Polk County Multi-Jurisdictional Natural Hazard Mitigation Plan



Photos courtesy of Oregon State Archives and IPRE

Effective: March XX, 2024 through March XX-1, 2029

Prepared for
Polk County
Dallas, Falls City, Independence, Monmouth

Prepared by
The University of Oregon
Institute for Policy Research & Engagement
School of Planning, Public Policy, and Management

UNIVERSITY OF OREGON | Institute for Policy Research and Engagement

This Natural Hazard Mitigation Plan was prepared by:

POLK COUNTY
OREGON

OREGON PARTNERSHIP FOR DISASTER RESILIENCE

With support from:

UNIVERSITY OF OREGON

PPPM
Department of Planning, Public Policy and Management
School of Architecture and Allied Arts

Planning grant funding provided by:

FEMA

Federal Emergency Management Agency (FEMA)
Hazard Mitigation Grant Program
Project Award Number: DR-4562-08

Additional Support Provided by:

OREGON
Department of
Land Conservation
& Development

Acknowledgements

Polk County developed this Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP) through a regional partnership funded by the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP): HMGP-DR-4562-08 through the assistance of the Department of Land Conservation and Development (DLCD). This updated Natural Hazard Mitigation Plan is a collaboration between Polk County and the cities of Dallas, Falls City, Independence, and Monmouth. Planning process, plan templates, and plan development support was provided by the Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Institute for Policy Research and Engagement.

Polk County Emergency Management Staff

Austin McGuigan, Polk County Planning Director

Dean Bender, Polk County Emergency Manager

Institute for Policy Research and Engagement Research Team

Michael Howard, Director, Oregon Partnership for Disaster Resilience

Amanda Ferguson, Project Coordinator

Student Researchers:

Sam Amick, Research Associate

Anna Heironimus, Research Associate

Polk County NHMP Update Steering Committees

Polk County

- Eric Knudson, Associate Planner
- Sidney Mulder, Planning Manager
- Austin McGuigan, Planning Director
- Dean Bender, Emergency Manager
- Kari Wilhite, Human Resource Supervisor
- Todd Whitaker, Public Works Director

Stakeholders (City, Special District, State and Federal Agencies, etc.)

- Charlie Mitchel, City of Dallas, Economic & Community Development Director
- Chase Ballew, City of Dallas, Planner II
- Gerald Fisher, City of Independence, Public Works Director

- Suzanne Dufner, City of Monmouth, Community Development Director
- Carter Craig, City of Monmouth, Community Planner
- AJ Foscoli, City of Falls City, City Manager

About the Institute for Policy Research and Engagement

The Institute for Policy Research & Engagement (IPRE) is a research center affiliated with the School of Planning, Public Policy, and Management at the University of Oregon. It is an interdisciplinary organization that assists Oregon communities by providing planning and technical assistance to help solve local issues and improve the quality of life for Oregon residents. The role of IPRE is to link the skills, expertise, and innovation of higher education with the transportation, economic development, and environmental needs of communities and regions in the State of Oregon, thereby providing service to Oregon and learning opportunities to the students involved.

About the Oregon Partnership for Disaster Resilience

The Oregon Partnership for Disaster Resilience (OPDR) is a coalition of public, private, and professional organizations working collectively toward the mission of creating a disaster resilient and sustainable state. Developed and coordinated by the Institute for Policy Research and Engagement at the University of Oregon, the OPDR employs a service-learning model to increase community capacity and enhance disaster safety and resilience statewide.

NHMP Template Disclaimer

This NHMP is based in part on a plan template developed by the Oregon Partnership for Disaster Resilience. The template is structured to address the requirements contained in Title 44 CFR Section 201.6; where language is applicable to communities throughout Oregon, OPDR encourages the use of standardized language. As part of this regional planning initiative, OPDR provided copies of the plan templates to communities for use in developing or updating their hazards mitigation plans. OPDR hereby authorizes the use of all content and language provided to Josephine County in the plan template.

This page intentionally left blank.

Table of Contents

VOLUME I: BASIC PLAN

VOLUME I: BASIC PLAN I

PLAN SUMMARY I

Why Develop this Mitigation Plan? I
Who Participated in Developing the NHMP? II
How does Mitigation Planning Reduce Risk III
What is Polk County's Overall Risk to Hazards? IV
Community Vulnerability IV
How are the Action Items Organized? VIII
How will the NHMP be implemented? IX
NHMP Adoption IX

1. SECTION 1: INTRODUCTION 1

What is Natural Hazard Mitigation? 1
Why Develop a Mitigation Plan? 1
What Federal Requirements Does This NHMP Address? 2
What is the Policy Framework for Natural Hazard Planning in Oregon? 2
How was the NHMP Developed? 3
How is the NHMP Organized? 4
Volume I: Basic Plan and Appendices *4*
Volume II: Appendices *5*
Volume III: Jurisdictional Addenda *6*

2. SECTION 2: HAZARD IDENTIFICATION AND RISK ASSESSMENT 7

What is a Risk Assessment? 8
Hazard Identification 8
Risk Assessment 9
Hazard Analysis Matrix *9*
City Specific Risk Assessment *10*
Federal Disaster and Emergency Declarations 11
Hazard Profiles 14
Drought *14*
Earthquake *21*
Flood *32*
Landslide *44*
Severe Weather *51*
Extreme Heat *51*
Windstorm *53*
Winter Storm *58*
Volcanic Event *65*
Wildfire *69*

3. SECTION 3: MITIGATION STRATEGY 76

Mitigation Plan Mission 76
Mitigation Plan Goals 76
Action Item Development Process 78
Action Items *79*
Mitigation Successes *79*
Action Item Framework *79*

Action Item Development and Prioritization *79*

4. SECTION 4: PLAN IMPLEMENTATION AND MAINTENANCE 90

IMPLEMENTING THE NHMP 90
NHMP Adoption *90*
Convener *90*
Steering Committee *91*
IMPLEMENTATION THROUGH EXISTING PROGRAMS 92
CAPABILITIES ASSESSMENT 92
Existing Authorities *93*
Policies and Programs *94*
Personnel *96*
Capital Projects *97*
Capital Resources *97*
Findings *98*
NHMP MAINTENANCE 99
Meetings *99*
Project Prioritization Process *99*
Continued Public Involvement and Participation *102*
Five-Year Review of NHMP *103*

VOLUME II: APPENDICES 1

6. APPENDIX A: GLOSSARY AND ACRONYMS 1

GLOSSARY 1
ACRONYMS 5

7. APPENDIX B: PLANNING AND PUBLIC PROCESS 1

Project Background *1*
2023-2024 NHMP Update Changes *1*
PUBLIC PARTICIPATION PROCESS 7
ENGAGEMENT SUMMARY 7
WEBSITE POSTING 9
POLK COUNTY STEERING COMMITTEE 10

8. APPENDIX C: COMMUNITY PROFILE 1

POLITICAL CAPACITY 2
Government Structure *2*
Existing Plans and Policies *5*
NATURAL ENVIRONMENT CAPACITY 8
Geography *8*
Potential impacts of global climate change *9*
Synthesis *12*
SOCIAL/DEMOGRAPHIC CAPACITY 14
Population *14*
Vulnerable Populations *15*
Language Barriers *16*
Race and Ethnicity *16*
Gender *16*
Age *17*
Families and Living Arrangements *18*
Income *19*
Education *20*
Health *21*

Synthesis *22*
Economic Capacity 24
Regional Affordability *24*
Economic Diversity *25*
Employment and Wages *27*
Industry *30*
Synthesis *30*
Physical Infrastructure Capacity 31
Housing *31*
Infrastructure Profile *33*
Synthesis *41*
Community Connectivity Capacity 41
Social Systems and Service Providers *41*
Civic Engagement *43*
Cultural Resources *43*
Community Stability *44*
Synthesis *45*

9. APPENDIX D: ECONOMIC ANALYSIS OF NATURAL HAZARD MITIGATION PROJECTS 1

Why Evaluate Mitigation Strategies? 1
Mitigation Strategy Economic Analyses Approaches 2
Benefit/Cost Analysis *2*
Cost-Effectiveness Analysis *2*
STAPLE/E Approach *3*
When to use the Various Approaches 5
Implementing the Approaches *6*
Economic Returns of Natural Hazard Mitigation *7*
Additional Costs from Natural Hazards *8*
Additional Considerations *8*
Resources 9

10. APPENDIX E: GRANT PROGRAMS AND RESOURCES 1

Introduction 1
Post-Disaster Federal Programs 1
Non-Disaster Federal Programs 1
State Programs 2
Federal Mitigation Programs, Activities & Initiatives 4
Basic & Applied Research/Development *4*
Hazard ID and Mapping *4*
Project Support *5*

11. APPENDIX F: SURVEY REPORT 1

Overview & Methodology 1
Synthesis of Responses *1*
Findings: 3
Polk County Hazards Survey Results 4

VOLUME III: JURISDICTION ADDENDA

City of Dallas
City of Falls City
City of Independence
City of Monmouth

List of Figures

Figure 1 Understanding Risk iii
Figure 2 Hazard Analysis Matrix iv
Figure 3 Understanding Risk 7
Figure 4 Three Phases of a Risk Assessment 8
Figure 5 Polk County Hazard Identification 9
Figure 6 Hazard Analysis Matrix – Polk County 10
Figure 7 FEMA Major Disasters (DR) for Polk County 12
Figure 8 FEMA Emergency and Fire Management Assistance Declarations for Polk County 13
Figure 9 Standardized Precipitation-Evapotranspiration Index (1895-2023) 16
Figure 10 Liquification Susceptability, Earthquake Epicenters (2005-2023), and Active Faults 23
Figure 11 Cascadia Subduction Zone Perceived Shaking 27
Figure 12 Flood Insurance Rate Maps (FIRMs) 34
Figure 13 FEMA Special Flood Hazard Zone 35
Figure 14 Risk Report Flood Loss Scenario Findings 39
Figure 15 High Hazard Potential Dams in Polk County 41
Figure 16 Repetitive Flood Loss Detail 43
Figure 17 Landslide Susceptibility 45
Figure 18 Landslide Susceptibility Exposure 46
Figure 19 Probability of Severe Wind Events (Region 3) 57
Figure 20 Oregon Climate Divisions 59
Figure 21 Regional Tephra-fall Maps 66
Figure 22 Historic Volcanic Eruptions 67
Figure 23 Wildfire-Areas of Special Concern 71
Figure 24 Wildfire Risk 72
Figure 25 Development of Action Items 78
Figure 26 Action Items 81
Figure 27 Action Item and Project Review Process 100
Figure 28 Benefit Cost Decision Criteria 102
Figure 29 Natural Hazard Mitigation Plan Update Toolkit 104
Figure 30 Changes to NHMP Organization 2
Figure 31 Status of All Hazard Mitigation Actions in the Previous Plan 4
Figure 32 Polk County Incoporated Cities Population, 2016-2021 2
Figure 33 Existing Plans 6
Figure 34 Polk County Normal Precipitation: Annual 12
Figure 35 Population Estimates and Change (2016-2021) 15
Figure 36 Vulnerable Age Groups in Polk County, 2021 and 2035 18
Figure 37 Household by Type, Including Living Alone 18
Figure 38 Married-Couple and Single Parent Families with Children 19
Figure 39 Median Household Income 19
Figure 40 Poverty Rates 20
Figure 41 Educational Attainment 21
Figure 42 Health Insurance Coverage 21
Figure 43 Disability Status by Age Group 22

Figure 44 Regional Income Inequality 25
Figure 45 Household Mortgages > 30% of Household Income 25
Figure 46 Regional Herfindahl Index Scores 26
Figure 47 Unemployment Rate 27
Figure 48 Polk County Laborshed 28
Figure 49 Commute Shed (Where Workers are Employed who Live in Polk County), 2021 29
Figure 50 Labor Shed (Where Workers Live who are Employed in Polk County), 2021 29
Figure 51 Housing Profile 31
Figure 52 Oregon's Seismic Design Level Benchmark Years 32
Figure 53 Year Structure Built 33
Figure 54 Polk County Dams and Hazard Threat 37
Figure 55 Polk County High Hazard Dam Inventory 38
Figure 56 Bridge Inventory 40
Figure 57 Communication Process 42
Figure 58 Regional Residential Stability 44
Figure 59 Housing Tenure and Vacancy 45

This page intentionally left blank.

Volume I: Basic Plan

This page intentionally left blank

Plan Summary

Polk County updated this Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP) to prepare for the long-term effects resulting from hazards. It is impossible 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 public agencies, private sector organizations and residents within the community, it is possible to create a resilient community that will benefit from long-term recovery planning efforts.

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, hazard mitigation is a method of permanently reducing or alleviating the losses of life, property and injuries resulting from 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 non-English speaking residents or the elderly. Hazard mitigation is the responsibility of the "Whole Community." FEMA defines Whole Community as, "private and nonprofit sectors, including businesses, faith-based and disability organizations and the general public, in conjunction with the participation of local, tribal, state, territorial and Federal governmental partners."

> *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…*

Why Develop this Mitigation Plan?

The Disaster Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions (counties, cities, special districts, etc.) maintain an approved Natural Hazard Mitigation Plan (NHMP) to receive FEMA Hazard Mitigation Assistance funds for mitigation projects. To that end, Polk County is involved in a broad range of hazard and emergency management planning activities. Local and federal approval of this NHMP ensures that the County and listed jurisdictions will (1) remain eligible for pre- and post-disaster mitigation project grants and (2) promote local mechanisms to accomplish risk reduction strategies.

> *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…*

What is Mitigation?

"Any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event."

- U.S. Federal Emergency Management Agency

Who Participated in Developing the NHMP?

The Polk County NHMP is the result of a collaborative effort between the County, cities, special districts, residents, public agencies, non-profit organizations, the private sector, and regional organizations. County and City steering committees guided the NHMP development process.

For a list of individual County steering committee participants, refer to the acknowledgements section above. The update process included representatives from the following jurisdictions and agencies:

- Polk County Emergency Management
- Polk County Economic & Community Development
- Polk County Public Works
- City of Falls City
- City of Dallas
- City of Independence
- City of Monmouth
- Polk County Fire District #1
- Oregon Department of Emergency Management
- Mid-Willamette Valley Council of Governments

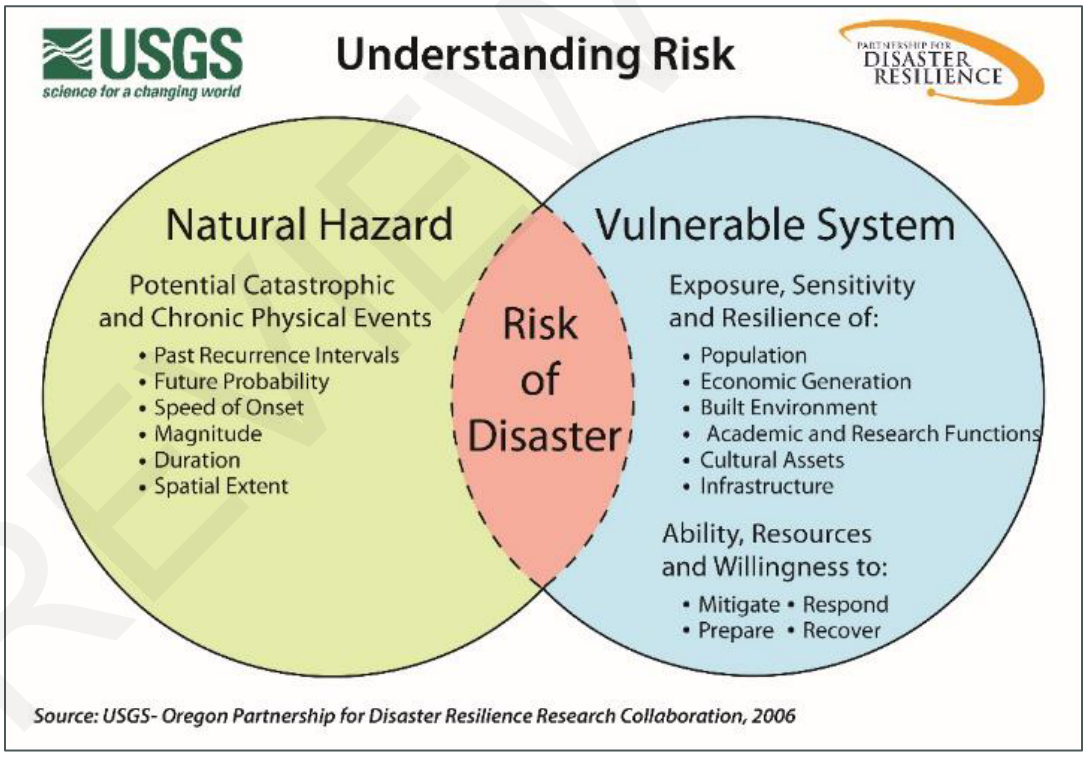
The Polk County Emergency Manager and Planning Director convened the planning process and will take the lead in implementing, maintaining, and updating the County NHMP. Each of the participating jurisdictions have also named a local convener who is responsible for implementing, maintaining, and updating their addendum (see addenda, Volume III, for specific names and positions). Polk County is dedicated to directly involving the public in the continual review and update of the Natural Hazards Mitigation Plan. The County achieves this through systematic engagement of a wide variety of active groups, organizations, or committees, including but not limited to public and private infrastructure partners, watershed and neighborhood groups, and numerous others. The public is encouraged to provide feedback about the NHMP throughout the implementation and maintenance period.

How does Mitigation Planning 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 Polk County reduce the risk from hazards by identifying resources, information, and strategies for risk reduction. It is also intended to guide and coordinate mitigation activities throughout the County. A risk assessment consists of three phases: hazard identification, vulnerability assessment and risk analysis, as illustrated in the following graphic.

Figure 1 Understanding Risk



Source: Oregon Partnership for Disaster Resilience.

By identifying and understanding the relationship between hazards, vulnerable systems and existing capacity, Polk County is better equipped to identify and implement actions aimed at reducing the overall risk to hazards. Notably, Polk County took the unique step of directly engaging representatives in four critical lifeline sectors: Communication, Energy, Transportation, and Water. Because these four lifeline sectors are critical to virtually all other activity in the county, this approach was used to better understand each sector's unique vulnerabilities, threats, and hazards. The County utilized the information collected to inform specific, targeted actions aimed at reducing risks across each of the four lifeline sectors.

What is Polk County's Overall Risk to Hazards?

Polk County reviewed and updated the risk assessment to evaluate the probability of each hazard as well as the vulnerability of the community to that hazard. The chart below presents the updated hazard analysis matrix for Polk County. The hazards are listed in rank order from high to low. The table shows that hazard scores are influenced by each of the four categories combined. With considerations for past historical events, the probability or likelihood of a hazard event occurring, the vulnerability to the community and the maximum threat or worst-case scenario, winter storm, windstorm, and earthquake (Cascadia) events rank as the top hazard threats to the County (top tier). Extreme heat, flood, and wildfire events rank in the middle (middle tier). Landslide, earthquake (Crustal), and volcanic events comprise the lowest ranked hazards in the county (bottom tier).

Figure 2 Hazard Analysis Matrix

Hazard	History	Probability	Vulnerability	Maximum Threat	Total Threat Score	Hazard Rank	Tier
Winter Storm	20	70	40	80	210	# 1	Top Tier
Windstorm	12	70	40	80	202	# 2	
Earthquake - Cascadia	2	35	40	100	177	# 3	
Extreme Heat Event	16	70	25	50	161	#4	Middle Tier
Flood - Riverine	16	70	25	50	161	# 4	
Wildfire (WUI)	16	56	25	50	147	# 6	
Drought	10	35	25	50	120	# 7	
Landslide	8	70	5	10	93	# 8	Bottom Tier
Earthquake - Crustal	2	21	15	50	88	# 9	
Volcanic Event	2	7	5	50	74	# 10	

Source: Polk County NHMP Steering Committee, 2023

Community Vulnerability

Community vulnerabilities are an important component of the NHMP risk assessment. For more in-depth information regarding specific community vulnerabilities see Volume II,

Appendix C and Volume III. Changes to population, economy, built environment, critical facilities, and infrastructure have not significantly influenced vulnerability. Recent development has complied with the standards of the Oregon Building Code and the county's development code including their floodplain ordinance. Data sources for the following community vulnerability information can be found in Volume II, Appendix C unless otherwise noted below.

Population

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.[1] Of this number, a disproportionate burden is placed upon special needs groups, particularly children, the elderly, the disabled, minorities and low-income persons. Population vulnerabilities can be reduced or eliminated with proper outreach and community mitigation planning.

Population Vulnerabilities

- As of 2021, approximately 18% of Polk County's population is over the age of 64.
- The Polk County age dependency ratio[2] is 62 indicating a higher percentage of dependent aged people to that of working aged.
- Approximately 28% of Polk County population lives alone; this percentage is greatest in Dallas (29%) and Monmouth (26%).
- Approximately 12% of the total Polk County population lived at or below the poverty line in 2021, with 14% being children.
- While over 91% of the population over 25 has graduated high school or higher, about 30% have a bachelor's degree or higher.
- Approximately 15% of the Polk County population is estimated to have a disability. Of that, 5,309 individuals over 65 (35% of county population age 65 and older) are disabled.
- Approximately 88% of all homeless individuals and families in Polk County are unsheltered as of 2023. Approximately 225 individuals are unsheltered (2.53 per 1000 residents) and 31 people are sheltered.[3]
- On Jan. 10, 2023, Governor Kotek signed Executive Order 23-02, declaring a state of emergency due to unsheltered homelessness in seven Continuum of Care regions across the state, including Marion-Polk. The Governor chose the regions like Marion-Polk counties based on the 2022 Point-in-Time Count data, which showed an increase in unsheltered homelessness of 50% or greater since 2017.[4]

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

[2] Dependency Ratio: the ratio of population typically not in the work force (less than 15, greater than 64)

[3] Portland State University Population Research Center, 2023 Oregon Statewide Homelessness Estimates (pdx.edu).

[4] Oregon Housing and Community Services, Community Plan Summary Marion Polk.pdf (oregon.gov).

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 absorb disaster impacts for a quick recovery.

Economic Vulnerabilities

- Over 46% of Polk County renters spend more than 30% of their income on housing. The city with the highest percentage of renters spending 30% or more of their income on housing is Falls City (54.5%).
- According to the Oregon Employment Department, Polk County unemployment has remained about the same as at about 5%.
- About 27% of the workforce comes into the county from outside of the county and about 26% of the population travels to outside of the county for work.
- 43% of the workforce in Polk County live and work in the county (8,680). Of those who are employed and live in Polk County now, 77% (28,640) work outside the county.
- The top five industry sectors in Polk County with the most employees, as of 2021, are Professional and Related (22%, 8,748), Management, Business, and Financial Operations (15%, 6,012), Office and Administrative Support (10%, 4,098), Sales (9%, 3,622), and Construction, Extraction, and Maintenance (7.5%, 2,986).
- Approximately 12% of renters do not have a personal vehicle in Polk County, whereas 28% of renters in Falls City and 19% of renters in Dallas do not have a car.

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 resiliency to natural hazards. The natural environment includes land, air, water, and other natural resources that support and provide space to live, work and recreate.[5] 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.

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

Environmental Vulnerabilities

- Forest ecosystems are vulnerable to drought, wildfire, and severe storm impacts.
- Water and air quality may be affected in both long- and short-term measures because of direct and indirect impacts from natural hazards.

Built Environment, Critical Facilities, and Infrastructure

Critical facilities (i.e. police, fire, and government facilities), housing supply, and physical infrastructure are vital 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 Vulnerabilities

- Mobile homes and other non-permanent residential structures account for 8% of the housing in Polk County. Mobile homes (including Boats, RVs, and Vans, etc.) account for about 35% of housing within Falls City. These structures are particularly vulnerable to certain natural hazards, such as earthquakes, windstorms, and heavy flooding events.
- Based on U.S. Census data, approximately 54% of the residential housing in Polk County was built before the current seismic building standards of 1990.[6]
- Approximately 26% of residential structures were constructed prior to the local implementation of the flood elevation requirements of the 1970's (Flood Insurance Rate Maps –FIRMs – were not completed for the County until the late 1970s and early 1980s).
- The housing vacancy rate in Polk County was estimated at 5% in 2021 (with a low of 2.3% in Dallas, and a high of 5.8% in Monmouth). Approximately 33% of the housing units in Polk County are occupied by renters, with the highest number of renters (40%) in Independence.

Critical Facilities and Infrastructure Vulnerabilities

- Virtually all state and county roads and bridges in Polk County are vulnerable to multiple hazards including floods, landslides, and earthquakes. Impacts to the transportation system can result in the isolation of vulnerable populations, limit access to critical facilities such as hospitals and adversely impact local commerce, employment, and economic activity.
- There one (1) general hospital in the county with 24/7 emergency room and inpatient services, located in Dallas. The Salem Hospital is located just outside of the county in Marion County.

[6] Ibid.

- There is a power plant located in west Salem. There are some redundancies in power transmission but limited redundancy in the power distribution network, especially in relation to the more rural or unincorporated areas of the county.
- There is one "high threat potential" dam in Polk County (Mercer Dam) (Appendix C). According to the Oregon Water Resources Department (OWRD) Mercer Dam qualifies for FEMAs Rehabilitation of High Hazard Potential Dams grant program as of 8/25/2023.

How are the Action Items Organized?

The action items are organized within an action matrix (Figure 26) included within Volume I, Section 3.

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

Data collection, research and the public participation process resulted in the development of the action items. The Action Item Matrix portrays the overall NHMP framework and identifies linkages between the NHMP goals and actions. The matrix documents the title of each action along with, the coordinating organization, timeline and the NHMP goals addressed. City specific action items are included in Volume III, Jurisdictional Addenda.

High Priority NHMP Actions: Polk County

The following summarizes specific priority NHMP actions. Refer to Volume I, Section 3 for a complete list of county actions and Volume III for a complete list of city and special district actions.

Polk County High Priority NHMP Actions

1. Identify mitigation measures necessary to maintain identified primary and secondary transportation routes to interconnect critical facilities. Maintain a map with these emergency routes to be used in the event of a natural hazard.
2. Reduce potential isolation of critical facilities in the event of a natural hazard by creating redundancy. Create a map with alternative transportation routes. Create a plan for multiple communication alternatives.
3. Utilize social media as a communication outlet in the event of a natural hazard.
4. Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm or winter storm events. Identify hazard trees, encourage harvesting of hazard trees within utility and road corridors, and those blown down during storm events.

How will the NHMP 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 . . .

Volume I, Section 4 of this NHMP details the formal process that will ensure that the Polk County NHMP remains an active and relevant document. The NHMP will be implemented, maintained, and updated by a designated convener. The Polk County Emergency Manager is the designated convener (NHMP Convener) and is responsible for overseeing the review and implementation processes (see City Addenda for city conveners). The NHMP maintenance process includes a schedule for monitoring and evaluating the NHMP quarterly and producing a NHMP revision every five years. This section also describes how the communities will integrate public participation throughout the NHMP maintenance process.

NHMP 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 NHMP is locally reviewed and deemed complete the NHMP Convener (or their designee) submits it to the State Hazard Mitigation Officer at the Oregon Department of Emergency Management (OEM). OEM reviews the NHMP and submits it to the Federal Emergency Management Agency (FEMA – Region X) for review. This review will address the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201.6. Once the NHMP is pre-approved by FEMA, the County and cities formally adopt the NHMP via resolution. The Polk County NHMP Convener will be responsible for ensuring local adoption of the NHMP and providing the support necessary to ensure NHMP implementation. Once the resolution is executed at the local level and documentation is provided to FEMA, the NHMP is formally acknowledged by FEMA and the County (and participating cities) will maintain eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and the Flood Mitigation Assistance program funds.

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

The Steering Committees for Polk County and participating cities each met to review the NHMP update process, and their governing bodies adopted the NHMP. The county date of

adoption, FEMA approval, and plan expiration is shown below. See Volume III for dates specific to each participating city.

Polk County adopted the NHMP on [Month Day], 2024. FEMA Region X approved the Polk County NHMP on [Month Day], 2024. With approval of this NHMP, 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 [Month Day-1], 2029.

Section 1: Introduction

This section provides a general introduction to natural hazard mitigation planning in Polk County. In addition, it 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 NHMP 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."[7] 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, 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, private businesses and industries, state and local governments and the federal government.

Engaging in mitigation activities provides jurisdictions (counties, cities, special districts, etc.) with many 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?

Polk County updated this Multi-Jurisdictional Natural Hazard Mitigation Plan (NHMP) to reduce future loss of life and damage to property resulting from natural hazards. It is impossible 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 residents within the community, it is possible to minimize the losses that can result from natural hazards.

[7] FEMA, *What is Mitigation?* http://www.fema.gov/what-mitigation

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 NHMP ensures that the County and listed cities will remain eligible for pre- and post-disaster mitigation project grants.

What Federal Requirements Does This NHMP Address?

DMA2K 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 (often referred to as the non-disaster grant program) and new 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 mitigation plans in place to qualify to receive post-disaster HMGP funds. Mitigation plans must demonstrate that State and local jurisdictions' proposed mitigation measures are based on a sound planning process that accounts for the risk to the individual and State and local jurisdictions' capabilities.

Title 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.[8] Pursuant of Title 44 CFR, the NHMP planning processes shall include opportunity for the public to comment on the NHMP during review and the updated NHMP shall include documentation of the public planning process used to develop the NHMP.[9] The NHMP update must also contain a risk assessment, mitigation strategy and a NHMP maintenance process that has been formally adopted by the governing body of the jurisdiction.[10] Lastly, the NHMP must be submitted to the Oregon Department of Emergency Management (OEM) for initial review and then sent to FEMA for federal approval.[11] Additionally, the way OEM administers 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 Hazard 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

[8] Code of Federal Regulations, Title 44, Part 201, Section 201.6, subsection (a).

[9] ibid, subsection (b).

[10] ibid, subsection (c).

[11] ibid, subsection (d).

(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 land use 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 jurisdiction's Comprehensive Plan and helps each jurisdiction meet the requirements of statewide land use planning Goal 7.

The primary responsibility for the development and implementation of risk reduction strategies and policies lies with local jurisdictions. However, additional resources exist at the state and federal levels. Some of the key agencies in this area include Oregon Department of Emergency Management (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 NHMP Developed?

The NHMP was developed by the Polk County Natural Hazard Mitigation Plan Steering Committee and the Steering Committees for the cities of Dallas, Falls City, Independence, and Monmouth. *Note: The City of Salem, including west Salem, which is in Polk County, has a stand-alone NHMP.*

The Polk County Steering Committee formally convened on several occasions to discuss and revise the NHMP. Each of the participating city Steering Committees met at least once formally. Steering Committee members contributed data and maps, and reviewed and updated the community profile, risk assessment, action items, and the implementation and maintenance plan.

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 shall include opportunity for the public, neighboring communities, and local and regional agencies, as well as private and non-profit entities to comment on the NHMP during review.[12] Polk County provided an accessible project website for the public to provide feedback on the draft NHMP. In addition, Polk County provided a press release on their website to encourage the public to offer feedback on the NHMP update and distributed a survey of household preparedness through their website and in written form. The County and city websites continue to be a focal point for distribution natural hazard information

[12] Code of Federal Regulations, Chapter 44. Section 201.6, subsection (b). 2015

using hazard viewers, emergency alerts, hazard preparation, and annual natural hazard progress reports.

How is the NHMP 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 mitigation plan that furthers the community's mission to reduce or eliminate long-term 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.

Volume I: Basic Plan and Appendices

Plan Summary

The NHMP summary provides an overview of the FEMA requirements, planning 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 NHMP.

Section 2: Hazard Identification and Risk Assessment

This section provides the factual basis for the mitigation strategies contained in Volume I, Section 3. (Additional information is included within Volume II, Appendix C, which contains an overall description of Polk County and the 4 incorporated cities.) This section includes a brief description of community sensitivities and vulnerabilities. The Risk Assessment allows readers to gain an understanding of each jurisdiction's vulnerability and resilience to natural hazards.

A hazard summary is provided for each of the hazards addressed in the NHMP. The summary includes hazard history, location, extent, vulnerability, impacts, and probability. This NHMP addresses the following hazards:

- Drought
- Earthquake
  - Cascadia
  - Crustal
- Flood
- Landslide
- Severe Weather
  - Extreme Heat
  - Windstorm
  - Winter Storm
- Volcanic Event
- Wildfire

Additionally, this section provides information on each jurisdictions' participation in the National Flood Insurance Program (NFIP).

Section 3: Mitigation Strategy

This section documents the NHMP vision, mission, goals, and actions (mitigation strategy) and describes the components that guide implementation of the identified actions. Actions are based on community sensitivity and resilience factors and the risk assessments in Volume I, Section 2.

Section 4: Plan Implementation and Maintenance

This section provides information on the implementation and maintenance of the NHMP. It describes the process for prioritizing projects and includes a suggested list of tasks for updating the NHMP, to be completed at the semi-annual and five-year review meetings.

Volume II: Appendices

The appendices are designed to provide the users of the Polk County NHMP with additional information to assist them in understanding the contents of the NHMP and provide them with potential resources to assist with NHMP implementation.

Appendix A: Glossary and Acronyms

This appendix includes a list of terms, and their acronyms, related to natural hazard mitigation that are found throughout this NHMP.

Appendix B: Planning and Public Process

This appendix includes documentation of all the countywide public processes utilized to develop the NHMP. It includes invitation lists, agendas, attendance, and summaries of Steering Committee meetings as well as any other public involvement methods.

Appendix C: Community Profile

The community profile describes the County and participating cities from several perspectives to help define and understand the region's 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.

Appendix D: Economic Analysis of Natural Hazard Mitigation Projects

This appendix describes the Federal Emergency Management Agency's (FEMA) requirements for benefit cost analysis in natural hazards mitigation, as well as various approaches for conducting economic analysis of proposed mitigation activities.

Appendix E: Grant Programs and Resources

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

Appendix F: Community Survey

The survey was designed to get a better understanding of the community's concerns and needs relating to natural hazards throughout the county.

Volume III: Jurisdictional Addenda

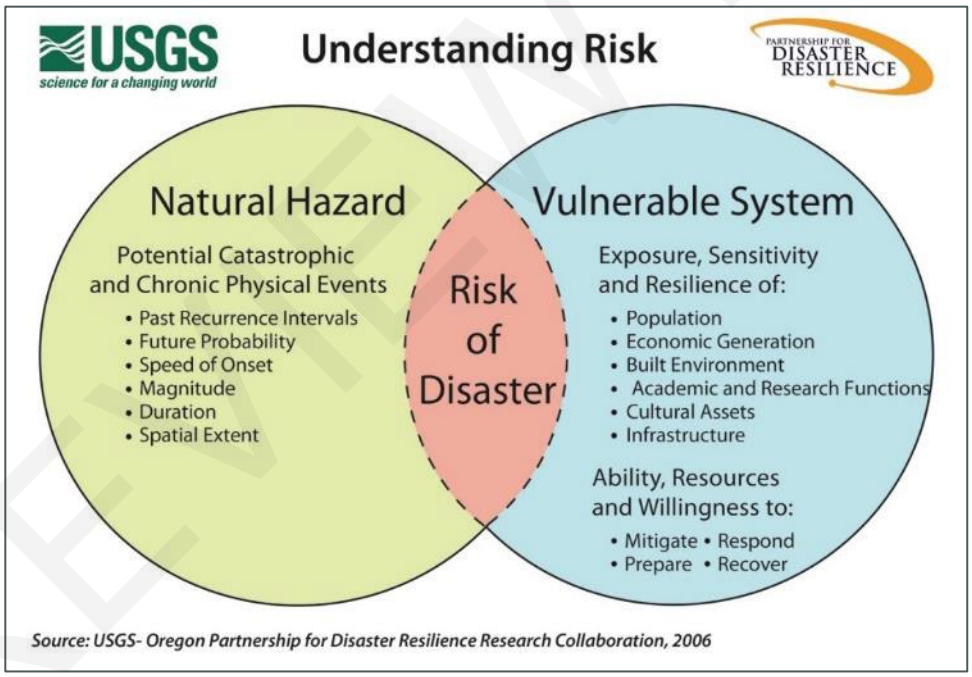
Volume III of this NHMP is reserved for city addenda developed in this multi-jurisdictional planning process. Four of the cities within the County created addenda. As such, the five-year update cycle will be the same for these cities and the County.

Section 2: Hazard Identification and Risk Assessment

This section of the NHMP addresses 44 CFR 201.6(b)(2) - Risk Assessment. The Risk Assessment applies to Polk County and the city addenda included in the NHMP. We address city specific information where relevant. In addition, this chapter can assist with addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards.

We use the information presented in this section, along with community characteristics presented in Volume II, Appendix C to inform the risk reduction actions identified Volume I, Section 2. The figure below shows how we conceptualize risk in this NHMP. Ultimately, the goal of hazard mitigation is to reduce the area where hazards and vulnerable systems overlap.

Figure 3 Understanding Risk



Source: Oregon Partnership for Disaster Resilience.

What is a Risk Assessment?

A risk assessment consists of three phases: hazard identification, vulnerability assessment, and risk analysis.

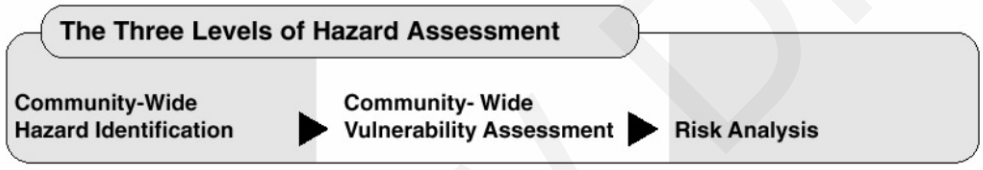
Phase 1: Identify hazards that can affect the jurisdiction. This includes an evaluation of potential hazard impacts – type, location, extent, etc.

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 following figure illustrates the three-phase risk assessment process:

Figure 4 Three Phases of a Risk Assessment



Source: Planning for Natural Hazards: Oregon Technical Resource Guide, 1998

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

Hazard Identification

Polk County identifies ten natural hazards that could have an impact on the County and participating cities. Figure 5 lists the hazards identified in the county in comparison to the hazards identified in the Oregon NHMP for the Southwest Oregon (Region 4), which includes Polk County.

Figure 5 Polk County Hazard Identification

Polk County	State of Oregon NHMP Region 3: Mid/ Southern Willamette Valley
Drought	Drought
Earthquake	Earthquake
Flood	Flood
Landslide	Landslide
Volcanic Event	Volcano
Wildfire	Wildfire
Windstorm	Windstorm
Winter Storm	Winter Storm

Source: Polk County NHMP Steering Committee (2023) and
State of Oregon NHMP, Region 3: Mid/South Willamette Valley (2020)

Risk Assessment

Multi-jurisdictional Risk Assessment - §201.6(c) (2) (iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

Hazard Analysis Matrix

For hazard mitigation planning at the county and local level, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a hazard. It doesn't predict the occurrence of a hazard, but it does "quantify" the risk of one hazard compared with another. By doing this analysis, planning can first be focused where the risk is greatest.

For the purposes of this NHMP, the County and cities utilized the Oregon Department of Emergency Management (OEM) Hazard Analysis methodology. The hazard analysis methodology in Oregon was first developed by FEMA circa 1983 and gradually refined by OEM over the years.

The methodology produces scores that range from 24 (lowest possible) to 240 (highest possible). Vulnerability and probability are the two key components of the methodology. Vulnerability examines both typical and maximum credible events and probability reflects 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 approximately 40%. The hazard analysis summary is included here to ensure consistency between the EOP and NHMP.

Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous sections) and (2) the likelihood or probability of the harm occurring. Figure 6 presents the entire updated hazard analysis matrix for Polk County. The hazards are listed in rank order from high to low. The figure shows that hazard scores are influenced by each of the four categories combined. With considerations for past historical events, the probability or likelihood of a hazard event occurring, the vulnerability to the community and the maximum threat or worst-case scenario, winter storm, windstorm, and earthquake (Cascadia) events rank as the top hazard threats to the County (top tier). Extreme heat, flood, wildfire, and drought events rank in the middle (middle tier). Landslide, earthquake (Crustal), and volcanic event comprise the lowest ranked hazards in the county (bottom tier).

Figure 6 Hazard Analysis Matrix – Polk County

Hazard	History	Probability	Vulnerability	Maximum Threat	Total Threat Score	Hazard Rank	Tier
Winter Storm	20	70	40	80	210	# 1	Top Tier
Windstorm	12	70	40	80	202	# 2	
Earthquake - Cascadia	2	35	40	100	177	# 3	
Extreme Heat Event	16	70	25	50	161	#4	Middle Tier
Flood - Riverine	16	70	25	50	161	# 4	
Wildfire (WUI)	16	56	25	50	147	# 6	
Drought	10	35	25	50	120	# 7	
Landslide	8	70	5	10	93	# 8	Bottom Tier
Earthquake - Crustal	2	21	15	50	88	# 9	
Volcanic Event	2	7	5	50	74	# 10	

Source: Polk County Steering Committee (2023); Analysis and Ranking by OPDR

For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a particular hazard.

City Specific Risk Assessment

Multi-jurisdictional Risk Assessment - §201.6(c) (2) (iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

The four (4) participating cities held Steering Committee meetings and completed a jurisdiction specific hazard analysis. The multi-jurisdictional risk assessment information is located herein and within the Risk Assessment of each jurisdiction's addendum (Volume III).

Federal Disaster and Emergency Declarations

Reviewing past events 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 because of natural hazard related events. As of March 2023, FEMA has approved a total of 39 major disaster declarations, 98 fire management assistance declarations and four (4) emergency declarations in Oregon.[13] When governors ask for presidential declarations of major disaster or emergency, they stipulate which counties in their state they want included in the declaration. Figure 7 summarizes the major disasters declared in Oregon that affected Polk County, since 1953. The table shows that there have been 14 major disaster declarations for the County, most of which were related to weather events resulting primarily in flooding, snow, and landslide related damage.

[13] FEMA, *Declared Disasters by Year or State*, http://www.fema.gov/news/disaster_totals_annual.fema#markS. Accessed March 2, 2016.

Figure 7 FEMA Major Disasters (DR) for Polk County

Declaration Number	Declaration Date	Incident Period		Incident	Individual Assistance	Public Assistance Categories
		From	To			
DR-184	12/24/1964	12/24/1964	12/24/1964	Heavy rains and flooding	Yes	A, B, C, D, E, F, G
DR-413	1/25/1974	1/25/1974	1/25/1974	Severe Storms, Snowmelt, Flooding	Yes	A, B, C, D, E, F, G
DR-1099	2/9/1996	2/4/1996	2/21/1996	Severe Storms/Flooding	Yes	A, B, C, D, E, F, G
DR-1510	2/19/2004	12/26/2003	1/14/2004	Severe Winter Storm	None	A, B, C, D, E, F, G
DR-1632	3/20/2006	12/18/2005	1/21/2006	Severe Storms, Flooding, Landslides, and Mudslides	None	A, B, C, D, E, F, G
DR-1683	2/22/2007	12/14/2006	12/15/2006	Severe Winter Storm and Flooding	None	A, B, C, D, E, F, G
DR-1733	12/8/2007	12/1/2007	12/17/2007	Severe Storms, Flooding, Landslides, and Mudslides	None	A, B, C, D, E, F, G
DR-1824	3/2/2009	12/13/2008	12/26/2008	Severe Winter Storm, Record and Near Record Snow, Landslides, and Mudslides	None	A, B, C, D, E, F, G
DR-4055	3/2/2012	1/17/2012	1/21/2012	Severe Winter Storm, Flooding, Landslides, and Mudslides	None	A, B, C, D, E, F, G
DR-4258	2/17/2016	12/6/2015	12/23/2015	Oregon Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides	None	A, B, C, D, E, F, G
DR-4499-OR	3/28/2020	1/20/2020	ongoing	Oregon Covid-19 Pandemic	Yes	B

Source: FEMA, Oregon Disaster History. Major Disaster Declarations.

Figure 8 summarizes fire management assistance and emergency declarations. Fire Management Assistance may be provided after a State submits a request for assistance to the FEMA Regional Director at the time a "threat of major disaster" for a fire emergency exists. 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. Polk County has four (4) recorded Emergency Declarations: the 1987 Shady Lane Fire, 2005 Hurricane Katrina evacuation, 2020 Covid-19 Pandemic, and the Oregon Winter Storm in 2021.

Figure 8 FEMA Emergency (EM) and Fire Management Assistance (FMA) Declarations for Polk County

Declaration Number	Declaration Date	Incident Period		Incident	Individual Assistance	Public Assistance Categories
		From	To			
FM-2066	10/10/1987	10/9/1987	-	Shady Lane Fire	None	-
EM-3228	9/7/2005	8/29/2005	10/1/2005	Hurricane Katrina Evacuation	None	B
EM-3429-OR	3/13/2020	1/20/2020	ongoing	Oregon Covid-19	Yes	B
4599-DR-OR	5/4/2021	2/11/2021	2/15/2021	Oregon Winter Storm 2-13-2021	None	A, B, C, D, E, F, G, H

Source: FEMA, Oregon Disaster History. Major Disaster Declarations.

Hazard Profiles

The following subsections briefly describe relevant information for each hazard. For additional background on the hazards, vulnerabilities and general risk assessment information for hazards in Southwest Oregon (Region 4), refer to the State of Oregon NHMP, Region 4, Southwest Oregon Risk Assessment (2020).

Drought

Significant Changes since Previous NHMP:

The drought hazard section has been edited to reference new history since the previous NHMP. No development changes affected the jurisdiction's overall vulnerability to this hazard.

Characteristics

A drought is a period of drier than normal conditions. Drought occurs in virtually every climatic zone, but its characteristics vary significantly from one region to another. Drought is a temporary condition; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate. 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.

Location and Extent

Droughts occur in every climate zone and can vary from region to region. Drought may occur throughout Polk County and may have profound effects on the economy, particularly the agricultural and hydro-power sectors. Reasons for why drought can have such broad and significant impacts on Polk County include:

- Higher population density and growing population throughout Polk County and the Willamette Valley;
- Ever growing dependence on surface water supplies for many jurisdictions and municipalities, agriculture, and industries from large flood control reservoirs in the Willamette and Santiam River system;
- Increase in frequency of toxic algal blooms in the Willamette and Santiam River system reservoirs, resulting in restrictions on the use of water from these reservoirs for drinking, as well as potentially being unsafe for agricultural irrigation and other uses. Algal blooms can necessitate purchasing and transporting water from alternative sources;
- As drought is typically accompanied by earlier onset of snowmelt (e.g., during flood control or early storage season), little or no snowmelt runoff is stored for later;
- Earlier start of growing season, before the start of irrigation season, which means that crops may not be irrigated until the irrigation season begins; and

- Insufficient number of farm workers available to work during the early onset growing season, as they are scheduled to arrive during the onset of irrigation season.

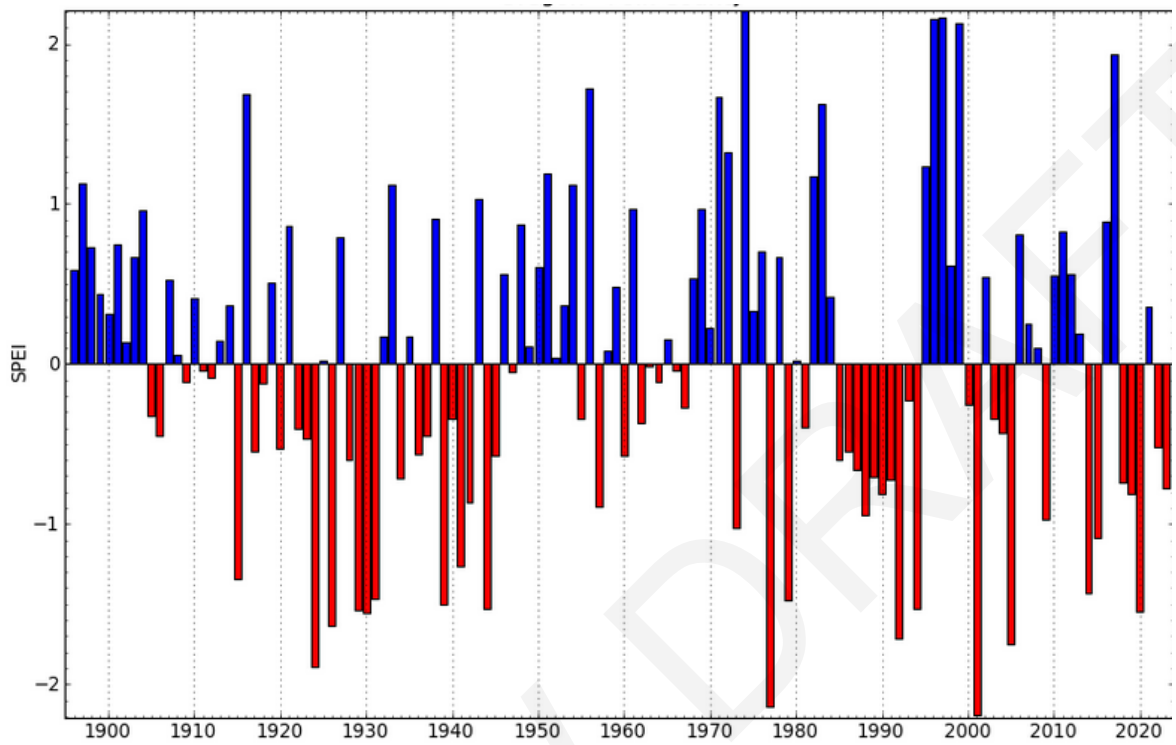
Drought is typically measured in terms of water availability in a defined geographical area. It is common to express drought with a numerical index that ranks severity. Most federal agencies use the Palmer Method which incorporates precipitation, runoff, evaporation, and soil moisture. However, the Palmer Method does not incorporate snowpack as a variable. Therefore, it is not believed to provide a very accurate indication of drought conditions in Oregon and the Pacific Northwest.

The Standardized Precipitation-Evapotranspiration Index (SPEI) is an index of water conditions throughout the state. The index is designed to account for precipitation and evapotranspiration to determine drought. The lowest SPEI values, below -2.0, indicate extreme drought conditions. Severe drought occurs at SPEI values between -2.0 and -1.5, and moderate drought occurs between -1.5 and -1.0.

Figure 9 shows the water year (October 1 – September 30) history of SPEI from 1895 to 2023 for Polk County. The SPEI record indicates that the county has experienced two (2) periods of extreme drought (water years 1977 and 2001) and 14 periods of severe drought (including water years 1987, 1992, 1994, 2003, 2015, and 2021). In addition, there are five (5) years of moderate drought.[14]

[14] Oregon Water Resources Department Public Declaration Status Report, http://apps.wrd.state.or.us/apps/wr/wr_drought/declaration_status_report.aspx, accessed April 7, 2023.

Figure 9 Standardized Precipitation-Evapotranspiration Index, 12-Months Ending in September, Polk County, OR (1895-2023)



Source: Western Regional Climate Center. West Wide Drought Tracker. https://wrcc.dri.edu/wwdt/time/. Created February 13, 2024. Data retrieval method: Counties.

History

- 1904-1905: A statewide drought period of about 18 months.
- 1917-1931: A very dry period throughout Oregon, punctuated by brief wet spells in 1920-21 and 1927.
- 1928-1941: Statewide prolonged drought caused major agricultural problems.
- 1939-1941: A three-year intense drought in Oregon.
- 1976-1981: Intense drought in western Oregon; 1976-1977 single driest year of century (eclipsed only by 2015 water-year). During this period Polk County used dry ice seeding to enhance winter precipitation for agriculture use.
- 1985- 1994: Ten consecutive years of drought cause problems statewide; fires were common and insects attacked trees; a drought emergency was declared in 1992. As a result, Polk County adopted a water curtailment plan. Crop damage was documented and water systems were affected. However, no Polk County residents submitted claims for losses. The governor declared drought.
- 2000-2001: Severe drought conditions; October 2000 to February 2001 was the second driest period of record in Washington and Oregon.
- 2005: February 2005 was the driest since 1977.
- August 2015: Federal Drought Declaration due to low snowpack levels, and low water conditions. Governor and federal declarations of drought.

