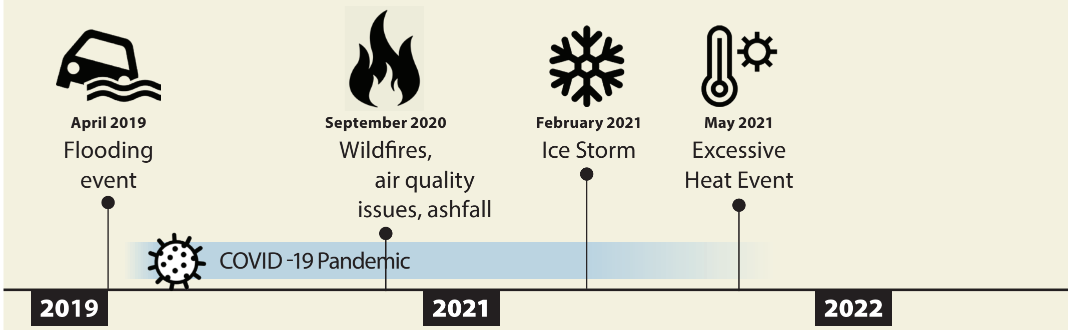
EXECUTIVE SUMMARY

Natural Hazard Mitigation Plan (NHMP)
2023 Update

This plan focuses on the natural hazards which historically and could affect the City of Albany again in the future. This plan also looks at the potential of hazards of increased magnitude due to climate change.



Recent Natural Hazard Events

How have natural hazards affected Albany?

Natural hazards pose a threat to the city's economy and its residents' property and health. Natural disasters have caused major problems in Albany's recent history. Windstorms, heavy rainstorms, wildfires in other communities and ice storms have posed threats within the last 10 years. Albany's location near a major earthquake subduction zone and faults places it in danger of significant earthquake damage. Flooding is a primary concern to the city due to its location in the Willamette River valley. Planning for natural hazards is vital due to the potential devastating effects on property and the local economy.

Albany has been or could be greatly affected by several natural hazards including windstorms, winter storms, flooding, and earthquakes. Luckily, landslides and wildfires are limited within the city limits due to a lack of urban interface area and minimal development on slopes but are still a concern. The following is a brief outline of the history of natural disaster events that have recently impacted the city.

Winter Storm: The most recent winter storm events (during the past five years reviewed for this plan update) include an ice storm lasting from February 11 to February 15.

Windstorm: A wind event in 2020 was a declared disaster (Presidential Declaration DR-4562). In 2015, between December 6-23, high winds resulted in widespread tree damage and power outages in the South Willamette Valley. This event was Presidential Declaration DR-4258, a severe storm event including high winds, flooding, landslides, and mudslides in other parts of the state.

Flood: Due to Albany's location along the Calapooia and Willamette Rivers, the city has had many floods going back to the founding of the city. April 6-21, 2019, saw a particularly strong atmospheric river occur, producing anywhere up to 5 inches of rain over a 48-hour period. This heavy rain combined with snow melt from snow received a few weeks prior, caused flooding along many rivers in Western Oregon. The Willamette River near Harrisburg crested at 15.3 feet around 9 AM on April 9th, which is 1.3 feet above flood stage. Albany received assistance as a part of Presidential Declaration DR-4452 for Severe Storm and Flooding damages.

Earthquake: Minor earthquakes have occurred in Albany. On August 18, 1961, a 4.5 magnitude earthquake caused minor damage and several earthquakes outside Albany have produced tremors felt in the city. In 1993, the Scotts Mills earthquake was magnitude 5.7 on the Richter scale. Locally, there are nearby faults that could cause much more damage to the city.

Public Health Emergency: The COVID-19 Pandemic (DR-4499) occurred January 20, 2020 and was the first pandemic declared a natural disaster in Oregon.

Which hazards should we be most concerned about?

Risk assessment is a process of collecting information and assigning values to risks for the purpose of informing priorities, developing, or comparing courses of action, and informing decision making. In other words, which natural hazards should we focus on when developing a course of action for the city?

Conducting a risk assessment can provide information on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events.

Assessing Our Risk:

As part of this analysis, the Steering Committee, facilitated by the Emergency Manager, developed risk scores for natural hazards that affect Albany. This method provides a sense of hazard priorities, or relative risk. It does not predict the occurrence of a particular hazard in a community, but it does "quantify" the risk of one hazard compared with another. By doing this analysis, efforts can first be focused where the risk is greatest.

The Process:

1. The Albany NHMP Steering Committee identified which hazards are relevant to the city.
2. Then, the Committee scored each hazard in four categories: history, probability, vulnerability, and maximum threat. Following is the definition and ranking method for each category:

✓ **History** = record of previous occurrences:
- Low: 0–1 event past 100 years,
- Moderate: 2–3 events past 100 years, and
- High: 4+ events past 100 years.

✓ **Probability** = likelihood of future occurrence within a specified period of time:
- Low: one incident likely within 75–100 years,
- Moderate: one incident likely within 35–75 years, and
- High: one incident likely within 10–35 years.

✓ **Vulnerability** = percentage of population and property likely to be affected under an "average" occurrence of the hazard:
- Low: < 1% affected,
- Moderate: 1–10% affected, and
- High: > 10% affected.

✓ **Maximum Threat** = highest percentage of population and property that could be impacted under a worst-case scenario:
- Low: < 5% affected,
- Moderate: 5–25% affected, and
- High: > 25% affected.

3. These numbers are the calculated using weight factors to determine the overall severity of the hazards.

2022 NHMP Steering Committee Vulnerability Assessment

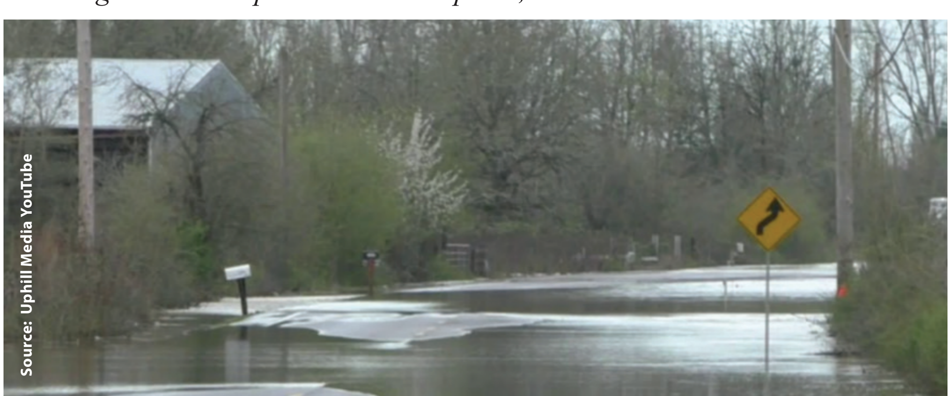
Completed by the City of Albany NHMP update Steering Committee during meetings held on November 8, 2021 and December 13, 2021. Based on the Oregon Department of Emergency Management (OEM) methodology combining factors of History, Probability, Vulnerability and Maximum Threat to assess risk. Further information upon request.

Hazard	History	Probability	Vulnerability	Max. Threat	Risk Score
Ice Storm	10	10	10	10	240
Snow Storm	10	10	10	10	240
Ash Fall/Poor Air Quality	8	10	10	9	226
Wind Storm	10	10	9	8	215
Public Health Emergency/Pandemic	8	8	8	10	212
Earthquake	5	6	10	10	202
Excessive Heat	10	10	4	8	190
Riverine Flood	10	10	4	4	150
Wildfire (WUI Fire)	7	8	6	4	140
Tornado	4	5	5	7	138
Drought	1	4	2	2	60
Landslide	1	3	1	2	48

During the NHMP update process, the steering committee members identified two additional natural hazards, Excessive Heat and Public Health Emergency/Pandemic, and modified one other. Volcanic eruptions are not a natural hazard experienced in the City of Albany, however, Ash Fall and Poor Air Quality are natural hazards that affect the city.

The previous Natural Hazard Mitigation Plan (NHMP) identified Climate Change as a separate Natural Hazard. The 2022 Steering Committee agreed that the impact of climate change is experienced in the increased severity and frequency of some natural hazard events and should be addressed throughout the NHMP rather than as a discreet natural hazard.

Flooding on the Calapooia River on April 9, 2019.



Citizen Concerns

The NHMP Steering Committee conducted a survey for citizens in 2021 to collect feedback and risk assessment information from the public during the NHMP update process. This feedback was incorporated into the development of the plan.

The survey effort showed that Wildfire is the natural hazard most people who responded to the survey were most concerned about.

More than 50% of respondents were Concerned or Very Concerned about Earthquake and the City of Albany NHMP Steering Committee also expressed great concern about the vulnerability of the city to earthquake as well as about the maximum threat such a hazard might present.

What natural hazard concerns you and your family the most?

