupants of the school are primarily elementary school aged students and are vulnerable should an event occur. Retrofitting the school will protect the students as well as staff and community members using the building.
- Arthur D. Hay elementary school has been identified as a critical facility by the Natural Hazard Mitigation Steering Committee
- Seismic vulnerability studies have shown that un-reinforced buildings perform poorly in earthquakes.
- The Statewide Seismic Needs Assessment Study conducted by DOGAMI identifies the school as having high risk to seismic activity.
- Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities, including schools.
- Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Advisory Service Report Number 483/484)
- Retrofitting the school will significantly reduce the school's vulnerability to seismic hazards and improve the safety of students, teachers, and community members that use the school
- The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6 (c)(3)(ii)].

Ideas for Implementation:

- Arthur D. Hay Elementary School is combined with Fremont Elementary School. Buildings of Fremont Elementary School were retrofitted in 2011 with funds from the Oregon SRGP program.
- Apply for additional grant funding through the Oregon Seismic Rehabilitation Grant Program, FEMA, or other sources to ensure the retrofit and restoration work is completed.

  Align project with School District Maintenance Plan.

Coordinating Organization:	Lake County School District #7

Internal Partners:	**External Partners:**

Lake County, Paisley		Lake County, Lakeview, DOGAMI, OEM, FEMA, ODE	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.		
Action Item Status:	Long-Term		

Proposed Action and Priority:	**Alignment with Plan Goals:**
EQ #3 – High-medium - Seismically assess and determine retrofit options for Union Elementary School to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options.	Goals 1 and 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Union Elementary was built ca. 1920 (remodeled 1998)
- Occupants of the school are primarily Elementary school students and are vulnerable to potential injury should an event occur
- Union Elementary School has been identified as a critical facility by the Natural Hazard Mitigation Steering Committee
- Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities, including schools.
- The Union Elementary School did not qualify for the statewide seismic needs assessment study conducted by DOGAMI in 2007 because its enrollment was below 200 students. A seismic needs assessment study should be performed to assess the school for collapse potential. In order to be eligible for SRGP the building needs to have a capacity for 250 people and be regularly used for student activities.
- Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Advisory Service Report Number 483/484)
- Retrofitting Union Elementary School will significantly reduce the school's vulnerability to seismic hazards and improve the safety of students, teachers, and community members that use the school
- The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6 (c)(3)(ii)].

Ideas for Implementation:

- Apply for additional grant funding through the Oregon Seismic Rehabilitation Grant Program, FEMA, or other sources to ensure the retrofit and restoration work is completed.

  Align project with School District Maintenance Plan.

Coordinating Organization:	Lake County School District #7

Internal Partners:	External Partners:	
Lake County, Lakeview	Lake County, DOGAMI, OEM, FEMA, ODE	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term
Form Submitted by:	2013 NHMP Steering Committee; Revised and confirmed in 2020.	
Action Item Status:	Long-Term	

Proposed Action and Priority:	Alignment with Plan Goals:
EQ #4 – High-medium - Seismically retrofit Lakeview Fire and Emergency Services Department building (245 N F St) to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Goas 1, 2, 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- The Lakeview Fire Department was built in 1984 and is constructed of reinforced masonry.
- Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities.
- Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Advisory Service Report Number 483/484)
- Retrofitting this building will significantly reduce the building's vulnerability to seismic hazards and improve the safety of service provides and community members.
- The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6 (c)(3)(ii)].

Ideas for Implementation:

- Conduct detailed structural evaluation that outlines recommendations for building deficiencies, and provides a cost estimate, incorporating DOGAMI's seismic assessment data.
- Apply for grant funding through the Oregon Seismic Rehabilitation Grant Program.
- Apply for FEMA project grant funding.
- Conduct cost-benefit analysis and potentially consider rebuilding a new structure.
- Align project with regular building maintenance plan.

Coordinating Organization:	Town of Lakeview and Lake County	
Internal Partners:	**External Partners:**	
Lake County and Town of Lakeview	DOGAMI, OEM, FEMA	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2013 NHMP Steering Committee; Revised and confirmed in 2020.
Action Item Status:	Long-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
EQ #5 – High-medium - Seismically retrofit Lake County Courthouse/Sheriff's Office (513 Center St) and the Lake County Emergency Services Dispatch building (245 N. F St.) to reduce the buildings vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Goas 1, 2, 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- The Lake County Courthouse/ Sheriff's Office was built in 1953 and is constructed with a concrete moment-resisting frame and is considered to have a very high collapse potential.
- Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities.
- Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Advisory Service Report Number 483/484)
- Retrofitting this building will significantly reduce the building's vulnerability to seismic hazards and improve the safety of service provides and community members.
- The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6 (c)(3)(ii)].

Ideas for Implementation:

- Conduct detailed structural evaluation that outlines recommendations for building deficiencies, and provides a cost estimate, incorporating DOGAMI's seismic assessment data to assist in retrofitting the building.
- Apply for grant funding through the Oregon Seismic Rehabilitation Grant Program
- Apply for FEMA project grant funding.
- Conduct structural evaluation and make recommendations (structural and non-structural) for fix.
- Align project with regular building maintenance plan.

Coordinating Organization:	Lake County

Internal Partners:	**External Partners:**	
Lake County, Lakeview	Lake County, Lakeview, DOGAMI, OEM, FEMA	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2013 NHMP Steering Committee; Revised and confirmed in 2020.
Action Item Status:	Long-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
EQ #6 – High-medium - Seismically retrofit Silver Lake Rural Fire Protection District (RFPD) to reduce the building's vulnerability to seismic hazards. Consider both structural and non-structural retrofit options. Explore funding options.	Goals 1 and 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- The Silver Lake RFPD was built ca. 1960 and is constructed with a light wood-frame structure that has a high collapse potential.
- The Statewide Seismic Needs Assessment Study conducted by DOGAMI identifies Silver Lake RFPD as having high risk to seismic activity
- Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities, including fire stations. Careful review of this data will assist in developing a strategy to seismically retrofit the Silver Lake RFPD.
- Retrofitting of vital infrastructure, such as fire department buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Advisory Service Report Number 483/484).
- Retrofitting Silver Lake RFPD will significantly reduce the building's vulnerability to seismic hazards and improve the safety of workers and ensure that equipment and personnel are available if a seismic event occurs.
- The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6 (c)(3)(ii)].

Ideas for Implementation:

- Conduct detailed structural evaluation that outlines recommendations for building deficiencies, and provides a cost estimate, incorporating DOGAMI's seismic assessment data to assist in retrofitting the building.
- Apply for grant funding through the Oregon Seismic Rehabilitation Grant Program
- Apply for FEMA project grant funding.
- Conduct structural evaluation and make recommendations (structural and non-structural) for fix.
- Align project with regular building maintenance plan.

Coordinating Organization:	Silver Lake RFPD

Internal Partners:	**External Partners:**	
Lake County (Silver Lake)	Lake County (Silver Lake), DOGAMI, OEM, FEMA	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2013 NHMP Steering Committee: Revised and confirmed in 2020.

Action Item Status:	Long-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
EQ #7 – High-medium - Update the existing Historical Inventory list that identifies historic structures, critical facilities and other public structures that represent a significant resource for the community. Focusing especially on unreinforced masonry building to protect them from seismic natural hazards. Index and digitize the list so that it can be uploaded to GIS as a layer.	Goals 1 and 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Unreinforced masonry buildings are particularly vulnerable to seismic events. There are buildings in Lake County that are unreinforced masonry buildings and are vulnerable to damage in the event of an earthquake. This could have significant impacts on local economies. Identifying mitigating measures for retrofitting unreinforced masonry buildings (and other high or very high collapse potential structures) will reduce the vulnerability of the buildings to an earthquake event and improve the resiliency of the local economy.
- There are 19 eligible/significant (ES), eligible/contributing (EC), non-eligible/out of period (NP), and non-eligible/non-contributing (NC) historic sites in Lake County (Oregon Historic Sites Database, http://heritagedata.prd.state.or.us/historic/). These sites serve as important cultural and historic resources for Lake County. Identifying mitigation actions for these resources will help protect Lake County's historical heritage and ensure their long-term viability.
- The Lake County Senior Center is an important facility for a vulnerable population. Assessing earthquake risk and implementing appropriate structural and non-structural retrofits to this facility is key to increasing resiliency within the community.
- Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Association. 1998. Planning for Post-Disaster Recovery and Reconstruction. Planning Advisory Service Report Number 483/484)
- Mitigating significant historic buildings, critical facilities and other public structures against natural hazards will reduce the vulnerability of these structures to natural hazard events. This will not only protect the building's occupants, but it will also ensure the long-term viability of the historic structures.
- The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)].

Ideas for Implementation:

- Identify and assess for seismic stability significant cultural and historic resources, whether on the national register or not, critical facilities and other public structures that may need protection.
- Determine potential vulnerabilities of these resources to natural hazards that affect Lake County.
- Identify mitigation measures (structural and non-structural) to help preserve significant historic

and cultural resources.			
Coordinating Organization:	Lake County Historic Society, Lake County Building and Planning Departments		
Internal Partners:		**External Partners:**	
County Building and Planning Departments, City Building and Planning Departments, Lake County Emergency Management		Lakeview and Paisley Building and Planning Departments, Lake County Emergency Management, State Historic Preservation Office	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.		
Action Item Status:	Long-Term		

Proposed Action and Priority:	**Alignment with Plan Goals:**
EQ #8 – High-medium - Seismically assess and determine retrofit options for Paisley Disaster Unit/Ambulance Unit building (1009 and 1011 Cottonwood St, Paisley) and the Fire Department building (1007 Cottonwood St, Paisley) to reduce vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Goals 1-5
Alignment with Existing Plans/Policies:	
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action Item:	
• There are buildings in Lake County that are vulnerable to damage in the event of an earthquake. This could have significant impacts on local economies. Identifying mitigating measures for retrofitting buildings will reduce the vulnerability of the buildings and improve the resiliency of the local economy. In addition, service providers will be better able to help others if they and their equipment are able avoid damage. • Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Association. 1998. Planning for Post-Disaster Recovery and Reconstruction. Planning Advisory Service Report Number 483/484) • Mitigating significant historic buildings, critical facilities and other public structures against natural hazards will reduce the vulnerability of these structures to natural hazard events. This will not only protect the building's occupants, but it will also ensure the long-term viability of the historic structures. • The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)].	
Ideas for Implementation:	

- Conduct detailed structural evaluation that outlines recommendations for building deficiencies, and provides a cost estimate, incorporating DOGAMI's seismic assessment data to assist in retrofitting the building.
- Apply for grant funding through the Oregon Seismic Rehabilitation Grant Program
- Apply for FEMA project grant funding.
- Conduct structural evaluation and make recommendations (structural and non-structural) for fix.

  Align project with regular building maintenance plan.

Coordinating Organization:	City of Paisley

Internal Partners:	**External Partners:**
County Building and Planning Departments, City Building and Planning Departments, Lake County Emergency Management	Lake County Emergency Services Coordinator, DOGAMI, OEM, FEMA, Oregon Department of Education (ODE)

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2020 NHMP Steering Committee.
Action Item Status:	Long-Term

Proposed Action Item:	**Alignment with Plan Goals:**
EQ #9 – High-medium - Seismically assess and determine retrofit options for North Lake EMS building (87345 Holly Lane, Christmas Valley) to reduce the building's vulnerability to seismic hazards. Consider both structural and nonstructural retrofit options. Explore funding options.	Goals 1-5

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- There are buildings in Lake County that are vulnerable to damage in the event of an earthquake. This could have significant impacts on local economies. Identifying mitigating measures for retrofitting buildings will reduce the vulnerability of the buildings and improve the resiliency of the local economy. In addition, service providers will be better able to help others if they and their equipment are able avoid damage.
- Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Association. 1998. Planning for Post-Disaster Recovery and Reconstruction. Planning Advisory Service Report Number 483/484)
- Mitigating significant historic buildings, critical facilities and other public structures against natural hazards will reduce the vulnerability of these structures to natural hazard events. This will not only protect the building's occupants, but it will also ensure the long-term viability of the historic structures.
- The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)]. The Disaster Mitigation Act of 2000 requires communities to identify actions and

projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)]. Identifying important cultural historic buildings, critical facilities and other public structures, especially unreinforced masonry buildings, and seismically retrofitting them will reduce the overall vulnerability of the buildings to natural hazards.

Ideas for Implementation:

- Conduct detailed structural evaluation that outlines recommendations for building deficiencies, and provides a cost estimate, incorporating DOGAMI's seismic assessment data to assist in retrofitting the building.
- Apply for grant funding through the Oregon Seismic Rehabilitation Grant Program
- Apply for FEMA project grant funding.
- Conduct structural evaluation and make recommendations (structural and non-structural) for fix.

  Align project with regular building maintenance plan.

Coordinating Organization:	Lake County Emergency Manager	
Internal Partners:	**External Partners:**	
County Building and Planning Departments, City Building and Planning Departments, Lake County Emergency Management	DOGAMI, OEM, FEMA, ODE	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term
Form Submitted by:	2020 NHMP Steering Committee.	
Action Item Status:	Long-Term	

Proposed Action and Priority:	**Alignment with Plan Goals:**
FL #1 – High - Replace insufficient drainage culverts with bridge over Crane Creek at Hwy 395 and County Road 1-15	Goals 1 and 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Existing culverts are 6 foot flat bottom pipes and easily clogged with debris during high flow.
- County Road 1-15 has direct access to State Highway 395.
- There are residences on county road 1-15.
- Crane Creek is managed as a Wild Fish Stream for the Red-Band Trout. Replacing the culvert with a bridge will promote stream and fish habitat continuity, helping to preserve this sensitive fish species.
- Past flooding events have washed the road out.

Ideas for Implementation:

- Install pre-fabricated 50 foot bridge or other bridge style that functions as needed.
- Work with ODOT to coordinate updating drainages.

• Coordinate with Lake County Watershed Councils and ODFW to outline stream development and restoration program. • Cost-share on project with Oregon Department of Fish and Wildlife and ODOT. • Seek state and federal funding.			
Coordinating Organization:	Lake County Roads Department		
Internal Partners:		**External Partners:**	
Lake County		OWEB, ODFW, ODOT, Lake County Watershed Councils, Ranchers with water rights to the creek, U.S. Army Corps of Engineers Silver Jackets	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
OWEB			Long-Term and ongoing
Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.		
Action Item Status:	Long-Term and ongoing		

Proposed Action and Priority:		**Alignment with Plan Goals:**	
FL #2 – High - Establish a County culvert list that assesses and prioritizes which culverts need to be modified or replaced throughout Lake County. Map this information.		Goals 1 and 4	
Alignment with Existing Plans/Policies:			
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans			
Rationale for Proposed Action Item:			
• There are areas in Lake County that are subject to repeat clogging and back-up over roadways due to insufficient culvert size, including Hart Mountain Road 3-12, Hart Mountain Road 3-12 services 3 ranches and is used by USFW. • Culvert back-up has occasionally caused road wash-outs and closures. • Flooding events occur about every 5 years, according to Lake County Roads Master.			
Ideas for Implementation:			
• Prioritize replacement of problem culverts, focusing on those with repeat clogging and flooding. • Coordinate with OFW and local Watershed Council to ensure proper stream and fish habitat.			
Coordinating Organization:	Lake County Roads Department		
Internal Partners:		**External Partners:**	
Lake County		Lake County Planning Department, OWEB, ODFW, Lake County Watershed Councils, ODOT, USFW, BLM	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.		
Action Item Status:	Long-Term		

Proposed Action and Priority:	Alignment with Plan Goals:
FL #3 – High - Revisit the maintenance procedures and responsibilities described in the Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR. Implement maintenance program on drainage channels from Deadman and Bullard Canyon through Lakeview. The Manual is included in the *2020 Lake County NHMP* as an appendix.	Goals 1, 2, 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Drainage channels have been inundated with sediment and are not at sufficient depth to carry drainage load. This creates flooding over channels on public and private lands causing property damage and over roadways
- Willows have encroached on channels, blocking entrances to culverts creating back up of drainage flow
- Some drainage culverts cannot be replaced with larger diameter culverts because they are buried and there are height limitations on diameter of pipes
- Culverts buried at Center St. and T St. to S St. have flooded due to clogging from debris creating standing water on nearby private property where homes are located. This has resulted in standing high water across the intersection.
- The intersection of Stockdrive Rd and Roberta Rd has been flooded due to clogged ditches. This back up has overflowed the intersection causing standing high water. Both Stockdrive Rd and Roberta Rd are secondary roads in Lakeview and are frequently used.
- Flooding and water back-up events have occurred about every 5 years, according to Lake County Roads Master.
- If a heavy rain or snow-melt year were to occur Lakeview would be at risk of flooding due to insufficient drainages.

Ideas for Implementation:

- Coordinate with Lake County Watershed Councils and ODFW to ensure proper stream habitat and quality.
- Coordinate with Town of Lakeview Public Works to obtain applicable permits to clean channels.

Coordinating Organization:	Town of Lakeview, Lake County, and Lake County Soil and Water Conservation District

Internal Partners:	External Partners:	
Lakeview, Lakeview Public Works	ODFW, Lake County Watershed Councils,	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		On-going

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	On-going

Proposed Action and Priority:	Alignment with Plan Goals:
FL #4 – High - Replace to enlarge and properly construct storm drain at Hwy 31 and Mill Street in Paisley.	Goal 1 and 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Water flow problems create hazardous situation and flooding in this area. The situation should be evaluated and reconfigured.
- Currently every time it rains the storm drain backs up with water. This occurs approximately 20 times annually according to a Paisley resident.
- Water often floods the intersection of Hwy 31 and Mill Street to an average depth of 14-16 inches.
- Standing water usually takes about 3 days to drain.
- Existing culvert is approximately 12" in diameter but is filled with debris only allowing approx. 4-5" drainage room on top portion of culvert.
- Drainage sink is approximately 2' deep and is also filled with debris to a depth of approx. 12".
- Highway 31 is managed by the State of Oregon, while Mill Street is managed by Lake County Roads Department.

Ideas for Implementation:

- Coordination with Paisley, Lake County, and ODOT is needed to determine what to do, how to fund it, and establish a timeline.

Coordinating Organization:	City of Paisley	
Internal Partners:	**External Partners:**	
Paisley, Lake County	Paisley, Lake County Roads Department, ODOT	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term
Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.	
Action Item Status:	Long-Term	

Proposed Action and Priority:	Alignment with Plan Goals:
FL #5 – High - Ensure continued compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain management ordinances.	Goal 1 and 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- The National Flood Insurance Program provides communities federally backed flood insurance to homeowners, renters, and business owners, provided that communities develop and enforce adequate floodplain management ordinances. The benefits of adopting NFIP standards for communities are a reduced level of flood damage in the community and stronger buildings that can withstand floods. According to the NFIP, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance.
- Like many locations in Eastern Oregon, FEMA has not updated the Flood Insurance Rate Maps (FIRMS) in several years. Due to their ages, maps are not guaranteed to accurately represent present flood conditions. Additionally, maps are not digital. Lake County, Lakeview and Paisley's FIRMs were completed in 1989 and 1990.
- The Disaster Mitigation Act of 2000 requires communities to identify mitigation actions that address new and existing buildings and infrastructure [201.6(c)(3)(ii)]. Continued participation in the NFIP will help reduce the level of flood damage to new and existing buildings in communities while providing homeowners, renters and business owners additional flood insurance protection.
- The Community Assistant Visit (CAV) is a visit from the Oregon NFIP Coordinator to a community participating in the NFIP for the purpose of: 1) Conducting a comprehensive assessment of the community's floodplain management program; 2) assisting the community and its staff in understanding the NFIP and its requirements; and 3) assisting the community in implementing effective flood loss reduction measures when program deficiencies or violations are discovered.

Ideas for Implementation:

- Actively participate with DLCD and FEMA during Community Assistance Visits.
- Conduct an assessment of the floodplain ordinances to ensure they reflect current flood hazards and situations, and meet NFIP requirements.
- The cities should coordinate with the county to ensure that floodplain ordinances and NFIP regulations are maintained and enforced.

Coordinating Organization:	Lake County Planning		
Internal Partners:		**External Partners:**	
Town of Lakeview, City of Paisley,		FEMA, OEM, DLCD, State NFIP Coordinator	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			On-going
Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.		
Action Item Status:	On-going		

Proposed Action and Priority:	**Alignment with Plan Goals:**
FL #7 – High - Connect and establish a relationship with the U.S. Army Corps of Engineers Silver Jackets Program, which is able to provide timely assistance to requests from Lake and all rural counties.	Goals 1-5

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Lake County and the Cities have limited resources and a great need for assistance with projects. The Silver Jackets program has a reputation for being collaborative and accomplishing projects efficiently and effectively. Building a relationship with the Silver Jackets will strengthen the ability of the County and Cities to accomplish projects, notably those listed in the *2020 Lake County NHMP* mitigation actions.
- Lake County should coordinate with the State IHMT Silver Jackets program, which is a joint state-federal and local flood mitigation subcommittee, which is tied to a national USACE initiative. 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.

  Objectives of this 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.
- The State of Oregon established "Silver Jackets", as a subcommittee to the IHMT, with the primary intents of strengthening interagency relationships and cooperation, optimizing resources, and improving risk communication and messaging.

Ideas for Implementation:

- Discuss the NHMP mitigation actions at least twice a year.
- Establish a liaison on two from Lake County and the Cities with the Silver Jackets.
- Keep apprised of the projects that the Silver Jackets can assist with and the timing of them.

Coordinating Organization:	Lake County Emergency Manager

Internal Partners:	**External Partners:**
Lakeview, Paisley, Lake County	Lake County, Lakeview, Paisley, OEM, DLCD, IHMT, U.S. Army Corps of Engineers Silver Jackets, State of Oregon NFIP Coordinator

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Short-Term

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	Short-Term

Proposed Action Item:	Alignment with Plan Goals:
FL #8 – High - Levees and canals need to be revamped in Warner Valley. Have discussions to identify: what needs to be accomplished, who are the responsible parties, what is the timeline, and what resources are needed.	Goals 1-5

Alignment with Existing Plans/Policies:
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:
• The Emergency Manager identified this need. • Coordination is needed on this matter and will include the Warner Valley Water District, Lake County Emergency Manager, Lake County Water Master, and the Lake County Cooperative Weed Management Area. • Water users may have different needs and perspectives on what should be done.

Ideas for Implementation:
• Invite stakeholders to the discussion. Set date and time for the discussion. • Identify what needs to be accomplished, who are the responsible parties, what are the resources needed, and what is the timeline to accomplish it. • Seek funding.

Coordinating Organization:	Adel Water Improvement District, Plush Water Users, Lake County Emergency Manager, Lake County Water Master, Lake County Cooperative Weed Management Area

Internal Partners:	External Partners:	
Lake County, Lakeview, Paisley	Water users in Warner Valley	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Long-Term

Proposed Action and Priority:	Alignment with Plan Goals:
FL #9 – High - Identify three or four places in Lakeview to keep sandbags at around the County. Have the Warner Creek Correctional Facility make at least one sandbag machine and install it in the identified place.	Goal 1-5

Alignment with Existing Plans/Policies:
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Flooding is a natural hazard with high priority to address in Lake County.
- Having sandbags readily available and accessible around the County will make it easier for service providers and residents to reduce risk to people and property from flooding.
- Having a sandbag machine will expedite the process of filling sandbags.
- Warner Creek Correctional Facility can provide materials at an economical rate.

Ideas for Implementation:

- Have the NHMP Steering Committee and Emergency Management Team identify the three or four places the sandbags can be located in the County.
- Talk with Warner Creek Correctional Facility about making the sandbag machine and installing it. Obtain a cost estimate for those activities.

Coordinating Organization:	Lake County Emergency Manager and Lake County Roads Department

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	Town of Lakeview, City of Paisley, Warner Creek Correctional Facility

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Short-Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Short-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
FL #10 – High - Identify which culverts need to be replaced and other relevant work to improve drainage on Roberta Street in Lakeview.	Goal 1-5

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- The NHMP Steering Committee noted that culverts on Roberta Street are not functioning well. They should be replaced and other work should be done to improve drainage on the street.
- More specific evaluation is needed. A list of which culverts need to be replaced should be made. Corresponding work to improve drainage should also be identified.
- Work should be prioritized and funding identified to support it. A timeline will need to be established.

Ideas for Implementation:

- The Coordinating Organizations and partners should discuss the matter. These discussions could occur at the NHMP maintenance meetings and or the Emergency Management Team meetings.

Coordinating Organization:	Lake County Emergency Manager, Town of Lakeview

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	U.S. Army Corps of Engineers Silver Jackets

Potential Funding Sources:	Estimated cost:	Timeline:
		Short-Term
Form Submitted by:	2020 NHMP Steering Committee	
Action Item Status:	Short-Term	

Proposed Action and Priority:	Alignment with Plan Goals:
FL #11 – High - Explore the option to: put up NO DUMPING signs at locations near Deadman and Bullard Creeks; and to send letters to each property owner in the area to remind them to trim willows, clear culverts, and not dump into water. Include information about removing and burning vegetation and other materials.	Goals 1, 2, 4

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Debris in the creeks, ranging from vegetation to trash, impedes water flow.
- Sending letters to property owners on a yearly basis will remind people of their responsibilities and of the potential hazard of an overflowing/flooding creek.
- Inform people of the consequences of not trimming vegetation and dumping material into the water.
- Having signs that say NO DUMPING provides a clear visual that dumping of debris into the creeks is not allowed and is not tolerated.

Ideas for Implementation:

- NO DUMPING signs and letters can be put together as a collaboration between the Coordinating Organization and the partners.
- This information is part of the outreach that is described on the Natural Hazards Mitigation Plan Outreach Calendar that is included in the appendix of the *2020 Lake County NHMP*.

Coordinating Organization:	Lake County Emergency Manager, Lake County Road Department, Town of Lakeview Public Works

Internal Partners:	External Partners:	
Lake County, Lakeview, Paisley	Lake County Tax Assessor	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Short-Term
Form Submitted by:	2020 NHMP Steering Committee	
Action Item Status:	Short-Term	

Proposed Action and Priority:	Alignment with Plan Goals:
FL #12 – High - Initiate, plan, and accomplish a collaborative effort to remove vegetation (primarily willows) at the north end of Crump Lake in the "Narrows." Consider also doing vegetation removal at 20 Mile Creek. The lake contain the Warner sucker (*Catostomus warnerensis*) which is a rare species of freshwater ray-finned fish in the family *Catostomidae*. The fish is a native to Oregon found only in the Warner Basin. It is a federally listed threatened species. The purpose of the removal of vegetation is to remove impediments to water flow (which ultimately causes flooding). The vegetation removal work would occur in a seasonally appropriate timeframe. Maintenance of the area identified for vegetation removal would continue in subsequent years as needed. Possible methods of removal include 1) pesticide application and burning vegetation, 2) mechanical removal such as use of a backhoe, and 3) constructing a spillway. At this time, the pesticide application and burning vegetation is identified as the cheapest and most effective means to use.	Goals 1-5

Alignment with Existing Plans/Policies:
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:
• This mitigation action is one of several that were discussed at the Flood After Action meeting on 4/18/19. It is a complex situation involving multiple agencies and many requirements. Based on conversations with numerous identified partners, all were supportive of this mitigation action to try to address the problems. • Additional conversations are needed.

Ideas for Implementation:
• The NHMP Steering Committee and the Emergency Management Team could discuss this at their meetings. Additional meetings may also be needed work through the issues, establish the next steps, identify responsible partners and funding sources, and set a timeline.

Coordinating Organization:	Lake County Cooperative Weed Management Area, Adel Water Improvement District, Plush Water Users

Internal Partners:	External Partners:
Lake County, Lakeview, Paisley	Lake County Emergency Manager, ODFW, DSL, USFW, BLM

Potential Funding Sources:	Estimated cost:	Timeline:
		Long-Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Long-Term

Proposed Action and Priority:	Alignment with Plan Goals:

FL #13 – High - Redesign stream crossing on road to Warner Shooting Range. Design it in a fashion that will allow water to pass over the road in a designated, armored location that will prevent the road from washing out in the event the stream crossing becomes blocked or compromised by debris.	Goals 1-5
Alignment with Existing Plans/Policies:	
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action Item:	
• This mitigation action is one of several that were discussed at the Flood After Action meeting on 4/18/19. It is a complex situation involving multiple agencies and many requirements. Based on conversations with numerous identified partners, all were supportive of this mitigation action to try to address the problems. • Additional conversations are needed.	
Ideas for Implementation:	
• The NHMP Steering Committee and the Emergency Management Team could discuss this at their meetings. Additional meetings may also be needed work through the issues, establish the next steps, identify responsible partners and funding sources, and set a timeline.	

Coordinating Organization:	Lake County Emergency Manager, Lake County Road Department, Town of Lakeview		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		USFS, ODF	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2020 NHMP Steering Committee		
Action Item Status:	Long-Term		

Proposed Action and Priority:	**Alignment with Plan Goals:**
FL #14 – High - Install at least one continuous monitoring device at Bullard Dam and Reservoir which would provide an alarm in the event a catastrophic failure of the structure occurred.	Goal 1-5
Alignment with Existing Plans/Policies:	
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action Item:	
• The Emergency Action Plan Bullard Dam (signed in 1998) says there are no continuous monitoring devices at Bullard Dam and Reservoir. • One needs to be installed. • Doing the required maintenance at Bullard Dam and Reservoir has been lacking. The responsible parties have agreed to be more attentive henceforth.	
Ideas for Implementation:	

• Review the Emergency Action Plan Bullard Dam annually with the NHMP Steering Committee and Emergency Management Team. Review other related documents. • Establish the steps and funds to obtain the continuous monitoring device and install it.			
Coordinating Organization:	Lake County Emergency Manager, Town of Lakeview Public Works, Lake County Soil and Water Conservation District		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		Lake District Hospital	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2020 NHMP Steering Committee		
Action Item Status:	Long-Term		

Proposed Action and Priority:		**Alignment with Plan Goals:**	
FL #15 – High - Install a radio telemetered staff gage at the Bullard Creek Flood Conduit at the mouth of the canyon. It would be designed to alert the Town of Lakeview Department of Public Works that there is an unusual rise in the downstream water surface and monitoring for a potentially hazardous condition should be initialized.		Goal 1-5	
Alignment with Existing Plans/Policies:			
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans			
Rationale for Proposed Action Item:			
• In the Emergency Action Plan Bullard Dam (signed in 1998) it says there are plans to install one. • A radio telemetered staff gage needs to be installed as designated by the Emergency Action Plan Bullard Dam. • The responsible parties will purchase and install one.			
Ideas for Implementation:			
• Review the Emergency Action Plan Bullard Dam annually with the NHMP Steering Committee and Emergency Management Team. Review other related documents. • Establish the steps and funds to obtain the radio telemetered staff age device and install it.			
Coordinating Organization:	Lake County Emergency Manager, Town of Lakeview Public Works, Lake County Soil and Water Conservation District		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		Lake District Hospital	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2020 NHMP Steering Committee		
Action Item Status:	Long-Term		

Proposed Action and Priority:	Alignment with Plan Goals:
FL #16 – High - Work with ODOT to accomplish storm drain maintenance and clean out culverts.	Goals 1, 2, 4

Alignment with Existing Plans/Policies:
Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:
• This mitigation action was suggested by the NHMP Steering Committee on 5/22/19. • Culvert and storm drain maintenance is a concern for the County and the Cities.

Ideas for Implementation:
• Have the Lake County staff, including the Emergency Manager, meet with ODOT to identify needs, list and prioritize them, identify responsibilities, and establish a more effective relationship to meet needs.

Coordinating Organization:	Lakeview Public Works

Internal Partners:	External Partners:	
Lake County, Lakeview, Paisley	ODOT	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Long-Term

Proposed Action and Priority:	Alignment with Plan Goals:
WF #1 – High-medium - Establish fuel breaks to the south and west of Christmas Valley as recommended by the Lake County Community Wildfire Protection Plan Phase II	Goals 1, 3, 4, 5

Alignment with Existing Plans/Policies:
Lake County CWPP, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:
• BLM has made fuel breaks along the road but additional work needs to be done. • Christmas Valley is surrounded by highly-ignitable and quick-burning sagebrush flats • Establishing fuel breaks and fuel reduction efforts reduce the risk of fire spreading to and from public and private lands • Fuel mitigation projects were identified and prioritized based on proximity to community, hazardous fuel load and continuity, terrain and professional experience (CWPP, 21). • Fuel breaks break up continuity of fuel such as juniper, sagebrush, grass and weeds to reduce wildfire rate of spread and severity to allow fire fighters a chance at suppression (CWPP, 24). • Christmas Valley is surrounded by parcels of irrigated and non-irrigated hayfields and wetlands. These may provide wildfire protection because they break up continuity of wildland fuels.

However, during late summer and fall the hayfields and some wetlands may dry and become hazardous fuels (CWPP, 28).

- Fuel breaks would limit the potential for embers from wildfires to ignite dried vegetation in town causing spot fires (CWPP, 28).
- Values at risk of wildfire include human welfare, private and public lands, businesses, farmland, ranchland, grazing land, and hunting and other recreation land. They are at risk because of hazardous fuel build-up around communities and structures, poor emergency vehicle ingress and egress, and then on-going need for training and/or upgrading of fire suppression equipment (CWPP, 11).
- Christmas Valley is under the authority of the Christmas Valley Rural Fire Protection District which is limited by personnel, equipment and funds. Partnering to creating fuel breaks would ease responsibility of the CVRFPD both in wildfire mitigation and fuels management.

Ideas for Implementation:

- Fuel breaks would be constructed using hand crews, mowers, brush choppers, livestock grazing prescribed fire, or bulldozer depending on the vegetation type and terrain (CWPP, 27).
- Appropriate best management practices would be followed in fuel break implementation (CWPP, 27).
- Fuel breaks would be at least 30-50 feet wide or wider on slopes with length varying according to placement and terrain (CWPP, 27).
- Care is needed to ensure minimal vegetation removals so the fuel break does not become potential habitat for annual weeds (CWPP, 27).
- The economical use of logs and small diameter materials for biomass energy production should be explored (CWPP, 24).
- All hazardous fuel treatments would be implemented following federal, state and county policy (CWPP, 24).

Coordinating Organization:	Community Wildfire Protection Plan (CWPP) Committee

Internal Partners:	**External Partners:**
BLM, ODF, USFS, Lakeview Interagency Fire Center, Lake County Planning Department	BLM, ODF, USFS, Lakeview Interagency Fire Center, Lake County Resource Initiative, Lake County Planning Department, Rural Fire Protection Districts, Rangeland Fire Protection Associations

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Short-Term

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	Short-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
WF #2 – High-medium - Determine appropriate location; establish fuel reduction projects and implement landscape scale forest restoration to reduce wildfire risk in and around Drews Gap, Lakeview, Paisley, and Summer Lake.	Goals 1, 3, 4, 5

Alignment with Existing Plans/Policies:

Lake County CWPP, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Build upon past successful efforts and continue to work comprehensively with watershed and forest restoration efforts.
- The communities of Drews Gap, Lakeview, Paisley, and Summer Lake will benefit from the broader restoration approach.
- Drews Gap is located adjacent to the Winema-Fremont National Forest and has been determined to be in a WUI area by head of the Lake County Fire Council.
- Actions pertaining to Drews Gap have been prioritized by Head of the Lake County Fire Council.
- Phase II of the LCCWPP did not determine or suggest fuel break location but recommended that fuel breaks be implemented.
- Establishing fuel breaks and fuel reduction efforts reduce the risk of fire spreading to and from public and private lands.
- Fuel mitigation projects were identified and prioritized based on proximity to community, hazardous fuel load and continuity, terrain and professional experience (CWPP, 21)
- Fuel breaks break up continuity of fuel such as juniper, sagebrush, grass and weeds to reduce wildfire rate of spread and severity to allow fire fighters a chance at suppression (CWPP, 24).
- Values at risk of wildfire include human welfare, private and public lands, businesses, farmland, ranchland, grazing land, and hunting and other recreation land. They are at risk because of hazardous fuel build-up around communities and structures, poor emergency vehicle ingress and egress, and then on-going need for training and/or upgrading of fire suppression equipment (CWPP, 11).
- Drews Gap is not under a specified RFPD and therefore has no formal fire protection. Currently, if there is a fire in the area, fire authorities that respond are reimbursed for their efforts. However, response times for initial attack are lengthy (CWPP, 9).

Ideas for Implementation:

- Fuel breaks would be constructed using hand crews, mowers, brush choppers, livestock grazing prescribed fire, or bulldozer depending on the vegetation type and terrain (CWPP, 27).
- Appropriate best management practices would be followed in fuel break implementation (CWPP, 27).
- Fuel breaks would be at least 30-50 feet wide or wider on slopes with length varying according to placement and terrain (CWPP, 27).
- Care is needed to ensure minimal vegetation removals so the fuel break does not become potential habitat for annual weeds (CWPP, 27).
- The economical use of logs and small diameter materials for biomass energy production should be explored (LCCWPP, 24).
- All hazardous fuel treatments would be implemented following federal, state and county policy (CWPP, 24).