El Niño/La Nina

El Niño Southern Oscillation (ENSO) weather patterns can increase the frequency and severity of drought. During El Niño periods, alterations in atmospheric pressure in equatorial regions yield an increase in the surface temperature off the west coast of North America. This gradual warming sets off a chain reaction affecting major air and water currents throughout the Pacific Ocean; La Niña periods are the reverse with sustained cooling of these same areas. In the North Pacific, the Jet Stream is pushed north, carrying moisture laden air up and away from its normal landfall along the Pacific Northwest coast. In Oregon, this shift results in reduced precipitation and warmer temperatures, normally experienced several months after the initial onset of the El Niño. These periods tend to last nine to twelve months, after which surface temperatures begin to trend back towards the long-term average. El Niño periods tend to develop between March and June and peak from December to April. ENSO generally follows a two to seven-year cycle, with El Niño or La Niña periods occurring every three to five years. However, the cycle is highly irregular, and no set pattern exists. The last major El Niño was during 1997-1998 and in 2015-2016 Oregon experience a "super" El Niño (the strongest in 15 years, the two previous events occurred in 1982-1983 and 1997-1998) that included record rainfall and snowpack in areas of the state.[15] In 2023, a new El Niño period began, which has a 54% chance of ending up "historically strong", potentially ranking in the top 5 on record.[16]

Future Projections[17]

According to OCCRI report "*Future Climate Projections: Polk County" (March 2023)*, drought, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is projected to become more frequent in Polk County by the 2050s. The incidence of related negative physical and mental health outcomes, especially among low income, tribal, rural, and agricultural communities, is likely to increase.

Increasingly frequent droughts will have economic and social impacts upon those who depend upon predictable growing periods (ranches, farms, vineyards, gardeners) as well as upon the price and availability of fresh vegetables. It may also stress local jurisdiction's ability to provide water for irrigation or commercial and household use. Low income, tribal, rural, and farming and farmworker communities will be especially susceptible to negative health effects because of drought and associated water scarcity and poor water quality.

[15] Cho, Renne. "El Nino and global warming – what's the connection." Phys.org, February 3, 2016. https://phys.org/news/2016-02-el-nino-global-warmingwhat.html

[16] December 2023 El Niño update: adventure! **Emily Becker, December 13, 2023,** NOAA Climate.gov

[17] Oregon Climate Change Research Institute (OCCRI), Oregon Climate Assessment Report (2010) and Northwest Climate Assessment Report (2013). http://occri.net/reports

Climate models for Oregon suggest future regional climate changes include increases in temperature around 0.2-1°F per decade in the 21st Century, along with warmer and drier summers, and some evidence that extreme precipitation will increase in the future. Increased droughts may occur in the Willamette Valley under various climate change scenarios as a result of various factors, including reduced snowpack, rising temperatures, and likely reductions in summer precipitation. Climate models suggest that as the region warms, winter snow precipitation will likely shift to higher elevations and snowpack will be diminished as more precipitation falls as rain altering surface flows. As mountain snowpack declines, seasonal drought will become less predictable and snow droughts will increase the likelihood of hydrological and agricultural drought during the following spring and summer.

Expansive Soils

The addition of moisture to any type of soil will cause a change in volume, which is referred to as a shrink-swell characteristic.[18] Expansive soils are typically comprised of clay minerals that under some conditions are capable of significantly increasing in volume when moisture is added. Clay soils consist of mineral particles that are less than 0.002 millimeters in diameter.

Linear extensibility is used to determine the shrink-swell potential of soils. Linear extensibility refers to the change in soil volume as the moisture content is decreased from a moist to a dry state. The amount and type of clay minerals in the soil influence volume change. The volume change is described as a percentage value change for the soil being tested. A low shrink-swell potential is considered less than a 3% change in soil volume; whereas a high shrink- swell potential is greater than 6% change in soil volume.[19]

Soil expansion may be caused by changes in soil moisture, variations in thickness and composition of the expansive foundation soil, non-uniform structural loads, and the geometry of the structure. Potential sources of moisture changes are variation in precipitation, poor gutter or water drainage, vegetation changes over time (such as root growth of nearby trees), and plumbing leaks. By affecting the relative moisture of soils underlying foundations, uneven movement such as localized heave can occur, causing shifting and non- uniform foundation movements, thus impacting the structures above.

Many sources of soil moisture change can be avoided, minimized, or mitigated through planning and structure maintenance. Some signs of possible soil expansion include: separation of joints and trim; cracks in walls, floors, or concrete; and bowed or non-vertical walls. Some possible mitigation measures are maintaining separation between structures and runoff, using compact fill to shed water, not absorb it, and planting trees a distance equal to their mature height away from buildings to reduce root interference.

Several different types of soil expansion related to structures and infrastructure exist, which can include but are not limited to:

[18] US Department of Agriculture, Natural Resources Conservation Service (USDA NRCS). 2008. National Cooperative Soil Survey, Physical Soil Properties–Polk County, Oregon.
[19] Ibid.

- Doming heave - upward, long-term, dome-shaped foundation movement that develops over many years
- Cyclic heave - shrink and swell associated with seasonal or water leak events
- Edge heave - damaging edge or dish-shaped heaving
- Lateral movement – lateral thrust of expansive soils

More than 162,000 acres in Polk County contain soils with "moderate" to "severe" shrink-swell potential. These areas are primarily located in the northern and eastern parts of the county. The City of Dallas has large areas of moderate to severe shrink-swell potential.

The geographic extent of expansive soil events is directly dependent on the extent of clay-based expansive soil types and the size and type of moisture event that triggers the soil expansion.

Another dependent factor contributing to risk is the amount and type of infrastructure that exists at the expansive soil location and near proximity, as well as the percentage volume change of the swelling or shrinking soil. The vulnerability of critical infrastructure could be assessed by the location of expansive soil types. The extent of expansive soil effects could be very local and limited to a single structure (i.e., resulting from a plumbing leak), or more landscape in nature due to a large area of soil moisture change (i.e., resulting from a large flood or storm event).

Probability Assessment

Droughts are not uncommon in the State of Oregon, nor are they just an "east of the mountains" phenomenon. They occur in all parts of the state, in both summer and winter. 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 and 12 years. According to SPEI analysis there have been five years of severe drought between 1923 and 2023.

Based on the available data and research for Polk County the NHMP Steering Committee assessed the **probability of experiencing a locally severe drought as "moderate,"** meaning one incident is likely within the next 35 to 75 years; *this rating has not changed since the previous NHMP.*

Expansive soil events are difficult to predict since the location and time when water is available to the soil varies throughout the lifespan of a structure. Most soil expansion and associated structural damage has been shown to occur within five to eight years following construction. However, the effects of heave may also not be observed for many years until some change occurs in the foundation conditions to disrupt the moisture regime. The probability of damages increases for structures on expansive soils when the climate (increased rain), structure construction (type of foundation used), or occupancy habits (e.g., gardening, water diversion, etc.), increases the amount of moisture in the soil.

Vulnerability Assessment

The environmental and economic consequences can be significant, especially for the agricultural sector. Other direct environmental effects of drought include livestock death or decreased production, wildland fire, impaired productivity of forest land, damage to fish habitat, loss of wetlands, and decreased air quality. Drought is also associated with insect infestation, disease, and wind erosion. Indirect effects to society are measured by the economic and physical hardships brought on by drought and by the increased stress on residents of a drought-stricken area. The economic impact of drought is estimated between $6 and $8 billion annually in the United States. These costs primarily affect agricultural, forestry, fisheries, recreation and tourism, transportation, and energy sectors.

Drought can affect all segments of Polk County'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) as per the county's water management plan and could be faced with significant increases in electricity rates.

All parts of Polk County are susceptible to drought; however, the following areas and issues are of particular concern:

- Agriculture
- Drinking water system
- Power and water enterprises
- Residential and community wells in rural areas
- Fire response capabilities
- Fish and wildlife

Potential impacts to community water supplies and farming are the greatest threats. Additionally, long-term drought periods of more than a year can impact forest conditions and set the stage for potentially destructive wildfires.

The NHMP Steering Committee rated the County as having a "moderate" vulnerability to drought hazards, meaning 1 - 10% of the region's population or assets would be affected by a major drought emergency or disaster; *this rating has not changed since the previous NHMP.*

Potential damages to structures from expansive soils in Polk County include: cracks in grade beams, walls, and drilled shafts; distortion and cracking of pavements and on-grade floor slabs; failure of steel or concrete blocks supporting grade beams; jammed or misaligned doors and windows; and buckling of basement and retaining walls due to lateral forces. Extensive damage can potentially result in the condemnation of structures.

A comprehensive risk and vulnerability assessment is not available for the drought hazard. Statewide droughts have historically occurred in Oregon, and as it is a region-wide phenomenon, all residents are equally at risk. Structural damage from drought is not

expected; rather the risks are present to humans and resources. Agriculture, fishing, and timber have historically been impacted, as well as local and regional economies.

In Polk County, there are several roads that show signs of pavement heaving due to underlying expansive soils: James Howe Road, Crowley Road, Perrydale Road, and Grand Ronde Road appear to be underlain with expansive soils. At the north end of Perrydale road, there are obvious horizontal cracks indicative of pavement heaving.

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2020).

Future Projections

According to the Oregon Climate Change Research Institute (OCCRI report) "Future Climate Projections, Polk County,"[20] the incidence, extent, and severity of drought has increased over the last 20 years relative to the twentieth century, and this trend is expected to continue. Seasonal drought conditions are projected to occur more frequently in Polk County by the 2050s. The incidence of related negative physical and mental health outcomes, especially among low income, tribal, rural, and agricultural communities, is likely to increase.

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

Earthquake

Significant Changes since Previous NHMP:

No significant changes have been made to this section since the previous update. No development changes affected the jurisdiction's overall vulnerability to this hazard.

Characteristics

The Pacific Northwest in general is susceptible to earthquakes from four sources: 1) the offshore Cascadia Subduction Zone; 2) deep intraplate events within the subducting Juan de Fuca Plate; 3) shallow crustal events within the North American Plate and 4) earthquakes associated with volcanic activity.

Per the Oregon Natural Hazard Mitigation Plan: Region 3 Profile, four types of earthquakes affect Region 3: (a) shallow crustal events, (b) deep intra-plate events within the subducting Juan de Fuca plate, (c) the offshore Cascadia Subduction Zone (CSZ) Fault, and (d) earthquakes associated with renewed volcanic activity.

[20] Oregon Climate Change Research Institute, *Future Climate Projections, Polk County, Oregon*. May 2023.

The Cascadia Subduction Zone is a 680-mile-long zone of active tectonic convergence where oceanic crust of the Juan de Fuca Plate is subducting beneath the North American continent at a rate of 4 cm per year. Scientists have found evidence that 11 large, tsunami-producing earthquakes have occurred off the Pacific Northwest coast in the past 6,000 years. These earthquakes took place roughly between 300 and 5,400 years ago with an average occurrence interval of about 510 years. The most recent of these large earthquakes took place in 1700 A.D.[21]

The CSZ is the chief earthquake hazard for the Mid/Southern Willamette Valley. This area is particularly vulnerable due to the large area susceptible to earthquake-induced landslide, liquefaction, and ground shaking.

In a 500-year model for a CSZ event or combined crustal events, five of the 15 counties with highest expected damages and losses are in this region: Lane, Marion, Benton, Linn, and Yamhill. Seismic lifelines will be affected by prolonged ground shaking with several roadways susceptible to landslide, rockfall, or liquefaction. In Region 3, a CSZ event could cause a potential loss of almost $843M in state building and critical facility assets, 93% of it in Marion County alone. The potential loss in local critical facilities is somewhat greater at almost $1.2B. Again, Marion County's potential loss is greatest at 48%. Potential losses in Lane Line, Polk, and Yamhill Counties are similar, ranging from 9-14%. Benton County's potential loss is significantly less.

Location and Extent

Polk County is located within the geographical area bordering the Cascadia Subduction Zone. This zone is comprised of an 800-mile sloping fault and several smaller inland and offshore faults extending from British Columbia to the north and Northern California to the south. The fault system separates the Juan de Fuca and North American plates.

The other earthquake scenario examined in the Oregon Department of Geology and Mineral Industries (DOGAMI) 2024 Multi-Hazard Risk Report for Polk County is the Turner and Mill Creek Fault, located approximately 8 miles (~13 km) east of Independence and oriented east to west. Unlike CSZ, which is a very large and deep fault between two tectonics plates, the Turner and Mill Creek Fault is crustal, meaning it is a crack within the North American plate. Despite their comparatively small size, crustal earthquakes can cause significant damage due to their proximity to the surface and the built environment. The estimated maximum fault displacement for the Turner and Mill Creek Fault could produce relatively large (Mw-6.6) earthquakes, enough to pose a significant hazard.[22] Although the damage produced from this fault would be far more localized than a CSZ event, it poses a serious seismic threat to the communities in the vicinity of the eastern portion of Polk County. The current understanding of this fault and various aspects of its frequency and magnitude are limited. However, the

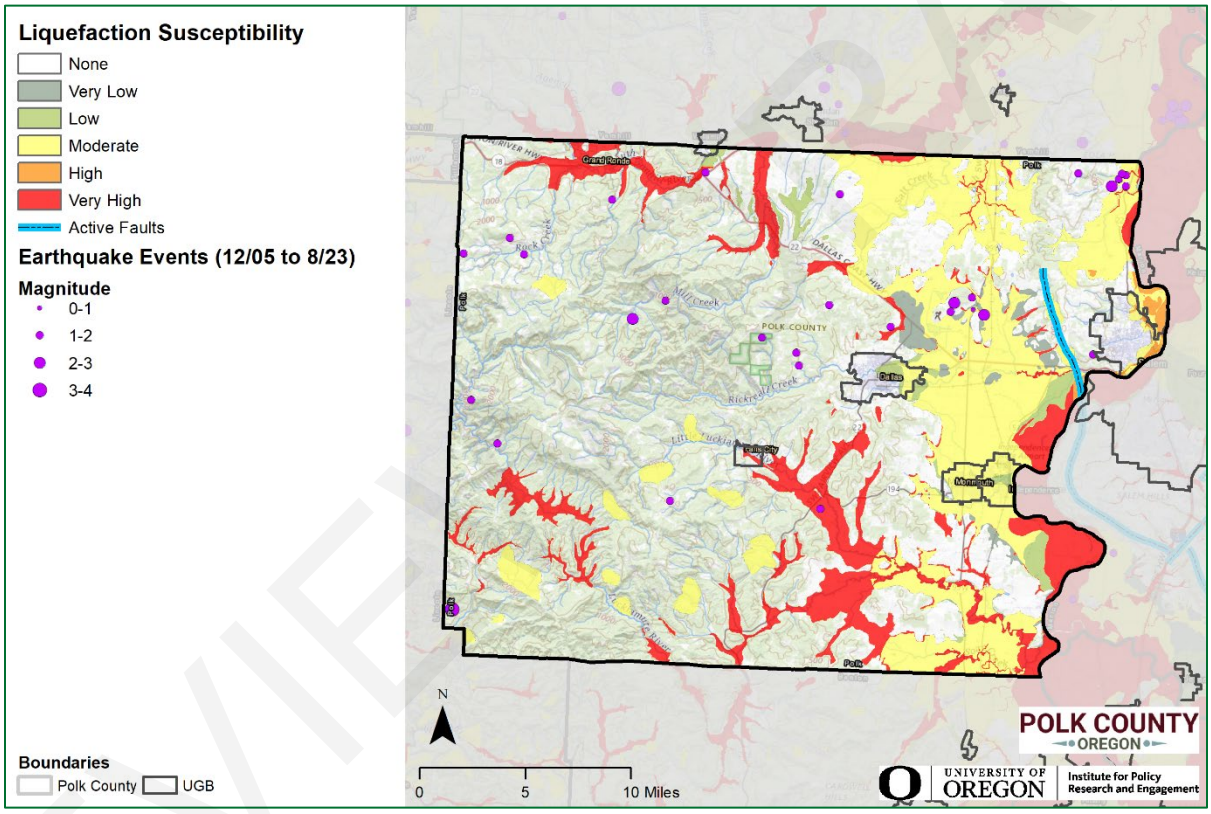
[21] The Cascadia Region Earthquake Workgroup, 2005. Cascadia Subduction Zone Earthquakes: A magnitude 9.0 earthquake scenario. http://www.crew.org/PDFs/CREWSubductionZoneSmall.pdf

[22] DOGAMI Polk County Multi-Hazard Risk Report OR-24-XXX, May 2024.

likelihood of a damaging Cascadia Subduction Zone earthquake occurring is far higher than a Turner and Mill Creek Fault.

Figure 10 shows earthquake epicenters, active faults, and soft soils of Polk County. The earthquakes shown in the figure are relatively insignificant events below M 2.0. The larger events may have been felt slightly, but little to no structural/property damage resulted. Thus, the seismic hazard for Polk County arises predominantly from major earthquakes within the Cascadia Subduction Zone. Smaller, crustal earthquakes in or near Polk County could be locally damaging but would not be expected to produce widespread or major damage.

Figure 10 Liquification Susceptability, Earthquake Epicenters (2005-2023), and Active Faults



Source: Oregon Partnership for Disaster Resilience. Oregon Department of Geology and Mineral Industries.
Note: To view detail click this link to access Oregon HazVu. Refer to Appendix D: Community Risk Profiles for more information.

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 several seismic hazard maps that are available for communities to use. The maps show liquefaction, ground motion amplification, landslide susceptibility, and relative earthquake hazards. OPDR used the DOGAMI Statewide Geohazards Viewer to

present a visual map of recent earthquake activity, active faults, and liquefaction; ground shaking is generally expected to be higher in the areas marked by soft soils. The severity of an earthquake is dependent upon several factors including: 1) the distance from the earthquake's source (or epicenter); 2) the ability of the soil and rock to conduct the earthquake's seismic energy; 3) the degree (i.e., angle) of slope materials; 4) the composition of slope materials; 5) the magnitude of the earthquake; and 6) the type of earthquake.

For more information, see the following reports:

- Open File Report - O-13-06 Statewide Cascadia Earthquake Hazard Data, 2013
- Open-File-Report: O-03-02 – Map of Selected earthquakes for Oregon (1841-2002), 2003
- Open-File-Report: O-07-02 - Statewide seismic needs assessment: Implementation of Oregon 2005 Senate Bill 2 relating to public safety, earthquakes, and seismic rehabilitation of public buildings, 2007
- Interpretive Map Series: IMS-9 - Relative earthquake hazard maps for selected urban areas in western Oregon 2000
- Open-File-Report: O-13-22 - Cascadia Subduction Zone earthquakes: A magnitude 9.0 earthquake scenario, 2013
- Additional reports are available via DOGAMI's Publications Search website: https://www.oregongeology.org/pubs/pubsearch.htm

Other agency/ consultant reports:

- Oregon Resilience Plan (2013)

History

Polk County has not experienced any major earthquake events in recent history. Seismic events do, however, pose a significant threat. A Cascadia Subduction Zone (CSZ) event could produce catastrophic damage and loss of life in Polk County.

While Polk County has not experienced any significant earthquakes in recent history, earthquakes in Oregon that have affected the county are listed below[23] (there have not been any significant earthquake events since the previous NHMP):

- January 1700: Offshore, Cascadia Subduction Zone (CSZ)- Approximate 9.0 magnitude earthquake generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast (additional CSZ events occurred approximately in 1400 BCE, 1050 BCE, 600 BCE, 400, 750, and 900).
- April 1949: Olympia, 7.1 magnitude, felt in Polk County.
- April 1961: Albany, 4.5 magnitude, minor damage in Albany.

[23] Ivan Wong and Jacqueline D.J. Bolt, 1995, "A Look Back at Oregon's Earthquake History, 1841-1994", Oregon Geology, pp. 125-139.

- November 1962: Portland- A 5.2-5.5 magnitude earthquake caused damage to many homes (chimneys, windows, etc.); the earthquake was a crustal event.
- March 1963: Salem, 4.6 magnitude, minor damage in Salem.
- March 1993: Scotts Mills- A 5.6 magnitude earthquake caused $27-$30 million in damages to homes, schools, businesses, state buildings (Salem). Crustal Event (FEMA-985-DR-OR).

Future Projections

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

Probability Assessment

Polk County is susceptible to deep intraplate events within the Cascadia Subduction Zone (CSZ), where the Juan de Fuca Plate is diving beneath the North American Plate and shallow crustal events within the North American Plate.

Based on the available data and research for Polk County the NHMP Steering Committee determined the probability of experiencing a Cascadia Subduction Zone (CSZ) is "medium", meaning one incident is likely within the next 35 to 75 years. *This is decreased from the previous NHMP which rated the probability as high.* Additionally, the probability of a crustal earthquake is "low", meaning one incident is likely within the 100 years. *This is decreased from the previous NHMP which rated the probability as moderate.*

Cascadia Subduction Zone

According to the Oregon NHMP, the return period for the largest of the CSZ earthquakes (Magnitude 9.0+) is 530 years with the last CSZ event occurring 314 years ago in January of 1700. The probability of a 9.0+ CSZ event occurring in the next 50 years ranges from 7 - 12%. Notably, 10 - 20 "smaller" Magnitude 8.3 - 8.5 earthquakes occurred over the past 10,000 years that primarily affected the southern half of Oregon and northern California. The average return period for these events is roughly 240 years. The combined probability of any CSZ earthquake occurring in the next 50 years is 37 - 43%.

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 quake may differ from north to south. Quakes 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.

Benioff (Deep) Zone
Deep intraplate earthquakes may have magnitudes up to 7.5, with probable recurrence intervals of about 500 to 100 years (recurrence intervals are poorly determined by current geologic data).

Crustal Zone
Establishing a probability for crustal earthquakes is difficult given the small number of historic events in the region. Based on the historical seismicity in Western Oregon and on analogies to other geologically similar areas, small to moderate earthquakes up to M5 or M5.5 are possible almost anywhere in Western Oregon, including Polk County. Although the possibility of larger crustal earthquakes in the M6+ range cannot be ruled out, the probability of such events is likely to be very low. Earthquakes generated by volcanic activity in Oregon's Cascade Range are possible, but likewise unpredictable. For more information, see DOGAMI reports linked above.

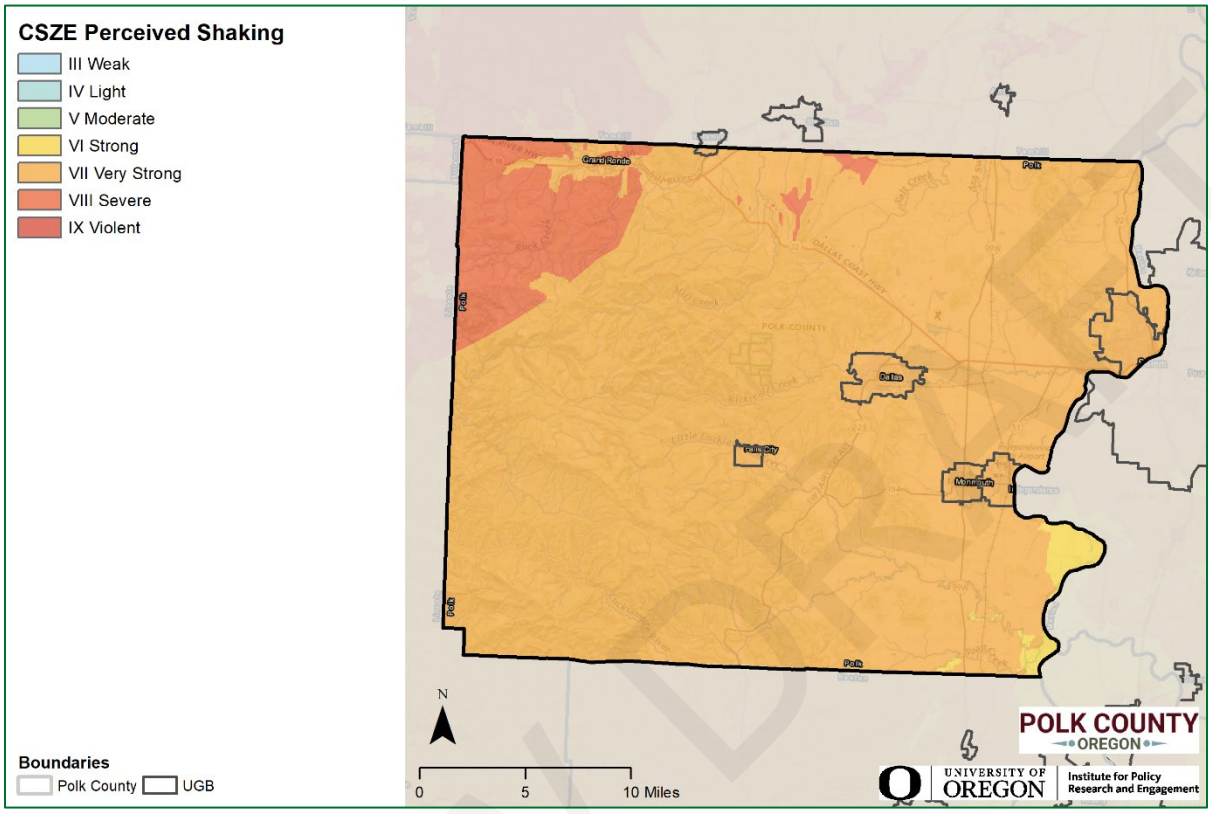
Vulnerability Assessment

The local faults, the county's proximity to the Cascadia Subduction Zone, potential slope instability and the prevalence of certain soils subject to liquefaction and amplification combine to give the county a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places Polk County predominately within the "Willamette Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades). However, portions of the county are within the "Coastal Zone" (the area outside of the tsunami zone, from the Oregon coastline to the summit of the Coast Range)[24]. Within the Valley Zone damage and shaking is expected to be widespread but moderate, an event may be disruptive to daily life and commerce, and the main priority is expected to be restoring services to business and residents.[25] Within the Coastal Zone, damage and shaking is expected to be severe and communities may be isolated, the main priority after an event would be to keep the population sheltered, fed, and healthy.[26]

Figure 11 shows the expected shaking/ damage potential for Polk County because of a Cascadia Subduction Zone (CSZ) earthquake event. The figure shows that the county will experience "very strong" to "severe" shaking that will last two to four minutes. The strong shaking will be extremely damaging to lifeline transportation routes including I-5, Highway 22, and Highway 99W. For more information on expected losses due to a CSZ event see the Oregon Resilience Plan (note, several of the County and City mitigation actions utilize the analysis within the ORP as justification and to inform their rationale).

[24] Oregon Seismic Safety Policy Advisory Commission, *Oregon Resilience Plan* (2013)
[25] Ibid.
[26] Ibid.

Figure 11 Cascadia Subduction Zone Perceived Shaking



Source: Oregon Partnership for Disaster Resilience. Oregon Department of Geology and Mineral Industries.
Note: To view detail click this link to access Oregon HazVu. Refer to Appendix D: Community Risk Profiles for more information.

The NHMP Steering Committee rated the County as having a **"high" vulnerability to the Cascadia Subduction Zone (CSZ) earthquake hazard** meaning that more than 10% of the region's population or assets would be affected by a major CSZ event. All of Polk County is subject to earthquakes; however, the western portion of the county is more susceptible to damages because of its proximity to the Cascadia Subduction Zone.

Additionally, the Steering Committee rated the County as having a **"low" vulnerability to a crustal earthquake event**, meaning that less than 1% of the region's population or assets would be affected by a major crustal earthquake event. *The previous NHMP rated CSZ earthquake vulnerability as "moderate" and crustal earthquake vulnerability as "moderate".*

2007 Rapid Visual Survey

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 ranked each building surveyed with a 'low,' 'moderate,' 'high,' or 'very high' potential for 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. To fully assess a building's potential for collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to survey.

DOGAMI surveyed 23 buildings in Polk County (not including facilities located in Salem). Buildings with a 'high' or 'very high' potential for collapse are listed below. Additional information can be found within the RVS study on DOGAMI's website (www.oregongeology.org).

'Very High' Collapse Potential

- Dallas Police Department (Dallas)
- Henry Hill Elementary School (Independence)
- Independence Elementary School (Independence)

'High' Collapse Potential

- Dallas High School (Dallas)
- LaCreole Middle School (Dallas)
- Lyle Elementary School (Dallas)
- Whitworth Elementary School (Dallas)
- Dallas Academy (Dallas)
- Dallas Fire Station (Dallas)
- Willamina Middle School at Grand Ronde (Grand Ronde)
- Central High School (Independence)
- Henry Hill Elementary School (Independence)
- Talmadge Middle School (Independence)
- Independence Police Department (Independence)
- Polk County Fire District 1 (Independence)

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

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water and wastewater treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.[27]

[27] Regional All Hazard Mitigation Master Plan for Polk, Lane and Linn Counties: Phase II (2001)

Mitigation Successes

Seismic retrofit grant awards per the Seismic Rehabilitation Grant Program[28] have been funded to retrofit the following critical facilities within the last five years (2017-2022):

- Dallas School District – Whitworth Elementary Gym - $700,160
- Dallas School District – LaCreole Middle School Gym - $2,046,735
- Dallas School District – Dallas HS Gym - $2,495,005
- Falls City School District – Falls City HS Gym - $2,495,060

In addition, the following structures have also had some structural and/or non-structural seismic retrofitting:

- *Whitworth Elementary School (Dallas School District 2), brick flue was removed and a stainless steel flue was installed, funded per 2009 local school bond (completed in August 2010).*
- *Lyle Elementary School (Dallas School District 2), brick flue was removed and a stainless steel flue was installed, funded per 2009 local school bond (completed in August 2010).*
- *Dallas High School (Dallas School District 2), brick flue was removed and a stainless steel flue was installed, funded per 2009 local school bond (completed in August 2010).*
- *Morrison Campus Alternative School (1251 Main St., Dallas School District 2), brick flue was removed and a stainless steel flue was installed, stadium concrete foundation was installed, dry rot removed and structural upgrades to columns, press box support was engineered and upgraded; funded per 2009 local school bond (completed in August 2010, stadium upgrades in September 2011).*
    - *Independence Elementary School remodeled.*

For more information, see: Open-File-Report: O-07-02 - Statewide seismic needs assessment: Implementation of Oregon 2005 Senate Bill 2 relating to public safety, earthquakes and seismic rehabilitation of public buildings.

DOGAMI Statewide Seismic Needs Assessment Using Rapid Visual Screening (RVS)

[28] 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.

2008 Assessment

In 2008, the Oregon Department of Geology and Mineral Industries (DOGAMI) developed regional earthquake hazard information to assess potential damages and losses for various earthquake scenarios in the Mid-Willamette Valley[29]. More specifically, DOGAMI:

- Identified the primary geologic hazards of Yamhill, Marion, Polk, Benton, Linn, and Lane Counties and the City of Albany;
- Developed countywide earthquake and landslide hazard maps for each county; and
- Developed future earthquake damage estimates for each community.

Damage and loss estimates for each community were analyzed for two earthquake scenarios:

- A magnitude ~6.7 crustal fault earthquake (Mill Creek)
- A magnitude 8.5 Cascadia Subduction Zone earthquake

Information was consolidated into the Hazards U.S. Multi-Hazard methodology and computer application (HAZUS – MH), which is a federally developed program used to model various earthquake scenarios and estimate associated damage and loss. The following is a brief summary of damage and loss estimates for Polk County in a magnitude 8.5 Cascadia Subduction Zone earthquake scenario:

- Estimated fatalities during late afternoon business hours: 49
- Injuries from minor to life threatening: 720
- Households displaced: 1,822
- People needing shelter: 464
- Injuries requiring hospitalization: 186
- Approximately 29% of buildings would be at least moderately damaged.

Note: Polk County has one hospital with 6 beds (up to 15). The hospital is expected to incur moderate damage due to earthquake impacts in the HAZUS M8.5 CSZ scenario.

For more information, see: Interpretive Map Series: IMS-024 - Geologic hazards, earthquake and landslide hazard maps, and future earthquake damage estimates for six counties in the Mid/Southern Willamette Valley including Yamhill, Marion, Polk, Benton, Linn, and Lane Counties, and the City of Albany, Oregon, 2008.

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2020).

[29] Burns, William J., R. Jon Hofmeister, and Yumei Wang. Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates for Six Counties in the Mid/Southern Willamette Valley including Yamhill, Marion, Polk, Benton, Linn, and Lane Counties, and the City of Albany, Oregon. Oregon Department of Geology and Mineral Industries Interpretive Map Series IMS-24. 2008.

2024 DOGAMI Assessment

In 2024, the Oregon Department of Geology and Mineral Industries (DOGAMI) developed a multi-hazard risk report (O-24-XX) for Polk County[30]. The purpose of this project was to provide communities with detailed risk assessment information to enable them to compare hazards and act to reduce their risk. More specifically, damage and loss estimates for each community were analyzed for two earthquake scenarios:

- A magnitude ~6.6 crustal fault earthquake (Turner and Mill Creek)
- A magnitude 9.0 Cascadia Subduction Zone earthquake

The results indicate that a Cascadia Subduction Zone (CSZ) earthquake will cause significant damage and losses (10%) throughout Polk County. Findings indicate that most of the study area's critical facilities are at high risk during a CSZ earthquake. Many of the contributing factors to damage are soils that are susceptible to seismic shaking. The Willamette River and Ash Creek floodplains are composed of seismically reactive soils where the majority of the buildings in Polk County are located. Since these soils amplify ground shaking, the probability of earthquake damage is greater for structures built in these areas.

Under a CSZ Mw-9.0 earthquake scenario, 2,782 buildings, including ten (10) of 14 critical facilities, in unincorporated Polk County may be non-functioning following a Cascadia earthquake. Over 553 individuals may be displaced (2.8% of the population), with a loss estimate of $528.2M (a loss ratio of 11%). Throughout the County, a CSZ event will cause an estimated total loss of $1.3 billion.

While a CSZ event will cause substantial widespread damage throughout the entire study area, our results indicate a Turner and Mill Creek Fault Mw-6.6 earthquake will cause moderate damage to areas in the eastern portion of the county. Two (2) of 14 critical facilities in unincorporated Polk County and over 1,000 buildings would be non-functioning after this type of earthquake, and 1,728 individuals may be displaced, with a loss estimate of $216.2M (a loss ratio of 4.6%). Throughout the county, a Turner and Mill Creek Fault episode could cause $726.5M in losses.

Building vulnerabilities such as the age of the building stock and occupancy type are contributing factors in loss estimates. The first seismic buildings codes were implemented in Oregon in the 1970's (Judson, 2012) and by the 1990's modern seismic building codes were being enforced. Approximately 60% of Polk County's buildings were built before the 1990's. If buildings could be seismically retrofitted to moderate-or high-code standards, the impact of an earthquake event would be greatly reduced.

Future Projections

Future development (residential, commercial, or industrial) within the city will be at risk to earthquake impacts, although this risk can be mitigated by the adoption and enforcement of

[30] DOGAMI, Multi-Hazard Risk Report for Polk County, Oregon, OR-24-XXX, Table A-1. March 2024.

high development and building standards. Reducing risks to vulnerable populations should be considered during the redevelopment of existing properties.

Flood

Significant Changes since Previous NHMP:

This section has updated data for the National Flood Insurance Program and hazard history. No development changes affected the jurisdiction's overall vulnerability to this hazard.

Characteristics

Flooding results when rain and snowmelt create 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 destructive natural disasters have been floods.[31] The principal types of floods that occur in Polk County include: riverine floods and urban floods.

Riverine or overbank flooding of rivers and streams is the most common type of flood hazard. Riverine flooding most frequently occurs in winter and late spring. Air rises and cools over the Coast Range and its foothills and heavy rainfall develops over high-elevation streams, as storms move from the Pacific across the Oregon Coast. In this region, as much as four to six inches of rain can fall over a 24-hour period. Severe and prolonged storms can raise rivers and streams to their flood stages for three to four days or longer.

Urban flooding occurs in developed areas where the amount of water generated from rainfall and runoff exceeds the stormwater systems' capacity. As land is converted from agricultural and forest uses to urban uses, it often loses its ability to absorb rainfall. Rain flows over impervious surfaces such as concrete and asphalt and into nearby storm sewers and streams. This runoff can result in the rapid rise of floodwaters. During urban floods, streets can become inundated, and basements can fill with water. Storm drains often back up because of the volume of water and become blocked by vegetative debris like yard waste, which can cause additional flooding. Development in the floodplain can raise the base flood elevation and cause floodwaters to expand past their historic floodplains.

Location and Extent

Polk County lies within the Mid-Willamette Valley between the Coastal Range and the Cascade Range, striated with rivers and tributaries. Melting snow and heavy winter rains combine to produce devastating flood events because of the County's alluvial floodplain topography on the main valley floor. These waterways easily exceed their banks because of the relatively flat terrain.

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

Floods frequently occur in Polk County during periods of heavy rainfall. The primary sources of riverine flooding include: the Willamette, Luckiamute, Little Luckiamute, and Yamhill rivers, in addition to the North and South Ash, Berry, Gold, Gooseneck, Maxfield, Mill, Pedee, Rickreall, Ritner, Rowell, Salt, Soap, and Teal creeks along with many lesser creeks and tributaries. Communities near these waterways are all susceptible to flood damage during a flood event. A common thread from these water courses is their potential to disrupt infrastructure by causing landslides, inundating roads, and eroding riverbanks and bridge abutments.

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies often use historical records, such as stream-flow gauges, to determine the probability of occurrence for floods of different magnitudes. The probability of occurrence is expressed in percentages as the chance of a flood of a specific extent occurring in any given year.

The magnitude of flood used as the standard for floodplain management in the United States is a flood having a one percent probability of occurrence in any given year. This flood is also known as the 100-year flood or base flood. The most readily available source of information regarding the 100-year flood is the system of Flood Insurance Rate Maps (FIRMs) prepared by FEMA. These maps are used to support the National Flood Insurance Program (NFIP). The FIRMs show 100-year floodplain boundaries for identified flood hazards. These areas are also referred to as Special Flood Hazard Areas (SFHAs) and are the basis for flood insurance and floodplain management requirements.

FEMA released the current Digital Flood Insurance Rate Map (DFIRM) for Polk County on December 18, 2006, which included data from city and unincorporated communities. This map delineates the flood extent within the County. Some panels of this flood map set were updated and reissued in October 2019.

Although FEMA is working through the Risk MAP process in Lane County to update the FIRMs, Polk County is not participating currently. Instead, the County is deferring floodplain map amendments until such time as FEMA completes their programming and proposed amendments related to Endangered Species Act compliance.

Areas with significant development in the mapped floodplains include North Dallas, East of West Salem along the Willamette River, Northwest of Independence along the North fork of Ash Creek, South of Monmouth along the South fork of Ash Creek, and Southeast of Falls City along the Little Luckiamute River. Portions of the following smaller communities are also within FEMA-mapped floodplains: Rickreall, Pedee, Willamina, Grand Ronde, and McCoy. For more information, refer to Figure 12 and the following Flood Insurance Study (FIS) and associated Flood Insurance Rate Maps (FIRM):

- Polk County Flood Insurance Study (December 18, 2006)

Figure 12 Flood Insurance Rate Maps (FIRMs)

Flood Source	Flood Insurance Rate Map (FIRM)	Notes
Willamette River	41053C0575F, 41053C0425F, 41053C0450F, 41053C0410F, 41053C0270F, 41053C0286F, 41053C0287F, 41053C0279F, 41053C0283F, 41053C0281F, 41053C0277F, 41053C0150F	Drainage area of 7,270 square miles 100-year peak discharge of 506,000 cubic feet per second (cfs) 500-year peak discharge of 675,000 cfs
Little Luckiamute River	41053C0355F, 41053C0360F, 41053C0400F	Drainage area of 22.4 square miles 100-year peak discharge of 5,390 cfs 500-year peak discharge of 7,070 cfs Peak discharge had a 5 percent chance of occurrence.
Lukiamute River	41053C0350F, 41053C0500F, 41053C0525F, 41053C0375F, 41053C0400F, 41053C0425F, 41053C0575F	Drainage area of 116 square miles 100-year peak discharge of 15,800 cfs 500-year peak discharge of 20,200 cfs
Yamhill River	41053C0040F, 41053C0030F, 41053C0035F, 41053C0045F, 41053C0065F, 41053C0055F	Drainage area of 129 square miles 100-year peak discharge of 18,600 cfs 500-year peak discharge of 21,800 cfs Peak flow of 19,000 cfs at the USGS stream gage near Wallace Bridge, about two miles upstream from Willamina.
North Ash Creek	41053C0236F, 41053C0238F, 41053C0239F, 41053C0237F, 41053C0241F, 41053C0242F, 41053C0245F, 41053C0265F, 41053C0401F, 41053C0402F	
South Ash Creek	41053C0245F, 41053C0400F, 41053C0403F, 41053C0404F, 41053C0402F	
Berry Creek	41053C0550F, 41053C0575F	
Gold Creek	41053C0200F, 41053C0045F	
Gooseneck Creek	41053C0200F, 41053C0045F, 41053C0065F, 41053C0075F	
Mill Creek	41053C0200F, 41053C0225F, 41053C0075F, 41053C0065F	Drainage area of 27.5 square miles 100-year peak discharge of 6,640 cfs 500-year peak discharge of 7,890 cfs
Pedee Creek	41053C0375F, 41053C0525F	
Rickreall Creek	41053C0200F, 41053C0225F, 41053C0217F, 41053C0236F, 41053C0237F, 41053C0241F, 41053C0242F, 41053C0265F, 41053C0270F, 41053C0286F	Drainage area of 46 square miles 100-year peak discharge of 13,300 cfs 500-year peak discharge of 17,200 cfs
Rowell Creek	41053C0200F, 41053C0040F	
Salt Creek	41053C0225F, 41053C0250F, 41053C0100F	
Soap Creek	41053C0575F	
Teal Creek	41053C0355F, 41053C0360F	

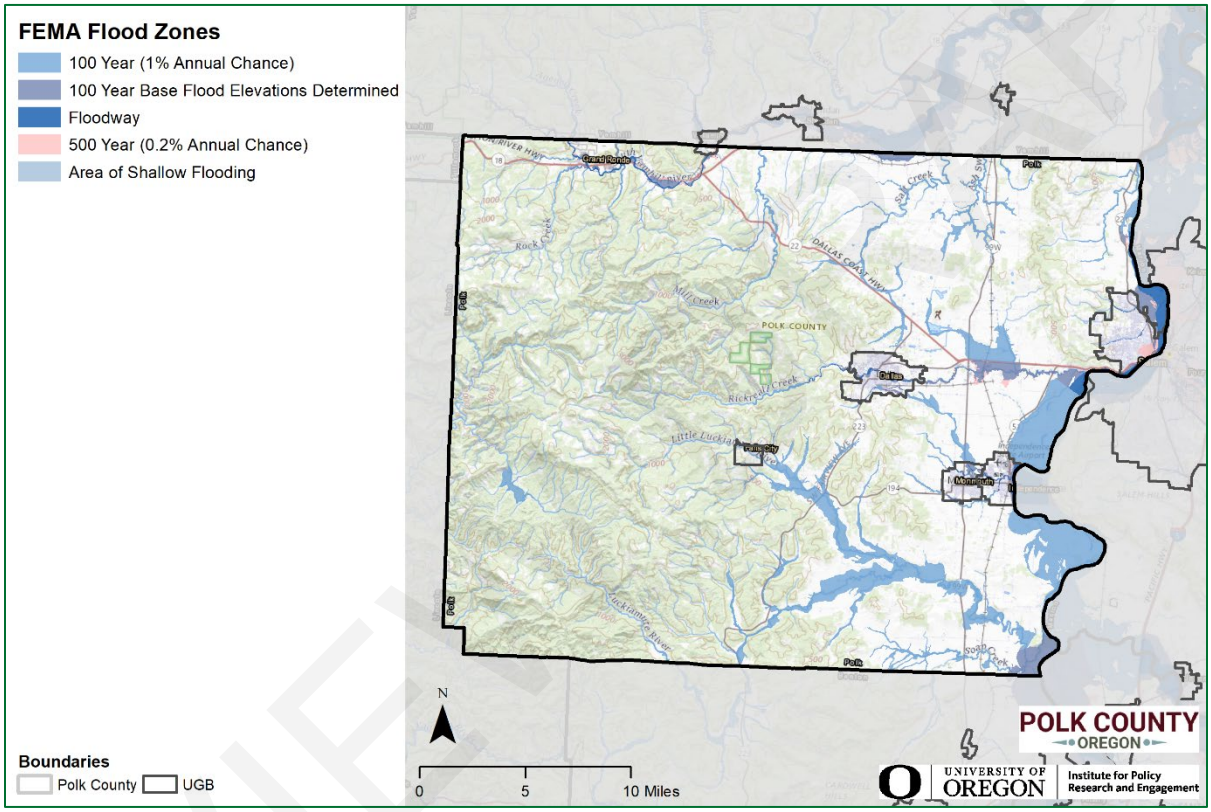
Source: Polk County Flood Insurance Study (December 18, 2006)

The FEMA-mapped floodplains in Polk County include, for the most part, only areas along the larger rivers and creeks which also have significant population and/or development. However, many agricultural fields are mapped floodplains (generally A zone). Many other areas in the county have significant flood risk but are not included in the FIRMs because of small stream size or low population in the area. Flood hazard evaluation for Polk County must

also consider these localized high flood risk or repetitive flooding areas which lie outside mapped floodplains.

The special flood hazard that identifies the location and extent of the flood hazard is included as Figure 13, for more detailed mapping see the 2006 Flood Insurance Study or the community profile for Polk County located on the Oregon Risk MAP website. The Polk County Website also has information on flood hazards.

Figure 13 FEMA Special Flood Hazard Zone



Source: Oregon Partnership for Disaster Resilience. Oregon Department of Geology and Mineral Industries.
Note: To view detail click this link to access Oregon HazVu. Refer to Appendix D: Community Risk Profiles for more information.

Additional reports are available via FEMA's Flood Map Service Center website:

https://msc.fema.gov/portal

Additional reports are available via DOGAMI's Publications Search website:

https://www.oregongeology.org/pubs/pubsearch.htm

History

Polk County, as well as much of western Oregon, has recorded several very destructive floods throughout the years. Listed below are historical flooding events that affected Polk County.

The main flooding problems within Polk County are primarily in the areas of Grand Ronde, Independence, (West) Salem, and, to a lesser degree, Dallas. The unincorporated county also has a high level of estimated damage along the South Yamhill River. There are few areas of concentrated flood damage in the study area along Ash Creek, Rickreall Creek, South Yamhill River, and the Willamette River.

The list below details significant flood events that have occurred in Polk County in the last fifty years. No significant flood events have been added since the 2015 plan.

- December 1964: Nearly every river in the state of Oregon exceeded its flood stages as weather stations set new precipitation records. This "Christmas Flood" event triggered debris flows, bridge failures and flooding that caused thousands to evacuate and closed airports, railways, and hundreds of miles of roads across the state. The event ultimately killed 20 people and caused more than $157 million in damages.
- January 1965: Residents were still recovering from the Christmas Flood when they were hit again by the January 31, 1965 flood. What made these back-to-back floods so disastrous was the heavy rainfall onto near-record early snow depths. The resulting water could not soak into frozen ground.
- February 1987: Rains caused the Willamette and Luckiamute rivers and Rockreall Creek to overtop their banks, inundate homes, and create highway problems from extensive mudslides.
- February 1996: Virtually every county in the state received a disaster declaration due to a combination of warm temperatures, heavy snowpack, and four days of record-breaking rain. Many areas had already received above-average rainfall. Rivers were at or reaching their capacities and flood stages. Increased runoff and atypical sediment and debris from recent logging activities contributed to conditions ripe for flooding and landslides. Hundreds of homes were destroyed, power outages were widespread, thousands were evacuated to public shelters, and five people died. Flood-related damage estimates exceeded $1 billion.
- November 1996-January 1997: A tropical air mass swept across the state, once again bringing record-breaking precipitation. The stormy weather continued into December and early January 1997, as 26 major rivers reached flood stage. Snow melt and intense rain caused extensive flooding that led to widespread landslides, erosion, power outages, damaged homes and businesses, closed roads, and eventually resulted in a Presidential Disaster Declaration.
    - Polk County's Luckiamute and Willamette Rivers experienced extreme high water flooding along with the rest of the State. Laurel Mountain, west of the City of Dallas, far exceeded any Oregon location's record rainfall receiving 204.12 inches of rain (17 feet) which ultimately flowed into the Luckiamute River and Rockreall Creek. The Willamette River's rapid water rise forced many residents along its course to evacuate. Telecommunications, including some emergency communications, were disrupted. FEMA disbursed repair and response assistance totaling more than $3,000,000 to the State's public entities.

- December 2007: Severe storms, winds, mudslides, landslides, and flooding occurred between December 1 and 17, 2007 shutting down roads and highways including Interstate 5. Public infrastructure, homes, and personal property were damaged. In Oregon, 73,000 residents were without power, and wastewater treatment plants were overwhelmed. A major disaster was declared for the State of Oregon on December 8, 2007 with Polk County included in the declaration. Estimated losses within Polk County are $1,043,278.87.
- Jan 15-18, 2011**:** Flooding of Luckiamute River results in the closing of Sarah Helmick State Park and covers Maple Grove Road near Monmouth. No reported injuries or damages.
- Jan 18, 2012: Independence OR – flooding of Ash Creek trapped a driver at car-door water level. No reported injuries or damages.
- Dec 8, 2015**:** Flooding of the Luckiamute River prompting the closing of Sarah Helmick State Recreation Area and Luckiamute Landing State Natural Area. 2,000 utilities customers in Salem and Keizer areas went without power as a result. No reported injuries or damages.

Note: Other notable flooding events occurred in January 1972, November 1973, January 1974, December 1995, December 2003-January 2004, March 2006, and December 2006.

Erosion

Erosion is a process that involves the wearing away, transport, and movement of land. Erosion is typically a gradual process; however, it can also occur quickly as the result of a flash flood, coastal storm, or other event. Most of the geomorphic change that occurs in a river system is in response to a peak flow event. It is a natural process but its effects can be exacerbated by human activity.

Generally, erosion occurs when the flow of the river changes and is directed towards the banks or mid-channel islands. These changes can be caused by surface wind stress and gravity waves that occur during storm events (primarily severe winter storms), transporting sediment by bottom currents.

Several areas along the rivers and creeks in Polk County have been identified as vulnerable to riverine erosion. Riverine erosion in local creeks was a particular concern during the 1964 flood event.

Erosion loss has historically occurred in Polk County. Rivers and creeks that have been identified to be subject to the effects of erosion include the Willamette, Luckiamute, Little Luckiamute, and South Yamhill Rivers, and Rickreall, Ash, Boughey, Glenn, Gibson, Berry, Dutch, Everz, and Teal Creeks. The annual amounts of rain and wind that assail the bank combined with debris flows within the watersheds and loss of plant cover in riparian areas induce erosion, particularly during severe storm events.

Erosion is considered a particular concern in the following locations:

- Falls City: affecting Little Luckiamute River and Berry, Dutch, Everz, and Teal creeks.

- Independence: affecting the Willamette River to the east of Riverview Park.

While erosion has been identified as occurring within the county, only one event was reported to result in damage. Based on past events and the lack of development in proximity to erosion hazard areas, the magnitude and severity of erosion impacts in Polk County are considered negligible, with the potential for critical facilities to be shut down for 24 hours or less, and less than 10% of property or critical infrastructure being severely damaged.

Future Projections

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

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

Probability Assessment

Polk County and the incorporated Cities of Dallas, Falls City, Independence, and Monmouth, participate in the National Flood Insurance Program (NFIP) and are required to regulate floodplain development. Any structure built in the floodplain after 1974 must meet NFIP requirements for elevation and flood proofing. Polk County and the incorporated jurisdictions use FEMA developed floodplain maps as the basis for implementing floodplain regulations. FEMA has mapped the 10, 50, 100, and 500-year floodplains in portions of Polk County (see Figure 12 and referenced FIS for more information). This corresponds to a 10%, 2%, 1% and 0.2% chance of a certain magnitude flood in any given year. The 100-year flood is the benchmark upon which the NFIP is based.

Flooding in western Oregon generally occurs when storms from the Pacific Ocean bring intense or prolonged rainfall to the west coast. Polk County typically experiences the most severe floods from winter rainfall floods in December, January, and February. These floods are occasionally exacerbated by frozen snow packs where rain and snowmelt combine while the ground is frozen, preventing ground seepage capability. The county is also subject to flooding from river overflows, as well as flooding from local stormwater drainage. The county is susceptible to winter rain flooding from October through April; while the months between May and July bring snowmelt and runoff floods.