Hazard	5 (extremely concerned)	4	3	2	1 (not concerned)
Drought	19%	36%	22%	16%	8%
Earthquake	21%	30%	20%	23%	6%
Flood	9%	27%	30%	26%	9%
Landslide	0%	2%	12%	30%	56%
Volcanic event	0%	6%	14%	21%	59%
Wildfire	34%	32%	23%	8%	2%
Wind storm	3%	33%	30%	23%	10%
Ice/snow storm	3%	21%	36%	30%	10%

What actions are planned to mitigate or reduce risk from natural hazards?

Forty-five mitigation actions are listed and more fully detailed in the full plan. The table below highlights some of the highest priority or most attainable actions from among that list.

Action item description	Action type
Develop a Debris Management Plan including pre-storm strategies for coordinated debris removal following wind and winter storms.	Plan
Provide educational awareness material to City employees. Provide information on developing emergency plans and assembling 14-day kits.	Communication
Provide educational and outreach articles to explain how to develop an emergency plan and assemble 14-day kits to residents of Albany. Consider developing an annual public information program to include the multiple educational and outreach actions in the plan.	Communication
Explore development of program to address seismically deficient buildings	Plan
Develop specific emergency evacuation or shelter-in-place plans for residential areas that are near significant hazard material storage facilities and heavy industrial areas.	Communication
Evaluate city emergency transportation routes with City, County and State partners	Monitoring and Maintenance
Evaluate City-owned bridges to determine which need to be seismically updated and seek appropriate funds. Especially as relates to the primary transportation routes.	Plan/Analyze
Conduct a vulnerability analysis of Albany's wastewater collection system to identify elements with the potential for failure in an earthquake, and seek funding for alternatives to seismically retrofit them	Plan/Analyze
Identify alternative methods for managing wastewater if system elements fail during earthquake.	Plan
Conduct a vulnerability analysis of Albany water distribution system to identify elements with the potential for failure and seek funding alternatives to seismically retrofit them.	Plan/Analyze
Identify alternative methods for managing water if system elements fail during earthquake.	Plan
Develop public/private partnerships to seek outside funding for retrofitting structures in the downtown and historic districts	Project
Update the Flood and Dam Failure Warning and Response Plan	Plan
Identify options for safeguarding the aerial fiber optic communications cable that connects the Courthouse with Albany Police Department because it is at risk for damage from high wind events.	Project

How has the plan been developed? How will it be used beyond 2022?

The Emergency Manger served as the convener for the 2022 NHMP update and established a Steering Committee comprised of city department heads.

1 Steering Committee created: 2021
The Emergency Manager led the creation of the committee including department heads and staff with a critical natural hazard focus.

2 Committee review/update plan information and mitigation strategies: 2021–2022
Steering Committee members met to complete the hazard analysis, update information and review the action items established in the 2016 NHMP. The updated plan was reviewed and approved by the Steering Committee.

3 Public input gathered throughout the process and included in the updated NHMP: 2021–2022

4 Draft plan sent to State and FEMA for approval: Oct.–Dec. 2022

5 City Council adopts the plan: Dec. 2022
Once adopted, staff will begin work on the action items within the plan. The Steering Committee will meet quarterly to review progress. The plan will be revised again in 2027.

Where the Plan meets other City priorities

The City of Albany Natural Hazard Mitigation Plan is directly tied to the City's Strategic Plan and, as a result of this connection, will be implemented through a number of existing plans, programs, and policies. Including:

- Capital Improvement Plan
- Central Albany Revitalization Area (CARA) Plan
- Comprehensive Plan
- State Building Codes

The Natural Hazard Mitigation Plan provides a series of recommendations, many of which are closely related to the goals and objectives of these existing planning programs. The Steering Committee is responsible for determining how each individual action will be implemented through existing programs.

2023

City of Albany

NATURAL HAZARDS MITIGATION PLAN

FEMA

Effective April 13, 2023 through April 12, 2028

The 2023 City of Albany Natural Hazards Mitigation Plan is a living document that will be reviewed and updated periodically to address the requirements contained in 44 CFR 201. It will be integrated with existing plans, policies, and programs. The Disaster Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions maintain an approved mitigation plan in order to receive federal funds for hazard mitigation grants. This plan meets those requirements as evidenced by FEMA approval which is effective per the cover date range of this plan.

Cover photos: (clockwise from top left): Car damaged in 2021 Ice Storm; Winter flooding; Road closure due to flooding April 2019; City of Albany smoke from wildfires 2020; April 2019 flooding; Timber Linn bridge April 2019. Photos courtesy of City of Albany.

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

For further information and to provide comments, contact:

Chuck Perino, Emergency
Manager City of Albany
611 Lyon Street
SE Albany, OR
97321
541-917-7725 (office)
Email: chuck.perino@cityofalbany.net

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City of Albany Natural Hazard Mitigation Plan

Special Thanks & Acknowledgements

This Natural Hazard Mitigation Plan was developed by the City of Albany departments and their employees, and the public who participated in the review of the updated plan, and action items. The City of Albany would like to thank these participants for their time and input:

Regional Partners

Federal Emergency Management Agency Region 10
Oregon Emergency Management
Oregon Climate Change Research Institute

2022-23 City of Albany Steering Committee

Chuck Perino	Emergency Manager
Alison Crow	Planning Department, Floodplain Management
Chris Bailey	Public Works Operations Director
David Martineau	Community Development
Holly Roten	Human Resources Director
Jeanna Yeager	Finance Director
Kate Hennessy	Administrative Assistant, Fire Dept.
Kim Lyddane	Parks & Recreation Director
Kristin Preston	City of Albany Operations Manager
Marcia Harnden	Police Chief
Matt Harrington	Management Assistant/Public Information Officer
Matthew Ruettgers	Development Services Manager
Peter Troedsson	City Manager & Emergency Program Manager
Sean Park	Chief Information Officer
Shane Wooton	Fire Chief
Staci Belcastro	Public Works Engineering & Community Development Director

Project Manager

Katherine Daniel, Natural Hazards Planner, Oregon Department of Land Conservation and Development

Special Thanks

Kate Hennessy, City of Albany Administrative Assistant

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Section 1: Introduction

The City of Albany developed this Natural Hazard Mitigation Plan (NHMP) and continues to update the NHMP every five years in an effort to reduce future loss of life and property resulting from natural disasters. It is impossible to predict exactly when these disasters will occur or the extent to which they will affect the City of Albany. However, with careful planning and collaboration among public agencies, private-sector organizations, and citizens within the community, it is possible to minimize the losses that can result from natural disasters.

A natural disaster occurs when a natural hazard impacts people or property and creates adverse conditions within a community. Natural hazards include floods, earthquakes, coastal erosion, tsunami, volcanic eruption, severe winter storms, windstorms, drought, and wildland/urban interface fire; each has the potential to harm people or property. This plan focuses on the natural hazards which could affect the City of Albany, Oregon and the exacerbating effect of climate change on some of those natural hazards.

Albany's topography, the presence of streams and rivers and its proximity to the Cascade Range all play roles in determining which natural hazards affect the City of Albany. Albany is subject to and has been affected by flooding, windstorms, severe weather, earthquakes, wildfires, and volcanic eruption. Landslides have not significantly impacted Albany in the past, but this hazard may become more prominent as the City of Albany expands and building continues on lands in North Albany. The historic impacts of these hazards have resulted in economic loss and damaged infrastructure in and around the City of Albany.

Flooding and landslides in Oregon in 1996 provide a point of reference for natural hazard event impacts. One result of the 1996 flood was increased awareness of the natural hazards that pose a risk to Albany residents. City departments understood that mitigation of specific identified hazards after the flooding was important to reduce future property loss in and around Albany. After the flooding, the City applied for and received mitigation grant funds to install an alarm system on the Santiam-Albany Canal and to have a portion of the Calapooia riverbank strengthened with riprap.

In 1998, Albany participated with Benton County, which had been selected by FEMA as a Project Impact Community, on several mitigation projects including community preparedness, school earthquake assessment, public preparedness, and a mitigation project for Quarry Road. Participation with Benton County reinforced the importance of hazard mitigation and led to the City's involvement in the Region 3 Hazard Mitigation Grant Program.

Throughout the development of the City of Albany's stand-alone Natural Hazard Mitigation Plan, the city worked with neighboring counties Linn and Benton, local and regional agencies involved in mitigation through the Local Emergency Preparedness Committee (LEPC), other entities such as the Albany Municipal Airport Advisory Commission, and other agencies that regulate development such as the Oregon Department of Land Conservation and Development and the Office of the Oregon State Fire Marshal.

City of Albany staff worked with both Linn and Benton counties to assure all three plans are compatible and dovetail with one another. The City of Albany used portions of Benton County's Natural Hazard Mitigation Plan throughout its 2006 stand-alone NHMP. You will continue to find reference to Benton County in many sections of the City of Albany plan. The city also participated in meetings with Linn County during the development of the Linn County NHMP and will continue to participate in NHMP updates in the future. The City of Albany engaged both Linn and Benton County during development of the NHMP update. The city participated in both the Linn and Benton County Multi-Jurisdictional NHMPs as an interested party to these plans. This participation informed the City of Albany stand- alone NHMP, in particular in the Mitigation Strategy where both counties were counted among the city's partners for multiple mitigation action items.