Coordinating Organization:	Klamath Lake Forest Health Partnership

Internal Partners:	External Partners:	
Lake County Emergency Management and Lake County Planning Department	BLM, ODF, USFS, OSU Extension, Lake County Umbrella Watershed Council, Lakeview Interagency Fire Center, Lake County Resource Initiative, Lake County Planning Department, Rural Fire Protection Districts, Rangeland Fire Protection Associations, Lake County CWMA, NRCS, Lake County SWCD	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Short-Term
Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013. Substantially revised in 2020.	
Action Item Status:	Short-Term	

Proposed Action Item and Priority:	Alignment with Plan Goals:
WF #3 – High-medium - Develop management plan and actively manage the Town of Lakeview's municipal watershed to reduce wildfire risk.	Goals 1, 3, 4, 5

Alignment with Existing Plans/Policies:

Lake County CWPP, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- Expand upon past success. Coordinate with landscape scale restoration on adjacent public and private lands.
- The East half of Lakeview borders a Wildland-Urban Interface area. Creating a fuel break will both prevent a wildland fire from entering Lakeview and a structure fire from Lakeview to enter into forested lands.
- Fuel mitigation projects were identified and prioritized based on proximity to community, hazardous fuel load and continuity, terrain and professional experience (CCWPP, 21).
- Fuel breaks break up continuity of fuel such as juniper, sagebrush, grass and weeds to reduce wildfire rate of spread and severity to allow fire fighters a chance at suppression (CWPP, 24).
- Values at risk of wildfire include human welfare, private and public lands, businesses, farmland, ranchland, grazing land, and hunting and other recreation land. They are at risk because of hazardous fuel build-up around communities and structures, poor emergency vehicle ingress and egress, and then on-going need for training and/or upgrading of fire suppression equipment (CWPP, 9)
- Fuel breaks would limit the potential for embers from wildfires to ignite dried vegetation in town causing spot fires (CWPP, 25).
- Lakeview Fire Department has responsibility for structure, grass and vehicle fires within the Town of Lakeview. However, the department will respond to fires within a 1-mile radius around Lakeview (CWPP, 8).

Ideas for Implementation:

- Fuel breaks would be constructed using hand crews, mowers, brush choppers, livestock grazing

prescribed fire, or bulldozer depending on the vegetation type and terrain (LCCWPP, 25).

- Appropriate best management practices would be followed in fuel break implementation (LCCWPP, 25).
- Fuel breaks would be at least 30-50 feet wide or wider on slopes with length varying according to placement and terrain (LCCWPP, 25).
- Care is needed to ensure minimal vegetation removals so the fuel break does not become potential habitat for annual weeds (LCCWPP, 25).
- The economical use of logs and small diameter materials for biomass energy production should be explored (LCCWPP, 24).
- All hazardous fuel treatments would be implemented following federal, state and county policy (CWPP, 25).

Coordinating Organization:	Town of Lakeview and ODF

Internal Partners:	**External Partners:**	
Lake County Emergency Management and Lake County Planning	USFS, Lake County Resource Initiative, Lake County Umbrella Watershed Council, OSU Extension, ODFW, Lake County CWMA	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		On-going

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013. Substantially revised in 2020.
Action Item Status:	On-going

Proposed Action and Priority:	**Alignment with Plan Goals:**
WF#4 – High-medium - Construct barriers on pole power transformers to prevent birds from building nests on them, thereby reducing the chance of wildfires from transformer shorts.	Goals 1, 2, 4

Alignment with Existing Plans/Policies:

Lake County CWPP, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

This action was developed for the Harney County NHMP and incorporated into the Lake County NHMP since the Harney Electric Cooperatives service area includes a portion of Lake County.

Rationale for Proposed Action Item:

• Birds making nests on transformers attached to power poles can cause power shorts which often lead to wildfires. Installing barriers on power transformers to prevent birds from nesting on them will reduce the electrocution risk to birds, decrease the amount of power outages, and reduce the chance of sparking a wildfire.

• The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that will reduce the effects of hazards on the community, particularly to critical infrastructure [201.6(c)(3)(ii)]. Constructing barriers on power transformers will assist in reducing the potential for power outages, while also protecting wildlife and reducing the likelihood of wildfires.

• This action is considered to be a multi-jurisdictional action since it benefits both the County and all the participating cities.

Ideas for Implementation:

• Coordinate with the nature organizations such as the Audubon Society or the Nature Conservancy to develop appropriate barriers that will prevent wildlife from nesting on power transformers.

Seek funding opportunities.

Coordinating Organization:	Harney Electric Cooperative, Inc. (covers Lake, Harney, and Malheur Counties)

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley	Lake County, Lakeview, Paisley, Audubon Society, Nature Conservancy, USFW, , Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		On-going

Form Submitted by:	2007 NHMP Steering Committee; Revised and confirmed in 2013 and 2020.
Action Item Status:	On-going

Proposed Action and Priority:	**Alignment with Plan Goals:**
WF#5 – High-medium - Manage weeds and vegetation growth at base of poles in fire prone regions.	Goal 1, 2, 4

Alignment with Existing Plans/Policies:

Lake County CWPP, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

This action was developed for the Harney County NHMP and incorporated into the Lake County NHMP since the Harney Electric Cooperatives service area includes a portion of Lake County.

Rationale for Proposed Action Item:

•For example soil sterilant herbicides are total kill products that last in the soil for long periods, particularly in arid environments. They are sometimes called bare-ground herbicides, as they are used to remove all vegetation from the area of application, and they persist in their active form for long periods. They are designed to be used in areas where wildfire is a risk.

• The application of sterilant around the base of poles may prevent wildfires from damaging poles in high-risk areas.

• Another example is to use a spray-on product that could be applied on the pole to retard wildfire.

• The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that will reduce the effects of hazards on the community, particularly to critical infrastructure [201.6(c)(3)(ii)]. Constructing barriers on power transformers will assist in reducing the potential for power outages, while also protecting wildlife and reducing the likelihood of wildfires.

• This action is considered to be a multi-jurisdictional action since it benefits both the County and all the participating cities.

Ideas for Implementation:

•Apply sterilant around power poles in high fire risk areas.

•Apply fire retardant spray around outside of power poles in high fire risk areas.

Coordinating Organization:	Mid-state Electric Cooperative, PacifiCorp (Pacific Power & Light), Surprise Valley Electric Cooperative, Harney Electric Cooperative, Inc.

Internal Partners:	**External Partners:**	
Lake County, Lakeview, Paisley	Lake County, Lakeview, Paisley, BLM, USFW,	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		On-going

Form Submitted by:	2013 NHMP Steering Committee; reviewed and confirmed in 2020.
Action Item Status:	On-going

Proposed Action and Priority:	**Alignment with Plan Goals:**
WF#6 – High medium - The Community Wildfire Protection Plan (CWPP) group will be convened within three months from the FEMA approval of the NHMP (if it hasn't yet begun convening already).	Goals 1-5

Alignment with Existing Plans/Policies:

Lake County CWPP, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

•It is a priority identified by the NHMP Steering Committee to update the *2011 Lake County CWPP*.

• The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that will reduce the effects of hazards on the community, particularly to critical infrastructure [201.6(c)(3)(ii)].

• This action is considered to be a multi-jurisdictional action since it benefits both the County and all the participating cities.

Ideas for Implementation:

• Have the Coordinating Organizations invite existing and new members to the CWPP meeting. • Set a date and time for the first meeting. • At the first meeting, discuss membership, budget, schedule, and timeline.			
Coordinating Organization:	Lake County Emergency Manager, Lake County Commissioners, Oregon Department of Forestry		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		CWPP Committee, Fire Defense Board, BLM, Town of Lakeview, City of Paisley, volunteer fire departments, RFPAs	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2020 NHMP Steering Committee		
Action Item Status:	Long-Term		

Proposed Action and Priority:	**Alignment with Plan Goals:**
WF#7 – High-medium - Review the fire events that have occurred, pre-planning and response actions, and note the successes and areas in need of improvement.	Goals 1-5
Alignment with Existing Plans/Policies:	
Lake County CWPP, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action Item:	
•Reviewing the events that have occurred provides an opportunity to go through what was working effectively working and what was not. • Discussion can provide insight and ideas for ways to improve the situation. • Brainstorming on projects, tasks, relationships, and funding opportunities can occur. • The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that will reduce the effects of hazards on the community, particularly to critical infrastructure [201.6(c)(3)(ii)].	
Ideas for Implementation:	
• Have the discussion at the next NHMP Steering Committee maintenance meeting, the Emergency Management Team meeting, and or the Community Wildfire Protection Plan meeting. • Document the discussion and keep the information on file.	

Coordinating Organization:	Lake County Emergency Manager, Oregon Department of Forestry, Fire Defense Board		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		CWPP Committee, Fire Defense Board, BLM, Town of Lakeview, City of Paisley, volunteer fire departments, RFPAs, ODF, USFS, USF&W	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**

		Long-Term
Form Submitted by:	2020 NHMP Steering Committee	
Action Item Status:	Long-Term	

Proposed Action and Priority:	**Alignment with Plan Goals:**
WF #8 – High-medium -Explore the option to stablish a provision in the local building code that limits or prohibits the use of wood shingles on buildings in certain areas as determined appropriate.	Goals 1, 2, 3,5

Alignment with Existing Plans/Policies:

Lake County Community Wildfire Protection Plan (Phase I and II), Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that will reduce the effects of hazards on the community, particularly to critical infrastructure [201.6(c)(3)(ii)].
- Wood shingles burn easily in fires. Other building materials could be used. Or if would shingles are used, they should be treated to withstand fires.
- The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that will reduce the effects of hazards on the community, particularly to critical infrastructure [201.6(c)(3)(ii)].

Ideas for Implementation:

- Coordinate Wildfire Action Items through the CWPP and CWPP Core Team
- Examine fire data to see where fires are occurring, the size of the fire, and the extent of fire damage. Examine the use of different building materials and the ability of them to withstand fire.
- Think about a table or matrix of fire hazard level and type/size of structure.

Coordinating Organization:	Lake County Emergency Manager, Lake County Planning Department, Lake County Building Department

Internal Partners:	**External Partners:**	
Lake County, Lakeview, Paisley	Town of Lakeview, City of Paisley, State or Oregon Building Codes Division	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term
Form Submitted by:	2020 NHMP Steering Committee	
Action Item Status:	Long-Term	

Proposed Action and Priority:	**Alignment with Plan Goals:**
AQ #1 – High - Complete the EPA Advance Program's "Path Forward" for Lakeview and implement the regulatory programs developed within the document in order to meet	Goals 1, 2, 4

EPA PM 2.5 requirements.	

Alignment with Existing Plans/Policies:
2011 Lake County CWPP, *Lakeview Area PM Advance Program Action Plan – Update 2019*, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans
Rationale for Proposed Action Item:
• The Town of Lakeview experienced poor air quality in the 1990s, 2000s, and 2010s. In 2014, the Town of Lakeview and Lake County submitted a plan to DE to achieve emission reductions to help the area meet daily and annual PM2.5 standards. The plan is the Lakeview Area PM Advance Program Action Plan. Each year an update is made. Lakeview and Lake County work closely with DEQ to monitor the air quality. • Lakeview has a part time staff person, the Air Quality Program Coordinator. • There are multiple avenues of improving the air quality that Lake County and Lakeview focus upon. These include: the mandatory wood stove curtailment program; the wood stove changeout program and weatherization of homes; open burning prohibitions; public awareness and education; and prescribed burning limitations.
Ideas for Implementation:
The *Lakeview Area PM Advance Program Action Plan – Update 2019* provides details on the on-going activities. This *2020 Lake County NHMP* provides mitigation actions to further the existing efforts.

Coordinating Organization:	Lake County Road Department	
Internal Partners:	**External Partners:**	
Lake County Board of Commissioners, Paisley, Summer Lake	ODOT	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		On-going
Form Submitted by:	2013 NHMP Steering Committee; reviewed and confirmed in 2020.	
Action Item Status:	On-going	

Proposed Action and Priority:	**Alignment with Plan Goals:**
AQ #2 – High - Upgrade the air quality monitor owned by North Lake School District in Silver Lake.	Goals 1, 3, 4, 5
Alignment with Existing Plans/Policies:	
2011 Lake County CWPP, *Lakeview Area PM Advance Program Action Plan – Update 2019*, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action Item:	

- The Town of Lakeview experienced poor air quality in the 1990s, 2000s, and 2010s. In 2014, the Town of Lakeview and Lake County submitted a plan to DE to achieve emission reductions to help the area meet daily and annual PM2.5 standards. The plan is the Lakeview Area PM Advance Program Action Plan. Each year an update is made. Lakeview and Lake County work closely with DEQ to monitor the air quality.
- Lakeview has a part time staff person, the Air Quality Program Coordinator.
- There are multiple avenues of improving the air quality that Lake County and Lakeview focus upon. These include: the mandatory wood stove curtailment program; the wood stove changeout program and weatherization of homes; open burning prohibitions; public awareness and education; and prescribed burning limitations.

Ideas for Implementation:

The *Lakeview Area PM Advance Program Action Plan – Update 2019* provides details on the on-going activities. This *2020 Lake County NHMP* provides mitigation actions to further the existing efforts.

Coordinating Organization:	Lake County Emergency Manger and North Lake School District/Superintendent

Internal Partners:	**External Partners:**	
Lake County, Lakeview, Paisley,	DEQ, Lake District Hospital	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Long-Term

Proposed Action and Priority:	**Alignment with Plan Goals:**
AQ #3 – High -Evaluate the options of air quality monitors, then purchase and install an air quality monitor in the City of Paisley. Maintain it.	Goals 1, 3, 4, 5,

Alignment with Existing Plans/Policies:

2011 Lake County CWPP, *Lakeview Area PM Advance Program Action Plan – Update 2019*, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- The Town of Lakeview experienced poor air quality in the 1990s, 2000s, and 2010s. In 2014, the Town of Lakeview and Lake County submitted a plan to DE to achieve emission reductions to help the area meet daily and annual PM2.5 standards. The plan is the Lakeview Area PM Advance Program Action Plan. Each year an update is made. Lakeview and Lake County work closely with DEQ to monitor the air quality.
- Lakeview has a part time staff person, the Air Quality Program Coordinator.
- There are multiple avenues of improving the air quality that Lake County and Lakeview focus upon. These include: the mandatory wood stove curtailment program; the wood stove changeout program and weatherization of homes; open burning prohibitions; public awareness and education; and prescribed burning limitations.

Ideas for Implementation:

The *Lakeview Area PM Advance Program Action Plan – Update 2019* provides details on the on-going activities. This *2020 Lake County NHMP* provides mitigation actions to further the existing efforts.			
Coordinating Organization:	Lake County Emergency Manager and City of Paisley		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley		Paisley School District, DEQ, Lake District Hospital	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2020 NHMP Steering Committee		
Action Item Status:	Long-Term		

Proposed Action and Priority:	**Alignment with Plan Goals:**
AQ #4 – High - Reinstall education in the school districts about air quality: impacts of it, steps to take, and so forth.	Goals 1, 3, 4, 5,
Alignment with Existing Plans/Policies:	
2011 Lake County CWPP, *Lakeview Area PM Advance Program Action Plan – Update 2019*, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans	
Rationale for Proposed Action Item:	
• The Town of Lakeview experienced poor air quality in the 1990s, 2000s, and 2010s. In 2014, the Town of Lakeview and Lake County submitted a plan to DE to achieve emission reductions to help the area meet daily and annual PM2.5 standards. The plan is the Lakeview Area PM Advance Program Action Plan. Each year an update is made. Lakeview and Lake County work closely with DEQ to monitor the air quality. • Lakeview has a part time staff person, the Air Quality Program Coordinator. • There are multiple avenues of improving the air quality that Lake County and Lakeview focus upon. These include: the mandatory wood stove curtailment program; the wood stove changeout program and weatherization of homes; open burning prohibitions; public awareness and education; and prescribed burning limitations.	
Ideas for Implementation:	
The *Lakeview Area PM Advance Program Action Plan – Update 2019* provides details on the on-going activities. This *2020 Lake County NHMP* provides mitigation actions to further the existing efforts.	
Coordinating Organization:	Lake County Emergency Manager, Lake County School District, North Lake School District, Paisley School District, Lake District Hospital,

Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley,		DEQ, City of Paisley, Town of Lakeview, SCOFMP	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Long-Term
Form Submitted by:	2020 NHMP Steering Committee		
Action Item Status:	Long-Term		

Proposed Action and Priority:	Alignment with Plan Goals:
AQ #5 – High - Expand outreach efforts to the community about air quality: impacts of it, steps to take, advice for air filters, and so forth.	Goals 1, 3, 4, 5

Alignment with Existing Plans/Policies:

2011 Lake County CWPP, *Lakeview Area PM Advance Program Action Plan – Update 2019*, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- The Town of Lakeview experienced poor air quality in the 1990s, 2000s, and 2010s. In 2014, the Town of Lakeview and Lake County submitted a plan to DE to achieve emission reductions to help the area meet daily and annual PM2.5 standards. The plan is the Lakeview Area PM Advance Program Action Plan. Each year an update is made. Lakeview and Lake County work closely with DEQ to monitor the air quality.
- Lakeview has a part time staff person, the Air Quality Program Coordinator.
- There are multiple avenues of improving the air quality that Lake County and Lakeview focus upon. These include: the mandatory wood stove curtailment program; the wood stove changeout program and weatherization of homes; open burning prohibitions; public awareness and education; and prescribed burning limitations.

Ideas for Implementation:

The *Lakeview Area PM Advance Program Action Plan – Update 2019* provides details on the on-going activities. This *2020 Lake County NHMP* provides mitigation actions to further the existing efforts.

Coordinating Organization:	Lake County Emergency Manger, City of Paisley, Town of Lakeview, Lake District Hospital

Internal Partners:	External Partners:	
Lake County, Lakeview, Paisley,	DEQ, SCOFMP	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		Long-Term

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	Long-Term

Proposed Action and Priority:	Alignment with Plan Goals:
AQ #6 – High - Lake County NHMP Steering Committee / Emergency Preparedness Group read and discuss the Lakeview Area – Particulate Matter (PM 2.5) Advance Action Plan (September 2014) and the most current edition of the Lakeview Area PM Advance Program Action Plan – Update (currently dated October 2019) each year at an NHMP maintenance meeting.	Goals 1, 3, 4, 5

Alignment with Existing Plans/Policies:

2011 Lake County CWPP, *Lakeview Area PM Advance Program Action Plan – Update 2019*, Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- The Town of Lakeview experienced poor air quality in the 1990s, 2000s, and 2010s. In 2014, the Town of Lakeview and Lake County submitted a plan to DE to achieve emission reductions to help the area meet daily and annual PM2.5 standards. The plan is the Lakeview Area PM Advance Program Action Plan. Each year an update is made. Lakeview and Lake County work closely with DEQ to monitor the air quality.
- Lakeview has a part time staff person, the Air Quality Program Coordinator.
- There are multiple avenues of improving the air quality that Lake County and Lakeview focus upon. These include: the mandatory wood stove curtailment program; the wood stove changeout program and weatherization of homes; open burning prohibitions; public awareness and education; and prescribed burning limitations.

Ideas for Implementation:

The *Lakeview Area PM Advance Program Action Plan – Update 2019* provides details on the on-going activities. This *2020 Lake County NHMP* provides mitigation actions to further the existing efforts.

Coordinating Organization:	Lake County Emergency Manager, NHMP Steering Committee/Emergency Preparedness Group

Internal Partners:	**External Partners:**
Lake County, Lakeview, Paisley,	DEQ, City of Paisley, Town of Lakeview, Lake District Hospital, ODF, Paisley School District, Lake County School District, North Lake School District, Adel School District 21, Plush School District 21

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		On-going

Form Submitted by:	2020 NHMP Steering Committee
Action Item Status:	On-going

Proposed Action and Priority:	**Alignment with Plan Goals:**
WWS #1 – High - Install reader boards along Highway 31 between Summer Lake and Paisley	Goals 1, 3, 5

Alignment with Existing Plans/Policies:

Emergency Operations Plan, *2020 Lake County NHMP*, County and City Comprehensive Plans

Rationale for Proposed Action Item:

- High wind events frequently occur along Highway 31 between Paisley and Summer Lake. Installing reader boards (temporary or permanent) would allow drivers to be warned of possible high wind events.
- It was noted that a dozen trucks have turned over in the past eight years along the road. There are small signs on the highway

Ideas for Implementation:

- Coordinate with ODOT and obtain reader boards at appropriate locations along Highway 31.
- Have a meeting with all the partners to discuss and establish a timeline, funding, responsibilities, and other matters as applicable.

Coordinating Organization:	Oregon State Police		
Internal Partners:		**External Partners:**	
Lake County, Lakeview, Paisley,		Lake County Board of Commissioners, Paisley, Summer Lake, ODOT	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
			Short-Term
Form Submitted by:	2020 NHMP Steering Committee		
Action Item Status:	Short-Term		

APPENDIX B:
PLANNING AND PUBLIC PROCESS

Table of Contents

Tables

Purpose

This Appendix describes the changes made to the *2013 Lake County Natural Hazards Mitigation Plan (NHMP)* during the plan update process that resulted in the *2020 Lake County NHMP*.

Project Background

Lake County partnered with the Oregon Department of Land Conservation and Development (DLCD) to update the *2013 Lake County Natural Hazards Mitigation Plan (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 Pre-Disaster Mitigation (PDM) program funding, Flood Mitigation Assistance (FMA) program funding, and Hazard Grant Mitigation Program (HMGP) funding.

DLCD staff met with members of the Lake County NHMP Steering Committee, led by Daniel Tague, for this update to the *2013 Lake County NHMP*. The Lake County NHMP Steering Committee includes Lake County, the Town of Lakeview, and the City of Paisley. A roster of the Steering Committee is included in the Acknowledgements section of this NHMP and in this Appendix.

2020 Plan Update Changes and Integration of Information

The entire *2013 Lake County NHMP* has been revised and updated. While the basic format of the existing NHMP was retained, substantial changes have been made. In Table B-1, the sections of the *2013 Lake County NHMP* are compared and contrasted to the *2020 Lake County NHMP*. A more complete description of each of the sections is provided in the text after Table B-1.

Table B-1 Changes to Plan Organization

2013 Lake County NHMP	2020 Lake County NHMP
Cover, FEMA Approval Letters, Jurisdictional Resolutions,	Cover, FEMA Approval Letters, Jurisdictional Resolutions,
Acknowledgements, Table of Contents	Acknowledgements, Table of Contents
Executive Summary	Executive Summary
Volume I: Basic Plan	Volume I: Basic Plan
Section 1: Introduction	Section 1: Introduction
Section 2: Risk Assessment	Section 2: Risk Assessment
Section 3: Mitigation Strategy	Section 3: Mitigation Strategy
Section 4: Plan Implementation and Maintenance	Section 4: Plan Implementation and Maintenance
Volume II: Hazard Annexes	Volume II: Hazard Annexes with Introduction
Drought	Drought
Earthquake	Earthquake
Flood	Flood
Landslide	Landslide

Volcanic Event	Volcanic Event
Wildfire	Wildfire
Wind Storms and Winter Storms in separate annexes	Wind Storms and Winter Storms together in one annex
There was no Air Quality Annex in the 2013 NHMP even though it was an identified hazard.	Air Quality
Volume III: Jurisdictional Addenda	Information from this section of the NHMP has been integrated into the main body of the NHMP. For example, each hazard section in Volume II includes Lake County, the Town of Lakeview, and the City of Paisley.
Town of Lakeview	
City of Paisley	
Volume IV: Mitigation Resources	Volume III: Mitigation Resources
Appendix A: Action Item Forms	Appendix A: Mitigation Action Forms
Appendix B: Planning and Public Process	Appendix B: Planning and Public Process
Appendix C: Community Profile	Appendix C: Community Profile
Appendix D: Economic Analysis of Natural Hazards Mitigation Projects	Appendix D: Economic Analysis of Natural Hazards Mitigation Projects
Appendix E: Grant Programs and Resources	Appendix E: Grant Programs and Resources
Appendix F: Regional Household Preparedness Survey	Appendix F: Future Climate Projections Reports
	Appendix G: Lake County NHMP Success Stories
	Appendix H: Lake County HAZUS Global Reports for Crustal and Probabilistic Scenarios
	Appendix I: Lake County Natural Hazards Mitigation Plan (NHMP) Natural Hazards Outreach Calendar
	Appendix J: Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR and the Emergency Action Plan Bullard Dam
	Appendix K: Lakeview Access Right-of-Way Agreement

Source: Tricia Sears, DLCD

The entire *2013 Lake County NHMP* was reviewed, revised, and updated. The *2020 Lake County 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. Information used ranges from local jurisdictional existing plans, studies, and policies, to state and federal information, and to 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 *2020 Lake County 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 County's resources as well as the

Cities. In addition to the plans listed in Tables 4-1 and C-23, the County and Cities also have 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.

During the NHMP update process, several key documents heretofore missing, were located and provide a basis for additional jurisdictional collaboration, and for several mitigation actions.

- In Appendix J, the Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR and the Emergency Action Plan Bullard Dam contain important details for the operation and maintenance of Bullard Creek and structures.
- In Appendix K, the Lakeview Access Right-of-Way Agreement is included. The agreement grants the right of the Town of Lakeview to go onto the landowner's property "for the sole and limited purpose of cleaning, clearing, repairing and maintaining the stream, stream bed and adjacent banks of Deadman Creek for flood, erosion and\or water flow control."

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 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 Lake County NHMP Steering Committee were to make the NHMP shorter, more user friendly, and less repetitive.

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 taken by Lake County and DLCD staff. Photos were also added to the Volume I, II, and III covers.
- The FEMA Approval Pending Adoption (APA) and final approval letter as well as the County and Cities resolutions of adoption are included (when available).
- The Acknowledgements have been updated to include the 2020 Lake County NHMP Steering Committee members.
- The Table of Contents has been updated.

Volume I: Basic Plan

Volume I includes the cover with photos, approval letters, jurisdictional resolutions, the Table of Contents, and the Executive Summary. It provides the overall plan framework for the *2020 Lake County NHMP*. It also contains Section 1: Introduction; Section 2: Risk Assessment; Section 3: Mitigation Strategy; and Section 4: Plan Implementation and Maintenance.

Executive Summary

The *2020 Lake County NHMP* includes an Executive Summary that provides information about the purpose of natural hazards mitigation planning and describes how the plan will be implemented.

Section 1: Introduction

Section 1 introduces the concept of natural hazards mitigation planning and answers the question, "Why develop a mitigation plan?" Additionally, Section 1 summarizes the plan update process, and provides an overview of how the plan is organized.

The main change to this section and the entire NHMP, is that information from the Town of Lakeview and the City of Paisley has been integrated into the Lake County information; in other words, rather than having separate addenda for the Cities, the Cities are included in the main body of the NHMP. Where applicable, the Cities are specifically called out for their unique situations.

Section 2: Risk Assessment

Section 2, Risk Assessment, consists of three phases: natural hazard identification, vulnerability assessment, and risk analysis. Hazard identification involves the identification of hazard geographic extent, its intensity, and probability of occurrence. The second phase combines the information from the hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard, then attempts to predict how different types of property and population groups will be affected by the hazard. The third phase involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time.

Changes to Section 2 include:

- Format changes to the document.
- The inclusion of the information from the Town of Lakeview and the City of Paisley in addition to the Lake County information in one Risk Assessment section instead of separate sections for the Cities.
- Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities were updated. More detailed information is within the specific hazard annexes of Volume II, the Appendix C Community Profile, and other Appendices.
- NFIP information was updated.
- The Lake County NHMP Steering Committee performed a new Hazard Vulnerability Analysis/Assessment (HVA), resulting in new scores for the identified hazards of drought, earthquake, flood, landslide, wind storms, winter storms, volcanic event, wildfire, and air quality. The HVA uses scores for the categories of history, maximum threat, probability, and vulnerability scores to obtain a risk score for each hazard. From these, the Steering Committee determined the risk level of each hazard. The risk level information was used to prioritize the mitigation actions into high, medium, and low.

Section 3: Mitigation Strategy

This section provides the basis and justification for the mission, goals, and mitigation actions identified in the NHMP. Changes to Section 3 include the following:

- The NHMP Steering Committee opted to prioritize mitigation actions as described in the section above, using the HVA risk levels. All the multi-hazard mitigation actions were identified as high priority while hazard specific mitigation actions are high, high-medium, medium, and low.
- The mission statement and the goals were reviewed and re-confirmed by the NHMP Steering Committee; one new goal was added.
- The mitigation actions from the *2013 Lake County NHMP* were reviewed. Actions were deleted, retained as is, or retained in a modified fashion. New mitigation actions were established. The process resulted in the creation of two mitigation actions tables.
    - **Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview** shows the Lake County 2020 NHMP Mitigation Actions, all the natural hazards - winter storms, wind storms, earthquakes, droughts,

floods, volcanic events, wildfire, landslides, and air quality - impacting Lake County and the Cities have mitigation actions. Volcanic events and landslides do not have hazard-specific mitigation actions but they are included in the multi-hazard mitigation actions.

- **Table 3-2, Lake County and the Cities Mitigation Actions 2013 Status** shows the status and explanation of the 2013 NHMP mitigation actions as provided by the Lake County NHMP Steering Committee (SC) at NHMP meetings during the plan update process.

Section 4: Plan Implementation and Maintenance

The Lake County NHMP convener is the Emergency Services Coordinator; this person will facilitate a Steering Committee for maintaining, updating, and implementing the NHMP. The coordinating body is composed of members of the NHMP Steering Committee. The coordinating body will meet twice per year to complete the tasks identified in Section 4 Plan Implementation and Maintenance.

Volume II: Hazard Annexes

A cover with photos and an Introduction was added to the Hazard Annexes section. All hazard specific annexes were reformatted and updated to include new history, data, maps, vulnerability information, and resources as available. Cross references to other information in the NHMP has been updated. Information about climate change has been integrated into the hazard specific annexes and added as Appendix F: Future Climate Projections Reports. Information from the Town of Lakeview and the City of Paisley has been integrated into the Lake County information. Where this is applicable, the Cities are specifically called out for their unique situations.

Volume III: Mitigation Resources

A cover with photos was added. Rather than having separate addenda for the Cities, the Cities are included with Lake County information in the main body of the NHMP. Where applicable, the Cities are specifically called out for their unique situations. All of the appendices have been revised and updated.

Appendix A: Mitigation Action Forms

The mitigation action item forms were updated to correspond to the *2020 Lake County NHMP* actions that are identified in Table 3-1, 2020 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview.

Appendix B: Planning and Public Process

This appendix describes and documents the planning and public process for this NHMP update.

Appendix C: Community Profile

The community profile has been updated for Lake County, the Town of Lakeview, and the City of Paisley.

Appendix D: Economic Analysis of Natural Hazards Mitigation Projects

Updates have been made to this appendix about the economic analysis of natural hazards mitigation projects.

Appendix E: Grant Programs and Resources

This appendix has been updated. Website links were also revised and updated as applicable.

Appendix F: Future Climate Projections Reports

The previous Appendix F was called Regional Household Preparedness Survey. It was deleted and replaced with the climate change information obtained from the Oregon Climate Change Research Institute (OCCRI). The two documents in this appendix are the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports* and the *Future Climate Projections: Lake County.*

Appendix G: Lake County NHMP Success Stories

This appendix is new; it describes examples of the communities in Lake County identifying a problem and finding a solution.

Appendix H: Lake County HAZUS Global Reports for Crustal and Probabilistic Scenarios

DOGAMI produced the *Lake County HAZUS Global Reports for Crustal and Probabilistic Scenarios*; it has details about two simulated scenarios and the results: Lake Arbitrary Crustal M6.9 and 2500 Year Probably Scenario M6.5 Driving.

Appendix I: Lake County Natural Hazards Mitigation Plan (NHMP) Natural Hazards Outreach Calendar

This calendar will be used each year to focus on outreach and education efforts on natural hazards on a month by month basis. It relates to multi-hazard mitigation action #2 (MH#2) in the *2020 Lake County NHMP*. See Table 3-1, 202 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview. 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 Lake County NHMP maintenance meeting.

Appendix J Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR and the Emergency Action Plan Bullard Dam

These two key documents are part of a PDF entitled Bullard Canyon Debris Basin Documents. The documents describe the operation and maintenance of Bullard Creek Floodwater Retarding Structure, a structure designed to retard floodwater flows in Bullard Canyon and release the water at a controlled rate. The documents relate to flood mitigation action #3 in the *2020 Lake County NHMP*. See Table 3-1, 202 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview.

Appendix K: Lakeview Access Right-of-Way Agreement

This appendix includes a sample of the agreement the Town of Lakeview has with landowners along Bullard and Deadman Creeks (Darryl Anderson, Anderson Engineering and Surveying, personal communication, 8/9/19). The agreement grants the right of the Town of Lakeview to go onto the landowner's property "for the sole and limited purpose of cleaning, clearing, repairing and maintaining the stream, stream bed and adjacent banks of Deadman Creek for flood, erosion and\or water flow control."

2020 NHMP Update

Lake County is dedicated to directly involving the public in the review and update of the natural hazard mitigation plan. Although members of the NHMP Steering Committee represent the public to some extent, the residents of Lake County, Lakeview, and Paisley are also given the opportunity to provide feedback about the NHMP. As described in in Section 4 Plan Implementation and Maintenance, the NHMP will undergo review twice per year.

Lake County made the *2020 Lake County NHMP* available via their websites for the Sheriff's Office and Planning Department for public comment after the January 31, 2020 draft was released by DLCD. Neither a press release nor a newspaper announcement was made for that draft. The NHMP will be approved by Lake County, the Town of Lakeview, and the City of Paisley. The final copy of the NHMP will be posted on the websites.

Partners include:

Lake County
Town of Lakeview
City of Paisley
Oregon Office of Emergency Management (OEM)
Federal Emergency Management Agency (FEMA) Region X
Oregon Department of Land Conservation and Development (DLCD)

Project Steering Committee:

Department of Land Conservation & Development Staff:

Tricia Sears, Natural Hazards Planner, DLCD

Lake County

Representatives from the following organizations served as Steering Committee members for the Lake County Natural Hazards Mitigation Plan update process.

Daniel Tague	Lake County Emergency Services Coordinator, Convenor
Kevin Hock	Road Superintendent, Lake County Road Department
Christy Horn	Office Manager, Lake County Road Department
Darwin Johnson	Planning Director, Lake County Planning Department
Ken Cooper	Building Official, Lake County Building Dept.
Jennifer Stephens	Asst. Building Director, Lake County Building Dept.
Ken Kestner	County Commissioner (former)
Dan Shoun	County Commissioner (former)

Mark Albertson	County Commissioner
Jill Harlan	Lake County Public Health
Michael Taylor	Sheriff

Town of Lakeview

Roberta Vanderwall	Town Manager
Jeff Marshall	Public Works Director, Lakeview Public Works
Scott Utley	911 Director
Janine Cannon	Town Planner

City of Paisley

Dustin Withers	Volunteer Fire Fighter, Paisley Volunteer Fire Dept.
Melissa “Missy” Waters	City Recorder
Ralph Paull	Mayor

Other Participants

Will Cahill	Superintendent, Lake County School District #7
Paul Hauder	Superintendent, Paisley School District
Darryl Anderson	President, Anderson Engineering & Surveying, Inc.
Carmen Tague	Business Manager, Anderson Engineering & Surveying, Inc.
Jason Jaeger	Program Coordinator, Lake County Cooperative Weed Management Area
Mike Warren	Lake County Radio (KCLR 95.3 FM)
Scott Hill	Sergeant, Oregon State Police
Peter Brewer	Air Quality Attainment Coordinator/Wildfire Smoke Response Coordinator, Oregon Dept. Environmental Quality
Dustin Gustaveson	Unit Forester, Oregon Dept. Forestry
Clint Albertson	Fire Planner, Fremont-Winema National Forest and BLM
Brian Mayer	Lake County Water Master, Oregon Water Resources Dept.
Barry Shullanberger	Interagency Fire Chief Staff Officer for Fremont-Winema national Forest and Lake District BLM, USFS
Mike Cuff	Interagency Safety Manager, Lakeview Interagency Offices USFS and BLM, USFS
Kristin Hill	EMS Manager, Lakeview Disaster Unit (former)

Project Managers:

Daniel Tague, Emergency Services Coordinator

Tricia Sears, Natural Hazards Planner, DLCD

The following pages include 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.