Based on the available data and research for Polk County, the NHMP Steering Committee determined the **probability of experiencing a flood is "high",** meaning one incident is likely within the next 10 to 35-year period; *this rating has not changed since the previous NHMP*.

Vulnerability Assessment

Flooding can occur every year depending on rainfall, snowmelt or how runoff from development impacts streams and rivers. Surveys by the Department of Geology and Mineral Industries (DOGAMI), the County and FEMA have established the 100-year floodplain.

Changes to development patterns since 2015 have the potential to incur increased risk of flooding. However, Polk County development standards regulate, , but do not prohibit, new development in areas identified as floodplain. This reduces the impact of flooding on future buildings.

A small proportion (1.4%) of Polk County's buildings were found to be within designated flood zones. Of the 592 buildings that are exposed to flooding, DOGAMI estimates that 113 (about 19%) are above the height of the 100-year flood. The Multi-Hazard Risk Report for Polk County also estimates that 1,087 residents might have mobility or access issues due to surrounding water.

Figure 14 Risk Report Flood Loss Scenario Findings

Polk Countywide 100-year flood loss:

- Number of buildings damaged: 479
- Loss estimate: $34,947,000
- Loss ratio: 0.3%
- Damaged critical facilities: 2 of 81
- Potentially displaced population: 1,087

Source: DOGAMI Multi-Hazard Risk Report for Polk County O-24-??

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

According to the Oregon Climate Change Research Institute (OCCRI report) "Future Climate Projections, Polk County," an estimated 5791 properties in Polk County (21%) have a ≥26% probability of being severely affected by flooding by 2050. Among the structures that may be affected by flooding are 4623 residences (19%) at moderate risk, 387 commercial properties (42%) at major risk, 19 critical infrastructure facilities (e.g., hospitals; police, fire, and power stations; and water treatment facilities) (35%) at moderate risk, and 27 (26%) of social facilities (schools, houses of worship, museums, and government or historic buildings) at moderate risk. More than 820 of the 2550 miles of roads in Polk County (32%) were estimated to be at severe risk of flooding and rendered impassable.

As of the publication of this NHMP, FEMA is providing an opportunity for the county and cities to participate in a Risk Mapping, Assessment, and Planning (Risk MAP) process that would generate additional data on risks and vulnerabilities. The Risk Report would provide a

quantitative risk assessment that informs communities of their risks related to certain natural hazards (including flood). The County has deferred participation in the Risk MAP project until such time as FEMA and the Oregon Department of Land Conservation and Development have determined what requirements will be imposed upon local jurisdictions related to Endangered Species Act compliance (Oregon BiOp). Once ordinance changes are made, the county can incorporate any federally generated risk assessment into this plan to provide greater detail to sensitivity and exposure to the flooding hazard.

The NHMP Steering Committee rated the county as having a **"moderate" vulnerability to flood hazards**, meaning that between 1-10% of the region's population or assets would be affected by a major flood event; *this rating has not changed since the previous NHMP*.

High Hazard Potential Dams

The Oregon Water Resources Department (OWRD) is the state authority for dam safety with specific authorizing laws and implementing regulations. Oregon's dam safety laws were re-written by HB 2085 which passed through the legislature and was signed by Governor Brown in 2019. This law became operative on July 1, 2020.

OWRD coordinates on but does not directly regulate the safety of dams owned by the United States or most dams used to generate hydropower. OWRD is the Oregon Emergency Response System contact in the event of a major emergency involving a state-regulated dam, or any dam in the State if the regulating agency is unknown.

Analysis and Characterization

Oregon's statutory size threshold for dams to be regulated by OWRD is at least 10 feet high and storing at least 3 million gallons. Many dams that fall below this threshold have water right permits for storage from OWRD.

Under normal loading conditions dams are generally at very low risk of failure. Specific events are associated with most dam failures. Events that might cause dams to fail include:

- An extreme flood that exceeds spillway capacity and causes an earthen dam to fail;
- Extended high water levels in a dam that has no protection against internal erosion;
- Movement of the dam in an earthquake; and
- A large rapidly moving landslide impacting the dam or reservoir.

Failures of some dams can result in loss of life, damage to property, infrastructure, and the natural environment. The impacts of dam failures range from local impacts to waters below the dam and the owner's property to community destruction with mass fatalities.

Where a dam's failure is expected to result in loss of life downstream of the dam, an Emergency Action Plan (EAP) must be developed. The EAP contains a map showing the area that would potentially be inundated by floodwaters from the failed dam. These dams are often monitored so that conditions that pose a potential for dam failure are identified to allow for emergency evacuations.

Dam Hazard Ratings

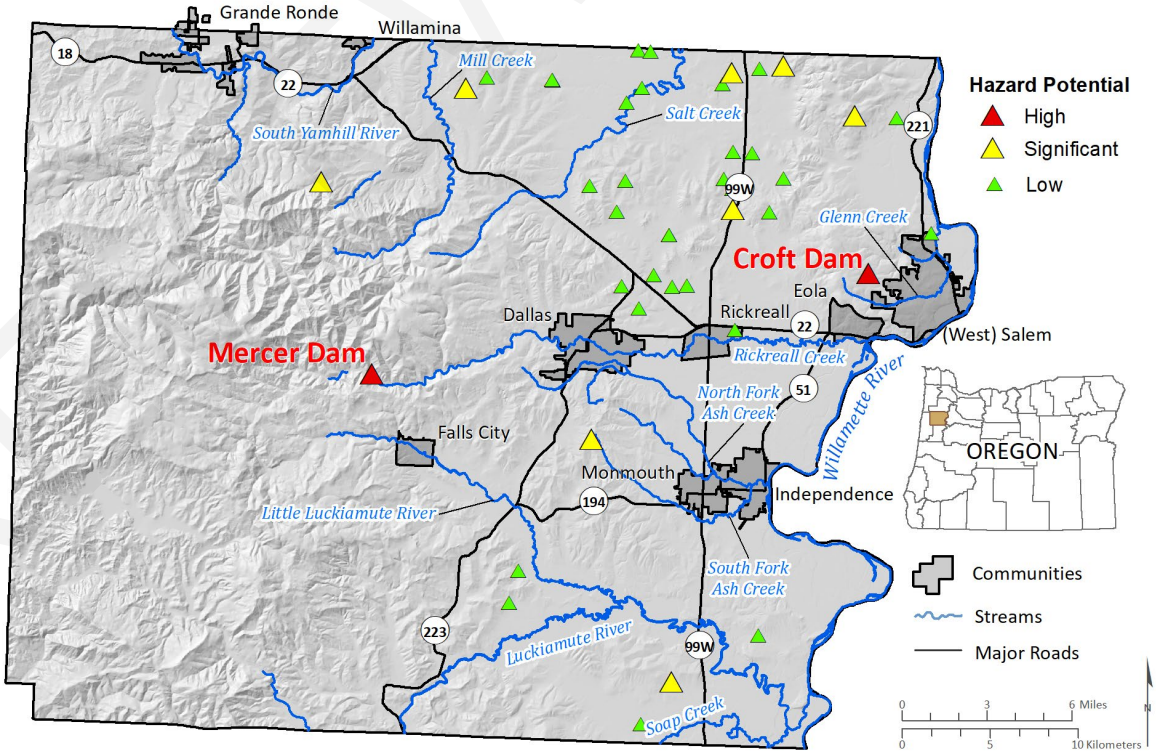
Oregon follows national guidance for assigning hazard ratings to dams and for the contents of Emergency Action Plans, which are now required for all dams rated as "high hazard." Each dam is rated according to the anticipated impacts of its potential failure. The state has adopted these definitions (ORS 540.443–491) for state-regulated dams:

- "High Hazard" means loss of life is expected if the dam fails.
- "Significant Hazard" means loss of life is not expected if the dam fails, but extensive damage to property or public infrastructure is.
- "Low Hazard" is assigned to all other state-regulated dams.
- "Emergency Action Plan" means a plan that assists a dam owner or operator, and local emergency management personnel, to perform actions to ensure human safety in the event of a potential or actual dam failure.

Hazard ratings may change for a number of reasons. For example, a dam's original rating may not have been based on current inundation analysis methodologies, or new development may have changed potential downstream impacts.

There are two dams in Polk County that are considered high hazard dams. One high hazard dam is the privately operated Croft Dam that forms the Croft Reservoir and is located less than a mile west of West Salem. The second high hazard dam is the Mercer Dam that was built to supply water for the City of Dallas on Rickreall Creek. The Mercer Dam is located six miles to the west of Dallas and forms the Aaron Mercer Reservoir.

Figure 15 High Hazard Potential Dams in Polk County



Source: DOGAMI Multi-Hazard Risk Assessment for Polk County, Oregon O-24-XX

Probability

Engineering risk assessment and analysis of a dam is the best indicator of the probability of failure. Without that, the condition of a dam as determined by OWRD engineering staff is a helpful indicator OWRD has for of the failure potential of a dam.

Dam safety regulators determine the condition of high hazard rated dams, both state- and federally regulated. A dam's condition is considered public information for state-regulated dams, but the conditions of federally regulated dams are generally not subject to disclosure. State-regulated significant hazard dams do not yet have condition ratings.

Oregon uses FEMA's condition classifications. These classifications are subject to change and revisions are being considered at the national level. Currently, FEMA's condition classifications are:

- "Satisfactory" means no existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.
- "Fair" means no existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.
- "Poor" means a dam safety deficiency is recognized for loading conditions that may realistically occur. Remedial action is necessary. A poor rating may also be used when uncertainties exist as to critical analysis parameters that identify a potential dam safety deficiency. Further investigations and studies are necessary.
- "Unsatisfactory" means a dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.
- "Not Rated" means the dam has not been inspected, is not under State jurisdiction, or has been inspected but, for whatever reason, has not been rated.

Polk County has one High Hazard State-Regulated dam identified as "satisfactory" (Croft), and one dam identified as "fair" (Mercer).

Data Limitations

Most, if not all, dams in Oregon have a data limitation related to extreme precipitation estimates. OWRD Dam Safety, is currently funding an updated precipitation frequency analysis that will address this issue.

National Flood Insurance Program (NFIP) Vulnerability

FEMA updated the Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) in 2018 (effective January 19, 2018). Polk County participates in the Community Rating System (CRS) and is currently rated as Class 9.

The community repetitive flood loss record identifies six (6) RL properties countywide, four of which are in unincorporated areas. Two of the RL properties in unincorporated areas are not insured. There have been 16 paid repetitive loss claims totaling $429,034 in the unincorporated areas of the county. There is one SRL property identified in Polk County. Substantially damaged buildings located in the Special Flood Hazard Area do not require benefit-cost analysis to qualify for mitigation funds.

Communities can reduce the likelihood of damaging floods by employing floodplain management practices that exceed NFIP minimum standards. DLCD encourages communities that adopt such standards to participate in FEMA's Community Rating System (CRS), which results in reduced flood insurance costs. Polk County participates in the CRS program.

Figure 16 provides information on the identified RL properties and gives the general location of these properties. For details on county repetitive loss properties see Volume I, Section 2. The County complies with the NFIP through their floodplain management program and enforcement of their flood damage prevention ordinance.

Figure 16 Repetitive Flood Loss Detail

Jurisdiction Name	Address City	Insured?	Flood Zone	Occupancy	Total Paid Claims	Total Paid Amount
Polk County	MONMOUTH	YES	A	SFD	3	$76,765.26
Polk County	RICKREALL	NO	AE	SFD	3	$30,525.25
Polk County	RICKREALL	YES	AE	SFD	2	$129,129.24
Polk County	RICKREALL	YES	AE	SFD	2	$126,927.56
Polk County	RICKREALL	SDF	AE	SFD	4	$57,282.57
Polk County	DALLAS	NO	A	SFD	2	$8,403.89

Source: FEMA Region X, Regional Flood Insurance Liaison, email February 13, 2023.

Landslide

Significant Changes since Previous NHMP:

The Landslide hazard profile has been edited to reference new history since the 2018 Plan. No development changes affected the jurisdiction's overall vulnerability to this hazard.

Characteristics

A landslide is any detached mass of soil, rock, or debris that falls, slides, or flows down a slope or a stream channel. Landslides are classified according to the type and rate of movement and the type of materials that are transported. In a landslide, two forces are at work: 1) the driving forces that cause the material to move down slope, and 2) the friction forces and strength of materials that act to retard the movement and stabilize the slope. When the driving forces exceed the resisting forces, a landslide occurs.

Polk County is subject to landslides or debris flows (mudslides), especially in the Cascade Range to the east of the county, which may affect buildings, roads, and utilities.

Additionally, landslides often occur together with other natural hazards, thereby exacerbating conditions, as described below:

- Shaking due to earthquakes can trigger events ranging from rockfalls and topples to massive slides.
- Intense or prolonged precipitation that causes flooding can also saturate slopes and cause failures leading to landslides.
- Landslides into a reservoir can indirectly compromise dam safety and a landslide can even affect the dam itself.
- Wildfires can remove vegetation from hillsides, significantly increasing runoff and landslide potential.

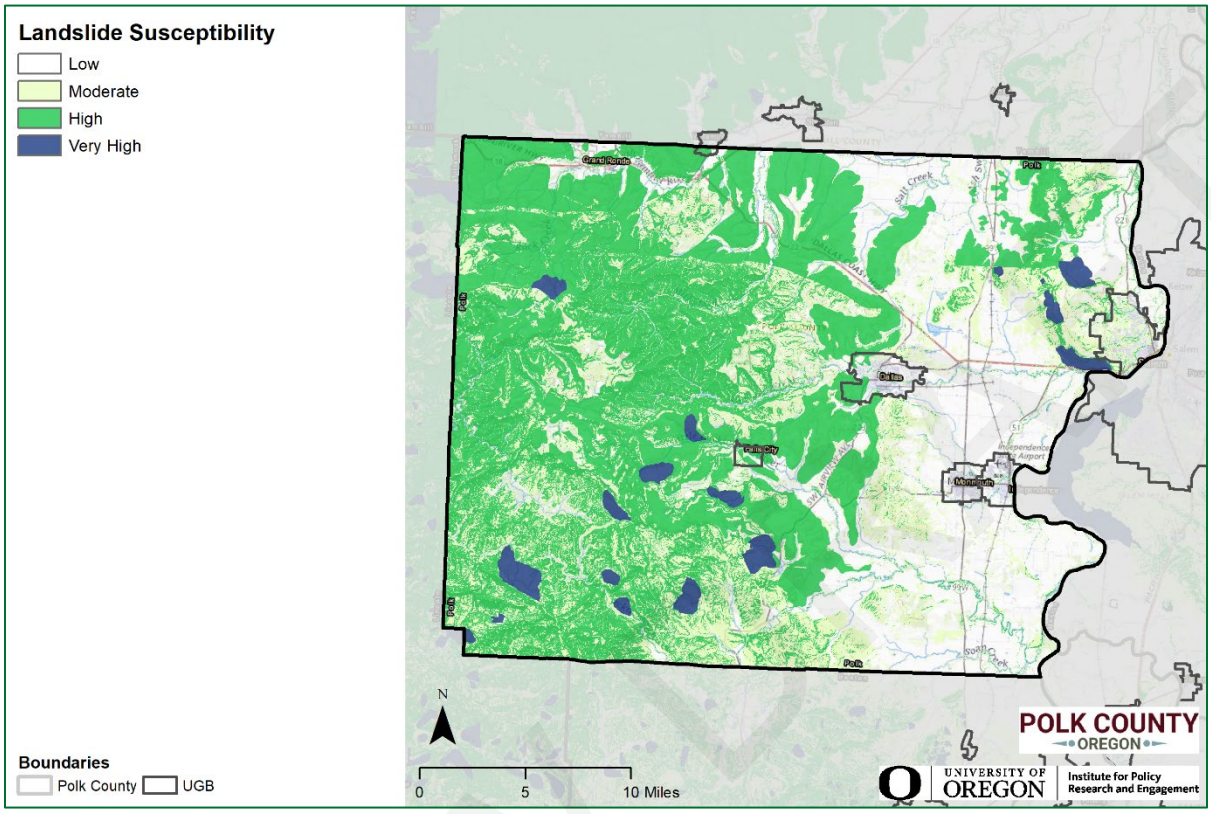
Location and Extent

The characteristics of the minerals and soils present in Polk County indicate the potential types of hazards that may occur. Rock hardness and soil characteristics can determine whether an area will be prone to geologic hazards such as landslides.

Landslides and debris flows are possible in any of the higher slope portions of Polk County, including much of the central and eastern portions of the county. Landslide prone areas also include portions of the hilly areas west of Falls City.

Figure 17 shows the landslide susceptibility of Polk County.

Figure 17 Landslide Susceptibility



Source: Oregon Partnership for Disaster Resilience. Oregon Department of Geology and Mineral Industries.
Note: To view detail click this link to access Oregon HazVu. Refer to Appendix D: Community Risk Profiles for more information.

For Polk County, many high landslide potential areas are in the hilly-forested areas western portion of the county. The western region of the county is hilly, primarily managed for timberland, and is sparsely populated. Landslides in these areas may damage or destroy some timber and impact logging roads. Many of the major highways in Polk County are at risk for landslides at one or more locations with a high potential for road closures and damage to utility lines. Especially in the western portions of the county, with a limited redundancy of the road network, such road closures may isolate some communities. In addition to direct landslide damage to roads and highways, affected communities are also subject to the economic impacts of road closures due to landslides, which may disrupt access to/egress from communities.

Figure 18 shows landslide susceptibility exposure for Polk County and the incorporated cities. Approximately 46% of the county land has High landslide susceptibility exposure and just over 2% has Very High landslide susceptibility. While the cities generally have less exposure, nearly 60% of Falls City is within the High landslide susceptibility area. Note that even if a county or city has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard and assets.

More detailed landslide hazard assessment at specific locations requires a site-specific analysis of the slope, soil/rock, and groundwater characteristics at a specific site. Such assessments are often conducted prior to major development projects in areas with moderate to high landslide potential, to evaluate the specific hazard at the development site.

Figure 18 Landslide Susceptibility Exposure

Jurisdiction	Area, ft^2	Low	Moderate	High	Very High
Polk County	20,738,900,872	31.2%	20.5%	46.0%	2.3%
Dallas	135,561,360	67.3%	13.4%	19.3%	0.0%
Falls City	33,481,019	24.6%	16.1%	59.3%	0.0%
Independence	82,442,831	88.4%	9.8%	1.8%	0.0%
Monmouth	58,577,531	91.1%	8.7%	0.2%	0.0%

Source: DOGAMI Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon (2016)

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.

For more information, refer to the following report and maps provided by DOGAMI:

- Open File Report: O-16-02, Landslide Susceptibility Overview Map of Oregon
- Open File Report: O-15-01, Landslide Susceptibility analysis of lifeline routes in the Oregon Coast Range (2015)
- Open-File Report: O-10-03, Digital geologic map of the southern Willamette Valley, Benton, Lane, Linn, Marion, and Polk Counties, Oregon
- Special Paper 34: Slope failures in Oregon: GIS inventory for three 1996/97 storm events, 2000

Additional reports are available via DOGAMI's Publications Search website: https://www.oregongeology.org/pubs/pubsearch.htm

History

Landslides are not common in Polk County. Much of the terrain is relatively flat with few hills. However, landslides have occurred in Polk County potentially threatening infrastructure. Many slides take place in undeveloped areas and are unreported or even unnoticed. Figure 17 shows that landslide prone landscape is generally in the western portion of the county which is remote and primarily managed for timberland. A statewide survey of winter storm landslides during 1996 and 1997, conducted by the Oregon Department of Geology and Mineral Industries (DOGAMI), reported 9,582 documented slides.[32] The actual number occurring was estimated to be many times the documented number.

Landslides in Polk County are often associated with heavy rain events and landslides were reported during rain events in October 1950, November 1951, December 1951, December

[32] DOGAMI, Special Paper 34: Slope Failures in Oregon: GIS Inventory for three 1996/97 storm events (2000)

1955, November 1958, March 1963, October 1967, March 1971, November 1981, December 1995, February 2002, December 2006. Below, the most severe landslide events are listed:

- October 1962, wind/ rain event; flood, landslides, tree toppling, utility disruption (Columbus Day Storm)
- December 1964, rain event, most severe flooding since 1870
- Feb. 1996: Entire State - Deep snow pack, warm temperatures, record-breaking rains. Flooding, landslides, power-outages. (FEMA-1099-DR-OR); $478,472 - Road damage, homes damaged from floodwater undercutting.
- Nov. – Dec. 1996: Entire State - Record-breaking precipitation; local flooding / landslides (FEMA-1107-DR-OR and FEMA-1149-DR-OR, *did not include Polk County*).
- *December 2005-January 2006: severe storms, flooding, landslides, and mudslides (FEMA-1632-DR-OR).*
- December 2007, snow and rain event; Heavy snowfall, rains, rapid temperature warming created widespread flooding, tree blockages, landslides, transportation and utility disruptions, and five deaths in Oregon. Statewide wind 50-100 mph -$180M damages.
- December 2008: snow, mudslide, and landslide event; A severe storm, record and near-record snow, mudslides, and landslides occurred between December 20 through 26, 2008.
- January, 2012: Heavy rain, landslides, downed trees, 24-hour rainfall of over 4-inches (FEMA-4055-DR-OR).
- December 2015: Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides (FEMA-4258-DR-OR)

Landslide maps are available via DOGAMI's Statewide Landslide Information Layer for Oregon (SLIDO):

DOGAMI Statewide Landslide Information Layer for Oregon (SLIDO)

For additional history see flood section above for events that included landslides.

Future Projections

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, the Oregon Climate Change Research Institute (OCCRI report) report looks at extreme precipitation. In Polk County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. Nevertheless, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 14% (range 2–33%) and 11% (range 2–22%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The number of days per year that exceeded a threshold for landslide risk, which is based on prior 18-day precipitation accumulation, is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard. Additional triggers, such as earthquakes, wildfires, or development,

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

Probability Assessment

The probability of rapidly moving landslide occurring depends on a number of factors, including steepness of slope, slope materials, local geology, vegetative cover, human activity, and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides (debris flows). Given the correlation between precipitation / snow melt and rapidly moving landslides, it would be feasible to construct a probability curve. Many slower moving slides present in developed areas have been identified and mapped; however, the probability and timing of their movement is difficult to quantify. The installation of slope indicators or the use of more advanced measuring techniques could provide information on these slower moving slides.

Based on the available data and research for Polk County the NHMP Steering Committee determined the **probability of experiencing a landslide or debris flow is "high",** meaning at least one incident is likely within the next 10 to 35-year period; *this rating has not changed since the previous NHMP*.

Vulnerability Assessment

Landslides can affect structures (residential, commercial, industrial), utility services, transportation systems, and critical lifelines among others. Communities may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the economy. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service community needs. Loss of electricity has the most widespread impact on other utilities and on the whole community. Natural gas pipes may also be at risk of breakage from slight landslide movements as small as an inch or two.

Roads and bridges are subject to closure during landslide events. Because many Polk County residents are dependent on roads and bridges for travel to work, delays and detours are likely to have an economic impact on county residents and businesses. To evaluate landslide mitigation for roads, the community can assess the number of vehicle trips per day, detour time around a road closure, and roads used for commercial traffic or emergency access. Particular vulnerabilities include major routes including Highway 51, 99, 223, and 22. In addition, the following roads within Polk County are susceptible to slides:

- High Frequency: Black Rock, Mill Creek, James Howe, and Liberty
- Lower Frequency: Buena Vista, Pioneer, and Pedee

Lifelines and critical facilities should remain accessible during a natural hazard event. The impact of closed transportation arteries may be increased if the closed road or bridge is a critical lifeline to hospitals or other emergency facilities. Therefore, inspection and repair of critical transportation facilities and routes is essential and should receive high priority. Losses

of power and phone service are also potential consequences of landslide events. Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas. Flood events can also cause landslides, which can have serious impacts on gas lines. Water and waste-water utilities may need treatment to quickly improve water quality by reducing excessive water turbidity and reestablishing wastewater disposal capability.

Mercer Reservoir is the drinking water source for Dallas and its spillway is vulnerable to impacts from landslide/debris flows. Falls City has experienced landslide debris flows from supersaturated soils.

A quantitative landslide hazard assessment requires overlay of landslide hazards (frequency and severity of landslides) with the inventory exposed to the hazard (value and vulnerability) by considering:

1. Extent of landslide susceptible areas;
2. Inventory of buildings and infrastructure in landslide susceptible areas;
3. Severity of earthquakes or winter storm event (inches of rainfall in 24 hours);
4. Percentage of landslide susceptible areas that will move and the range of movements (displacements) likely; and
5. Vulnerability (amount of damage for various ranges of movement).

2023 Assessment

In their 2023 Multi-Hazard Risk Report for Polk County, DOGAMI found that areas along Highway 22 and Route 223, including the communities of Dallas and Falls City, in the central part of the county have a high level of exposure to landslide hazard. Residential structures in Eola and an area northwest of (West) Salem are exposed to Very High landslide hazard. The percentage of building value exposed to Very High and High landslide susceptibility is approximately 15%, which equates to more than 8,000 buildings with a value approaching $2 billion.

Polk Countywide landslide exposure (High and Very High susceptibility):

- Number of buildings: 8,005
- Value of exposed buildings: $1,929,775,000
- Percentage of total county value exposed: 15%
- Critical facilities exposed: 11 of 81
- Potentially displaced population: 12,202

Source: DOGAMI Multi-Hazard Risk Assessment for Polk County, Oregon O-24-???

Most of the developed land in Polk County is located on the gentle terrain found in the Willamette River Valley, which is predominantly classified as having a low landslide susceptibility. However, there are developed areas just north and west of (West) Salem that are highly susceptible to landslide hazard. Landslide hazard is also ubiquitous in the hilly and steep central and western portions of Polk County which may present challenges for planning

and mitigation efforts. Awareness of nearby areas of landslide hazard is beneficial to reducing risk for every community and rural area of Polk County.

The NHMP Steering Committee rated the County as having a **"low" vulnerability to landslide hazards**, meaning that less than 1% of the region's population or assets would be affected by a major disaster; *this rating has not changed since the previous NHMP*.

Severe Weather

Severe weather in Polk County includes a variety of intense and potentially damaging weather events. These events include windstorms and winter storms. The following section describes the unique probability and vulnerability of each identified weather hazard. Other more abrupt or irregular events such as hail are also described in this section.

Extreme Heat

Significant Changes since Previous NHMP:

The extreme heat hazard section has been added since the previous NHMP to reflect the 2020 Oregon Natural Hazards Mitigation Plan hazard profile for Region 3, Mid/Southern Willamette Valley.

Characteristics

Extreme Heat Events are a geographically widespread temperature spike with days reaching over 90 degrees in all parts of the region. Extreme temperature events have the potential to inflict serious health damage especially during summer months. In extreme heat environments, the body must work harder to maintain a normal temperature, potentially causing dehydration and heatstroke from over-exposure. These heat-related illnesses are particularly impactful among vulnerable population types[33]. Between 1979 and 2003, heat waves killed at least 8,015 Americans, according to the Centers for Disease Control and Prevention. That's more than hurricanes, lightning, tornadoes, floods, and earthquakes combined. And it's largely an urban problem—the bulk of those deaths occur in cities.[49]

Location and Extent

Per the Oregon Natural Hazard Mitigation Plan Region 3 profile, extreme temperatures aren't as common in western Oregon compared to other parts of the state; however, Region 3 does experience days above 90°F nearly every year. Eugene has an average of about 13 days per year above 90°F. The frequency of prolonged periods of high temperatures is expected to increase. Because extreme heat isn't as common in western Oregon compared to other parts of the state, many people may not be accustomed or prepared when an extreme heat event occurs.

Similar to drought, prolonged elevated temperatures pose risks to agriculture, involving health and welfare to farmers, farm workers, crops and livestock. Some livestock, especially dairy cattle, are sensitive to heat. Milk production decreases and susceptibility to death increases during and for some time after a heat wave. Since risks to human health and welfare are also elevated during heat waves, Oregon and the federal government have regulations and guidelines to help prevent injury to those who work on farms. Impacts of

[33] FEMA "Extreme Heat" http://www.ready.gov/heat

extreme heat on state-owned facilities related to agriculture may include impacts to research conducted in outdoor settings, such as at extension stations and research farms. The value of state-owned and leased buildings and critical facilities in Region 3 is approximately $3,107,827,000 representing the total potential for loss of state assets due to extreme heat. The value of locally owned critical facilities is $7,490,014,000.

History

The following extreme heat episodes have occurred within Polk County:

EO 21-26 - July 29-August 5, 2021 – Multiple days of extreme heat with little or no cooling overnight impacting critical infrastructure, causing utility outages and transportation disruptions." Impacted Benton, Columbia, Clackamas, Curry, Douglas, Gilliam, Grant, Hood River, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Morrow, Multnomah, Polk, Sherman, Umatilla, Wasco, Washington, Wheeler, and Yamhill Counties.

EO 22-13 – July 25 – July 31, 2022 – Extreme heat event in Columbia, Clackamas, Crook, Curry, Deschutes, Douglas, Gilliam, Grant, Hood River, Jackson, Jefferson, Josephine, Klamath, Marion, Morrow, Multnomah, Polk, Sherman, Umatilla, Union, Wallowa, Wasco, Washington, Wheeler, and Yamhill Counties.

Future Projections

According to the Oregon Climate Change Research Institute (OCCRI report) "Future Climate Projections, Polk County,"[34] the number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Polk County, the number of extremely hot days (those on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower and higher emissions scenarios. The number of days per year with temperatures 90°F or higher is projected to increase by an average of 17 (range 6–30) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the hottest day of the year is projected to increase by an average of about 6°F (range 1–9°F) by the 2050s. Projected demographic changes in Polk County, such as an increase in the proportion of older adults and the absolute number of children, will increase the number of people in some of the populations that are vulnerable to extreme heat.

Probability Assessment

Based on the available data and research the NHMP Steering Committee determined the **probability of experiencing an extreme heat event is "high",** meaning one incident may occur within the next 10-35-year period. *This hazard was not rated in the previous plan.*

[34] Oregon Climate Change Research Institute, *Future Climate Projections, Jackson County, Oregon*. February 2023.

Extreme heat events occur every few years within the region, however, they are generally not long lasting. Climate models for Oregon suggest future regional climate changes include increases in temperature around 0.2-1°F per decade in the 21st Century, along with warmer and drier summers.

Vulnerability Assessment

The Steering Committee also determined that the County's **vulnerability to extreme heat is "moderate,"** meaning that 4-10% of the region's population would be affected by a major disaster. *This hazard was not rated in the previous plan.*

Due to insufficient data and resources, Polk County is currently unable to perform a quantitative risk assessment, or exposure analysis, for this hazard.

However, due to their expected high level of exposure to a climatic hazard event such as extreme heat in Polk County, many vulnerable populations are especially susceptible to its greatest impacts.

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, Oregon, of the Oregon NHMP (2020).

Windstorm

Significant Changes since Previous NHMP:

The Windstorm Hazard has been edited to reference new history since the last Plan. No development changes affected the jurisdiction's overall vulnerability to this hazard.

Characteristics

A windstorm is generally a short duration event involving straight-line winds and/or gusts more than 50 mph. The most persistent high winds take place along the Oregon Coast and in the Columbia River Gorge. High winds in the Columbia Gorge are well documented. The Gorge is the most significant east-west gap in the Cascade Mountains between California and Canada. Wind conditions in central Oregon are not as dramatic as those along the coast or in the Gorge yet can cause dust storms or be associated with severe winter conditions such as blizzards. Most of the destructive surface winds striking Oregon are from the southwest. Some winds blow from the east but most often do not carry the same destructive force as those from the Pacific Ocean.

Though tornadoes are not common in Oregon, these events do occasionally occur and sometime produce significant property damage and even injury. Tornadoes are the most concentrated and violent storms produced by earth's atmosphere, and can produce winds in excess of 300 mph. They have been reported in most of the regions throughout the state since 1887. Most of them are caused by intense local thunderstorms, common between April and October.

Location and Extent

The most common type of wind pattern affecting Polk County is straight-line winds, which originate as a downdraft of rain-cooled air and spread out rapidly when they reach. Straight-line winds can produce gusts of up to 100 mph. For Polk County, the wind hazard levels are generally highest near the Willamette River and then are uniform across most of the rest of the county. In the mountainous areas, however, the level of wind hazard is strongly determined by local specific conditions of topography and vegetation cover. Mountainous terrain slows down wind movement, which is why Oregon's sheltered valley areas have the slowest wind speed in the state. However, in the foothills, the wind speeds may increase due to down-sloping winds from the mountains.

Although windstorms can affect the entire county, they are especially dangerous in developed areas with significant tree stands and major infrastructure, especially above ground utility lines. A windstorm will frequently knock down trees and power lines, damage homes, businesses, public facilities, and create a significant amount of storm related debris.

History

Windstorms of various intensities occur yearly. More destructive storms occur once or twice per decade, most recently in December 2015. One damaging windstorm (tornado) occurred north of Independence in Polk County, November 11, 1925. The tornado damaged only a few structurally weak buildings and trees. Another tornado was documented in February 1926 that damaged homes and trees in Polk County.

The following windstorms have occurred within, and/or near Polk County:[35]

- November 10-11, 1951 (Statewide): Extensive timber, building, and utility losses and disruption. Damage was experienced statewide with wind speeds ranging from 40-80 mph.
- December 1951 (Statewide): Serious damage to buildings and utility system disruption. Statewide wind speeds ranging from 40-100 mph.
- December 1955 (Statewide): In addition to extensive damage to buildings, power and telephone lines throughout the state, heavy destruction occurred in the Willamette Valley orchards. Statewide wind speeds ranging from 55-70 mph.
- November 1958 (Statewide): Extensive timber, building, and utility losses and disruption. All highways closed at one or more points from fallen trees. Statewide wind speeds ranging from 50-75 mph.

[35] Taylor, George H., and Ray Hatton, 1999, The Oregon Weather Book; The Spatial Hazard Events and Losses Database for the United States, [Online Database]. Columbia, SC: University of South Carolina. Available at http://www.sheldus.org; U.S. Department of Commerce. National Climatic Data Center. Available at https://www.ncdc.noaa.gov/; National Weather Service Forecast Office. Available at http://www.wrh.noaa.gov/pqr/paststorms/wind.php; FEMA Disaster Declarations for Oregon. Available at https://www.fema.gov/disasters/grid/state-tribal-government/88?field_disaster_type_term_tid_1=All#

- October 1962 (Columbus Day Storm, Statewide): Downed trees and power lines, utility disruption, the Columbus Day storm was the equivalent of a Category IV hurricane in terms of central pressures and wind speeds. The storm, which started east of the Philippines as Typhoon Freda, measured 1,000 miles long as it hit the West Coast. There were a total of 38 fatalities, 84 houses destroyed, 5,000 houses severely damaged, and $200M damages statewide. Statewide wind speeds ranging from 29-138. Wind speeds in Portland hit 116 mph.
- March 1963 (Statewide): Widespread destruction with wind speeds ranging from 39-100 mph.
- October 1967 (Statewide): Extensive agricultural, timber, power and telephone utilities, and home losses. There was one fatality and 15 injuries with wind speeds ranging from 70- 115 mph,
- March 1971 (Most of Oregon): Damages included extensive roof damage, toppled trees, power line breakages, and extensive utility disruption. Statewide wind speeds ranging from 40-71 mph.
- November 1981 (Most of Oregon): Most destructive windstorm since the 1962 Columbus Day storm. There were 11 fatalities and $50M damages statewide. Average sustained wind speeds of 57 mph, with wind speeds ranging from 75-92 mph along coast, gusts.
- February 1989 (Statewide): Together with below-freezing temperatures (-40°F) and stiff winds, more than one foot of snow fell on some areas. Damages included burst pipes, flooding and water damage, Icy roads caused numerous accidents and injuries, several fires were also reported.
- December 1995 (Statewide): Very wet soil from an unusually rainy fall resulted in the toppling of many trees in the Willamette Valley. 100-119 mph coastal area winds creating extensive tree damage to forests, structures, autos, and utilities. (FEMA-1107-DR-OR)
- November 1997 (Western Oregon): Wind speed hit 52 mph in Willamette Valley. Trees were uprooted and considerable damage to small airports was reported.
- February 2002 (Western Oregon): Strongest storm to strike western Oregon in several years. Included downed power lines (due to tree fall), damage to buildings, and water supply problems (lack of power). Resulted in a Presidential declaration for coastal counties who experienced 70 mph winds, south of Polk County. Estimated damage costs $6.14 million. (FEMA-1405-DR-OR)
- January 2006 (Western Oregon): Wind speeds up to 58 mph caused a total of $500K in damages within Yamhill, Polk, Marion, Clackamas, Columbia, Washington, and Multnomah Counties.
- February 2006 (Western Oregon): Wind speeds up to 77 mph caused a total of $277K in damages within Linn, Lane, Marion, Benton, Polk, and Yamhill Counties.

- December 2007 (Most of Oregon): Heavy snowfall, rains, rapid temperature warming created widespread flooding, tree blockages, landslides, transportation, and utility disruptions, and 5 deaths in Oregon. Statewide wind speeds ranging from 50-100 mph and damages totaled $180M.
- January 17–21, 2012 (Willamette Valley): A severe winter storm that included high wind speeds, flooding, landslides, and mudslides. (FEMA-4055-DR-OR)
- March 11, 2012 (Western Oregon): Executive Order No. 12-06: State of Emergency declared in Polk County due to damaging winds, heavy rains, flooding, mudslides, and landslides impacting Federal highways. Damages are estimated at $5,856,881 of damage to federal-aid highways in the region.
- February 6–14, 2014 (Western Oregon): A strong winter storm system affected the Pacific Northwest February 6–10, 2014. The storm brought a mixture of arctic air, strong east winds, significant snowfall and freezing rain to several counties in northwest Oregon. (FEMA-4169-DR-OR, Polk not included in declaration)
- December 6-23, 2015 (Western Oregon): A severe winter storm, including straight-line winds, flooding, and landslides and mudslides occurring Dec. 6-23, 2015.Total estimated damages amounted to $2.6M of individual assistance and $24.4M of public assistance, 894 residences were impacted (11 destroyed, 75 major damage). Per capita damage estimate within Polk County of $5.24. (FEMA-4258-DR-OR)

Several additional, small windstorm events have occurred since the previous plan, see the Storm Events Database provided by the National Oceanic and Atmospheric Administration for more information.

Future Projections

Wind patterns affect provision of electricity, transportation safety, and the spread of wildfires and pollutants. Mean wind speeds in Oregon are projected to decrease slightly, but extreme winter wind speeds may increase, especially in western Oregon. The frequency of strong easterly winds during summer and autumn, however, is projected to decrease slightly. Those impacted by windstorms at present, including older residential or commercial developments with above-ground utilities, poor insulation or older construction, heavy tree canopies, or poor storm drainage, will continue to be impacted by windstorms in the future.

Probability Assessment

Windstorms in the county usually occur in the winter from October to March and their extent is determined by their track, intensity (the air pressure gradient they generate) and local terrain. Summer thunderstorms may also bring high winds along with heavy rain and/ or hail. The National Weather Service uses weather forecast models to predict oncoming windstorms, while monitoring storms with weather stations in protected valley locations throughout Oregon.

Figure 19 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 Region 3, which includes Polk County, can expect to be exposed to 60 mph winds in a 25-year recurrence interval (4% annual probability).

Figure 19 Probability of Severe Wind Events (Region 3)

	25-Year Event (4% annual probability)	50-Year Event (2% annual probability)	100-Year Event (1% annual probability)
Region 3: Mid/Southern Willamette Valley	60 mph	68 mph	75 mph

Source: Oregon State Natural Hazard Mitigation Plan, 2020

Based on the available data and research for Polk County the NHMP Steering Committee determined the **probability of experiencing a windstorm is "high",** meaning one incident is likely within the next 10 to 35-year period; *this rating has not changed since the previous NHMP.*

Vulnerabilities

Many buildings, utilities and transportation systems within Polk County are vulnerable to wind damage. This is especially true in open areas, such as natural grasslands or farmlands. It is also true in forested areas, along tree-lined roads and electrical transmission lines, and on residential parcels where trees have been planted or left for aesthetic purposes. Structures most vulnerable to high winds include insufficiently anchored manufactured homes and older buildings in need of roof repair.

Fallen trees are especially troublesome. They can block roads and rails for long periods of time, impacting emergency operations. In addition, up rooted or shattered trees can down power and/or utility lines and effectively bring local economic activity and other essential facilities to a standstill. Much of the problem may be attributed to a shallow or weakened root system in saturated ground. In Polk County, trees are more likely to blow over during the winter (wet season).

A comprehensive risk and vulnerability assessment is not available for the windstorm hazard. Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all residential and critical facilities and infrastructure within the County are at risk.

As such, the NHMP Steering Committee rated the county as having a **"high" vulnerability to windstorm hazards**, meaning that more than 10% of the region's population or assets would be affected by a major disaster; *this rating has not changed since the previous NHMP.*

Winter Storm

Significant Changes since Previous NHMP:

The Winter Storm hazard has been edited to reference new history since the 2015 Plan. No development changes affected the jurisdiction's overall vulnerability to this hazard.

Characteristics

Winter storms affecting Polk County are generally characterized by a combination of heavy rains and high winds throughout the county, sometimes with snowfall, especially at higher elevations. Heavy rains can result in localized or widespread flooding, as well as debris slides and landslides. High winds commonly result in tree falls which primarily affect the electric power system, but which may also affect roads, buildings, and vehicles. This chapter deals primarily with the snow and ice effects of winter storms.

The winter storms that affect Polk County typically are not local events affecting only small geographic areas. Rather, winter storms are usually large cyclonic low-pressure systems that move in from the Pacific Ocean and affect large areas of Oregon and/or the whole Pacific Northwest. These storms are most common from October through March.

Ice storms are comprised of cold temperatures and moisture, but subtle changes can result in varying types of ice formation which may include freezing rain, sleet, and hail. Of these, freezing rain can be the most damaging of ice formations.

Outside of mountainous areas, significant snow accumulations are much less likely in western Oregon than on the east side of the Cascades. However, if a cold air mass moves northwest through the Columbia Gorge and collides with a wet Pacific storm, then a larger than average snow fall may result.

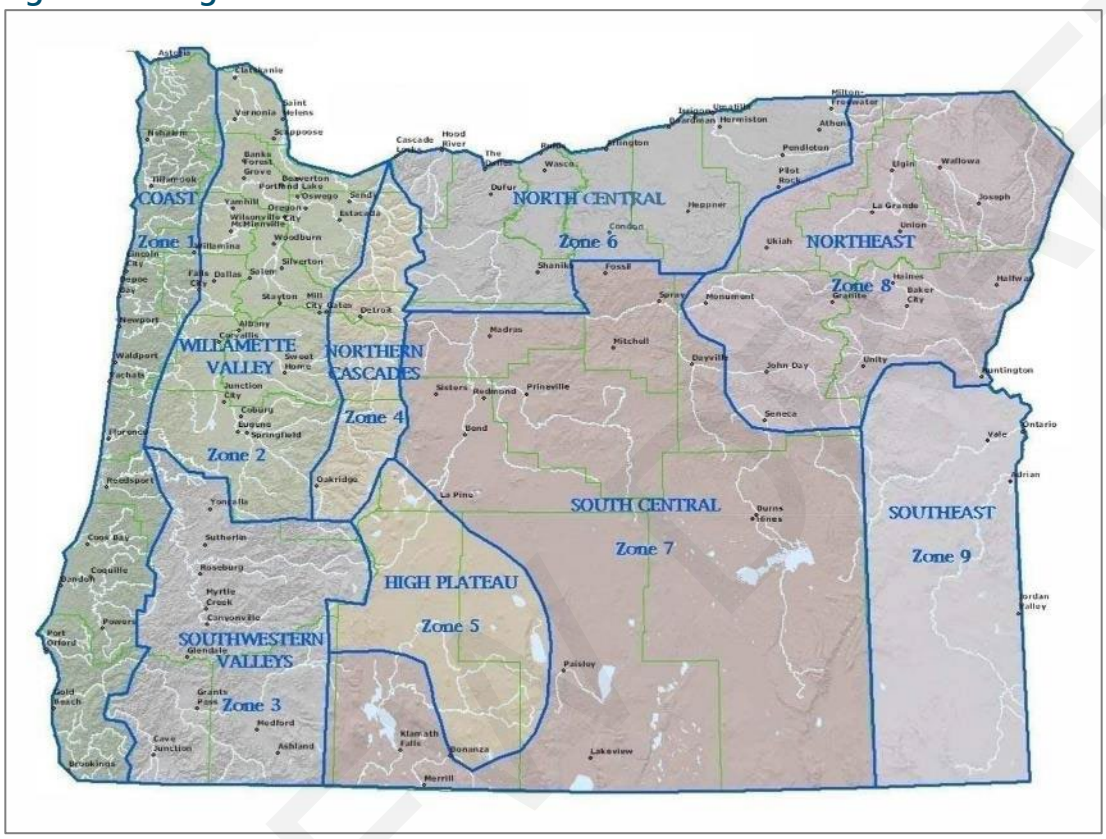
Location and Extent

Ice storms occasionally occur in northern areas of Oregon, resulting from cold air flowing westward through the Columbia Gorge. Sleet and hail can create hazards for motorists when it accumulates, but 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. The most common freezing rain problems occur near the Columbia Gorge. The Gorge is the most significant east-west air passage through the Cascades. Rain arriving from the west can fall on frozen streets, cars, and other sub-freezing surfaces, creating dangerous conditions.

The National Climatic Data Center has established climate zones 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. Polk County is located within Zone 1: Coast and Zone 2: Willamette Valley. The climate in Zone 1

and Zone 2 generally consists of cool, wet winters and warm, dry summers; the coastal area of Polk County (Zone 1) maintains cooler temperatures during the summer.[36] The wet winters result in potentially destructive winter storms that produce heavy snow, ice, rain and freezing rain, and high winds generally within the Zone 2 portion of the county.

Figure 20 Oregon Climate Divisions



Source: Oregon Climate Service.

The principal types of winter storms that occur include:

- Snowstorms: require three ingredients: cold air, moisture, and air disturbance. The result is snow, small ice particles that fall from the sky. In Oregon, the further inland and north one moves, the more snowfall can be expected. Blizzards are included in this category.
- Ice storms: are a type of winter storm that forms when a layer of warm air is sandwiched by two layers of cold air. Frozen precipitation melts when it hits the warm layer and refreezes when hitting the cold layer below the inversion. Ice storms can include sleet (when the rain freezes before hitting the ground) or freezing rain (when the rain freezes once hitting the ground).

[36] Oregon Climate Service, "Climate of Polk County,"

- **Extreme Cold:** Dangerously low temperatures accompany many winter storms. This is particularly dangerous because snow and ice storms can cause power outages, leaving many people without adequate heating.

Unlike most other hazards, it is not simple to systematically map winter storm hazard zones. The entire County is susceptible to damaging severe weather. Winter storms that bring snow and ice can impact infrastructure, business, and individuals. Those resources that exist at higher elevations will experience more risk of snow and ice, but the entire County can face damage from winter storms and, for example, hail or life threateningly cold temperatures that winter storms bring.

History

Winter storms with various intensities occur yearly. However, more destructive winter storms occur once or twice per decade, most recently in December/ January 2016. The following winter storms have occurred within, or near Polk County. Two (2) winter storm events were added to this hazard history section since the previous Plan (shown in *italics* below).[37]

- January 1950 (Willamette Valley): Winter storm event with the heaviest snowfall since 1890. Many highway closures occurred with considerable property damage. A total of 68 inches of snow fell in Polk County. Damages included floods caused by melting snow, collapsed buildings, fallen trees, utility disruption, and sub-freezing temperatures that caused frozen pipes.
- January 1956 (Western Oregon): The snowstorm began with 3.5 inches of snowfall which was followed by sub-freezing temperatures. Freezing temperatures and heavy fog disrupted transportation and caused school closures.
- March 1960 (Statewide): Large snowstorm with the heaviest snowfall accumulation since 1950, 11-inches, resulted in numerous accidents, several with serious injuries throughout Polk County.
- January 1963 (Willamette Valley): Four inches of snowfall and large amounts of ice caused transportation and utility disruption.
- January 1969 (Statewide): Ten inches of snowfall was reported in Dallas leading to school and business closures, transportation, and utility disruption. Sub-freezing temperatures caused burst pipes.
- November 1970 (County): An ice event caused electrical, heat, transportation and utility systems disruption, small fires, and school closures.

[37] Taylor, George H., and Ray Hatton, 1999, The Oregon Weather Book; The Spatial Hazard Events and Losses Database for the United States, [Online Database]. Columbia, SC: University of South Carolina. Available at http://www.sheldus.org; U.S. Department of Commerce. National Climatic Data Center. Available at https://www.ncdc.noaa.gov/; National Weather Service Forecast Office. Available at http://www.wrh.noaa.gov/pqr/paststorms/wind.php; FEMA Disaster Declarations for Oregon. Available at https://www.fema.gov/disasters/grid/state-tribal-government/88?field_disaster_type_term_tid_1=All#

- January 1978 (Willamette Valley): A freezing rain event led to transportation disruption with eight deaths and numerous accidents.
- January 1980 (Statewide): A series of storms brought snow, ice, wind, and freezing rain and caused six fatalities.
- February 1985 (Statewide): Western valleys received between 2-4 inches of snow which led to massive power failures (tree limbs broke power lines).
- December 1985 (Willamette Valley): Heavy snowfall was reported throughout the region.
- March 1988 (Statewide): Strong winds associated with heavy snow were reported throughout the state.
- February 1989 (Statewide): Together with below-freezing temperatures (-40°F) and stiff winds, more than one foot of snow fell on some areas. Damage included burst pipes, flooding and water damage, Icy roads caused numerous accidents and injuries; several fires were also reported.
- February 1990 (Statewide): The Willamette Valley was coated with 2 to 4 inches of snowfall, while the higher hills around Portland received up to 1 foot.
- December 1992 (Western Oregon): Heavy snow fell throughout western Oregon causing a temporary closure of Interstate-5.
- February 1993 (Western Oregon): About one foot of heavy snow fell within a 24-hour period. The wet snow load broke tree limbs and powerlines which caused utility disruption.
- February 1996 (portions of Willamette Valley): Freezing rain fell for two days leading to the disruption of transportation, one death, and numerous accidents.
- Winter 1998-1999 (Statewide): Series of storms led to one of the snowiest winters in Oregon history.
- December 2003 – January 2004 (Statewide): Wet snow blanketed highways in the Willamette Valley, causing power lines and trees to topple. Most airports experienced closures and delays. (FEMA-1510-DR-OR)
- December 2006 (Most of Oregon): Polk County federally declared disaster due to damages from freezing rain. (FEMA-1632-DR-OR)
- December 2007 (Most of Oregon): Heavy snowfall, rains, rapid temperature warming created widespread flooding, tree blockages, landslides, transportation, and utility disruptions, and 5 deaths in Oregon. Statewide wind speeds ranging from 50-100 mph and damages totaled $180M.
- December 2008 (Willamette Valley): A series of storms dropped feet of snow over portions of the Willamette Valley. The onset of cold air moved in around December 14 and lingered through Christmas morning. (FEMA-1824-DR-OR)
- November 2011 (Polk County): Heavy snowfall occurred with accumulations between 5 and 7 inches.