The City of Albany Emergency Manager provided information to the Local Emergency Preparedness Committee (LEPC) at each meeting to allow the entities that comprise the LEPC to provide input on the plan during its development. The LEPC is comprised of Linn and Benton County Emergency Managers, City Emergency Managers (Albany, Corvallis, Philomath, Brownsville, and Lebanon among them), three area hospitals (Samaritan Albany General Hospital, Samaritan Lebanon Community Hospital, and Good Samaritan Regional Medical Center in Corvallis) and local health department representatives, private industry, and volunteer groups (e.g. LDS Disaster Services).

Why Develop a Mitigation Plan?

In 2000, Congress passed, and President Clinton signed the Disaster Mitigation Act of 2000, commonly known as DMA 2000. Under this Act and rules published in 44 CFR Part 201.6, states, communities, and tribal governments must complete FEMA-approved natural hazard mitigation plans to be eligible for FEMA Hazard Mitigation Assistance (HMA) funding that includes three programs: Building Resilient Infrastructure & Communities (BRIC), formerly the Pre-Disaster Mitigation grant program, Hazard Mitigation Grant Program (HMGP), and the Flood Mitigation Assistance (FMA) program.

In 2006, after the Hazard Mitigation Plan was approved by FEMA, Albany applied for and received a grant for more than $920,000 to seismically stabilize its 1912 water treatment plant. Without an approved NHMP in effect, the city would not have been able to apply for this grant. In 2008, Albany received a grant from Oregon Emergency Management to survey its commercial and pre-1950 buildings and to do a re-run of its 2005 HAZUS results. This provided the City of Albany with a much more accurate damage estimate of what the community can expect after an earthquake. In 2010, the city received a grant from the State of Oregon to seismically update Fire Station 12 which was supported by the FEMA approved and locally adopted NHMP.

The dramatic increase in costs associated with natural disasters over the past decades has fostered interest in identifying and implementing effective means of reducing vulnerability. Natural hazard mitigation saves $6 on average for every $1 spent on federal mitigation grants, according to an analysis by the National Institute of Building Sciences[1]. This Natural Hazard Mitigation Plan is intended to assist the City of Albany in reducing its risk from natural hazards by identifying feasible mitigation actions, resources, information, and strategies for risk reduction. It is also intended to help guide and coordinate mitigation activities throughout the community.

The Plan is non-regulatory. It does however, provide:

(1) a foundation for coordination and collaboration among agencies and the public in the City of Albany;
(2) identification and prioritization of future mitigation activities; and
(3) assistance in meeting Federal planning requirements and qualification for assistance programs.

The Mitigation Plan works in conjunction with other city plans and programs including the Comprehensive Land Use Plan, Emergency Response Plan, Economic Development Strategic Plan, and Capital Improvement Program as well as Linn and Benton counties' Natural Hazard Mitigation Plans. More detail on integration of the NHMP with existing city plans and programs is located in Section 4.

[1] Mitigation Saves Fact Sheet (fema.gov)

The Plan provides a set of actions to prepare for and reduce the risks posed by natural hazards through education and outreach programs, development of partnerships, and implementation of preventative activities such as land use or watershed management programs. The actions described in the Plan are intended to be implemented through existing plans and programs in the city.

The City of Albany has undertaken a number of actions identified in the 2016 Natural Hazard Mitigation Plan. For example, the city has undergone seismic surveys for two of its fire stations; Fire Station 12 received a grant in 2010 to be seismically upgraded. City staff have also developed and routinely conduct public employee preparedness training.

Whom Does the Mitigation Plan Affect?

The 2023 City of Albany Natural Hazard Mitigation Plan Update affects the incorporated City of Albany and its urban growth area. The City of Albany is located in both Linn County and Benton County. While this plan does not establish mandates for the city, it does provide a viable framework for planning for natural hazards. The resources and background information in the Plan are applicable citywide, and the goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships. Recognizing that natural hazards do not start or stop at jurisdictional boundaries, mitigation action items identified in the City of Albany NHMP overlap with the counties', providing mutual benefit to many actions identified in each of the Linn County and Benton County Natural Hazard Mitigation Plans.

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 land use plans and implementing ordinances that are required to comply with statewide planning goals. The continuing challenge faced by local officials and state government is to keep this network of coordinated local plans effective in responding to the changing conditions and needs of Oregon communities.

Oregon's statewide program for land use is founded on a set of 19 Statewide Land Use Planning Goals. Goal 7: Areas Subject to Natural Hazards provides planning guidelines in areas subject to natural disasters and hazards. Goal 7 calls for local plans to include inventories, policies, and ordinances to guide development in or away from hazard areas. The goals and implementing regulations are adopted as a set of administrative rules (Oregon Administrative Rules Chapter 660). Goal 7 does not have administrative rules at this time. Most goals are accompanied by guidelines, which are suggestions about how a goal may be applied. Other goals are implemented by regulation when the legislature adopts a set of administrative rules. The coordination and implementation of the statewide goals is achieved most effectively through local comprehensive planning.

This is particularly true in the case of planning for natural hazards where communities must balance development pressures with detailed information on the nature and extent of hazards. Oregon's land use program has given its communities and citizens a unique opportunity to ensure that natural hazards are addressed in the development and implementation of local land use plans.

Goal 7 and other land use planning goals have helped to reduce losses from natural hazards. In 1996, FEMA estimated that Oregon saved about $10 million a year in flood losses because of strong land-use planning.

Previous Natural Hazard Mitigation Planning Efforts

The Regional All-Hazard Mitigation Master Plan for Benton, Lane, Lincoln, and Linn Counties was developed between 1998 and 2002. This Mitigation Master Plan is designed to help local communities gather the data necessary to compete for future FEMA funding of mitigation projects. The Mitigation Master Plan reviewed the principles of mitigation planning and presented a seven-step process for conducting a detailed, quantitative evaluation of prospective mitigation projects. Phase one of the Mitigation Master Plan addressed planning for flooding, severe winter storms, mud slides and landslides. Phase Two addressed earthquakes, wildland/urban interface fires and dam failures. Phase Three addressed hazardous materials.

Albany's first stand-alone Natural Hazard Mitigation Plan under DMA 2000 was adopted by the City Council in December of 2005 and approved by FEMA in January of 2006. The 2010 Plan was adopted by the City Council January 26, 2011 and formally approved by FEMA on February 1, 2011.

The 2023 City of Albany Natural Hazard Mitigation Plan was adopted by the City Council on April 12, 2023 and approved by FEMA on April 13, 2023. It is effective until April 12, 2028.

State Support for Natural Hazard Mitigation

All mitigation is local and primary responsibility for the development and implementation of risk reduction strategies and policies lies with local jurisdictions. Local jurisdictions, however, are not alone. Partners and resources exist at the State and Federal levels. Key State and Federal agencies involved in developing risk-reduction strategies and resources include Oregon Emergency Management (OEM), Oregon Building Codes Division (BCD), Oregon Department of Forestry (ODF), Oregon Department of Geology and Mineral Industries (DOGAMI), the Department of Land Conservation and Development (DLCD), and the Federal Emergency Management Agency (FEMA).

Some of the key state agencies:

- **Oregon Emergency Management** is responsible for disaster mitigation, preparedness, response, recovery, and the administration of federal funds after a major disaster declaration;

- **Building Codes Division** and local counterparts are responsible for construction and for some hazards that are building-specific in their occurrence (such as earthquakes); also, assessment of buildings after an earthquake;

- **Oregon Department of Forestry** is responsible for wildland fire protection on private, State, and Federal Bureau of Land Management forestlands in Western Oregon, and administers forest practices regulations, including landslide mitigation, on non-federal lands;

- **Oregon Department of Geology and Mineral Industries** is responsible for geologic hazards characterization, public education, the development of partnerships aimed at reducing risk, and exceptions (based on science-based refinement of tsunami inundation zone delineation) to state-mandated tsunami zone restrictions; and

- **Department of Land Conservation and Development** is responsible for planning-based hazard management including implementation of Goal 7 (Natural Hazards), with attention given to hazard assessments and hazard mitigation.

On July 1, 2015 the State of Oregon promulgated the Oregon Natural Hazard Mitigation Plan; the plan was approved by FEMA September 24, 2015 and was effective through September 2020[2]. The State's 2015 Natural Hazard Mitigation Plan (NHMP) became the model for the City of Albany's 2016 NHMP with the addition of some information pertaining to Albany such as history, demographics, climate change and previous natural hazard events in and around the city. The 2016 City of Albany, Oregon Natural Hazard Mitigation Plan was used as the basis of this 2023 update.

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[2] The State NHMP has since been updated and is effective through September 23, 2025. Department of Land Conservation and Development : Natural Hazards Mitigation Planning : Natural Hazards : State of Oregon

History of the City of Albany Natural Hazard Mitigation Plan

The City of Albany 2005 Natural Hazard Mitigation Plan was developed initially using a planning process created by the Oregon Natural Hazard Workgroup at the University of Oregon. The planning process was designed to result in a plan that was DMA-2000 compliant and coordinated with plans for Linn and Benton counties. Following is a summary of the activities included in the planning process from origination through two updates. The City of Albany 2023 Natural Hazard Mitigation Plan Update is the third update.