Summary of Outreach

Table B-2 Lake County NHMP Important Dates

Date	Description of Event/Activity
July 18, 2017	Regional Kickoff Meeting for NHMP Updates meeting held.
August 11, 2017	Tricia Sears sends the IGA/SOW for Lake County and DLCD to collaborate on the NHMP update, to Daniel Tague, Emergency Services Coordinator.
August 30, 2017	Tricia Sears distributes the Cost Share Form to Lake County.
November 28, 2017	Tricia provides a revised draft IGA/SOW to Lake County.
December 6, 2017	Lake County approves and signs IGA/SOW.
January 5, 2018	DLCD provides project schedule to Lake County.
January 11, 2018	Lake County provides copy of the signed IGA/SOW to DLCD.
January 17, 2018	DLCD provides fully executed IGA/SOW to Lake County.
April 11, 2018	The first meeting of the Lake County NHMP Steering Committee is held in Lakeview. Tricia facilitates the meeting. Agenda items included the Hazard Vulnerability Assessment, review of the critical infrastructure list, a discussion about creating a flyer for the NHMP to distribute (and other forms of outreach that could happen), and a conversation about success stories that could be included in the NHMP.
May 23, 2018	The second meeting of the Lake County NHMP Steering Committee is held in Lakeview. Tricia facilitates the meeting. Agenda items include discussion of mitigations actions – status of 2013 ones and crafting new ones, the *OCCRI Future Climate Projections* report research, the critical infrastructure list, and a review of the HVA. After this meeting, Tricia and Daniel did site visits around Lakeview and Lake County to see potential natural hazards.
May 30, 2018	The Lake County Natural Hazards Mitigation Plan flyer is finalized and distributed to the NHMP Steering Committee.
June 23, 2018	Daly Days Health Fair at Lake District Hospital. Jill Harlan has table with health and emergency preparedness information, and information about the Lake County Natural Hazards Mitigation Plan.

July 28-29, 2018	The City of Paisley Mosquito Festival is held. Outreach about the Lake County NHMP occurs.
September 1-3, 2018	Lake County Fair & Round-Up is held and outreach about the Lake County NHMP occurs.
October 10, 2018	The third Lake County NHMP Steering Committee meeting is held in Lakeview. Discussion focused on RiskMap with Dave Lentzner from DLCD, critical infrastructure list, and mitigation actions.
October 2018 – December 2019	Working through the mitigation actions to reach the point of having all mitigation actions ready for the NHMP.
April 18, 2019	The Lakeview Flood After Action Report (AAR) meeting is held in Lakeview. Daniel Tague, Emergency Services Coordinator, leads the discussion. Tricia Sears, DLCD, attends the meeting by phone.
May 22, 2019	The fourth Lake County NHMP Steering Committee meeting is held in Lakeview. Discussion focuses on outreach efforts and responsibilities of the Steering Committee, mitigation actions, the NHMP Natural Hazards Outreach Calendar which will be an appendix in the NHMP.
August 30 – September 2, 2019	Lake County Fair & Round-Up is held and outreach about the Lake County NHMP occurs.
Throughout the NHMP work	Tricia works with each NHMP Steering Committee member to obtain their fully completed cost share forms to be used as match in the grant funds that DLCD has (PDM 16) to support this NHMP update.
July 17, 2019	DLCD's request for an extension on the PDM 16 grant (PDMC-PL-10-OR-2016-005) that supports the work DLCD is doing with Harney, Lake, Malheur, and Wheeler Counties, as well as the Burns Paiute Tribe, is approved by FEMA. The new end date is August 30, 2020.
January 31, 2020	Tricia sends a draft of the *2020 Lake County NHMP* to the Steering Committee. She asks for comments and for the NHMP to be posted to the Lake County, Town of Lakeview, and the City of Paisley websites.
February 4, 2020	Darwin Johnson, Lake County Planning Director, sends Tricia the screenshot of the draft *2020 Lake County NHMP* as posted on the Lake County Planning Department website.
February 10, 2020	Tricia sends the Community Profile, which is Appendix C of the *2020 Lake County NHMP*, to the Steering Committee. It was the only portion of the NHMP not included in the draft she sent on January 31, 2020.
February 2020	Comments received and revisions made to the *2020 Lake County NHMP*.
March 13, 2020	The fifth Lake County NHMP Steering Committee meeting is held in Lakeview. The focus of discussion is to update committee members on the contents of the NHMP, including success stories and mitigation actions,

	and to refresh committee members on the NHMP approval process. The focus is also to gather additional input for the NHMP.
March 19, 2020	The *2020 Lake County NHMP* is submitted to Oregon Emergency Management (OEM).
March 19, 2020	The *2020 Lake County NHMP* is submitted to Federal Emergency Management Agency (FEMA). FEMA offered to review the directly, instead of OEM, because of the COVID-19 pandemic. So
May 15, 2020	A revised *2020 Lake County NHMP* is submitted to FEMA. The revised NHMP addresses the comments FEMA provided in the FEMA Local NHMP Review Tool in an email on 4/27/20 to DLC and discussed in a phone call on 5/13/20 (Tricia Sears, DLCD, and John Schelling, FEMA).
Month xx, 2020	The *2020 Lake County NHMP* receives the Approved Pending Adoption (APA) letter from FEMA.
Month xx, 2020	The *2020 Lake County NHMP* is approved by Lake County Board of County Commissioners on Month x, 2020; by the Town of Lakeview on Month x, 2020; and by the City of Paisley on Month x, 2020.
Month xx, 2020	The resolutions of approval from Lake County, Lakeview, and Paisley are sent to OEM and FEMA.
Month xx, 2020	The *2020 Lake County NHMP* receives the approval letter from FEMA. The dates of approval are from Month x, 2020 to Month x, 2025.

Source: Tricia Sears, DLCD, January 2020.

Steering Committee Meeting Agendas and Sign-in Sheets

Lake County NHMP Update
Steering Committee Meeting

Wednesday, April 11, 2018
10:00 AM – 12:00 PM

Lake County Emergency Management
Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

AGENDA

I. Welcome & Introductions (5 min) — Daniel Tague

II. NHMP Update Project (20 min) — Tricia Sears
- What is the Natural Hazards Mitigation Plan (NHMP)? (NHMP Info Sheet)
- NHMP Grant, including Cost Share (Cost Share Form)
- NHMP Process and Schedule (Project Schedule) (FEMA Approval 9/11/13)
- Public Outreach for the NHMP
- Oregon Climate Change Research Institute (OCCRI) Research (Handout)

III. Steering Committee (20 min) — Daniel and Tricia
- Composition of the Committee (SC Roster)
- Roles Participation
- Elect/Decide a Chairperson
- Ground Rules (e.g. Vote or Consensus)
- Mission and Goals (On back of Agenda)

IV. Hazard Vulnerability Analysis (HVA) (60 min) — Tricia
- Work Session (Significant Historic Hazard Events Tables, HVA Worksheet)
- County vs City HVAs

V. Critical Infrastructure, Critical Facilities, and Lifelines (10 min) — Daniel and Tricia
- Review Draft List

VI. Next Steps (5 min) — Tricia
- Next Meeting
- Meeting Notes and Follow up

Materials
From Lake County: Printed copies of 2013 NHMP
From DLCD: Meeting Agenda; NHMP Info Sheet; Cost Share Form; Project Schedule; SC Roster; Significant Historic Hazard Events Tables; HVA Worksheet; and Critical Infrastructure List

From the Lake County NHMP May 2013

Approval Process

The Lake County Board of Commissioners adopted the plan on **July 30, 2013**.

The Lakeview Town Council adopted the plan on **August 13, 2013.**

The Paisley City Council adopted the plan on **August 13, 2013.**

FEMA Region X approved the Lake County Multi-jurisdictional NHMP on **September 11, 2013**. With approval of this plan, the entities listed above are now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through **September 11, 2018**.

Mission

To create a disaster-resilient Lake County.

Goals

The plan goals describe the overall direction that the participating jurisdiction's agencies, organizations, and citizens can take toward mitigating risk from natural hazards.

Goal 1: Protect Human Welfare, Property, Cultural and Natural Resources: Develop mitigation actions to lessen the impact from natural disasters on human welfare, infrastructure and property, and the cultural and natural resources of Lake County.

Goal 2: Safeguard Economy: Develop mitigation actions to lessen the economic impacts from natural disasters on the region's economic development and local businesses.

Goal 3: Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase public awareness of hazards and risk-reduction practices.

Goal 4: Strengthen Community Capacity: Sustain and build upon community partnerships, resources, and collective knowledge to implement mitigation actions.

Lake County Natural Hazards Mitigation Plan
Steering Committee Meeting

Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

Wednesday, April 11, 2018 from 10:00 AM to 12:00 PM

PLEASE SIGN IN (Sign your name or add to the list)

Full Signature	Name	Title	Representing	Phone	Email
	Daniel Tague	Emergency Services Coordinator	Lake County Sheriff's Office	(541) 905-6955 (cell) 541-947-6027 x 120 (office)	dtague@co.lake.or.us
	Michael Taylor	Sheriff	Lake County Sheriff's Office	541-291-6033 (cell) 541-947-6027 x 120 (office)	mtaylor@co.lake.or.us
	Kevin Hock	Road Master	Lake County Road Department	541-219-0038 (cell) 541-947-6048 (office)	khock@co.lake.or.us
	Jill Harlan	Public Health Nurse	Lake County Public Health	541-947-6045 (office)	bhadley@co.lake.or.us
	Darwin Johnson	Planning Director	Lake County Planning Department	541-678-2502 (cell) 541-947-6036 (office)	djohnson@co.lake.or.us
	Ken Kestner	Commissioner	Lake County	541-947-6004 (office)	kkestner@co.lake.or.us
	Will Cahill	Superintendent	Lake County School District #7	541-417-1341 (cell) 541-947-3347 (office)	Cahillw@lakeview.k12.or.us
	Vacant	Chief of Police	Lakeview Police Department	541-947-2504 (office)	policechief@twonoflakevivew.org
	Roberta Vanderwall	Town Manager	Town of Lakeview	541-216-2278 (cell) 541-947-2029 (office)	townmanager@townoflakeview.org
	Jeff Marshall	Public Works Director	Lakeview Pubic Works	541-417-1331 (cell) 541-947-2029 (office)	jeffdeanrides@outlook.com
	Mike Warren	Town Council	Town of Lakeview		mike@lakecountyradio.com
	Vacant	Mayor	City of Paisley		
	Mike Cuff	Safety Manager	BLM/USFS		Dez450x@yahoo.com
	Scott Hill	Sergeant	Oregon State Police	503-507-7089 (cell) 541-947-2451 (office)	Scott.hill@state.or.us
	Kristin Hill	Director of EMS	LDU/Lake District Hospital	503-507-7088 (cell) 541-947-5555 (office)	khill@lakehealthdistrict.org
	Ralph Paull	Mayor Paisley	Paisley	541-219-0841 541-943-3173	paullra@yahoo.com
	Christy Horn	Office manager	Lake County Road Dept.	541-947-6048	lakecoroad@co.lake.or.us
	Tricia Sears	Natural Hazards Planner	Oregon Department of Land Conservation & Development	503-934-0031 (office)	tricia.sears@state.or.us
	Scott Utley	911 Director	Town of LAKEVIEW	541-947-2504	911 Director@townoflakeview.org
	Christy Horn	Office Manager	Lake County Rd Dept.	541-947-6148	lakecoroad@co.lake.or.us

Lake County NHMP Update
Steering Committee Meeting

Wednesday, May 23, 2018
9:00 AM – 12:00 PM

Lake County Emergency Management
Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

AGENDA

I. Welcome & Introductions (5 min) — Daniel Tague

II. Steering Committee (30 min) — Daniel and Tricia Sears
- Reminder to fill out the cost share form and supporting documentation (Cost Share Form & Cost Share Instructions)
- Updates from the group
- Status on posting NHMP information on the County and the Cities websites
- Identify/confirm public outreach activities and dates (Project Schedule)
- Lake County NHMP Flyer (Handout)
- Mission and Goals (On back of Agenda), confirm new Goal 5
- Success stories for the NHMP

III. Hazard Analysis Summary (10 min) — Tricia
- Review and discuss (Hazard Analysis Summary)

IV. Critical Infrastructure, Critical Facilities, and Lifelines (25 min) — Tricia
- Review Draft List (Critical Infrastructure List)

V. Mitigation Actions (100 min) — Daniel and Tricia
- Review 2013 list of actions, update with status, and identify (modify, delete, add) actions for 2017-2018 NHMP (Mitigation Actions Tables)
- Definitions of Mitigation Actions Timelines (On back of Agenda)
- Mitigation Actions Tables: Lake County, City of Lakeview, City of Paisley, NEW

VI. Next Steps (10 min) — Tricia
- Next Meeting
- Meeting Notes and Follow up

Materials
From Lake County: Printed copies of 2013 NHMP already provided
From DLCD: Meeting Agenda; Cost Share Form; Cost Share Instructions; Project Schedule; Lake County NHMP Flyer; Hazard Analysis Summary; Critical Infrastructure List; and Mitigation Actions Tables (Status and New).

Lake County NHMP, May 2013

Mission: *To create a disaster-resilient Lake County*

The plan goals describe the overall direction that the participating jurisdiction's agencies, organizations, and citizens can take toward mitigating risk from natural hazards.

Goal 1: Protect Human Welfare, Property, Cultural and Natural Resources: Develop mitigation actions to lessen the impact from natural disasters on human welfare, infrastructure and property, and the cultural and natural resources of Lake County

Goal 2: Safeguard Economy: Develop mitigation actions to lessen the economic impacts from natural disasters on the region's economic development and local businesses.

Goal 3: Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase public awareness of hazards and risk reduction practices.

Goal 4: Strengthen Community Capacity: Sustain and build upon community partnerships, resources, and collective knowledge to implement mitigation actions.

Goal 5 (new): Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase internal staff awareness and knowledge of hazards and risk reduction practices.

Mitigation Actions Timeline

"Action items 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. *Ongoing action items* are activities that are currently being performed and will continue into the foreseeable future."

need signatures

Lake County Natural Hazards Mitigation Plan
Steering Committee Meeting

Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

Wednesday, May 23, 2018 from 9:00 AM to 12:00 PM

PLEASE SIGN IN (Sign your name or add to the list)

Full Signature	Name	Title	Representing	Phone	Email
See attached	Justin Withers				
	Daniel Tague	Emergency Services Coordinator	Lake County Sheriff's Office	(541) 905-6955 (cell) 541-947-6027 x 120 (office)	dtague@co.lake.or.us
	Michael Taylor	Sheriff	Lake County Sheriff's Office	541-291-6033 (cell) 541-947-6027 x 120 (office)	mtaylor@co.lake.or.us
	Kevin Hock	Road Master	Lake County Road Department	541-219-0038 (cell) 541-947-6048 (office)	khock@co.lake.or.us
See attached	Jill Harlan	Public Health Nurse	Lake County Public Health	541-947-6045 (office)	jharlan@co.lake.or.us
	Darwin Johnson	Planning Director	Lake County Planning Department	541-678-2502 (cell) 541-947-6036 (office)	djohnson@co.lake.or.us
	Ken Kestner	Commissioner	Lake County	541-947-6004 (office)	kkestner@co.lake.or.us
	Will Cahill	Superintendent	Lake County School District #7	541-417-1341 (cell) 541-947-3347 (office)	Cahillw@lakeview.k12.or.us
See attached	William Behan	Chief of Police	Lakeview Police Department	541-947-2504 (office)	policechief@townoflakevivew.org
	Roberta Vanderwall	Town Manager	Town of Lakeview	541-216-2278 (cell) 541-947-2029 (office)	townmanager@townoflakeview.org
	Jeff Marshall	Public Works Director	Lakeview Pubic Works	541-417-1331 (cell) 541-947-2029 (office)	jeffdeanrides@outlook.com
	Mike Warren	Town Council	Town of Lakeview		mike@lakecountyradio.com
See attached	Ralph Paull	Mayor	City of Paisley	541-219-0841 and 541-943-3173	paullr@yahoo.com
	Mike Cuff	Safety Manager	BLM/USFS		Dez450x@yahoo.com
	Scott Hill	Sergeant	Oregon State Police	503-507-7089 (cell) 541-947-2451 (office)	Scott.hill@state.or.us
See attached	Kristin Hill	Director of EMS	LDU/Lake District Hospital	503-507-7088 (cell) 541-947-5555 (office)	khill@lakehealthdistrict.org
	Christy Horn	Officer Manager/ Road Superintendent	Lake County Road Department	541-947-6048	lakecoroad@co.lake.or.us
	Scott Utley	911 Director	Town of Lakeview	541-947-2504	911director@townoflakeview.org
	Tricia Sears	Natural Hazards Planner	Oregon Department of Land Conservation & Development	503-934-0031 (office)	tricia.sears@state.or.us
	Jason Gately	Natural Hazards Planner	Oregon Department of Land Conservation & Development	503-934-0043	Jason.gately@state.or.us

Lake County Natural Hazards Mitigation Plan
Steering Committee Meeting

Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

Wednesday, May 23, 2018 from 9:00 AM to 12:00 PM

PLEASE SIGN IN (Sign your name or add to the list)

Full Signature	Name	Title	Representing	Phone	Email
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	Kevin Hock	Road Master	Lake County Road Department	541-219-0038 (cell) 541-947-6048 (office)	khock@co.lake.or.us
	Jill Harlan	Public Health Nurse	Lake County Public Health	541-947-6045 (office)	jharlan@co.lake.or.us
	Darwin Johnson	Planning Director	Lake County Planning Department	541-678-2502 (cell) 541-947-6036 (office)	djohnson@co.lake.or.us
	Ken Kestner	Commissioner	Lake County	541-947-6004 (office)	kkestner@co.lake.or.us
	Will Cahill	Superintendent	Lake County School District #7	541-417-1341 (cell) 541-947-3347 (office)	Cahillw@lakeview.k12.or.us
	William Behan	Chief of Police	Lakeview Police Department	541-947-2504 (office)	policechief@townoflakevivew.org
	Roberta Vanderwall	Town Manager	Town of Lakeview	541-216-2278 (cell) 541-947-2029 (office)	townmanager@townoflakeview.org
	Jeff Marshall	Public Works Director	Lakeview Pubic Works	541-417-1331 (cell) 541-947-2029 (office)	jeffdeanrides@outlook.com
	Mike Warren	Town Council	Town of Lakeview		mike@lakecountyradio.com
Ralph Paull	Ralph Paull	Mayor	City of Paisley	541-219-0841 and 541-943-3173	paullr@yahoo.com
	Mike Cuff	Safety Manager	BLM/USFS		Dez450x@yahoo.com
	Scott Hill	Sergeant	Oregon State Police	503-507-7089 (cell) 541-947-2451 (office)	Scott.hill@state.or.us
	Kristin Hill	Director of EMS	LDU/Lake District Hospital	503-507-7088 (cell) 541-947-5555 (office)	khill@lakehealthdistrict.org
	Christy Horn	Officer Manager/ Road Superintendent	Lake County Road Department	541-947-6048	lakecoroad@co.lake.or.us
	Scott Utley	911 Director	Town of Lakeview	541-947-2504	911director@townoflakeview.org
	Tricia Sears	Natural Hazards Planner	Oregon Department of Land Conservation & Development	503-934-0031 (office)	tricia.sears@state.or.us
	Jason Gately	Natural Hazards Planner	Oregon Department of Land Conservation & Development	503-934-0043	Jason.gately@state.or.us
	Dustin withers	Paisley Fire Ast. Chief	Paisley Fire/City	541-219-2310	paisleyvfd@gmail.com

Wednesday, May 23, 2018 from 9:00 AM to 12:00 PM					
PLEASE SIGN IN (Sign your name or add to the list)					
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	Daniel Tague	Emergency Services Coordinator	Lake County Sheriff's Office	(541) 905-6955 (cell) 541-947-6027 x 120 (office)	dtague@co.lake.or.us
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Jill Harlan	Jill Harlan	Public Health Nurse	Lake County Public Health	541-947-6045 (office)	jharlan@co.lake.or.us
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	Wiiliam Behan	Chief of Police	Lakeview Police Department	541-947-2504 (office)	policechief@twonoflakevivew.org
	Roberta Vanderwall	Town Manager	Town of Lakeview	541-216-2278 (cell) 541-	townmanager@townoflakeview.org

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Full Signature	**Name**	**Title**	**Representing**	**Phone**	**Email**
				541-947-2029 (office)	
	Mike Warren	Town Council	Town of Lakeview		mike@lakecountyradio.com
	Ralph Paull	Mayor	City of Paisley	541-219-0841 and 541-943-3173	paullr@yahoo.com
	Mike Cuff	Safety Manager	BLM/USFS		Dez450x@yahoo.com
	Scott Hill	Sergeant	Oregon State Police	503-507-7089 (cell) 541-947-2451 (office)	Scott.hill@state.or.us
Kristin Hill	Kristin Hill	Director of EMS	LDU/Lake District Hospital	503-507-7088 (cell) 541-947-5555 (office)	khill@lakehealthdistrict.org
	Christy Horn	Officer Manager/ Road Superintendent	Lake County Road Department	541-947-6048	lakecoroad@co.lake.or.us
	Scott Utley	911 Director	Town of Lakeview	541-947-2504	911director@townoflakeview.org
	Tricia Sears	Natural Hazards Planner	Oregon Department of Land Conservation & Development	503-934-0031 (office)	tricia.sears@state.or.us
	Jason Gately	Natural Hazards Planner	Oregon Department of Land Conservation & Development	503-934-0043	Jason.gately@state.or.us

Wednesday, May 23, 2018 from 9:00 AM to 12:00 PM

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	Wiiliam Behan	Chief of Police	Lakeview Police Department	541-947-2504 (office)	policechief@twonoflakevivew.org
	Roberta Vanderwall	Town Manager	Town of Lakeview	541-216-2278 (cell) 541-	townmanager@townoflakeview.org

Lake County NHMP Update
Steering Committee Meeting

Wednesday, October 10, 2018
1:30 PM – 4:00 PM

Lake County Emergency Management
Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

AGENDA

I. Welcome & Introductions (5 min) — Daniel Tague

II. Steering Committee (30 min) — Daniel and Tricia Sears
- Fill out the cost share form (Cost Share Form)
- Sign the meeting sign in sheet from 5/23/18 and 10/10/18 (Sign In Sheets)
- Posting NHMP information on Lake County, Lakeview, Paisley websites
- Responses and input on the NHMP (Steering Committee Roster)
- Public outreach activities and dates, project timeline (Project Schedule)
- Success stories for the NHMP (e.g. seismic upgrades, others?)

III. Risk MAP (15 min) — Dave Lentzner
- Introduction of Risk MAP multi-hazard mitigation goals
- In Lake County, floods are tied with winter storms with the 2nd highest risk score (Risk Scores)
- Flood risk mapping for Lake County

IV. Critical Infrastructure, Critical Facilities, and Lifelines (30 min) — Tricia
- Review draft list and identify hazards that may impact assets (Critical Infrastructure List)

V. Mitigation Actions Lake County, City of Lakeview, City of Paisley (60 min) — Daniel and Tricia
- Review STATUS of 2013 Mitigation Actions Table: update with status, and identify (modify, delete, add) actions for 2017-2018 NHMP (Mitigation Actions Tables: STATUS)
- Review NEW Mitigation Actions Tables (Mitigation Actions Tables: NEW)
- Definitions of Mitigation Actions Timelines (On back of Agenda)

VI. Next Steps (10 min) — Tricia
- Next Meeting
- Meeting Notes and Follow up

Materials
From Lake County: Printed copies of 2013 NHMP already provided
From DLCD: Meeting Agenda; Cost Share Form; Sign In Sheets; Steering Committee Roster: Project Schedule; Lake County Risk Scores; Critical Infrastructure List; and Mitigation Actions Tables (Status and New).

Lake County NHMP, May 2013

Mission: *To create a disaster-resilient Lake County*

The plan goals describe the overall direction that the participating jurisdiction's agencies, organizations, and citizens can take toward mitigating risk from natural hazards.

Goal 1: Protect Human Welfare, Property, Cultural and Natural Resources: Develop mitigation actions to lessen the impact from natural disasters on human welfare, infrastructure and property, and the cultural and natural resources of Lake County

Goal 2: Safeguard Economy: Develop mitigation actions to lessen the economic impacts from natural disasters on the region's economic development and local businesses.

Goal 3: Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase public awareness of hazards and risk reduction practices.

Goal 4: Strengthen Community Capacity: Sustain and build upon community partnerships, resources, and collective knowledge to implement mitigation actions.

Goal 5 (new in 2018): Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase internal staff awareness and knowledge of hazards and risk reduction practices.

Mitigation Actions Timeline

Action items 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.

Ongoing action items are activities that are currently being performed and will continue into the foreseeable future.

Lake County Natural Hazards Mitigation Plan
Steering Committee Meeting

Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

Wednesday, October 10, 2018 from 1:30 PM to 4:00 PM

PLEASE SIGN IN (Sign your name or add to the list)

Full Signature	Name	Title	Representing	Phone	Email
	Daniel Tague	Emergency Services Coordinator	Lake County Sheriff's Office	(541) 905-6955 (cell) 541-947-6027 x 120 (office)	dtague@co.lake.or.us
	Michael Taylor	Sheriff	Lake County Sheriff's Office	541-291-6033 (cell) 541-947-6027 x 120 (office)	mtaylor@co.lake.or.us
	Kevin Hock	Road Master	Lake County Road Department	541-219-0038 (cell) 541-947-6048 (office)	khock@co.lake.or.us
	Jill Harlan	Public Health Nurse	Lake County Public Health	541-947-6045 (office)	jharlan@co.lake.or.us
	Darwin Johnson	Planning Director	Lake County Planning Department	541-678-2502 (cell) 541-947-6036 (office)	djohnson@co.lake.or.us
	Ken Kestner	Commissioner	Lake County	541-947-6004 (office)	kkestner@co.lake.or.us
	Will Cahill	Superintendent	Lake County School District #7	541-417-1341 (cell) 541-947-3347 (office)	Cahillw@lakeview.k12.or.us
		Chief of Police	Lakeview Police Department	541-947-2504 (office)	policechief@twonoflakevivew.org
	Roberta Vanderwall	Town Manager	Town of Lakeview	541-216-2278 (cell) 541-947-2029 (office)	townmanager@townoflakeview.org
	Jeff Marshall	Public Works Director	Lakeview Pubic Works	541-417-1331 (cell) 541-947-2029 (office)	jeffdeanrides@outlook.com
	Mike Warren	Town Council	Town of Lakeview		mike@lakecountyradio.com
	Dustin Withers		Paisley Volunteer Fire Department	541-219-2310	Paisleyvfd@gmail.com
	Mike Cuff	Safety Manager	BLM/USFS		Dez450x@yahoo.com
	Scott Hill	Sergeant	Oregon State Police	503-507-7089 (cell) 541-947-2451 (office)	Scott.hill@state.or.us
	Christy Horn	Officer Manager/ Road Superintendent	Lake County Road Department	541-947-6048	lakecoroad@co.lake.or.us
	Scott Utley	911 Director	Town of Lakeview	541-947-2504	911director@townoflakeview.org
	Dan Shoun	County Commissioner	Lake County	541-977-6002	Dshoun@co.lake.co.or.us
	Dustin Gustaveson		Oregon Department of Forestry	541-947-3311 (office) 541-219-0574 (cell)	Dustin.gustaveson@state.or.us
	Paul Hauder	Superintendent	Paisley School District	541-943-3111	P.hauder@paisleyschooldistrict.or.us
	Darryl Anderson	President	Anderson Engineering & Surveying, Inc.	541-947-4407	darryla@andersonengineering.com
	Peter Brewer	Air Quality Attainment Coordinator/ Wildfire Smoke Response Coordinator	Oregon Department of Environmental Quality	541-633-2004	Peter.brewer@state.or.us
	Tricia Sears	Natural Hazards Planner	Oregon Department of Land Conservation & Development (DLCD)	503-934-0031 (office)	tricia.sears@state.or.us
	Dave Lentzner	Natural Hazards Planner/ Risk MAP Coordinator	DLCD	503-934-0010 (office)	David.lentzner@state.or.us

Lake County NHMP Update
Steering Committee Meeting

Wednesday, May 22, 2019
1:00 PM – 3:30 PM

Lake County Emergency Management
Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

AGENDA

I. Welcome & Introductions (5 min) — Daniel Tague

II. Steering Committee (25 min) — Daniel and Tricia Sears
- Current members of the Steering Committee (Steering Committee Roster)
- Sign the meeting sign in sheet for today (Sign In Sheets)
- Fill out the cost share form (Cost Share Form)
- Status of the NHMP update process, where are we now
- Public outreach activities and dates, what's coming up

III. Lake County NHMP Natural Hazards Outreach Calendar (20 min) — Tricia
- Discuss the monthly schedule of natural hazards outreach, confirm leads and partners, finalize (Lake County Natural Hazards Outreach Calendar)

IV. Critical Infrastructure, Critical Facilities, and Lifelines (30 min) — Tricia
- Review list and finalize (Critical Infrastructure List)

V. Mitigation Actions for Lake County, Lakeview, and Paisley (60 min) — Daniel and Tricia
- Review 2019 Lake County NHMP Mitigation Actions (2019 Lake County NHMP Mitigation Actions for Lake County, Paisley, and Lakeview)
- Definitions of Mitigation Actions Timelines (on back of agenda)

VI. Next Steps (10 min) — Tricia
- Next Meeting
- Meeting Notes and Follow up

Materials
From Lake County: Printed copies of 2013 NHMP already provided
From DLCD: Meeting Agenda; Steering Committee Roster; Cost Share Form; Sign In Sheet; Lake County Natural Hazards Outreach Calendar (includes risk scores); Critical Infrastructure List; and 2019 Lake County NHMP Mitigation Actions for Lake County, Paisley, and Lakeview

Lake County NHMP, May 2013

Mission: *To create a disaster-resilient Lake County*

The plan goals describe the overall direction that the participating jurisdiction's agencies, organizations, and citizens can take toward mitigating risk from natural hazards.

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Goal 3: Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase public awareness of hazards and risk reduction practices.

Goal 4: Strengthen Community Capacity: Sustain and build upon community partnerships, resources, and collective knowledge to implement mitigation actions.

Goal 5 (new in 2018): Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase internal staff awareness and knowledge of hazards and risk reduction practices.

2019 Mitigation Actions Timeline

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

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Lake County Natural Hazards Mitigation Plan
Steering Committee Meeting

Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

Wednesday, May 22, 2019 from 1:00 PM to 3:30 PM

PLEASE SIGN IN (Sign your name or add to the list)

Full Signature	Name	Title	Representing	Phone	Email
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	Michael Taylor	Sheriff	Lake County Sheriff's Office	541-291-6033 (cell) 541-947-6027 x 120 (office)	mtaylor@co.lake.or.us
	Kevin Hock	Road Superintendent	Lake County Road Department	541-219-0038 (cell) 541-947-6048 (office)	khock@co.lake.or.us
	Jill Harlan	Public Health Nurse	Lake County Public Health	541-947-6045 (office)	jharlan@lakehealthdistrict.org
	Darwin Johnson	Planning Director	Lake County Planning Department	541-678-2502 (cell) 541-947-6036 (office)	djohnson@co.lake.or.us
	Ken Kestner	Volunteer/ former County Commissioner	Lake County	541-947-6004 (office)	kkestner@gmail.com
	Will Cahill	Superintendent	Lake County School District #7	541-417-1341 (cell) 541-947-3347 (office)	Cahillw@lakeview.k12.or.us
	Roberta Vanderwall	Town Manager	Town of Lakeview	541-216-2278 (cell) 541-947-2029 (office)	townmanager@townoflakeview.org
	Jeff Marshall	Public Works Director	Lakeview Pubic Works	541-417-1331 (cell) 541-947-2029 (office)	publicworks@townoflakeview.org
	Mike Warren	Staff/Emergency Radio Contact	Lake County Radio (KCLR 95.3 FM)	541-417-1308 (cell) 541-947-3325	mike@lakecountyradio.com
	Ken Cooper	Building Official	Lake County Building Department	541-947-6032 (office)	kcooper@co.lake.or.us
	Jennifer Stephens	Assistant Building Director	Lake County Building Department	541-947-6033 (office)	jstephens@co.lake.or.us
	Dustin Withers	Volunteer Fire Fighter	Paisley Volunteer Fire Department	541-219-2310	Paisleyvfd@gmail.com
	Mike Cuff	Interagency Safety Manager	Lakeview Interagency Office USFS and BLM (he is USFS)	760-336-1514 (cell) 541-947-2177 (office)	Dez450x@yahoo.com
	Scott Hill	Sergeant	Oregon State Police	503-507-7089 (cell) 541-947-2451 (office)	Scott.hill@state.or.us
	Christy Horn	Officer Manager/ Road Superintendent	Lake County Road Department	541-947-6048	lakecoroad@co.lake.or.us
	Scott Utley	911 Director	Town of Lakeview	541-947-2504	911director@townoflakeview.org
	Dan Shoun	Volunteer/ former County Commissioner	Lake County	541-417-0780 (cell)	Dshoun651@gmail.com
	Dustin Gustaveson	Unit Forester	Oregon Department of Forestry	541-947-3311 (office) 541-219-0574 (cell)	Dustin.gustaveson@state.or.us
	Paul Hauder	Superintendent	Paisley School District	541-943-3111 (office)	P.hauder@paisleyschooldistrict.or.us
	Darryl Anderson	President	Anderson Engineering & Surveying, Inc.	541-947-4407 (office)	darryla@andersonengineering.com
	Carmen Tague	Business Manager	Anderson Engineering & Surveying, Inc.	541-947-4407 (office) 541-905-5656 (cell)	Carment@andersonengineering.com

Wednesday, May 22, 2019 from 1:00 PM to 3:30 PM					
PLEASE SIGN IN (Sign your name or add to the list)					
Full Signature	**Name**	**Title**	**Representing**	**Phone**	**Email**
	Mark Albertson	County Commissioner	Lake County	541-947-6004	malbertson@co.lakeco.or.us
by phone	Peter Brewer	Air Quality Attainment Coordinator/ Wildfire Smoke Response Coordinator	Oregon Department of Environmental Quality	541-633-2004 (office)	Peter.brewer@state.or.us
	Clint Albertson	Fire Planner	Fremont-Winema National Forest for United States Forest Service (USFS) and BLM	541-417-0306 (cell) 541-947-6113 (office)	calbertson@fs.fed.us
	Barry Shullanberger	Interagency Fire Chief Staff Officer for the Fremont-Winema National Forest and Lake District BLM	Fremont-Winema National Forest for United States Forest Service (USFS) and BLM	541-947-6212 (office)	bshullanberger@fs.fed.us
Tricia Sears	Tricia Sears	Natural Hazards Planner	Oregon Department of Land Conservation & Development (DLCD)	503-934-0031 (office)	tricia.sears@state.or.us

Lake County NHMP Update
Steering Committee Meeting

Friday, March 13, 2019
2:00 PM – 4:00 PM

Lake County Emergency Management
Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

AGENDA

I. Welcome & Introductions (5 min) — Daniel Tague

II. Update and Overview of *2020 Lake County NHMP* (50 min) — Daniel and Tricia Sears
- Sign the meeting sign in sheet for today (Sign In Sheet)
- Fill out the cost share form (Cost Share Form)
- What is in the *2020 Lake County NHMP*?
  - Table of Contents (handout);
  - From the Risk Assessment: Summary of Vulnerabilities of Critical Infrastructure, Critical Facilities, and Lifelines (handout);
  - From the Mitigation Strategy: Table 3-1 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview (handout);
  - Appendix G Lake County Success Stories (handout)
- Status of the NHMP update process: where are we now, when does it end? (NHMP Approval Process)

III. Coronavirus Update (30 min) — Daniel

IV. OEM's Training Calendar from July 2020 to June 2021 (15 min) — Daniel

V. Alert Sense (15 min) — Daniel

VI. Next Steps (5 min) — Daniel and Tricia

Materials
From Lake County: Printed copies of 2013 NHMP already provided
From DLCD: Meeting Agenda; Cost Share Form; Sign In Sheet; 2020 Lake County NHMP Table of Contents; Summary of Vulnerabilities of Critical Infrastructure, Critical Facilities, and Lifelines; Table 3-1 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview; Appendix G Lake County Success Stories; NHMP Approval Process

2020 Lake County Natural Hazards Mitigation Plan (NHMP)

Mission: *To create a disaster-resilient Lake County*

The plan goals describe the overall direction that the participating jurisdiction's agencies, organizations, and citizens can take toward mitigating risk from natural hazards.

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Goal 5 (new in 2018): Increase Education, Outreach, and Awareness: Promote education and outreach programs to increase internal staff awareness and knowledge of hazards and risk reduction practices.