- January 17–21, 2012 (Willamette Valley): A severe winter storm that included high wind speeds, flooding, landslides, and mudslides. (FEMA-4055-DR-OR)
- March 2012 (Western Oregon): A mixture of snow, rain, and wind occurred throughout much of the coast and Willamette Valley. Storm included snowfall accumulations of up to 7-inches and included damages due to downed trees and closed roads.
- December 2013 (Willamette Valley): Region experienced heavy snowfall with accumulations up to 9-inches.
- February 6–14, 2014 (Western Oregon): A strong winter storm system affected the Pacific Northwest February 6–10, 2014. The storm brought a mixture of arctic air, strong east winds, significant snowfall, and freezing rain to several counties in northwest Oregon. (FEMA-4169-DR-OR, Polk County was not included in declaration.)
- December 6-23, 2015 (Western Oregon): A severe winter storm, including straight-line winds, flooding, and landslides and mudslides occurring Dec. 6-23, 2015.Total estimated damages amounted to $2.6M of individual assistance and $24.4M of public assistance, 894 residences were impacted (11 destroyed, 75 major damage). Per capita damage estimate within Polk County of $5.24. (FEMA-4258-DR-OR)
- December 2016 (Western Oregon): A winter storm event affected the region bringing snow, high winds, freezing rain, and flooding. (FEMA-4296-DR-OR, Polk County was not included in declaration.)
- January 2017 (Central and Southern Willamette Valley): Severe Winter Storms, Flooding, Landslides, And Mudslides. A broad shortwave trough brought multiple rounds of precipitation, including a wintry mix of snow and ice for many locations across Northwest Oregon. Strong easterly pressure gradients generated high winds through the Columbia River Gorge as well on January 8. General snowfall totals of 2-4 inches were reported, with the greatest total being 4.5 inches. Major ice accumulations occurred after the snow, with several locations reporting 0.50-1.00. The combination of snow and ice resulted in significant power outages and closures across the area. DR-4328. No counties in Region 3 declared.
- February 2021 (nine counties in Willamette Valley including Polk County): A winter storm affected the region bring snow, high winds, and freezing rain/ice. (State declaration)

Future Projections

According to the Oregon Climate Change Research Institute (OCCRI report) "Future Climate Projections, Polk County,"[38] cold extremes will become less frequent and intense as the climate warms. The number of cold days (maximum temperature 32°F or lower) per year in Polk County is projected to decrease by an average of 1 (range -1.4–0.3) by the 2050s,

[38] Oregon Climate Change Research Institute, *Future Climate Projections, Jackson County, Oregon*. February 2023.

relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the coldest night of the year is projected to increase by an average of 5°F (range 0–10°F) by the 2050s. The number of county residents vulnerable to extreme cold is likely to grow, although this increase may be offset somewhat by the decrease in incidence of cold extremes.

Probability Assessment

The recurrence interval for a moderate to severe winter storm is about once every year; however, there can be many localized storms between these periods. Severe winter storms occur in western Oregon regularly from November through February. Polk County experiences minor winter storms a couple times every year, to every other year and more severe winter storms once or twice per decade.

Based on the available data and research for Polk County the NHMP Steering Committee determined the **probability of experiencing a winter storm is "high",** meaning one incident is likely within the next 10 to 35-year period; *this rating has not changed since the previous NHMP.*

Vulnerabilities

Given current available data, no quantitative assessment of the risk of winter storm was possible at the time of this NHMP update. However, assessing the risk to the County from winter storms should remain an ongoing process determined by community characteristics and physical vulnerabilities. Weather forecasting can give County resources (emergency vehicles, warming shelters) time to prepare for an impending storm, but the changing character of the County population and resources will determine the impact of winter storms on life and property in Polk County.

The most likely impact of snow and ice events on Polk County are road closures limiting access/egress to/from some areas, especially roads to higher elevations. Winter storms with heavy wet snow or high winds and ice storms may also result in power outages from downed transmission lines and/or poles.

Winter storms which bring snow, ice and high winds can cause significant impacts on life and property. Many severe winter storm deaths occur because of traffic accidents on icy roads, heart attacks may occur from exertion while 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 a major obstacle to providing critical emergency response, police, fire, and other disaster recovery services.

Severe winter weather can also 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, industries, and individual homes. All these effects, if lasting more than several days, can create significant economic impacts for the affected communities and the surrounding region. In the rural areas of Oregon severe winter storms can isolate small communities, farms, and ranches.

At the time of this update, sufficient data was not available to determine winter storm vulnerability in terms of explicit types and numbers of existing and future buildings, infrastructure, or critical infrastructure, although it can be assumed that all residential and critical facilities and infrastructure within the County are at risk.

As such, the NHMP Steering Committee rated the County as having a **"moderate" vulnerability to winter storm hazards**, meaning that between 1 and 10% of the region's population or assets would be affected by a major disaster; *this rating has not changed since the previous NHMP.*

Volcanic Event

Significant Changes since Previous NHMP:

There have been no significant changes to this section since the previous NHMP. No development changes affected the jurisdiction's overall vulnerability to this hazard.

Characteristics

The Pacific Northwest lies 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 molten material, or magma, rises 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, or produce flying debris and ash clouds. The immediate danger area in a volcanic eruption generally lies within a 20-mile radius of the blast site.

Location and Extent

Volcanic eruption is not an immediate threat to the residents of Polk County, as there are no active volcanoes within the county. Nevertheless, the secondary threats caused by volcanoes in the Cascade region must be considered. Volcanic ash can contaminate water supplies, cause electrical storms, create health problems, collapse roofs, and impact agricultural crops.

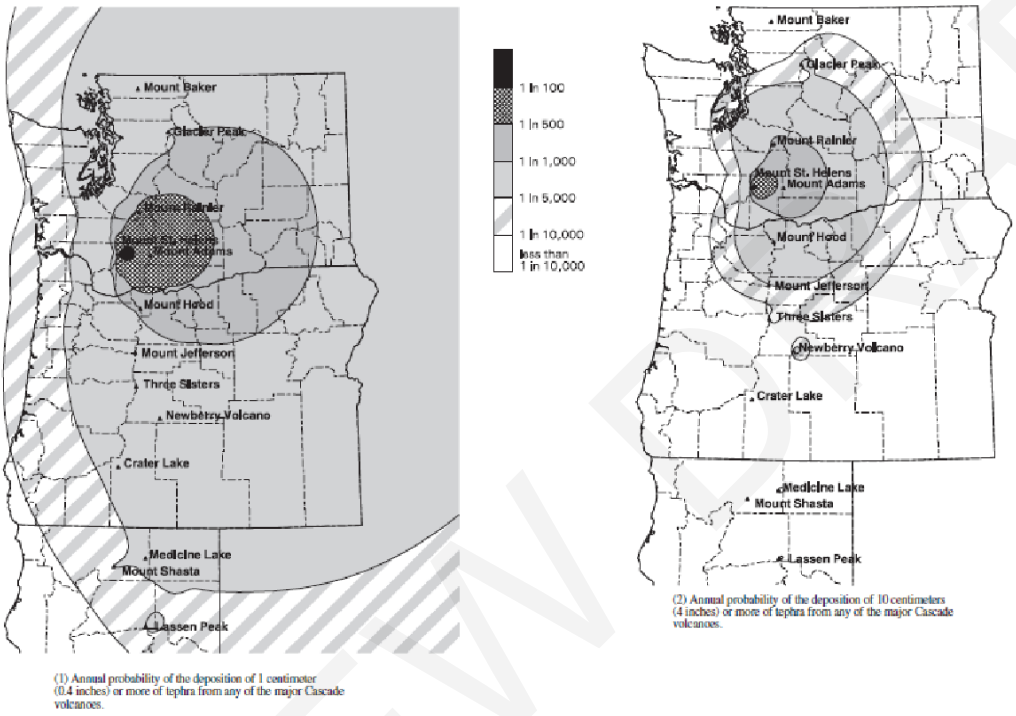
Polk County is located on the Pacific Rim. Tectonic movement within the earth's crust can renew nearby dormant volcanoes resulting in ash fallout in Polk County. Volcanic activity is possible from Mount Jefferson, Mount Hood and Mount Saint Helens, Three Sisters, Mount Bachelor, and the Newberry Crater areas. Because the distance to these potentially active volcanic areas is so great, the only adverse effect that would impact areas of Polk County is ash fallout, with perhaps some impact on water supplies. The area affected by ash fallout depends upon the height attained by the eruption column and the atmospheric conditions at the time of the eruption.

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.

Scientists 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 Cascades 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. Regional tephra fall shows the annual probability of ten centimeters or more of ash accumulation from Pacific Northwest volcanoes. Figure 21 depicts the potential and geographical extent of volcanic ash fall more than ten centimeters from a large eruption of Mt. St. Helens.

Figure 21 Regional Tephra-fall Maps



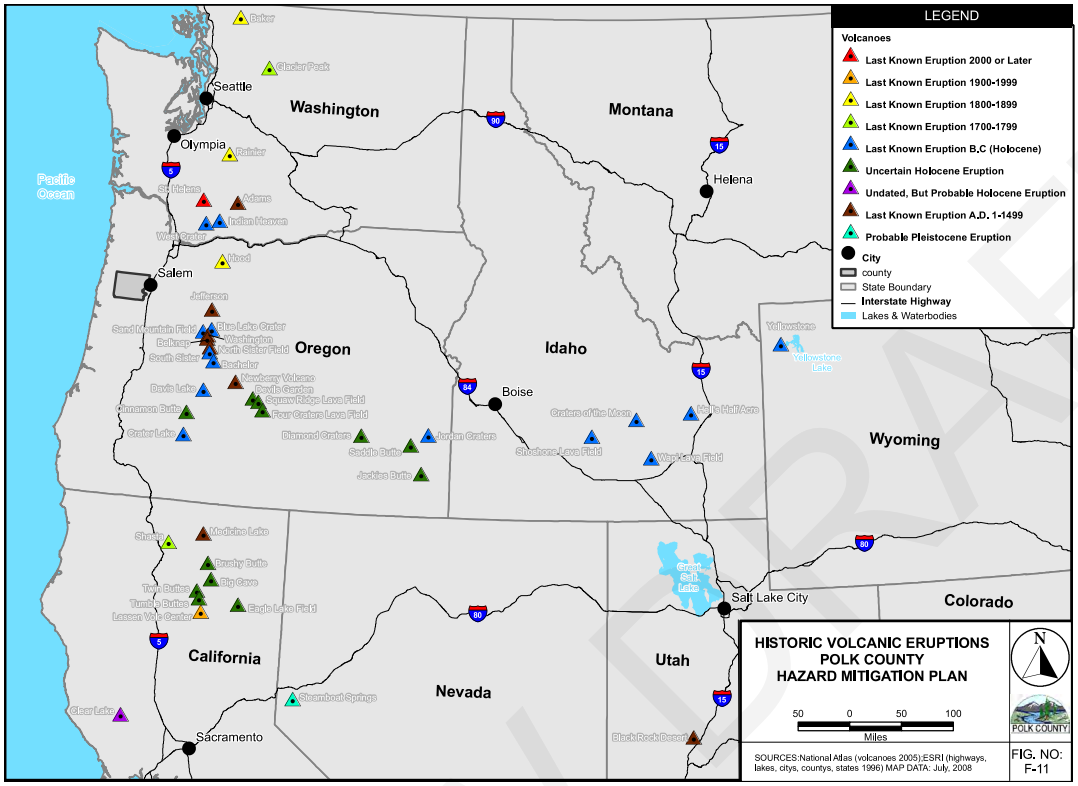
Source: USGS "Volcano Hazards in the Mount Jefferson Region, Oregon"

History

Mount Hood and Mount St. Helens are two active volcanoes near Polk County. Mount Hood is in the northeast of the county and is more than 500,000 years old. It has had two significant eruptive periods, one about 1,500 years ago and another about 200 years ago. Mount St. Helens, in southern Washington State, has been active throughout its 50,000-year lifetime. Additionally, in the past 200 years, seven of the Cascade volcanoes have erupted, including (from north to south): Mt. Baker, Glacier Peak, Mt. Rainier, and Mount St. Helens (Washington); Mt. Hood (Oregon); Mt. Shasta and Mt. Lassen (California).

There has been no recent volcanic activity in close proximity to the county. The 1980 explosion of Mount Saint Helens in southern Washington State is the latest on record; both Mount St. Helens and Mount Hood remain listed as active volcanoes.

Figure 22 Historic Volcanic Eruptions



Source: Polk County NHMP (2009).

Future Projections

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

Probability Assessment

The United States Geological Survey-Cascades Volcano Observatory (CVO) produced volcanic hazard zonation reports for Mount St. Helens and Mount Hood in 1995 and 1997. The reports include a description of potential hazards that may occur to immediate communities. The CVO created an updated annual probability of tephra (ash) fall map for the Cascade region in 2001, which could be a rough guide for Polk County in forecasting potential tephra hazard problems. The map identifies the location and extent of the hazard.

The CVO Volcanic tephra fall map is based on the combined likelihood of tephra-producing eruptions occurring at Cascade volcanoes. Probability zones extend farther east of the range because winds blow from westerly directions most of the time. The map shows annual probabilities for a fall of one centimeter (about 0.4 inch). The patterns on the map show the

dominating influence of Mount St. Helens as a tephra producer. Because small eruptions are more numerous than large eruptions, the probability of a thick tephra fall at a given locality is lower than that of a thin tephra fall. The annual probability of a fall of one centimeter or more of tephra is about 1 in 10,000 for Polk County. This is small when compared to other risks faced by the County. The USGS map on the previous page illustrates potential tephra fall in the region.

Based on the available data and research for Polk County the NHMP Steering Committee determined the **probability of experiencing volcanic activity is "low",** meaning one incident is likely within the next 75 to 100-year period; *this rating has not changed since the previous NHMP*.

Vulnerabilities

Risks for Polk County associated with regional volcanic activity would be ash fall, air quality, water quality, impacts to agricultural crops, and possible economic or social disruption due to air traffic issues due to the ash cloud.

At the time of this update, sufficient data was not available to determine volcanic eruption vulnerability in terms of explicit types and numbers of existing and future buildings, infrastructure, or critical infrastructure. Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all residential and critical facilities and infrastructure within the County are at risk.

Though unlikely, the impacts of a significant ash fall are substantial. Persons with respiratory problems are endangered, transportation, communications, and other lifeline services are interrupted, drainage systems become overloaded/clogged, buildings can become structurally threatened and the economy takes a major hit. Any future eruption of a nearby volcano (e.g., Hood, St. Helens, or Adams) occurring during a period of easterly winds would likely have adverse consequences for the county.

As such, the NHMP Steering Committee rated the county as having a **"low" vulnerability to volcanic activity**, meaning that less than 1% of the region's population or assets would be affected by a major disaster (volcanic ash); *this rating has not changed since the previous NHMP*.

Wildfire

Significant Changes since Previous NHMP:

The Wildfire hazard has been edited to reference new history since the 2015 Plan. No development changes affected the jurisdiction's overall vulnerability to this hazard.

Characteristics

Wildfires occur in areas with large amounts of flammable vegetation that require a suppression response due to uncontrolled burning. Fire is an essential part of Oregon's ecosystem but can also pose a serious threat to life and property, particularly in the state's growing rural communities. Wildfire can be divided into three categories: interface, wildland, and firestorms. Forest management, fuel availability, and 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 built-up urban areas, they have also left behind readily available fire services providing structural protection. Recent fires in Oregon and across the western United States have increased public awareness over the potential losses to life, property, and natural and cultural resources that fire can pose.

The following three factors contribute significantly to Wildfire behavior and can be used to identify Wildfire hazard areas.

Topography: As slope increases, the rate of wildfire spread increases. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying wildfire behavior. However, ridgetops may mark the end of wildfire spread, since fire spreads more slowly or may even be unable to spread downhill.

Fuel: The type and condition of vegetation plays a significant role in the occurrence and spread of wildfires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire (referred to as the "fuel load"). The ratio of living to dead plant matter is also important. The risk of fire is increased significantly during periods of prolonged drought as the moisture content of both living and dead plant matter decreases. The fuel's continuity, both horizontally and vertically, is also an important factor.

Weather: The most variable factor affecting wildfire behavior is weather. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme wildfire activity. By contrast, cooling and higher humidity often signal reduced Wildfire occurrence and easier containment.

The frequency and severity of wildfires is also dependent upon other hazards, such as lightning, drought, equipment use, railroads, recreation use, arson, and infestations. If not promptly controlled, wildfires may grow into an emergency or disaster. Even small fires can threaten lives and resources and destroy improved properties. In addition to affecting people, wildfires may severely affect livestock and pets. Such events may require emergency watering/feeding, evacuation, and shelter.

The indirect effects of wildfires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thereby enhancing flood potential, harming aquatic life, and degrading water quality. Lands stripped of vegetation are also subject to increased debris flow hazards, as described above.

Location and Extent

Wildfire hazard areas are commonly identified in regions of the Wildland Urban Interface (WUI). The interface is the urban-rural fringe where homes and other structures are built into a densely forested or natural landscape or adjacent to non-irrigated farmland. The interface area in Polk County is generally considered to be east of the coastal mountain range due to the combination of fuel conditions and residential development. If left unchecked, it is likely that fires in these areas will threaten lives and property. One challenge Polk County faces is from the increasing number of houses being built in the urban/rural fringe as compared to twenty years ago. The “interface” between urban or suburban areas and the resource lands has significantly increased the threat to life and property from fires. Responding to fires in the expanding Wildland Urban Interface area may tax existing fire protection systems beyond original design or current capability.

The ease of fire ignition further determines ranges of wildfire hazard due to natural or human conditions and the difficulty of fire suppression. The wildfire hazard is also magnified by several factors related to fire suppression/control, such as the surrounding fuel load, weather, topography, and property characteristics.

Fire susceptibility throughout the county dramatically increases in late summer and early autumn as summer thunderstorms with lightning strikes increases and vegetation dries out, decreasing plant moisture content and increasing the ratio of dead fuel to living fuel. However, various other factors, including humidity, wind speed and direction, fuel load and fuel type, and topography can contribute to the intensity and spread of wildland. In addition, common causes of wildfires include arson and negligence from industrial and recreational activities.

Polk County is approximately 90% forested with Douglas fir, spruce, and hemlock dominating the western half of the county; oak dominating the eastern half. The non- forested areas, east of the coast range, comprise either agricultural crop lands or urban development.

The actual fire hazard in these areas may be lower than expected because a high percentage of forest lands in Polk County are actively managed for timber. Harvested areas typically have lower fire risk because they are relatively free of dead and downed material that would contribute to the fuel load. In addition, forests within Polk County are relatively free of major insect and disease problems which often plague other forests in Oregon. Finally, typical rainfall amounts for Polk County are rated as either "moderately high" or "high", averaging 40 to 80 inches per year. High rainfall also reduces the threat of wildfires.

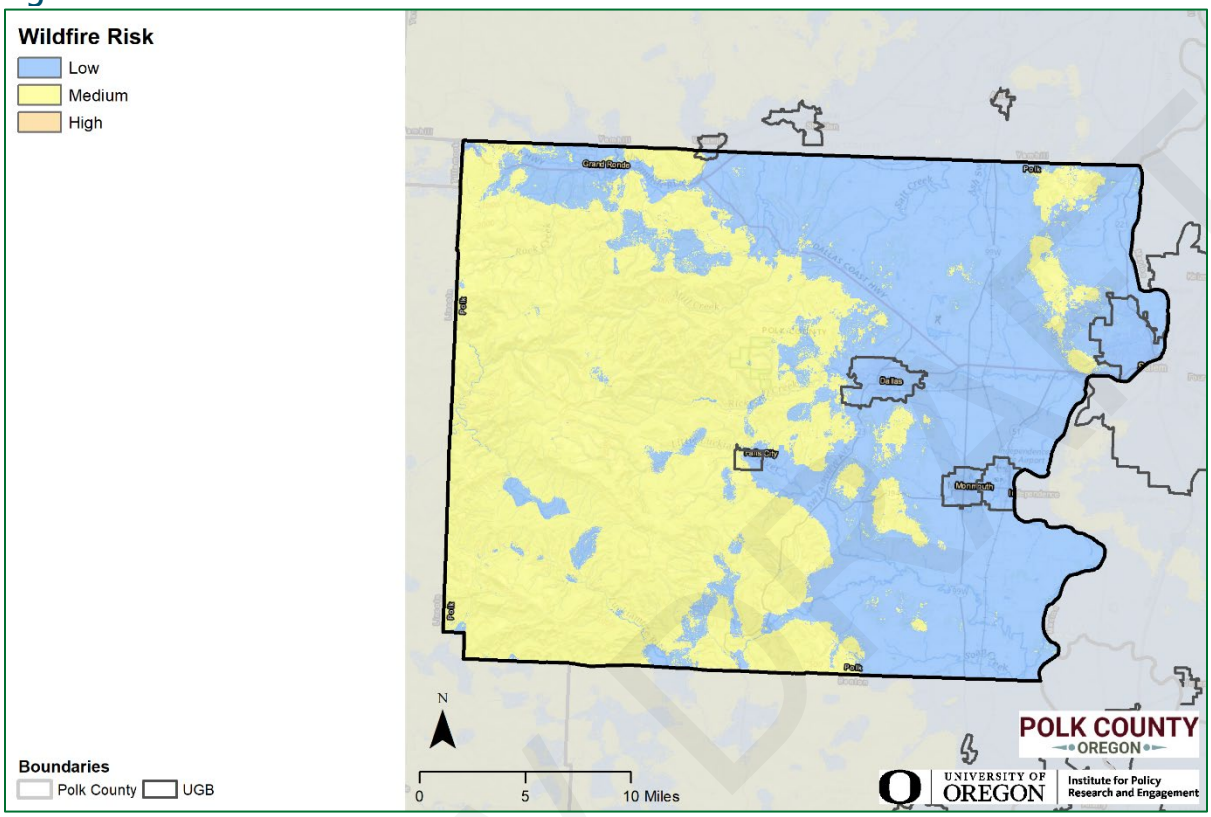
Figure 23 shows the areas of special concern for WUI fires that were identified by each committee. Figure 24 shows the wildfire risk to Polk County's community lifelines.

Figure 23 Wildfire-Areas of Special Concern

Community	Areas of Special Concern
Dallas	Populated areas of the interface adjoining natural cover and wildland areas. Can occur in hilly area around Bridlewood Water Treatment Plant, Mercer Reservoir, Watershed Infrastructure, and homes in SE portion of the community.
Falls City	Populated areas of the interface adjoining natural cover and wildland areas. Fire in the hills bordering the town could propagate into the City. Prior fire events have had favorable wind keeping the fire confined to the hills.
Independence	Populated areas of the interface adjoining natural cover and wildland areas. No damages occurred to date.
Monmouth	Populated areas of the interface adjoining natural cover and wildland areas. Droughts for last decade have increased elements compatible for wildfires; growing rural population leads to more accidental fires. Willamette Valley contains wheat crops, which are very prone to fire.

Source: 2009 Steering Committee (Updated in 2017)

Figure 24 Wildfire Risk



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

History

ODF records of historical fires show that minor wildland fires occur regularly in Polk County. Fire protection services have generally been able to contain these fires before they exceed 10 acres. The county's success in controlling wildland fires is likely due to a combination of well- run fire protection services, moderately high to high levels of rainfall, and the fact that most of the county's forests are disease-free and actively managed for timber.

Due to successful fire control, the minor wildland fires that have occurred in Polk County have damaged relatively few residential areas, scattered buildings, and natural resources in the affected forests. However, if a major wildland fire were to occur in the county, it would have the potential to severely impact residential structures, roads, power lines, and other critical infrastructure.

Significant conflagration fires have taken place in Polk County; such as the 1849 Siletz fire that burned at least two million acres of forestland (including 800,000 acres in portions of Lincoln and Polk counties), an unnamed fire in 1945 (12,785-acres), and the Rockhouse fire (5,000 acres), and Shady Lane fire (1,100 acres) in 1987. The Shady Lane fire, affecting the Rickreall Watershed, was declared a State Conflagration and received FEMA Fire Suppression

Assistance and caused sediment damage to the Mercer Reservoir the sources of the City of Dallas' water supply.[39]

There have been no significant wildfire events since the previous plan (as shown in *italics* below):

- August 17, 2013. 200-acre wildfire along Highway 22 burned near a winery close to Dallas. Firefighters from Dallas, Yamhill, Polk County, Sheridan, Willamina, McMinnville, and Depoe Bay were dispatched.
- July 24, 2015. 250- to 300-acre wildfire West of Monmouth – contained after several hours. No injuries or reported damages to property.

Future Projections

According to the Oregon Climate Change Research Institute "Future Climate Projections, Polk County,"[40] wildfire frequency and intensity and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Polk County by 11 days (range -7–28) by the 2050s, relative to the historical baseline, under the higher emissions scenario. The average number of days per year on which vapor pressure deficit is extreme is projected to increase by 25 (range 8–42) by the 2050s. Communities will need to address growing wildfire risks if populations are not restricted from expanding further into higher risk areas.

Probability Assessment

Certain conditions must be present for significant interface fires to occur. The most common are hot, dry, and windy weather; the inability of fire protection forces to contain or suppress the fire; the occurrence of multiple fires that overwhelm committed resources; and a large fuel load (dense vegetation). Once a fire has started, several conditions influence its behavior, including fuel, topography, weather, drought, and development.

Based on the available data and research for Polk County, the NHMP Steering Committee determined the **probability of experiencing a Wildfire is "moderate",** meaning one incident is likely within the next 10 to 35-year period; *this rating has not changed since the previous NHMP.*

Vulnerability Assessment

The 2009 Polk County Community Wildfire Protection Plan (CWPP) profiles two strategic planning areas: Zone 1 is the forested, mountainous area in the western portion of the county, and Zone 2 is the primarily agricultural areas to the east. Each zone is distinguished based on similar fuel conditions that would require similar initial attack techniques.

[39] Polk County Community Wildfire Protection Plan (2009)
[40] Oregon Climate Change Research Institute, *Future Climate Projections, Polk County, Oregon*. May 2023.

The risk rating presented below is from the Polk County CWPP (2009) and serves to identify where certain constant variables are present.

> ***Ignition Risk:*** *Most wildfires in Polk County are human-caused and the risk for wildfire ignition becomes greater as the density of homes increases. There are only a few homes in Zone 1, these being located on the eastern edge of the zone. The density of homes outside the incorporated cities is fairly uniform in Zone 2. However, there is a concentration of homes in the suburbs of West Salem and Dallas. Not surprisingly, the number of fire starts in these areas is higher than in most areas.*
>
> ***Hazard:*** *The high scores for this factor are primarily due to heavy fuel loads throughout both zones. Zone 1 does have heavier fuel loads overall, but the fuels in Zone 2 are considered flashy (easy to ignite and fast moving) which balances the heavier loads in Zone 1.*
>
> ***Values:*** *Zone 1 has important natural resource values while Zone 2 has agricultural products and homes at risk from wildfire. Both have important infrastructure to be considered.*
>
> ***Protection Capability:*** *While Zone 1 is vulnerable because response time from organized fire departments is high, it has proven mitigation efforts in place with loggers who are often on-site and have equipment for firefighting. Zone 2 lacks in community preparedness but response time from fire protection districts is good. Response capability for the Salem and Dallas Fire Departments is very strong.*
>
> ***Overall Wildfire Risk Rating:*** *Both Zones 1 and 2 are considered a High Risk based on the combined scores of the four factors. Total scores that are more than 119 are considered in the High Risk category.*

2023 Assessment

The 2023 Multi-Hazard Risk Report for Polk County emphasizes areas where lives and property are at greatest risk.

Polk Countywide wildfire exposure (High or Moderate Risk):

- Number of buildings: 907
- Value of exposed buildings: $192,294,000
- Percentage of total county value exposed: 1.4%
- Critical facilities exposed: 2 of 81
- Potentially displaced population: 1,529

For this risk assessment, the building locations were compared to the geographic extent of the wildfire hazard categories. More than 900 buildings in Polk County are exposed to High or Moderate wildfire hazard. Most of the exposure to wildfire hazard occurs in the unincorporated county, but also incorporated communities have some exposure to these hazard zones. The primary areas of exposure to this hazard are in the forested

unincorporated areas in the western portions of the county. Nearly all of the buildings in the incorporated communities of Polk County fell into the Low-risk category.[41]

The NHMP Steering Committee rated the county as having a **"moderate" vulnerability to wildfire hazards**, meaning that more than 10% of the County's population or assets would be affected by a major disaster; *this rating has not changed since the previous NHMP.*

[41] DOGAMI, Multi-Hazard Risk Report for Polk County, Oregon OR-24-???, March 2024.

Section 3: Mitigation Strategy

This section outlines Polk County's strategy to reduce or avoid long-term vulnerabilities to the identified hazards. Specifically, this section presents a mission and specific goals and actions thereby addressing the mitigation strategy requirements contained in 44 CFR 201.6(c). The NHMP Steering Committee reviewed and updated the mission, goals and action items documented in this NHMP. Additional planning process documentation is in Volume II, Appendix B.

Mitigation Plan Mission

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

The mission of the Polk County NHMP is:

To assist in reducing risk, preventing loss, and protecting life, property, and the environment from future natural hazard events. The plan fosters collaboration and coordinated partnerships among public and private partners. This can be achieved by increasing public awareness and education and identifying activities to guide the county towards building a safer community.

The 2023 NHMP Steering Committee (county and cities) reviewed the previous NHMP's mission statement and agreed to retain it without modifications.

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that Polk County residents 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 action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Stakeholder participation was a key aspect in developing the original NHMP goals in 2006. Meetings with the project Steering Committee, stakeholder interviews, 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 Polk County.

The 2023 Polk County NHMP Steering Committee (county and cities) reviewed the previous NHMP goals in comparison to the State Natural Hazard Mitigation Plan (2020) goals determined that they would retain their goals without modifications.

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

Below is a list of the NHMP goals:

GOAL 1: *PUBLIC EDUCATION AND AWARENESS*

Provide public information and education/awareness to all residents of the county concerning natural hazard areas and mitigation efforts.

GOAL 2: PREVENTIVE AND IMPLEMENTATION

Develop and implement activities to protect human life, commerce, property, and natural systems.

GOAL 3: COLLABORATION AND COORDINATION

Strengthen hazard mitigation by increasing collaboration and coordination among citizens, public agencies, non-profit organizations, businesses, and industry.

GOAL 4: FUNDING AND PARTNERSHIPS

Seek partnerships in funding and resources for future mitigation efforts.

GOAL 5: EMERGENCY OPERATIONS

Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

GOAL 6: NATURAL RESOURCES UTILIZATION

Link land use planning, development criteria, codes, and natural resources and watershed planning with natural hazard mitigation.

The participating cities agreed to retain the plan mission and goal statements.

Action Item Development Process

Development of action items was a multi-step, iterative process that involved brainstorming, discussion, review, and revisions. Action items can be developed through many sources. The figure below illustrates some of these sources.

Figure 25 Development of Action Items

Most of the action items were first created during the previous NHMP planning processes. During these processes, steering committees developed maps of local vulnerable populations, facilities, and infrastructure in respect to each identified hazard. Review of these maps generated discussion around potential actions to mitigate impacts to the vulnerable areas. The Oregon Partnership for Disaster Resilience (OPDR) provided guidance in the development of action items by presenting and discussing actions that were used in other communities. OPDR also took note of ideas that came up in Steering Committee meetings and drafted specific actions that met the intent of the Steering Committee. All actions were then reviewed by the Steering Committee, discussed at length, and revised as necessary before becoming a part of this document.

Action Items

Table 3-1 documents the title of each action along with, the lead organization, partners, timeline, cost, potential funding resources, and connection to community lifelines and vulnerable populations.

Mitigation Successes

Polk County has several examples of hazard mitigation including the following projects funded through FEMA Hazard Mitigation Assistance and the Oregon Infrastructure Finance Authority's Program[42].

FEMA Funded Mitigation Successes
None identified

Seismic Rehabilitation Grant Program Mitigation Successes
None identified

See city addenda for mitigation successes within each city.

Action Item Framework

Many of the NHMP's recommendations are consistent with the goals and objectives of each jurisdiction's (County, cities, special districts) existing plans and policies. Where possible, each jurisdiction will implement the NHMP's recommended actions through existing plans and policies. Plans and policies already in existence have support from residents, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented.

Action Item Development and Prioritization

The action items were developed through a two-stage process. In stage one, OPDR facilitated a work session with each jurisdiction's steering committee to discuss vulnerabilities, risk profile, and to identify potential issues. In the second stage, OPDR, working with each jurisdiction's steering committee, developed potential actions based on the hazards and the issues identified.

During the 2023 update process each of the jurisdiction's steering committee re-evaluated their hazard mitigation strategy (Action Items), noting what accomplishments had been

[42] 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.

made, and whether the actions were still relevant; any new action items were identified at this time (see Volume II, Appendix B and Volume III for more information).

Each steering committee developed action items priorities to reflect current conditions, needs, and capacity. High priority actions are shown in bold text with orange highlights. The Jurisdictions will focus their attention and resource availability upon these achievable, high leverage activities over the next five years. Although this methodology provides a guide for the jurisdictions in terms of implementation, each jurisdiction has the option to implement any of the action items at any time. This option to consider all action items for implementation allows jurisdictions to consider mitigation strategies as new opportunities arise, such as capitalizing on funding opportunities. Mitigation actions that were not prioritized will be considered for prioritization during maintenance meetings.

Prioritization of High Hazard Potential Dam Actions

Polk County has opted to locally prioritize the eligible high hazard potential dam. The Oregon Water Resources Department (OWRD) is the State determined eligible non-federal governmental organization that can meet the compliance requirements and will work with dam owners statewide to apply for the HHPD grant program.

HHPD Linkage to NHMP Goals

The four HHPD related actions (6.9, 6.10, 6.11, 6.12) reduce long term vulnerabilities consistent with NHMP Goal 3 (Prevention), Goal 4 (Property Protection), Goal 5 (Partnership and Coordination), and Goal 7 (Structural Protection).

See Volume III for the action items for each participating jurisdiction.

Figure 26 Action Items

Action Item #	Mitigation Actions	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Potential Funding Resources	Lead	Partners	Timeline	Cost
1	Identify mitigation measures necessary to maintain identified primary and secondary transportation routes to interconnect critical facilities. Maintain a map with these emergency routes to be used in the event of a natural hazard.		x		x	x	x	x			Local Funding Resources	Emergency Management	Public Works, GIS	O	L
2	Reduce potential isolation of critical facilities in the event of a natural hazard by creating redundancy. Create a map with alternative transportation routes. Create a plan for multiple communication alternatives.		x	x	x	x	x	x	x	x	Local Funding	Public Works	Fire Department, ODOT	L	L
3	Utilize social media as a communication outlet in the event of a natural hazard.	x	x	x	x	x	x	x	x	x	Local Funding	Emergency Management	Administration	O	L
4	Review and update the Polk County Emergency Operations Plan on an annual basis. Balance the objectives of existing program's goals with natural hazard mitigation.	x	x	x	x	x	x	x	x	x	Local Funding Resources, DLCD	Emergency Management	Planning	O	L
5	Identify coordination and collaboration opportunities to maximize or leverage funding opportunities that address multi-jurisdictional projects. Consider opportunities for public and private partnerships.	x	x	x	x	x	x	x	x	x	Local Funding Resources, FEMA	Emergency Management	Planning	O	L

Action Item #	Mitigation Actions	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Potential Funding Resources	Lead	Partners	Timeline	Cost
6	Strengthen emergency services preparedness and response by linking emergency services with natural hazard mitigation programs and enhance public education on a regional scale.	x	x	x	x	x	x	x	x	x	Local funding, HMGP	Emergency Management	Public Works, Planning	O	L
7	Develop, enhance, implement, and sustain education programs aimed at mitigating natural hazards and reducing the risks to citizens, public agencies, private property owners, businesses, and schools. Focus on providing web-based outreach materials concerning mitigation, preparedness, and safety procedures for all natural hazards.	x	x	x	x	x	x	x	x	x	Local Funding Resources, ODOE, HMA, HMGP	Planning	School districts, Willamette ESD, Emergency Management, County Administration	O	L
8	Develop, incorporate, and cross reference mitigation planning provisions into zoning ordinances and all community planning processes, such as comprehensive, capital improvement, land use, transportation, and emergency operations plans, etc., to demonstrate multi-benefit considerations and facilitate using multiple funding sources. Pay particular attention to maintaining the floodway and protecting critical infrastructure and private residences through floodplain development permit process.	x	x	x	x	x	x	x	x	x	General Fund, HMGP, HMA, EOC	Planning	Emergency Management, County Administration	O	L

Action Item #	Mitigation Actions	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Potential Funding Resources	Lead	Partners	Timeline	Cost
9	Update and maintain critical facility list needing emergency back-up power systems. Prioritize critical facilities susceptible to short term power disruption (i.e. first responder and medical facilities, schools, correctional facilities, and water and sewage pump stations, etc.). Purchase and install generators with main power distribution disconnect switches for identified and prioritized critical facilities as funding becomes available.		x	x	x	x	x	x	x	x	General Fund, HMGP, HMA, SPIRE	Emergency Management	Public Works, GIS	L	M
10	Update the county's debris management plan. Enhance strategies for debris management and/or removal after windstorm events.		x			x			x		General Fund, PA	Emergency Management	Community Development, Public Works	O	L
11	Encourage dissemination of ideas by county-based agencies on effective methods of water use curtailment and provide information about emergency water rights for domestic uses.	x		x							General Fund, NRCS	Community Development		O	L
12	Encourage water providers to inter-tie water systems.	x		x							General Fund	Community Development		O	L
13	Support agencies' plans for long-range water resources development that leads to additional water supplies and help determine funding sources for the studies.	x	x	x	x		x				General Fund, NRCS	Community Development	OWRD	O	L
14	Notify property owners when expansive soils are identified on their property.		x		x	x					General Fund	Community Development	Community Development	O	L

Action Item #	Mitigation Actions	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Potential Funding Resources	Lead	Partners	Timeline	Cost
15	Require road design, engineering, and construction processes that address expansive soil conditions. Water absorption prevention, impermeable membrane, soil compaction, and drainage methods need to be considered once geologic studies determine soil composition.	x	x		x	x					General Fund	Public Works	Community Development	O	L
16	Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices. Inform residents and business owners of the value of earthquake hazard insurance.		x								General Fund	Emergency Management	Community Development	O	L
17	Encourage seismic strength evaluations of critical facilities to identify vulnerabilities and to meet current seismic standards. Improve local capabilities to perform earthquake building safety evaluations.		x								General Fund	Emergency Management	Building Division, Public Works	O	L
18	Use priority transportation route map to identify and prioritize bridges that are not seismically adequate. Retrofit these bridges as funding becomes available.		x								General Fund, FHWA	Public Works	Community Development, ODOT	L	H
19	Implement and enforce State Building Codes. Inspect and/or certify all new construction as applicable.		x		x	x			x		General Fund	Building Division	Public Works	O	L

Action Item #	Mitigation Actions	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Potential Funding Resources	Lead	Partners	Timeline	Cost
20	Develop web-based outreach program to educate public concerning NFIP participation benefits, floodplain development, land use regulation, and NFIP flood insurance availability to facilitate continued compliance with the NFIP. Conduct workshops for target audiences on NFIP and mitigation activities.				x						General Fund, HMGP	Community Development	FEMA	O	L
21	Identify and mitigate repetitively flooded structures and infrastructure, analyze the threat to these facilities, and prioritize mitigation actions to acquire, relocate, elevate, and/or flood proof to protect the threatened population. Prioritize most cost beneficial and feasible projects.				x						Local Funding Resources, DLCD, FEMA, ASFPM	Community Development	DLCD, FEMA	S	H
22	Continue to coordinate with appropriate agencies and maintain an inventory of all aggregate operations adjacent to or within the floodplain.				x						Local Funding Resources, FEMA, DLCD	Community Development	Public Works	O	L
23	Prioritize locations along County roads that have frequent flooding. Use this prioritized list to determine projects for reducing frequency of flooding such as: increase culvert sizes and drainage efficiency, construct concrete wing walls at culvert or bridge entrances and outlets to direct water flow into their openings, raise bridge height or convert bridge from a multi-span to a single span to increase water flow and reduce debris catchment.				x						General Fund, HMGP, HMA, PA	Public Works	Community Development	O	H
24	Install new precipitation measuring gauges and develop monitoring and early warning program.				x						General Fund, NOAA/NWS, HMGP	Emergency Management	Public Works, GIS	O	M

Action Item #	Mitigation Actions	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Potential Funding Resources	Lead	Partners	Timeline	Cost
25	Maintain public drainage systems and encourage property owners to maintain private drainage systems.				x						General Fund	Public Works	Community Development	O	L
26	Develop and provide information to all residents on riverbank erosion and methods to prevent it in an easily distributed format.				x	x					General Fund, HMGP, HMA	Emergency Management	Public Works	O	L
27	Install riprap or pilings to harden streambanks where severe erosion occurs.				x	x					Local Funding, HMGP, NRCS	Public Works	DSL, FEMA	O	M
28	Install bank protection such as rock, concrete, asphalt, vegetation, or other armoring or protective materials to provide riverbank protection.				x	x					Local Funding, HMGP, NRCS	Public Works	DSL, FEMA	O	M
29	Harden culvert entrance bottoms with asphalt, concrete, rock, etc. to reduce erosion or scour.				x	x					Local Funding, HMGP, NRCS	Public Works	DSL, FEMA	O	M
30	Coordinate with FEMA and state agencies to maintain and update Flood Insurance Rate Maps (FIRM) for Polk County as funding becomes available. Use information obtained to update flood insurance and for feasibility determination and project design at the planning level.				x						General Fund, HMGP	Public Works	FEMA	L	L

Action Item #	Mitigation Actions	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Potential Funding Resources	Lead	Partners	Timeline	Cost
31	Use LIDAR data to improve knowledge of landslide hazard areas and prioritize primary and secondary lifeline transportation routes based on this information.		x			x					General Fund	Public Works	GIS	O	L
32	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm or winter storm events. Identify hazard trees, encourage harvesting of hazard trees within utility and road corridors, and those blown down during storm events.								x	x	Utilities, Local Funding Resources, HGMP	Public Works	HMT, Emergency Management, Community Development	S	L
33	Increase and maintain public awareness of severe windstorms and winter storms and the benefits of mitigation activities through web-based education aimed at households and businesses and increase targeting of special needs populations.								x	x	General Fund, HMGP	Emergency Management	Utilities, Community Development	O	L
34	Enhance strategies for management of debris from severe winter storms.								x	x	General Fund	Public Works	Emergency Management, GIS, Community Development, solid waste facilities	O	L
35	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe storms.								x	x	General Fund, Utilities	Emergency Management	Public Works	O	L

Action Item #	Mitigation Actions	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Potential Funding Resources	Lead	Partners	Timeline	Cost
36	Inform citizens about the most current Uniform International and State Building Codes to ensure structures can withstand storm hazards such as high winds, rain, water, and snow.				x				x	x	General Fund	Building Division	Public Works	O	L
37	Review critical facilities and government building energy efficiency, winter readiness, and electrical protection capability. Identify, prioritize, and implement infrastructure upgrade or rehabilitation project prioritization and development.			x					x	x	General Fund, HMGP	County Administration	Emergency Management, Public Works	O	H
38	Increase awareness of volcanic eruptions and their potential impact to the county.						x				General Fund	Emergency Management	Community Development	O	L
39	Work with Polk Fire Defense Board in the review of plans and inspection of structures, access, and water supply for fire code compliance. Promote FireWise building, siting, design, and construction materials.							x			General Fund, FMAP	Building Division	Fire Districts	O	L
40	Advocate accessible water storage facilities in development not connected to a community water/hydrant system in the wildland/urban interface (WUI).							x			General Fund, FMAP	Community Development	Public Works	O	L
41	Enhance and promote existing outreach and education programs aimed at mitigating wildfire hazards and reducing or preventing the exposure of citizens, public agencies, private property owners, and businesses to natural hazards, particularly those in the WUI. Consider updating maps related to fire hazards and encourage fire-safe construction practices.							x			General Fund, FMAP	Emergency Management	Community Development, Fire Districts	O	L

Action Item #	Mitigation Actions	Drought	Earthquake	Extreme Heat	Flood	Landslide	Volcanic Event	Wildfire	Windstorm	Winter Storm	Potential Funding Resources	Lead	Partners	Timeline	Cost
42	Inform citizens about programs that assist landowners in reducing fuel loads on private property. Encourage home landscape cleanup (defensible space) and define debris disposal programs. Identify, develop, implement, and enforce mitigation actions such as fuel breaks and reduction zones for potential wildland fire hazard areas. Incorporate enforceable conditions in residential permits in forest zones.							x	x		General Fund, FMAP	Emergency Management	Community Development, Fire Districts	O	L
43	Look for solutions to protect structures located outside of fire districts through partnerships, grant funding, fire protection contracts, or expansion of fire district services.							x			General Fund, FMAP	Emergency Management	Polk Fire Defense Board, Fire Districts	O	M
44	Identify evacuation routes away from high hazard areas and develop outreach programs to educate the public concerning warnings and evacuation procedures.		x		x	x		x	x	x	General Fund, FMAP	Emergency Management	Fire Districts, Public Works, Sherrif's Office	O	L
45	Participate in the maintenance, implementation, and update of the Polk County Community Wildfire Protection Plan (2024).							x			General Fund, HMGP	Emergency Management	Community Development, Fire Districts, Polk Fire Defense Board	O	L

Cost: L – Low (less than $50,000), M - Medium ($50,000-$150,000), H - High (more than $150,000)
Timing: O-Ongoing (continuous), S-Short (1-2 years), M-Medium (3-5 years), L-Long (5 or more years)
Priority Actions: Identified with **bold** text and **orange** highlight.

Section 4: Plan Implementation and Maintenance

This section details the formal process that will ensure that the NHMP remains an active and relevant document. The plan implementation and maintenance process include a schedule for monitoring and evaluating the NHMP semi-annually, as well as producing an updated plan every five years. Finally, this section describes how the County will integrate public participation throughout the NHMP maintenance and implementation process.

Implementing the NHMP

The success of the Polk County NHMP depends on how well the outlined action items are implemented. In an effort to ensure that the activities identified are implemented, the following steps will be taken: 1) the NHMP will be formally adopted, 2) a Steering Committee will be assigned, 3) a convener shall be designated, 4) semi-annual meetings will be held, 5) the identified activities will be prioritized and evaluated, and 6) the NHMP will be implemented through existing plans, programs and policies.

NHMP Adoption

The Polk County NHMP was developed and will be implemented through a collaborative process. After the NHMP is locally reviewed and deemed complete, the Polk County Emergency Manager, or their designee, shall submit it to the State Hazard Mitigation Officer (SHMO) at the Oregon Department of Emergency Management (OEM). OEM submits the NHMP to FEMA-Region X for review. This review addresses the federal criteria outlined in the FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, the County will adopt the NHMP via resolution. At that point, the County will gain eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program, and Flood Mitigation Assistance program funds. Following adoption by the County, the participating jurisdictions should convene local decision makers and adopt the Polk County Multijurisdictional NHMP.

Convener

The Polk County & Economic Community Development Department will take responsibility for NHMP implementation and will facilitate the Hazard Mitigation Steering Committee meetings and will assign tasks such as updating and presenting the NHMP to the rest of the members of the Steering Committee (see City Addenda for city conveners). NHMP

implementation and evaluation will be a shared responsibility among all of the assigned Steering Committee Members. The Convener's responsibilities include:

- Coordinate Steering Committee meeting dates, times, locations, agendas and member notification;
- Document the discussions and outcomes of committee meetings;
- Serve as a communication conduit between the Steering Committee and the public/stakeholders;
- Identify emergency management-related funding sources for natural hazard mitigation projects; and
- Utilize the Risk Assessment as a tool for prioritizing proposed natural hazard risk reduction projects.

Steering Committee

The Polk County Convener will maintain a Natural Hazard Steering Committee for updating and implementing the NHMP. The Steering Committee responsibilities include:

- Attend future maintenance and NHMP update meetings (or designating a representative to serve in your place);
- Serve as the local evaluation committee for funding programs such as the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds and Flood Mitigation Assistance program funds;
- Prioritize and recommend funding for natural hazard risk reduction projects;
- Evaluate and update the NHMP in accordance with the prescribed maintenance schedule;
- Develop and coordinate ad hoc and/or standing subcommittees as needed; and
- Coordinate public involvement activities.

Members

The following jurisdictions, agencies and/or organizations were represented and served on the Steering Committee during the development of the Polk County NHMP and may be represented during implementation and maintenance phase (for a list of individuals see *Acknowledgements*):

- Polk County Emergency Management
- Polk County Economic & Community Development
- Polk County Public Works
- Polk County Public Health
- City of Dallas
- City of Falls City
- City of Independence
- City of Monmouth

To make the coordination and review of the Polk County NHMP as broad and useful as possible, the Steering Committee will engage additional stakeholders and other relevant hazard mitigation organizations and agencies to implement the identified action items. Specific organizations have been identified as partners in the action item matrices.

Implementation through existing programs

The NHMP includes a range of action items 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. Polk County and the participating cities currently address statewide planning goals and legislative requirements through their comprehensive land use plans, capital improvement plans, mandated standards and building codes. To the extent possible, Polk County and participating cities will work to incorporate the recommended mitigation action items into existing programs and procedures.

Many of the recommendations contained in the NHMP are consistent with the goals and objectives of the participating City and County's existing plans and policies. Where possible, Polk County and participating cities should implement the recommended actions contained in the NHMP through existing plans and policies. Plans and policies already in existence often have support from residents, businesses, and policy makers. Many land-use, comprehensive and strategic plans get updated regularly and can adapt easily to changing conditions and needs. Implementing the action items contained in 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 activities include:

- City and County Budgets
- Community Wildfire Protection Plans
- Comprehensive Land Use Plans
- Economic Development Action Plans
- Zoning Ordinances and Building Codes

For additional examples of plans, programs or agencies that may be used to implement mitigation activities refer to list of plans in Volume I, Section 2.

Capabilities Assessment

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

Existing Authorities

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

Comprehensive Plan

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

The Polk County Comprehensive plan provides the policy and regulatory foundation for all land use management in Polk County. It integrates policies and recommendations to meet the Oregon Statewide Planning Goals, including Statewide Planning Goal 7, Natural Hazards.

Section D, Natural Resources, includes goals to conserve and manage water resources in order to maintain and protect water quality and quantity and to abate flood, erosion, and sedimentation problems.

Section F, Land Capability/Resource Quality, includes goals and policies to protect life and property from natural hazards and disasters. Hazards identified include flooding, erosion, geological, and air quality.

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

Land Use Regulations

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

Land Use Codes

Polk County Zoning and Development Ordinance regulates land use and development in unincorporated areas throughout the county, including floodplain management. The Community Development Department administers state, regional and local land use and zoning regulations in unincorporated areas. This department reviews residential, commercial, and industrial development land use permits, and develops long-range planning strategies. Community Development also administers the Floodplain Overlay District.

Floodplain Overlay District

Chapter 178 of the Polk County Code establishes a Floodplain Overlay District "to regulate the use of those areas subject to periodic flooding and to permit and encourage the retention of open land uses that are compatible and harmonious in nature."[43]

The areas of special flood hazard regulated by this code are identified in the "The Flood Insurance Study for Polk County, Oregon, and Incorporated Areas" dated December 19, 2006.

Structural Building Codes
The Oregon Legislature recently adopted updated building codes for both residential (2021 adoption) and commercial structures (2022) since the last update of this Plan. These building codes are based on the 2021 version of the International Building Code, International Fire Code, and International Existing Building Code. Polk County administers and enforces the most recent Oregon Structural and Oregon Specialty Codes (2022), and the 2022 Oregon Fire Code. As a result, both new residential and commercial structures will be required to build according to the latest seismic and wind hardening standards in addition to requiring fire resistant building materials for those structures constructed in proximity or within the WUI.

Policies and Programs

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

Stormwater Management Plan, 2023
Polk County administers a Stormwater Management Program (SWMP) for the area of Polk County located within the City of Salem urban growth boundary (UGB). This program was updated in 2023 to meet the Municipal Separate Storm Sewer System (MS4) Phase II General Permit requirements of the National Pollutant Discharge Elimination System (NPDES), which became effective on March 1, 2019.

TMDL Implementation Plan
Polk County also implements a Total Maximum Daily Load (TMDL) Implementation Plan. The TMDL Implementation Plan is designed to reduce river and stream temperatures as well as the levels of bacteria and mercury that enter County rivers and streams. The TMDL Implementation Plan applies countywide.

Polk County Emergency Operations Plan, 2022
The Polk County Emergency Operations Plan (EOP) is a framework that provides guidance for coordinated preparedness, response, and recovery activities in the county. It was developed through collaboration across County departments, local jurisdictions, special districts, and community partners.

Communications Plan, 2023

[43] 178.010 Purpose, Floodplain Overlay District, Polk County Code.

The Public Safety Communications Plan for Interoperability is a locally driven strategic planning approach in enhancing communications interoperability across the County. This plan includes a three-phase plan for implementation, including work that is already underway as well as in the planning stages.

Community Wildfire Fire Protection Plan (2024)
The Community Wildfire Protection Plan will be incorporated into this Plan as a functioning annex. This plan seeks to reduce the risk of wildfire to life, property and natural resources in Polk County by coordinating public agencies, community organizations, private landowners, and the public to increase their awareness of and responsibility for fire issues.