Plan Development 2005-2016

For its original plan in 2005, the City contracted with a mitigation planning coordinator to develop the plan, conduct research, and write some of its sections. The coordinator worked closely with the City's Emergency Management Coordinator/Fire Chief to set up committees, determine participation, develop drafts of plan sections, and make sure the planning process was moving forward. Both the mitigation planning coordinator and the Emergency Management Coordinator/Fire Chief worked with the State of Oregon Emergency Management and Oregon Natural Hazard Workgroup by participating in training sessions and telephone conferences, where applicable, that were held throughout the planning process.

In the 2010 plan update, the City of Albany used its Emergency Management Specialist to coordinate and update the planning elements with the steering committee.

The 2016 plan update was completed in cooperation with City of Albany Emergency Management and Community Development and the Building Department, Public Works Engineering and Operations, Fire Department, Parks and Recreation, Information Technology, Economic Development and the City Manager's office. No external grant was used to update the plan.

The 2023 City of Albany Natural Hazard Mitigation Plan Update reviewed and updated natural hazard event inventories and mitigation strategies with the same group of city departments and often the same individuals through a series of meetings that were held in 2021 and 2022.

Plan Development 2023 NHMP update

The Emergency Manger served as the convener for the 2023 NHMP update and established a Steering Committee comprised of city department heads.

Steering Committee:

The Steering Committee was the policy maker. Its members made final recommendations and approvals of the Plan before it was submitted to the State of Oregon Emergency Management and subsequently to the Federal Emergency Management Agency for review and, finally, to the City Council for adoption. The committee reviewed the goals and action items in the Plan for each of the natural hazards addressed. Members reviewed and approved each section of the Plan and provided direction on strategies to be used to involve the public in the Plan's update and over the next five years. The committee met nine times. Following an initial presentation at the April 14, 2021 Executive Leadership Team to introduce the project, the Steering Committee met on the following dates:

- November 8, 2021,
- December 13, 2021,
- January 24, 2022,
- February 14, 2022,
- March 11, 2022,
- April 25, 2022,
- May 16, 2022,
- July 25, 2022, and
- August 29, 2022.

The committee was made up of the City Manager, City department directors from Community Development, Public Works, Parks and Recreation, Human Resources, the Fire Department, the Public Works Operations Manager, and the City's Public Information Officer. Each meeting included an attendance sheet, an agenda and meeting notes from the previous meeting. Appendix B has the dates and summaries of the Steering Committee meetings. All original attendance sheets, agenda and minutes are on record with the City of Albany in its Mitigation Plan files.

Mitigation Strategy Review and Update
The Project Manager and the Emergency Management Specialist met with Steering Committee members as a group and also one-on-one to review the action items established in the 2016 NHMP. Committee members made recommendations on whether the action should be kept, deleted or revised. The completed Mitigation Strategy was reviewed by the Steering Committee and approved or modified as appropriate.

Public participation
The City of Albany launched a survey to collect feedback and risk assessment information from the public during the course of the NHMP update process. This feedback was incorporated into the development of the plan. The final draft plan was posted on the city website to provide a further opportunity for input during the development of the plan.

How is the Natural Hazard Mitigation Plan Organized?

Each section of the Mitigation Plan provides information and available City resources to assist people in understanding hazard-related issues facing Albany's citizens, businesses, and the natural environment. Combined, the sections of the Plan work together to create a document that supports the intent of the Plan to reduce risk and prevent loss from future natural hazard events.

The structure of the Plan enables people to use a section of interest to them. It allows City government to review and update sections when new data becomes available. The ability to update individual sections of the Mitigation Plan places less of a financial burden on the City. Decision-makers can allocate funding and staff resources to selected pieces that need review, thereby avoiding a full update which can be costly and time-consuming. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to the City of Albany.

The Mitigation Plan is organized in three volumes. Volume I contains an executive summary, introduction, community profile, risk assessment, mission, goals, objectives and action items, and plan implementation and maintenance. Volume II contains the natural hazard sections and Volume III includes five appendices.

Volume I: Mitigation Action Plan

Executive Summary: Five-year Action Plan
The five-year action plan provides an overview of the Mitigation Plan mission, goals, and action items. The priority action items are provided in this section and address multi-hazard issues as well as hazard-specific activities. A complete list of mitigation actions is found in Section 4.

Section 1: Introduction
The introduction describes the background and purpose of developing the Mitigation Plan for the City of Albany. This section describes the process used to develop the plan. Documentation of the process is located in Appendix B.

Section 2: Community Profile
This section presents the history, geography, demographics, and socioeconomics of the City of Albany. It provides a historical perspective of natural hazards in the community and includes an analysis of existing and future development trends.

Section 3: Risk Assessment
This section provides information on hazard identification, vulnerability and risk associated with natural hazards in the City of Albany. The Hazard Vulnerability Assessment conducted with the Steering Committee is located here as are the results of the HAZUS model to quantify losses and exposure of critical facilities to natural hazards.

Section 4: Mitigation Plan Mission, Goals, Objectives, and Action Items
This section provides information on the process used to develop goals and action items that cut across the natural hazards addressed in the Natural Hazard Mitigation Plan. It includes mitigation measures that are not hazard-dependent. These are measures to increase a community's hazard resilience regardless of which hazard might strike.

Section 5: Plan Implementation and Maintenance
This section outlines the schedule and methods that will be used to implement, monitor and evaluate the Plan.

Volume II: Hazard-Specific Information

Section 6: Flood
Section 7: Earthquake
Section 8: Severe Weather
Section 9: Wildfire
Section 10: Poor Air Quality/ Volcanic Ashfall
Section 11: Landslide
Section 12: Drought
Section 13: Extreme Heat
Section 14: Public Health Emergency/Pandemic

Each of the hazard sections listed above includes the risk assessment requirements of the Disaster Mitigation Act of 2000, including hazard identification, previous occurrences, probability of future occurrence, and vulnerability and hazard impacts.

The City of Albany NHMP Steering Committee determined that seven natural hazards have or could have a negative impact on the community and its citizens. The NHMP Steering Committee has addressed the exacerbating effect of climate change throughout this update because of the impact it can have on the majority of the natural hazards within the Natural Hazard Mitigation Plan.

Volume III: Resources
The plan appendices provide users of the City of Albany Natural Hazards Mitigation Plan with additional information to assist them in understanding the contents of the Mitigation Plan, and potential resources to assist them with implementation.

Appendix A: Resource Directory
The resource directory includes City, State, and Federal programs which may be of technical or financial assistance to the City of Albany during plan implementation.

Appendix B: Public Process and Committees
This appendix includes specific information on the various Steering Committee and public processes used during development of the plan.

Appendix C: Approaches for Economic Analysis
This section describes FEMA’s requirements for benefit/cost analysis in natural hazards mitigation, as well as various approaches for conducting economic analysis of proposed mitigation activities.

Appendix D: List of Acronyms
This section provides a list of acronyms and definitions for state and federal agencies and organizations that may be referred to within the City of Albany Natural Hazards Mitigation Plan.

Appendix E: Mitigation Action Item Proposal Sheets
Detailed proposals sheets for each priority mitigation action. Intended to serve as a jumping off point for project pre-applications.

Appendix F: **Future Climate Projections Linn County, Oregon**
The 2022 Oregon Climate Change Research Institute report of projected changes to in climate and its effect on natural hazards in Linn County.

Appendix G: Flood Information and Public Outreach
Floodplain program information to address Community Rating System requirements.

Appendix H: FEMA Review Tool, APA Letter and Resolution of Approval
Location for FEMA review and approval documents as well as the city’s Resolution of Approval or Resolution of Adoption.

Section 2: Community Profile

Why Plan for Natural Hazards in the City of Albany?

In 2000, Congress passed, and President Clinton signed the Disaster Mitigation Act of 2000, commonly known as DMA 2000. Under DMA 2000 and rules published in 44 CFR Part 201.6, communities, states, and tribal governments must complete Federal Emergency Management Agency-approved natural hazard mitigation plans by November 1, 2004 to be eligible for certain federal assistance programs such as the FEMA Hazard Mitigation Assistance (HMA) funding that includes three programs: Building Resilient Infrastructure & Communities (BRIC), formerly the Pre-Disaster Mitigation grant program, Hazard Mitigation Grant Program (HMGP), and the Flood Mitigation Assistance (FMA) program The City of Albany's first plan was adopted by the Albany City Council in December 2005 and by FEMA in January 2006. It was updated in 2010 and 2016. It is being updated by this document in 2022 and 2023.

While Albany's climate is generally mild and its terrain flat, natural hazards do pose a threat to the city's economy and its residents' property and health. Natural disasters have caused major problems in Albany's recent history. Windstorms, heavy rain storms and ice storms have posed threats within the last 10 years. Albany's location near a major earthquake subduction zone and faults places it in danger of significant earthquake damage. Albany is in both Linn and Benton counties which are considered to have high risk in both Cascadia subduction zone and 500-year return interval earthquake events. Linn and Benton counties are two of only four Oregon counties expected to have high losses in both types of earthquakes.[3] Flooding is a primary concern to the city due to its location in the Willamette River valley. Planning for natural hazards is important because these natural events can have devastating effects on property and the local economy.