NHMP Mitigation Actions Timeline

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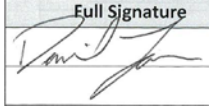
Lake County Natural Hazards Mitigation Plan
Steering Committee Meeting

Emergency Services Building, 245 N. F St.
Lakeview, OR 97630

Friday, March 13, 2020 from 2:00 PM to 4:00 PM

PLEASE SIGN IN (Sign your name or add to the list)

Full Signature	Name	Title	Representing	Phone	Email
	Daniel Tague	Emergency Services Coordinator	Lake County Sheriff's Office	541-905-6955 (cell) 541-947-6027 x 120 (office)	dtague@co.lake.or.us
	Michael Taylor	Sheriff	Lake County Sheriff's Office	541-291-6033 (cell) 541-947-6027 x 120 (office)	mtaylor@co.lake.or.us
	Kevin Hock	Road Superintendent	Lake County Road Department	541-219-0038 (cell) 541-947-6048 (office)	khock@co.lake.or.us
	Christy Horn	Officer Manager/ Road Superintendent	Lake County Road Department	541-947-6048	lakecoroad@co.lake.or.us
	Jill Harlan	Public Health Nurse	Lake County Public Health	541-947-6045 (office)	jharlan@co.lakehealthdistrict.org
	Darwin Johnson	Planning Director	Lake County Planning Department	541-678-2502 (cell) 541-947-6036 (office)	djohnson@co.lake.or.us
	Ken Cooper	Building Official	Lake County Building Department	541-947-6032 (office)	kcooper@co.lake.or.us
	Jennifer Stephens	Assistant Building Director	Lake County Building Department	541-947-6033 (office)	jstephens@co.lake.or.us
	Ken Kestner	Volunteer/ former County Commissioner	Lake County	541-947-6004 (office)	kkestner@gmail.com
	Dan Shoun	Volunteer/ former County Commissioner	Lake County	541-417-0780 (cell)	Dshoun651@gmail.com
	Mark Albertson	County Commissioner	Lake County	541-947-6004	malbertson@co.lakeco.or.us
	Brian Mayer	Lake County Water Master	Oregon Water Resources Department	541-947-6038	Brian.mayer@oregon.gov
	Will Cahill	Superintendent	Lake County School District #7	541-417-1341 (cell) 541-947-3347 (office)	Cahillw@lakeview.k12.or.us
	Michele Parry	Town Manager	Town of Lakeview	541-216-2278 (cell) 541-947-2029 (office)	townmanager@townoflakeview.org
	Janine Cannon	Town Planner	Town of Lakeview	541-947-2029	townplanner@townoflakeview.org
	Jeff Marshall	Public Works Director	Town of Lakeview Pubic Works	541-417-1331 (cell) 541-947-2029 (office)	publicworks@townoflakeview.org
	Scott Utley	911 Director	Town of Lakeview	541-947-2504	911director@townoflakeview.org
	Dustin Withers	Volunteer Fire Fighter	Paisley Volunteer Fire Department	541-219-2310	Paisleyvfd@gmail.com
	Ralph Paull	Mayor	City of Paisley	541-299-0841	paullr@yahoo.com
	Missy Walton	City Recorder	City of Paisley	541-943-3173	info@cityofpaisley.net
	Mike Cuff	Interagency Safety Manager	Lakeview Interagency Office USFS and BLM (he is USFS)	760-336-1514 (cell) 541-947-2177 (office)	Dez450x@yahoo.com
	Scott Hill	Sergeant	Oregon State Police	503-507-7089 (cell) 541-947-2451 (office)	Scott.hill@state.or.us
	Dustin Gustaveson	Unit Forester	Oregon Department of Forestry	541-947-3311 (office) 541-219-0574 (cell)	Dustin.gustaveson@state.or.us

Friday, March 13, 2020 from 2:00 PM to 4:00 PM

PLEASE SIGN IN (Sign your name or add to the list)

Full Signature	Name	Title	Representing	Phone	Email
	Paul Hauder	Superintendent	Paisley School District	541-943-3111 (office)	P.hauder@paisleyschooldistrict.or.us
	Darryl Anderson	President	Anderson Engineering & Surveying, Inc.	541-947-4407 (office)	darryla@andersonengineering.com
	Carmen Tague	Business Manager	Anderson Engineering & Surveying, Inc.	541-947-4407 (office) 541-905-5656 (cell)	Carment@andersonengineering.com
By Phone	Peter Brewer	Air Quality Attainment Coordinator/ Wildfire Smoke Response Coordinator	Oregon Department of Environmental Quality	541-633-2004 (office)	Peter.brewer@state.or.us
	Clint Albertson	Fire Planner	Fremont-Winema National Forest for United States Forest Service (USFS) and BLM	541-417-0306 (cell) 541-947-6113 (office)	calbertson@fs.fed.us
B. Shullanberger	Barry Shullanberger	Interagency Fire Chief Staff Officer for the Fremont-Winema National Forest and Lake District BLM	Fremont-Winema National Forest for United States Forest Service (USFS) and BLM	541-947-6212 (office)	bshullanberger@fs.fed.us
	Jason Jaeger	Program Coordinator	Lake County Cooperative Weed Management Area	541-219-0537	lakecountyweeds@gmail.com
	Mike Warren	Staff/Emergency Radio Contact	Lake County Radio (KCLR 95.3 FM)	541-417-1308 (cell) 541-947-3325	mike@lakecountyradio.com
Tricia Sears	Tricia Sears	Natural Hazards Planner	Oregon Department of Land Conservation & Development (DLCD)	503-934-0031 (office)	tricia.sears@state.or.us

Lakeview Flood After Action Review Meeting 4/18/19

From: Daniel Tague
To: asstchief3102@centurytel.net; bobstory59@yahoo.com; Brian Lee (brian.w.lee@doc.state.or.us); catskiner73@gmail.com; ccwonly@yahoo.com; Chris Johnston (Chris.R.Johnston@doc.state.or.us); Dustin Gustaveson; dustinrstubbs@gmail.com; Glenna Wade (glennasonly@yahoo.com); Jake Greer; Jill Harlan; Juanita Trenkle (jtrenkle@lakehealthdistrict.org); keithlittle510@gmail.com; lakeviewdisasterunit@yahoo.com; messner.inc@gmail.com; Mike Cuff; Mike Warren-KLCR (outback@lakecountyradio.com); msuba@fs.fed.us; NHMP; northlakeems@yahoo.com; pnewton@lakehealthdistrict.org; Ray Turner (turbo97630@yahoo.com); rwood@odf.state.or.us; HILL Scott; scott.rice@state.or.us; smlk31@gmail.com; ANDERSON Steve B; Eric Sarensen; teresa.l.thomas@oregon.gov; McClain Josh J; Sears, Tricia
Subject: Reminder of Flood AAR Today at 10 AM at Emergency Services Building
Date: Thursday, April 18, 2019 8:24:54 AM
Attachments: 041819 April 2019 Flood AAR Agenda.docx

Good Morning All,

I just wanted to remind everyone involved with the flooding on April 8, there will be an After Action Review today at 10 AM at the Emergency Services Building. I have attached the agenda. I have mentioned this to most folks but I am sure I am missing some and trying to hit those I missed with this email. If you have any questions, concerns, comments or can't attend but want me to pass something on let me know.

Thanks,

Daniel J. Tague
Deputy Sheriff/Emergency Services Coordinator
Lake County Sheriff's Office
513 Center Street
Lakeview, OR 97630
Duty Cell (541) 219-6601
Direct (541) 947-6027 x 1204
Fax (541) 947-6029
Dispatch (541) 947-2504

April 8, 2019 Lakeview Flood After Action Review

April 18, 2019, 10:00 AM ESB

AGENDA

1. Introductions and role played in flood. (Appoint scribe)
2. Overview of Incident (Public Works/County EM/Incident Management Team)
3. Feed Back-Local Agencies (ESF's Primary Agencies)

ESF 1 Transportation

Town of Lakeview Public Works, Lake County Road Department

ESF 2 Communication

Lake County Sheriff's Office, Lake Emergency Telecommunications System

ESF 3 Public Works and Engineering

Town of Lakeview Public Works, Lake County Road Department

ESF 4 Firefighting

Lakeview Fire Department, Thomas Creek – Westside R.F.P.D.

ESF 5 Emergency Management

Lake County Sheriff's Office

ESF 6 Mass Care, Emergency Assistance Housing and Human Services

Lake County Public Health

ESF 7 Logistics Management and Resource Support

Lake County Business Services Department

ESF 8 Public Health and Medical Services

Lake County Public Health

ESF 9 Search and Rescue

Lake County Sheriff's Office

ESF 10 Oil and Hazardous Materials Response

Lakeview Fire Department, Thomas Creek-Westside RFPD

ESF 11 Agriculture and Natural Resources

Lake County Public Health

ESF 12 Energy

Lake County Road Department

ESF 13 Public Safety and Security

Lake County Sheriff's Office

ESF 14 Long-Term Community Recovery

Lakeview Town Council, Lake County Board of Directors

Others:

Lake County School District's

4. Feed Back- State Partners
   -Oregon Department of Corrections-WCCF, Oregon Department of Transportation, Oregon Department of Forestry, Oregon State Police

5. Feed Back – Federal Partners

   -Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife, Lakeview Interagency Fire Center

6. Damage Assessment
7. The future

Rules:

No personal attacks.

Don't be offended, only way we get better is discussing our shortfalls, every incident has them.

Offer constructive comments.

April 8, 2019 Lakeview Flood After Action Review			4/18/19
Name *(print clearly)*	**Agency**	**Phone**	**Email Address**
Abel Harrington	LKV BLM	541-219-0103	aharring@blm.gov
Scott Havel	LKV BLM	541-219-1870	sehavel@blm.gov
Trent Wilkie	LKV BLM	541-219-0084	twilkie@blm.gov
Jill Harlan	Lakeview Public Health	541-947-6045 x405	jharlan@lakehealthdistrict.org
Kattaryna Stiles	Oregon Health Authority	541 410 0291	Kattaryna.L.Stiles@dhsoha.state.or.us
Patti Newton	Lake Health District	541-947-7298	pnewton@lakehealthdistrict.org
MARK SUBA	THOMAS CREEK - WESTSIDE RFPD	541-219-9048	marksuba12@gmail.com
Dan Thomas	Thomas Creek/westside	541-420-3939	dangysgt@msn.com
Kevin Hock	Lake County Rid Dept.	541 947 6048	khock@co.lake.or.us
Mitch Ishida	LKV BLM / Thomas Creek Westside	541-883-3144	mishida@blm.gov
Jesse Merris	LKV BLM/Lakeview Fire dept.	218-766-2662	merrisjh23@hotmail.com
Teresa Thomas	LKV ODF/LIFC	541.219.9144	teresa.l.thomas@oregon.gov
Justin Phillips	USFS-Fremont-Winema NF	541-417-0974	charles.j.phillips@usda.gov
Tamara Schmidt	USFS-Fremont-Winema NF	541-947-6243	tamara.schmidt@usda.gov
RICHARD S. GATES	LKV ODF-LIFC	541-219-0611	RICHARD.S.GATES@OREGON.GOV
Josh McClain	ODOC/WCCF	541-219-6587	Josh.J.McClain@doc.state.or.us
Brian Lee	ODOC/WCCF	541.219-1224	Brian.W.Lee@doc.state.OR.US
Ray Turner	Mayor Lakeview	541-219-0489	Turbo97630@yahoo.com
James Williams	County Commissioner	541-410-8075	jwilliams@co.lake.or.us
Michael Cuff	BLM/USFS	760 326 1514	dez450x@yahoo.com
Joe Belshe	Lakeview BLM	480 338 2907	JBelshe@BLM.gov
Dennis Morrill	Lakeview FD	541-219-2866	Fire@townoflakeview.org
Justin Westcott	Lake Health	541-417-0388	Justin.Westcott@lakehealthdistrict.org

April 8, 2019 Lakeview Flood After Action Review			4/18/19
Name *(print clearly)*	**Agency**	**Phone**	**Email Address**
Steve Anderson	ODOT	541-947-2203	steve.b.anderson@odot.state.or.u
Dustin Gustaveson	ODF	541-947-3311	dustin.gustaveson@oregon.gov
Tricia Sears typing	DLCD	503-934-0031	tricia.sears@state.or.us

Lake County NHMP Flyer (original and revised)

Lake County
Natural Hazards Mitigation Plan Update
June 2018

Sandbags 2017

Jade Creek Fire 2017

Drought, Floods, Winter Storms, Wildfires…
What Concerns You?

Communities are stronger when they recognize the risks from natural hazards and make efforts to prepare for them and to reduce potential damage.

Lake County's existing ***Natural Hazards Mitigation Plan*** (NHMP) was updated in September 2013. NHMPs must be updated every five years.

Now, Lake County is collaborating with the Oregon Department of Land Conservation and Development (DLCD) to update the NHMP again. The updated NHMP will continue the County's eligibility for disaster related funding.

> ***"To create a disaster-resilient Lake County."***
>
> Lake County 2013 Natural Hazards Mitigation Plan

A Steering Committee, chaired by the Emergency Manager, is working with DLCD staff to update the NHMP. The NHMP is targeted for completion by March 2019.

Oregon Department of Land Conservation and Development

For more information and to provide comments:

Daniel J. Tague, Deputy Sheriff/Emergency Services Coordinator| Lake County | 541-947-6027 x 1204
Email: dtague@co.lake.or.us
Website: http://www.lakecountyor.org/index.php

Emergency preparedness and hazard mitigation planning involve preparing the individual and the community for hazards that may impact them.

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 maintain eligibility*** for disaster related funding.
- ***To increase safety and resiliency*** by integrating hazard mitigation into the plans, programs, and policies.

Lake County's Natural Hazards

Drought
Floods
Wildfires
Winter Storms
Air Quality
Wind Storms
Landslides
Earthquakes
Volcanic Events

Crane Creek Fire 2017

Abert Rim, Largest Exposed Fault Block in North America, Lake County, Oregon

Participation

This is a multi-jurisdictional Natural Hazards Mitigation Plan (NHMP) involving Lake County, the City of Lakeview, and the City of Paisley. Representatives from these jurisdictions and other organizations are actively participating in this NHMP update process.

Lake County flyer 6-20-18

All photos provided by Daniel Tague, Lake County.

Lake County

Natural Hazards Mitigation Plan Update

May 2019

Sandbags in Winter 2017

Jade Creek Fire 2017

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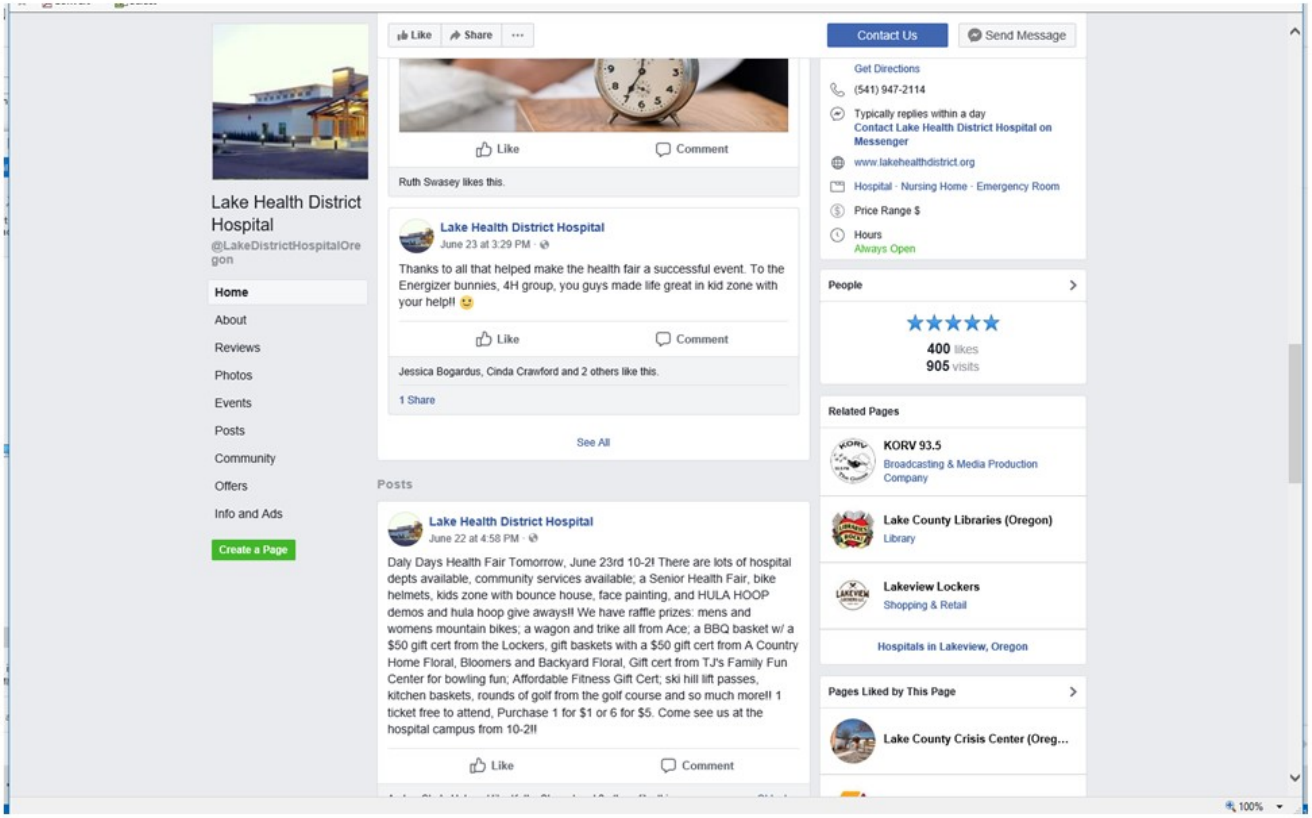
Lake County NHMP Flyer 5-30-19

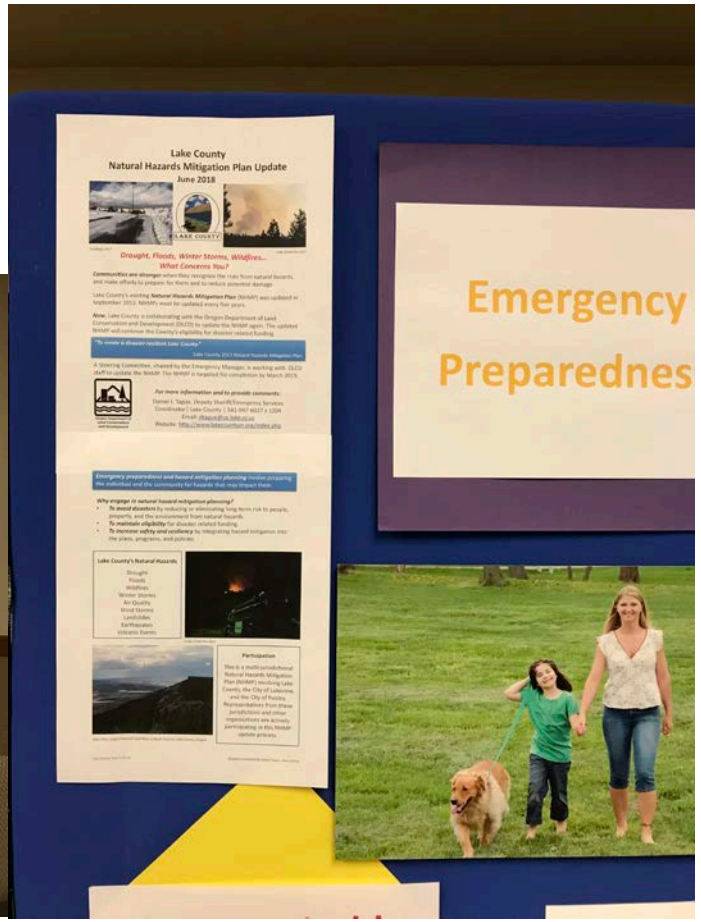
All photos provided by Daniel Tague, Lake County.

Website and Facebook Screen Shots, and Events

Lake Health District Hospital 7-11-18
View of the Health Fair Information on Facebook

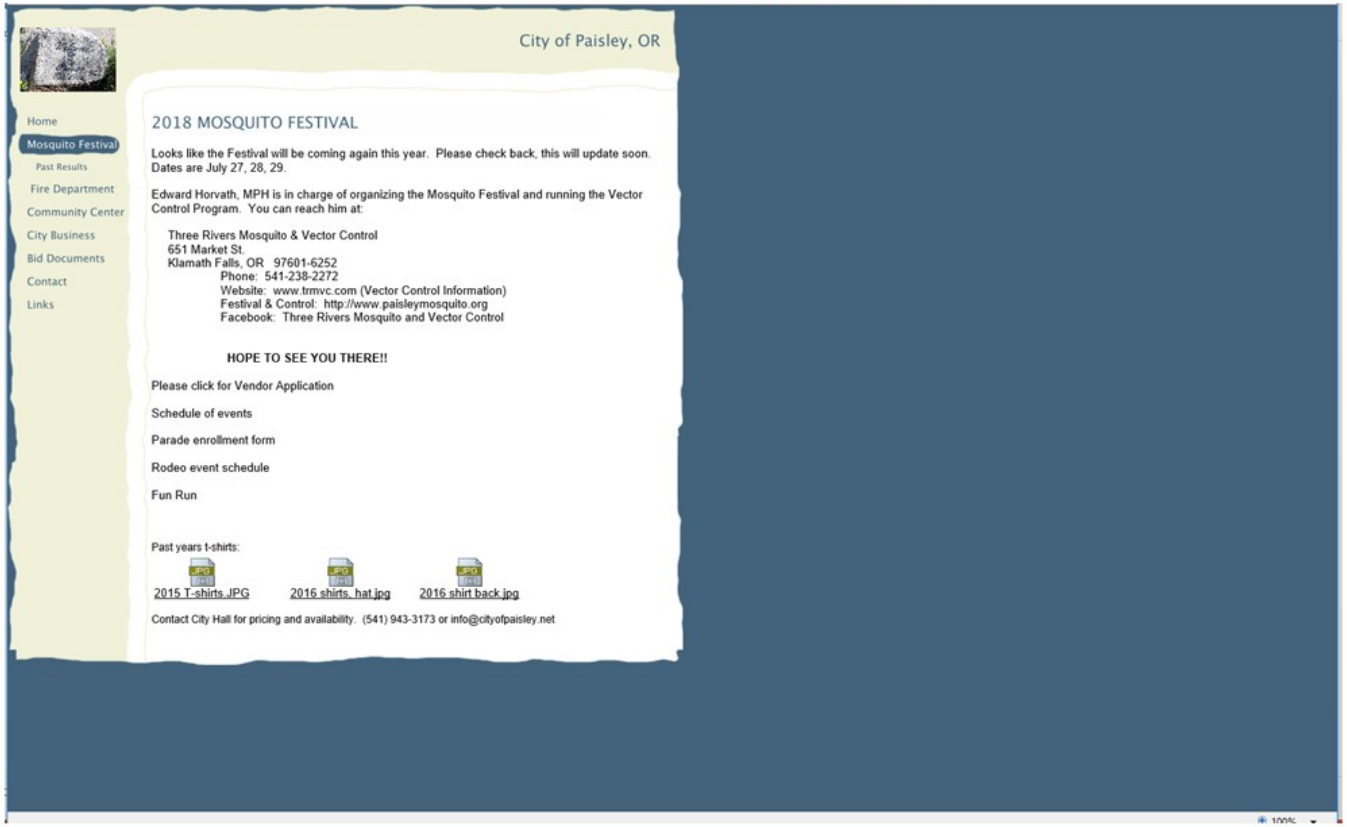


Photos from the June 23, 2018 Health Fair

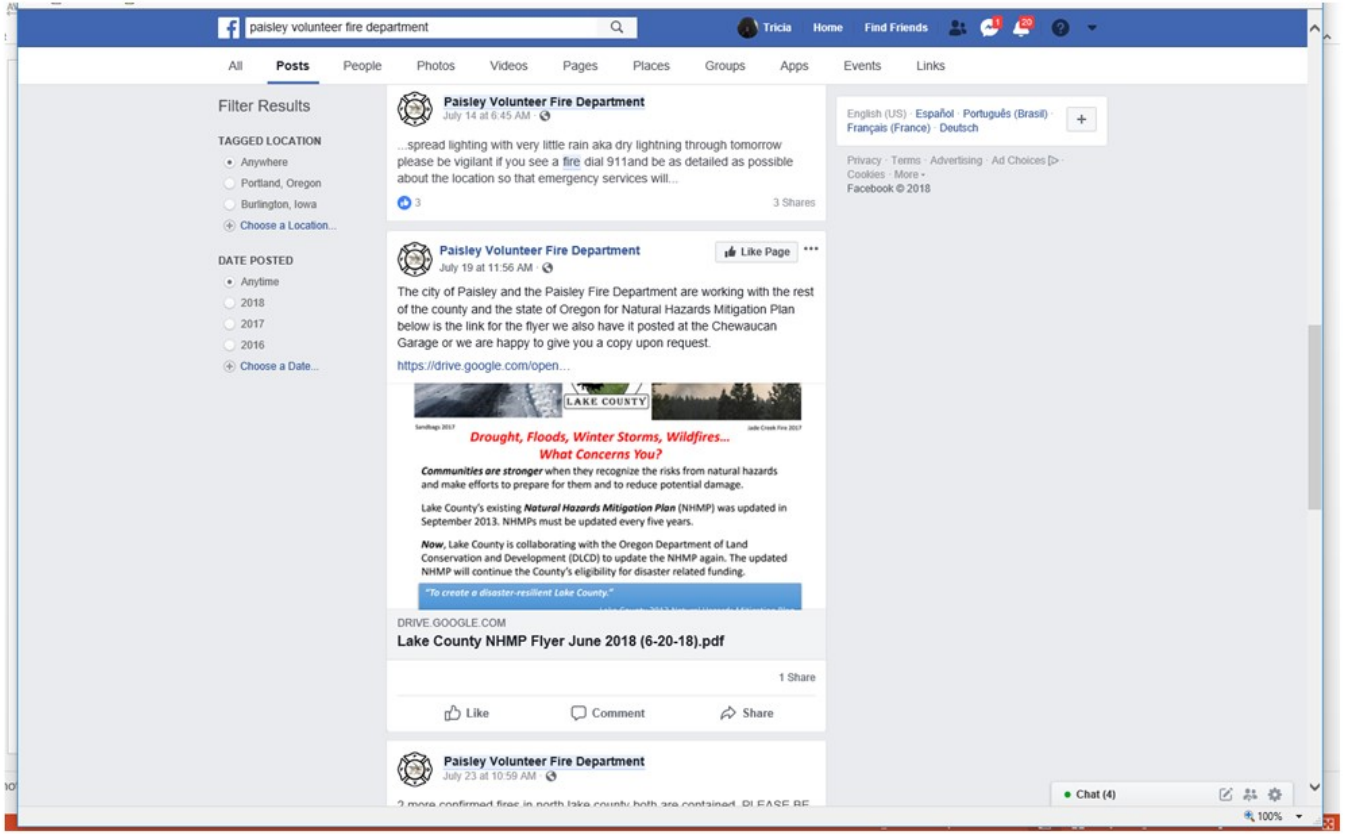


City of Paisley 7/11/18

http://www.cityofpaisley.net/1852/index.html



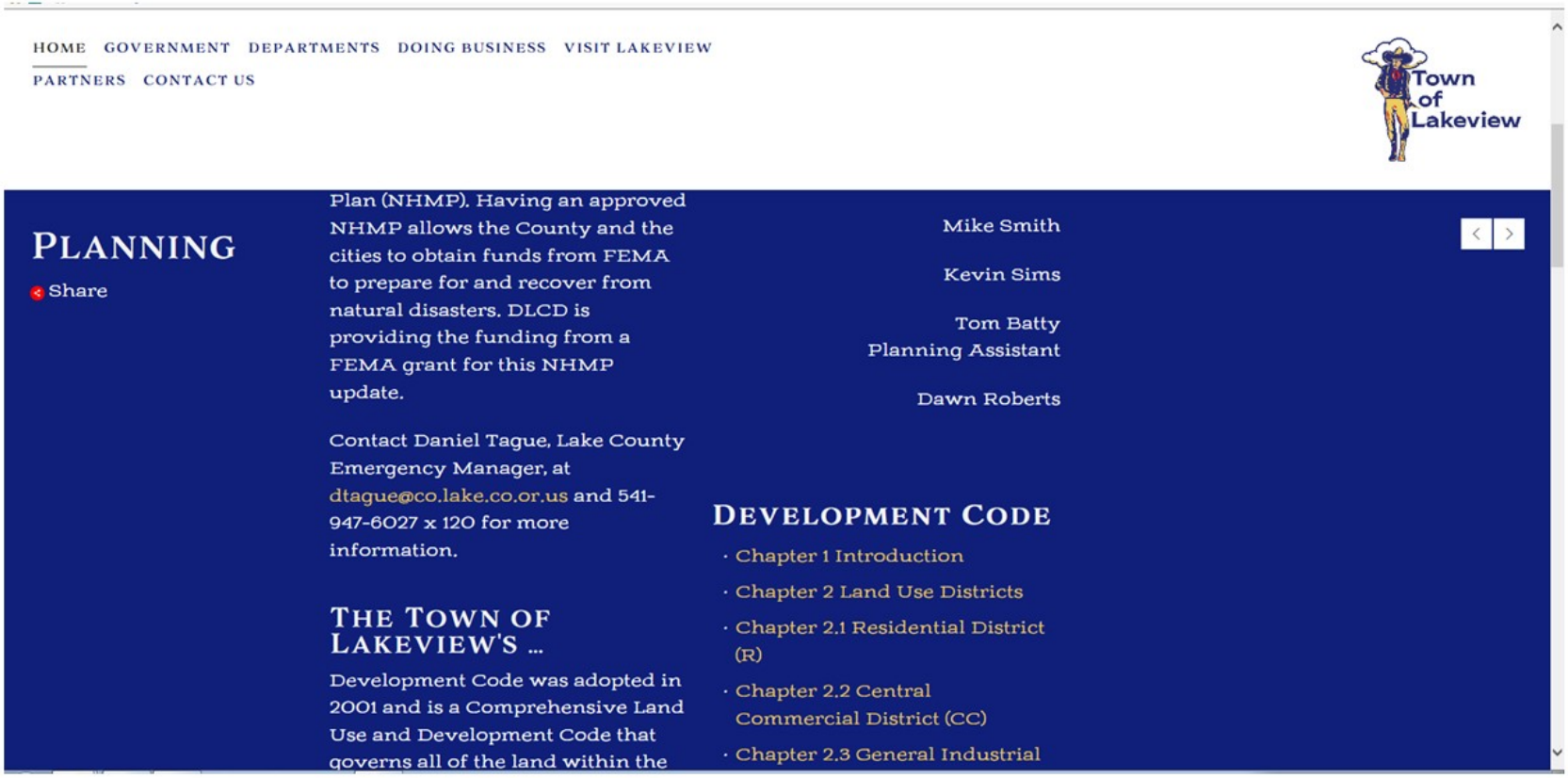
Paisley Volunteer Fire Department
Facebook 7-19-18



Lake County Planning Department 10/31/18
http://www.lakecountyor.org/government/land_use_planning.php

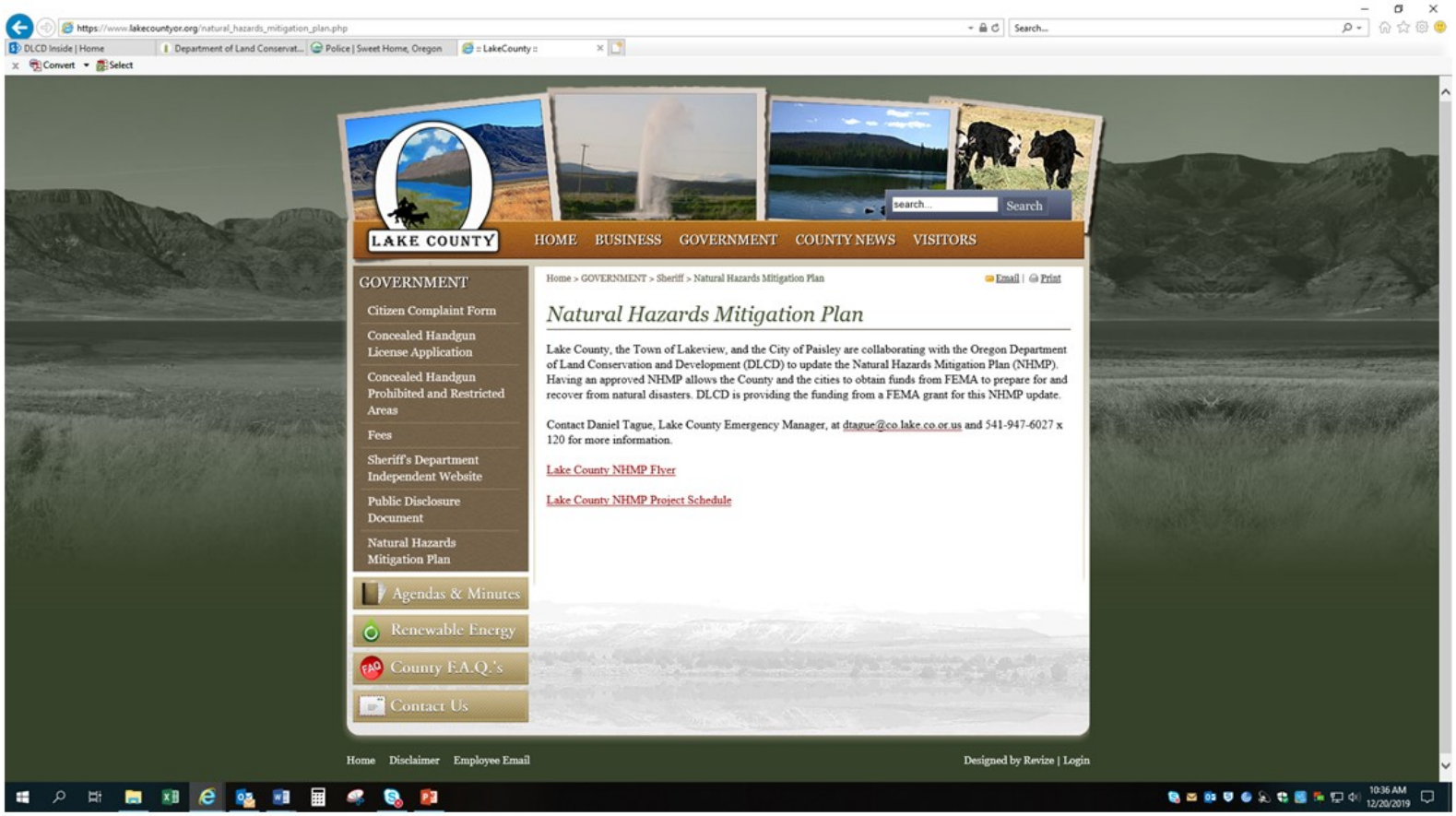
Town of Lakeview 11/6/18
https://www.lakeview-oregon.com/#/planning/

Town of Lakeview 11/6/18
https://www.lakeview-oregon.com/#/planning/



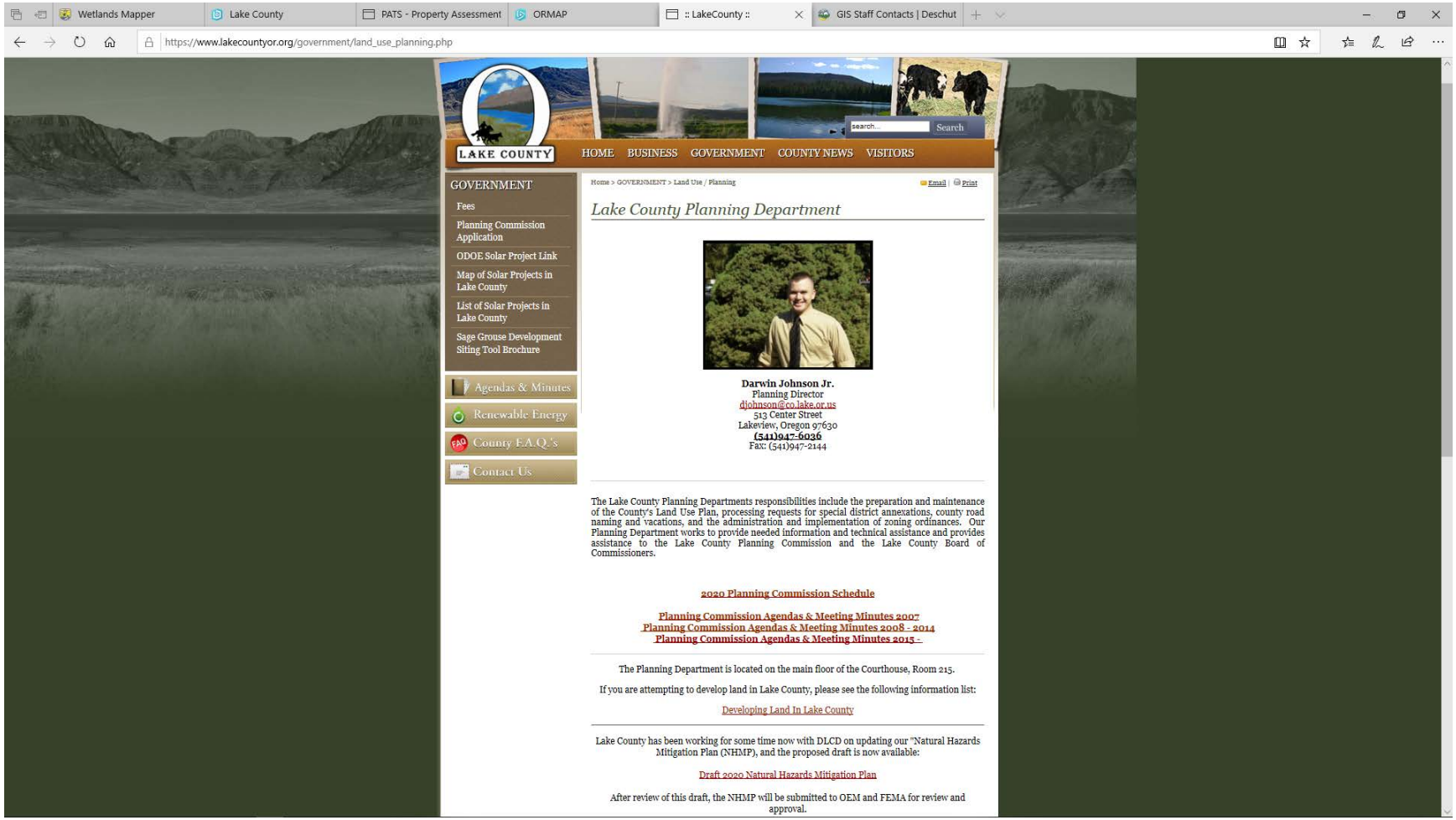
Lake County Sheriff's Office 12/20/19

https://www.lakecountyor.org/natural_hazards_mitigation_plan.php



Lake County Planning Department 2/4/20

https://www.lakecountyor.org/government/land_use_planning.php



Lake County Sheriff's Office 2/26/20

https://www.lakecountyor.org/natural_hazards_mitigation_plan.php

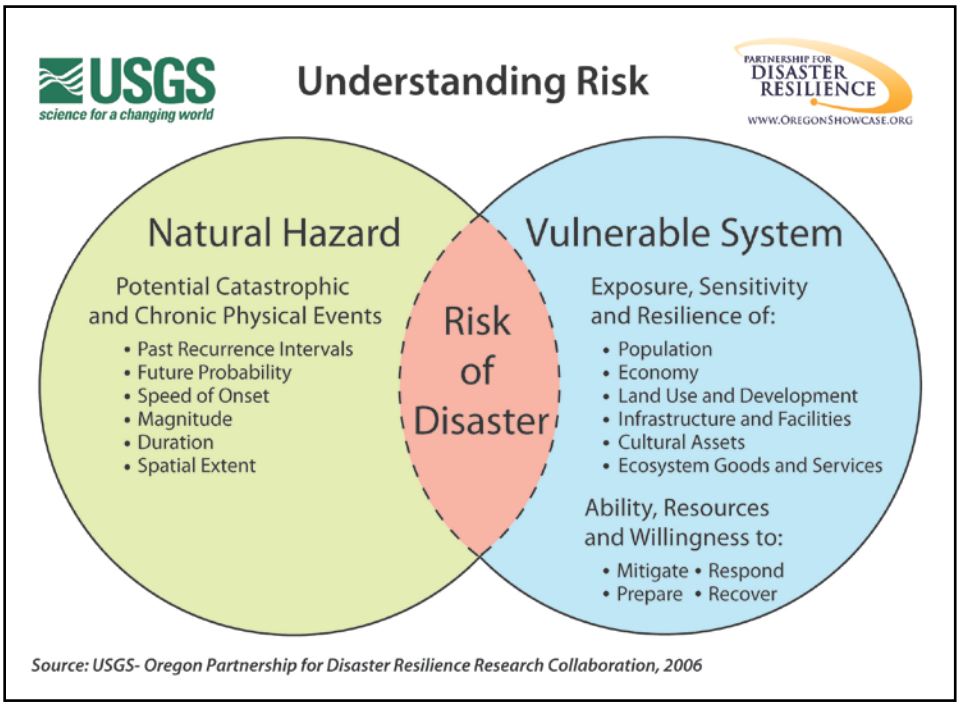
Appendix C:
Community Profile

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] To help define and understand Lake County's, Lakeview's, and Paisley's resilience to natural hazards, these capacities will be examined:

- Natural Environment,
- Socio-Demographic,
- Regional Economic,
- Built (or Infrastructure),
- Community Connectivity, and
- Political.