National Flood Insurance Program
Polk County participates in the National Flood Insurance Program. The Planning Director is responsible for administering the day-to-day activities of the County's floodplain program. They are assisted by the Building Official, Engineering, and by the County Administrator.

Specifically, the floodplain manager:

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

Polk County participates in the NFIP's Community Rating System (CRS) at a rating of 9. This program provides discounts to residents' flood insurance payments connected to enhanced programs offered/enforced by the County that reduce risk from floods.

Community Emergency Response Team (CERT)
There are three (3) active CERT teams in Polk County:

- Polk CERT
- Grand Ronde CERT

- Salem CERT

Personnel

The following Polk County personnel have assignments related to natural hazard mitigation planning and implementation:

Emergency Management: Dean Bender- Polk County Emergency Manager (EM)

Public Information Officer: Dean Bender- EM; Dustin Newman-Polk County Sheriff's Office; Greg Hansen- Polk County Administrator

Floodplain Manager: Austin McGuigan- Polk County Planning Director

Grant writing (for Public Works or emergency management):

- Public Works: Todd Whitaker- Public Works Director
- Emergency Management: Dean Bender for EM type grants like State Preparedness and Incident Response Equipment (SPIRE) Grant and State Homeland Security Grant

Capital improvement planning: Greg Hansen- Polk County Board of Commissioners (BOC) Office

Capital improvement execution: Greg Hansen- Polk County Administrator

These personnel integrate hazards and resilience planning into their greater work programs to the best of their abilities. However, there is limited capacity to expand upon their capabilities or workloads.

County Administration

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

County Emergency Management

Polk County Disaster Management (CCDM) is responsible for the mitigation, preparedness, planning, coordination of response, and recovery activities related to county emergencies and disasters. County Emergency Management also serves as the primary coordination point between local, State, and Federal agencies when emergency activities are affecting more than one jurisdiction, county department, incorporated city, unincorporated area, special district, or other partner agencies.

Public Health

Polk County Public Health includes programs and policies related to communicable disease, health promotion programs, immunizations, and family and child welfare.

Polk County Environmental Public Health promotes the health and safety of the community through education and enforcement of public health regulations pertaining to food, pool, and lodging facilities; public drinking water systems; as well as wood stoves and open burning.

Capital Projects

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

- Communications Towers at Polk County Fairgrounds, Polk County Public Works Office, and Mt. Pisgah
- Jail HVAC -2017
- Buchanan Building Remodel – 2017-2018
- Jail New Roof – 2020
- Courthouse Remodel – 2021 (includes the historic and annex upgrades)
- Fairgrounds Building A remodel – 2022
- Emergency Operations Center (new building) – 2021
- Public Works Remodel – 2022
- Family and Community Outreach Building – 2023
- Replaced large arch pipe on Oakdale Road with a bridge
- Culvert removal project at Falls City for a new bridge on Mitchell St.

Capital Resources

Polk County maintains several capital resources that have important roles to play in the implementation of the natural hazard mitigation plan, including:

Communication towers:

Eagles Crest Tower, Fairgrounds Tower, Public Works Tower, Cupid's Knoll Tower, IDP Rooftop Tower, Mt. Pisgah Tower, Bald Mt. Tower, Fishback Tower, Prospect Hill Tower, Courthouse Rooftop Tower, Grand Ronde Tower, Doane Creek Tower, WVCC Tower, Marion County Fire Cordon Road Tower, Lowen Tower

Critical facilities with power generators:

The Polk County Courthouse, Fairgrounds, Public Works, and Public Health buildings are all critical facilities with power generators. In addition, there is the Partnering First Responder City and District locations. Polk County also has two (2) large mobile generators.

Warming or cooling shelters:

Warming and cooling shelters are open on a rotating and temporary basis. See https://polkwarming.weebly.com/ for more information.

Community shelters:

Family Promise (Salem)

Food pantries:

Dallas Food Bank, Dallas H2O, Dallas Seventh Day Adventist, Department of Human Services (Dallas), Ella Curran Food Bank (Independence), Family Life (Salem), Grand Ronde Food Bank, Kingwood Bible Church (Salem), Life Church (Salem), Monmouth Christian Church , Mountain Gospel Fellowship (Falls City), Polk County Resource Center (Dallas), Shared Blessing @ Family Life Church (Salem), Valley Life Center (Dallas), Winston Salem United Methodist Church (Salem), Western Oregon University Food Pantry (Monmouth), James 2 Community Kitchen (Dallas and Falls City), Mountain Gospel Fellowship (Falls City)

Fueling storage:

The Polk County Public Works Department yard has large fuel storage tanks and has been identified by Oregon as the fuel hub for Polk County (both gasoline and diesel fuel).

Findings

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

Staffing Limitations and Capacity

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

Reliance upon outside funding streams and local match requirements

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

Leveraging Partnerships with Public and Nonprofit Entities

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

NHMP Maintenance

NHMP maintenance is a critical component of the NHMP. Proper maintenance of the NHMP ensures that it will maximize the County and participating cities' efforts to reduce the risks posed by natural hazards. This section was developed by OPDR and includes a process to ensure that a regular review and update of the NHMP occurs. The County Steering Committee and local staff are responsible for implementing this process, in addition to maintaining and updating the NHMP through a series of meetings outlined in the maintenance schedule below.

Meetings

The Steering Committee will meet on a semi-annual basis to complete the following tasks. During the first meeting the Steering Committee will:

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

During the second meeting, the Steering Committee will:

- Review existing and new risk assessment data;
- Discuss methods for continued public involvement;
- Evaluate effectiveness of the NHMP at achieving its purpose and goals (use Table 4-1 as one tool to help measure effectiveness); and
- Document successes and lessons learned during the year.

These meetings are an opportunity for the cities to report back to the County on progress that has been made towards their components of the NHMP. The cities will submit written reports on their progress annually based on local steering committee meetings.

The convener will be responsible for documenting the outcome of the semi-annual meetings in Volume II, Appendix B. The process the Steering Committee will use to prioritize mitigation projects is detailed in the section below. The NHMP's format allows the County and participating cities to review and update sections when new data becomes available. New data can be easily incorporated, resulting in a NHMP that remains current and relevant to the participating jurisdictions.

Project Prioritization Process

The Disaster Mitigation Act of 2000 requires that jurisdictions identify a process for prioritizing potential actions. Potential mitigation activities often come from a variety of sources; therefore, the project prioritization process needs to be flexible. Committee members, local government staff, other planning documents or the risk assessment may be

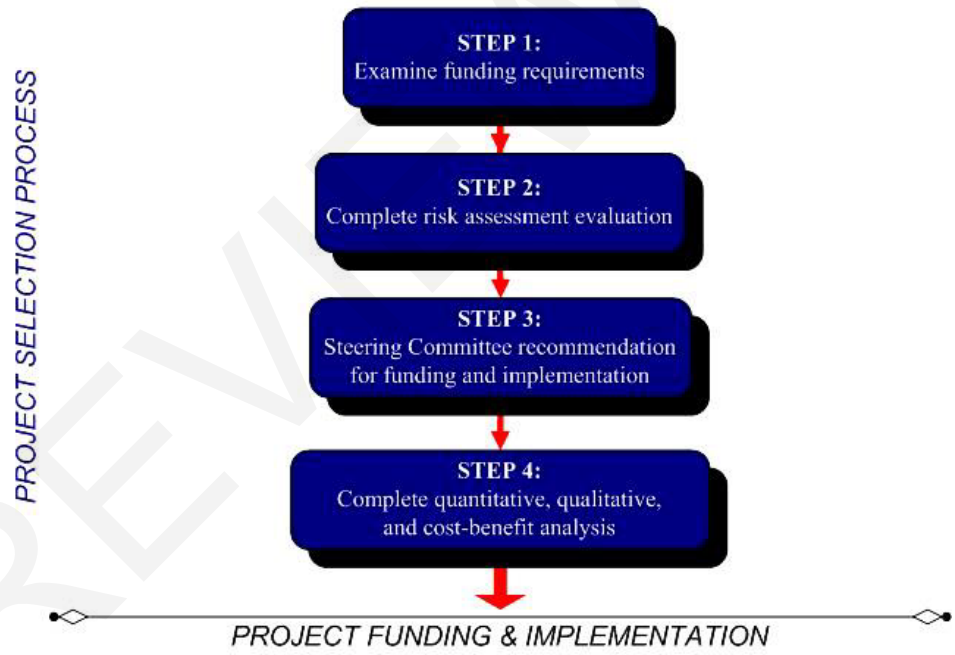
the source to identify projects. Figure 27 illustrates the project development and prioritization process.

Step 1: Examine funding requirements

The first step in prioritizing the NHMP's action items is to determine which funding sources are open for application. Several funding sources may be appropriate for the County's proposed mitigation projects. Examples of mitigation funding sources include but are not limited to: FEMA's Pre-Disaster Mitigation competitive grant 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 Volume II, Appendix E for a more comprehensive list of potential grant programs.

Because grant programs open and close on differing schedules, the Steering Committee will examine upcoming funding streams' requirements to determine which mitigation activities would be eligible. The Steering Committee may consult with the funding entity, Oregon Department 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 Steering Committee's semi-annual NHMP maintenance meetings.

Figure 27 Action Item and Project Review Process



Source: Oregon Partnership for Disaster Resilience, 2008.

Step 2: Complete risk assessment evaluation

The second step in prioritizing the NHMP's action items is to examine which hazards the selected actions are associated with and where these hazards rank in terms of community risk. The Steering Committee will determine whether the NHMP'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 Steering Committee 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.

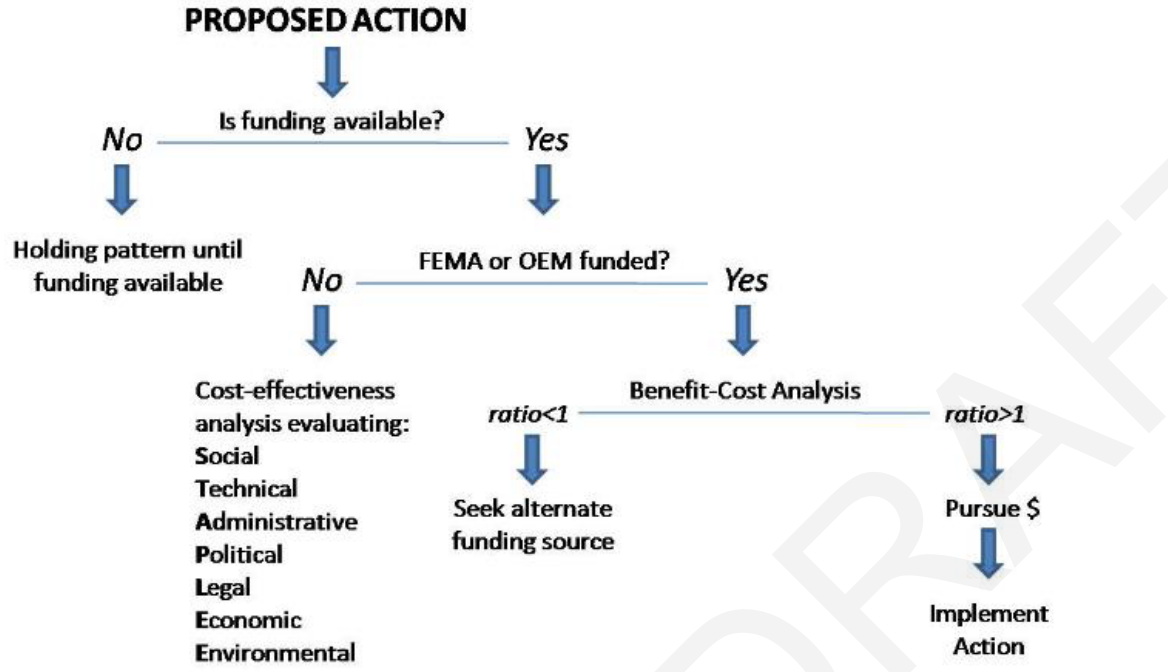
Step 3: Steering Committee Recommendation

Based on the steps above, the Steering Committee will recommend which mitigation activities should be moved forward. If the Steering Committee decides to move forward with an action, the coordinating organization designated in the matrix will be responsible for taking further action and, if applicable, documenting success upon project completion. The Steering Committee 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 strategies, measures, or projects. Two categories of analysis that are used in this step are: (1) cost-benefit analysis and (2) cost-effectiveness analysis. Conducting cost-benefit analysis for a mitigation activity assists in determining whether a project is worth undertaking now, to avoid disaster-related damages later. Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards provides decision makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects. The figure below shows decision criteria for selecting the appropriate method of analysis.

Figure 28 Benefit Cost Decision Criteria



Source: Oregon Partnership for Disaster Resilience, 2010.

If the activity requires federal funding for a structural project, the Steering Committee will use a FEMA-approved cost-benefit analysis tool to evaluate the appropriateness of the activity. A project must have a cost-benefit 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 Steering Committee will 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. OPDR at the University of Oregon's Community Service Center has tailored the STAPLE/E technique for use in natural hazard action item prioritization.

Continued Public Involvement and Participation

The participating jurisdictions are dedicated to involving the public directly in the continual reshaping and updating of the Polk County NHMP. To ensure that these opportunities will continue, the County and participating jurisdictions will:

- Post copies of their plan on corresponding 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.

In addition to the involvement activities listed above, Polk County, cities, and special districts will ensure continued public involvement by posting a link to the Polk County NHMP on their websites.

Five-Year Review of NHMP

This NHMP will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. The Polk County NHMP is due to be updated by [month day], 2029. The Convener will be responsible for organizing the Steering Committee to address NHMP update needs. The Steering Committee will be responsible for updating any deficiencies found in the NHMP and for ultimately meeting the Disaster Mitigation Act of 2000's NHMP update requirements.

The following 'toolkit' can assist the Convener in determining which NHMP update activities can be discussed during regularly scheduled NHMP maintenance meetings and which activities require additional meeting time and/or the formation of sub-committees.

Figure 29 Natural Hazard 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

Source: Oregon Partnership for Disaster Resilience, 2010.

Question	Yes	No	Plan Update Action
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: Appendices

This page intentionally left blank.

Appendix A: Glossary and Acronyms

Glossary

100-year flood means a flooding condition which has a one percent chance of occurring each year. The 100-year flood level is used as the base planning level for floodplain management in the National Flood Insurance Program. https://www.fema.gov/flood-zones

Cascadia Subduction Zone (CSZ) is the area where the seafloor plate (the Juan de Fuca and Gorda) is sliding down and below the North American plate. https://pnsn.org/outreach/earthquakesources/csz

Community Wildfire Protection Plan (CWPP) In 2003, Congress passed the federal Healthy Forests Restoration Act (HFRA), which encourages local communities to collaborate with federal land managers to develop comprehensive fuels reduction strategies. This is accomplished through the creation of a Community Wildfire Protection Plan (CWPP). https://www.fs.usda.gov/managing-land/fire

Disaster Mitigation Act of 2000 (DMA2K) amended the Stafford Act, including: establishing a national program for pre-disaster mitigation; streamlining the administration of disaster relief; changing FEMA's post-disaster programs for individuals and families, including creating the Individuals and Households Program; establishing minimum standards for public and private structures; requiring local and state natural hazards mitigation plans that meet a FEMA standard (Section 322); revising - in part - FEMA funding for the repair, restoration and replacement of damaged facilities (Section 406); revising FEMA's participation in the costs of WUI fire suppression through an expanded and renamed Fire Management Assistance Grant Program (Section 420); removing the requirement for post-disaster IHMT or HMST meetings and reports; and other amendments. https://www.fema.gov/sites/default/files/2020-11/fema_disaster-mitigation-act-of-2000_10-30-2000.pd

El Niño-Southern Oscillation is a cycle in the Pacific Basin involving water and air temperatures that has a profound effect on weather patterns around the world, events typically last 6-18 months. https://www.climate.gov/news-features/blogs/enso/what-el-ni%C3%B1o%E2%80%93southern-oscillation-enso-nutshell

Firewise is a program developed by the National Fire Protection Association (NFPA) featuring templates to help communities reduce risk and protect property form the dangers of wildland fires, an interactive resource-rich website and training programs throughout the nation. http://www.firewise.org

Floodplain is a land area adjacent to a river, stream, lake, estuary, or other water body that is subject to flooding. These areas, if left undisturbed, act to store excess flood water. https://www.fema.gov/flood-zones

Floodplain Administrator/Manager is the person designated by the governing body in a flood-prone community who is responsible for making floodplain determinations for construction sites, issuing building permits for floodplain construction, ensuring compliance and other floodplain management activities. https://www.fema.gov/floodplain-managers

Floodway is the channel of a river and the portion of the floodplain that carries most of the flood flow. Floodways are usually the area where water velocities and forces are the greatest and most destructive. The National Flood Insurance Program (NFIP) definition of floodway is the channel of a river or other watercourse and adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. NFIP regulations, adopted in local ordinances, require that floodways be kept open so that flood flows are not obstructed or diverted onto other properties. https://www.fema.gov/flood-zones

Goal 7 of the statewide land use planning program calls for local comprehensive plans to include inventories, policies and implementing measures to guide development in hazard areas thereby reducing losses from flooding, landslides, earthquakes, tsunamis, coastal erosion and wildfires. https://www.oregon.gov/lcd/OP/Pages/Goal-7.aspx

Hazard is any situation that has the potential of causing damage to people, property, or the environment.

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. (44 CFR 201.2) https://www.fema.gov/hazard-mitigation-planning

Hazard Mitigation Grant Program is the program authorized under Section 404 of the Stafford Act and implemented at 44 CFR Part 206, Subpart N, which authorizes funding for certain mitigation measures identified through the evaluation of natural hazards conducted under Section 322 of the Stafford Act (44 CFR 201.2). https://www.fema.gov/hazard-mitigation-grant-program

Hazus-MH (HAZards United States Multi-Hazard) is a standardized loss estimation methodology that is also a FEMA software program using mathematical formulas and Geographical Information Systems (GIS) data about building stock, local geology, etc. and the location and size of potential hazards (earthquakes, floods, and hurricanes) to estimate physical, economic, and social impacts of disaster. https://www.fema.gov/hazus

Landslide is any detached mass of soil, rock or debris that moves down a slope or a stream channel. https://www.oregongeology.org/Landslide/landslidehome.htm

LiDAR (Light Detection and Ranging) is an optical remote sensing technology that can measure the distance to and other properties of a target, by illuminating the target with light, often using pulses from a laser. http://www.oregongeology.org/lidar/

Major disaster is any natural catastrophe including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm or drought, or, regardless of cause, any fire, flood, or explosion in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance to supplement the efforts and available resources of states, local governments and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby (44 CFR 206.2). https://www.fema.gov/disasters

National Fire Plan is a federal program that helps manage the impact of wildfires on communities, it has five main components: (1) firefighting, (2) rehabilitation and restoration, (3) hazardous fuel reduction, (4) community assistance and (5) accountability. https://www.hsdl.org/?abstract&did=480165

National Flood Insurance Program is the program run by the federal government to improve floodplain management, to reduce flood-related disaster costs and to provide low-cost flood insurance for residents of flood-prone communities. https://www.fema.gov/national-flood-insurance-program

Natural Hazard Mitigation Plan is a plan resulting from a risk assessment of the nature and extent of vulnerability to the effects of natural hazards present in a geographic area and actions needed to minimize future vulnerability to those hazards, especially a plan developed and adopted which meets the requirements of 44 CFR Part 201.4/5/6. https://www.fema.gov/hazard-mitigation-planning

Public Assistance is the part of the disaster assistance program in which the federal government supplements the efforts and available resources of state and local governments to restore certain public facilities or services. Public Assistance includes emergency assistance, debris removal, community disaster loans and the permanent repair, restoration or replacement of public and designated private nonprofit facilities damaged or destroyed by a major disaster and is further described under Section 406 of the Stafford Act. https://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

Rogue Valley Integrated Community Wildfire Protection Plan is the CWPP for Polk and Josephine counties. https://Polkcountyor.org/emergency/County-Plans/Fire-Plan

Senate Bill 762 in 2021 directed the Oregon Department of Consumer and Business Services and the Oregon State Fire Marshal to update building codes and defensible space requirements for structures located in the Wildland Urban Interface (WUI) rated in high and extreme risk areas. As regulations are put in place to implement this legislation, Polk County should implement these updated requirements through their building and land use codes. https://www.oregon.gov/odf/pages/sb762.aspx

Special Flood Hazard Area is the land area covered by the floodwaters of the base flood and is where the NFIP's floodplain management regulations must be enforced; also the area where the mandatory purchase of flood insurance applies. https://www.fema.gov/flood-zones

Stafford Act is the Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 100-707, which amended PL 91-606 and PL 93-288; then was further amended by PL 106-390, the Disaster Mitigation Act of 2000; and PL 109-295, the Post-Katrina Emergency Reform Act). https://www.fema.gov/robert-t-stafford-disaster-relief-and-emergency-assistance-act-public-law-93-288-amended

State Hazard Mitigation Officer is the official representative of state government who is the primary point of contact with FEMA, other federal agencies and local governments in mitigation planning and implementation of mitigation programs and activities required under the Stafford Act. In Oregon, this person is on the staff of Oregon Emergency Management. https://www.fema.gov/state-hazard-mitigation-officers

State Interagency Hazard Mitigation Team is a team of state agency officials who, in 1997, Governor Kitzhaber directed Oregon Emergency Management to make a permanent body and establish regular meeting dates to understand losses arising from natural hazards and coordinate recommended strategies to mitigate loss of life, property and natural resources. http://www.oregon.gov/oem/Councils-and-Committees/Pages/IHMT.aspx

Subduction zone is the area between two converging plates, one of which is sliding down and below the other. http://www.oregongeology.org/sub/publications/ims/ims-028/unit20.htm

Subduction zone earthquake is an earthquake along the subduction zone. In Oregon, this refers to the Cascadia Subduction Zone (CSZ), which lies offshore of the Oregon, California, and Washington Coasts. https://www.oregongeology.org/pubs/ims/ims-028/unit20.htm

Vulnerability is the susceptibility of life, property, or the environment to damage if a hazard manifests to potential.

Wildfire hazard zone (OAR Chapter 629, Division 44) is the portion of a local government jurisdiction that has been determined to be at risk of a catastrophic wildfire. https://secure.sos.state.or.us/oard/displayChapterRules.action?selectedChapter=82

Wildland-urban interface (WUI) is an area where structures are adjacent to or are intermingled with natural vegetation fuels which is prone to the occurrence of wildland fires. https://www.usfa.fema.gov/wui/

Acronyms

ASFPM – Association of State Floodplain Managers

BLM – Bureau of Land Management

CSZ – Cascadia Subduction Zone

CWPP – Community Wildfire Protection Plan

DEQ – Department of Environmental Quality

DLCD – Oregon Department of Land Conservation and Development

DOGAMI – Oregon Department of Geology and Mineral Industries

FEMA – Federal Emergency Management Agency

FMA – Flood Mitigation Assistance

HMA – Hazard Mitigation Assistance

HMGP – Hazard Mitigation Grant Program

NFPA – National Fire Protection Association

OEM- Oregon Office of Emergency Management

OPRD – Oregon Parks and Recreation Department

OWRD – Oregon Water Resourced Department

PDM – Pre-Disaster Mitigation Grant Program

RVCOG – Rogue Valley Council of Governments

RVIFP – Rogue Valley Integrated Community Wildfire Protection Plan

SFHA – Special Flood Hazard Area

SRGP – Seismic Rehabilitation Grant Program

USFS – United States Forest Service

This page intentionally left blank.

Appendix B: Planning and Public Process

This appendix describes the changes made to the 2017 Polk County Natural Hazard Mitigation Plan (NHMP) during the 2024 NHMP update process.

Project Background

Polk County and the cities of Dallas, Falls City, Independence, and Monmouth partnered with the Oregon Partnership for Disaster Resilience (OPDR) to update the multi-jurisdictional 2018 Polk County NHMP. 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. A Federal Emergency Management Pre-Disaster Mitigation grant funded the plan update with non-federal match provided by the Oregon Legislature.

OPDR and the committees made several changes to update and consolidate the previous NHMP. Major changes are documented and summarized in this memo.

2023-2024 NHMP Update Changes

The sections below only discuss *major* changes made to the NHMPs during the 2024 NHMP update process. Major changes include the replacement or deletion of large portions of text, changes to the NHMP's organization, new mitigation action items, and the addition of a new hazard profile (extreme heat) to the NHMP. If a section is not addressed in this memo, then it can be assumed that no significant changes occurred.

The NHMP's format and organization have been altered to fit within OPDR's NHMP templates. Figure 30 lists the 2018 Polk County NHMP section names and the corresponding 2024 section names, as updated (major Volumes are highlighted). This memo will use the 2024 NHMP update section names to reference any changes, additions, or deletions within the NHMP.

Figure 30 Changes to NHMP Organization

2018 Polk County MNHMP	2024 Polk County MNHMP
Acknowledgements	Acknowledgements
Table of Contents	Table of Contents
Approval Letters and Resolutions	Approval Letters and Resolutions
FEMA Review Tool	FEMA Review Tool
Volume 1: Basic Plan	**Volume 1: Basic Plan**
Plan Summary of the NHMP	Plan Summary of the NHMP
Section 1: Introduction	Section 1: Introduction
Section 2: Community Profile	__
Section 3: Hazard Identification and Risk Assessment	Section 2: Hazard Identification and Risk Assessment
Section 4: Mitigation Strategy	Section 3: Mitigation Strategy
Section 5: Plan Implementation and Maintenance	Section 4: Plan Implementation and Maintenance
Volume III: City Addenda	**Volume III: Jurisdicational Addenda**
Dallas	Dallas
Falls City	Falls City
Independence	Independence
Monmouth	Monmouth
Volume II: Appendices	**Volume II: Appendices**
Appendix A: Glossary and Acronyms	Appendix A: Glossary and Acronyms
Appendix B: Planning and Public Process	Appendix B: Planning and Public Process
Section 2: Community Profile	Appendix C: Community Profile
Appendix C: Hazard Analysis	__
Appendix D: Economic Analysis	Appendix D: Economic Analysis
Appendix E: Grant Programs	Appendix E: Grant Programs
Appendix F: Community Survey	Appendix F: Community Survey

As the table indicates the structure of the NHMP has changed slightly including the addition of several additional addenda. Content and changes are described below.

Front Pages

- The NHMP's cover has been updated.
- Acknowledgements have been updated to include the 2024 project partners and planning participants.
- The FEMA approval letter, review tool, and county, and city documents of adoption are included.

Volume I: Basic Plan

Volume I provides the overall NHMP framework for the 2024 Multi-jurisdictional NHMP update. Volume I includes the following sections:

Plan Summary
The 2024 NHMP includes an updated NHMP summary that provides information about the purpose of Natural Hazard Mitigation planning and describes how the NHMP will be implemented.

Section 1: Introduction
Section 1 introduces the concept of Natural Hazard Mitigation planning and answers the question, "Why develop a mitigation plan?" Additionally, Section 1 summarizes the 2024 NHMP update process, and provides an overview of how the NHMP is organized. Major changes to Section 1 include the following:

- Section 1 of the 2024 update outlines the entire layout of the NHMP update, which has been altered as described herein.

Section 2: Hazard Identification and Risk Assessment
This section consists of three phases: 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 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. Changes include:

- Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities were updated. Outdated and extraneous information was removed and links to technical reports were added as a replacement.
- Links to specific hazard studies and data are embedded directly into the NHMP where relevant and available.
- NFIP information was updated.
- The hazard vulnerability analysis has been updated for the county. City hazard vulnerability is included with more detail within Volume III.

Section 3: Mitigation Strategy

This section provides the basis and justification for the mission, goals, and mitigation actions identified in the NHMP. The mission and goals were reviewed in relation to the State NHMP. The County and cities agreed to retain the existing mission and goals.

Volume I, Section 3 provides a summary list of actions for the County. Figure 31 is an accounting of the status (complete or not complete) and major changes to actions since the previous NHMP. All actions were renumbered in this update to be consistent with other jurisdictions that are participating in the multi-jurisdictional NHMP. Actions identified as still relevant are included in the updated action plan (Figure 26).

Previous NHMP Actions that are Complete:

Multi-Hazard (MH) #10: *Install lightning rods and lightning grade surge protection devices on any new critical electronic components such as warning systems, communication equipment, and computers for critical facilities.*

Drought (DR) #4: *Encourage storage of water, especially off stream storage*.

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

Drought (DR) #3: *Support technical services and low interest loans provided to farmers and ranchers so that they can develop livestock watering systems.*

Winter Storm (WT) #3: *Develop, implement, and maintain public awareness of severe winter storms and the benefits of mitigation activities through education aimed at households and businesses, and increase targeting of special needs populations. Include strategies for debris management.* This is normal practice for Polk County that will continue to occur where opportunities arise.

Winter Storm (WT)#4: *Identify and harvest potential high-risk trees that could cause damage from a winter storm along utility and road corridors.* This is normal practice for Polk County that will continue to occur where opportunities arise.

Figure 31 Status of All Hazard Mitigation Actions in the Previous Plan

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
Multi-Hazard Mitigations Items			
MH #1	1	Ongoing, modified	Yes
MH #2	2	Prioritized for implementation	Yes
MH #3	3	Ongoing	Yes
MH #4	4	Ongoing	Yes
MH #5	5	Ongoing	Yes
MH #6	6	Ongoing	Yes
MH #7	7	Ongoing, modified	Yes

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
MH #8	8	Ongoing, modified	Yes
MH #9	9	Ongoing, partially implemented	Yes
MH #10	-	Complete	No
MH #11	10	Ongoing	Yes
Drought Mitigation Items			
DR #1	11	Ongoing	Yes
DR #2	12	Ongoing	Yes
DR #3	-	Not Complete	No
DR #4	-	Complete	No
DR #5	13	Ongoing	Yes
DR #6	14	Ongoing	Yes
DR #7	15	Partially complete, ongoing modified	Yes
Earthquake Mitigation Items			
EQ #1	16	Ongoing	Yes
EQ #2	17	Ongoing	Yes
EQ #3	18	ongoing, changed timeframe	Yes
EQ #4	19	Ongoing	Yes
Flood Mitigation Items			
FL #1	20	ongoing, modified	Yes
FL #2	21	ongoing, increased costs	Yes
FL #3	22	Ongoing	Yes
FL #4	23	Ongoing	Yes
FL #5	24	Ongoing	Yes
FL #6	25	Ongoing	Yes
FL #7	26	Ongoing	Yes
FL #8	27	Ongoing	Yes
FL #9	28	Ongoing	Yes
FL #10	29	Ongoing	Yes
FL #11	30	Ongoing, changed timeframe	Yes
Landslide Mitigation Items			
LS #1	31	Ongoing, modified	Yes
Severe Weather Mitigation Items			
WS #1	32	Ongoing, modified	Yes
WS #2	33	Ongoing, modified	Yes
WT #1	34	Ongoing	Yes
WT #2	35	Ongoing, modified	Yes
WT #3	-	Complete	No
WT #4	-	Not Complete	No

2018 Action Item	2024 Action Item	Status	Still Relevant? (Yes/No)
WT #5	36	Ongoing	Yes
WT #6	37	Ongoing, increased cost	Yes
Volcanic Event Mitigation Items			
VE #1	38	Ongoing	Yes
Wildfire Mitigation Items			
WF #1	39	Ongoing	Yes
WF #2	40	Ongoing	Yes
WF #3	41	Ongoing	Yes
WF #4	42	Ongoing, modified	Yes
WF #5	43	Ongoing	Yes
WF #6	44	Ongoing	Yes
WF #7	45	Ongoing	Yes

Section 4: Plan Implementation and Maintenance
Polk County Emergency Management will continue to convene and coordinate the County Steering Committee (documentation for the city Steering Committees is contained within Volume III).

Volume II: Appendices

Below is a summary of the appendices included in the 2024 NHMP:

Appendix A: Glossary and Acronyms
This appendix was updated with this version of the NHMP and includes common words and their acronyms found throughout the NHMP.

Appendix B: Planning and Public Process
This planning and public process appendix reflects changes made to the Polk County NHMP and documents the 2023-2024 planning and public process.

Appendix C: Community Profile
The community profile has been updated.

Appendix D: Economic Analysis of Natural Hazard Mitigation Projects
Updates are provided for the economic analysis of natural hazard mitigation projects.

Appendix E: Grant Programs and Resources
Updates were made to grant programs and resources.

Appendix F: Community Survey
This survey was administered during the development of the NHMP. This survey was utilized to inform the development of mitigation strategies. It is provided herein as documentation and to serve as a resource for future planning efforts.

Volume III: Jurisdictional Addenda

The cities of Dallas, Falls City, Independence, and Monmouth opted to participate again and include addenda in the Polk NHMP.

Where appropriate, information has been consolidated and a reference is provided within the addenda to the appropriate NHMP section. New data and hazard information was included for the participating cities and actions were reviewed, revised, and prioritized as described in the addenda.

Public Participation Process

Polk County is dedicated to directly involving the public in the review and update of the natural hazard mitigation plan. Although members of the steering committee represent the public to some extent, the residents of Polk County, Dallas, Falls City, Independence, and Monmouth were provided the opportunity to provide feedback about the NHMP. The NHMP will undergo review by the County NHMP steering committee on a semiannual basis and by the city steering committees on an annual basis.

Polk County made the NHMP available via their website throughout the update process and the updated NHMP was made available for public review and comment through the FEMA review period. The participating cities were included within the press release that was provided (see following page).

Engagement Summary

The planning process provided a variety of opportunities for the public and stakeholders to be involved.

Work Session: Polk County Board of Commissioners
On _____, Polk County Emergency Management staff briefed the Polk County Board of Commissioners on the updates to the Multi-Jurisdictional Polk County Natural Hazard Mitigation Plan.

In addition, Polk County Emergency Management presented the draft multi-jurisdictional NHMP at the following and provided a method to provide content and feedback:

The following agencies and organizations were provided an opportunity to provide input to inform the plan's content through a variety of mechanisms including the opportunity for comment on the draft plan via the meetings referenced above. The agencies and organizations represent local and regional agencies involved in hazard mitigation activities, those that have the authority to regulate development, neighboring communities, representatives of businesses, academia, and other private organizations, and representatives of nonprofit organizations, including community-based organizations, that

work directly with and/or provide support to underserved communities and socially vulnerable populations. Additional agencies and organizations are identified within each jurisdictional addendum.

- Mid Willamette Valley Council of Governments
- City of Salem
- NW Natural Gas
- Pacific Power and Light
- MINET
- Polk County Fire District No. 1
- Polk County Emergency Services
- Oregon Department of Transportation District No. 3
- Central School District

Additionally, a survey was provided to the public during the early stages of the update cycle (Volume II, Appendix F). Information from this survey was used by the steering committee to help inform their risk assessment and mitigation strategies.

During the public review period (see next page) there were xx comments received that have been integrated into revisions of the NHMP.

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

Website Posting

To be provided

Polk County Steering Committee

Steering committee members possessed familiarity with the Polk County community and how it's affected by natural hazard events. The steering committee guided the update process through several steps including goal confirmation and prioritization, action item review and development and information sharing to update the NHMP and to make the NHMP as comprehensive as possible. The steering committee met formally on the following dates:

Meeting #1: Kickoff, April 26, 2023
During this meeting, the steering committee reviewed the natural hazard mitigation planning process, including the benefits of developing a multi-jurisdictional natural hazard mitigation plan. The committee reviewed the previous NHMP and were provided a project timeline. They also reviewed and revised the NHMP's mission and goals and discussed the public outreach strategy.

Meeting #2: May 1, 2023
During this meeting, the steering committee was introduced to the Future Climate Projections for Polk County and considered these projections in the context of the types of natural hazards in the plan. They also discussed vulnerable populations to account for in the plan and identified Community Lifelines.

Meeting #3: June 15, 2023
During this meeting, the steering committee reviewed the 2017 hazard vulnerability assessment and made updates for Polk County to reflect the future climate projections. They also discussed potential action items and finalized public engagement plans (including reviewing the survey tool).

Meeting #4: October 18, 2023
During this meeting, Matt Williams from DOGAMI presented the findings of the Polk County Multi-Hazard Risk Report. The committee also reviewed and provided detailed comments on the actions. The process for implementation and maintenance was refined through a capabilities assessment. The previous NHMP's implementation and maintenance program was reviewed and any changes that were necessary were made as indicated in this appendix and Volume I, Section 5.

Meeting #5: December 12, 2023
The committee reviewed and approved the final Hazard Assessment. They also reviewed the results of the Polk County Hazard Preparedness Survey and made recommendations to incorporate/change actions based on community feedback. Other potential action Items were discussed, and the committee considered prioritization.

In addition to the meetings listed above, there were numerous informal meetings and email exchanges between steering committee members, OPDR, and other state agencies. For city specific meeting see the applicable addendum in Volume III.

The following pages includes copies of meeting agendas and sign-in sheets.

Agenda

Meeting: **Polk County NHMP Update - Kickoff**
Date: April 26, 2023
Time: 2:00 PM – 3:30 PM (1.5 hours)
Location: Zoom

I. Welcome and Background
- a. Introductions
- b. Kickoff meeting goals
- c. Review agenda

II. Natural Hazard Mitigation Planning (NHMP) Overview
- a. What is mitigation?
- b. Benefits of natural hazard mitigation planning
- c. Components of NHMP

III. NHMP Update Project Overview
- a. Project Timeline

IV. Mission and Goals review
- a. Examples
- b. Feedback

V. Public Outreach Strategy
- a. Examples of outreach
- b. Document your outreach!

VI. Wrap Up and Next Steps
- a. Second Steering Committee meeting will be in May – Set date
- b. Homework
- c. Questions?

Agenda

Meeting: **Polk County NHMP Update**
Date: May 10, 2023
Time: 10:00AM-11:30AM
Location: Zoom (linked here)

I. **Welcome**

II. **Climate Projections and Implications for Natural Hazards**
   a. Presentation by Erica Fleishman, Oregon Climate Change Research Institute (OCCRI)
      i. Future Projections are linked here (Polk County's is in development)

III. **Progress Since Last Meeting**
   a. New website to share!
   b. Mitigation successes and action items progress

IV. **Overview of Natural Hazards Included in NHMP**
   a. Drought, earthquake (crustal and Cascadia), extreme heat (new for 2023 NHMP), flooding, landslide, volcano, wildfire, windstorm, and winter storm

V. **Vulnerable Populations**

VI. **Community Lifelines**
   a. What are they and how we will identify them

VII. **Wrap Up and Next Steps**
   a. Our next whole-group meeting will be in the next few weeks (late May/early June, details to come!
   b. We will also schedule meetings in the next few months with each jurisdiction (both the County and each City) to work on the action items and addenda

Agenda

Meeting: **Polk County NHMP Update**
Date: June 15, 2023
Time: 11:00AM-12:00PM
Location: Zoom (linked here)

I. **Welcome**

II. **Community Lifelines**
   a. Review list together to add new Lifelines and remove old ones

III. **Climate Projections and Implications for Natural Hazards Refresher**

IV. **Hazard Vulnerability Assessment**
   a. Order and prioritize hazard types

V. **Potential Action Items**

VI. **Public Engagement Strategy**
   a. Polk County (August 9-12; best time to attend?)
   b. Dallas events, Independence concert series?

VII. **Wrap Up and Next Steps**
   a. Our next whole-group meeting will be this summer
   b. DOGAMI will have Polk County multi-hazard risk report in July!
   c. We will also schedule meetings in the next few months with each jurisdiction (both the County and each City) to work on the action items, Community Lifelines, and addenda

UNIVERSITY OF OREGON

Agenda

Meeting: **Polk County NHMP Update**
Date: October 18, 2023
Time: 1:30PM-3:00PM
Location: Zoom (linked here)

I. **Welcome**

II. **Multi-Hazard Risk Report**
   a. Matt Williams (DOGAMI)

III. **2017 Action Items: 2023 status and update**
   a. Please review the actions in this link and provide content on their status. Add comments on what has occurred since 2017 or what has prevented the action from happening.

IV. **Implementation and Maintenance**
   a. Semi-Annual Meetings
   b. Integration of NHMP
   c. Assessment of capabilities

V. **Wrap Up and Next Steps**
   a. Review DRAFT Update
   b. Update on ODEM/FEMA review schedule
   c. BRIC 23
      i. Oct. 27: pre-application due to ODEM
      ii. Feb. 29: sub application submittal due to FEMA

UNIVERSITY OF OREGON

AGENDA

Meeting: **Polk County NHMP Update: Funding Opportunities & Wrap-Up**
Date: **12/12/23**
Time: 9:00am – 10:00am
Location: Teams Link

Meeting Goals:

- To review HMA funding opportunities

I. **Welcome and Introductions**

II. **FEMA HMA opportunities** – OEM mitigation

III. **Final Hazard Assessment**

IV. **Polk County Survey review**

V. **Mitigation Strategy Update**

VI. **Internal Review, Public Comment, and OEM/FEMA Review process**

VII. **Other business**

This page intentionally left blank.

Appendix C: Community Profile

The following section describes the county from several perspectives to help define and understand the county's sensitivity and resilience to natural hazards. Sensitivity and resilience indicators are identified through the examination of community capitals, which include natural environment, social/demographic capacity, economic, physical infrastructure, community connectivity, and political capital. These community capitals can be defined as resources or assets that represent all aspects of community life. When combined, community capitals can influence the decision-making process to ensure that the needs of the community are being met.[44]

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).

The Community Profile describes Polk County's sensitivity and resilience to natural hazards as they relate to each capacity. It provides a snapshot of the time when the plan was developed and will assist in preparation for a more resilient county. The information in this section, along with the hazard assessments located in Volume I, Section 2 should be used as the local-level rationale for the risk reduction actions identified in Volume I, Section 3. The identification of actions that reduce the county's sensitivity and increase its resiliency assist in reducing overall risk of disaster, the area of overlap shown in Figure 1 Understanding Risk.

Figure 32 shows recent population trends for incorporated cities within Polk County. West Salem is considered part of the metropolitan area of Salem and is not covered within this plan. In addition, the Confederated Tribes of Grande Ronde, who have ancestral lands within Polk County, is not included in this plan, although the tribal government is headquartered in Grand Ronde (a census designated place and unincorporated community located in northwest Polk/southern Yamhill County).

[44] Mary Emery and others, "Using Community Capitals to Develop Assets for Positive Community Change," *CD Practice* 13 (2006): 2

Figure 32 Polk County Incoporated Cities Population, 2016-2021

Jurisdiction	2016		2021		Change (2016-2021)		AAGR
	Number	Percent	Number	Percent	Number	Percent	
Polk County	79,730	100%	88,916	100%	9,186	12%	2.2%
Dallas	15,345	19%	17,320	19%	1,975	13%	2.5%
Falls City	950	1%	1,064	1%	114	12%	2.3%
Independence	9,250	12%	10,081	11%	831	9%	1.7%
Monmouth	9,745	12%	11,142	13%	1,397	14%	2.7%
Salem*	26,001	33%	30,212	34%	4,211	16%	3.0%
Willamina*	869	1%	924	1%	55	6%	1.2%
Unincorporated	17,571	22%	18,173	20%	602	3%	0.7%

Source: U.S. Census Bureau Tiger Lines Files

The remainder of this section will provide detailed information for the unincorporated communities and summarized data for the incorporated cities. Detailed information for each incorporated city participating in this NHMP is provided within each city's addendum (Volume III).

Political Capacity

Political capacity is recognized as the government and planning structures established within the community. In terms of hazard resilience, it is essential for political capital to encompass diverse government and non-government entities in collaboration, as disaster losses stem from a predictable result of interactions between the physical environment, social and demographic characteristics and the built environment.[45] Resilient political capital seeks to involve various 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

A three-member Board of Commissioners governs Polk County. The Commissioners serve as the Executive Branch and perform legislative and quasi-judicial functions of the County. Commissioners are responsible for the planning, formation, and implementation of the annual budget. In addition, Commissioners serve on other federal, state, and local mandated governmental panels, boards and commissions with fiscal duties and authority over public monies.[46] A County Administrator is staff to the Board of Commissioners and is responsible for County management, policy implementation, and financial planning.

[45] Mileti, D. 1999. Disaster by Design: A Reassessment of Natural Hazards in the United States. Washington D.C.: Joseph Henry Press.

[46] Polk County. http://www.co.Polk.or.us/Departments.asp.

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.

County departments and divisions that are most involved with natural hazard mitigation include the following:

- Sheriff's Office: The mission of the Polk County Sheriff's Office is "Demonstrate leadership through honoring public trust and developing partnerships within the communities we serve by providing effective law enforcement services which we promote, preserve, and deliver public safety and security." The Sheriff's Office interacts with the vulnerable aspects of the community on a day-to-day basis and can help identify areas for focused mitigation.
- Emergency Management: The Polk County Emergency Management Department plans and directs emergency procedures to protect citizens from natural and human-caused disasters. Polk County Emergency Management works with municipalities within the County on preparedness for emergencies, including emergency response training and exercises and maintaining an Emergency Operations Center where response agencies coordinate actions and allocate resources in an emergency. Emergency Management's goal is to limit Polk County's exposure to emergencies and disasters while managing all aspects of that if they do occur. Through management plans, this division coordinates the efforts of citizens and teams to prevent and minimize the effects of emergencies and disasters in Polk County.[47] The Polk County Emergency Operations Plan provides detail on the organization and operations of emergency management.
- Community Development: The mission of the Community Development Department is to provide "Excellence in customer service by providing courteous, timely and professional service to the citizens of Polk County through innovation in administration of planning, building, and environmental health regulations and policies in order to protect the health and safety of the citizens of the County." The Community Development Department is divided into three divisions (see below) and two programs (Code Compliance and Economic Development).
- Community Development – Planning: The Planning Division is responsible for managing the Comprehensive Land Use Plan and administering the County's zoning regulations and long-range land use planning. Through the County Comprehensive Plan and subsequent policies, this department guides decisions about growth, development, and conservation of natural resources. The Planning Division can be partners in mitigation by developing, implementing, and monitoring policies that incorporate hazard mitigation principles such as ensuring homes, businesses and other buildings are built to current seismic code and out of the flood zones.

47 Emergency Management | Polk County Oregon Official Website, https://www.co.polk.or.us/em

- Community Development – Building: The Building Division is responsible for administering the building permit and inspection program for the County (outside city limits) and Falls City. This division can collaborate to do outreach to the owners of structures that were not built up to modern, resilient code. Professionals from this division could also even be called on to help survey buildings after an incident.
- Community Development – Environmental Health: The Environmental Health Division is responsible for the review and approval of permits for the installation of septic tanks and drain fields, licensing and inspecting restaurants, swimming pools and tourist facilities, monitoring drinking water systems for compliance with Safe Drinking Water Act, administering the solid waste collection franchise ordinance and coordinating recycling efforts, and conducting food handlers' classes.
- Fairgrounds and Event Center: The Fair and Events Center is dedicated to the idea of providing the general public and the local community with the space, buildings, and equipment needed to engage in events that promote fun, learning, and social activity. Mitigation could include specific actions to ensure the facilities could be used during response, such as providing extra power should it need to be used as a shelter.
- Geographic Information Systems: The Geographic Information Systems section develops and maintains a Geographic Information System (GIS) for Polk County. The GIS is a computer-based tool used for mapping and for providing information on a variety of systems and information within the County. In all phases of the disaster cycle, information is key. Building robust data that catalogues not only the County's risk and vulnerability, but also resources and response capability, can ensure that efficient and effective mitigation activities.
- Information Services: The Polk County Information Services focuses on providing the mainframe, personal computer, and network support for all County Departments. Without this critical component, the County could not effectively serve its residents. Mitigation efforts from this department would not likely involve residents but would go a long way to ensuring uninterrupted services during hazard incidents.
- Health Services: Polk County Health Services provides quality public health services consistent with laws, available resources, and community support, through the prevention of disease, health education and promotion, and protection of the community and the environment. Programs include supplemental nutritional programs for women, infants, and children, communicable disease and immunization services, and public health emergency preparedness. As an inherently mitigation-focused department, Public Health can be an ally in preparing the community for natural hazards. Public Health has a distribution network established for information and supplies; these connections to the community can be used to encourage personal preparedness and during incident response.
- Polk County Parks: Polk County Parks maintains and enhances the quality of life in Polk County by providing parks and recreational opportunities for residents and visitors. The system includes local parks, playgrounds, trails, fishing lakes, and more. This department can help to prioritize projects for mitigation within public lands.

- Polk County Public Works: Public Works includes the road crew, who is responsible for road and bridge maintenance and operation, as well as the maintenance of the County's vehicles, and staff associated with programs related to vegetation management and surveying/engineering (including assisting the public with recording and research into property records and the review of pending subdivisions and partitions). This department can help to prioritize projects for mitigation and will be a key partner in implementation.

Expand and Improve Capabilities and Integration Process

Funding and staff resource availability are the primary constraints to achieving natural hazard mitigation priorities. As such the County, and participating jurisdictions, have identified actions (Table 3-1 and within jurisdictional addenda) that seek to expand and improve capabilities to achieve natural hazard mitigation.

In addition, the County will seek opportunities to integrate the plan's data, information, and hazard mitigation goals and actions into other planning mechanisms (e.g., budgets, ordinances, comprehensive plan, water, wastewater, and transportation system plans). See Volume I, Section 4 for additional information.

Existing Plans and Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, technical reports, or studies. Plans and policies already in existence have support from residents, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly and can adapt easily to changing conditions and needs.[48]

The Polk County Natural Hazard Mitigation Plan includes a range of recommended action items that, when implemented, will reduce the County's vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the County's existing plans and policies. Linking existing plans and policies to the Natural Hazard Mitigation Plan helps identify what resources already exist that can be used to implement the action items identified in the Plan. 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. In addition to the plans listed below the County and incorporated cities also have zoning ordinances (including floodplain development regulations) and building regulations.

Polk County's current plans and policies include the following:

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

Figure 33 Existing Plans

Name	Author/ Owner	Description	Relation to Natural Hazard Mitigation
Polk County Zoning Ordinance (updated in 2022)	Polk County Community Development Planning Division	Administer Development Code and zoning ordinance governing land uses in Polk County.	Land use ordinances may be used or developed to direct future development away from known hazard areas.
Polk County Comprehensive Land Use Plan (updated in 2015)	Polk County Community Development Department	To anticipate and plan for future land use within Polk County in accordance with Statewide Land Use Planning Program.	Section D, Natural Resources, includes goals to conserve and manage water resources in order to maintain and protect water quality and quantity and to abate flood, erosion, and sedimentation problems. Section F, Land Capability/Resource Quality, includes goals and policies to protect life and property from natural hazards and disasters. Hazards identified include flooding, erosion, geological, and air quality.
Polk County Community Wildfire Protection Plan (updated in 2024)	Prepared by Polk County, the Oregon Department of Forestry and Wildland Fire Associates	Assists Polk County clarify and refine priorities for protection of life, property, and critical infrastructure in the wildland-urban interface on public and private lands.	Enhances the NHMP risk assessment, identification of hazard zones, and includes mitigation actions to reduce risk to wildfire.

Name	Author/ Owner	Description	Relation to Natural Hazard Mitigation
Polk County Public Safety Communications Plan (2023)	Polk County Emergency Management	Locally driven strategic planning approach to enhance communications interoperability across the County.	This plan includes a three phase plan for implementation and mitigation, including work that is already underway as well as in the planning stages.
Polk County Emergency Operations Plan (2022)	Prepared by Polk County and Kittelson & Associates, Inc.	Framework that provides guidance for coordinated preparedness, response, and recovery activities in the county.	The Emergency Operations Plan can be utilized to implement mitigation measures aimed at improving emergency response capabilities, evacuation routes, and recovery.

Source: Polk County

Other plans are available via the County website or by contacting staff.

Natural Environment Capacity

Natural environment capacity is recognized as 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.[49] Natural resources 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. However, natural systems are often impacted or depleted by human activities adversely affecting community resilience.

Geography

Polk County is located in the lower northwestern part of Oregon within the Mid-Willamette Valley between the Coastal Range and the Cascade Range. The county was officially created from the Yamhill District of the Oregon Territory on December 22, 1845. On August 13, 1848, President James K. Polk signed a bill approving the boundaries of the Oregon territory, which officially separated the territory from England.

The present area of Polk County comprises 472,960 acres (739 square miles). Elevations within the county range from 325 feet in the east to 3,450 feet near Sugarloaf Mountain in the west. The western half of the County is timbered, with the eastern half as prairie or farmlands.