Identifying the risks posed by natural hazards and developing strategies to reduce the impact of a hazard event are ways to plan a mitigation strategy for natural hazards. Natural Hazard Mitigation Plans can assist in protecting life and property from damage due to natural hazard events. Local residents and businesses can work together with the City of Albany to create a natural hazards mitigation plan that addresses the potential impacts of natural hazard events.

History of Natural Hazards in Albany[4] [5]

Albany has been or could be greatly affected by a number of natural hazards including windstorms, winter storms, flooding, and earthquakes. Landslides and wildfires are limited within the city limits due to a lack of urban interface area and minimal development on slopes. Volcanic activity is possible, but even in the Mt. St. Helens event in 1980 there was little threat to the city. The following is a brief outline of the history of natural disaster events that have significantly impacted the City of Albany.

Winter Storm: The city has had ice and snowstorms in the past. The most recent winter storm events (during the past five years reviewed for this plan update) include an ice storm in February, 2021 lasting from February 11 to February 15 (Presidential Declaration DR-4599).

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[3] Earthquake damage in Oregon: Preliminary estimates of future earthquake losses; Special Paper 29, Yumei Wang and J.L.Clark, Oregon Department of Geology and Mineral Industries 1999.

[4] Declared Disasters | FEMA.gov

[5] Storm Events Database | National Centers for Environmental Information (noaa.gov)

Windstorm: A straight line wind event that occurred between September 7 and 8, 2020 was also a declared disaster (Presidential Declaration DR-4562) that affected Linn County more than it affected the City of Albany. The NOAA Storm Event Database records several high wind events in the Coast Range several times each year during that period. In 2015, between December 6-23, high winds resulted in widespread tree damage and power outages in the South Willamette Valley. This event was Presidential Declaration DR-4258, a severe storm event including straight-line winds, flooding, landslides, and mudslides in other parts of the state.

The residents of Albany have also experienced several tornadoes during the five-year period of review. The NOAA Storm Event Database records funnel clouds near or in Albany on April 24, 2016; May 15, 2016; and May 21, 2019.

Flood: Because of Albany's location along the Willamette River, the city has had many floods during recorded history going back to the 1860s. During the past five years, the period reviewed for this NHMP update, April 6-21, 2019 saw a particularly strong atmospheric river occur in the south Willamette Valley that sat over areas south of Salem for two days, producing anywhere from 2.5 to 5 inches of rain over a 48-hour period. In Albany flooding on the Calapooia River is shown in the photo in Figure XX. Heavy rain combined with snow melt from all the snow from a few weeks prior in this same area caused flooding along most of the rivers in this area as well as along the main-stem Willamette River up to around Oregon City. The Willamette River near Harrisburg crested at 15.3 feet around 9 AM on April 9th, which is 1.3 feet above flood stage.[6] Presidential Declaration DR-4452 for Severe Storm, Flooding, Landslides and Mudslides designated Linn County as an affected location.

Figure 1. Flooding on the Calapooia River on April 9, 2019

Source: Uphill Media YouTube

Earthquake: Minor earthquakes have occurred in Albany. On August 18, 1961, a 4.5 magnitude earthquake caused minor damage and several earthquakes outside Albany have produced tremors felt in the city. In 1993, the Scotts Mills earthquake (also known as the "Spring Break Quake") shook the

[6] NOAA Storm Event Database

northern Willamette Valley. It was a magnitude 5.7 on the Richter scale and caused extensive damage primarily in the communities of Molalla, Woodburn, Newberg, McMinnville, and Salem. The Albany Democrat-Herald reported broken windows; otherwise, there was no damage created in Albany by this earthquake and, depending on where you lived, few people felt it locally.

Public Health Emergency: The COVID-19 Pandemic (DR-4499) occurred January 20, 2020 and was the first pandemic declared a natural disaster in Oregon.

There have been no landslides experienced or earthquakes felt in the City of Albany since the 2016 City of Albany NHMP became effective until the present.

Geography and the Environment

The City of Albany has an area of 17.7 square miles with an Urban Growth Boundary (UGB) of 21.7 square miles. Its population is approximately 57,199 as calculated by Portland State University's Population Research Center in the July 1, 2021 certified population estimates. The City of Albany is situated in both Linn and Benton counties and located in the central Willamette Valley along Interstate 5, 25 miles south of Salem and 45 miles north of Eugene.

The elevation of Albany ranges from 210 to 521 feet above sea level and the community is between the Coast Range and the Cascade Mountains. Albany sits on mostly flat level land with some hills in the northern part, in Benton County. Bottomland hardwood forests once dominated much of the Willamette River floodplain. Native grasslands and prairie stretched out across the valley floor. Oak savannas and conifer forests covered the hills in North Albany and on Knox Butte.

Albany has a short, dry, temperate growing season which is ideal for many specialized crops such as seed production (grasses, flowers, and vegetables), tree fruits, nursery stock, nuts, berries, mint, and grains.

Major Rivers

Willamette River

The Willamette River Basin has 13 major tributaries and drains approximately 12,000 square miles, almost one-eighth of Oregon's total area. It is the tenth largest river in the continental United States. The river originates at the confluence of the Middle and Coast Forks just upstream from Eugene and flows 187 miles before entering the Columbia River downstream from Portland. At Eugene, the river emerges from the foothills and meanders for many miles over a flat, extensive floodplain up to five miles wide, with numerous secondary changes, sloughs, and oxbow lakes. Upstream from Oregon City, the river flows through a breach in a low range of hills and then drops approximately 50 feet at Willamette Falls.[7]

Calapooia River

The Calapooia River originates in the Cascade Mountains and flows northwest for about 75 miles before joining the Willamette River at Albany. The basin is long and narrow in shape and encompasses 374 square miles. Elevations in the basin range from about 200 feet above mean sea level at Albany to almost 5,200 feet above mean sea level on Tidbits Mountain. The stream gradient is about three feet per mile. The only major tributary to the river is Oak Creek.[8]

At one time, the Calapooia River provided extensive waterpower to many of the mills that were built in towns and villages along its 70 miles. Mills in Brownsville and Albany were but two examples. Today the river is less used because of the vegetation growing over the riverbanks and difficulty gaining access

[7] City of Albany Comprehensive plan Background Report; 1980
[8] Ibid.

due to private property. In and around Albany, the river still causes flooding problems because of back-up when the Willamette River rises, and low-lying areas found next to the river.

Santiam River
The Santiam River flows into the Willamette River in Marion County approximately seven miles downstream from Albany. At a location approximately 10 miles upstream, where the North and South Santiam converge, the City of Albany and the City of Millersburg have constructed a joint drinking water intake and treatment plant for municipal use. For the City of Albany, this is the second treatment plant, and for the City of Millersburg, its first. For both cities, this plant is the primary treatment plant.

The U.S. Army Corps of Engineers (ACOE) operates and maintains 13 reservoirs in the Willamette Basin. These federal reservoirs in the middle and upper Willamette Basin were built in the late 1930s, principally for flood control. Flooding has always been an issue. Prior to the construction of dams upriver, flooding of the Albany area was quite significant, but the dams have reduced the threat.

Federal Dams

The following dams constructed by the U.S. Army Corps of Engineers are located upstream from the City of Albany on the Willamette and McKenzie Rivers:[9]

Hills Creek Dam, Middle Fork of the Willamette River.
Hills Creek Dam is located 40 miles southeast of Eugene and 26.5 miles upstream from Lookout Point Dam on the Middle Fork of the Willamette River. The dam was constructed between 1956 and 1961. It is an earth-and-gravel embankment 304 feet high and 2,235 feet long. Flood flows from a catastrophic failure of Hills Creek Dam would follow the Middle Fork Willamette River channel, breach Lookout Point and Dexter dams and continue to the main stem Willamette River, eventually affecting the city of Albany.

Lookout Point Dam, Middle Fork of the Willamette River.
Lookout Point Dam is located 22 miles upstream of Eugene on the Middle Fork of the Willamette River. This dam was constructed between 1948 and 1954. The dam consists of an earth- fill embankment section, a concrete spillway section, and a concrete right abutment. The maximum height of the dam is 295 feet, with a length of 3,262 feet. A possible cause of failure of this dam would be breaching due to flood flows from failure of Hills Creek Dam, upstream of Lookout Point. Flood flows from a catastrophic failure of Lookout Point Dam would follow the Middle Fork Willamette River channel, breach Dexter Dam and continue to the confluence with the main stem Willamette River, eventually affecting the city of Albany.

Dexter Dam, Middle Fork of the Willamette River.
Dexter Dam is located 20 miles upstream of Eugene on the Middle Fork of the Willamette River. The dam was constructed in 1955. The dam consists of an earth-fill embankment and is 117 feet high. Flood flows from a catastrophic failure of Dexter Dam would follow the Middle Fork Willamette River channel; and continue to the confluence with the main stem Willamette River, and eventually affecting the city of Albany.