The Community Profile provides a snapshot in time when the NHMP was updated. It assists in establishing mitigation actions and in preparation of a more resilient community. The identification of mitigation actions that reduce Lake County's and the Cities' sensitivity and exposure, and increases the resiliency, assists in reducing overall risk of disaster. See Figure C-1.

Figure C-1 Understanding Risk



Source: *2013 Lake County NHMP*, Oregon Partnership for Disaster Resilience

[1] Rand Corporation, *Community Resilience*, https://www.rand.org/topics/community-resilience.html

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.[2] 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.

The following assets were identified by the NHMP Steering Committee in 2007; they were reconfirmed in 2013 and 2020, and are thus are again included in the NHMP.

Table C-1: Natural Resource Asset Identification

Natural Resource Assets
Fremont-Winema National Forest
Provides timber resources and recreational tourism opportunities
Local geology and tourism
Lake County is known as the "hang gliding capital of the west" and Abert Rim, Black Cap, Doherty Slide and Hadley Butte are all designated Hang-gliding launch sites in Lake County
Local geology in Lake County attracts many tourists to areas such as Abert Rim, Hart Mountain Antelope Reserve, Fort Rock, Hole in the Ground, Crack in the Ground, Christmas Valley Sand Dunes, and numerous hot springs.
Winter recreation in the form of snowmobiling and cross country skiing in the Fremont-Winema National Forest, and downhill skiing at Warner Mt. Ski Area
Local wildlife attracts hunters and birders to areas such as Hart Mountain Antelope Reserve, Summer Lake, The Warner Wetlands and Goose Lake
75% of lands are held by federal and state government and 65% of that is used for cattle grazing
Should grass and grazing be compromised due to natural hazards, then many ranchers could suffer losses or incur additional expenses to feed livestock
Water resources
2.66% of the county is covered by water, primarily in the form of large, shallow and fluctuating alkali lakes
Perlite mining is an economic asset

Source: Lake County NHMP Steering Committee, 2007, 2013, and 2020.

The economy in Lake County is dependent on its natural resources. The future of agriculture, forestry and wood products manufacturing industries are reliant on natural environment capacity.[3] Management of agricultural and timber resources will be a primary factor in determining the vitality of these industries in the future.[4] Lake County relies on alternative energy such as geothermal energy through the Lake County Resource Initiative (LCRI).[5] Lakeview and Paisley have known geothermal resources.[6]

[2] 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

[3] Lake County Comprehensive Plan Appendix, 1980 p. 73

[4] Ibid P. 79

[5] Lake County Resources Initiatives (LCRI), http://www.lcri.org

[6] South Central Oregon Economic Development District (SCOEDD) p. 3.11, as included in the *2013 Lake County NHMP*.

Geography

Lake County is located in the south-central high desert of Oregon along the California border; it spans 8,275 square miles making it the third largest county in Oregon. Lake County's natural features are varied and include national forests, national refuges, numerous lakes, and scattered rivers which accent the otherwise arid landscape.

There are two geographic and climatic divisions (5 and 7) in Lake County, the northern part is the High Plateau region and the southern half is the South Central Region. See the Oregon Climate Division map in Table WWS-1.7 Most of the County is located in the High Plateau region. The remoteness and ruggedness of the High Plateau has resulted in low area population. Only a few small unincorporated towns, including Christmas Valley, Fort Rock, and Silver Lake, serve as population centers; none exceeds 1,000 residents. The majority of residents live in the southern half of the County where the incorporated communities of Paisley and Lakeview area. Lakeview, the largest community in the County and County seat, is located along the merging highways of 140 and 395. The western part of Lake County features the Deschutes and Fremont National Forests. Lying parallel to these forests are the larger alkali lakes, Summer Lake and Goose Lake. The eastern part has the Hart Mountain Antelope Refuge, 270,000 acres.

Warner Mountains

The Warner Mountains branch north from the California border and reach the eastern part of Lakeview to form the Goose Lake Valley.[8] The range belongs to the Fremont National Forest.[9]

Fremont Mountains

The mountains on the western side of Lake County are also all located within the Fremont National Forest. These mountains include Gearhart Mountain and Yamsay Mountain.

Current and Projected Climate

Lakeview is the biggest city in Lake County. In Lakeview, the summers are warm and mostly clear, the winters are freezing and partly cloudy, and it is dry year round. Over the course of the year, the temperature typically varies from 18°F to 84°F and is rarely below 3°F or above 92°F.[10]

Lake County climate is semi-arid with long, severe winters and short, warm summers.

Lake County receives the occasional wind storm, which may be accompanied by flooding. Summer Lake and Christmas Valley are particularly susceptible to high winds and strong wind gusts.[11] Summer precipitation is very low, increasing the risk of wildfire and requiring irrigation for crops.

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

[8] Loy, W. G., ed. 2001. *Atlas of Oregon*, 2nd Edition. Eugene, OR: University of Oregon Press

[9] USDA Forest Service, *FSTopo Primary Base Series/States & Territories*, http://fsgeodata.fs.fed.us/rastergateway/states-regions/grid_zoom.php?regionID=r6&gridSrc=42120, link broken as of 2/5/20

[10] Weather Spark, *Average Weather in Lakeview*, *OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20

[11] *2013 Lake County NHMP*, p. 3.2

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.[12] See Appendix F for the *Future Climate Projections* report produced by the Oregon Climate Change Research Institute (OCCRI). The information is specific to Lake County. In addition to describing the current climate, the following sections discuss climate projections for the Pacific Northwest.

In the *2015 Oregon NHMP*, the U.S. EPA's ecoregions are used to describe areas of ecosystem similarity. Also within the *2015 Oregon NHMP*, Oregon's Natural Hazard Regions are identified as 1 through 8. Region 6 is composed of Lake, Wheeler, Klamath, Jefferson, Deschutes, and Crook Counties. Region 6 has four ecoregions: the Blue Mountains, the Cascades, the Eastern Cascades Slope and Foothills, and Northern Basin and Range.

The ecoregions have diverse ecoregions with varying climatic conditions. The region is subject to droughts, floods, landslides, wind storms, winter storms, volcanic events, earthquakes, and wildfires. All of these natural hazards, with the addition of and air quality, are identified in Lake County's Hazard Vulnerability Assessment (HVA).

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.[13]

See Volume II Hazard Annexes on 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 Volume I Section 2. The Wind Storms and Winter Storms Annex also includes weather and climate information. In that Annex, the weather averages by month, the weather averages by year, and the climate graph for Lakeview and Summer Lake are included to illustrate the climate information for two cities in different geographic areas of Lake County. Climate data such as precipitation,

[12] 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.

[13] OCCRI, *Fourth Oregon Climate Assessment Report: State of Climate Science: 2019, http://www.occri.net/publications-and-reports/fourth-oregon-climate-assessment-report-2019/.*

temperature, humidity, clouds, and sunshine provides a framework for understanding the climate in Lake County.

Precipitation, Rainfall, and Snowfall

The average annual precipitation is comparable at different NOAA stations throughout Lake County. Precipitation includes snowfall unless otherwise specified.

OCCRI's *Future Climate Projections* report states that there is greater uncertainty in future projections of precipitation-related metrics than temperature-related metrics. The reason for this is that the large natural variability in precipitation patterns and the fact that the atmospheric patterns that influence precipitation are manifested differently across global climate models.[14]

Table C-2 shows the monthly average and the annual average precipitation for four locations in Lake County. Figures that illustrate that include Figure C-2 which shows the average daily chance of precipitation throughout the year in Lakeview, and Figure C-3 which shows the average monthly rainfall in Lakeview throughout the year.

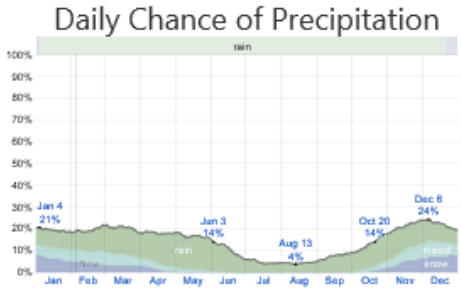
Precipitation

A wet day is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The chance of wet days in Lakeview varies throughout the year. The wetter season lasts 7.4 months, from October 20 to June 3, with a greater than 14% chance of a given day being a wet day. The chance of a wet day peaks at 24% on December 6. The drier season lasts 4.5 months, from June 3 to October 20. The smallest chance of a wet day is 4% on August 13. Among wet days, there is a distinction between those that experience rain alone, snow alone, or a mixture of the two. Based on this categorization, the most common form of precipitation in Lakeview changes throughout the year. Rain alone is the most common for 12 months, from January 4 to December 20. The highest chance of a day with rain alone is 16% on May 4. Snow alone is the most common for 2.1 weeks, from December 20 to January 4. The highest chance of a day with snow alone is 9% on December 26.[15]

[14] OCCRI, *Future Climate Projections Lake County*, August 2018, https://www.oregon.gov/lcd/CL/Documents/OCCRI_PDM16_LakeCoFutureProjections2018.pdf

[15] Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

Figure C-2 Daily Chance of Precipitation (inches)



The percentage of days in which various types of precipitation are observed, excluding trace quantities: rain alone, snow alone, and mixed (both rain and snow fell in the same day).

Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

Table C-2 Average Precipitation (Inches) for Areas in Lake County

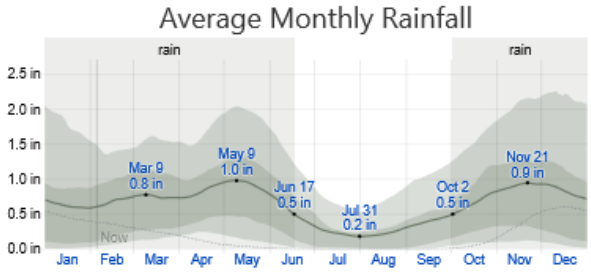
Month	Lakeview	Paisley	Alkali Lake	Summer Lake
January	1.75	1.09	.46	1.45
February	1.52	.98	.58	1.26
March	1.47	1.02	.75	1.15
April	1.38	1.00	.91	1.15
May	1.40	1.05	1.27	1.29
June	.89	.90	.77	.89
July	.37	.45	.39	.53
August	.26	.60	.56	.50
September	.65	.54	.43	.56
October	.94	.52	.65	.86
November	1.84	1.14	.53	1.74
December	2.20	1.77	.73	1.93
Annual	1.22	.96	.67	1.11

Source: NOAA Centers for Environmental Information, Data Tools: 1981-2010 Normals, https://www.ncdc.noaa.gov/cdo-web/datatools/normals, accessed 2/5/20

Rainfall

To show variation within the months and not just the monthly totals, the figure shows the rainfall accumulated over a sliding 31-day period centered around each day of the year. Lakeview experiences some seasonal variation in monthly rainfall. The rainy period of the year lasts for 8.5 months, from October 2 to June 17, with a sliding 31-day rainfall of at least 0.5 inches. The most rain falls during the 31 days centered around May 9, with an average total accumulation of 1.0 inches. The rainless period of the year lasts for 3.5 months, from June 17 to October 2. The least rain falls around July 31, with an average total accumulation of 0.2 inches.[16]

Figure C-3 Average Monthly Rainfall (inches)



The average rainfall (solid line) accumulated over the course of a sliding 31-day period centered on the day in question, with 25th to 75th and 10th to 90th percentile bands. The thin dotted line is the corresponding average liquid-equivalent snowfall.

Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

According to the *Future Climate Projections* report for Lake County, the intensity of extreme precipitation events is expected to increase slightly in the future as the atmosphere warms and is able to hold more water vapor. In Lake County, the magnitude of precipitation on the wettest day and wettest consecutive five days per year is projected to increase on average by about 19% (with a range of 6% to 33%) and 13% (with a range of -3% to 39%), respectively, by the 2050s under the higher emissions scenario compared to the historical baseline. The frequency of days with at least ¾" of precipitation and the frequency of days exceeding a threshold for landslide risk is not projected to change substantially.[17]

Snowfall

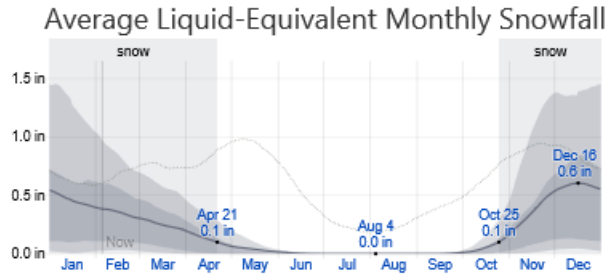
We report snowfall in liquid-equivalent terms. The actual depth of new snowfall is typically between 5 and 10 times the liquid-equivalent amount, assuming the ground is frozen. Colder, drier snow tends to be on the higher end of that range and warmer, wetter snow on the lower end. As with rainfall, we consider the snowfall accumulated over a sliding 31-day period centered around each day of the year. Lakeview experiences some seasonal variation in monthly liquid-equivalent snowfall. The snowy period of the year lasts for 5.9 months, from October 25 to April 21, with a sliding 31-day liquid-equivalent snowfall of at least 0.1 inches. The most snow falls during the 31

[16] Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

[17] OCCRI, *Future Climate Projections Lake County*, August 2018, https://www.oregon.gov/lcd/CL/Documents/OCCRI_PDM16_LakeCoFutureProjections2018.pdf

days centered around December 16, with an average total liquid-equivalent accumulation of 0.6 inches. The snowless period of the year lasts for 6.1 months, from April 21 to October 25. The least snow falls around August 4, with an average total liquid-equivalent accumulation of 0.0 inches.[18]

Figure C-4 Average Liquid-Equivalent Monthly Snowfall



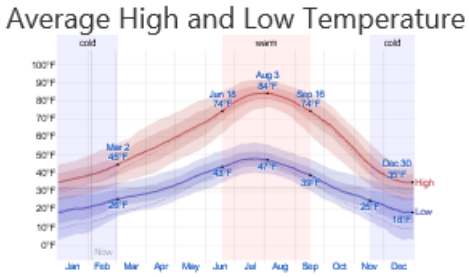
The average liquid-equivalent snowfall (solid line) accumulated over the course of a sliding 31-day period centered on the day in question, with 25th to 75th and 10th to 90th percentile bands. The thin dotted line is the corresponding average rainfall.

Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

Temperature

The warm season lasts for 3.0 months, from June 18 to September 16, with an average daily high temperature above 74°F. The hottest day of the year is August 3, with an average high of 84°F and low of 47°F. The cold season lasts for 3.6 months, from November 16 to March 2, with an average daily high temperature below 45°F. The coldest day of the year is December 30, with an average low of 18°F and high of 35°F.[19]

Figure C-5 Average High and Low Temperature in Lakeview, Oregon



The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. The thin dotted lines are the corresponding average perceived temperatures.

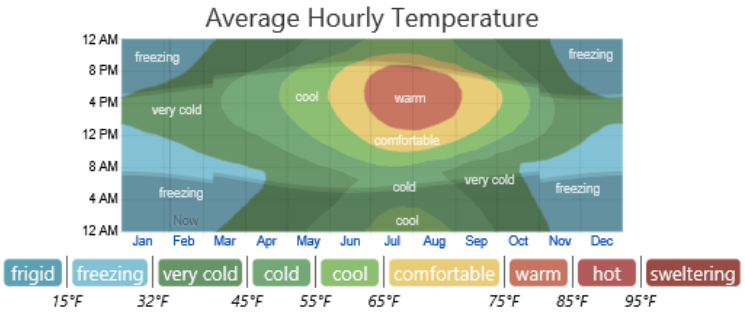
Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

[18] Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

[19] Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

Figure C-6 below shows a compact characterization of the entire year of hourly average temperatures. The horizontal axis is the day of the year, the vertical axis is the hour of the day, and the color is the average temperature for that hour and day.

Figure C-6 Average Hourly Temperature in Lakeview, Oregon



The average hourly temperature, color coded into bands. The shaded overlays indicate night and civil twilight.

Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

Table C-3 Average Temperature (Degrees F) for Areas in Lake County

Month	Lakeview	Paisley	Alkali Lake	Summer Lake
January	29.7	32.5	30.8	34.3
February	32.2	35.3	32.7	36.8
March	38.0	40.5	38.1	42.2
April	43.5	45.6	43.0	47.4
May	51.1	53.1	50.7	55.0
June	59.3	59.8	58.7	62.6
July	67.8	67.0	66.7	70.1
August	66.2	66.2	65.5	69.0
September	58.5	58.4	56.8	61.0
October	48.0	48.5	45.9	50.7
November	36.4	37.4	36.0	39.6
December	29.3	30.7	29.4	33.1
Annual	46.7	47.9	46.2	50.2

Source: NOAA Centers for Environmental Information, Data Tools: 1981-2010 Normals, https://www.ncdc.noaa.gov/cdo-web/datatools/normals, accessed 2/5/20

Table C-4 Min/Max Temperature (Degrees F) for Areas in Lake County

Month	Lakeview Station: Lakeview 2 NNW	Paisley Station: Paisley	Alkali Lake Station: Alkali Lake	Summer Lake Station: Summer Lake 1 S
January	20.7/38.7	22.1/ 42.8	19.6/42.1	24.9/43.7
February	22.4/42.1	23.6/47.0	20.8/44.7	26.5/47.2
March	27.3/48.8	27.7/53.2	24.6/51.6	30.7/53.8
April	31.0/55.9	31.5/59.7	27.7/58.3	34.4/60.4
May	37.4/64.9	38.1/68.1	34.1/67.3	40.7/69.3
June	44.0/74.5	43.4/76.3	40.8/76.6	46.8/78.4
July	50.5/85.0	48.2//85.9	46.3/87.1	52.1/88.2
August	48.3/84.2	46.9/85.6	44.7/86.3	50.4/87.6
September	41.0/76.0	39.6/77.2	36.1//77.5	42.8/79.2
October	32.8/63.2	31.8/65.1	27.7/64.2	35.4/66.0
November	26.0/46.8	25.4/49.4	22.6/49.3	29.1/50.1
December	20.3/38.2	20.6//40.7	18.3/40.6	24.0/42.2
Annual	33.5/60.0	33.3/62.7	30.3/62.2	36.5/63.9

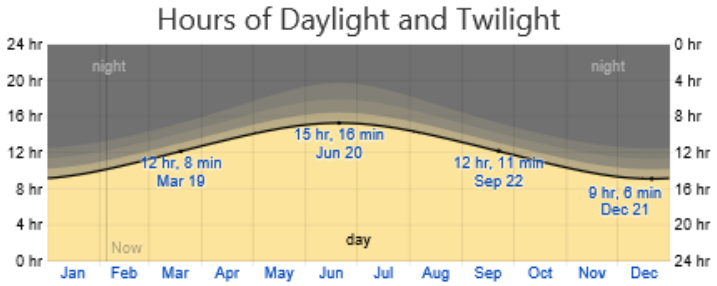
Source: NOAA Centers for Environmental Information, Data Tools: Monthly Temperature Normals 1981-2010, https://www.ncdc.noaa.gov/normalsPDFaccess/, accessed 2/5/20

Sun

The length of the day in Lakeview varies significantly over the course of the year. In 2020, the shortest day is December 21, with 9 hours, 6 minutes of daylight; the longest day is June 20, with 15 hours, 16 minutes of daylight.[20]

[20] Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

Figure C-7 Hours of Daylight and Twilight in Lakeview, Oregon

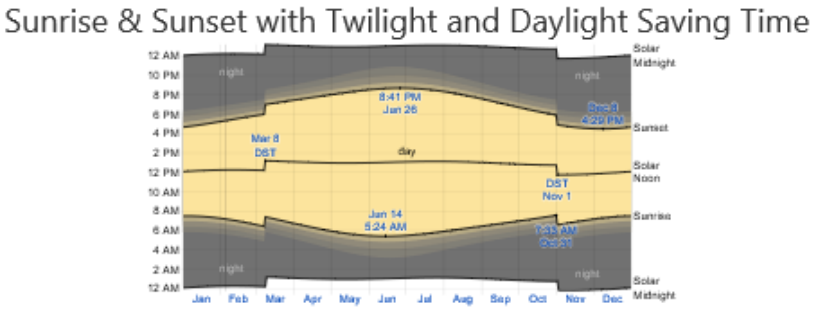


The number of hours during which the Sun is visible (black line). From bottom (most yellow) to top (most gray), the color bands indicate: full daylight, twilight (civil, nautical, and astronomical), and full night.

Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

The earliest sunrise is at 5:24 AM on June 14, and the latest sunrise is 2 hours, 9 minutes later at 7:33 AM on October 31. The earliest sunset is at 4:29 PM on December 8, and the latest sunset is 4 hours, 13 minutes later at 8:41 PM on June 26. Daylight saving time (DST) is observed in Lakeview during 2020, starting in the spring on March 8, lasting 7.8 months, and ending in the fall on November 1.[21]

Figure C-8 Sunrise and Sunset with Twilight and Daylight Savings Time in November



The solar day over the course of the year 2020. From bottom to top, the black lines are the previous solar midnight, sunrise, solar noon, sunset, and the next solar midnight. The day, twilights (civil, nautical, and astronomical), and night are indicated by the color bands from yellow to gray. The transitions to and from daylight saving time are indicated by the 'DST' labels.

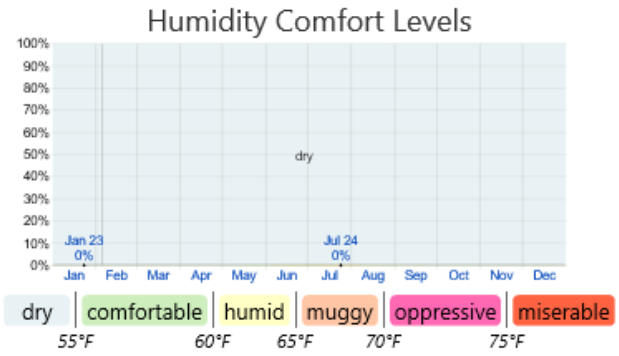
Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

[21] Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

Humidity

We base the humidity comfort level on the dew point, as it determines whether perspiration will evaporate from the skin, thereby cooling the body. Lower dew points feel drier and higher dew points feel more humid. Unlike temperature, which typically varies significantly between night and day, dew point tends to change more slowly, so while the temperature may drop at night, a muggy day is typically followed by a muggy night. The perceived humidity level in Lakeview, as measured by the percentage of time in which the humidity comfort level is muggy, oppressive, or miserable, does not vary significantly over the course of the year, remaining a virtually constant 0% throughout.[22]

Figure C-9 Humidity Comfort Levels in November



The percentage of time spent at various humidity comfort levels, categorized by dew point.

Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

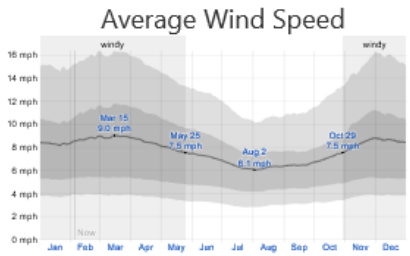
Wind

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 Lakeview experiences mild seasonal variation over the course of the year. The windier part of the year lasts for 6.9 months, from October 29 to May 25, with average wind speeds of more than 7.5 miles per hour. The windiest day of the year is March 15, with an average hourly wind speed of 9.0 miles per hour. The calmer time of year lasts for 5.1 months, from May 25 to October 29. The calmest day of the year is August 2, with an average hourly wind speed of 6.1 miles per hour.[23]

[22] Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

[23] Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

Figure C-10 Average Wind Speed in November



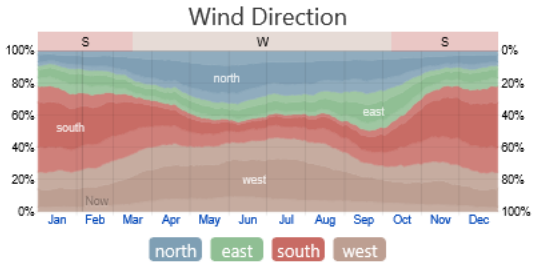
The average of mean hourly wind speeds (dark gray line), with 25th to 75th and 10th to 90th percentile bands.

Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

The predominant average hourly wind direction in Lakeview varies throughout the year.

The wind is most often from the west for 6.7 months, from March 16 to October 8, with a peak percentage of 46% on July 8. The wind is most often from the south for 5.3 months, from October 8 to March 16, with a peak percentage of 53% on January 1.[24]

Figure C-11 Wind Direction in November



The percentage of hours in which the mean wind direction is from each of the four cardinal wind directions, excluding hours in which the mean wind speed is less than 1.0 mph. The lightly tinted areas at the boundaries are the percentage of hours spent in the implied intermediate directions (northeast, southeast, southwest, and northwest).

Source: Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

Hazard Severity

As part of the PDM 16 grants, the Department of Land Conservation and Development (DLCD) contracted with the Oregon Climate Change Research Institute (OCCRI) to provide an analysis of

[24] Weather Spark, *Average Weather in Lakeview, OR,* https://weatherspark.com/y/1384/Average-Weather-in-Lakeview-Oregon-United-States-Year-Round, accessed 2/5/20.

climate change influences on natural hazards. The details of this information are provided in Appendix F Future Climate Projections Reports: *Future Climate Projections: Lake County* and *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports.*

Table HA-2 provides an overview of expected climate change impacts for Lake County. The table shows the direction of change (increasing, decreasing, and unchanging) and indicates the level of confidence in direction of change (high, medium, and low).

According to the OCCRI reports:

- There is high confidence that heat waves will increase and that cold waves will decrease.
- There is medium confidence that heavy rains, wildfire, droughts, prevalence of invasive species, and loss of wetland ecosystems will increase.
- There is low confidence that wind storms will remain unchanged, dust storms will decrease, and poor air quality and river flooding will increase.

The overview describes results for the natural hazards using climate metrics in summary and as a comparison. For more information see the OCCRI reports in Appendix F. Of note, the climate metrics used by OCCRI do not exactly match the natural hazards identified by Lake County.

Land Use

Recall that Lake County is largely comprised of grasslands, rangelands, agricultural lands, and primarily small communities, with Lakeview as the biggest city. There are some forested areas, primarily of ponderosa pine.

Most of the County is very sparsely populated and much of the land is owned by federal agencies. The federal governments owns 67.8% of Lake County land. The federal land ownership is primarily held by the Bureau of Land Management (BLM), who owns 48.6% of the land, primarily in the north and eastern parts of the County. The U.S. Forest Service owns about 20% of the land on the western border of the County.[25] State and other local agencies have other land holdings. Interestingly, in 2010, the west had the largest proportion of the wildland urban interface that is developed (16.3% while Lake County had the smallest (.2%).[26] Land ownership and development are also discussed in the Wildfire Annex.

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, throughout Volume 2 in the Introduction and the Hazard Annexes, and in the OCCRI reports in Appendix F.

[25] BLM, *Summary Profile of Lake County, OR*, 12/27/19.

[26] Ibid.

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 in such as graduation rate, quality of schools, median household income can have long term impacts on the Lake County economy and stability of the community ultimately affecting future resilience. These factors that are vulnerabilities can be reduced with outreach and mitigation planning.

Population

Lake County's total population as of 2010 was 7,895 and the population in 2018 was 8,115. Table C-5 illustrates the number of people living in Lake, Harney, and Malheur Counties from 1980 to 2018. The rank column is the rank of the specific county out of the thirty-six counties in Oregon.[27] The population of Lake County rose 23.7% from 1970 to 2018, while the population of the U.S. during that time period rose 60.5%.[28]

Table C-5 Population of Lake County and Adjacent Counties

Rank	County	% Change	2018	2010	2000	1990	1980
32	Harney	-.6	7,380	7,422	7,609	7,060	8,314
30	Lake	2.8	8,115	7,895	7,422	7,186	7,532
20	Malheur	2.0	31,925	31,313	31,615	26,038	26,896

Source: State of Oregon, *Oregon Blue Book*, https://sos.oregon.gov/blue-book/Pages/local/county-population.aspx, accessed 11/1/19.

"Lake County's positive population growth in the 2000s was largely the result of sporadic net in-migration. An aging population not only led to an increase in deaths but also resulted in a smaller proportion of women in their childbearing years. This, along with more women having children at older ages has led to births stagnating in recent years. A larger number of deaths relative to births caused natural decrease (more deaths than births) in every year from 2001 to 2016. While natural decrease outweighed net in-migration during the early and late years of the last decade, in recent years (2012-16) net in-migration has increased, leading to meager population growth.[29]

Looking to the future, "Total population in Lake County as a whole as well as within its sub-areas will likely grow at a faster pace in the near-term (2018 to 2043) compared to the long-term. The tapering of growth rates is largely driven by a growing natural decrease that will cut into population growth from net in-migration. Lake County's total population is forecast to increase by nearly 375 over the next 25 years (2018-2043) and by 400 over the entire 50-year period (2018-2068)."[30]

[27] 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.

[28] BLM, *Summary of Lake County, OR*, 12/27/19.

[29] Portland State University Population Research Center, *Coordinated Population Forecast for Lake County, its Urban Growth Boundaries (UGBs), and Area Outside UGBs 2018-2068*, dated 6/30/18.

[30] Portland State University Population Research Center, *Coordinated Population Forecast for Lake County, its Urban Growth Boundaries (UGBs), and Area Outside UGBs 2018-2068*, dated 6/30/18.

Urban and rural growth patterns can impact how agencies, cities, and counties prepare for emergencies, because changes in development can increase risk associated with hazards.

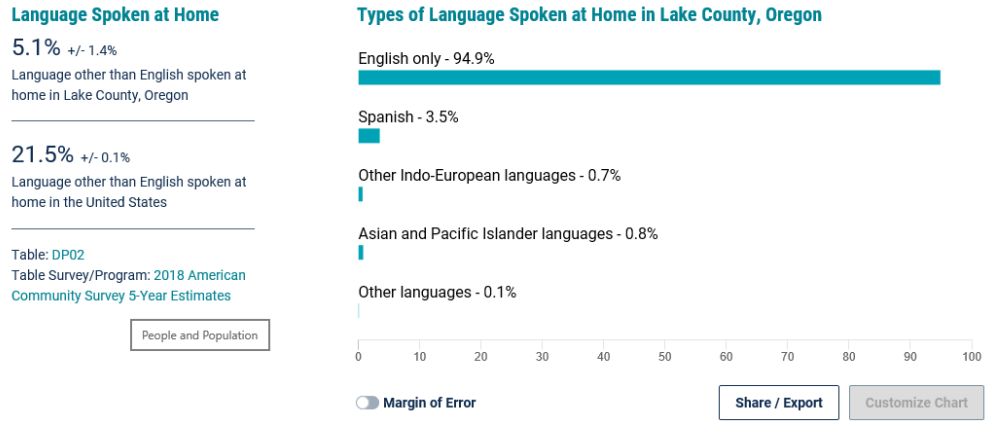
Population size itself is not an indicator of vulnerability. More important is the location, composition, and capacity of the population within the community. Research by social scientists demonstrates that human capital indices such as language, race, age, income, education and health can affect the integrity of a community. Therefore, these human capitals can impact community resilience to natural hazards. For example, Lake County's trend away from urbanization suggests that the population may be relatively less reliant on external goods and services. However, the significant increase in the age dependency ratio may pose significant challenges for the state in terms of natural disaster resilience and should not be overlooked.