Further settlement from eastern United States migrations began in the early 1840's, one of the earliest settlements is near the present site of Dallas. Jason Lee was the vanguard of this settlement, having established his mission at Wheatland on the east bank of the Willamette River in 1834.

The County seat was located at Cynthian (later Dallas) in 1850. A new courthouse was completed in 1860 and destroyed by fire in 1898 and the present courthouse was completed in 1900. The City of Dallas is the northern most incorporated jurisdiction located centrally within the county.

The City of Independence was named after Independence, Missouri by E.A. Thorp, a former resident of the Missouri city who platted the town in 1850. The site began to be settled in 1845. Located close to the eastern border of the county, the City of Independence is a close neighbor to the City of Monmouth.

The City of Monmouth was founded in 1853 by settlers from Monmouth, Illinois in August 1852 who spent their first winter at a point about three and one-half miles north-northeast of Rickreall. Monmouth University, now known as Western Oregon State College, was originally founded in 1858.

Falls City, named for the historically prominent falls was originally named both Syracuse and Luckiamute Falls. In 1891, when the town was incorporated, the name was changed. However, due to the dual origin, there are two "Main Streets" in town – North and South Main Street run

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

parallel to each other on either side of the river. Historical photos show a power plant constructed at the top of the falls, and records indicate a sawmill operation operated by John Thorpe in 1852. The elevation at the falls is approximately 300 feet. Falls City is located centrally in the county.

The Grand Ronde Indian Reservation was formed in 1856 combining settlements from several Willamette Valley Indian tribes as well as Indians from other parts of Oregon. The reservation is located in northwestern Polk County as well as southwestern Yamhill County. More than 1,000 Indians were on the reservation at one time during the 1860's. The reservation was divided in 1908 among the various Indians residing there. The Grand Ronde Agency was terminated in 1925 with the U.S. Federal Government maintaining supervisory control over the remaining 500 acres of reservation land until 1957.

River navigation, agriculture, timber, and livestock all contributed to Polk County's development, economy, industry, and trade activities during its early history. World War II changed the county's land use focus towards more residential or other urban uses. Agricultural land was decreasing rapidly requiring the County to allocate agricultural and timber land to preserve the industries.

Potential impacts of global climate change

Climate refers to the temperatures, weather patterns, and precipitation in Polk County. This section covers historic climate information. Estimated future climate conditions and possible impacts are also provided (for a more detailed analysis refer to the State Risk Assessment.)

Polk County has a modified marine climate where winters are cool and wet, while summers are moderately warm and dry. Cool air flows west from the Pacific Ocean and is tempered by the Cascade Mountains to the east. From 1961 to 1990, the average annual precipitation in Polk County was approximately 52 inches with most received in the Coast Range and gradually decreasing eastward toward the Willamette Valley floor. The Laurel Mountain Weather Station, located at an elevation of 3,589 feet in the Coast Range west of Falls City, was established in 1970. Between 1970 and 2000, average annual precipitation recorded at the station was about 121 inches. A total of 204 inches was recorded during the winter of 1996-97. In the Mid-Willamette Valley, 90 percent of the rainfall is experienced between October and the end of May.

Total precipitation in the Pacific Northwest region may remain similar to historic levels but climate projections indicate the likelihood of increased winter precipitation and decreased summer precipitation. Scientific data and research also anticipate an increase in intense precipitation events.[50]

Increasing temperatures affects hydrology in the region. Spring snowpack has substantially decreased throughout the Western part of the United States, particularly in areas with milder winter temperatures, such as the Cascade Mountains. In other areas of the West, such as east of

[50] Oregon Wetlands Explorer. (2009). Coastal Climate Effects. Retrieved from http://oregonexplorer.info/wetlands/ClimateChange/CoastalClimateEffects

the Cascades Mountains, snowfall is affected less by the increasing temperature because the temperatures are already cold and more by precipitation patterns.[51]

There is a consensus among the scientific community that global climate change is occurring and will have important ecological, social, and economic consequences over the next decades and beyond.[52] Extensive research shows that Oregon and other Western states already have experienced noticeable changes in climate and predicts that more change will occur in the future.[53]

In the Pacific Northwest, climate change is likely to (1) increase average annual temperatures, (2) increase the number and duration of heat waves, (3) increase the amount of precipitation falling as rain during the year, (4) increase the intensity of rainfall events, and 5) increase sea level. These changes are also likely to reduce winter snowpack and shift the timing of spring runoff earlier in the year.[54]

These anticipated changes point toward some of the ways that climate change is likely to impact ecological systems and the goods and services they provide. There is considerable uncertainty about how long it would take for some of the impacts to materialize, and the magnitude of the associated economic consequences. Assuming climate change proceeds as today's models predict, however, some of the potential economic impacts of climate change in the Pacific Northwest will likely include:[55]

[51] Mote, Philip W., et. al., "Variability and trends in Mountain Snowpack in Western North America," http://cses.washington.edu/db/pdf/moteetalvarandtrends436.pdf

[52] Karl, T.R., J.M. Melillo, and T.C. Peterson, eds. 2009. *Global Climate Change Impacts in the United States.* U.S. Global Change Research Program. June. Retrieved June 16, 2009, from www.globalchange.gov/usimpacts; and Pachauri, R.K. and A. Reisinger, eds. 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.*

[53] Doppelt, B., R. Hamilton, C. Deacon Williams, et al. 2009. *Preparing for Climate Change in the Upper Willamette River Basin of Western Oregon.* Climate Leadership Initiative, Institute for a Sustainable Environment, University of Oregon. March. Retrieved June 16, 2009, from http://climlead.uoregon.edu/pdfs/willamette_report3.11FINAL.pdf and Doppelt, B., R. Hamilton, C. Deacon Williams, et al. 2009. *Preparing for Climate Change in the Rogue River Basin of Southwest Oregon.* Climate Leadership Initiative, Institute for a Sustainable Environment, University of Oregon. March. Retrieved June 16, 2009 from http://climlead.uoregon.edu/pdfs/ROGUE percent20WS_FINAL.pdf

[54] Mote, P., E. Salathe, V. Duliere, and E. Jump. 2008. Scenarios of Future Climate for the Pacific Northwest. Climate Impacts Group, University of Washington. March. Retrieved June 16, 2009, from http://cses.washington.edu/db/pdf/moteetal2008scenarios628.pdf; Littell, J.S., M. McGuire Elsner, L.C. Whitely Binder, and A.K. Snover (eds). 2009. "The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate - Executive Summary." In The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate, Climate Impacts Group, University of Washington. Retrieved June 16, 2009, from www.cses.washington.edu/db/pdf/wacciaexecsummary638.pdf; Madsen, T. and E. Figdor. 2007. When it Rains, it Pours: Global Warming and the Rising Frequency of Extreme Precipitation in the United States. Environment America Research & Policy Center and Frontier Group.; and Mote, P.W. 2006. "Climate-driven variability and trends in mountain snowpack in western North America." Journal of Climate 19(23): 6209-6220.

[55] The issue of global climate change is complex and there is a substantial amount of uncertainty about climate change. This discussion is not intended to describe all potential impacts of climate change but to present a few ways that climate change may impact the economy of cities in Oregon and the Pacific Northwest.

Potential impact on agriculture and forestry

Climate change may impact Oregon's agriculture through changes in growing season, temperature ranges, and water availability.[56] Climate change may impact Oregon's forestry through increase in wildfires, decrease in the rate of tree growth, change in mix of tree species, and increases in disease and pests that damage trees. [57]

Potential impact on tourism and recreation

Impacts on tourism and recreation may range from: (1) decreases in snow-based recreation if snow-pack in the Cascades decreases, (2) negative impacts to tourism along the Oregon Coast as a result of damage and beach erosion from rising sea levels[58], (3) negative impacts on availability of water summer river recreation (e.g., river rafting or sports fishing) as a result of lower summer river flows, and (4) negative impacts on the availability of water for domestic and business uses.

Temperature and Precipitation

Climate models project that the annual average temperatures in Polk County are likely to increase by between 3.2°F to 7.4°F between 2050 and 2074 (over historical average temperatures recorded between 1981 and 2010).[59] Figure 34 describes the mean annual rainfall amount for Polk County.

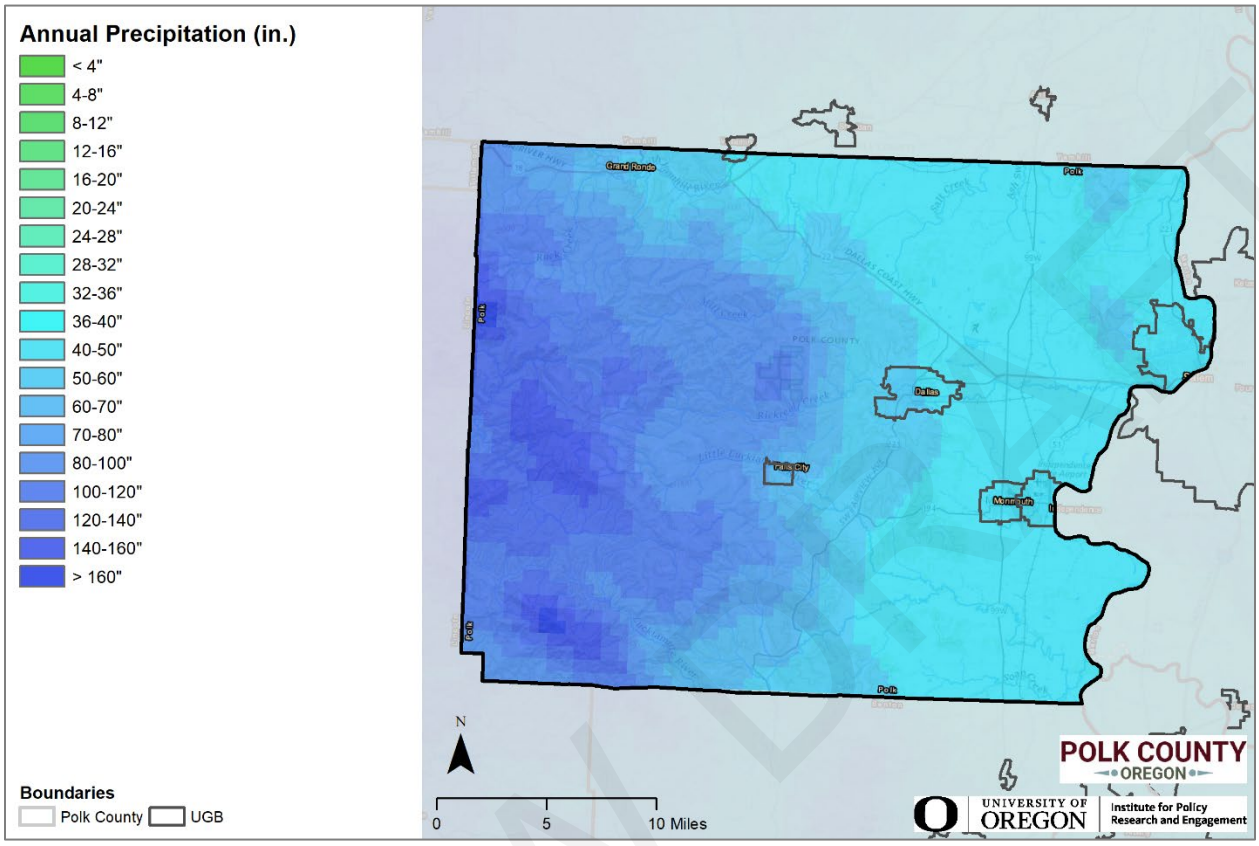
[56] "The Economic Impacts of Climate Change in Oregon: A preliminary Assessment," Climate Leadership Initiative, Institute for Sustainable Environment, University of Oregon, October 2005.

[57] "Economic Impacts of Climate Change on Forest Resources in Oregon: A Preliminary Analysis," Climate Leadership Initiative, Institute for Sustainable Environment, University of Oregon, May 2007.

[58] "The Economic Impacts of Climate Change in Oregon: A preliminary Assessment," Climate Leadership Initiative, Institute for Sustainable Environment, University of Oregon, October 2005.

[59] National Climate Change Viewer, https://apps.usgs.gov/nccv/maca2/maca2_counties.html

Figure 34 Polk County Normal Precipitation: Annual



Source: OPDR, data PRISM Climate Group

Land Cover

The Polk County Comprehensive Plan states that the vast majority of the County is devoted to private timber production with minimal federal, state, and county managed forested lands. A very limited percentage of land is designated for high density use, approximately four percent. The county feels limited high-density increases will occur around the four incorporated jurisdictions of Dallas, Falls City, Independence, and Monmouth. However, there is significant pressure to develop low density residential development. The County has designated two percent of its land area for such use.

One significant way in which Polk County residents can increase or decrease their vulnerability to natural hazards is through development patterns. The way in which land is used – is it a parking lot or maintained as an open space – will determine how closely the man-made systems of transportation, economy, etc., interact with the natural environment. All patterns of development, density as well as sprawl, bring separate sets of challenges for hazard mitigation.

Synthesis

The physical geography, weather, climate, and land cover of an area represent various interrelated systems that affect overall risk and exposure to natural hazards. The projected climate change models representing western Oregon indicate the potential for increased effects

of hazards, particularly drought and wildfire due to changing climate of the region. Western Oregon is projected to have warmer and drier summers with less precipitation. In addition, winter temperatures will be warmer, which means a decrease in mountain snowpack. These factors combined with periods of population growth 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.

Precipitation, like across much of the state, falls most commonly around the winter months and most sparsely in the summer months. Despite being drier than counties further north, Polk County also experiences periods of heavy rain, sometimes in conjunction with high winds or with winter storm-conditions, that can cause flooding, landslides, and other risks to safety and property, particularly infrastructure. When severe windstorms strike a community, downed trees, powerlines, and damaged property are major hindrances to response and recovery.[60] Winter storms can cause similar issues, as well as causing water pipes to freeze, which cuts off water supply and can result in pipes that burst and lead to flooding.

Polk County's dry summer months are also getting drier and hotter. Like many other communities across the western United States, Polk County is increasingly threatened by drought and extreme heat. As noted in OCCRI's Future Climate Projections (Polk County, Oregon): "The number, duration, and intensity of extreme heat events will increase as temperatures continue to warm. In Polk County, the number of extremely hot days (those on which the temperature is 90°F or higher) is projected to increase by an average of 17 (range 6–30) by the 2050s. The temperature on the hottest day of the year is projected to increase by an average of about 6°F (range 1–9°F) by the 2050s." Drought, as represented by low summer soil moisture, low spring snowpack, low summer runoff, and low summer precipitation, is also projected to become more frequent in Polk County by the 2050s.

In broad terms, climate in the Pacific Northwest is characterized by variability, and that variability is largely dominated by the interaction between the atmosphere and ocean in the tropical Pacific Ocean that is responsible for El Niño and La Niña. Human activities are changing the climate, particularly temperature, beyond natural variability. Climate change is already affecting Oregon communities and resources and needs to be recognized in various planning efforts as an important stressor that significantly influences the incidence—and in some cases the location—of natural hazards and hazard events. Climate change is anticipated to affect the frequency and/or magnitude of some kinds of natural hazards in Oregon. On the coast, increasing deep-water wave heights in recent decades are likely to have increased the frequency of coastal flooding and erosion. In Oregon's forested areas, large areas have been impacted by disturbances that include wildfire in recent years. As noted in OCCRI's Future Climate Projections (Polk County, Oregon):

"Wildfire frequency and intensity and area burned are projected to continue increasing in the Northwest. Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Polk County by 11 days (range -7–28) by the 2050s, relative to the historical baseline, under the higher emissions scenario. The average number of

[60] Oregon Natural Hazards Mitigation Plan (NHMP).

days per year on which vapor pressure deficit is extreme is projected to increase by 25 (range 8–42) by the 2050s."

Social/Demographic Capacity

Social/demographic capacity is a significant indicator of community hazard resilience. The characteristics and qualities of the community population such as language, race and ethnicity, age, income, educational attainment, and health are significant factors that can influence the community's ability to cope, adapt to and recover from natural disasters. Population vulnerabilities can be reduced or eliminated with proper outreach and community mitigation planning.

The American Community Survey data that is used for this analysis has varying levels of reliability depending on geographic area, demographic group, and types of data. County level data is relatively reliable, but it should be noted that some city and unincorporated community (CDP) level data is less reliable. It is mainly used for estimation and getting an idea of the demographics of a location and should not be mistaken for precise numbers.

Population

Polk County is composed of four incorporated municipalities and four census designated places. According to the Population Research Center at Portland State University Polk County experienced modest population growth (12%) between 2016 and 2021.

Dallas, Monmouth, and Salem (portion in Polk County) had the fastest growth rates at 13%, 14%, and 16% respectively, while the unincorporated areas of the county grew by just 3%. The western part of Salem (30,212), Dallas (17,320), and the unincorporated parts of the county (18,173) are the county's most populous. The unincorporated area of the county accounts for about 20% of the overall population.

Oregon's state-wide land use planning policies require local jurisdictions to manage growth using an urban growth boundary, which contains most new growth inside of incorporated areas. The unincorporated area of the county grew faster between 2010 and 2015 than almost all of the incorporated cities; the incorporated areas grew faster between 2015 and 2020. The growth in these areas emphasizes the importance of partnerships between the county and the cities for effective county-wide mitigation efforts.

Figure 35 Population Estimates and Change (2016-2021)

Jurisdiction	2016		2021		Change (2016-2021)		AAGR
	Number	Percent	Number	Percent	Number	Percent	
Polk County	79,730	100%	88,916	100%	9,186	12%	2.2%
Dallas	15,345	19%	17,320	19%	1,975	13%	2.5%
Falls City	950	1%	1,064	1%	114	12%	2.3%
Independence	9,250	12%	10,081	11%	831	9%	1.7%
Monmouth	9,745	12%	11,142	13%	1,397	14%	2.7%
Salem*	26,001	33%	30,212	34%	4,211	16%	3.0%
Willamina*	869	1%	924	1%	55	6%	1.2%
Unincorporated	17,571	22%	18,173	20%	602	3%	0.7%

Source: Portland State University, Population Research Center, "Annual Population Estimates", 2021.

The 2021 Population Research Center's Coordinated Population Forecast for Polk County projects that by 2045 Polk County's population will increase to over 138,783. The total population is projected to increase by 49% between 2021 and 2045.

Tourists

Tourists are not counted in population statistics; and are therefore considered separately in this analysis. Tourists are specifically vulnerable due to the difficulty of locating or accounting for travelers within the region. Tourists are often at greater risk during a natural disaster because of unfamiliarity with evacuation routes, communication outlets, or even the type of hazard that may occur. Knowing whether the region's visitors are staying in friends'/relatives' homes in hotels/motels, or elsewhere can be instructive when developing outreach efforts.[61] For hazard preparedness and mitigation purposes, outreach to residents in Polk County will likely be transferred to these visitors in some capacity. Visitors staying at hotel/motels are less likely to benefit from local preparedness outreach efforts aimed at residents.

Vulnerable Populations

Vulnerable populations include those with access and functional needs and may include seniors, people with disabilities, and children, as well those people living in poverty, who often experience the impacts of natural hazards and disasters more acutely. Vulnerability exists for migrant short-term workers for the agricultural industry in Polk County. Hazard mitigation that targets the specific needs of these groups has the potential to greatly reduce their vulnerability. Examining the reach of hazard mitigation policies to special needs populations may assist in increasing access to services and programs. FEMA's Office of Equal Rights addresses this need by suggesting that agencies and organizations planning for natural hazards identify special needs

[61] MDC Consultants (n.d.). When Disaster Strikes – Promising Practices. Retrieved March 18, 2014, from http://www.mdcinc.org/sites/default/files/resources/When%20Disaster%20Strikes%20-%20Promising%20Practices%20- %20Tourists.pdf.

populations, make recovery centers more accessible, and review practices and procedures to remedy any discrimination in relief application or assistance.

Language Barriers

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 public, and it is less likely they will be prepared if special attention is not given to language and culturally appropriate outreach techniques.

There are various languages spoken across Polk County; the primary language is English. Over 13% of the Polk County population speaks a language other than English. Spanish is the second most widely spoken language with about 10% of the population 5 years and over speaking Spanish (27% of the population of Independence speaks Spanish).[62] Overall, about 4.1% of the total population in Polk County is not proficient in English. Outreach materials used to communicate with, plan for, and respond to non-English speaking populations should take into consideration the language needs of these populations.

Race and Ethnicity

The impact in terms of loss and the ability to recover may also vary among minority population groups following a disaster. Studies have shown that racial and ethnic minorities can be more vulnerable to natural disaster events. This is not reflective of individual characteristics; instead, historic patterns of inequality along racial or ethnic divides have often resulted in minority communities that are more likely to have inferior building stock, degraded infrastructure, or less access to public services. Table C-6 displays Polk County's population by race and or ethnicity.

The majority of the population in Polk County is racially white (87%); Independence and Monmouth have the largest percentages of non-white population. Individually, Independence supports a 34% Hispanic or Latino population while Monmouth supports 19%. Approximately 15% of the county population is Hispanic or Latino.

It is important to identify specific ways to support all portions of the community through hazard mitigation, preparedness, and response. Culturally appropriate and effective outreach can include both methods and messaging targeted to diverse audiences. For example, connecting to historically disenfranchised populations through already trusted sources or providing preparedness handouts and presentations in the languages spoken by the population will go a long way to increasing overall community resilience.

Gender

Polk County has slightly more females than males (Female 51%, Male: 49%).[63] It is important to recognize that women tend to have more institutionalized obstacles than men during recovery

[62] U.S. Census Bureau, 2021 American Community Survey, Table DP02.

[63] ACS Demographic and Housing Estimates, Table DP05, U.S. Census Bureau, 2021 American Community Survey

due to sector-specific employment, lower wages, and family care responsibilities.[64]

Table C-6 Polk Race and Hispanic or Latino Origin

Race	Polk	Dallas	Falls City	Independence	Monmouth
Total Population	77,264	14,896	994	8,772	9,869
White	61,558	13,397	875	5,801	7,408
Black	525	16	0	31	152
AIAN	764	73	20	9	59
Asian	1,592	235	1	52	324
NHPI	278	21	0	39	0
Some Other Race	0	0	0	0	0
Races	2,637	382	70	337	444
Hispanic or Latino	9,910	772	28	2,503	1,482
Percent	12.8%	5.2%	2.8%	28.5%	15.0%

Source: Social Explorer, Table T14, U.S. Census Bureau, 2021 American Community Survey Estimates.

Age

Of the factors influencing socio demographic capacity, the most significant indicator in Polk County may be the age of the population. Depicted in the table below, as of 2021, 18% of the county population is over the age of 64. The Polk County age dependency ratio[65] is 57 (Dallas has the largest age dependency ration at 65). The age dependency ratio indicates a higher percentage of dependent aged people to that of working age. The Population Research Center projects that, in 2035, there will be a higher percentage of the county population over the age of 62. By 2035, population in the 75-79 age groups accounts for over 5% of the total, compared to 4% in 2010. As the population ages, Polk County may need to consider different mitigation and preparedness actions to address the specific needs of this group.

[64] Ibid.

[65] The age 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. A number close to 50 indicates about twice as many people are of working age than non-working age. A number that is closer to 100 implies an equal number of working age population as non-working age population. A higher number indicates greater sensitivity.

Figure 36 Vulnerable Age Groups in Polk County, 2021 and 2035

Jurisdiction	Total	< 15 Years Old		> 64 Years Old		15 to 64 Years Old	Age Dependency Ratio
		Number	Percent	Number	Percent		
Oregon	4,207,177	722,001	17.2%	743,125	17.7%	2,742,051	53.4
Polk County	86,347	15,953	18.5%	15,400	17.8%	54,994	57.0
Dallas	16,663	2,637	15.8%	3,941	23.7%	10,085	65.2
Falls City	1,678	340	20.3%	211	12.6%	1,127	48.9
Independence	9,850	414	4.2%	311	3.2%	6,869	10.6
Monmouth	10,735	2,019	18.8%	368	3.4%	7,855	30.4
2035							
Oregon	4,995,200	865,889	17.3%	1,082,781	21.7%	3,046,530	62.9
Polk County	113,348	20,994	18.5%	21,798	19.2%	70,556	61.5

Source: Social Explorer, Table XX, U.S. Census Bureau, 2017-2021 American Community Survey 5-Year Estimates.

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 and cold, have few transportation options, and require assistance to access medical facilities. 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.

Families and Living Arrangements

The census defines households by type of living arrangement and family structure. Approximately 32% of all households in Polk County include one or more child under the age of 18 (Monmouth has the most, with 42%). Of all households in Polk County, 25.5% are one-person non-family households (householder living alone). Countywide about 13% of householders live alone and are over the age of 65 (about 14% of all households in Dallas).

Figure 37 Household by Type, Including Living Alone

Jurisdiction	Total Households	Family Households		Householder Living Alone		Householder Living Alone (age 65+)	
	Estimate	Estimate	Percent	Estimate	Percent	Estimate	Percent
Polk County	31,742	21,527	67.8%	8,092	25.5%	4,014	12.6%
Dallas	6,612	4,283	64.8%	1,942	29.4%	954	14.4%
Falls City	563	399	70.9%	111	19.7%	58	10.3%
Independence	2,971	2,037	68.6%	611	20.6%	146	4.9%
Monmouth	3,346	2,051	61.3%	874	26.1%	244	7.3%

Source: Social Explorer, Table SE:A 10025, U.S. Census Bureau, 2017-2021 American Community Survey Estimates.

The table below shows household structures for families with children. Nearly 32% of all households within the county are married family households that have children; Independence and Dallas have the highest percentages. Falls City (19%) and Independence (23%) have the highest percentage of single parent households. These populations will likely require additional support during a disaster and will inflict strain on the system if improperly managed.

Figure 38 Married-Couple and Single Parent Families with Children

Jurisdiction	Total Households Estimate	Married-Couple with Children		Single Parent with Children	
		Estimate	Percent	Estimate	Percent
Polk County	21,527	6,885	32.0%	3,118	14.5%
Dallas	4,283	1,249	29.2%	498	11.6%
Falls City	399	119	29.8%	74	18.5%
Independence	2,037	688	33.8%	458	22.5%
Monmouth	2,051	858	41.8%	273	13.3%

Source: U.S. Census Bureau, 2021 American Community Survey Estimates, Table ACS 2021.

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.

Figure 39 Median Household Income

	Median Household Income		Percent Change
	2016^	2021	
Polk County	$54,010	$70,238	30.0%
Dallas	$51,349	$60,511	17.8%
Falls City	$32,500	$37,969	16.8%
Independence	$42,746	$65,019	52.1%
Monmouth	$35,295	$54,310	53.9%

Source: Social Explorer, ACS 2016 (SE), U.S. Census Bureau, 2021 American Community Survey Estimates and 2015 American Community Survey Estimates.

The table below identifies the percentage of individuals and cohort groups that are below the poverty level in 2020. It is estimated that about 12% of individuals, 14% of children under 18, and 10% of seniors live below the poverty level across the county. Falls City and Monmouth have the highest poverty rates. Falls City has the highest poverty rate for children under 18 (49%).

Figure 40 Poverty Rates

	Total Population in Poverty		Children Under 18 in Poverty		18 to 64 in Poverty		65 or over in Poverty	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Polk County	10,127	12%	2,608	14%	5,967	12%	1,552	10%
Dallas	2,351	14%	553	18%	1,242	13%	556	15%
Falls City	471	28%	189	49%	244	23%	38	18%
Independence	927	9%	349	13%	526	8%	52	7%
Monmouth	2,271	23%	476	19%	1,694	27%	101	12%

Source: Social Explorer, Tables ACS 2016, U.S. Census Bureau, 2021 American Community Survey Estimates.

Affluent communities are more likely to have both the collective and individual capacity to rebound from a hazard event more quickly, while impoverished communities and individuals may not have this capacity – leading to increased vulnerability. Wealth can help those affected by hazard incidents to absorb the impacts of a disaster more easily. Conversely, poverty, at both an individual and community level, can drastically alter recovery time and quality.[66]

Federal assistance programs such as food stamps are another indicator of poverty or lack of resource access. Statewide social assistance programs like the Supplemental Nutritional Assistance Program (SNAP) and Temporary Assistance for Needy Families (TANF) provide assistance to individuals and families. In 2018, 14% of households in Polk County received help from SNAP.[67] In spring of 2023 in Polk County, TANF reached approximately 1,184 families per month and SNAP helped to feed about 14,603 people per month.[68] Those reliant on state and federal assistance are more vulnerable in the wake of disaster because of a lack of personal financial resources and reliance on government support.

Education

Educational attainment of community residents is also identified as an influencing factor in sociodemographic 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.

Approximately 92% of the Polk County population over 25 years of age has graduated from high school or received a high school equivalency, with 31% going on to earn a Bachelor's Degree.

[66] Statewide Supplemental Nutrition Assistance Program Activity - Nov. 2014 (SSP, APD, and AAA combined); P. 3 of report. Temporary Assistance for Needy Families One and two Parent Families Combined; P. 3 of report. http://www.oregon.gov/dhs/assistance/Pages/data/main.aspx

[67] Profile of SNAP Households in 2018, USDA Food and Nutrition Services; https://fns-prod.azureedge.us/sites/default/files/resource-files/Oregon_5.pdf.

68 Email, Self-Sufficiency Programs Directors Office, July 26, 2023.

Falls City (23%) and Independence (13%) have the lowest percentages of individuals without high school degrees.

Figure 41 Educational Attainment

	Polk County	Dallas	Falls City	Independence	Monmouth
Population 25 years and over	56,120	11,294	1,128	5,555	5,358
Less than high school	4,729	849	261	721	620
High school graduate or GED	12,871	3,088	431	1,427	1,067
Some college, no degree	21,251	4,601	308	2,399	2,154
Bachelor's degree	10,500	1,900	85	681	898
Graduate or professional degree	6,769	856	43	327	619
Percent without Highschool Degree	*8.4%*	*7.5%*	*23.1%*	*13.0%*	*11.6%*
Percent High School Graduate or Higher	*91.6%*	*92.5%*	*76.9%*	*87.0%*	*88.4%*
Percent Bachelor's Degree or Higher	*30.8%*	*24.4%*	*11.3%*	*18.1%*	*28.3%*

Source: Social Explorer, Table S1501, U.S. Census Bureau, 2017-2021 American Community Survey 5-Year Estimates.

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 to, and cope with the impacts of a disaster.

The Resilience Capacity Index recognizes 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. Polk County has 5% of its population without health insurance; Monmouth (8%) has the highest percentage. The percentage of uninsured changes with age, the highest rates of uninsured are within the 18 to 64-year cohort; Monmouth has the highest percentage of this age group that is uninsured (11%). The ability to provide services to the uninsured populations may burden local providers following a natural disaster.

Figure 42 Health Insurance Coverage

		Without Health Insurance							
		Total Uninsured		Under 18 years		18 to 64 years		65+ years	
Jurisdiction	Population	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Polk County	85,871	4,486	5%	545	3%	3,904	8%	37	< 1%
Dallas	16,318	635	0	157	4%	478	5%	0	0%
Falls City	1,678	84	5%	2	0	82	8%	0	0%
Independence	9,835	410	0	125	4%	285	5%	0	0%
Monmouth	10,730	874	8%	138	0	736	11%	0	0%

Source: Table S2701, Special Characteristics of Health Insurance Coverage, U.S. Census Bureau, 2021 American Community Survey Estimates.

The table below describes disability status of the population. Approximately 15% of the Polk County civilian non-institutionalized population identifies with one or more disabilities. Falls City has the highest percentage of its total population with a disability (28%) and the highest percentage of individuals 65 years and over with a disability (54%). Falls City also has the highest percentage of individuals under 18 with a disability (14%).

Figure 43 Disability Status by Age Group

	Population Estimate^	With a disability		Under 18 years with a disability		65 years and over with a disability	
		Estimate	Percent	Estimate	Percent*	Estimate	Percent*
Polk County	85,871	12,548	15%	1,034	5%	5,309	35%
Dallas	16,318	2,871	18%	95	3%	1,258	33%
Falls City	1678	470	28%	56	14%	113	54%
Independence	9,835	1,221	12%	151	6%	252	33%
Monmouth	10,730	1,278	12%	76	3%	337	39%

Source: U.S. Census Bureau, 2021 American Community Survey Estimates, Table DP02.
Notes: ^ Non-institutionalized civilian population, ** Percent of age group

In 2019, Oregon Housing and Community Services (OHCS) conducted a point-in-time homeless count to identify the number of homeless, their age and their family type. The OHCS study found that 121 individuals and persons in families in Polk County identify as homeless; 46% were experiencing chronic homelessness. This represents a 19% increase from 2017 to 2019.

The homeless have little resources to rely on, especially during an emergency. It will likely be the responsibility of the county and local non-profit entities to provide services such as shelter, food, and medical assistance. Therefore, it is critical to foster collaborative relationships with agencies that will provide additional relief such as the American Red Cross and homeless shelters. It will also be important to identify how to communicate with these populations, since traditional means of communication may not be appropriate or available.

Synthesis

For planning purposes, it is essential Polk County consider both immediate and long-term socio-demographic implications of hazard resilience. Immediate concerns include the growing elderly population and language barriers associated with a culturally diverse community. Other social/-demographic capacity indicators such as graduation rate, poverty level, and median household income can have long-term impacts on the economy and stability of the community, ultimately affecting future resilience.

Even though most of the population is reported as proficient in English, there is still a segment of the population not proficient in English. Language barriers will often make it difficult to reach populations of residents who do not speak English. Resiliency efforts need to focus on targeting these populations as they will be most vulnerable and may have trouble knowing what to do in the event of a disaster. These populations would benefit from mitigation outreach, with special

attention to the variety of cultural backgrounds present in the county, and considerations for differing access to visual and digital outreach materials.

In mitigation and preparedness planning it is critical for the safety of all residents that messaging and actions are culturally sensitive to all racial and ethnic groups. This may range from providing multi-lingual services to adopting entirely different strategies for outreach or specialized mitigation actions to address the unique risk faced by various racial and ethnic groups. For example, if multigenerational family units are more typical in some cultures, evacuation may be more take longer to accommodate the elderly and children living at home, or could even be impeded if there is only one family car. Additionally, varying cultural perceptions of the trustworthiness of government may need to be overcome so that suggestions to evacuate or shelter in place are taken seriously by residents.

Economic Capacity

Economic capacity refers to the financial resources 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 component parts of employment sectors, workforce, resources, and infrastructure are interconnected in the existing economic picture. Once any inherent strengths or systematic vulnerabilities become apparent, both the public and private sectors can act to increase the resilience of the local economy.

Regional Affordability

The evaluation of regional affordability supplements the identification of social/demographic capacity indicators, i.e., median income, and is a critical analysis tool to understanding the economic status of a community. This information can capture the likelihood of individuals' ability to prepare for hazards, through for example 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 community residents to get back on their feet 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 table below illustrates the county and cities' level of income inequality. The Gini index is a measure of income inequality. The index varies from zero to one. A value of one indicates perfect inequality (only one household has any income). A value of zero indicates perfect equality (all households have the same income).[69]

The county has an average income inequality of 0.46, which is similar to that of Dallas and Monmouth. Independence has the greatest income equality (0.38), and Falls City has the lowest (0.52). Based on social science research, the region's cohesive response to a hazard event may be affected by the distribution of wealth in communities that have less income equality[70].

[69]University of California Berkeley. Building Resilient Regions, Resilience Capacity Index. http://brr.berkeley.edu/rci/.

[70] 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

Figure 44 Regional Income Inequality

Jurisdiction	Income Inequality Coefficient
Polk County	0.46
Dallas	0.48
Falls City	0.52
Independence	0.38
Monmouth	0.49

Source: Social Explorer, Table 157, U.S. Census Bureau, 2017-2021 American Community Survey Estimates

Housing Affordability

Housing affordability is a measure of economic security gauged by the percentage of an area's households paying less than 30% of their income on housing.[71] Households spending more than 30% are considered housing cost burdened. The table below displays the percentage of homeowners and renters reflecting housing cost burden across the region.

Overall roughly 19% of homeowners with a mortgage have a housing cost burden, compared to over 45% of renters. Amongst renters, the city of Falls City has more than 50% of renters with a housing cost burden. In general, the population that spends more of their income on housing has proportionally fewer resources and less flexibility for alternative investments in times of crisis.[72] This disparity imposes challenges for a community recovering from a disaster as housing costs may exceed the ability of residents to repair or move to a new location. These populations may live paycheck to paycheck and are extremely dependent on their employer, in the event their employer is also impacted it will further the losses experienced by these individuals and families.

Figure 45 Household Mortgages > 30% of Household Income

Jurisdiction	Owners		Renters
	With Mortgage	Without Mortgage	
Polk County	19%	4%	46%
Dallas	20%	4%	48%
Falls City	23%	11%	55%
Independence	29%	5%	45%
Monmouth	19%	6%	48%

Source: Social Explorer, Tables 103 and 109, U.S. Census Bureau, 2017-2021 American Community Survey Estimates.

Economic Diversity

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. One method for measuring economic diversity is through use of the Herfindahl Index, a

[71] University of California Berkeley. Building Resilient Regions, Resilience Capacity Index. http://brr.berkeley.edu/rci/.
[72] Ibid.

formula that compares the composition of county and regional economies with those of states or the nation. Using the Herfindahl Index, a diversity ranking of 1 indicates the county with the most diverse economic activity compared to the state, while a ranking of 36 corresponds with the least diverse county economy.

The table below describes the Herfindahl Index Scores for counties in the region and shows that Polk County had an economic diversity rank of 9 as of 2013, which had gone down to 16 as of 2022. This is on a scale between all 36 counties in the state where 1 is the most diverse economic county in Oregon and 36 is the least diverse.

Figure 46 Regional Herfindahl Index Scores

	2013			2022		
County	Employment	Number of Industries	State Rank	Employment	Number of Industries	State Rank
Polk	12,179	167	9	16,244	188	16
Benton	25,247	201	21	28,091	216	21
Linn	33,934	222	4	42,475	227	5
Marion	101,571	245	3	126,503	251	3
Yamhill	27,860	209	6	33,570	219	9

Source: Email from Oregon Employment Department February 21, 2024.

While illustrative, economic diversity is not a guarantor of economic vitality or resilience. Polk County, as of 2022, is listed as a non-distressed community by Business Oregon as prescribed by Oregon Law. The economic distress measure is based on indicators of decreasing new jobs, average wages, and income, and is associated with an increase of unemployment.[73]

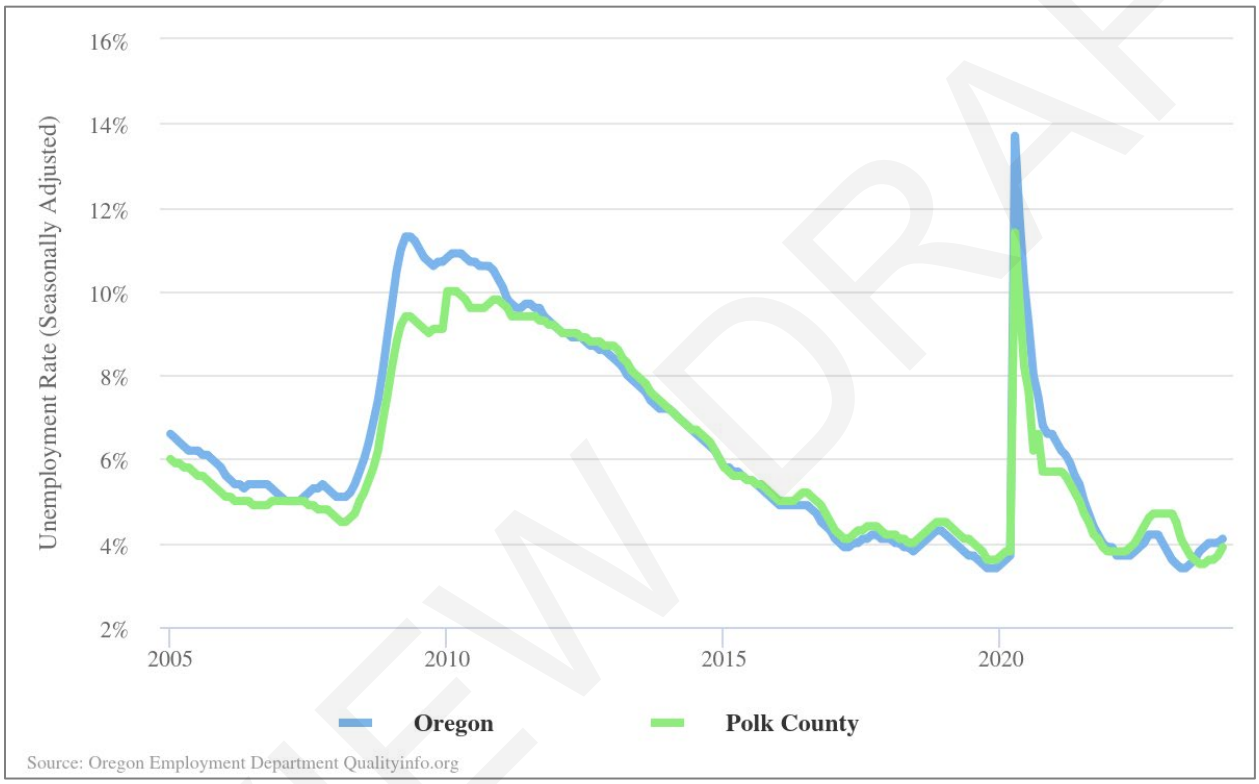
[73] Business Oregon – Oregon Economic Data "Distressed Communities List", http://www.oregon4biz.com/Publications/Distressed-List/

Employment and Wages

According to the Oregon Employment Department, unemployment was at 3.9% as of January 2024, just slightly lower than Oregon's average rate of 4.1%.

Note: there was a spike in unemployment related to the COVID-19 pandemic in 2020, but unemployment has returned to low levels following the end of the pandemic.

Figure 47 Unemployment Rate



Source: Mid-Valley Economic Indicators, Labor Market Information, Oregon Employment Department, www.QualityInfo.org

According to the Oregon Employment Department, the Mid-Valley Workforce Area (Linn, Marion, Polk, and Yamhill counties) will add more than 28,500 jobs between 2022 and 2032. This represents a 10% increase in employment over 10 years. Beyond gains from economic growth, an additional 351,000 job openings will be created by 2032 as workers change occupations or leave for other reasons, such as retirement.[74]

Labor and Commute Shed

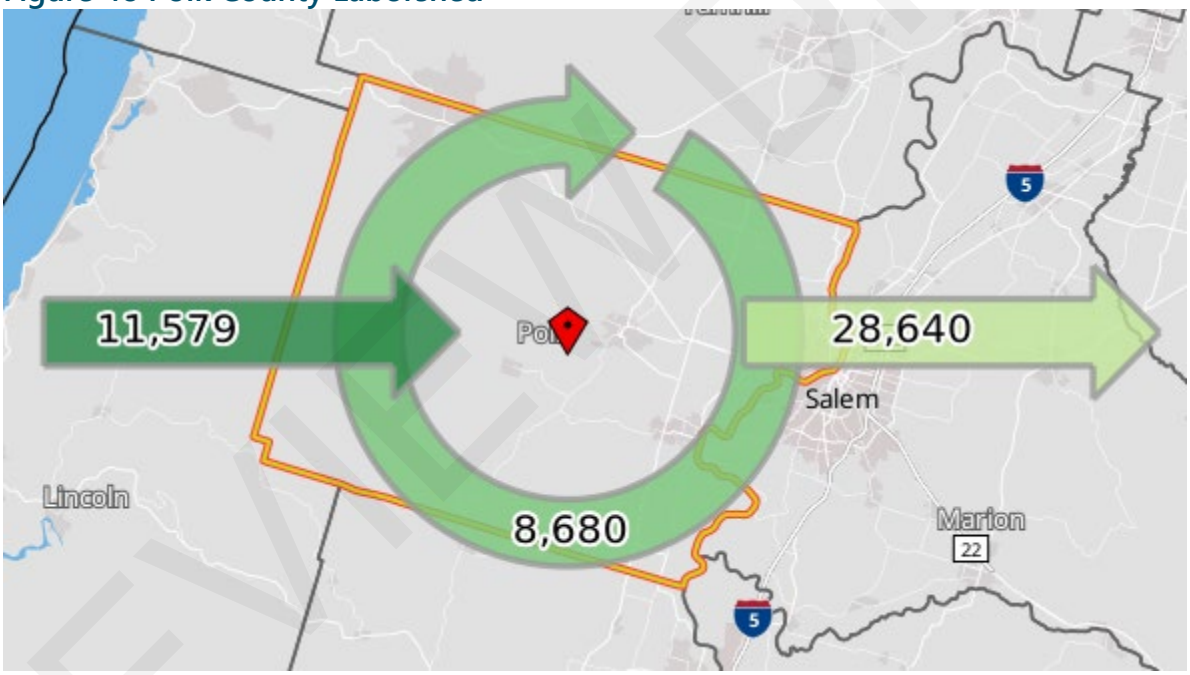
Most hazards can happen at any time during the day or night. It may be possible to give advance warning to residents and first responders who can take immediate preparedness and protection measures, but the variability of hazards is one part of why they can have such varied impact. A

[74] Pat O'Conner, Oregon Employment Department, 2022-2032 Projections Show Broad-Based Employment Growth in the Mid-Valley - 2022-2032 Projections Show Broad-Based Employment Growth in the Mid-Valley - QualityInfo, January 29, 2024.

snowstorm during the workday will have different impacts than one that comes during the night. During the day, a hazard has the potential to segregate the population by age or type of employment (e.g., school children at school, office workers in downtown areas). This may complicate some aspects of initial response such as transportation or the identification of wounded or missing. Conversely, a hazard at midnight may occur when most people are asleep and unable to receive an advance warning through typical communication channels. The following labor shed and commute shed analysis is intended to document where county residents work and where people who work in Polk County reside.

Polk County employers draw in more than 11,500 workers from outside the county, but a greater number of local residents commute outside of the county for work, largely to the Salem metropolitan area. The Polk County economy is a cornerstone of regional economic vitality. The figure below shows the county's labor shed; the map shows that of those who are employed in Polk County, 43% live and work in the county (8,680) and 57% of workers come from outside the county (11,579). Of those who are employed and live in Polk County now, 77% (28,640) work outside the county.

Figure 48 Polk County Laborshed



Source: U.S. Bureau of the Census, On The Map.

The table below shows where workers commute to, who reside in Polk County. Of 37,320 jobs, approximately one third of Polk County employed residents work in Salem (Marion County).

Figure 49 Commute Shed (Where Workers are Employed who Live in Polk County), 2021

Jurisdiction	Number of Jobs	Share
All Jurisdictions	37,320	100.00%
Salem	12,225	32.8%
Portland	2,530	6.8%
Dallas	2,437	6.5%
Independence	1,325	3.6%
Monmouth	1,177	3.2%
Corvallis	1,103	3.0%
McMinnville	952	2.6%
Albany	842	2.3%
Keizer	769	2.1%
Grand Ronde	736	2.0%
All Other Locations	13,224	35%

Source: U.S. Bureau of the Census, On The Map.

The table below shows where workers live who work in Polk County. Approximately 20% of Polk County workers live in Salem; one quarter of workers live in one of the four cities within Polk County.

Figure 50 Labor Shed (Where Workers Live who are Employed in Polk County), 2021

Jurisdiction	Number of Jobs	Share
All Jurisdictions	20,259	100.00%
Salem	4,138	20.4%
Dallas	2,310	11.4%
Monmouth	1,369	6.8%
Independence	1,308	6.5%
Keizer	677	3.3%
McMinnville	444	2.2%
Albany	427	2.1%
Corvallis	371	1.8%
Hayesville	355	1.8%
Portland	346	1.7%
All Other Locations	8,514	42%

Source: U.S. Bureau of the Census, On The Map.

Mitigation activities are needed at the business level to ensure the health and safety of workers and limit damage to industrial infrastructure. Employees are highly mobile, commuting from all over the surrounding area to industrial and business centers. As daily transit rises, there is an increased risk that a natural hazard event will disrupt the travel plans of residents across the

region and seriously hinder the ability of the economy to meet the needs of Polk County residents and businesses.

Industry

Key industries are those that represent major employers and are significant revenue generators. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry specific discussions below. Identifying key industries in the region enables communities to target mitigation activities towards those industries' specific sensitivities. It is important to recognize that the impact that a natural hazard event has on one industry can reverberate throughout the regional economy.

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 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.

Employment by Industry

Economic resilience to natural disasters is particularly important for the major employment industries in the region. If these industries are negatively impacted by a natural hazard, such that employment is affected, the impact will be felt throughout the regional economy. Thus, understanding and addressing the sensitivities of these industries is a strategic way to increase the resiliency of the entire regional economy.

The industry sectors in Polk County with the highest percentage of the workforce are Trade, Transportation & Utilities (22%); Education and Health Services (20%); and Leisure and Hospitality (20%).

Synthesis

Regional economic capacity refers to the present financial resources and revenue generated in the community to achieve a higher quality of life. Forms of economic capital include income equality, housing affordability, economic diversification, employment, and industry. 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 county to absorb disaster impacts for a quick recovery.

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. The county's economy is expected to grow by 2031. It is important to consider what might happen to the county economy if the largest revenue generators and employers are impacted by a disaster. Strategies and actions to reduce vulnerability from an economic focus are imperative and should focus on risk management for the county's dominant industries.

Physical Infrastructure Capacity

Physical infrastructure 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.

Housing

The table below identifies the types of housing most common throughout the county. Of interest are mobile homes (including RVs, Vans, Boats, etc.), which account for about 35% of the housing in Falls City, although it is only 8% of the housing county-wide. Mobile homes are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing the structures, because they are more prone to wind damage than wood-frame construction. In other natural hazard events, such as earthquakes and floods, moveable structures like mobile homes are more likely to shift on their foundations and create hazardous conditions for occupants.

Figure 51 Housing Profile

	Housing Units	Single Family		Multi-Family		Mobile Homes*	
		Estimate	Percent	Estimate	Percent	Estimate	Percent
Polk County	33,406	24,979	75%	5,806	17%	2,621	8%
Dallas	6,767	4,981	74%	1,240	18%	546	8%
Falls City	578	378	65%	0	0%	200	35%
Independence	3,056	2,102	69%	631	21%	323	11%
Monmouth	3,589	2,380	66%	1,011	28%	198	6%

*May include boats, RV, van, etc.

Source: Social Explorer, Table 97, U.S. Census Bureau, 2017-2021 American Community Survey

Aside from location and type of housing, the year structures were built has implications. In the 1970's, FEMA began assisting communities with floodplain mapping as a response to administer the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Upon receipt of floodplain maps, communities started to develop floodplain management ordinances to protect people and property from flood loss and damage. Housing within the floodplain is generally less vulnerable to flood if it was built after the implementation of floodplain development ordinances.

The National Flood Insurance Program's (NFIP's) Flood Insurance Rate Maps (FIRMs) delineate flood-prone areas. They are used to assess flood insurance premiums and to regulate construction so that in the event of a flood, damage is minimized. For more information about the flood hazard, NFIP, and FIRMs, please refer to Flood Hazard section of the Risk Assessment.

Seismic building standards were codified in Oregon building code starting in 1974; more rigorous building code standards were passed in 1993 that accounted for the Cascadia earthquake fault.[75] Therefore, homes built before 1993 are more vulnerable to seismic events. DOGAMI's interpretation of state building code histories and evolution as described by Judson (2012), Oregon Building Codes Division (2002, 2010) and Business Oregon (2015) is shown below.