Cougar Dam, South McKenzie River.
Located on the South Fork of the McKenzie River, Cougar Dam is about 42 air miles east of Eugene. Construction of the dam occurred between 1956 and 1964. Cougar Dam is a rock- fill embankment about

[9] Information for this section comes from US Army Corps of Engineer Guidelines for Flood Emergency Plans November 1981

1,500 feet long and a maximum of 452 feet high. Flood flows from a catastrophic failure of Cougar Dam would follow the South Fork of the McKenzie River into the McKenzie River channel and on into the Willamette River. Flooded area would include a small portion of Albany.

The following US Army Corps of Engineers dams are located up stream of the City of Albany on the Santiam River:

Green Peter Dam, Middle Santiam River.
Green Peter Dam is located on the Middle Santiam River about eight miles northeast of Foster. Dam construction was completed in 1967. The dam is a concrete gravity structure with a height of 327 feet and a crest length of 1,517 feet. Flood flows from a catastrophic failure of Green Peter Dam would follow the Middle Santiam River channel, breach Foster Dam, and continue to the confluence with the South Santiam River. The flood would then continue down the Oak Creek and Burkhart Creek channels. The main flow would go down the South Santiam to the main stem Santiam River and would affect the outskirts of Albany.

Foster Dam, South Santiam River.
This dam is located at Foster, Oregon two miles below the junction of the Middle and South Santiam rivers, and eight miles below Green Peter Dam. Construction of the dam was completed in 1967. The dam is a rock-fill embankment dam with a concrete spillway. The embankment is 126 feet high and 4,800 feet long. A possible cause of failure of this dam would be breaching due to flood flows from a failure of Green Peter Dam, eight miles upstream. Flood flows from a catastrophic failure of Foster Dam would follow the South Santiam River channel about to the town of Jefferson. Flood waters would also branch off from the main flow and follow Oak Creek and Burkhart Creek channels to the outskirts of Albany.

Figure 2. Location Map of Dams in the Willamette Basin

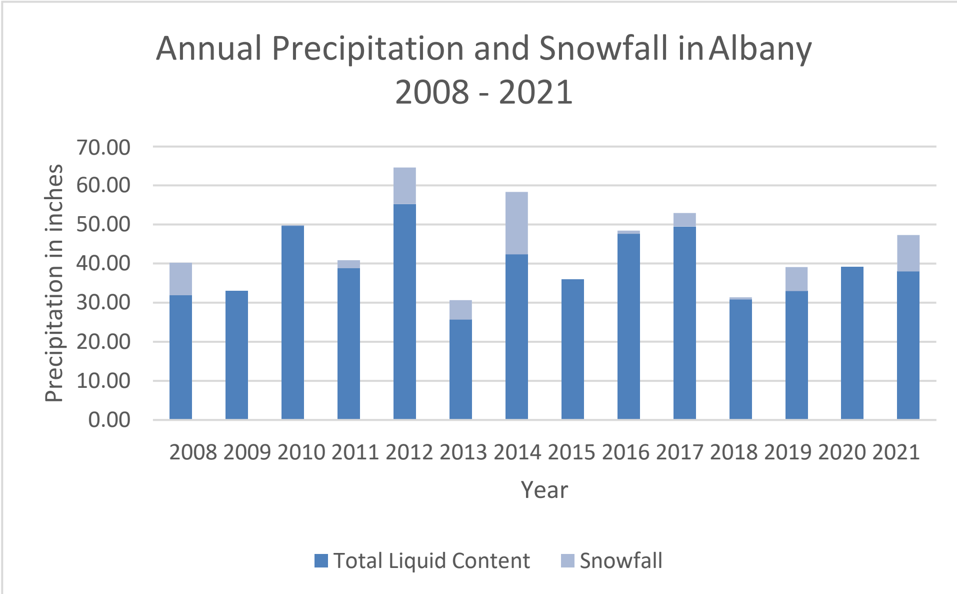
Source: US Army Corps of Engineers

Climate

The climate of the Willamette Valley is relatively mild throughout the year, characterized by cool, wet winters and warm, dry summers. Albany is about 80 miles from the Pacific Ocean, which provides a modified marine climate. Extreme summer and winter temperatures are moderated by the airflow across the area from the Pacific Ocean. The Cascade Mountains to the east of Albany act as a barrier that prevents colder continental air masses originating in the arctic regions of Canada from reaching Albany. Occasionally, extreme temperatures can occur when the airflow comes from the east. Temperatures rarely exceed 95° F in the summer months (June – August) and rarely drop below 25° F in the winter months (November – March). Extreme fluctuations of temperature and precipitation are becoming increasingly likely due to effects associated with climate change. The average growing season is about 150 – 180 days in the lower valley.

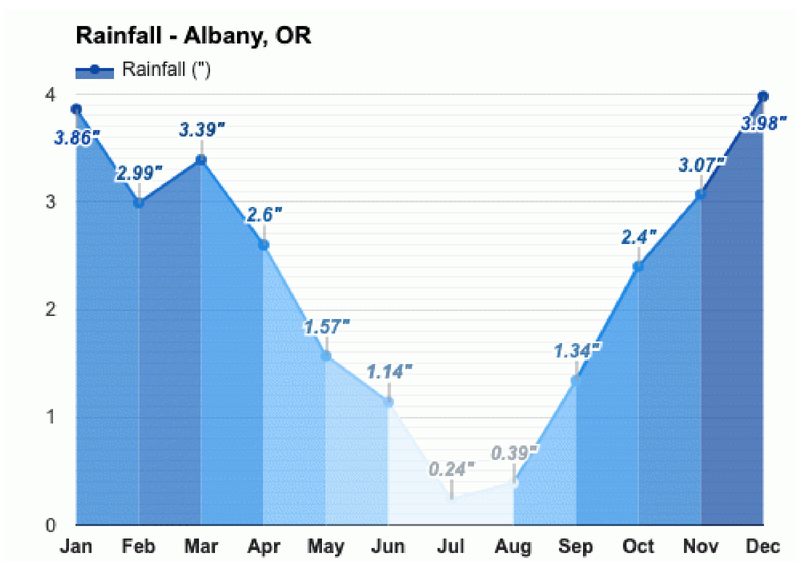
During the period between January 1, 2008 and December 31, 2021 the NOAA weather station Albany 0.5 SE provided the following data. An image showing this station's location is provided in Figure XX. Average monthly precipitation ranged from 0.24 inches in July to 3.98 inches in December, with an average yearly rainfall of 39.36 inches per year.

Figure 3. Precipitation and Snowfall in Albany



Source: [Climate Data Online (CDO) - The National Climatic Data Center's (NCDC) Climate Data Online (CDO) provides free access to NCDC's archive of historical weather and climate data in addition to station history information. | National Climatic Data Center (NCDC) (noaa.gov)]

Figure 4. Average Monthly Rainfall



Source: [Albany, OR - Detailed climate information and monthly weather forecast | Weather Atlas (weather-atlas.com)]

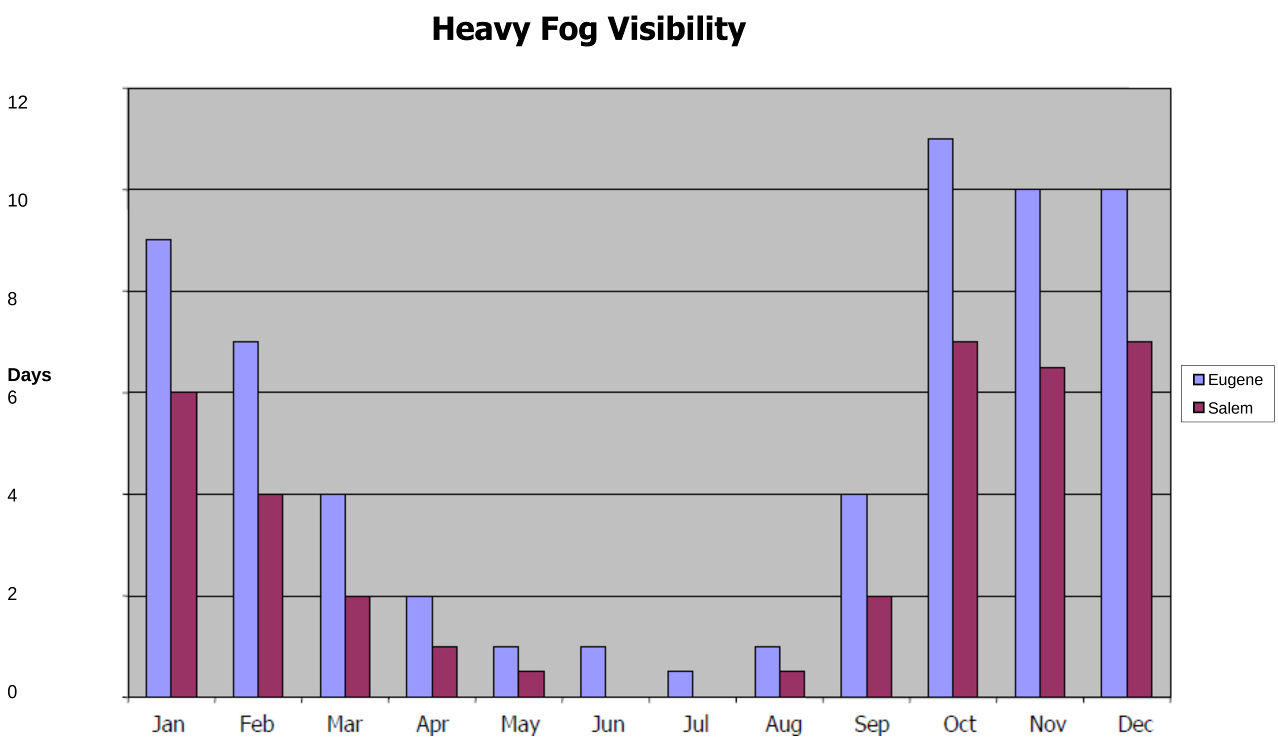
During this period average snowfall was 4.4 inches, occurring between November and March.