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.[31]

English is the predominant language in Lake County; about 95% of the population speaks English as their primary language. Among the 5.1 percent whose primary language is not English, 3.5% speak Spanish. See Figure C-12. The population would benefit from specialized emergency and mitigation hazard planning outreach, with attention to cultural, visual and technology sensitive materials.[32]

Figure C-12 Language Spoken at Home in Lake County, OR



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

Race

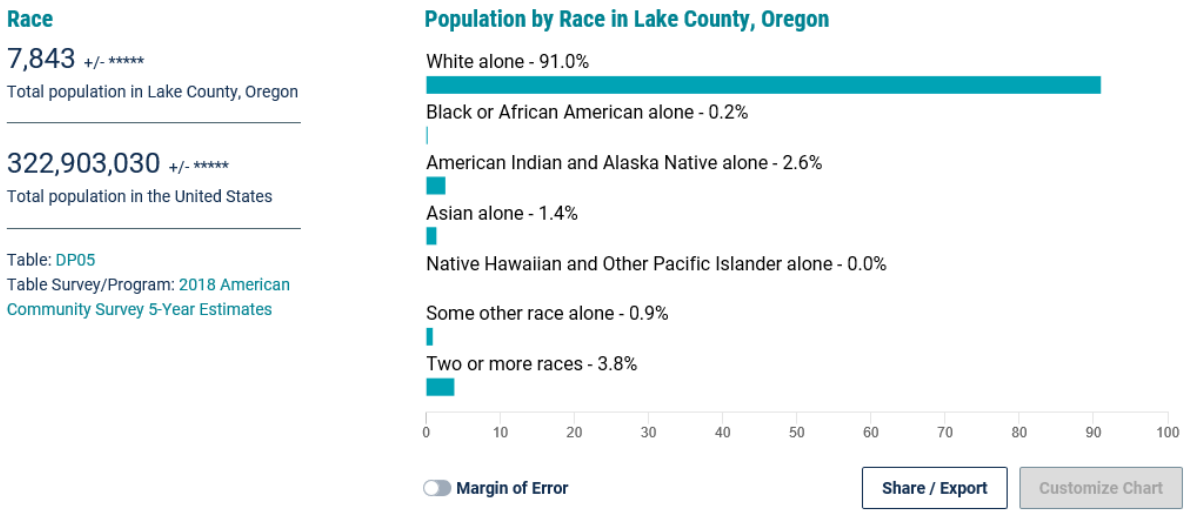
The impact in terms of loss and the ability to recover may also vary among minority population groups following a disaster. Studies have shown that racial and ethnic minorities can be more vulnerable to natural disaster events. This is not reflective of individual characteristics; instead,

[31] 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

[32] U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

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. Figure C-13 describes Lake County's population by race and ethnicity.

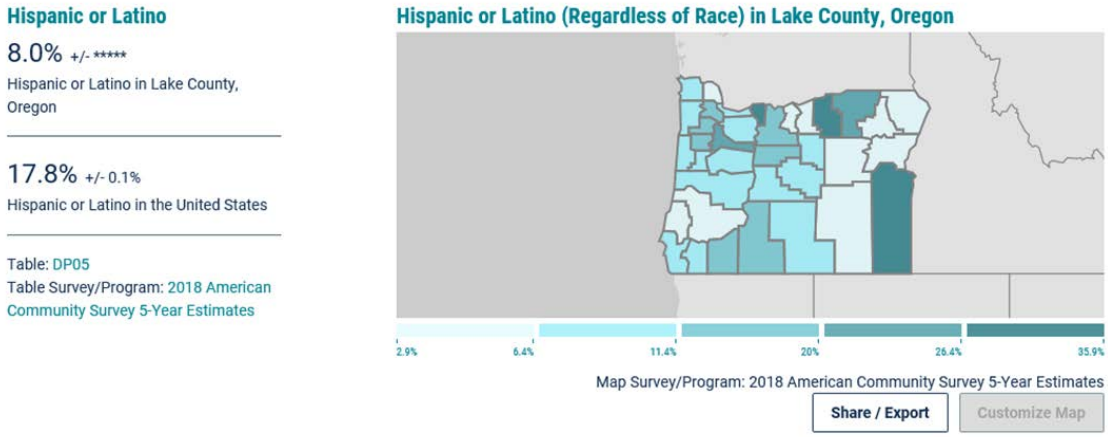
Figure C-13 Race and Ethnicity in Lake County, OR



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

Approximately 9% of residents identified as a race other than white on the 2010 Census, and 8% identified as Hispanic or Latino. It will be important for the County to identify specific ways to support all portions of the community through hazard preparedness and response.

Figure C-14 Hispanic or Latino in Lake County, OR



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

Age

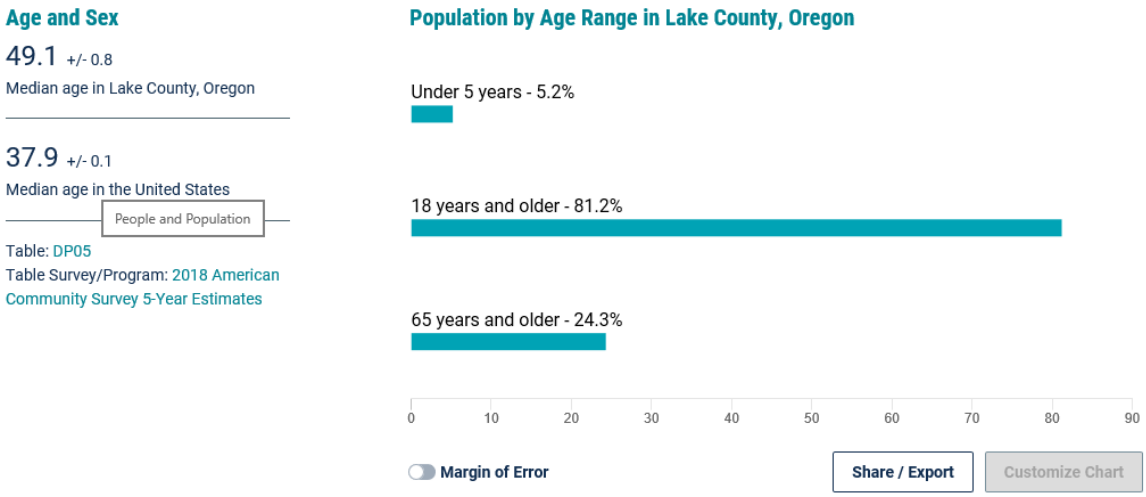
The most significant indicator that influences socio demographic capacity in Lake County may be the age dependency ratio of the population. The dependency ratio is a generalized analytical tool that evaluates the population under the age of 15 and over the age of 64. The dependency ratio is derived by 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. Figure C-15 shows that the percentage of persons over the age of 65 in Lake County in 2018 was 24.3% [33]

Rural Oregon's share of population 65 years of age and older increased from around 18 percent to nearly 22 percent in 2015. The retirement age population grew by 24 percent, while the working age population (-3%) and the youth population (-2%) both declined.[34]

At a glance, the share of rural workforce that is above the age of 55 doesn't seem to off from the share in metro areas, which is 23 percent to 27 percent in non-metro areas. However, in combination with the smaller population under the age of 18, retirements are likely to hit these communities harder as there are fewer young workers to rejuvenate the workforce.[35]

Figure C-15 People and Population in Lake County, OR



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

The age profile of an area has a direct impact both on what actions are prioritized for mitigation and how response to hazard incidents is carried out. School age children rarely make decisions about emergency management. Therefore, a larger youth population in an area will increase the importance of outreach to schools and parents on effective ways to teach children about fire safety, earthquake response, and evacuation plans. Furthermore, children are more vulnerable to the heat

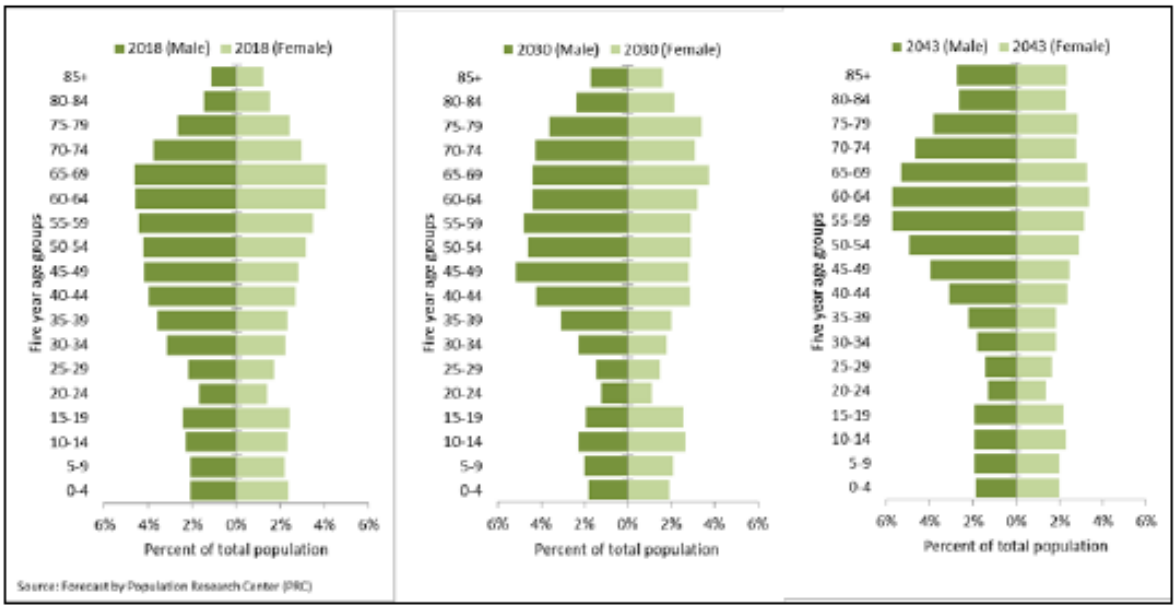
[33] U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037

[34] 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.

[35] 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.

and cold, have few transportation options and require assistance to access medical facilities.[36] Older populations may also have special needs prior to, during, and after a natural disaster. Older populations may require assistance in evacuation due to limited mobility or health issues. Additionally, older populations may require special medical equipment or medications, and can lack the social and economic resources needed for post-disaster recovery.[37]

Figure C-16 Lake County, OR – Age Structure of the Population 2018, 2030, and 2043



Source: Portland State University Population Research Center, *Coordinated Population Forecast for Lake County, its Urban Growth Boundaries (UGBs), and Area Outside UGBs 2018-2068*, dated 6/30/18.

Similar to most areas across rural Oregon, Lake County's population is aging. An aging population significantly influences the number of deaths but also yields a smaller proportion of women in their childbearing years, which may result in a slowdown or decline in births. The shifts in the age structure are shown in Figure C-16. In summary, population growth is expected to peak in 2020, and then taper through the remainder of the forecast period. Net in-migration is expected to remain relatively steady throughout the forecast period, but a growing natural decrease will slow population growth dramatically overtime.[38]

[36] 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

[37] Wood, Nathan, *Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon*, U.S. Geological Survey, Reston, VA, 2007.

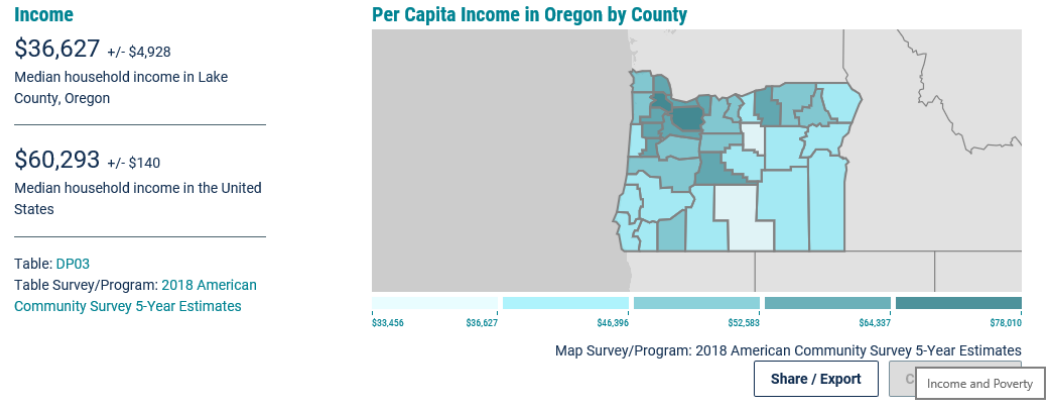
[38] Portland State University Population Research Center, *Coordinated Population Forecast for Lake County, its Urban Growth Boundaries (UGBs), and Area Outside UGBs 2018-2068*, dated 6/30/18.

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, but does not reflect how the income is divided among the area residents.[39]

The median household income in Lake County is $36,627. This amount is noticeably lower than the median household income for the U.S. See Figure C-17. [40]

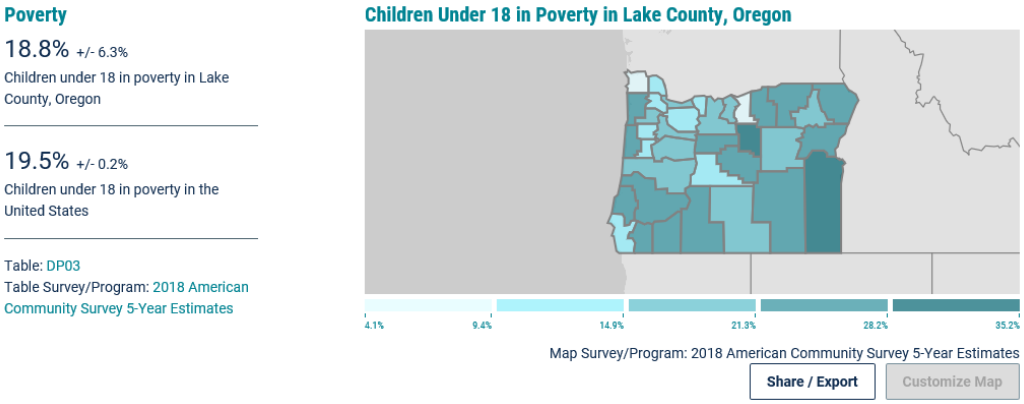
Figure C-17 Income and Poverty in Lake County, OR



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

Figure C-18 identifies the percentage of children under 18 that are below the poverty level in 2018 as 18.8%. This is lower than the percentage of children under the age of 18 below the poverty level in the U.S. which is 19.5.

Figure C-18 Children Under 18 in Poverty in Lake County, OR



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

[39]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

[40] U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

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.[41]

Table C-6 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

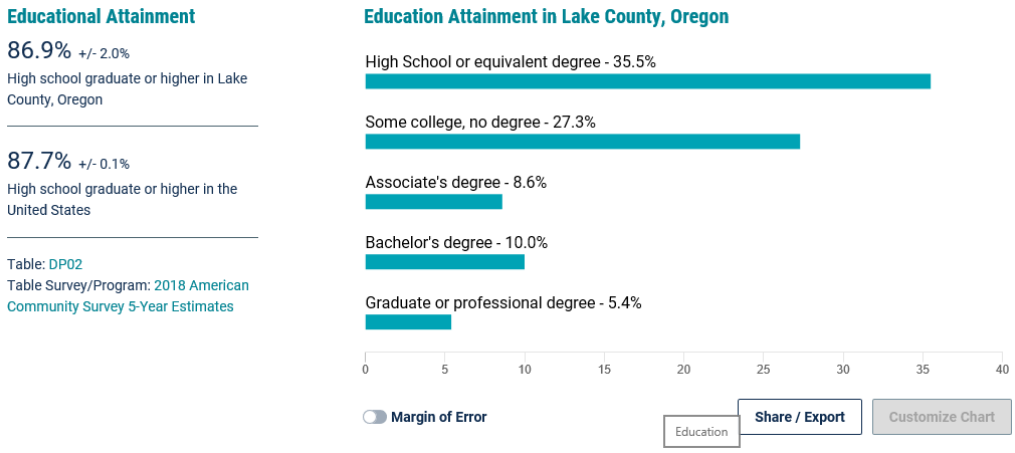
Income is a resiliency indicator, as higher incomes are often associated with increased self-reliance, and ability to prepare oneself if an emergency does occur. The higher the poverty rate, the more assistance the community will likely need in the event of a disaster in the form of sheltering, medical 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.

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 resiliency of the community.

[41] 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

Figure C-19 Educational Attainment in Lake County, OR



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

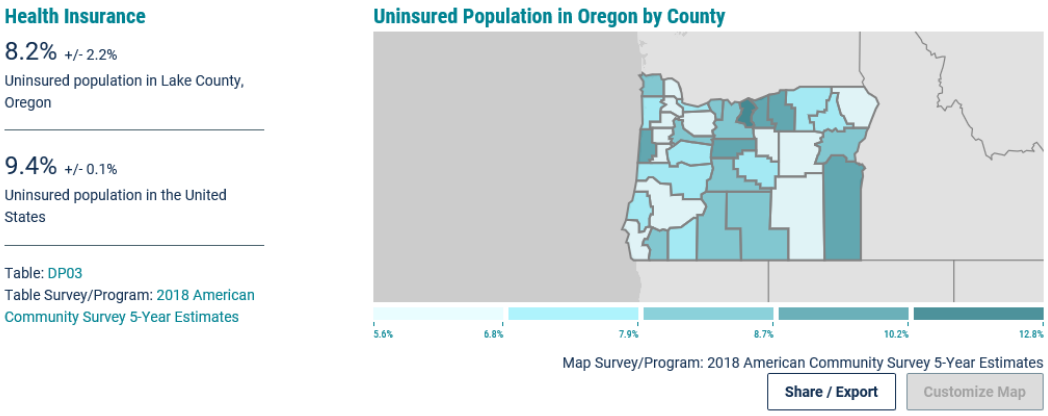
According to the U.S. Census, 86.9% of the Lake County population over 18 years of age has graduated from high school or received a high school equivalency, with 8.61% receiving an associate college degree and 10% receiving a bachelor's degree.

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.

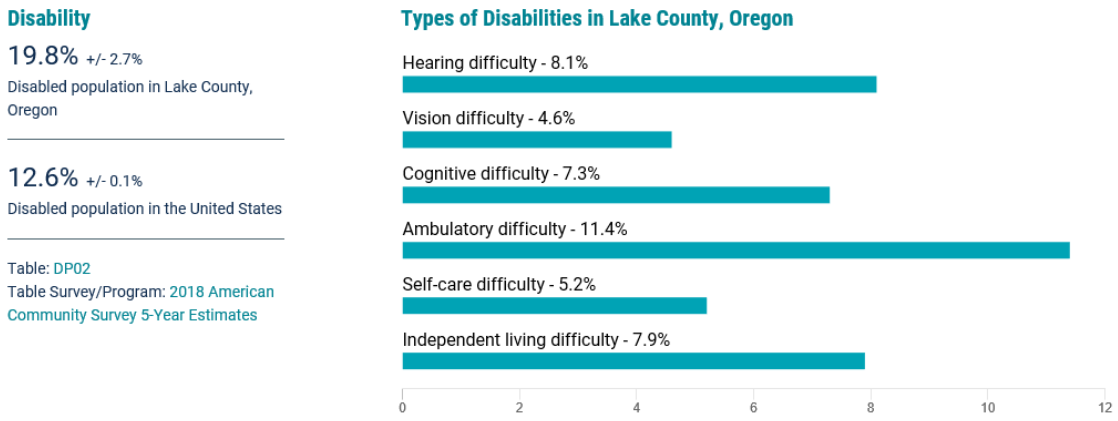
It is recognized that those who lack health insurance or are impaired with sensory, mental or physical disabilities, have higher vulnerability to hazards and will likely require additional community support and resources. On a similar note, a community with high percentages of drug dependency and violent 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.

Figure C-20 Health in Lake County, OR



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

Figure C-21 Disability in Lake County, OR



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

Table C-7 Behavior Health Profile of Lake County, OR

Lake County Behavioral Health Profile, 2015

Population Statistics	**County**	**Oregon**
Population	7,990	3,962,710
Growth Rate	-1.1%	4.1%
Poverty Rate (all ages)	17.8%	16.7%
Poverty Rate (ages 5 to 17)	9.8%	20.1%
Unemployment Rate	7.8%	5.7%
Percent on Medicaid	35.5%	31.8%
Identified Mental Health (MH) or Substance Use (SU) Conditions, Medicaid Population		
Children under 12 with MH Condition	43.2 %	27.7 %
Youth (12 to 17) with MH Condition	54.8%	33.9%
Youth (12 to 17) Identified SU Condition	6.6 %	7.5 %
Young Adults (18 to 25) with Mild to Moderate MH Condition	26.3%	26.7%
Young Adults (18 to 25) with Serious MH Condition	5.9%	8.3%
Young Adults (18 to 25) with SU Condition	20.2 %	20.2 %
Adults (26 and older) with Mild to Moderate MH Condition	25.3%	27.6%
Adults (26 and older) with Serious MH Condition	9.0%	14.0%
Adults (26 and older) with SU Condition	8.3%	7.6%
Count of Persons Admitted to Oregon State Hospital		
Civil Commitments		470
Aid & Assist	2	674
Guilty Except for Insanity	5	299
Per Capita Public Funding		
OHP Funding	$111.81	$140.91
Other Medicaid Funding	$33.23	$53.97
State and Local Investments	$90.70	$55.00
Total Per Capita Public Behavioral Health Funding	$235.74	$249.88
CCO Plan(s)		
Eastern Oregon Coordinated Care Org.		

Source: Oregon Health Authority, *Lake County Behavioral Health Profile*, 2015, https://www.oregon.gov/oha/HSD/AMH/BH%20Mapping%20Profiles/Lake%20County%20BH%20Profile.pdf

Synthesis

Lake County must 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 large elderly population and low income, can result in a substantial reliance on public services and assistance. 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.

Regional 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.

Considering the high regional unemployment, low income, high housing cost burden, and an economy heavily dependent on a single or few key industries, Lake County may experience a more difficult time in recovering after a disaster than one with a more diverse economic base.[42]

However to the benefit of Lake County, there is a mix of sectors that are dependent and independent of external markets. Having local sectors that are solely dependent, or solely independent, can potentially have negative impacts during a natural hazard event. It is important that Lake County recognizes that economic diversification is a long-term goal; more immediate strategies to reduce vulnerability should focus on risk management for the dominant industries.[43]

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.

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

[42] 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

[43] Ibid.

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.[44]

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.[45]

Lake County is listed as #19 in the top 25 counties (out of 36) in Oregon on the Gini Index. The counties shown on Oregon's Gini Index are those with more than 24,999 population and at least 25 housing units. [46] 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. [47]

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".[48]

In Figure C-22, the median family income by race is shown for families in Lake County. It reveals a substantial difference in income by race. Everyone in Lake County should take note of these disparities and identify the priority of closing the gaps. In Figure C-23, the source of income for families is identified as coming from the following five sources: wages, self-employment, investments and retirement, social security, and public assistance and SSI.

[44] U.S. Census Bureau*, Income Inequality, The Gini Index*, https://www.census.gov/topics/income-poverty/income-inequality/about/metrics/gini-index.html

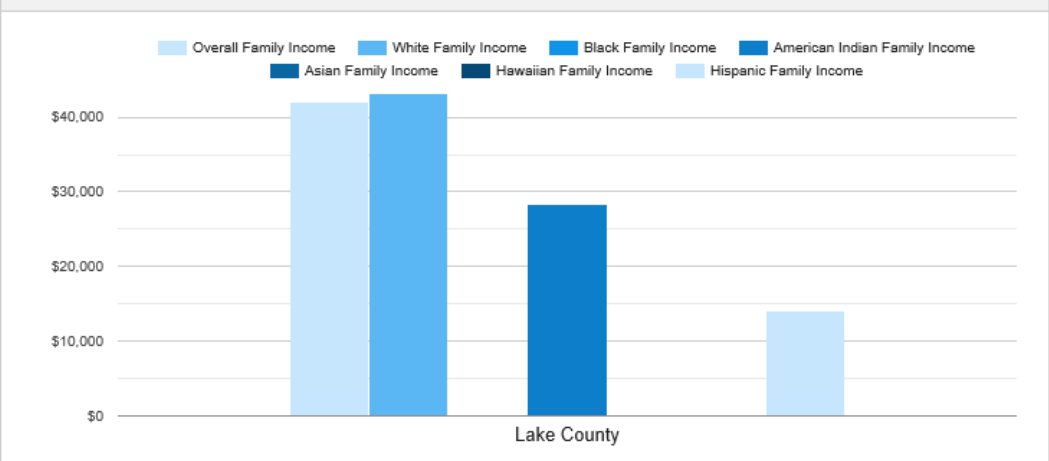
[45] Susan Cutter, Christopher G. Burton, and Christopher T. Emrich. 2010, *Disaster Resilience Indicators for Benchmarking Baseline Conditions*, Journal of Homeland Security and Emergency Management 7, no.1: 1-22, http://resiliencesystem.com/sites/default/files/Cutter_jhsem.2010.7.1.1732.pdf

[46] Town Charts, *Top 25 Oregon Counties Ranked by the Gini Index,* http://www.towncharts.com/Oregon/Top-25-Counties-in-Oregon-ranked-by-The-Gini-Index.html.

[47] 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

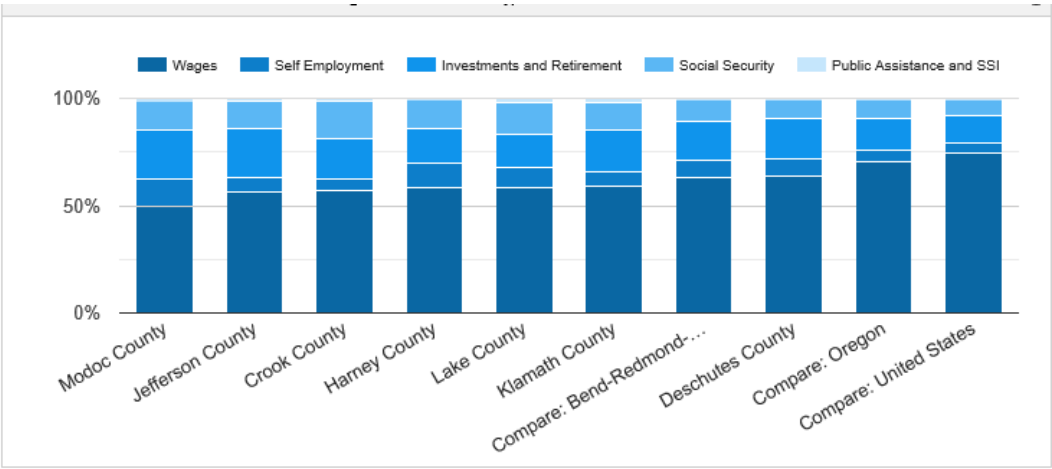
[48] Oregon Employment Department, *Wage Inequality in Oregon: The Widening Gap*, https://www.qualityinfo.org/-/wage-inequality-in-oregon-the-widening-gap

Figure C-22 Median Family Income by Race in Lake County, OR



Source: Town Charts, Lake County, OR, https://www.towncharts.com/Oregon/Economy/Lake-County-OR-Economy-data.html#Figure31, accessed 2/6/20

Figure C-23 Source Income in Lake County, OR



Source: Town Charts, Lake County, OR, https://www.towncharts.com/Oregon/Economy/Lake-County-OR-Economy-data.html#Figure31, accessed 2/6/20

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.[49] Households spending more than 35% are considered housing cost burdened.

Table C-8 shows the percentage of households in Lake County, Lakeview, and Paisley that are paying more than 35% of their income on housing. Among homeowners with and without a mortgage, Lake

[49] MacArthur Foundation, *Research Network on Building Resilient Regions*, https://www.macfound.org/networks/research-network-on-building-resilient-regions/

County has the highest rates of housing cost burden. Among renters, Lakeview residents have the greatest rates of households with housing cost burdens.

In general, the population that spends more of their income on housing has proportionally fewer resources and less flexibility for alternative investments and expenditures in times of crisis.[50] The high percentage of homeowners and renters paying more than 35% of their income on housing poses 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 detrimentally impacted, it will further the hardship experienced by these individuals and families.

Table C-8 Households Spending > 35% of Income on Housing

Jurisdiction	Owners		Renters
	With Mortgage	Without Mortgage	
Lake County	27.3%	17.5%	39.3%
Lakeview	18.2%	9.4%	40.9%
Paisley	14.3%	4.7%	17.3%

Source: U.S. Census Bureau, American Fact Finder, Table DP04, Selected Housing Characteristics, 2013-2017, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF

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. [51]

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. In the eight-county Eastern Oregon region, growth is pegged at 6 percent – less than half the statewide rate.[52]

South Central Oregon (Klamath and Lake Counties) is expected to grow about 7 percent between 2014 and 2024. The region anticipates 1,800 job openings due to growth and 6,500 due to replacements by 2024. The educational and health services is once again a major source of replacement openings, accounting for 1,300 openings. Retail trade and leisure and hospitality will each have close to 1,000 openings.[53]

[50] Ibid.

[51] Business Oregon, *Distressed Areas in Oregon*, https://www.oregon4biz.com/Publications/Distressed-List/

[52] 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

[53] Ibid.

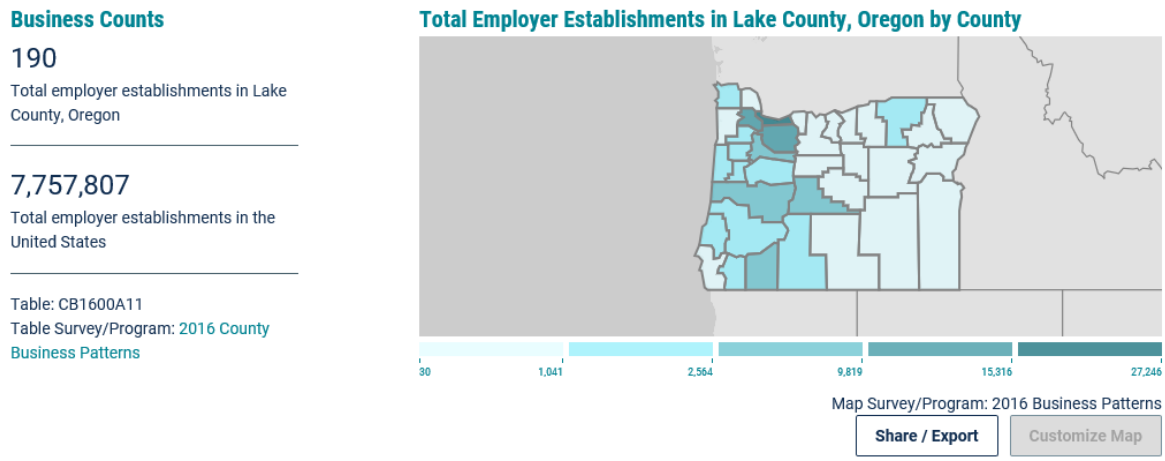
No matter what the size of the local economy, a certain level of demand for workers exists. Approaching opportunity through the lens of high-wage and high-demand jobs or the level of replacement openings in an area illustrates how varied job opportunities are in rural Oregon.[54]

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.[55]

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. Lake County is listed as a distressed area.[56]

Figures C-24 and C-25 show the number of employer establishments and firms in Lake County.

Figure C-24 Total Number of Employer Establishments in Lake County



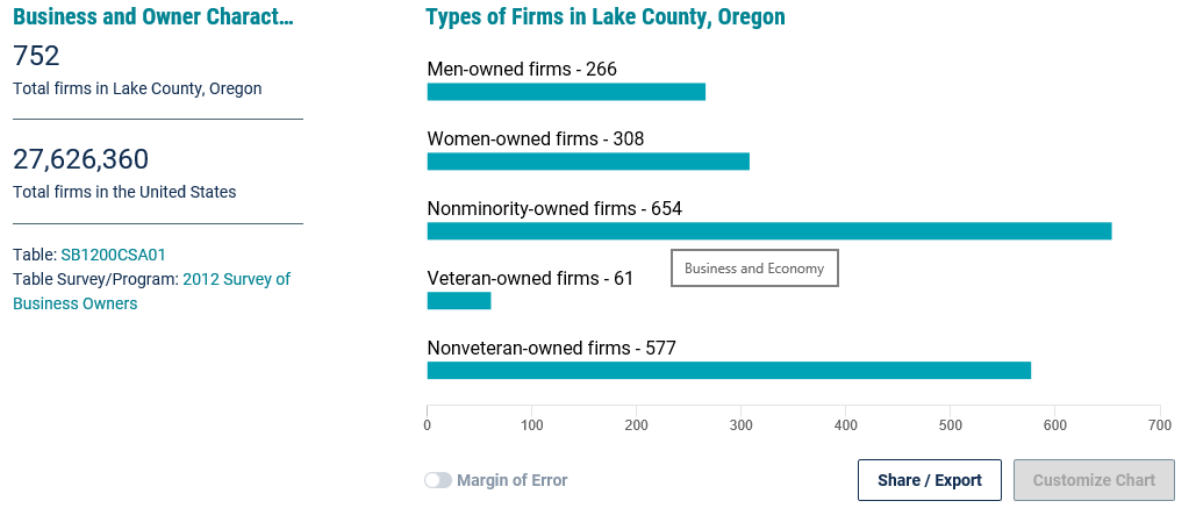
Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

[54] Ibid.

[55] 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

[56] Business Oregon, *Distressed Areas in Oregon*, https://www.oregon4biz.com/Publications/Distressed-List/

Figure C-25 Total Number of Firms in Lake County



Source: U.S. Census Bureau, Lake County, https://data.census.gov/cedsci/profile?q=Lake%20County,%20Oregon&g=0500000US41037, accessed 2/6/20

Employment and Wages

Table C-9 Lake County Unemployment Rate 2006-2017

Year	% Rate
2006	7.5
2007	7.3
2008	8.6
2009	12.6
2010	13.5
2011	13.1
2012	12.9
2013	11.4
2014	9.6
2015	7.8
2016	6.4
2017	5.7

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 , and BLM Socioeconomic Profile for Lake County, saved as PDF on 12/27/19

Table C-6 showed the per capita personal income (PCPI) for metro and non-metro (urban and rural) areas in Oregon and compared to the U.S. Table C-10 shows the components of PCPI for Lake County in 2015.

Table C-10 PCPI and Components of PCPI in Lake County in 2015

Per Capita Personal Income	Per Capita Net Earnings	Per Capita Personal Current Transfer Receipts	Per Capita Dividends, Interest, and Rent
$36,944	$18,038	$10,556	$8,350

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 C-11 Summary of Socioeconomic Indicators for Lake County

Summary

Lake County, OR

Overview

	Lake County, OR	U.S.
Population, 2018	7,879	327,167,434
Trends		
Population % change, 1970-2018	23.7%	60.5%
Employment % change, 1970-2018	28.0%	119.9%
Personal Income % change, 1970-2018	91.6%	222.1%
Prosperity		
Unemployment rate, 2018	5.7%	3.9%
Average earnings per job, 2018 ($s)	$41,748	$62,321
Per capita income, 2018 ($s)	$39,797	$54,446
Economy		
Non-Labor % of personal income, 2018	55.2%	37.4%
Services % of employment, 2018	~39.4%	73.1%
Government % of employment, 2018	28.8%	12.2%
Use Sectors^		
Timber % of private employment, 2016	~14.6%	0.6%
Mining % of private employment, 2016	~2.7%	0.5%
Fossil fuels (oil, gas, & coal), 2016	~0.3%	0.4%
Other mining, 2016	~2.4%	0.3%
Agriculture % of employment, 2018	15.6%	1.3%
Travel & Tourism % of private emp., 2016	~17.7%	15.8%
Federal Land*		
Federal Land % total land ownership	73.1%	27.5%
Forest Service %	19.2%	8.4%
BLM %	48.6%	10.5%
Park Service %	0.0%	3.4%
Military %	0.0%	1.1%
Other %	5.3%	4.1%
Federal land % Type A**	11.6%	37.6%
Federal payments % of gov. revenue, FY201	33.5%	
Development		
Residential area % change, 2000-2010	79.7%	12.3%
Wildland-Urban Interface % developed, 2010	0.2%	16.3%

Estimates for data that were not disclosed are indicated with tildes (~).

Source: BLM, *Socioeconomic Profile for Lake County*, saved as PDF on 12/27/19

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. Identifying key industries in the region enables communities to target mitigation activities towards those industries' specific sensitivities. The impact that a natural hazard event has on one industry can reverberate throughout the regional economy.[57] These cascading impacts should also be considered.

This is of specific concern when the businesses belong to the basic sector industry. Basic sector industries are those that are dependent on sales outside of the local community; they bring money into a local community via employment. The farm and ranch, information, and wholesale trade

[57] Business Oregon, *Distressed Areas in Oregon*, https://www.oregon4biz.com/Publications/Distressed-List/

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 services.[58]

Employment by Industry

Table C-14 identifies wages by industry. The top industry sectors in Lake County are Services Related (37.8%), Non-Services Related (24.6%), and Government (37.6%).[59]

Some of the highest wage jobs are in the manufacturing and natural resource dependent industries (e.g. forestry, oil and gas drilling and support services, and mining) that are often associated with public lands. Usually, these high wage industries employ fewer people than other sectors. Some services-related industries offer high wages (e.g., information, financial activities, and professional and business services).