Figure 52 Oregon's Seismic Design Level Benchmark Years

Building Type	Year Built	Design Level	Basis
Single Family Dwelling (including Duplexes)	prior to 1976 1976-1991 1992-2003 2004-present	Pre Code Low Code Moderate Code High Code	Interpretation of Judson (2012)
Manufactured Housing	prior to 2003 2003-2010	Pre Code Low Code	Interpretation of Oregon Manufactured Dwelling Special Codes (Oregon Building Codes Division, 2002)
	2011-present	Moderate Code	Interpretation of Oregon Manufactured Dwelling Special Codes Update (Oregon Building Codes Division, 2010)
All other buildings	prior to 1976 1976-190 1991-present	Pre Code Low Code Moderate Code	Business Oregon 2014-0311 Oregon Benefit-Cost Analysis Tool, p. 24 (Business Oregon, 2015)

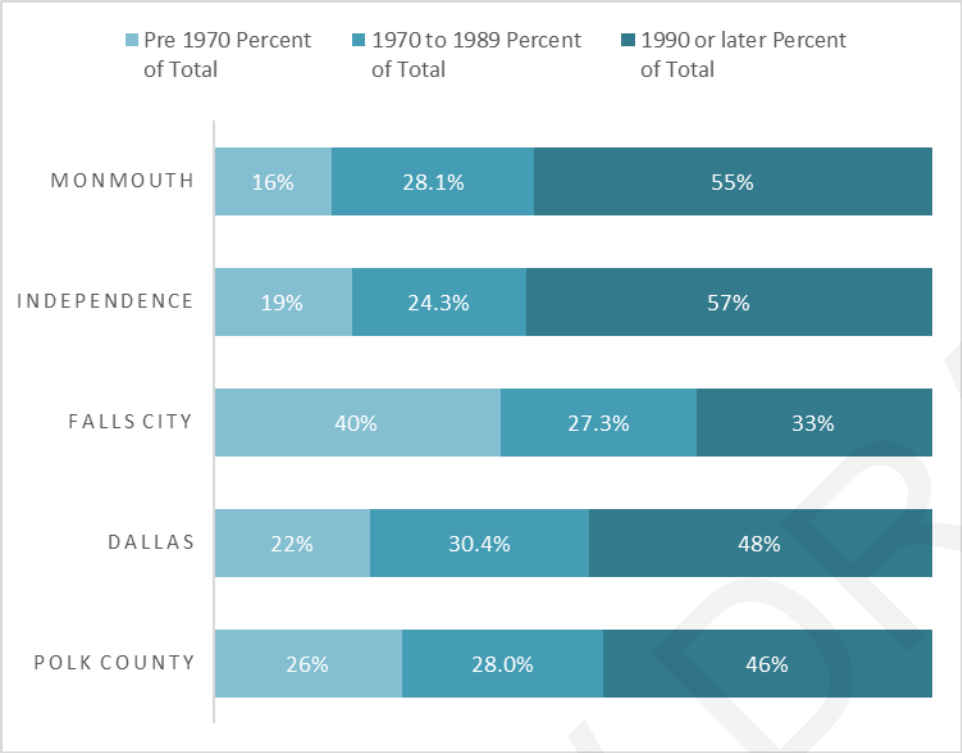
Source: DOGAMI, Open-File Report O-23-01. Multi-Hazard Risk Report for Tillamook County, Oregon: Appendix C – Hazus MH Methodology.

The figure below shows that, countywide, 26% of the housing stock was built prior to 1970, before the implementation of floodplain management ordinances; Falls City has almost one-half of its housing units built prior to 1970.

Countywide, 54% of the housing stock was built before 1990 and the codification of stricter seismic building standards (Table C-25).

[75] State of Oregon Building Codes Division. *Earthquake Design History: A summary of Requirements in the State of Oregon*, February 7, 2012. http://www.oregon.gov/OMD/OEM/osspac/docs/history_seismic_codes_or.pdf

Figure 53 Year Structure Built



Source: U.S. Census Bureau, 2017-2021 American Community Survey Estimates, Table B25034

Infrastructure Profile

Physical infrastructure such as dams, roads, bridges, railways, and airports support Polk County communities and economies. Critical facilities are those facilities that are vital in government response and recovery activities and are important to consider as there can be serious secondary impacts to such facilities when disrupted. Critical facilities and infrastructure can be a wide range of things depending on the social, environmental, economic, and physical makeup of the area under consideration. Such facilities can include emergency services, communication services, transportation systems, government facilities, healthcare and public health facilities, information technology, water services, and energy generation and transmission. Due to the fundamental role that infrastructure plays both pre- and post-disaster, special attention in the context of creating more resilient communities is important. The information provided in this section will outline important infrastructures throughout the county, which will help provide a basis for informed decisions about how to reduce the county's infrastructural vulnerabilities to natural hazards.

Utility Lifelines

Utility lifelines are the resources 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 transmission lines running through the county may be vulnerable to severe, but infrequent natural hazards, such as windstorms, winter storms, and earthquakes.

Energy

In Polk County, electrical and gas utilities are provided by both private companies and some smaller cooperatives. Organizing mitigation across these diverse organizational structures and philosophies will ensure that services are provided equitably, even if a hazard incident stresses the supply or demand. Critical infrastructure includes power substations, gas-lines, and both underground and above ground transmission lines.

The electric power system is central to community function. The impacts of loss of electric power are large: residential, commercial, and public customers are all heavily dependent on electric power for normal functioning. Furthermore, other utility systems, especially water and wastewater systems, are heavily dependent on electric power for normal operations. Loss of electric power may have large impacts on affected communities, especially if outages are prolonged.

Natural Gas Systems

Polk County's primary natural gas provider is Northwest Natural. Natural gas transmission and distribution pipes are not usually affected by flooding, because the pipes are pressurized. However, compressor stations may be subject to inundation damage or loss of electrical power to run electrical and mechanical equipment.

Transmission and distribution pipes are also subject to rupture in slide areas and in earthquakes. Buried utility pipes are very subject to failure in small ground movements. Movements as small as an inch or two are often sufficient to break the pipes, especially for older cast-iron pipe which is more brittle than welded steel or polyethylene pipe. Possible mitigation actions include pipe upgrades for a few critical locations and nonstructural seismic mitigation for control equipment.

Telecommunications Systems

Telephone (land lines and cellular) systems, broadcast radio and TV systems and cable TV systems may all be vulnerable to damages and services outages from hazards. However, in general, such systems have proved to be somewhat less vulnerable to service outages than other utility systems. System nodes (broadcast studios, switching offices and such) are subject to flooding if located in flood-prone areas. However, because of the importance of such facilities, few are in highly flood-prone sites.

Similarly, few such facilities are likely to be in landslide prone areas. Cellular towers in hilly areas, however, may be more subject to landslide hazards.

Buried communications (copper and fiber optic) and cable television cables are usually flexible enough to accommodate several feet of ground movement before failure. While major landslides may rupture such cables, minor settlements or small slides are not nearly as likely to impact such cables as they are to break buried gas or water pipes. Such lines typically perform relatively well in earthquakes.

Above ground communications and cable television cables are subject to wind- induced failures from tree falls and pole failures. However, such failures are less common than failures of electric

power lines. The better performance of communications cables arises in part because the electrical cables are always highest on the poles, thus a falling branch is usually first resisted by the power cables. Also, because the voltage levels in communications cables are much lower than those in power cables, the communication cables are not subject to "burn down" or shorting if wind-swayed cables touch each other or get too close.

Some telecommunications facilities are subject to failure because of loss of electric power. However, key facilities almost always have backup battery power and/or generators. Therefore, telecommunications facilities are generally much less vulnerable to outages from loss of electric power than are water or wastewater systems.

Potable Water

Water treatment plants are often located in flood prone areas and are subject to inundation when untreated water enters the filters, sedimentation, or flocculation basins, resulting in loss of capability to treat incoming untreated water properly. Water system control buildings and pump stations may also be subject to flood damage. Public or private water systems with wells as the water source are subject to outages when flood waters contaminate well heads; this is a common problem for smaller water systems.

Water transmission or distribution pipes are rarely damaged by flood waters, unless there are soil settlements or major erosion, because the lines are sufficiently pressurized (for water quality) to prevent intrusion of flood waters. Water transmission or distribution pipes are, however, subject to breakage when they cross landslide areas or in earthquakes. Water treatment plants are also subject to earthquake damage to the building and to process and control equipment.

Water systems are also highly vulnerable to electric power outages. Many water systems include pumped storage systems where water is pumped to storage tanks which are typically located 60 to 200 feet above the elevation of water system customers. Such tanks generally contain no more than 1 or 2 days of storage beyond typical daily usage (for reasons of water quality). Thus, electric power outages of more than 1 or 2 days may result in loss of potable water due to the inability of pumping plants to pump water. The most logical mitigation projects to minimize such outages are to provide back-up generators at key pumping plants or to provide quick connects so that portable generators (if available) can be quickly installed. Water treatment plants are also subject to outages due to loss of electric power.

Wastewater Systems

Wastewater systems are often highly vulnerable to flood impacts. Rising water may cause collection pipes to back up and overflow. Intrusion of storm water into collection systems may result in flows that exceed treatment plant capacities, resulting in release of untreated or only partially treated flows. Treatment plants are often located in floodplains, at low elevations, to facilitate gravity flow. However, such locations also facilitate flood damage.

Lift stations and treatment plants are also subject to loss of function due to electric power outages, with resulting overflows or releases. Collection pipes are also subject to breakage due to landslides. However, such impacts are not particularly common since most wastewater collection systems are in more urbanized areas with only selected areas subject to slides.

Wastewater pipes are, however, subject to breakage in earthquakes. Wastewater treatment plants are also subject to earthquake damage to the building and to process and control equipment.

Dams

Dams are manmade structures built to impound water. Dams are built for many purposes including water storage for potable water supply, livestock water supply, irrigation, or fire suppression. Other dams are built for flood control, recreation, navigation, hydroelectric power, or to contain mine tailings. These critical infrastructure pieces not only protect water resources that are used for drinking, agriculture, and recreation, but they protect downstream development from inundation. Dams may also be multifunctional, serving two or more of these purposes.

The National Inventory of Dams (Figure C-11 and Table C-26), NID, which is maintained by the United States Army Corps of Engineers, is a database of approximately 91,750 dams in the United States. The NID does not include all dams in the United States. Rather, the NID includes dams that are deemed to have a high or significant hazard potential and dams deemed to pose a low hazard if they meet inclusion criteria based on dam height and storage volume. Low hazard potential dams are included only if they meet either of the following selection criteria:

- exceed 25 feet in height and 15 acre-feet of storage, or
- exceed 6 feet in height and 50-acre feet of storage.

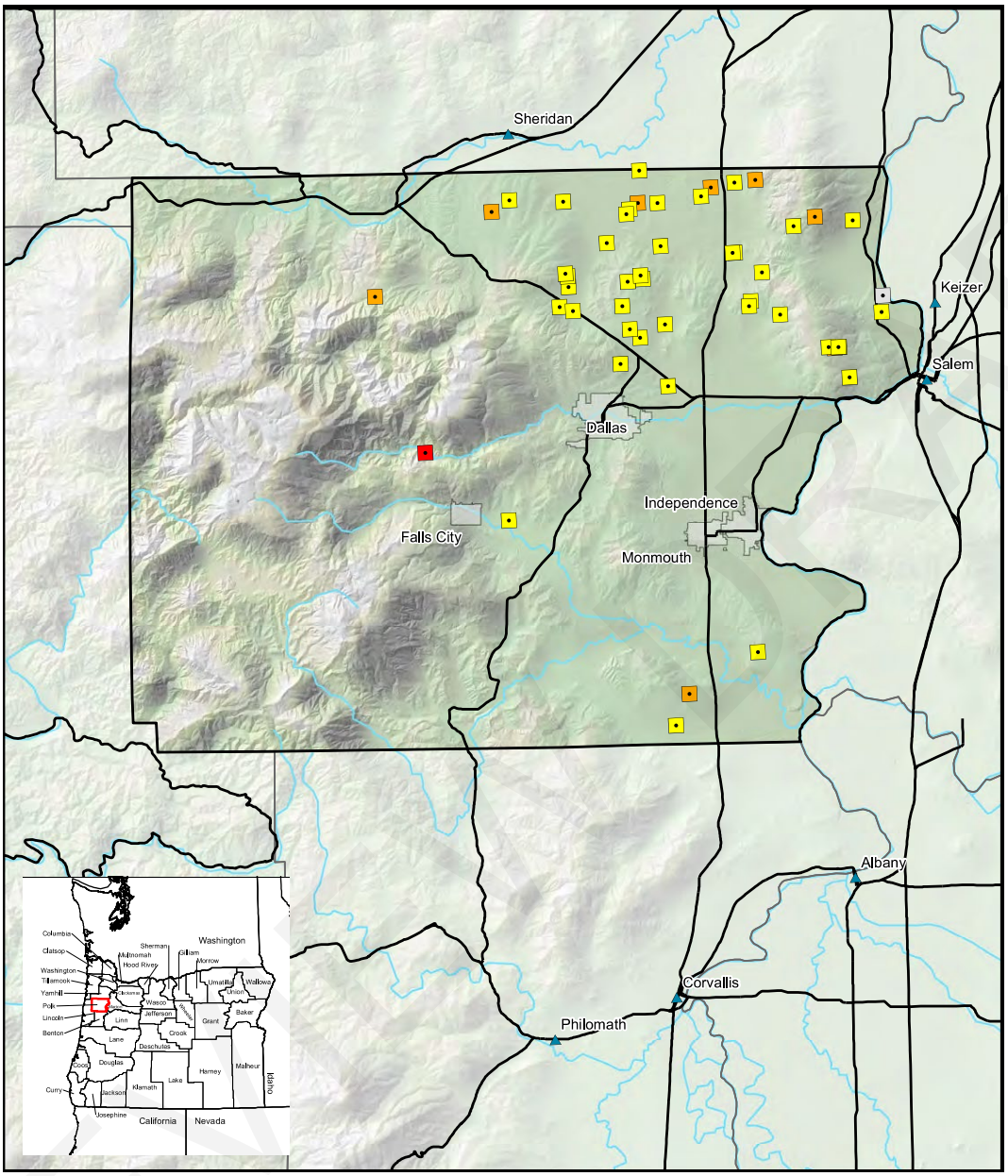
There are many thousands of dams too small to meet the NID selection criteria. However, these small dams are generally too small to have significant impacts if they fail and thus are generally not considered for purposes of risk assessment or mitigation planning.

NID potential hazard classification is solely a measure of the probable impacts if a dam fails. Thus, a dam classified as High Potential Hazard does not mean that the dam is unsafe or likely to fail. The level of risk (probability of failure) of a given dam is not even considered in this classification scheme. Rather, the High Potential Hazard classification simply means that there are people at risk downstream from the dam in the inundation area if the dam were to fail.

Dams assigned to the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life. Failure of dams in the high classification will generally also result in economic, environmental or lifeline losses, but the classification is based solely on probable loss of life.

There are 2 High Hazard dams in Polk County. Mercer Dam, although located in a rural unincorporated area, is owned, and managed by the City of Dallas.

Figure 54 Polk County Dams and Hazard Threat



Source: OPDR, data National Inventory of Dams - Link. Note: Text in red indicates HHDP eligible as of 6/1/2022.

Figure 55 Polk County High Hazard Dam Inventory

Threat Potential	Number of Dams	River (Dam)
High	2	Gibson Gulch (Croft Reservoir); Rickreall Creek (Mercer Reservoir)
Significant	7	Gooseneck Creek (Mt. Springs Ranch Dam); Berry Creek (Kennel Reservoir); Ash Swale (Olson Reservoir, Deraeve Reservoir #1); Tributary to Ash Creek (Koning "E" Reservoir); Tributary to King Creek (Eola Hills Reservoir); Tributary to South Yamhill River (Shaffer Reservoir)
Low	52	-
Total	**61**	

Source: National Inventory of Dams - Link. Oregon Water Resources Department Inquiry on HHPD Eligibility (2/22/2024).

Dams assigned to the significant hazard potential classification are those where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, or disruption of lifeline facilities. Significant hazard potential dams are often located in predominantly rural or agricultural areas. There are 8 Significant Hazard dams in Polk County.

Dams assigned the low hazard potential classification are those where failure or mis- operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the dam owner's property. There are 40 Low Hazard dams in Polk County.

Dam failures can occur at any time in a dam's life; however, failures are most common when water storage for the dam is at or near design capacity. At high water levels, the water force on the dam is higher and several of the most common failure modes are more likely to occur. Correspondingly, for any dam, the probability of failure is much lower when water levels are substantially below the design capacity for the reservoir.

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. However, the potential for severe damage still exists.

Railroads

Railroads are major providers of regional and national cargo trade flows. The Portland & Western Railroad has two freight lines, one of which runs north-south through Polk County through Independence, with a spur to Dallas, and the second of which follows 99E and I-5 through Salem, before circling around West Salem along the Willamette River and continuing south to Millersburg. The Hampton Railway, a Portland & Western spur, enters the county in the north, connecting Grand Ronde to Sheridan and McMinnville in Yamhill County.

Rails are sensitive to icing from winter storms that can occur in the Southwest Oregon region. For industries in the region that utilize rail transport, these disruptions in service can result in economic losses. The potential for rail accidents caused by natural hazards can also have serious implications for the local communities if hazardous materials are involved.

Airports
Polk County has one airport, the Independence State Airport. This airport, located one mile north of Independence, is run by the Oregon Department of Aviation. Serving as a general aviation airport, Independence State Airport also hosts a larger residential airpark (or "fly-in community").

Roads
Urban Polk County meets its current transportation needs through a mixture of municipal road systems, county roads, and state and federal highways. Major highways in the county include Oregon Route 99W, which runs from north to south, linking the cities of McMinnville and Corvallis, and Oregon Route 22, running east to west and connecting Salem to the coast. Oregon Route 223 branches west from Rickreall and connects Dallas to Wren along Interstate 20 to the south. Oregon Route 194 spans a 7.5-mile connection from east to west between Monmouth and Oregon Route 223.

Seismic lifeline routes help maintain transportation facilities for public safety and resilience in the case of natural disasters. Following a major earthquake, it is important for response and recovery agencies to know which roadways are most prepared for a major seismic event. The Oregon Department of Transportation has identified lifeline routes to provide a secure lifeline network of streets, highways, and bridges to facilitate emergency services response after a disaster.[76]

System connectivity and key geographical features were used to identify a three-tiered seismic lifeline system. Routes identified as Tier 1 are the most significant and necessary to ensure a functioning statewide transportation network. The Tier 2 system provides additional connectivity to the Tier 1 system; it allows for direct access to more locations and increased traffic volume capacity. The Tier 3 lifeline routes provide additional connectivity to the systems provided by Tiers 1 and 2.

The Lifeline Routes in the SouthI-5 and Cascades Regions affecting Polk County consist of the following:

- Tier I: Interstate 5 (Marion County)
- Tier II: Oregon Route 18
- Tier III: Oregon Route 99W
- Tier IV: Oregon Route 22

Bridges

Because of earthquake risk, the seismic vulnerability of the county's bridges is an important issue. Non-functional bridges can disrupt emergency operations, sever lifelines, and disrupt local and freight traffic. These disruptions may exacerbate local economic losses if industries are unable to transport goods. The county's bridges are part of the state and interstate highway

[76] CH2MHILL, Prepared for Oregon Department of Transportation. Oregon Seismic Lifeline Routes Identification Project, *Lifeline Selection Summary Report,* May 15, 2012.

system, which is maintained by the Oregon Department of Transportation (ODOT), or are part of regional and local systems, maintained by the region's counties and cities.

The table below shows the structural condition of bridges in the region. A distressed bridge is a condition rating used by the Oregon Department of Transportation (ODOT) indicating that a bridge has been identified as having a structural or other deficiency, while a deficient bridge is a federal performance measure used for non-ODOT bridges; the ratings do not imply that a bridge is unsafe.[77] The table shows that the county has a lower percentage of bridges that are distressed and/ or deficient (12.5%), than does the state (28%). About 43% of the total county and city owned bridges are distressed, compared to 28% of State owned (ODOT) bridges. Half the bridges in the County that are privately owned are distressed.

Figure 56 Bridge Inventory

	Bridge Condition	Oregon	Region 3	Polk
State Owned	Distressed	610	118	14
	Sub-total	2,718	610	51
	Percent Distressed	22.4%	19.3%	28.0%
County Owned	Deficient	633	194	11
	Sub-total	3,420	942	88
	Percent Distressed	18.5%	20.6%	12.5%
City Owned	Deficient	160	44	4
	Sub-total	614	208	13
	Percent Deficient	26.1%	21.2%	30.8%
Other Owned	Deficient	40	6	1
	Sub-total	115	24	2
	Percent Deficient	34.8%	25.0%	50.0%
Area Total (All Owners)	Deficient	1,443	362	30
	Sub-total	6,769	1,741	153
	Percent Deficient	21.3%	20.8%	19.6%
Historic Covered		334	71	6

Source: Oregon Department of Transportation, 2022; Oregon's Historic Bridge Field Guide

The bridges in Polk County require ongoing management and maintenance due to the age and types of bridges. Modern bridges, which require minimum maintenance and are designed to withstand earthquakes, consist of pre-stressed reinforced concrete structures set on deep steel piling foundations.

The County's bridge maintenance and engineering divisions work in coordination to inspect and maintain the bridges within the county. Bridges within Polk County are inspected at two-year intervals or more frequently if special conditions exist. Bridges that are found to be in critical condition during an inspection are prioritized for immediate replacement.

[77] Oregon. Bridge Engineering Section (2012). 2012 Bridge Condition Report. Salem, Oregon: Bridge Section, Oregon Department. of Transportation.

Synthesis

Built capacity refers to the built environment and infrastructure that support a community. The various forms of built capital mentioned above will play significant roles in the event of a disaster. Physical infrastructures, along with utility and transportation lifelines are critical during a disaster and are essential for proper functioning and response. Community resilience is directly affected by the quality and quantity of built capital and lack of, or poor condition of, infrastructure can negatively affect a community's ability to cope, respond, and recover from a natural disaster. Initially following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions will force communities to rely on local and immediate resources, so it is important to identify critical infrastructures throughout the county as they may play crucial roles in the mitigation and recovery stages of a disaster.

It is important for the county to consider these numbers when producing mitigation and educational outreach materials as it is important to reach all populations, especially the ones who face a higher risk of damage. There are 2 dams in the county classified with a high threat potential. There are a variety of critical facilities located throughout county limits that in the event of a disaster can make communication efforts challenging. Several minor highways run throughout the county, giving residents several alternative routes that may provide service access, or serve as evacuation routes, yet if these roads are destroyed it can isolate communities and make rescue efforts more challenging.

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.

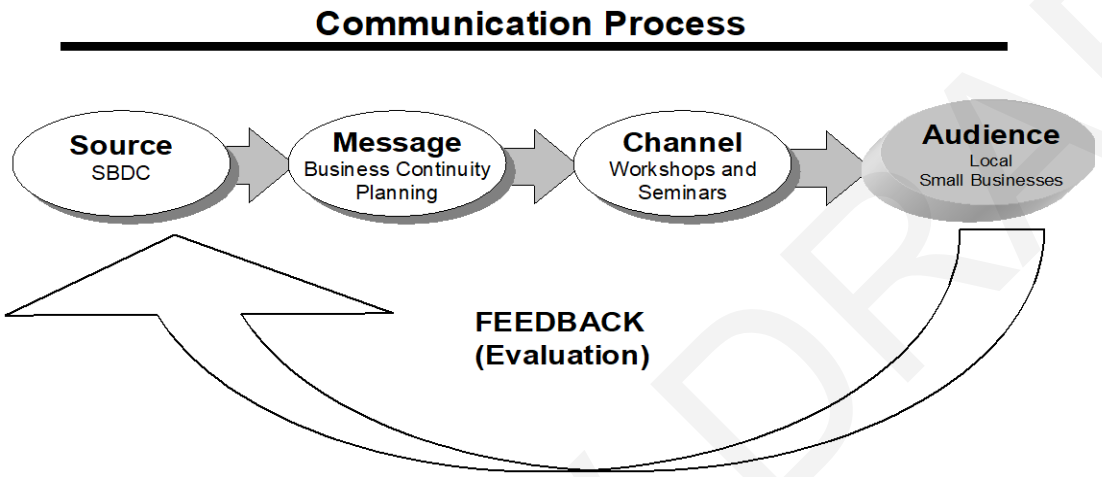
Social Systems and Service Providers

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 planning for natural hazard mitigation, it is important to know what social systems exist within the community because of their existing connections to the public. Often, actions identified by the plan 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 several issues, one of which could be natural hazard

preparedness and mitigation. The presence of these services is more predominantly located in urbanized areas of the county, this is synonymous with the general urbanizing trend of residents.

The figure below displays the NHMP's communication process. It is followed by a brief explanation of how the communication process works and how the community's existing social service providers could be used to provide natural hazard related messages to their clients.

Figure 57 Communication Process



Source: Adapted from the U.S. Environmental Protection Agency Radon Division's outreach program

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.

The following list highlights organizations that are active within the community and may be potential partners for implementing mitigation actions. The three involvement methods are defined below.

Education and outreach – organization could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.

Information dissemination – organization could partner with the community to provide hazard-related information to target audiences.

Plan/project implementation – organization may have plans and/or policies that may be used to implement mitigation activities, or the organization could serve as the coordinator or partner organization to implement mitigation actions.

Civic Engagement

Civic engagement and involvement in local, state, and national politics are important indicators of community connectivity. Those who are more invested in their community may have a higher tendency to vote in political elections. The 2020 presidential General Election resulted in 80.9% voter turnout in the county.[78] These results are slightly above voter participation reported across the State (78.5%) for the 2020 election.[79] 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

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 public libraries in Dallas, Independence, and Monmouth. There are several museums in Polk County, including the Polk County Museum and Historical Society in Rickreall and the Heritage Museum in Independence.

Cultural Events

Other such institutions that can strengthen community connectivity are the presence of festivals and organizations that engage diverse cultural interests. Examples of events include the River's Edge Summer concert series in Independence at Riverview Park and the Monmouth Music in the Park Series, and institutions such as Western Oregon University in Monmouth.

Not only do events and institutions like these bring revenue into the community, they have potential to 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 culture.

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 an important role in defining and supporting the community.

[78] Official Summary Report, November 3, 2020, Polk County Clerk. https://Polkcountyor.org/clerk/Elections/Election-Archives.

[79] Voter Turnout History for General Elections, Oregon Secretary of State. https://sos.oregon.gov/elections/Documents/Voter_Turnout_History_General_Election.pdf.

Historic buildings and places in Polk County include: Beulah Methodist Episcopal Church; Brunk, Harrison, House; Cooper, James s. and Jennie M., House; Craven, Joseph and Priscilla, House; Davidson, Dr. John E. and Mary D., House; Domes, Walter J., House; Eldridge, Kersey C., House; Fort Yamhill Site; Graves-Fisher-Strong House; Harritt, Jesse and Julia, House; Howell, John W., House; Independence Historic District; Independence National Bank (Citizens Valley Bank); Parker School; Phillips, John, House; Polk County Bank; Pumping Station Bridge; Riley-Cutler House; Ritner Creek Bridge; Saint Patrick's Roman Catholic Church (Methodist Episcopal Church, South); Sherman, Eleanor, House; Spring Valley Presbyterian Church; Well, George A., Jr., House; West Salem City Hall, Old (West Salem Library Building); Wheeler, J. A., House; Wilson, A.K., Building (Stafrin Drug Store/Greenwood Building)[80].

Community Stability

Community stability is a measure of rootedness in place. It is hypothesized that resilience to a disaster stem 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. [81]

Residential Geographic Stability

The chart below estimates residential stability across the region. It is calculated by the number of people who have lived in the same house and those who have moved within the same county a year ago, compared to the percentage of people who have migrated into the region. Polk County overall has a geographic stability rating of about 89% (i.e., 89% of the population lived in the same house or moved within the county). Falls City has the highest geographic stability (92.8%) while Monmouth has the lowest (76.8%).

Figure 58 Regional Residential Stability

Jurisdiction	Population	Geographic Stability	Same House	Moved Within Same County
Polk	76,484	89.2%	80.9%	8.3%
Dallas	14,631	90.7%	77.7%	13.0%
Falls City	988	92.8%	87.6%	5.2%
Independence	8,631	89.2%	77.8%	11.4%
Monmouth	9,823	76.8%	61.5%	15.3%

Source: Social Explorer, Table 130, U.S. Census Bureau, 2017-2021 American Community Survey Estimates

Homeownership

Housing tenure describes whether residents rent or own the housing units they occupy. Homeowners are typically more financially stable but are at risk of greater property loss in a

[80] "Oregon Historic Sites Database." Oregon Historic Sites Database. Accessed August 10, 2016. http://heritagedata.prd.state.or.us/historic/.

[81] Cutter, Susan, Christopher Burton, Christopher Emrich. "Disaster Resilience Indicators for Benchmarking Baseline Conditions". Journal of Homeland Security and Emergency Management.

post-disaster situation. People may rent because they choose not to own, they do not have the financial resources for home ownership, or they are transient.

Collectively, about 62% of the occupied housing units in Polk County are owner-occupied; about 33% are renter occupied. Falls City and Dallas have the highest rate of owner-occupied units. Seasonal or recreational housing accounts for a small (5%) portion of housing units in Polk County.

Figure 59 Housing Tenure and Vacancy

	Housing Units	Owner-occupied		Renter-occupied		Vacant^	
		Estimate	Percent	Estimate	Percent	Estimate	Percent
Polk County	33,406	20,727	62%	11,015	33%	1,525	5%
Dallas	6,767	4,563	67%	2,049	30%	84	1%
Falls City	578	396	69%	167	29%	13	2%
Independence	3,056	1,750	57%	1,221	40%	44	1%
Monmouth	3,589	1,289	36%	2,057	57%	11	0%

Source: Social Explorer, Tables 94, and 95, U.S. Census Bureau, 2017-2021 American Community Survey Estimates, Table B25004
^ = Seasonal, recreational, or occasional housing units. ^^ = Functional vacant units, computed after removing seasonal, recreational, or occasional housing units from vacant housing units.

According to Cutter, wealth increases resiliency and recovery from disasters. Renters often do not have personal financial resources or insurance to assist them post-disaster. On the other hand, renters tend to be more mobile and have fewer assets at risk of natural hazards.[82] In the most extreme cases, renters lack enough shelter options when lodging becomes uninhabitable or unaffordable post-disaster.

Synthesis

Polk County has distinct social and cultural resources that work to increase community connectivity and resilience. Sustaining social and cultural resources, such as social services and cultural events, may be essential to preserving community cohesion and a sense of place. The presence of larger communities makes additional resources and services available for the public. However, it is important to consider that these amenities may not be equally distributed to the rural portions of the county and may produce implications for recovery in the event of a disaster.

In the long-term, it may be of specific interest to the county to evaluate community stability. A community experiencing instability and low homeownership may hinder the effectiveness of social and cultural resources, distressing community coping and response mechanisms.

[82] Cutter, S. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*.

Appendix D: Economic Analysis of Natural Hazard Mitigation Projects

This appendix was developed by the Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center. It has been reviewed and accepted by the Federal Emergency Management Agency as a means of documenting how the prioritization of actions shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

The appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects. It 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 Department of Emergency Management, 2000), and Federal Emergency Management Agency 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 an economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred. Evaluating possible natural hazard mitigation activities provides decision-makers with an understanding of the potential benefits and costs of an activity, 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. First, natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, law enforcement, utilities, and schools. Second, 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. Third, 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, from a public policy perspective, in assessing the positive and negative impacts from mitigation activities and obtaining an instructive benefit/cost

comparison. Otherwise, the decision to pursue or not pursue various mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

Mitigation Strategy Economic Analyses Approaches

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. The distinction between the three methods is outlined below:

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by the state Oregon Department of Emergency Management (OEM), the Federal Emergency Management Agency, 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 mitigation efforts exceed the cost of the mitigation activity. Conducting benefit/cost analysis for a mitigation activity 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 (i.e., 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 Activities

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 Activities

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:

1. Request cost sharing from public agencies;
2. Dispose of the building or land either by sale or demolition;
3. Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
4. 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 activity could be very time consuming and may not be practical. There are some alternate approaches for conducting a quick evaluation of the proposed mitigation activities which could be used to identify those mitigation activities that merit more detailed assessment. One of those methods is the STAPLE/E approach.

Using STAPLE/E criteria, mitigation activities can be evaluated quickly by steering committees in a synthetic fashion. This set of criteria requires the committee to assess the mitigation activities based on Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLE/E) constraints and opportunities of implementing the particular mitigation item 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 county 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.

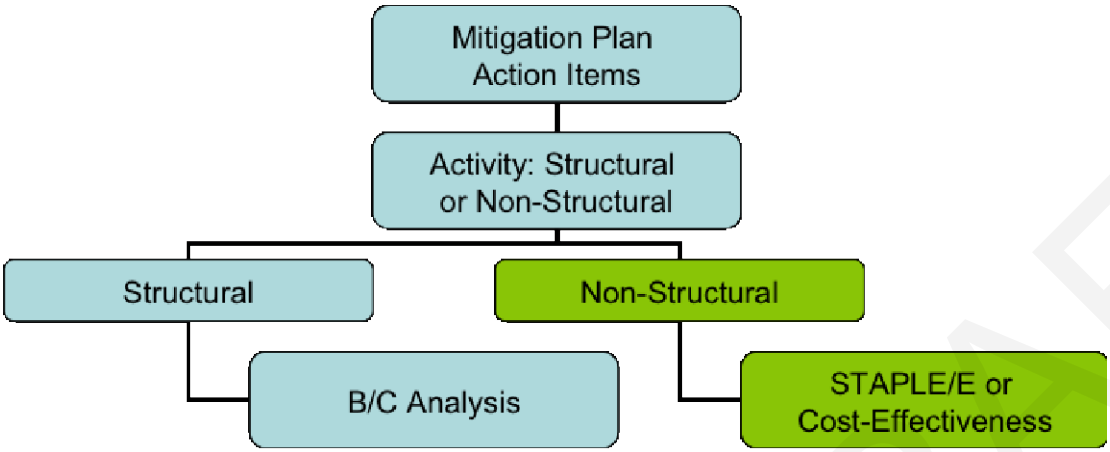
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

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. Figure D-1 is to serve as a guideline for when to use the various approaches.

Figure D-1 Economic Analysis Flowchart



Source: Oregon Partnership for Disaster Resilience. 2005.

Implementing the Approaches

Benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E are important tools in evaluating whether to implement a mitigation activity. A framework for evaluating mitigation activities is outlined below. This framework should be used in further analyzing the feasibility of prioritized mitigation activities.

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 on 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 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 landowners 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
- 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 time.

Additional Costs from Natural Hazards

Property owners should also assess the broader impacts 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
- 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 the total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters 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. 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

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 Department 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.

This page intentionally left blank.

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 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.

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, and then becomes available statewide if funding is still available.
http://www.fema.gov/hazard-mitigation-grant-program

Physical Disaster Loan Program

When physical disaster loans are made to homeowners and businesses following disaster declarations by the U.S. Small Business Administration (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

Non-Disaster Federal Programs

Building Resilient Infrastructure and Communities Grant Program

The Building Resilient Infrastructure and Communities (BRIC) 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. BRIC grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds. The BRIC 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.
https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

Flood Mitigation Assistance Program

The overall goal of the Flood Mitigation Assistance (FMA) Program is to fund cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other National Flood Insurance Program (NFIP) insurable structures. This specifically includes:

- Reducing the number of repetitively or substantially damaged structures and the associated flood insurance claims;
- Encouraging long-term, comprehensive hazard mitigation planning;
- Responding to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development activities; and
- Complementing other federal and state mitigation programs with similar, long-term mitigation goals.

http://www.fema.gov/flood-mitigation-assistance-program

Detailed program and application information for federal post-disaster and non-disaster programs can be found in the FY15 Hazard Mitigation Assistance Unified Guidance, available at: https://www.fema.gov/media-library/assets/documents/103279. 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, which should be garnered well before the application period opens.

For Oregon Department of Emergency Management (OEM) grant guidance on Federal Hazard Mitigation Assistance, visit:
https://www.oregon.gov/OEM/emresources/Grants/Pages/HMA.aspx

Contact: shmo@mil.state.or.us

State Programs

Special Public Works Fund

The Special Public Works Fund (SPWF) provides funds for publicly owned facilities that support economic and community development in Oregon. Funds are available to public entities for:

planning, designing, purchasing, improving, and constructing publicly owned facilities, replacing publicly owned essential community facilities, and emergency projects resulting from a disaster. Public agencies that are eligible to apply include: cities, counties, county service districts, (organized under ORS Chapter 451), tribal councils, ports, districts as defined in ORS 198.010, and airport districts (ORS 838). Facilities and infrastructure projects that are eligible for funding are: airport facilities, buildings and associated equipment, levee accreditation, certification, and repair, restoration of environmental conditions on publicly-owned industrial lands, port facilities, wharves, and docks, the purchase of land, rights of way and easements necessary for a public facility, telecommunications facilities, railroads, roadways and bridges, solid waste disposal sites, storm drainage systems, wastewater systems, and water systems.
https://www.orinfrastructure.org/Infrastructure-Programs/SPWF/

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

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/

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.
http://coastalmanagement.noaa.gov/

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. http://www.rurdev.usda.gov/Utilities_Programs_Grants.html

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 necessary. http://www.rurdev.usda.gov/HAD-HCFPGrants.html

Public Assistance Grant Program, FEMA

The objective of FEMA Public Assistance (PA) Grant Program is to aid 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-nonprofit

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. http://www.hud.gov/offices/cpd/affordablehousing/programs/home/

Disaster Recovery Initiative, HUD

The DRI provides grants to fund gaps in available recovery assistance after disasters (including mitigation).
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. http://www.fema.gov/fy-2012-emergency-management-performance-grants-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.
http://www.fws.gov/birdhabitat/Grants/index.shtm

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/

Community Wildfire Defense Grant Program

The Community Wildfire Defense Grant Program provides communities at risk of wildfire funding to plan for and reduce the risk of wildfire. The program provides funding to at-risk communities for the purposes of developing/revising their Community Wildfire Protection Plans (CWPP) and/or implementing mitigation activities identified within their CWPPs. The Program also helps communities in the wildland urban interface (WUI) implement activities related to restoring and maintaining the landscape, creating fire adapted communities, and improving wildfire responses.
https://www.fs.usda.gov/managing-land/fire/grants

This page intentionally left blank.

Appendix F: Survey Report

Overview & Methodology

As part of an effort to engage with the community, learn their needs and concerns related to potential natural hazards, and inform local decision-making relating to hazard mitigation and resilience, a public survey was developed for the Polk County NHMP planning project. This survey was made available online and distributed at events to Polk County residents in August and September 2023. IPRE staff and interns intercepted patrons at the Dallas Krazy Dayz Festival on July 28, at the Polk County Fair on August 11, at a concert in Independence on August 18, 2023. The cities and Polk County announced the survey in their newsletter and on websites. The survey closed on September 23, 2023, with 144 survey responses. Respondents were from across Polk County -- Dallas (52), Monmouth (17), Independence (13), Falls City (11), and unincorporated Polk County (51).

The findings below provide an overview of the attached Survey Report. Throughout the report we present the number of respondents for each question to provide context. While survey results should not be interpreted as representative of all Polk County residents, they do provide some insight into the perspective of residents within the community.

Information on our Survey Takers:

- 82% of respondents own their primary residence (in Polk County)
- 72% of respondents identified as female
- 28% are retired
- 15% are living with a disability
- 73% identify as white/Caucasian, 11% as Hispanic/Latino

Synthesis of Responses

Hazards of Concern:

When asked how concerned they were about natural hazards affecting where they live/work, respondents showed that they were:

- Extremely concerned most about Wildfire (37%), Drought (24%), Extreme Heat (24%), and Earthquake (23%)
- Moderately concerned about Winter Storms (31%) and Floods (26%)
- Not at all concerned about Volcanic Events (40%) or Landslides (39%)

Preparedness:

When asked how prepared they were for natural hazards, respondents said they were:

- Extremely or somewhat prepared for Extreme Heat (41%)
- Extremely or somewhat prepared for Winter storms (33%) and Windstorms (32%), and Air Quality events (35%).
- Not prepared at all for Volcanic Events (56%), Landslides (55%), and Floods (38%)

Preparedness activities they have invested time/money in include:

- 85% have smoke detectors
- 64% have prepared some kind of Disaster supply kit
- 59% have First Aid or CPR training
- 50% have a household or family emergency plan in place
- 40% are insured against wildfires and 38% against earthquakes

Education/Information:

Several questions asked respondents about the community's efforts at communicating about natural hazards. 24% of respondents have received no information on hazards impacting the community. None felt extremely informed, although 21% felt moderately informed.

Preferred methods of communication include text message/cellphone alerts, emails, internet/online news, social media, and mail. Outdoor advertising, churches/places of worship, brochures, newspapers, radio and television, and public meetings were all ranked low as means of communication at this time.

Evacuation:

Several questions were designed to see if residents will evacuate when requested. Almost half (47%) said they would evacuate when asked. Most (41%) will go to a family or friend outside of the area; 21% would evacuate to a hotel or motel, 14% to a Red Cross Shelter.

Three (3%) said they would not evacuate. They expressed concerns about traffic jams, leaving their property unprotected, personal safety, and leaving pets. Over one-third (57) of respondents said they would bring pets with them when they evacuate.

"Communities and residents need to work on building resiliency through resiliency training, practice drills and emergency supply preparations."

Findings:

- While most residents have basic safety measures at home (smoke detectors, etc.), less than half have taken any steps to be ready for evacuation or shelter-in-place orders. The community needs to take steps to assist vulnerable populations with self-preparedness to build whole-community resilience.
- Evacuation centers need to be able to accommodate household pets.
- Cell phones, social media, and the internet have surpassed traditional methods of communication (television, radio, newspapers). Education and outreach efforts need to be modified to utilize these technologies to their fullest.

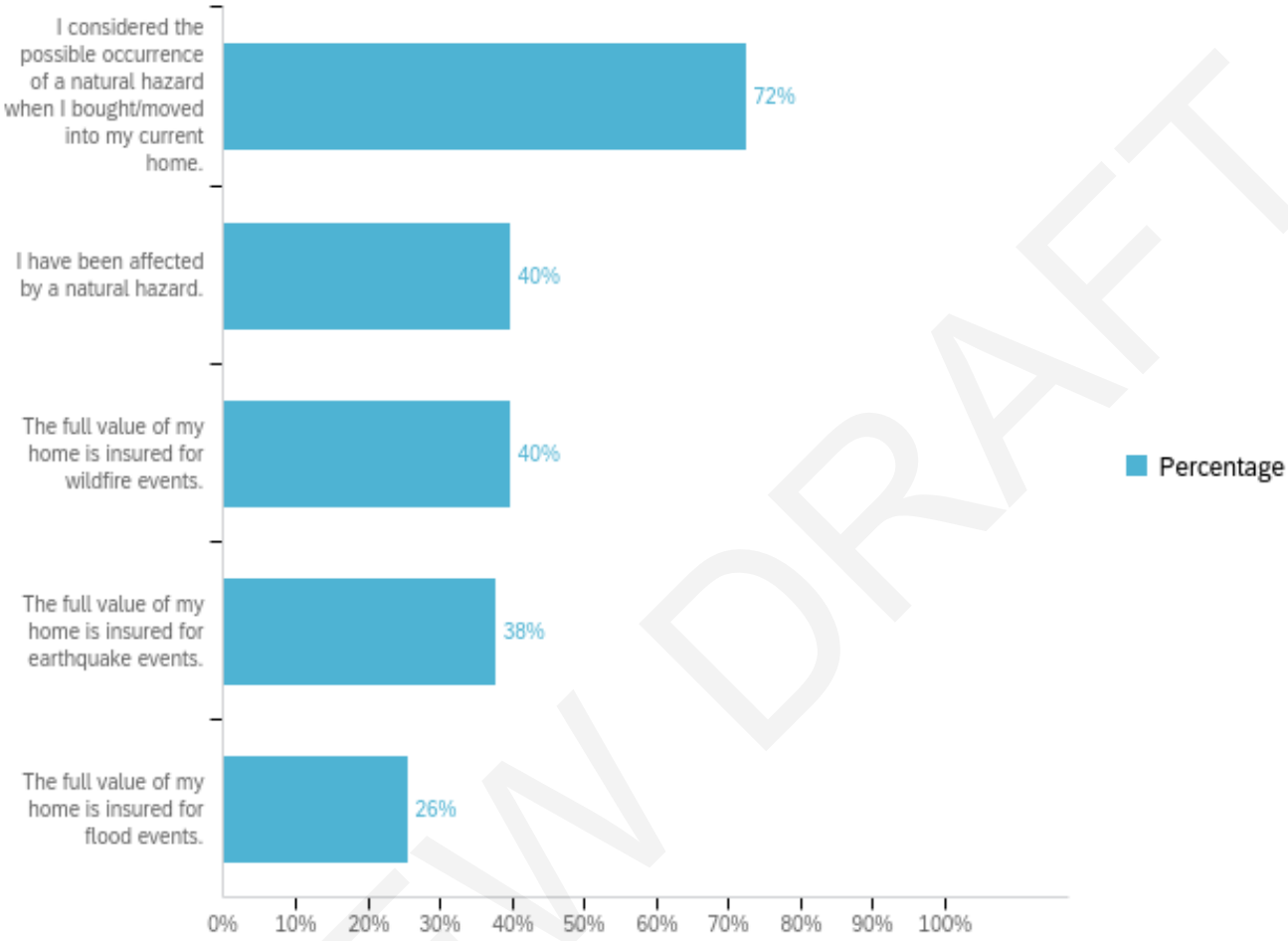
Polk County Hazards Survey Results

Printed November 23, 2023

Q1 - How concerned are you about the following natural hazards affecting the area where you live/work?

#	Question	Extremely Concerned	Somewhat Concerned	Slightly Concerned	Not at all Concerned	Moderately Concerned	Total
8	Wildfire	37%	17%	8%	3%	34%	86
2	Drought	24%	19%	14%	8%	35%	85
4	Extreme Heat	24%	19%	12%	4%	42%	85
3	Earthquake	23%	21%	11%	7%	38%	87
10	Winter storm	17%	26%	19%	6%	33%	86
1	Air Quality/Smoke	16%	19%	11%	7%	47%	85
9	Windstorm	13%	21%	21%	14%	31%	85
5	Flood	5%	18%	29%	22%	26%	85
7	Volcanic Event	2%	28%	24%	40%	6%	85
6	Landslide	1%	18%	31%	39%	12%	85

Q4 - Please select any of the following that apply to you: (select all that apply)



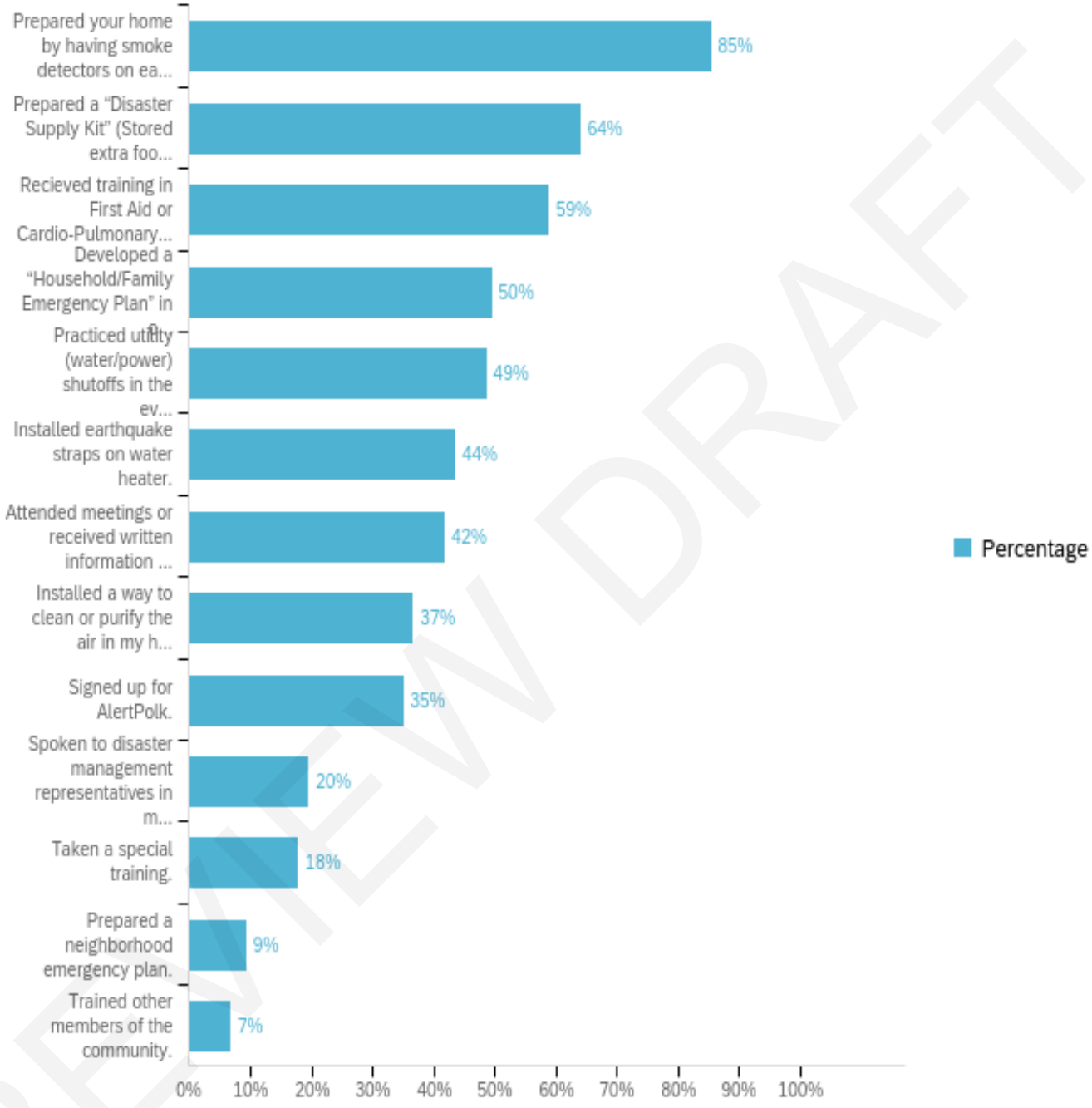
#	Please select any of the following that apply to you: (select all that apply)	Count
1	Please select any of the following that apply to you: (select all that apply)	98

Q5 - How prepared are you for the following natural hazards?