Figure 5. Snowfall in Albany 2008-2021

Year	Snowfall	Extreme Max Snowfall	Date of Occurrence
2008	8.3	2.5	Dec-19
2009	0.0T	0.0T	Mar-10
2010	0.2	0.2	Nov-23
2011	2.0	1.5	Feb-25
2012	9.3	6.0	Mar-22
2013	5.0	2.5	Dec-07
2014	16.0	10.0	Feb-07
2015	0.0	0.0	Dec-31
2016	0.8	0.6	Dec-15
2017	3.5	2.6	Jan-08
2018	0.5	0.5	Feb-22
2019	6.1	3.3	Feb-27
2020	0.0T	0.0T	Mar-14
2021	9.3	5.0	Dec-26
Average	**4.4**		

Source: [Climate Data Online (CDO) - The National Climatic Data Center's (NCDC) Climate Data Online (CDO) provides free access to NCDC's archive of historical weather and climate data in addition to station history information. | National Climatic Data Center (NCDC) (noaa.gov)]

Fog can be an extreme hazard in the Albany area. The following chart shows the number of days with heavy fog visibility, ¼ of mile or less, between Eugene and Salem on average per year. The City of Albany can expect about 60 heavy fog days a year.



Soils

Albany is centrally located on the broad alluvial plain of the Willamette Valley. The city shares the same temperate climate of the region characterized by warm summers and mild, wet winters. The alluvial soils of the valley overlay thick bedrock of many mixed layers of consolidated volcanic material, basalt, and marine sandstone. Throughout most of the Albany area, the alluvial deposition consists predominantly of deep, silty loam and clay soils overlaying a number of old river terraces of pebbles and cobbles, gravels, sand, and clay. These river terraces surface in the northeast portion of the UGB where the soils are much thinner than elsewhere.

The majority of the soils west of Interstate 5 are loam and silty loam with poor drainage and a high water table. Soils immediately adjacent to Periwinkle and Oak Creeks are clay and silty clay with severe construction limitations because of poor drainage, compressibility, and location in flood-prone areas.[10]

The soils of North Albany are similar silty loams and silty clay loams with areas that are moderately deep, moderately well-drained to somewhat poorly drained, and areas that are deep, moderately well-drained to somewhat poorly drained, and areas that are deep, moderately well-drained to well-drained.[11]

The soil pattern of the East Albany neighborhood is more complicated, with linear strips of clay loam intermixed with gravelly and stony loam and some silty loam.[12]

The clay-rich soils and generally flat topography found within the Albany UGB combine with the alternating wet/dry weather cycle to produce poor drainage conditions throughout the area. These soil conditions result in ponding, a seasonal (winter) high water table, and some localized flooding during the winter, which limits construction methods and septic tank use. Disturbance of the natural drainage patterns and the removal of protective vegetative ground cover by urban development and upstream agricultural and forest practices have aggravated these soil conditions and have increased surface runoff.

Generally, soils within the Albany area are of low permeability. The infiltration rate of rainwater is slow and flat surfaces provide no natural gradient for the resulting overland runoff. Ponding occurs when soaked soils can no longer absorb heavy amounts of rainwater or when the rising groundwater table has actually surfaced.

Nearly all of the area soils are subject to severe shrink-swell limitations. These clay soils dry out and crack in summer months and then, with the first winter rains, swell shut and become impermeable, thus increasing surface runoff.

There are 14 drainage basins within the City of Albany's UGB. Four of these basins are in North Albany while the remaining ten encompass the rest of the city. The Oak Creek drainage area, containing four basins, extends into the foothills beyond the cities of Lebanon and Sodaville. Periwinkle Creek is one of the largest and most developed drainage areas within the UGB. This area is divided into four basins. The Truax, Burkhart and Cox Creek basins are currently largely undeveloped, with the majority of the basins outside the UGB. The Calapooia River Basin is located in the western area of the UGB.

Together, the bedrock structure and the alluvial deposits have given the Albany area a generally flat topography. Slopes south and east of the Willamette River are less than three percent. North Albany has more hilly terrain with ridges and valleys resulting from the underlying sandstone pediment. Twenty-five

[10] City of Albany Comprehensive plan Background Report; 1980
[11] Ibid.
[12] Ibid.

percent of the land in North Albany has slopes of more than 15 percent. Extensive development on these slopes could cause soil slippage and increased erosion. Such problems can be minimized through retention of vegetative cover, particularly trees, and by ensuring that any development follows existing contours as much as possible and replaces lost vegetation around building sites.

Poor drainage caused by relatively flat topography, a high water table, and a clay-rich subsurface has determined soil capability. Drainage channels and land immediately adjacent to them are generally Class III and IV soils. Because of the many drainage ways in the Albany area, there are few large expanses of Class I and II soils except in North Albany.

Ninety-eight percent of the soils within the Albany UGB are classified by the Soil Conservation Service as I-IV soils, capable of supporting a wide variety of crops and forage for livestock. Most of the soils in Albany are distributed in a complex mottled pattern throughout the area.

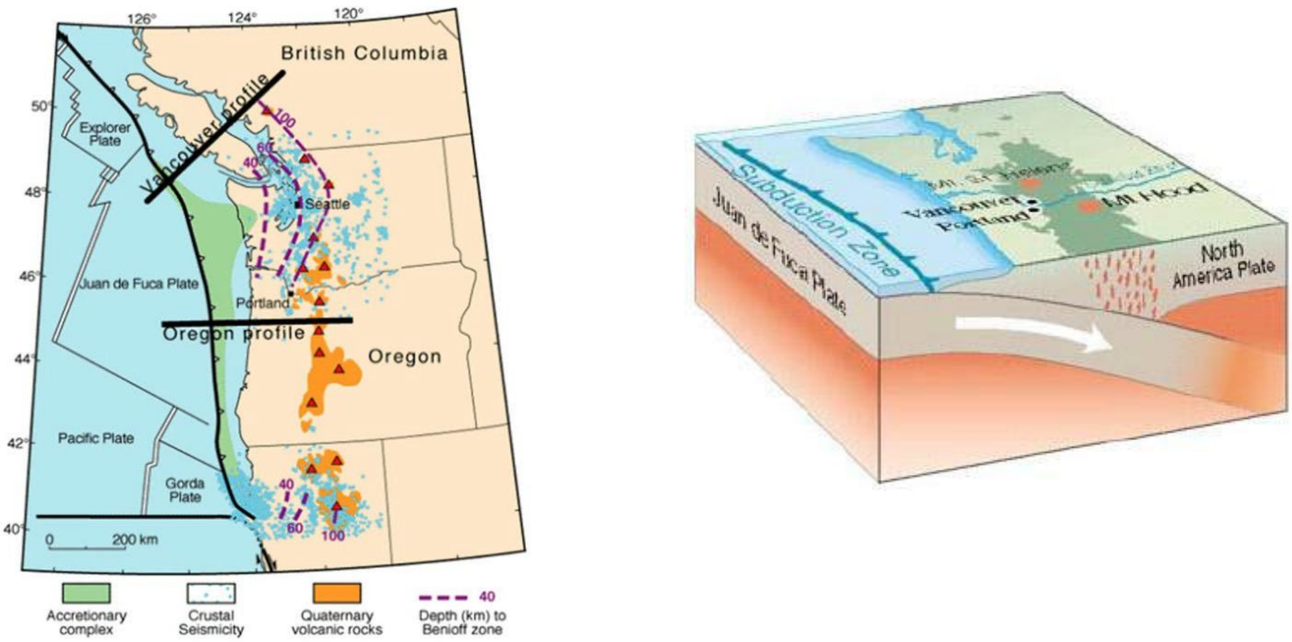
Liquifiable soils can occur in valley floor locations such as the Willamette Valley. Liquefaction occurs when ground shaking causes wet granular soils to change from a solid to a liquid state. This result in the loss of soil strength and three potential types of ground failure: lateral spreading, flow failure, and loss of bearing strength. Buildings and their occupants are at risk when the ground can no longer support buildings and structures. Areas of susceptibility to liquefaction include areas with high ground water tables and sandy soils.