Even if the average wages for a given sector are relatively low, that sector may still be an important driver of the local economy if it supports a significant share of the total jobs in the area. Wages provide a good counter-part to the per capita income figure. In some areas, per capita income can be high (sometimes driven by a high proportion of non-labor income) while wages are low. A good indicator of an overall strong local economy is when both per capita income and wages are high.[60]

Table C-14 Wages by Industry for Lake County

Socioeconomic Measures

Lake County, OR

Wages by Industry

Employment and Wages in 2018	Wage & Salary Employment	% of Total Employment	Avg. Annual Wages (2018 $s)	% Above or Below Avg.
Total	2,549		$40,068	
Private	1,444	56.6%	$31,519	-21.3%
Non-Services Related	630	24.7%	$35,276	-12.0%
Natural Resources and Mining	372	14.6%	$33,427	-16.6%
Agriculture, forestry, fishing & hunting	na	na	na	na
Mining (incl. fossil fuels)	na	na	na	na
Construction	66	2.6%	$33,332	-16.8%
Manufacturing (Incl. forest products)	192	7.5%	$39,526	-1.4%
Services Related	814	31.9%	$28,611	-28.6%
Trade, Transportation, and Utilities	330	12.9%	$34,072	-15.0%
Information	18	0.7%	$63,885	59.4%
Financial Activities	37	1.5%	$38,830	-3.1%
Professional and Business Services	70	2.7%	$37,650	-6.0%
Education and Health Services	99	3.9%	$26,107	-34.8%
Leisure and Hospitality	187	7.3%	$14,638	-63.5%
Other Services	72	2.8%	$20,681	-48.4%
Unclassified	1	0.0%	$12,843	-67.9%
Government	1,105	43.4%	$51,240	27.9%
Federal Government	252	9.9%	$65,368	63.1%
State Government	174	6.8%	$59,763	49.2%
Local Government	679	26.6%	$43,812	9.3%

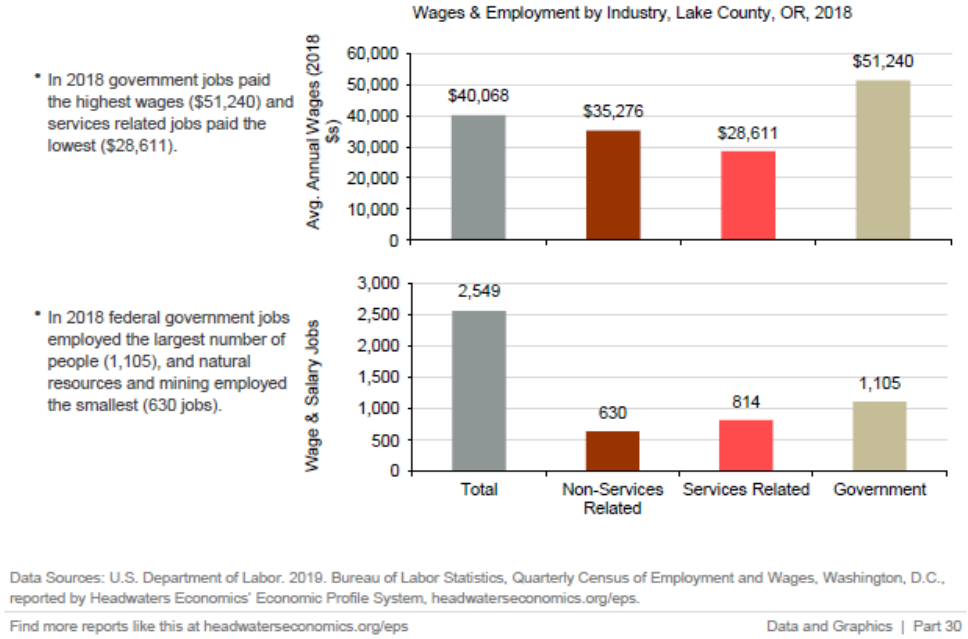
Source: BLM, *Socioeconomic Profile for Lake County*, saved as PDF on 12/27/19

[58] Ibid.

[59] BLM, *Socioeconomic Profile for Lake County*, saved as PDF on 12/27/19

[60] BLM, *Socioeconomic Profile for Lake County*, saved as PDF on 12/27/19

Figure C-26 Wages and Employment by Industry for Lake County



Source: BLM, *Socioeconomic Profile for Lake County*, saved as PDF on 12/27/19

High Revenue Sectors

Sectors anticipated to be major employers in the future also warrant special attention in the hazard mitigation planning process. In the event that these primary sectors are impacted by a disaster, Lake County may experience a significant disruption of economic productivity. The term sectors and industry are interchangeable. Table C-14 shows the earnings by industry in Lake County.

Lake County relies on both private and government industries. It is important to consider the effects each may have on the economy before and after a disaster. Existing jobs can a multiplier effect on a local economy that can spur the creation of new jobs. The presence of jobs can help keep the economy resilient and can speed the local recovery after a disaster. However, if jobs are greatly impacted by a natural hazard event, the multiplier effect could be experienced in a detrimental fashion. In this case, a decrease in purchasing power results in lower profits and potential job losses for the private and government industries that are dependent on them.[61]

[61] 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

Table C-15 Employment by Industry for Lake County

Socioeconomic Measures

Lake County, OR

Employment by Industry (since 2000)

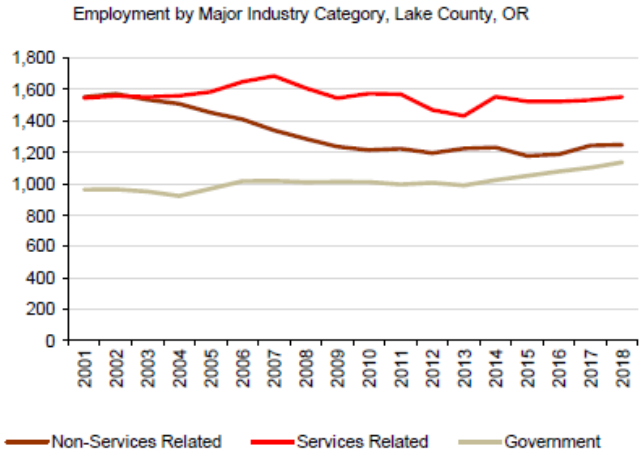
	2001	2010	2018	Change 2010-2018
Total Employment (number of jobs)	4,182	3,809	3,940	131
Non-services related	1,552	~1,214	~1,248	~34
Farm	861	610	616	6
Forestry, fishing, & ag. services	193	~187	~185	-~2
Mining (including fossil fuels)	52	~52	~52	~0
Construction	153	164	156	-8
Manufacturing	293	201	239	38
Services related	~1,546	~1,574	~1,553	-~21
Utilities	16	~14	~13	-~1
Wholesale trade	64	67	~51	-~16
Retail trade	386	389	326	-63
Transportation and warehousing	103	~89	~116	~27
Information	65	~32	26	-~6
Finance and insurance	66	48	56	8
Real estate and rental and leasing	84	120	149	29
Professional and technical services	82	105	118	13
Management of companies	~1	~1	~13	~12
Administrative and waste services	~75	~62	~60	-~2
Educational services	~10	~27	19	-~8
Health care and social assistance	~135	~175	135	-~40
Arts, entertainment, and recreation	~23	25	~32	~7
Accommodation and food services	~242	248	~251	~3
Other services, except public admin.	194	172	188	16
Government	962	1,011	1,136	125

All employment data are reported by *place of work*. Estimates for data that were not disclosed are indicated with tildes (~).

Source: BLM, *Socioeconomic Profile for Lake County*, saved as PDF on 12/27/19

Figure C-27 Employment by Industry for Lake County

- From 2001 to 2018, jobs in non-services related industries shrank from 1,552 to 1,248, a 20% decrease.
- From 2001 to 2018, jobs in services related industries grew from 1,546 to 1,553, a <1% increase.
- From 2001 to 2018, jobs in government grew from 962 to 1,136, a 18% increase.



Data Sources: U.S. Department of Commerce. 2019. Bureau of Economic Analysis, Regional Economic Accounts, Washington, D.C., reported by Headwaters Economics' Economic Profile System, headwaterseconomics.org/eps.

Find more reports like this at headwaterseconomics.org/eps

Data and Graphics | Part 16

Source: BLM, *Socioeconomic Profile for Lake County*, saved as PDF on 12/27/19

Future Employment in Industry

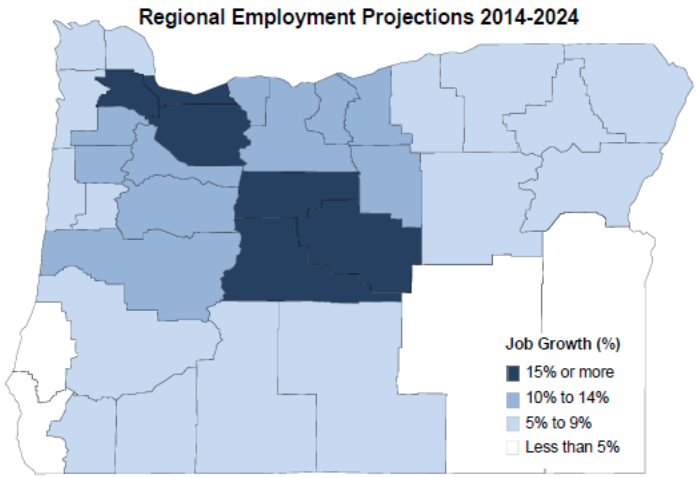
According to the *The Employment Landscape of Rural Oregon*, anticipated job growth in rural areas of Oregon, according to employment projections covering the 2014 to 2024 period, is muted compared with anticipated growth in metro areas. Between 2014 and 2024 statewide growth is anticipated to be about 14 percent. In the eight-county Eastern Oregon region, growth is pegged at 6 percent – less than half the statewide rate. South Central Oregon (Klamath and Lake Counties) anticipates growth of almost 7 percent. In the Southwestern Oregon area – made up of Coos and Curry counties along the south coast and Douglas County inland – projections show growth of 7 percent by 2024.[62]

Table C-16 County Workforce by Age Group in Lake County

Age	Number
All Ages 14-99	2,101
55-64	492
65-99	188
Share 55+	32%

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

Figure C-28 County Workforce by Age Group in Lake County



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

The following is excerpted from the Oregon Employment Department's article *Long-Term Outlook for Klamath and Lake County's Job Market is Mixed*, dated June 27, 2018.

"South Central Oregon (Klamath and Lake Counties) is expected to see job growth over the next 10 years (2017-2027). However, the region is expected to be amongst the slowest growing over the forecast period. The two county region is anticipated to add around 1,760 jobs by 2027, a growth

[62] 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

rate of 6 percent. This is far slower than the statewide pace of 12 percent. Growth is expected to be largely concentrated in Oregon's metro areas with rural parts of the state forecast to have slow growth.

Although job growth is expected to be slower than in other parts of the state over the next 10 years, a larger number of job openings is expected in order to replace retiring workers and those moving to new occupations. For every one job opening due to economic growth there are expected to be around 18 replacement openings. Together growth and replacement job openings add up to around 34,500 total openings by 2027.

Construction is expected to be the fastest growing industry in the region, expanding by 20 percent over the next 10 years (+190 jobs). This is a continuation of the recent recovery in the construction industry. The largest number of jobs added will be in health care and social assistance (+450), expanding by around 12 percent. Job growth in health care is largely a reflection of an aging population in Klamath and Lake Counties. Notable gains are also anticipated in natural resources and mining (+200 jobs); leisure and hospitality (+160 jobs); and retail trade (+160 jobs).

The only major industry sector expected to lose jobs over the forecast period is information. This is a small employment sector that is expected to see only modest declines by 2027 (-20 jobs).

Although industry job losses are limited, several important industry sectors are projected to see very slow growth, including manufacturing (+1%) and professional and business services (+3%). The manufacturing sector struggled to recover from the most recent recession and very little growth is expected in the long-term outlook.

Government employment is expected to rise by a modest 2 percent (+100 jobs). Public sector growth is projected to be split between local government and state government with federal agencies anticipated to see modest declines over the forecast period.

Occupational growth is expected to follow many of the industry trends with the fastest growth among construction and extraction occupations (+15.2%), as well as health support occupations (+12.2%) and health care practitioners and technical occupations (+11.5%).

Despite fast growth in these construction and health related occupational groups, openings are expected to be dominated by office and administrative support occupations (+4,620 openings); sales and related occupations (+4,480 openings); and food preparation and serving occupations (+3,887 openings). These are not particularly large growth occupational groups. However, due to higher rates of turnover and a large number of jobs these occupations will account for a large share of the total openings by 2027."[63]

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. Considering the high

[63]State of Oregon Employment Department, *Long-Term Outlook for Klamath and Lake County's Job Market is Mixed*, https://www.qualityinfo.org/-/long-term-outlook-for-klamath-and-lake-county-s-job-market-is-mixed, June 27, 2018

regional unemployment, high housing cost burden, and an economy heavily dependent on a few key industries and small businesses, Lake County may experience a more difficult time in recovering after a disaster than one with a more diverse economic base.[64] It is important to consider what might happen to the Lake County economy if the largest revenue generators and employers are impacted by a disaster. It is important that Lake County recognizes that economic diversification is a long-term issue; more immediate strategies to reduce vulnerability should focus on risk management for the dominant industries.[65]

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

In addition to location, the characteristics of the housing stock affect the level of risk posed by natural hazards. Table C-17 identifies the types of housing most common throughout Lake County. Of particular interest are mobile homes and other non-permanent housing structures, which account for about 23.4% of the housing in Lake County. Mobile structures are particularly vulnerable to certain natural hazards, such as wind storms, and special attention should be given to securing the structures, because they are more prone to wind damage than wood-frame construction.[66]

Table C-17 Lake County Housing Profile

Jurisdiction	Total Housing Units	Single-Family		Multiple-Family		Mobile Homes or Other	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Lake County	4,503	3,105	69%	258	5.7%	153	23.4%
Lakeview	1,403	1,107	79%	152	10.8	131	9.3%
Paisley	176	100	56.8%	9	5.1%	64	36.4%

Source: U.S. Census Bureau, American Fact Finder, Table DP04, Selected Housing Characteristics, 2013-2017, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF, accessed 2/7/20

[64]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

[65] Ibid.

[66] Ibid.

Age of housing is another characteristic that influences a structure's vulnerability to hazards. Generally, the older the home is, the greater the risk of damage. Structures built after the late 1960's in the Pacific Northwest utilized earthquake resistant designs and construction. Communities began implementing flood elevation ordinances in the 1970's, with the local FEMA flood insurance study completed in the mid-1980s, and in 1990 Oregon again upgraded seismic standards to include earthquake loading in the building design.[67]

Knowing the age of the structure is helpful in targeting outreach regarding retrofitting and insurance for owners of older structures.[68] Based on U.S. Census data, 63.4% of Lake County housing was built prior to 1980 and the implementation of flood elevation requirements. There is a need to identify if these homes are located in a floodplain, and target outreach to the property owners to encourage appropriate flood mitigation. The data shows 36.6% of the housing units in the County were built after 1980 and 29.1% after 1990 when more stringent building codes were put in place. Prior to 1990 the housing stock may have questionable seismic stability. In addition to single-family households, it is also important to consider the structural integrity of multi-unit residences, as these structures will have an amplified impact on the population. Table C-17 shows the numbers for single-family, multi-family, and mobile home housing stock. Table C-18 shows the number of housing units constructed in each jurisdiction within certain timeframes.

Table C-18 Lake County Housing Year Built

Date Constructed	Lake County	Lakeview	Paisley
Total Housing Units	4,503	1,403	176
Pre 1980	2,857 (63.4%	1,032	52
1980 to 1989	335	74	1
1990 and Later	1,311 (29.1%)	297	124

Source: U.S. Census Bureau, American Fact Finder, Table DP04, Selected Housing Characteristics, 2013-2017, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF, accessed 2/7/20

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.

[67] 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.

[68] 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

Critical infrastructure, critical facilities, and lifelines in Lake County 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 Lake County, Lakeview, and Paisley to natural hazards.

Dependent Facilities

In addition to the critical facilities mentioned above in Volume I Section 2 Risk Assessment, there are other facilities that are vital to the continued delivery of health services and may significantly impact the public's ability to recover from emergencies. 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; and also these facilities can serve as secondary medical facilities as they are equipped with nurses, medical supplies and beds.

In a google search for medical facilities in Lake County, the Lake District Hospital in Lakeview, Lake County Mental Health (operated by Lake District Hospital) in Lakeview, and North Lake Clinic in Christmas Valley. In a google search for assisted living centers or nursing homes in Lake County, the following were listed: the Lakeview Gardens at the Lakeview District Hospital and the J & J Adult Foster Care.[69]

Correctional Facilities

Correctional facilities are incorporated into physical infrastructure as they play an important role in everyday society by maintaining a safe separation from the public. There is one correctional facility located in Lakeview. Warner Creek Correctional Facility (WCCF) is a minimum-security facility located four miles northwest of Lakeview. WCCF opened in September 2005. It received the State Energy Efficiency Design award in May 2008 for its progress in design efficiency. The most energy efficient element at WCCF is the use of geothermal energy, providing 100 percent of the hot water to the facility.[70] There are 406 beds in Warner Creek Correctional Facility.[71]

Physical Infrastructure

Physical infrastructure such as dams, levees, roads, bridges, railways and airports support Lake County communities and economies. 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

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.[72] However, the potential for severe damage still exists and should be considered in mitigation planning efforts. The Oregon Water and Resources Department (OWRD) has inventoried all dams located in Oregon. The high hazard dams in Lake

[69] Medical facilities, assisted living facilities, and nursing homes in Lake County, *google search,* 2/7/20

[70] Oregon Department of Corrections, *Warner Creek Correctional Facility*, https://www.oregon.gov/doc/about/pages/prison-locations.aspx, accessed 2//7/20

[71] Inmate Aid, *Warner Creek Correctional Facility*, https://www.inmateaid.com/prisons/or-doc-warner-creek-correctional-facility-wccf, accessed 2/7/20

[72] Federal Emergency Management Agency, *Dam Failure Information*, https://www.fema.gov/dam-failure-information, accessed March 12, 2019.

County are those of special concern: Drews Reservoir, Cottonwood, and Bullard Creek. All three of those were last inspected in October 2019. Because they are rated high hazard, they are inspected annually.[73] All high hazard dams are required to have an Emergency Action Plan.[74] See the Flood Annex for additional information.

Table C-19 Lake County Dam Inventory

Number of Dams	Hazard Level or Potential
3	High
5	Significant
59	Low

Source: Arden Babb, Oregon Water Resources Department, personal communication, 2/10/20; the OWRD Dam Inventory Query was not working, http://apps.wrd.state.or.us/apps/misc/dam_inventory/

Railways

Railroads are major providers of regional and national cargo trade flows. The Oregon Department of Transportation (ODOT) map of railroads shows the Lake Railway (LRY) railroad running through part of Lake County.[75] 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 if hazardous materials are involved. The Lake County Railroad runs approximately 55 miles from Lakeview to California. Rail along the ties goes back as far as the 1930's, freight income is not sufficient to make major replacement of critical track infrastructure. According to the South Central Oregon Economic Development District, rail line upgrades is a high priority in the near term.[76]

Airports

There are three Community General Aviation Airports: Lake County Airport located near Lakeview, Paisley Airport, and Christmas Valley Airport. Five public use airports: Silver Lake Airport, Akali Lake Airport, Christmas Valley Airport, Paisley Airport, and Lake County Airport. The Lakeview District Hospital also has an airport/is considered an airport. [77] Access to these airports face the potential for closure from a number of natural hazards, including wind and winter storms common to the region. Another important consideration for airports is the type and condition of runway surfaces at these various facilities, as they will impact the ability to utilize the airport. Common runway surface types in Lake County are turf, dirt, asphalt, concrete, and gravel.

[73] Arden Babb, Oregon Water Resources Department, personal communication, 2/10/20

[74] Oregon Water Resources Department, *Dam Safety Program*, accessed 2/10/20

[75] Oregon Department of Transportation, *State of Oregon, Oregon Railroads*, https://www.oregon.gov/ODOT/ROW/Documents/railroads.pdf, accessed 2/7/20

[76] As stated in the *2013 Lake County NHMP* with source as South Central Oregon Economic Development District, not found on current website accessed 2/7/20

[77] As stated in the *2013 Lake County NHMP* with source as South Central Oregon Economic Development District, not found on current website accessed 2/7/20 and Federal Aviation Administration, Lake County Airports, Information Current as of 1/30/20 https://www.faa.gov/airports/airport_safety/airportdata_5010/menu/contacts.cfm?Region=&District=&State=OR&County=LAKE&City=&Use=&Certification=

Power Plants

There are no identified power plants in Lake County.[78]

Roads and Bridges

Major highways that service this region include:

- OR Highway 140 goes east-west from Klamath Falls to Lakeview;
- OR Highway 31 goes northwest-southeast through Silver Lake, Summer Lake, Paisley, before merging into 391 at Valley Falls; and
- OR Highway 391 goes north-south through Alkali Lake, Lake Abert, to Lakeview.

Oregon Highway 31 or the Oregon Outback Scenic Byway takes travelers along sprawling landscape and geological features of Lake County. This highway passes through areas prone to wildland fires and there are frequently burned trees along the sides of the road.

A study completed in 2008 by ODOT, who interviewed 50 carriers, 19 shippers and 12 farmers to determine the use of the highway for shipping cattle, hay, potatoes and other materials and products, shows the road condition is negatively affecting regional producers.[79]

Daily transportation infrastructure capacity in the Southwest Oregon region is stressed by maintenance, congestion, and oversized loads. Natural hazards can further disrupt automobile traffic and create gridlock; this is of specific concern in periods of evacuation.[80]

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.[81]

Each year the Oregon Department of Transportation (ODOT) evaluates and assesses the bridges in Oregon. This information is shared in published yearly *Bridge Condition Report and Tunnel Data*. Much of ODOT's work has focused on seismic upgrades.

ODOT measures bridge conditions based on Key Performance Measure (KPM) 16 – Percent of Bridges Not Distressed (%ND). The KPM 16 includes two categories of bridges: 1) the percent of bridges not structurally deficient (SD) as defined by the Federal Highway Administration (FHWA) and 2) the percent of bridges without other deficiencies (OD) as defined by ODOT. SD and OD components capture different characteristics of bridge conditions as shown. A condition of distressed indicates that the bridge is rated as SD or has at least one OD. ODOT considers both SD and OD aspects in determining bridge needs and selecting projects for the statewide Transportation Improvement Program (STIP). Figure C-29 includes several graphics that demonstrate the status of

[78] Loy, W. G., ed. 2001. *Atlas of Oregon*, 2nd Edition. Eugene, OR: University of Oregon Press

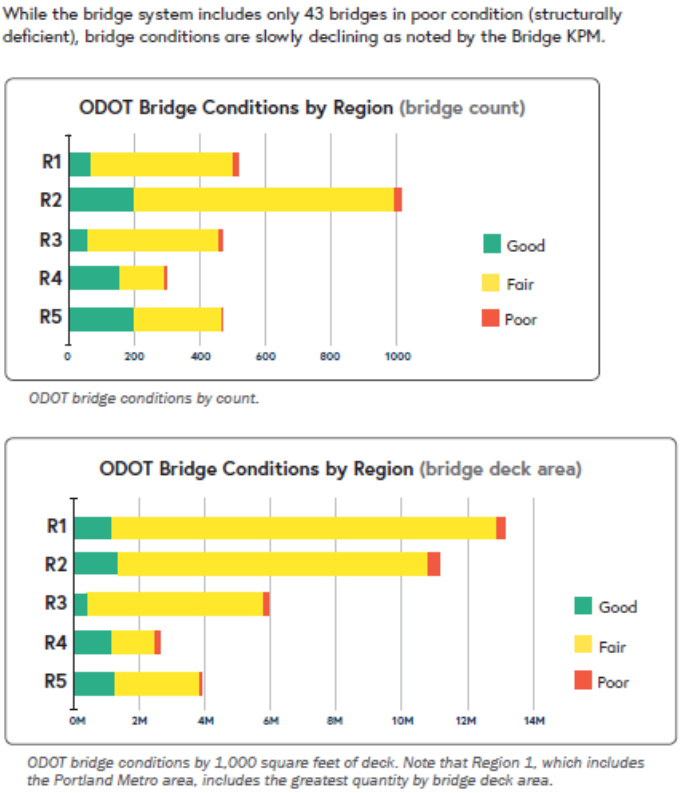
[79] As stated in the *2013 Lake County NHMP* with source as South Central Oregon Economic Development District, not found on current website accessed 2/7/20

[80] 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

[81] Ibid.

bridges and bridge deck areas in three categories: not distressed, other deficiencies, and structural deficiencies by regions in Oregon. Lake County is in Region 4.[82]

Figure C-29 ODOT 2019 Bridge Conditions by Region



Source: Oregon Department of Transportation, *2019 Bridge Condition Report and Tunnel Data*, https://www.oregon.gov/ODOT/Bridge/Documents/Bridge-Condition-Report-2019.pdf

Utility Lifelines

Utility lifelines 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. Utility lifelines are closely related to physical infrastructure, (i.e., dams and power plants) as they transmit the power generated from these facilities.

The network of electricity transmission lines running through the South Central Oregon region is operated by Bonneville Power Administration and facilitates major local energy production and distribution through the region. A smaller transmission line also comes through west-to-east from Pacific Power. There is no natural gas line in Lake County. Lake County has numerous thermal springs where it can tap into geothermal energy including the Summer Lake Hot Springs, the Crump Geyser, and springs nearby Lakeview.[83]

[82] Oregon Department of Transportation, *2019 Bridge Condition Report and Tunnel Data*, https://www.oregon.gov/ODOT/Bridge/Documents/Bridge-Condition-Report-2019.pdf

[83] As stated in the *2013 Lake County NHMP*

Synthesis

Given the rural nature of Lake County, it is critical to maintain the quality of built capacity throughout the area. Recognizing that this can be difficult with limited resources, it is important that Lake County keep contingency planning for these elements, especially medical resources and critical infrastructure, facilities, and lifeline systems.

With medical resources, a notable concern is the availability of medical beds in the County hospital and dependent care facilities. Some of these facilities may run at almost full capacity on a daily basis. There is only one hospital in Lake County. In the event of a disaster, medical beds may be at a premium. It is important to consider medical surge planning and develop memorandums with surrounding counties for medical transport and treatment.

Note the majority of Lake County residents live in detached housing and commute by driving alone. Creating memorandums of agreement about utility and transportation lifelines such as airports, railways, roads and bridges with surrounding counties for utility service and infrastructure repair will be useful in and after a natural disaster. It is essential to start building relationships and establishing contractual agreements now.

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 Lake County.

It has been noted that 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,
- 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.

There are three suggested involvement methods:

Education and outreach – An organization could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.

Information dissemination – An organization could partner with the community to provide hazard-related information to target audiences.

Plan/project implementation – An organization may have plans and/or policies that may be used to implement mitigation activities or the organization could serve as the coordinating or partner organization to implement mitigation actions.[84]

The involvement methods can be used to implement the mitigation actions which are listed in Table 3-1 and in Appendix A Mitigation Action Forms.

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 other civic engagement that may increase community connectivity.

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."[85] If a structure does not meet these criteria, it is considered to be non-contributing.

Table C-20 identifies that there are 19 eligible/significant (ES), eligible/contributing (EC), non-eligible/out of period (NP), and non-eligible/non-contributing (NC) historic sites in Lake County. The table also shows how many of the sites are located in incorporated cities.

[84] *2013 Lake County NHMP*.

[85] 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/

Table C-20 Lake County Historic Places

Eligible Sites	Total Sites (19)	Located in Incorporated Cities
ES-Significant	19	7
EC-Contributing	0	0
NP-Non-Eligible/Out of Period and NC-Non-Eligible and Non-Contributing	0	0

Source: Oregon Historic Sites Database, http://heritagedata.prd.state.or.us/historic/

Libraries and Museums

Libraries and museums develop cultural capacity and community connectivity as they are places of knowledge and recognition, they are common spaces for the community to gather, and can serve critical functions in maintaining the sense of community during a disaster. They are recognized as safe places and reflect normalcy in times of distress. There are currently four libraries in Lake County located in Lakeview, Paisley, Silver Lake, and Christmas Valley.[86] There are a few museums in Lake County: the Lake County Museum and the Schmink Memorial Museum in Lakeview and the Fort Rock Homestead Village Museum in Fort Rock. The Lake County museum details the history of Lake County involving education, business, government, cultures, and artifacts indigenous to the area.[87]

Cultural Events

Other such institutions that can strengthen community connectivity are the presence of festivals and organizations that engage diverse cultural interests. Lake County is home to local art galleries, museums, and the Lake County Fair and Rodeo. 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

Residential Geographic Stability and Homeownership

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.[88]

[86] State Library of Oregon, *Oregon Library Directory*, http://libdir.osl.state.or.us/index.php?sort=&search_string=lake&search_filter=county

[87] Lake County museums google search, https://www.google.com/search?q=museums+in+lake+county,+or&sourceid=ie7&rls=com.microsoft:en-US:IE-Address&ie=&oe=#spf=1581116441162 and Lake County Museum, http://www.lakecountyor.org/links/museum.php

[88] 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

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.

Table C-21 identifies housing tenure which is demonstrated by identifying the number of occupied households and within that, the number of owner occupied and renter occupied households.

Table C-21 Homeownership in Lake County

Jurisdiction	Occupied Households	Owner Occupied	Percent Owner Occupied	Renter Occupied	Percent Renter Occupied
Lake County	3,522	2,097	59.5%	1,425	40.5%
Lakeview	1,275	694	54.4%	581	45.6%
Paisley	159	92	57.9%	67	42.1%

Source: U.S. Census Bureau, American Fact Finder, Table DP04, Selected Housing Characteristics, 2013-2017, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF, accessed 2/7/20

Synthesis

Lake County 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 preserving community cohesion and a sense of place. Communities like Lakeview, Paisley, and Christmas Valley 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.[89] 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.

Government Structure

The Lake County Board of Commissioners is comprised of three elected officials that serve four year overlapping terms. County Commissioners serve countywide appointments. The Board's duties

[89] 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

include executive, judicial (quasi-judicial) and legislative authority over policy matters of countywide concern. The duties include preparing and monitoring the budget, membership appointments to numerous county committees and overseeing these activities, and adopting and enacting ordinances and policies.[90]

Beyond Emergency Management, all the departments within the county governance structure have some degree of responsibility in building overall community resilience. Each plays a role in ensuring that county functions and normal operations resume after an incident, and the needs of the population are met.

Offices of Lake County government that have a role in hazard mitigation are:

- **Planning**: Responsibilities include the preparation and maintenance of the County's Land Use Plan, processing requests for special district annexations, county road naming and vacations and the administration and implementation of zoning ordinances. The Planning Department works to provide needed information and technical assistance and provides assistance to the Lake County Planning Commission and the Lake County Board of Commissioners. The Lake County Planning Department implements and enforces the Comprehensive Land Use Plan, Zoning Ordinances and Town of Lakeview Development Code Handbook. The Section titled "Areas subject to natural hazards and disasters" of the Comprehensive Land Use Plan and Lake County Zoning Ordinances addresses policies and recommendations to align with State Planning Goal 7 to help limit and protect buildings in disaster prone areas. Chapter 3.7 of the Town of Lakeview Development Code Handbook titled "Sensitive Lands" outlines how planning and building should be conducted in flood plain areas to minimize future personal, physical and financial losses from flooding.[91]
- **Health Department**: The Lake County Public Health's mission is to build a healthy community through prevention and education. Public Health programs include Family Planning, Maternal and Child Health, Women Infants and Children Program (WIC) Immunizations, Vital Statistics, Communicable Disease Prevention and Surveillance, Tobacco Prevention, and Environmental Health.[92]
- **Road Department**: The Road Department is dedicated to the maintenance and well being of the entire Lake County road network including bridges, culverts, ditches, and roads.[93]
- **Sheriff's Office**: The Lake County Sheriff's Office is the primary criminal law enforcement agency for Lake County, working with other law enforcement agencies based in Lake County including the Oregon State Police, Lakeview Police, Bureau of Land Management Rangers, and Forest Service Law Enforcement. [94]

[90] Lake County Government, *Lake County Board of Commissioners*, http://www.lakecountyor.org/government/county_commissioners/index.php

[91] Lake County Government: Lake County Planning Department, https://www.lakecountyor.org/government/land_use_planning.php, accessed 2/7/20

[92] Lake County Government, Lake County Public Health, http://www.lakecountyor.org/government/public_health.php , accessed 2/7/20

[93] Lake County Government, Lake County Road Department, http://www.lakecountyor.org/government/road_master.php , accessed 2/20/20

[94] Lake County Government, Lake County Sheriff's Office, http://www.lakecountyor.org/government/sheriff.php, accessed 2/7/20

- **Lake County Building Department**: The Lake County Building Department implements and enforces the State of Oregon Building Codes including the Oregon Structural Specialty Code for commercial structures and the International Residential Code for residential dwelling. These codes establish the minimum safety requirements to safeguard public health, safety and general welfare through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation, and safety to life and property from fire and other hazards attributed to the built environment. This includes enforcing special seismic restrictions in which Lake County is located.
- **Lake County Commissioners**: Three elected officials serve on the Lake County Board of Commissioners. The Commissioners' roles are to determine the financial expenditures and other customary local government decisions regarding plans and policies. The Commissioners will participate in the reviewing and updating process of the Lake County NHMP every five years. They will also take part in implementing and overseeing mitigation actions.

Table C-22 Participating City Government Structure

Department	Lakeview	Paisley
Government Form	Mayor/Council	Mayor/Council (volunteer)
City Manager / Administrator/ Recorder	Yes, City Administrator and City Recorder	Yes, City Recorder (part time, paid)
Mayor	Yes	Yes
City Council	Yes	Yes (volunteer)
Building	No, uses Lake County Building Department	No, uses Lake County Building Department
Planning	Planning Commission	Mayor/Council
Public Works	Yes	Yes, water/wastewater/streets person (part time paid)
City Attorney / Engineer	Yes	Yes, attorney paid as needed
Police	Lake County Sheriff's Office	Lake County Sheriff's Office
Fire	Yes	Yes (volunteer)
Airport	Yes	Yes
Economic Development	Mayor/ Council / Town Manager	Mayor/ Council
Finance	Yes, Finance Director	Yes, budget committee consisting of Council and community members, City Recorder writes checks for approved expenses

Source: City of Lakeview, https://www.lakeview-oregon.com/, accessed 2/7/20; City of Paisley, http://www.cityofpaisley.net/1801.html, accessed 2/7/20; Missy Walton, City of Paisley, personal communication, 2/11/20

Existing Plan & Policies

In Section 4 Plan Implementation and Maintenance, under "Implementing through Existing Program" there is a description noting that Lake County and the participating Cities 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.[95]

The *2020 Lake County NHMP* includes mitigation action items that, when implemented, will reduce the County's and Cities' vulnerability to natural hazards. These mitigation actions are consistent with the goals and objectives of the County's existing plans and policies.

Linking existing plans and policies to the *2020 Lake County 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 County's resources as well as the Cities. In addition to the plans listed in Table C-23, the County and Cities also have zoning ordinances (including floodplain development regulations) and building regulations.