#	Question	Extremely Prepared	Somewhat Prepared	Slightly Prepared	Not at all Prepared	Moderately Prepared	Total
4	Extreme Heat	13%	28%	13%	8%	39%	116
10	Winter storm	10%	23%	14%	10%	42%	116
1	Air Quality/Smoke	9%	26%	17%	12%	35%	117
5	Flood	9%	15%	21%	38%	16%	117
9	Windstorm	5%	27%	23%	22%	23%	115
2	Drought	4%	32%	19%	24%	21%	116
6	Landslide	4%	13%	22%	55%	6%	110
8	Wildfire	4%	27%	19%	20%	30%	115
3	Earthquake	3%	27%	21%	24%	24%	119
7	Volcanic Event	3%	14%	20%	56%	7%	114

#	Question	Extremely Prepared	Somewhat Prepared	Slightly Prepared	Not at all Prepared	Moderately Prepared	Total
7	Volcanic Event	3%	14%	20%	56%	7%	114
6	Landslide	4%	13%	22%	55%	6%	110
5	Flood	9%	15%	21%	38%	16%	117
3	Earthquake	3%	27%	21%	24%	24%	119
2	Drought	4%	32%	19%	24%	21%	116
9	Windstorm	5%	27%	23%	22%	23%	115
11	Other (Please specify):	33%	11%	22%	22%	11%	9
8	Wildfire	4%	27%	19%	20%	30%	115
1	Air Quality/Smoke	9%	26%	17%	12%	35%	117
10	Winter storm	10%	23%	14%	10%	42%	116
4	Extreme Heat	13%	28%	13%	8%	39%	116

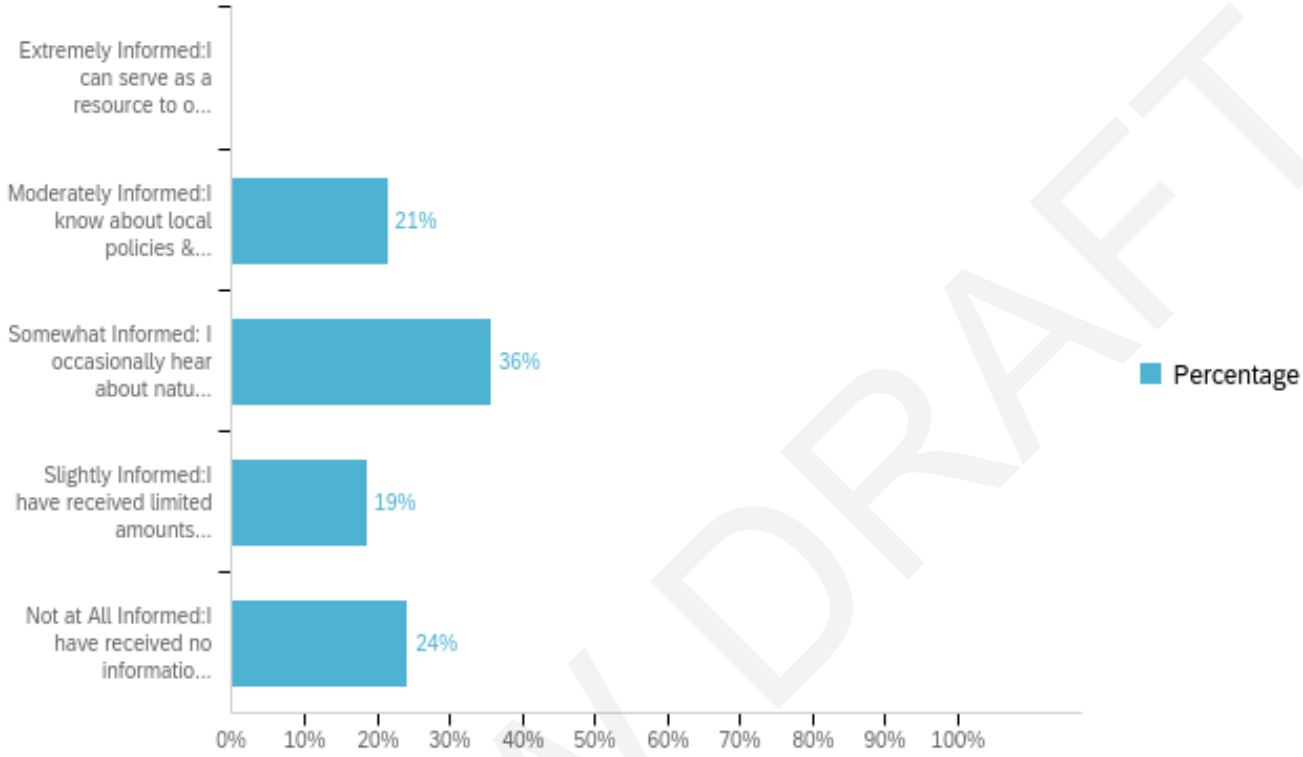
Q6 - What have you done to prepare for natural hazards? (select all that apply)



#	What have you done to prepare for natural hazards? (select all that apply) - Selected Choice	Count
1	What have you done to prepare for natural hazards? (select all that apply) - Selected Choice	117

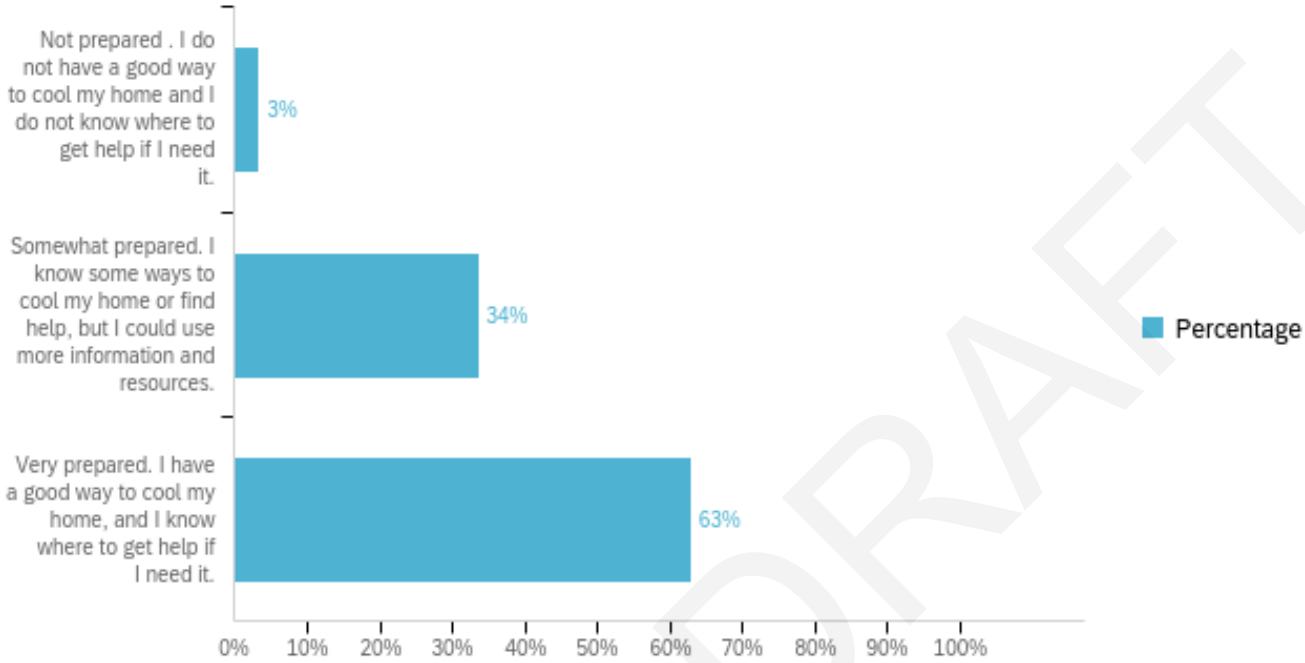
#	Answer	%	Count
6	Prepared your home by having smoke detectors on each level of the house.	16%	100
4	Prepared a “Disaster Supply Kit” (Stored extra food, water, batteries, or other emergency supplies).	12%	75
5	Received training in First Aid or Cardio-Pulmonary Resuscitation (CPR)	11%	69
3	Developed a “Household/Family Emergency Plan” in order to decide what everyone would do in the event of a disaster.	9%	58
7	Practiced utility (water/power) shutoffs in the event of a natural disaster.	9%	57
12	Installed earthquake straps on water heater.	8%	51
1	Attended meetings or received written information on natural disasters or emergency preparedness.	8%	49
11	Installed a way to clean or purify the air in my home during a smoke event.	7%	43
8	Signed up for AlertPolk.	7%	41
2	Spoken to disaster management representatives in my area.	4%	23
10	Taken a special training.	3%	21
9	Prepared a neighborhood emergency plan.	2%	11
13	Other (Please specify):	1%	8
15	Trained other members of the community.	1%	8
	Total	100%	614

Q7 - In your opinion how prepared is your community to respond to, or mitigate, natural hazard risks?



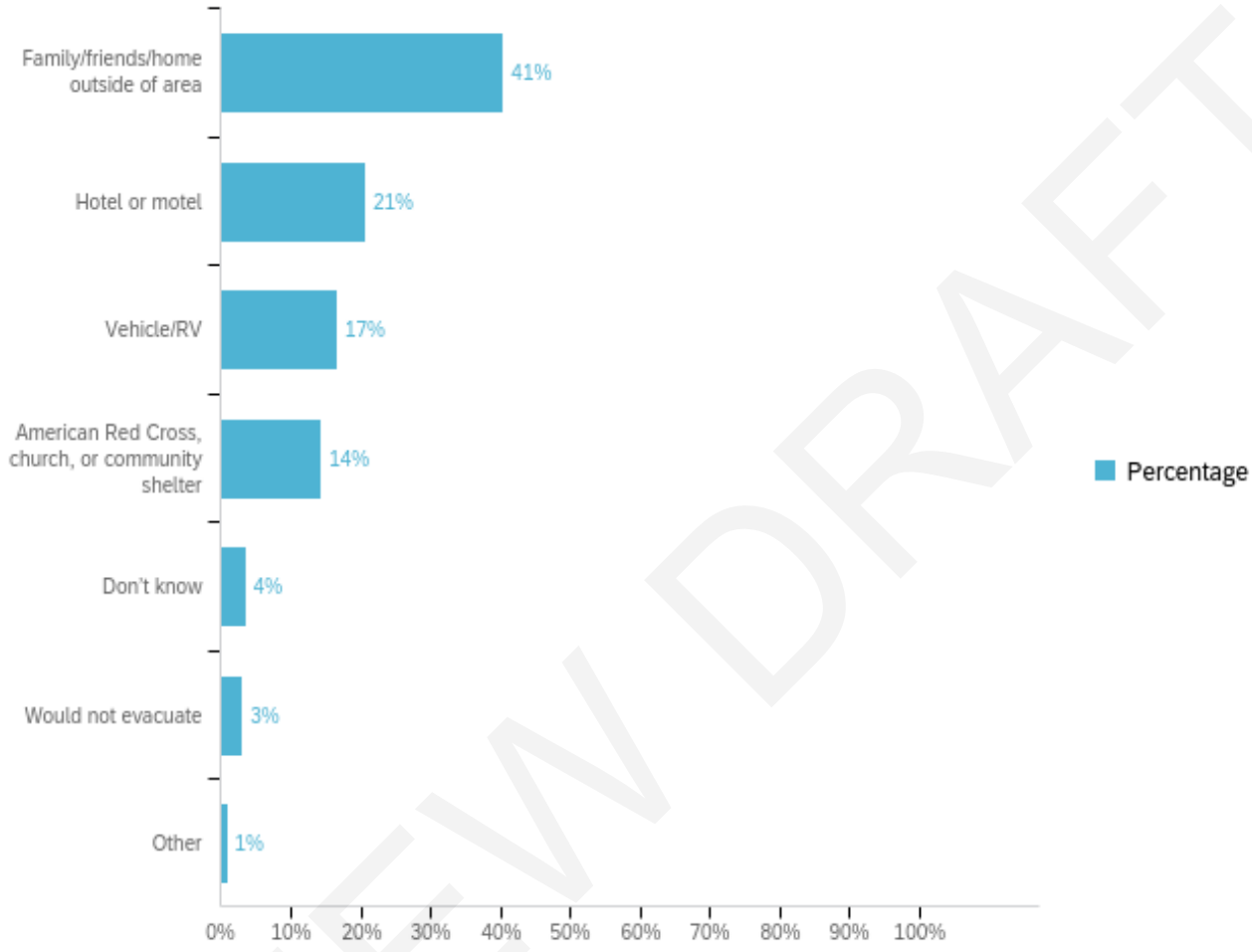
#	How informed do you feel about your community's programs for natural hazard mitigation and disaster preparedness?	Count
1	How informed do you feel about your community's programs for natural hazard mitigation and disaster preparedness?	70

Q8 - How prepared are you to deal with extreme heat events?



#	How prepared are you to deal with extreme heat events?	Count
1	How prepared are you to deal with extreme heat events?	116

Q10 - If your household had to evacuate due to a disaster or emergency, where would you go? (Select all that apply)



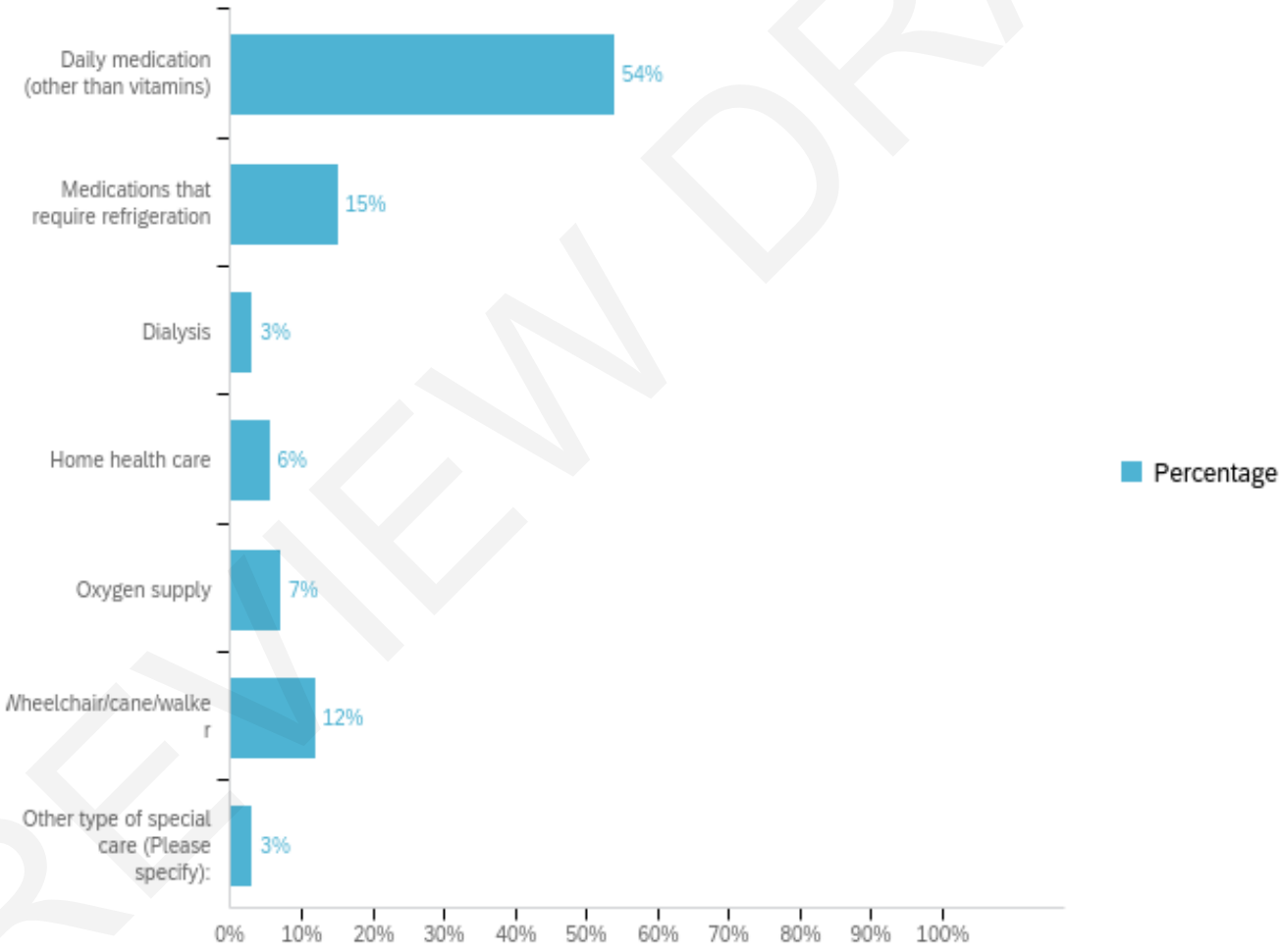
#	Answer	%	Count
1	Family/friends/home outside of area	41%	90
2	Hotel or motel	21%	46
3	American Red Cross, church, or community shelter	14%	32
4	Vehicle/RV	17%	37
5	Would not evacuate	3%	7
6	Don't know	4%	8
7	Other	1%	2
	Total	100%	222

Q19 - Do you have any comments/suggestions to reduce natural hazard risks and improve disaster management/preparedness in Polk County?

A reverse 911 plan would be super, or a text to communicate information prior to it occurring as opposed to only communicating in the event of an emergency.
What. are the plans for meeting the population's needs?;by disaster type and magnitude? How will you communicate?
Forestry officials should have public meetings/send out information regarding fire risk and what grants are available to mitigate fire risk for those whose properties have forest deferrals.
Would like more info on the earthquake readiness of the dam for Dallas…how likely are we to loose water or have the dam burst if a Cascadia event happens?
Appreciate the efforts to trim trees away from power lines. Need information about where potentially identified evacuation sites would be.
We should allow the arboretum to continue watering and irrigating during August and September. The city chooses to turn off our water during the worst of the drought. 7 acres of dry tinder is not going to help the surrounding neighborhoods in case of fire, especially when people still smoke in the arboretum regardless of signage or drought.
A program that helps family's prepare for a natural disaster would be very beneficial. Such as a kit or kit(s) that are prepared for individuals or family's and are available for purchase. I personally have tried to prepare for such an event but I get overwhelmed and give up. If there was something like this available, I would definitely take advantage
When I want information about natural disaster preparedness in Polk County, I will ask my neighbor, and do not know where to find it myself.
Don't over think it. Minimize bureaucracy.
I worry about fire safety because my neighbors brush and trees are too close to my house. We aren't on good terms, or I'd ask his cooperation to keep our shared fence line clear. I don't have a chainsaw or good physical health to keep the vegetation away from my roof. Or much money to pay to get it done regularly. I would be grateful for any ideas on how to make things safer/more fire resistant.
I'm wondering if there's a relationship with POLK CERT. The trainings are extremely valuable.
Have a plan. Tell people about that plan. Falls City talks about getting a plan, but never seems to actually come up with one. Every time it's brought up in public meetings, all we get are reasons why we have to wait to take care of this.
Communities and residents need to work on building resiliency through resiliency training, practice drills and emergency supply preparations.
Keep the politicians out of my personal choices. The push towards all electric is a hazard in itself. All the eggs in one basket has NEVER worked well for those that have tried it. Policies that reduce wildfire include forest harvesting. Policies that reduce landslides and flooding include good management of the resources. A "hands off" regimen is NOT the solution. I have a LOT more to say on this subject but I think you get the point.

Q7 - Do you or any member of your household require any of the following? (Check all that apply.)

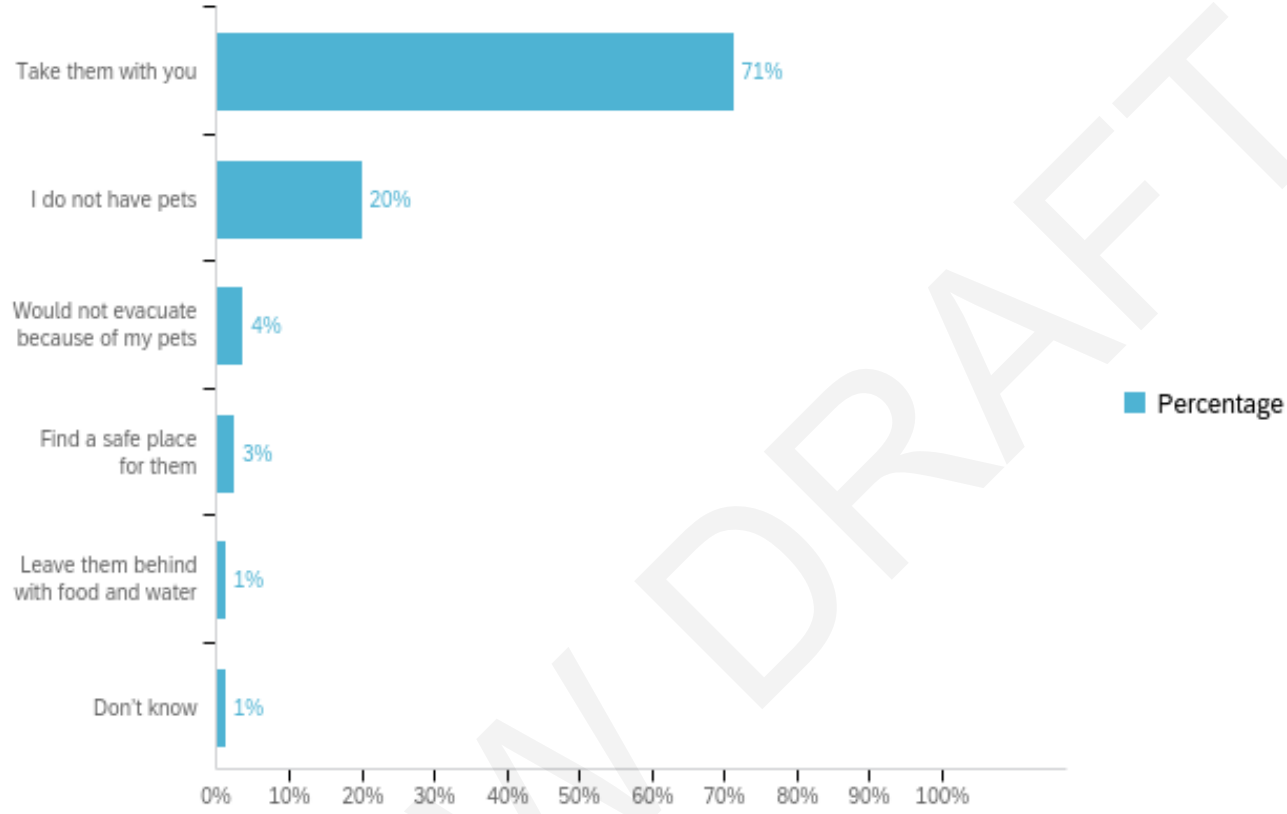
Other type of special care (Please specify): - Text
Electricity for CPAP
Household with disabilities and mental health problems
CPAP- electricity required
None of the above



#	Answer	%	Count
1	Daily medication (other than vitamins)	54%	68

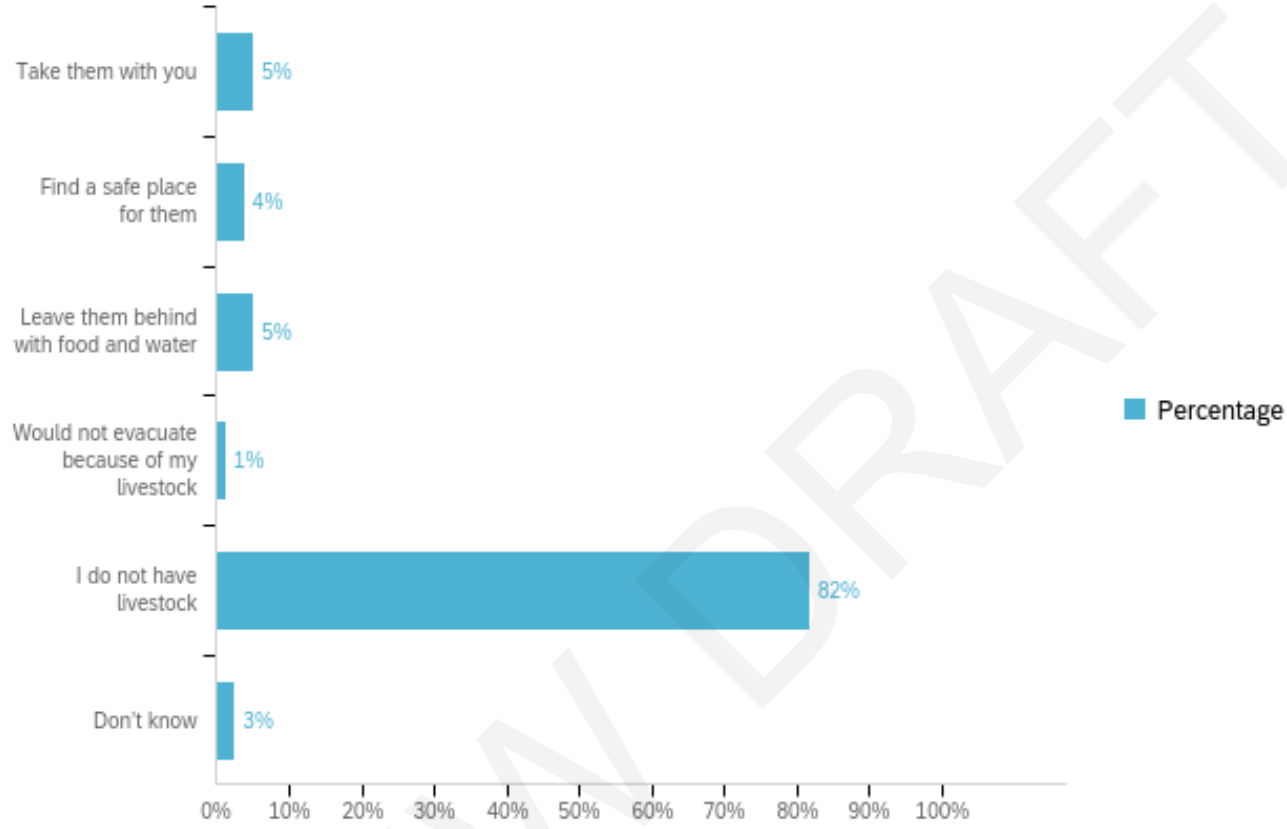
2	Medications that require refrigeration	15%	19
3	Dialysis	3%	4
4	Home health care	6%	7
5	Oxygen supply	7%	9
6	Wheelchair/cane/walker	12%	15
7	Other type of special care (Please specify):	3%	4
	Total	100%	126

Q11 - In an emergency, if your household was asked to evacuate, what would you do with your pet(s)? (Choose one)



#	Answer	%	Count
1	Take them with you	71%	57
2	Find a safe place for them	3%	2
3	Leave them behind with food and water	1%	1
4	Would not evacuate because of my pets	4%	3
5	I do not have pets	20%	16
6	Don't know	1%	1
	Total	100%	80

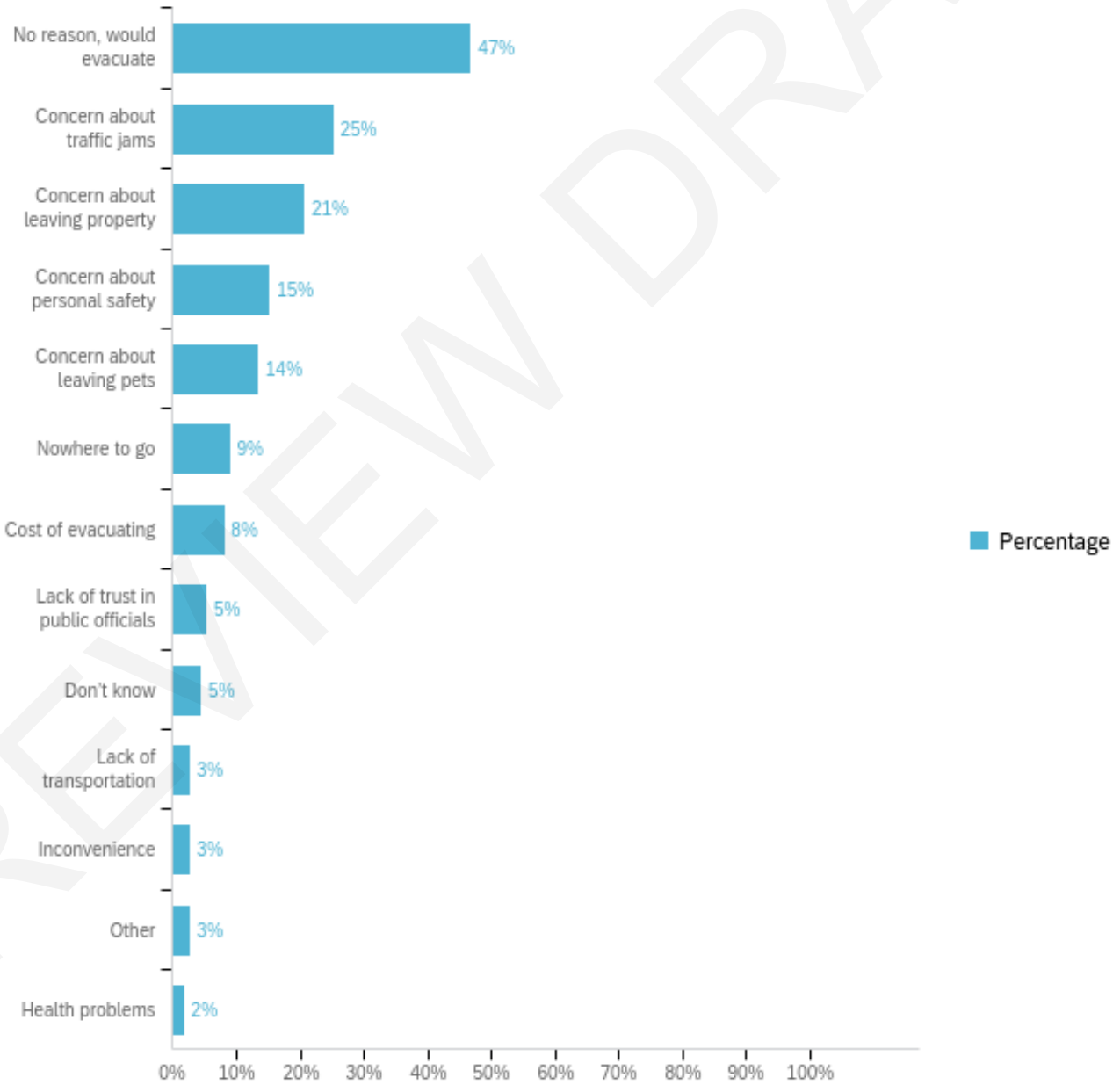
Q12 - In an emergency, if your household was asked to evacuate, what would you do with your livestock?(Choose one)



#	In an emergency, if your household was asked to evacuate, what would you do with your livestock?(Choose one)	Count
1	In an emergency, if your household was asked to evacuate, what would you do with your livestock?(Choose one)	77

Q13 - What would be the main reason that may prevent your household from evacuating? (Choose up to three)

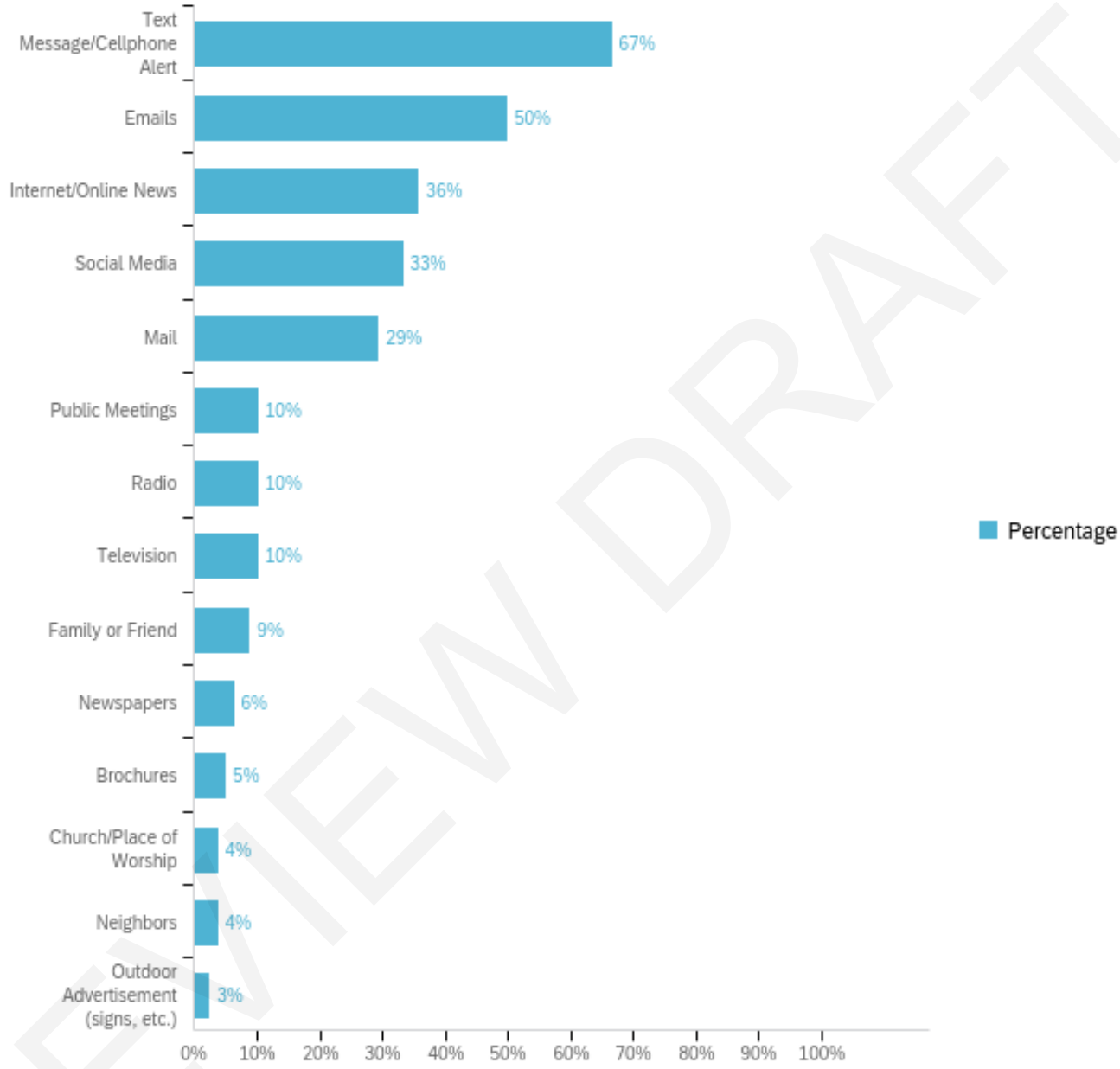
Other - Text
Water over bridge
Risk of being robbed
Concern about leaving livestock



#	Answer	%	Count
1	Lack of transportation	2%	3
2	Concern about personal safety	10%	17
3	Health problems	1%	2
4	Lack of trust in public officials	3%	6
5	Concern about leaving pets	9%	15
6	Concern about leaving property	13%	23
7	Concern about traffic jams	16%	28
8	Nowhere to go	6%	10
9	Inconvenience	2%	3
10	No reason, would evacuate	30%	52
11	Don’t know	3%	5
12	Other	2%	3
13	Cost of evacuating	5%	9
	Total	100%	176

#	What would be the main reason that may prevent your household from evacuating? (Choose up to three) - Selected Choice	Count
1	What would be the main reason that may prevent your household from evacuating? (Choose up to three) - Selected Choice	111

Q18 - How do you prefer to receive information about disasters or emergency situations? (Choose up to three)

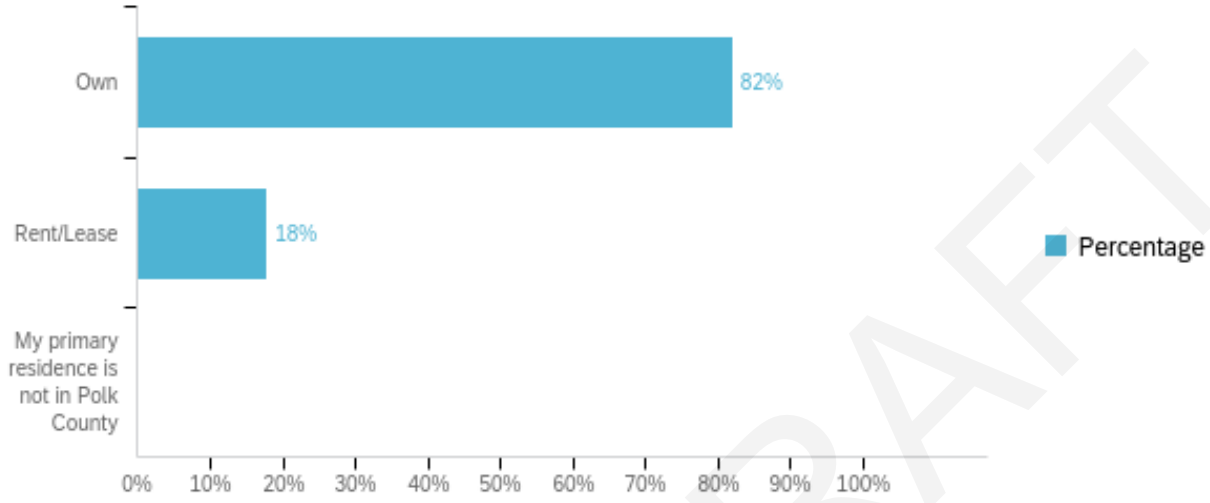


#	Answer	%	Count
13	Text Message/Cellphone Alert	24%	52
3	Emails	18%	39
5	Internet/Online News	13%	28

12	Social Media	12%	26
6	Mail	11%	23
14	Television	4%	8
11	Radio	4%	8
10	Public Meetings	4%	8
4	Family or Friend	3%	7
8	Newspapers	2%	5
1	Brochures	2%	4
2	Church/Place of Worship	1%	3
7	Neighbors	1%	3
9	Outdoor Advertisement (signs, etc.)	1%	2
	Total	100%	216

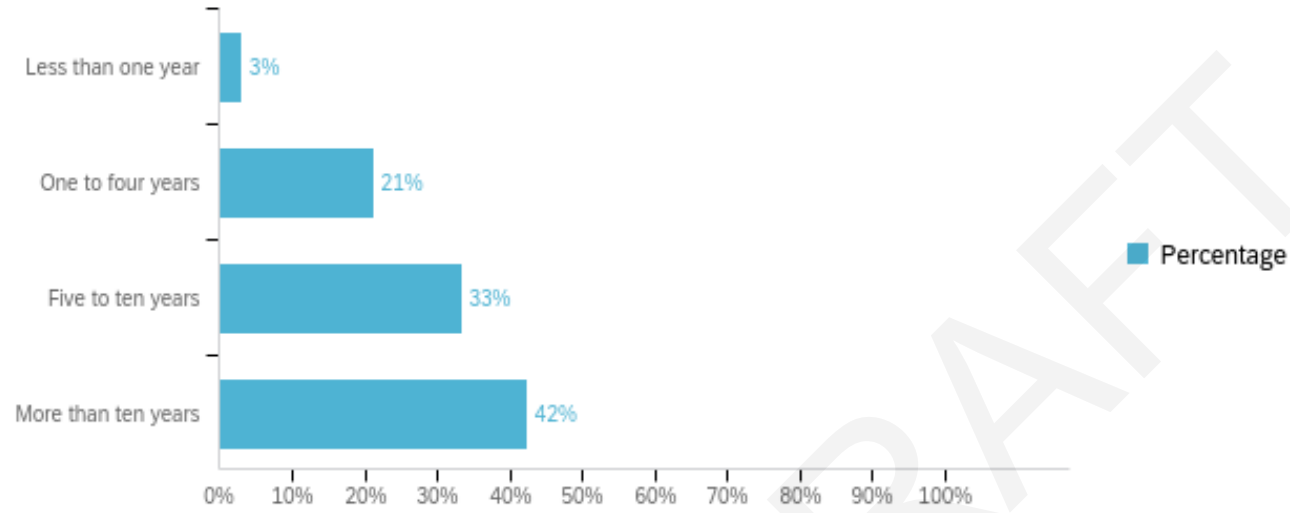
#	How do you prefer to receive information about disasters or emergency situations? (Choose up to three) - Selected Choice	Count
1	How do you prefer to receive information about disasters or emergency situations? (Choose up to three) - Selected Choice	78

Q14 - Do you own or rent/lease your primary residence in Polk County?



#	Do you own or rent/lease your primary residence in Polk County?	Count
1	Do you own or rent/lease your primary residence in Polk County?	67

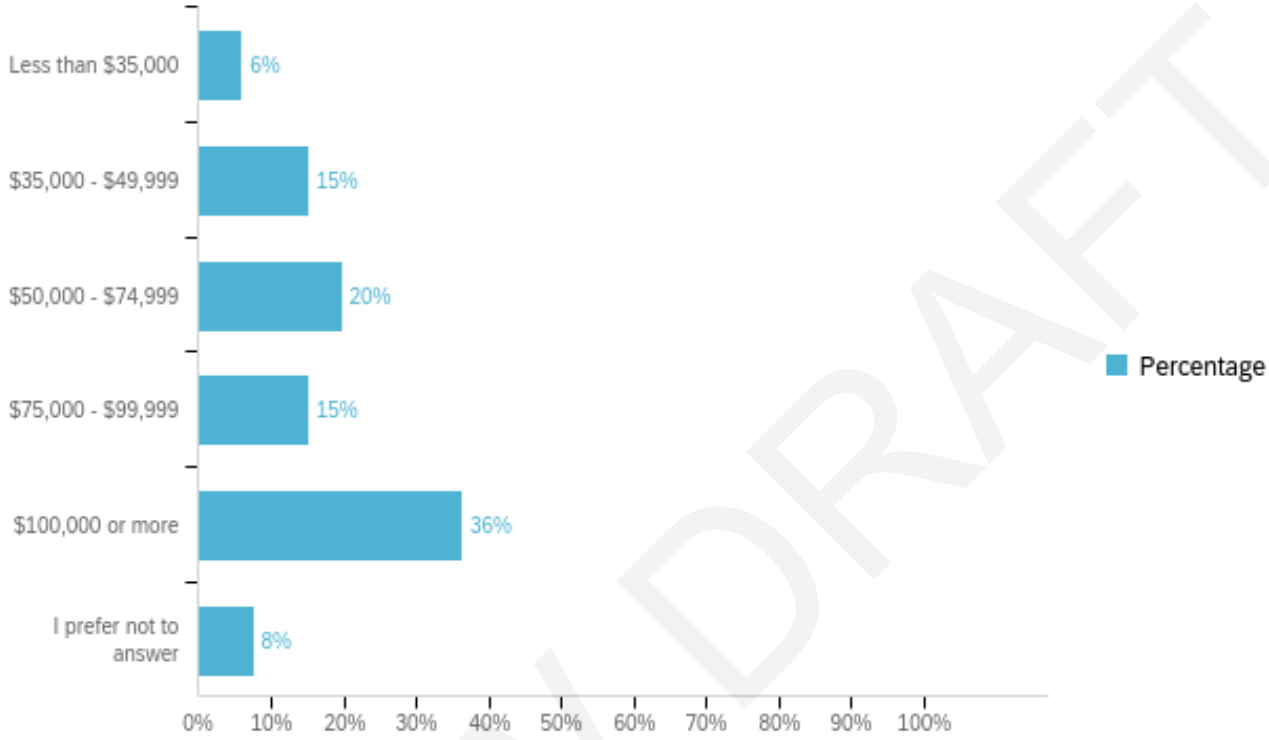
Q16 - How long have you lived in Polk County?



#	How long have you lived in Polk County?	Count
1	How long have you lived in Polk County?	66

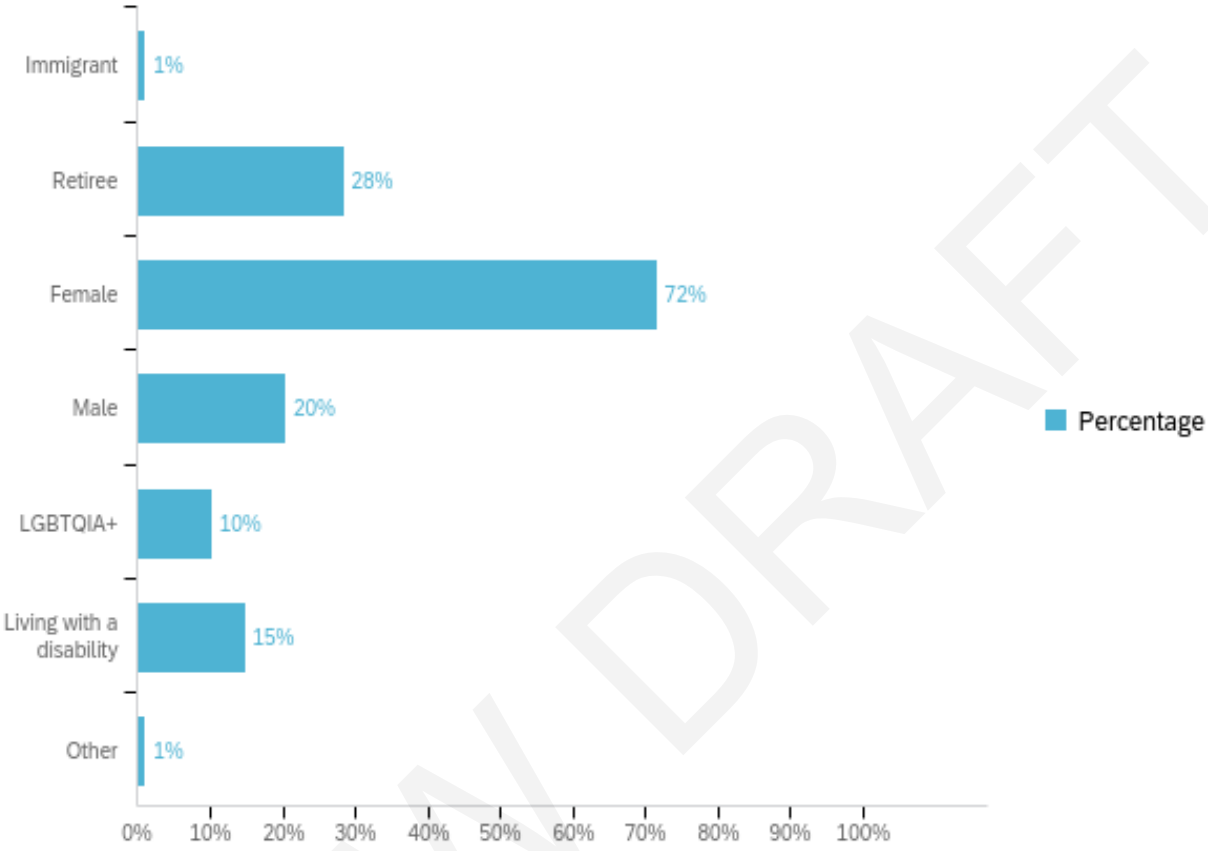
Q22 - Please provide your 5-digit ZIP code of your primary home or business that is in Polk County:

Q26 - Which best describes the combined annual income of all members of your household?



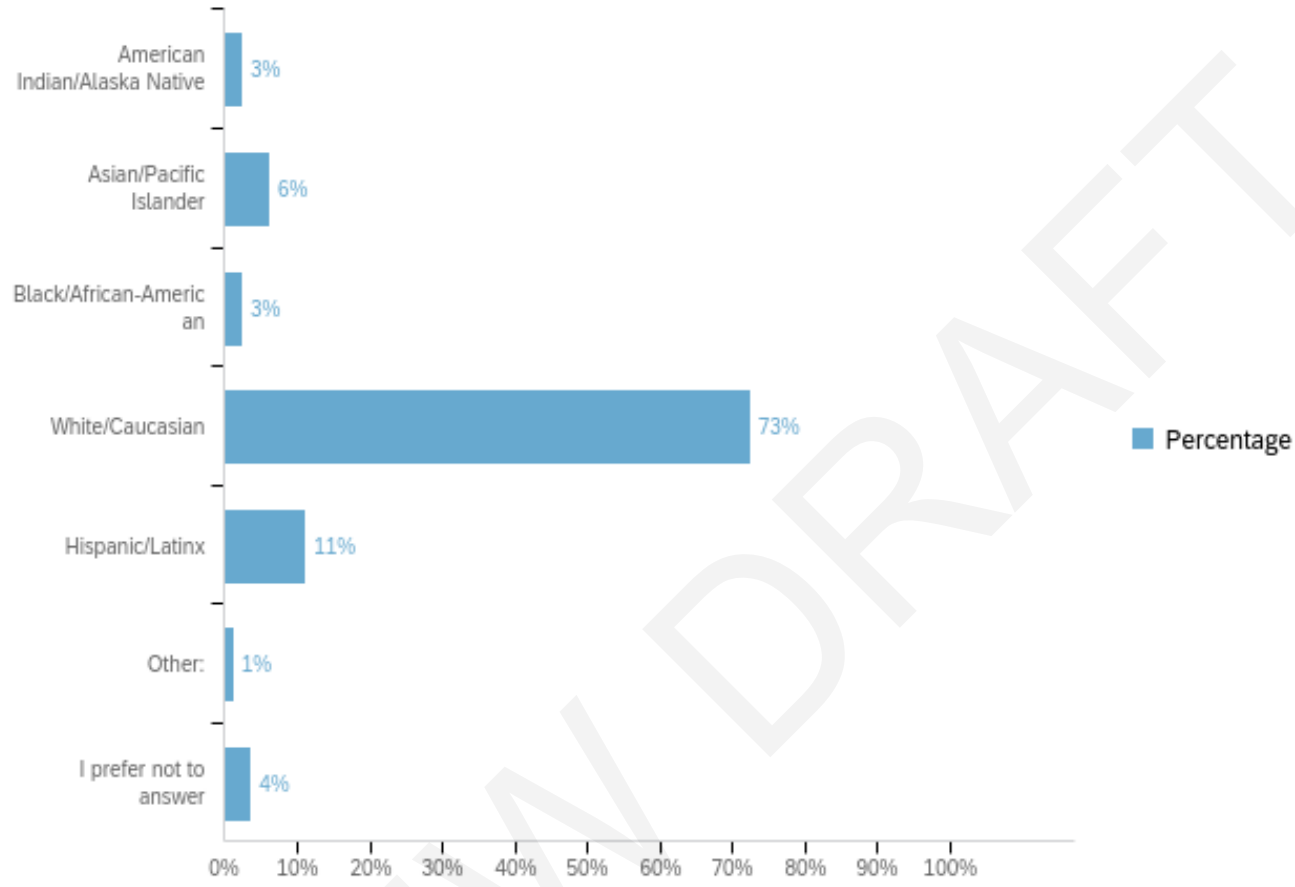
#	Answer	%	Count
3	Less than $35,000	6%	4
4	$35,000 - $49,999	15%	10
5	$50,000 - $74,999	20%	13
6	$75,000 - $99,999	15%	10
7	$100,000 or more	36%	24
10	I prefer not to answer	8%	5
	Total	100%	66

Q25 - Which of the following do you identify as? (select all that apply)



#	Which of the following do you identify as? (select all that apply) - Selected Choice	Count
1	Which of the following do you identify as? (select all that apply) - Selected Choice	88

Q24 - Which best describes your race or ethnic background? (Select all that apply.)

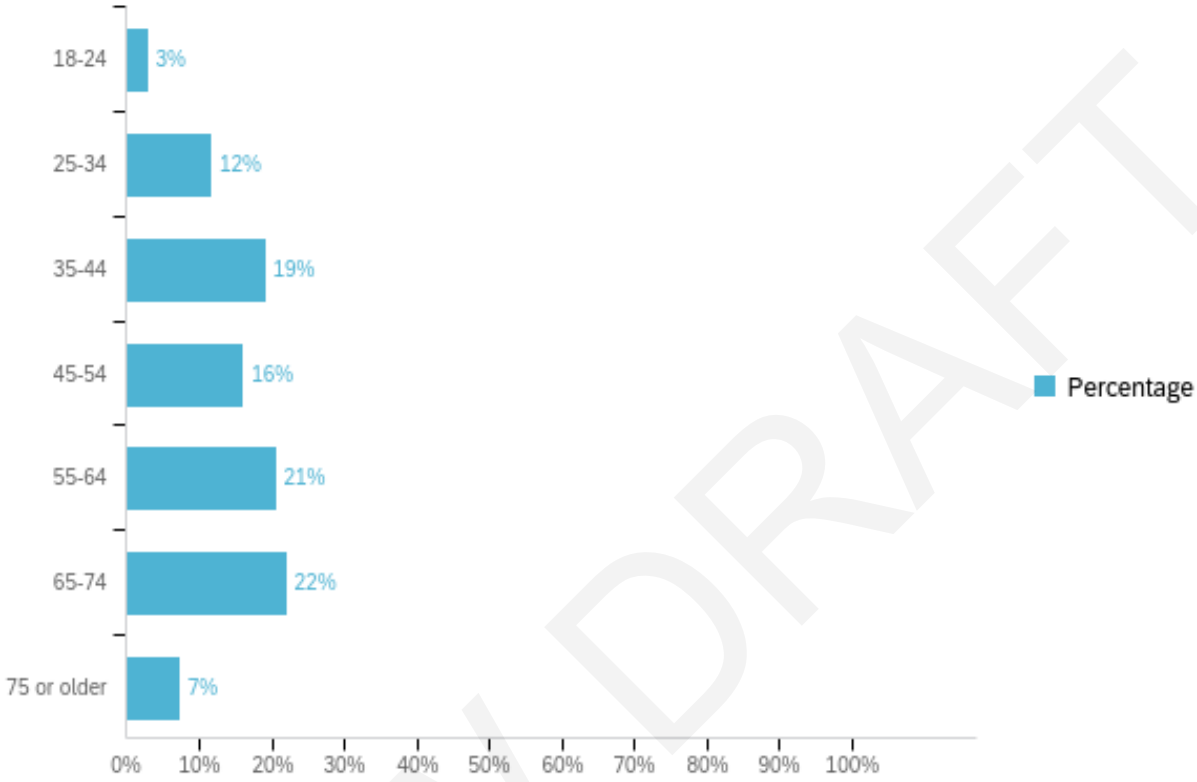


#	Which best describes your race or ethnic background? (Select all that apply.) - Selected Choice	Count
1	Which best describes your race or ethnic background? (Select all that apply.) - Selected Choice	73

Q20_6_TEXT - Other:

Other: - Text
Chinese

Q23 - Which best describes your age group?



#	Which best describes your age group?	Count
1	Which best describes your age group?	68