Table C-23 Existing Plans for Lake County, the Town of Lakeview, and the City of Paisley

Jurisdiction	Document	Year
Lake County	Community Wildfire Protection Plan	2005 and 2006, Revised and approved in 2011
Lake County	Comprehensive Plan	1980, amended in 1981, 1982, 1985, 1989
Lake County	Emergency Operations Plan	2013
Lake County	Lake County Ordinance 31 "In the matter of establishing emergency procedures for Lake County"	1999
Lake County, Town of Lakeview, City of Paisley	Natural Hazards Mitigation Plan	2020 in process 2013 existing
Lake County	Transportation Systems Plan	2002

[95] 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
Lake County	Zoning Ordinance	1980, amended in 1981, 1982, 1984, 1985, 1989
Lake County	Land Development Ordinance of 1980	1980, amended in 1981, 1982, 1984, 1989
Eastern Oregon Coordinated Care Organization (EOCCO)	EOCCO Community Health Plan (CHP) Lake County	2019
Lake County, Town of Lakeview, and Lake County Soil and Water Conservation District	Bullard Canyon Debris Basin Documents (PDF) which includes *Operation and Maintenance Manual Bullard Creek Floodwater Retarding Structure Deadman-Bullard Watershed Project Lakeview, OR* and *Emergency Action Plan Bullard Dam*	1998
Lake County	*Emergency Action Plan Drews Creek Dam (D-3) and Cottonwood Creek Dam (C-6) Lake County, Oregon Prepared for Lakeview Water Users* with support from the Oregon Water Resources Department Dam Safety Program	No information
Town of Lakeview and City of Paisley	Memorandum of Understanding Between the Oregon Dept. of Land Conservation and Development and the Cities of Lakeview and Paisley – Oregon Housing Project Housing Needs Analysis	2018
Town of Lakeview and City of Paisley	Town of Lakeview and City of Paisley Housing Needs Analyses, Final Report (will be adopted into the Comprehensive Plan)	June 2019
Town of Lakeview and City of Paisley	Economic Opportunities Analysis for Lakeview and Paisley in Lake County, Final Report (will be adopted into the Comprehensive Plan)	June 2019
Town of Lakeview	Comprehensive Plan	1980, as amended
Town of Lakeview	Development Code	2001, as amended
Town of Lakeview	Emergency Operations Plan	2012
Town of Lakeview	Municipal Code	Various dates
Town of Lakeview	Community Response Plan for Air Quality	In process 2020
City of Paisley	Comprehensive Plan	1980
City of Paisley	Zoning Code	1980, revised in November 1988
City of Paisley	Municipal Code	No information

Jurisdiction	Document	Year
U.S. Air Force and Air National Guard	*173rd Fighter Wing Kingsley Field, Klamath Falls, Oregon Full Spectrum Threat Response Plan 10-2*	April 2006
Oregon Department of Energy	*Oregon Fuel Action Plan*	October 2017

Source: *2013 Lake County NHMP*; Lake County Ordinance 31, https://www.lakecountyor.org/county_ordinances/docs/Ordinance%2031%20Declaring%20a%20State%20of%20Emergency.pdf; 2011 Lake County Community Wildfire Protection Plan, https://www.oregon.gov/ODF/Documents/Fire/CWPP/LakeCountyCWPP.pdf; Comprehensive Land Use Plan, Lake County, https://www.lakecountyor.org/government/docs/Comp%20Plan%20-%20June%201989.pdf; Lake County Zoning Ordinance, https://www.lakecountyor.org/government/docs/Lake_County_Zoning_Ordinance__Entire_Document_.pdf; Lake County Transportation System Plan, https://scholarsbank.uoregon.edu/xmlui/handle/1794/4116; EOCCO Community Health Plan (CHP) Lake County, https://www.eocco.com/eocco/~/media/eocco/pdfs/chip/chip_lake.pdf; Memorandum of Understanding Between the Oregon Dept. of Land Conservation and Development and the Cities of Lakeview and Paisley – Oregon Housing Project Housing Needs Analysis, https://static1.squarespace.com/static/5a95c820b10598aee241a43f/t/5c5b52fce5e5f0051af1018b/1549488893496/HNA+MOU+Lakeview+Paisley+DLCD.pdf; Lakeview Development Code, https://www.lakeview-oregon.com/planning; Darwin Johnson, Lake County, personal communication, 1/7/20; Janine Cannon, Town of Lakeview, personal communication 1/14/20 and 2/21/20; Melissa "Missy" Walton, City of Paisley, personal communication, 1/17/20; Daniel Tague, Lake County, personal communication, 1/30/20.

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 D: 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 the *2013 Lake County NHMP*. 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.

The 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.

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.

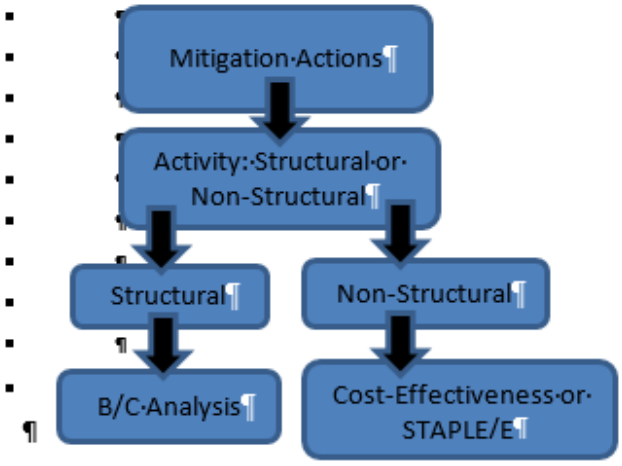
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

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 D-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.

Resources

These resources were identified in the *2013 Lake County NHMP* and 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 E:
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 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

Pre-Disaster Mitigation Grant Program

The Pre-Disaster Mitigation (PDM) program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds. The PDM grant program is offered annually; applications are submitted online. Applicants need a user profile approved by the State Hazard Mitigation Officer, which should be garnered well before the application period opens.
http://www.fema.gov/pre-disaster-mitigation-grant-program

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: https://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf. 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 upcoming deadline for this grant program, as listed on the OEM website (December 4, 2019), is March 1, 2019. The website has not been updated for the next round of applications. The contact for the SPIRE program is Jim Jungling, jim.jungling@state.or.us. 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 Program promotes viable communities by providing: 1) decent housing; 2) quality living environments; and 3) economic opportunities, especially for low and moderate income persons. Eligible activities most relevant to natural hazards mitigation include: acquisition of property for public purposes; construction/reconstruction of public infrastructure; community planning activities. Under special circumstances, CDBG funds also can be used to meet urgent community development needs arising in the last 18 months which pose immediate threats to health and welfare.
http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

Oregon Watershed Enhancement Board

While OWEB's primary responsibilities are implementing projects addressing coastal salmon restoration and improving water quality statewide, these projects can sometimes also benefit efforts to reduce flood and landslide hazards. In addition, OWEB conducts watershed workshops for landowners, watershed councils, educators, and others, and conducts a biennial conference highlighting watershed efforts statewide. Funding for OWEB programs comes from the general fund, state lottery, timber tax revenues, license plate revenues, angling license fees, and other sources. OWEB awards approximately $20 million in funding annually. More information at:
http://www.oregon.gov/OWEB/Pages/index.aspx

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. 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 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

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.

https://www.fema.gov/media-library/assets/documents/21123

National Map: Orthoimagery, DOI – USGS

Develops topographic quadrangles for use in mapping of flood and other hazards.
https://nationalmap.gov/ortho.html

Mapping Standards Support, DOI-USGS

Expertise in mapping and digital data standards to support the National Flood Insurance Program.
http://ncgmp.usgs.gov/standards.html

Soil Survey, USDA-NRCS

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 is a 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 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 (GEO), this is an electronic library of Oregon geographic information including Geographic Information System (GIS) data, orthophotography, Digital Elevation Models, and more.

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

RAPTOR is used within Oregon's emergency management community to view and interact with critical geospatial base maps, aerial imagery, preparedness, hazards, weather and event related data via the internet.

http://www.oregon.gov/oem/emops/Pages/RAPTOR.aspx

Project Support

Coastal Zone Management Program, NOAA.

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

Provides grants to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate- income persons.
http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/entitlement

National Fire Plan (DOI – USDA)

The NFP provides technical, financial, and resource guidance and support for wildland fire management across the United States. This plan addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability.
http://www.forestsandrangelands.gov/

Assistance to Firefighters Grant Program, FEMA

FEMA AFGM grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. 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). http://www.fema.gov/welcome-assistance-firefighters-grant-program

Emergency Watershed Protection Program, USDA-NRCS

Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp

Rural Development Assistance – Utilities, USDA

Direct and guaranteed rural economic loans and business enterprise grants to address utility issues and development needs.

https://www.rd.usda.gov/about-rd/agencies/rural-utilities-service

Rural Development Assistance – Housing, USDA.

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. http://www.fema.gov/national-flood-insurance-program

HOME Investments Partnerships Program, 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.
https://www.hud.gov/program_offices/comm_planning/affordablehousing/programs/home/

Disaster Recovery Initiative, HUD

The DRI provides grants to fund gaps in available recovery assistance after disasters (including mitigation). As of December 4, 2019, the link below takes you to a page that says "This page has been removed from the HUD.gov website."
http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/dri

Emergency Management Performance Grants, FEMA

EMPG grants help state and local governments to sustain and enhance their all-hazards emergency management programs. https://www.fema.gov/emergency-management-performance-grant-program

Partners for Fish and Wildlife, DOI – FWS

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. http://www.nps.gov/ncrc/programs/flp/index.htm

Wetlands Reserve program, USDA-NCRS

The WR program provides financial and technical assistance to protect and restore wetlands through easements and restoration agreements.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands

Secure Rural Schools and Community Self-Determination Act of 2000, US Forest Service.

Reauthorized for FY2012, 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.
http://www.fs.usda.gov/pts/

The Oregon Climate Change Adaptation Framework

This 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.

https://www.oregon.gov/lcd/Publications/Climate_Change_Adaptation_Framework_2010.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 Third Oregon Climate Assessment Report was released in January 2019.

http://www.occri.net/media/1095/ocar4full.pdf

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 in order 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

Special Edition Silver Jackets newsletter

This edition, prepared to provide a reference of federal agency programs, resources and training opportunities that interagency Silver Jackets teams can leverage to achieve their flood risk management goals, is also useful to local government seeking funds to advance their flood mitigation efforts.

https://silverjackets.nfrmp.us/doc/newsletter/BUZZUpdatedSpecialEditionOctober2019v4.pdf

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 on September 24, 2015 as an Enhanced State Plan and is effective through September 23, 2020.

https://www.oregon.gov/lcd/NH/Pages/Mitigation-Planning.aspx

Subscribe to the Oregon NHMP list serve and receive an email when the site is updated (approximately quarterly).

http://listsmart.osl.state.or.us/mailman/listinfo/2015-or-nhmp

APPENDIX F:
FUTURE CLIMATE PROJECTIONS REPORTS

Introduction

This appendix includes two reports provided by the Oregon Climate Change Research Institute (OCCRI): *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports* and *Future Climate Projections Lake County: A Report to the Oregon Land Conservation and Development*. Both reports are dated August 2018. These reports were funded by DLCD using a small portion of the PDM 16 grant funds obtained by DLCD.

APPENDIX G:
LAKE COUNTY 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 Lake County NHMP Steering Committee of success stories.

Seismic Upgrades for Schools and Critical Infrastructure

Building Collapse Potential

As described in the *2013 Lake County NHMP* and again in the *2020 Lake County NHMP*, 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 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 surveyed twenty-nine buildings that are in Lake County, Lakeview, and Paisley. 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.[1] 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.

Of the school facilities evaluated by DOGAMI using RVS, three buildings have high (greater than 10% chance) collapse potential; eight buildings have very high (100% chance) collapse potential. The Lake County Sheriff and the Lakeview Fire Department have buildings with a very high (100% chance) collapse potential. Fremont Elementary School, Daly Middle School, and Lakeview High School have since been awarded Seismic Rehabilitation Grants through the State of Oregon's competitive Seismic Rehabilitation Grant Program (SRGP; see below for more information).

[1] 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.

Table G-1: DOGAMI Building Collapse Potential Scores

Facility	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Daly Middle School (2 buildings)				X, X
Fremont/Hay Elementary School (3 buildings)			X	X, X
Lakeview Senior High School (3 buildings)				X, X, X
North Lake School (3 buildings)	X, X, X			
Paisley School (5 buildings)	X	X	X, X	X
Christmas Valley RFPD (2 buildings)	X, X			
Silver Lake RFPD			X	
Thomas Creek/Westside RFPD (2 buildings)	X, X			
Lake County Search & Rescue	X			
Lake County Sheriff Department				X
Lakeview Fire Department				X
Lakeview Police Department	X			
Paisley VFD (2 buildings)	X, X			
Lake District Hospital - Lakeview	X			

Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment. http://www.oregongeology.org/sub/projects/rvs/OFR-O-07-02-SNAA-onscreen.pdf

Seismic Rehabilitation Grant Program

The Seismic Rehabilitation Grant Program (SRGP) is a state of Oregon competitive grant program that provides funding for the seismic rehabilitation of critical public buildings, particularly public schools and emergency services facilities. Passed in the 2005 legislative session, Senate Bills 2, 3, 4 and 5 established a program to provide up to $1.2 billion in general obligation bonds for seismic rehabilitation grants to public schools and emergency services buildings. The first step of the program was for DOGAMI to inventory the potentially eligible facilities throughout the state, and evaluate their earthquake vulnerability using the established Rapid Visual Screening (RVS) technique

The Statewide Seismic Needs Assessment Using Rapid Visual Screening (RVS) was completed June 30, 2007. Oregon Emergency Management (OEM) was charged with setting up a grant program to provide the funds for retrofit (replacement is not allowed) using the results of the DOGAMI study to prioritize need. Subsequent legislatures have approved modest amounts of bond funding, and through 2011, grants totaling $30 million have been made for 25 schools and 18 emergency facilities. The program is considered a national model, and its success is limited only by the budget constraints facing recent legislatures. Several building rehabilitations in Lake County have been funded by this grant program.

Fremont Elementary School:

This work was funded with a grant from the Oregon Office of Emergency Management and was completed in 2011. The project implemented a number of seismic rehabilitation measures including installation of plywood shear walls, wood collector beams, continuity straps at interior shear walls, and side plates at beam-to-column connections, along with infill of some glass block windows. In addition, a few nonstructural measures were implemented such as anchoring masonry and bookshelves.[2]

Figure G-1 Fremont Elementary School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

[2] Carmen Tague, Anderson Engineering & Surveying, personal communication, 7/30/19.

Figure G-2 Fremont Elementary School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Figure G-3 Fremont Elementary School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Lakeview High School:

This work was funded with a grant from the Oregon Office of Emergency Management and was completed in 2011. The project implemented a number of seismic rehabilitation measures including the addition of plywood shear walls, and the addition of braced steel frames and upgraded foundations to support the frames in selected locations. Nonstructural measures such as anchoring masonry and bookshelves were also implemented.[3]

Figure G-4 Lakeview High School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

[3] Ibid.

Figure G-5 Lakeview High School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Figure G-6 Lakeview High School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Daly Middle School:

This work was funded with a grant from the Oregon Office of Emergency Management. The seismic rehabilitation was performed on the original classroom building; the gym and south wing areas were not rehabilitated. The project was completed in 2013. The improvements included adding: plywood sheathed wood stud shear walls, wall anchorage strengthening, and column and girder connection strengthening. Nonstructural improvements included anchoring masonry and bookshelves.[4]

Figure G-7 Daly Middle School

Source: Tricia Sears, DLCD, 10/10/18

[4] Ibid.

Figure G-8 Daly Middle School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Figure G-9 Daly Middle School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Figure G-10 Daly Middle School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Paisley High School:

This work was funded with a grant from Business Oregon – Infrastructure Finance Authority and was completed in 2017. Seismic improvements included additional shear walls, connection strengthening between the roof diaphragms and shear walls, improvements to concrete footings, and new plywood roof sheathing. Nonstructural improvements included anchoring of bookshelves and equipment.[5]

Figure G-11 Paisley High School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

[5] Ibid.

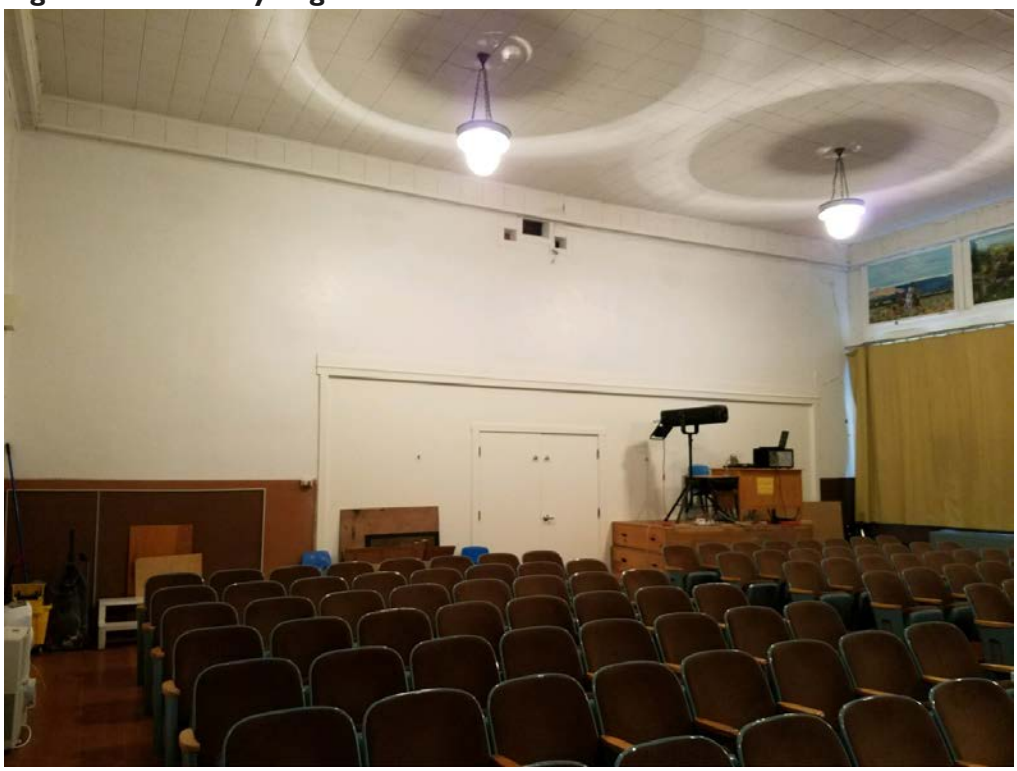
Figure G-12 Paisley High School

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Figure G-13 Paisley High School

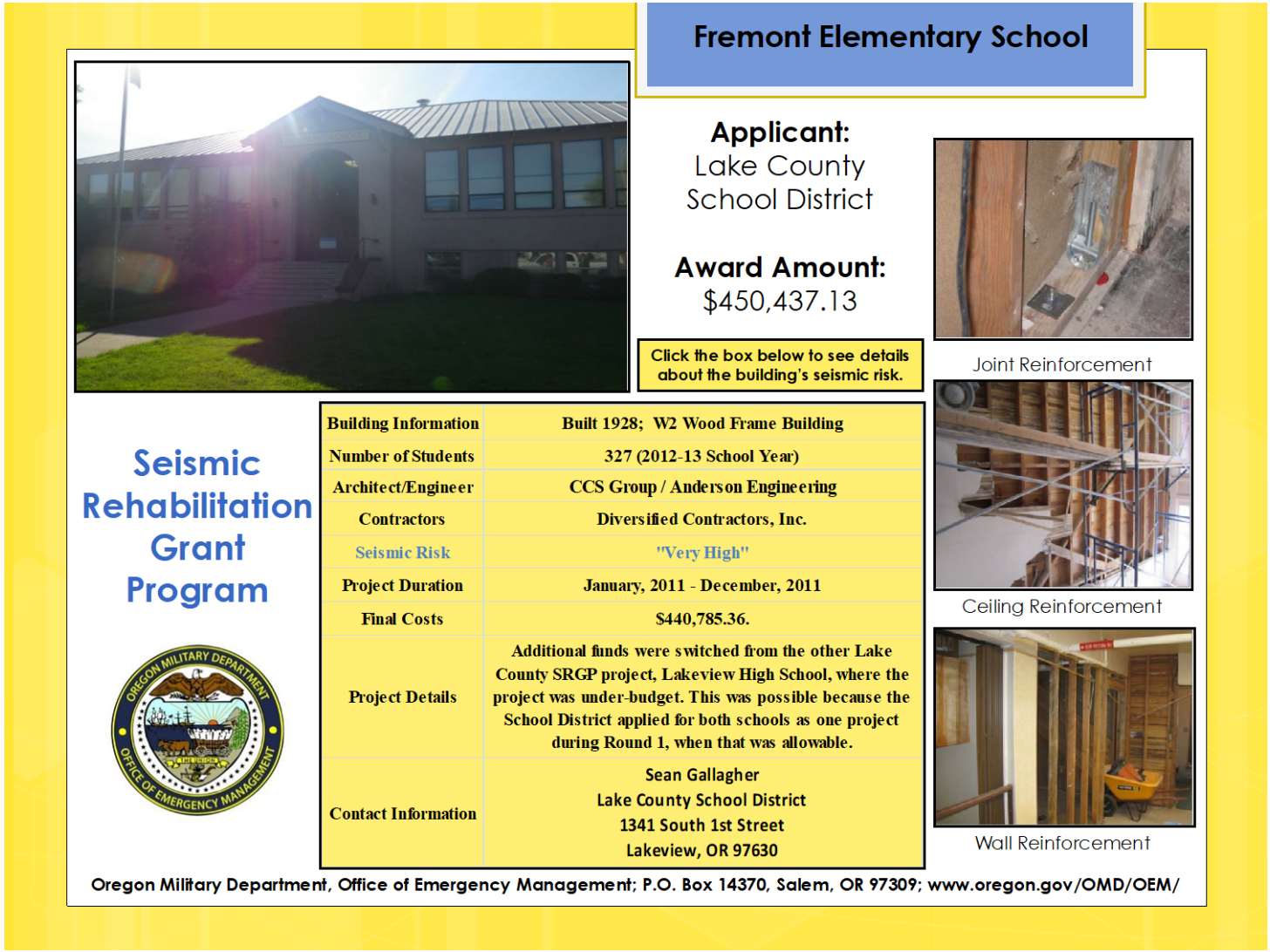
Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Figure G-14 Paisley High School



Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 5/24/19

Figure G-15 SRGP Project Summary – Fremont Elementary School



Source: *2013 Lake County NHMP* and Oregon Military Department, Office of Emergency Management

Figure G-16 SRGP Project Summary – Lakeview High School

Lakeview High School

Applicant:
Lake County
School District

Award Amount:
$537,362.87

Click the box below to see details about the building's seismic risk.

Ceiling Reinforcement

Ceiling Reinforcement

Wall Reinforcement

Seismic Rehabilitation Grant Program

Building Information	Built 1961; W2 Wood Frame Building
Number of Students	250 (2012-13 School Year)
Architect/Engineer	CCS Group / Anderson Engineering
Contractors	Diversified Contractors, Inc.
Seismic Risk	"Very High"
Project Duration	January, 2011 - December, 2011
Final Costs	$410,435.14
Project Details	Lake County School District, in partnership with the Town of Lakeview and the Lake Hospital District, received $1 million in federal stimulus dollars to complete a geothermal retrofit of Lakeview High School, which was successfully completed in conjunction with the SRGP.
Contact Information	Sean Gallagher Lake County School District 1341 South 1st Street Lakeview, OR 97630

Oregon Military Department, Office of Emergency Management; P.O. Box 14370, Salem, OR 97309; www.oregon.gov/OMD/OEM/

Source: *2013 Lake County NHMP* and Oregon Military Department, Office of Emergency Management

Figure G-17 SRGP Project Summary – Daly Middle School

Source: *2013 Lake County NHMP* and Oregon Military Department, Office of Emergency Management

Lakeview District Hospital

The majority of the hospital complex is built to current seismic codes. This includes the main hospital area (acute care, emergency room, radiology, obstetrics, and other areas.), the medical clinics, and the new Lakeview Gardens buildings (long-term care and assisted living facilities). The only areas that are not built to current seismic codes are the old acute care portion and the old long-term care building. The old acute care wing now houses physical therapy and wound care. This area was not upgraded during the project to build the addition to the hospital. The former long-term care building is now administrative offices.[6]

Figure G-18 Lakeview District Hospital

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 7/30/19

Figure G-19 Lakeview District Hospital

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 7/30/19

[6] Carmen Tague, Anderson Engineering and Surveying, personal communication, 7/30/19

Figure G-20 Lakeview District Hospital

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 7/30/19

Figure G-21 Lakeview District Hospital

Source: Carmen Tague, Anderson Engineering & Surveying, personal communication, 7/30/19

Paisley High School's Hazard Project

Paul Hauder, the Superintendent of the Paisley School District, described that one teacher, Courtney Wertz, had put together a project related to hazards and emergency preparedness. Ms. Wertz provided this write up and Paul sent it to Tricia Sears, DLCD Natural Hazards Planner, via email on 12/3/18.

Wildfires and natural disasters are a fact of life in rural southeastern Oregon. The west is getting hotter and continuous droughts threaten the homes, communities and livelihood of people who call the Oregon desert home. The land is ideal for ranching and farming but it's also ideal for wildfires. People who live in isolated communities need to be prepared to take care of themselves and each other when disaster strikes. However, it can be difficult for those giving assistance such as the local fire and governmental agencies when the authorities don't know the needs of the community. Additionally, these issues can become problematic when the community members aren't prepared to help themselves.

Ms. Wertz is using the National Geographic Geo-Inquiry model for a service learning project with her 9th/10th grade geography class. The goal is to better understand the needs of the community in regards to emergency and wildfire preparedness. After the students gathered this information they assist community members in becoming better prepared as well as work with local authorities and governmental agencies. They will share the information gathered with local authorities so that they will be better prepared to assist the next time disaster hits the community.

Scope of project:

1. Community outreach (students doing door-to-door survey of needs)
    a. Who lives in each house? Elderly, young children, etc. What special needs might they have in the event of disaster or evacuation?
2. Community education (based on demographics, survey and observational data)
    a. Including planning documents and "quick guides" in the event of a disaster
3. Provide opportunity to back-up important documents in the event of disaster
    a. Examples include: insurance documents, SS documents, personal/financial documents
4. Communication with first responders, particularly for special-needs residents
    a. Inform about needs of elderly and/or disabled residents, for example
5. Other activities may follow as needs are known, but will include:
    a. Assistance with preparation of 72 hour emergency kits
    b. Assistance with removal of fuels near dwellings

Red Rock Biofuels

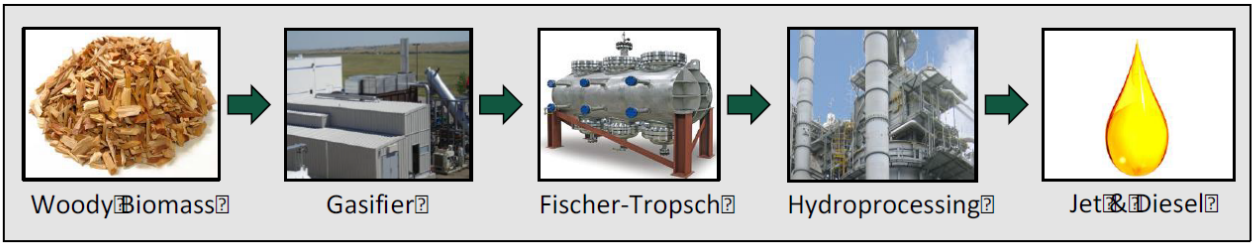
DLCD Natural Hazards Planner talked with Jeff Manternach of Red Rock Biofuels Holdings, Inc. He provided the following information on 11/11/18.

Red Rock Biofuels Holdings, Inc. ("Red Rock") is positioned to be the leading producer of drop-in, renewable, low-carbon jet and diesel fuels. With broad international agreement in the aviation industry for carbon-free growth beyond 2020 under CORSIA, airlines are actively seeking low-carbon jet fuel to reduce their greenhouse gas emissions. The civil aviation industry alone will require ~1.5 billion gallons per year of new renewable jet fuel production capacity to meet this commitment. The U.S. military has

also emerged as a major driver in the renewable jet and diesel fuel markets. The U.S. Navy has a goal to meet 50% of its total energy needs from alternative sources by 2020, which equates to a requirement for 336 million gallons per year, evenly split between aviation fuel and marine diesel. To meet these high demands for low-carbon renewable fuels, Red Rock will build a global portfolio of biorefineries to convert waste woody biomass into renewable jet and diesel fuels.

Through a proprietary integration of existing technologies, Red Rock makes the long-commercialized Fischer-Tropsch process economic at the biomass scale. And by using forest and sawmill residues, Red Rock will not only avoid competition for agricultural resources, but also reduce the risk of catastrophic wildfires by removing waste biomass from overgrown forests.

Technology Overview



Lakeview Project Summary:
Red Rock's first project in Lakeview, Oregon is shovel-ready, with all major permits issued.

Project: Convert 136,000 tons of waste woody biomass into 15.1 million gallons/year of renewable fuels (40% jet, 40% diesel, 20% gasoline blendstock)

Site: Lakeview, OR is fully permitted and ideally situated in large wood basket, next to interstate nat gas pipeline, State Highway 395, and adjacent to short line rail feeding the UP mainline.

Process Design: World class – Fluor. Incorporates three known technologies – gasification, Fischer-Tropsch, and hydroprocessing. Yields ASTM-approved fuels currently in use globally.

Biomass Supply: 70%+ contracted for 8yrs from start of ops, 3x+ available within 125 miles.

Fuel Offtakes: World class – Southwest Airlines and FedEx. All jet fuel contracted for 8yrs from start of operations.

Strong Management Team: Track record of delivering projects under budget, ahead of schedule, and producing over nameplate capacity. Developed/financed/built 8 renewable fuel plants; >$650 million in construction value; >325 million gal/yr.

The *Economic Impact of Proposed Red Rock Biofuels Plan in Oregon* (7/5/18), prepared by Michael Meyers, an economist with Business Oregon, provides some description of the economic impacts. The analysis is based on a Red Rock Biofuels plant creating 31 direct jobs in Oregon. Operation of the plant will create an additional 164 indirect and induced jobs throughout the state. Total impacts from operation of the biofuel plant will create 195 jobs. Labor income from direct jobs will total

about $2.2 million a year. Indirect and induced jobs created by operation of the biofuel plant will generate an additional $9.8 million a year in labor income.

Bullard Creek

Lakeview is at the mouth of steep, narrow Bullard and Deadman Creek Canyons. In the past, snowmelt and rains would rush through the canyons, repeatedly flooding and often dropping up to six feet of rocks and rubble along the town's main street. As a result of this, people came together to troubleshoot the situation. In the early to mid-1990s, the Natural Resources Conservation Service (NRCS) had done a preliminary design for a flood retarding structure (FRS) on Bullard Creek and detention basins on both Bullard and Deadman Creeks. But the NRCS suffered budget cuts, and could not do the project. In 1997, Lakeview had a flood that again emphasized the need for the FRS. NRCS then included $2.2 million for the project in their budget in 1998, but at that point they no longer had the capability to do it within the required 12 months. The NRCS then hired the team of URS Corporation and Anderson Engineering & Surveying to complete the project quickly.[7]

The FRS would hold back some flood surges and debris, but it would not protect Lakeview completely. The team designed four smaller basins below the dam and two on Deadman Creek to catch debris falling lower in the canyons. As a result of the project, floodwaters now flow under Lakeview through an improved 48-inch pipe and then into an enlarged creek stabilized with natural materials. Anderson Engineering & Surveying (AES) provided surveys throughout the project and provided construction administration.[8]

Since any delay would endanger the project funding, the team designed all aspects of the project to assure an easy and quick permitting process. The team provided for fish passage, although it was not required by the Oregon Department of Fish and Wildlife. The project was summarized by the NRCS's Conservation Engineer for Oregon, Dave Dishman, "URS and AES had to come up with technical solutions that met our tight budget within only nine months. Nonetheless, they provided us with an innovative yet easily constructible project that exceeded all of our goals."[9]

[7] Anderson Engineering & Surveying, Bullard Creek FRS, http://www.andersonengineering.com/services/bullard.html, accessed 1/29/20

[8] Ibid.

[9] Ibd.

Figure G-22 Bullard Creek Flood Retarding Structure

Source: Tricia Sears, DLCD, 5/23/18

Figure G-23 Bullard Creek Flood Retarding Structure

Source: Tricia Sears, DLCD, 5/23/18

APPENDIX H: LAKE COUNTY HAZUS GLOBAL REPORTS FOR CRUSTAL AND PROBABILISTIC SCENARIOS

Introduction

This report was prepared by DOGAMI in 2007. It was never published but it was included in the *2013 Lake County NHMP*. It contains scenarios for crustal and probabilistic earthquakes including maps and descriptions of the impacts. HAZUS is an earthquake loss estimation model that was developed by FEMA and the National Institute of Building Sciences. Using HAZUS, the described impacts are to buildings, critical facilities, transportation, and utilities. It describes the social impacts and economic loss. Also, it describes fires that can follow earthquakes, and debris generation. A similar report was produced for Harney County and Malheur County.

APPENDIX I: LAKE COUNTY NATURAL HAZARDS OUTREACH CALENDAR

Introduction

This calendar will be used each year to focus on outreach and education efforts on natural hazards on a month by month basis. It relates to **multi-hazard mitigation action #2 (MH#2)** in the *2020 Lake County NHMP*.

Media tools to use for outreach: newspapers, Lake County website, Town of Lakeview website, City of Paisley website, Facebook, Twitter, Instagram, utility bill inserts, newsletters. Flyers and other materials can be posted in locations such as city hall, courthouse, schools, gas stations, grocery stores etc.

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 Lake County NHMP maintenance meeting.

MONTH	NATURAL HAZARD	LEAD CONTACTS
January	Winter storms, wind storms, floods, landslides, volcanic events, earthquakes, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
February	Winter storms, wind storms, floods, landslides, volcanic events, earthquakes, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
March	Winter storms, wind storms, floods, landslides, volcanic events, earthquakes, air quality, wildfire	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
April	Winter storms, wind storms, floods, landslides, volcanic events, earthquakes, drought, wildfire, air quality,	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
May	Drought, wildfire, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)

June	Drought, wildfire, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
July	Drought, wildfire, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
August	Drought, wildfire, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
September	Drought, wildfire, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
October	Drought, wildfire, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
November	Winter storms, wind storms, floods, landslides, volcanic events, earthquakes, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)
December	Winter storms, wind storms, floods, landslides, volcanic events, earthquakes, air quality	Lake County Emergency Manager and Lake County Public Health Emergency Preparedness Coordinator (PHEP)

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 *2020 Lake County NHMP* update.

NATURAL HAZARD	RISK SCORE	RISK LEVEL (H-M-L)
Droughts	240	High
Air Quality	240	High
Winter Storms	236	High
Floods	236	High
Wildfire	210	High-Medium
Earthquakes	201	High-Medium
Wind Storms	193	High-Medium
Volcanic Events	129	Medium
Landslides	97	Low

In the table below, the natural hazards identified in the *2020 Lake County NHMP* are listed with the partner organizations at the local, state, and federal level related to those natural hazards.

NATURAL HAZARD	PARTNER CONTACTS
Droughts	Town of Lakeview, City of Paisley, ORWD, ODA, NRCS, Soil & Water Conservation Districts, RFPAs, BLM, USFS, OEM, FEMA
Air Quality	DEQ, Lake District Hospital, Town of Lakeview, ODF, school districts, OEM, FEMA, BLM, USFS
Winter Storms	Lake County Road Department, Town of Lakeview, City of Paisley, NWS, ODOT, OEM, FEMA, BLM, USFS
Floods	Lake County Road Department, Town of Lakeview, City of Paisley, ODOT, DOGAMI, OEM, FEMA, NWS, BLM, USFS
Wildfire	Bureau of Land Management, Town of Lakeview, City of Paisley, RFPAs, ODF, Oregon State Fire Marshall, USFS, USF&W, volunteer fire departments, Fire Defense Board, Community Wildfire Protection Plan (CWPP) Committee, OEM, FEMA, BLM
Earthquakes	Town of Lakeview, City of Paisley, OEM, FEMA, DOGAMI, BLM, USFS
Wind Storms	Town of Lakeview, City of Paisley, NWS, OEM, FEMA, ODOT, DOGAMI, BLM, USFS
Volcanic Events	Town of Lakeview, City of Paisley, USGS, DOGAMI, OEM, FEMA, BLM, USFS
Landslides	Lake County Road Department, Town of Lakeview, City of Paisley, ODOT, Oregon State Police, OEM, FEMA, DOGAMI, BLM, USFS

APPENDIX J:
OPERATION AND MAINTENANCE MANUAL BULLARD CREEK FLOODWATER RETARDING STRUCTURE DEADMAN-BULLARD WATERSHED PROJECT LAKEVIEW, OR AND THE EMERGENCY ACTION PLAN BULLARD DAM

Introduction

These two key documents are part of a PDF entitled Bullard Canyon Debris Basin Documents. The documents describe the operation and maintenance of Bullard Creek Floodwater Retarding Structure, a structure designed to retard floodwater flows in Bullard Canyon and release the water at a controlled rate. The documents relate to flood mitigation action #3 in the *2020 Lake County NHMP*. See Table 3-1, 202 Lake County NHMP Mitigation Actions for Lake County, the City of Paisley, and the Town of Lakeview.

APPENDIX K:
LAKEVIEW ACCESS RIGHT-OF-WAY AGREEMENT

Introduction

This appendix includes a sample of the agreement the Town of Lakeview has with landowners along Bullard and Deadman Creeks (Darryl Anderson, Anderson Engineering and Surveying, personal communication, 8/9/19). The agreement grants the right of the Town of Lakeview to go onto the landowner's property "for the sole and limited purpose of cleaning, clearing, repairing and maintaining the stream, stream bed and adjacent banks of Deadman Creek for flood, erosion and\or water flow control."