DOGAMI has provided a map of the relative susceptibility to liquefaction for soils in the City of Albany. This map can be seen in Section 7 Earthquake. A summary of the results indicates that most of Albany has a low to moderate susceptibility to liquefaction. These areas are found in the southern and eastern parts of Albany. All of the area which runs along the Willamette River has very high liquefaction susceptibility.

Significant Geologic Features

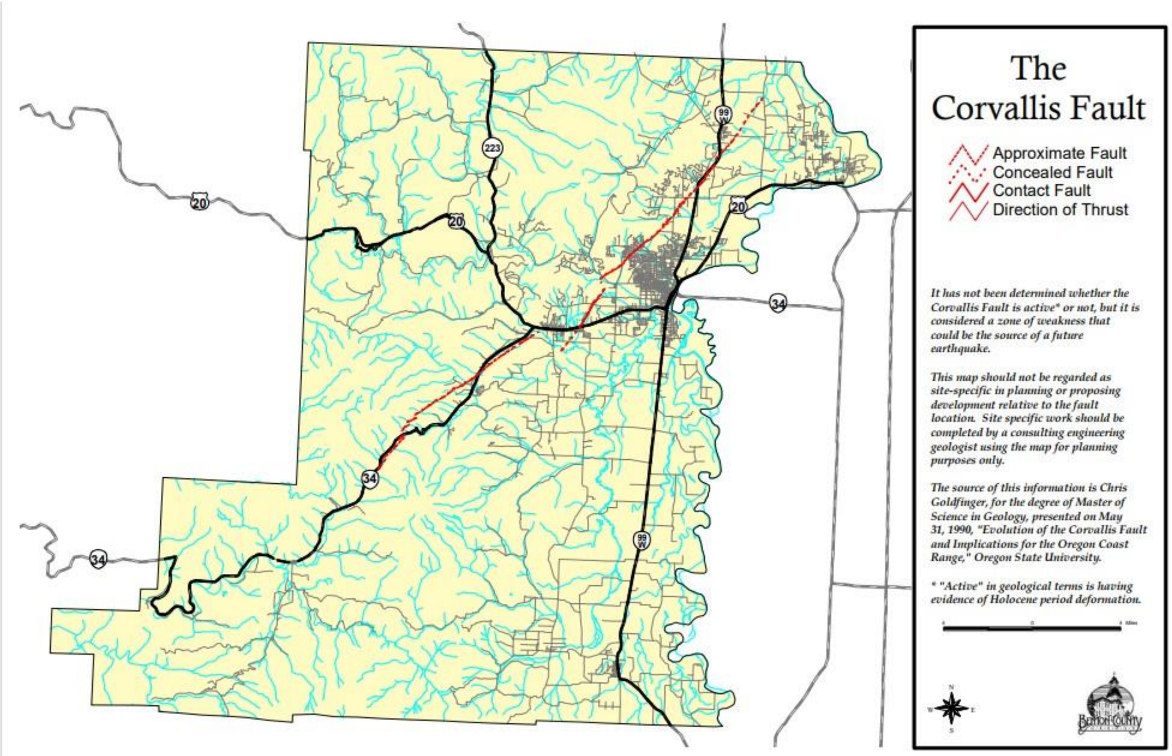
Most of the Pacific Northwest lies within the Cascadia Subduction Zone, where the Juan de Fuca and North American plates meet (Figure 6). The convergence of these tectonic plates puts most areas of western Oregon and Washington at risk for a catastrophic earthquake with a magnitude of 8.0 or higher. Albany lies in this area.

Figure 6. Representations of the Cascadia Subduction Zone



Another potential earthquake risk for Albany is the Corvallis zone Class B #869 fault (Figure 7). The northeast-striking, shallowly northwest-dipping Corvallis fault zone forms the western margin of the southern Willamette Valley in the vicinity of Corvallis. The fault trace is offset by two northwest-striking strike-slip faults that appear to be tear faults in the thrust sheet; however, these faults may extend eastward into the Willamette Valley and thus may not be tear faults. Mill Creek fault, Class A, #871, has the same strike and displacement direction as the Corvallis fault, but there is no evidence that these structures are continuous across the Willamette River. This fault is located to the west and north of Albany. As a result of the subduction zone, there are active volcanoes nearby, including Mt. St. Helens in southwest Washington, and Mt. Hood. Major eruptions of these volcanoes may cause ash fall in the Albany area.

Figure 7. The Corvallis Fault



Source: Benton County
https://www.co.benton.or.us/sites/default/files/fileattachments/sheriff039s_office/page/2708/corvallis_faultmap.pdf

The Three Sisters in the Cascade Range is one of three potentially active volcanic centers that lie close to rapidly growing communities and resort areas in Central Oregon. Two types of volcanoes exist in the Three Sisters region and each poses distinct hazards to people and property. South Sister, Middle Sister, and Broken Top, major composite volcanoes clustered near the center of the region, have erupted repeatedly over tens of thousands of years, and may erupt explosively in the future. In contrast, mafic volcanoes, which range from small cinder cones to large shield volcanoes like North Sister and Belknap Crater, are typically short-lived (weeks to centuries) and erupt less explosively than do composite volcanoes. Hundreds of mafic volcanoes scattered through the Three Sisters region are part of a much longer zone along the High Cascades of Oregon where new mafic volcanoes are possible.

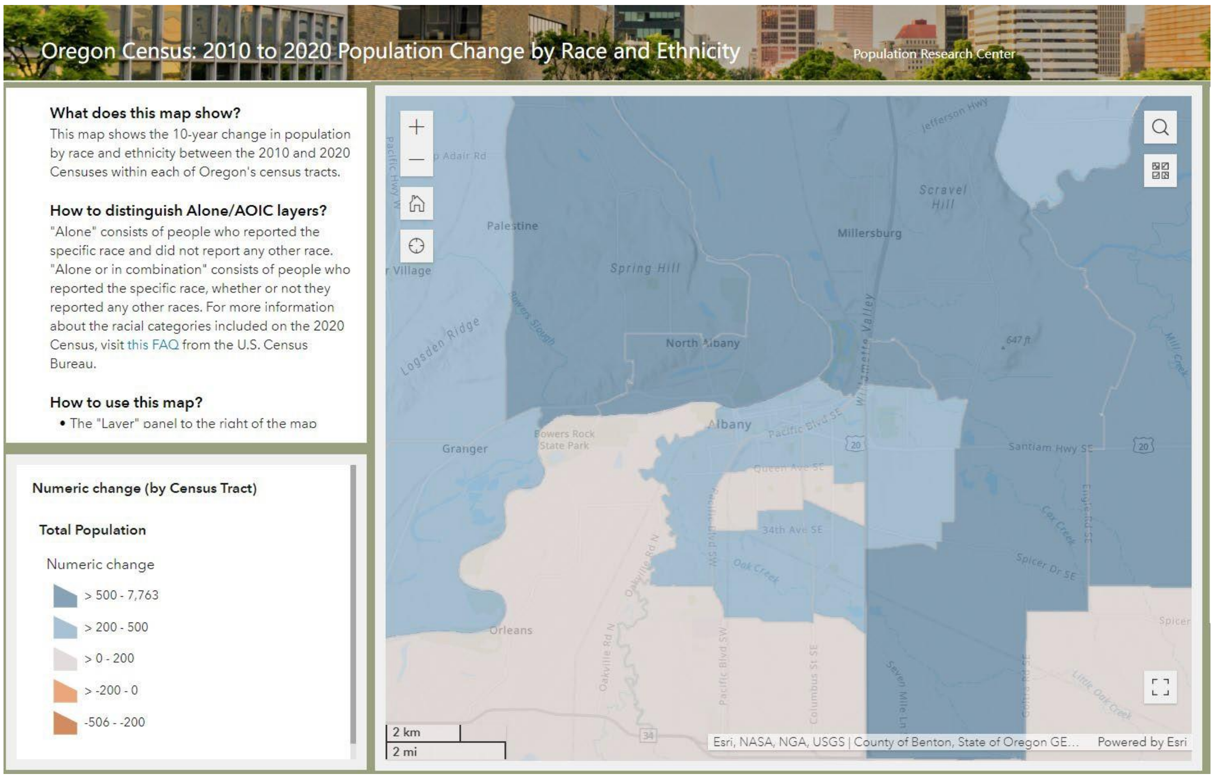
United States Geological Services scientists have detected a slight swelling or uplift of the ground surface over a broad area centered five kilometers (three miles) west of South Sister volcano. The Three Sisters region is located 22 miles west of Bend, Oregon, and 60 miles east of Eugene, Oregon. The uplift, which occurred between 1996 and 2000, covers an area about nine to 12 miles in diameter and the maximum amount of uplift at its center is about four inches. It is too broad and low to be noticed from the ground, and several close aerial inspections of the area have revealed no unusual surfacefeatures.

In the case of volcanoes, wind direction will determine Albany's risk. Winds out of the east would have the most severe impact on the city. Prevailing southwest winds would carry ash away from Albany. Historically, winds out of the east are most likely to occur in the summer rather than the winter.

Population and Demographics

The City of Albany is home to 57,199 people according to the Population Research Center at Portland State University[13][14]. The city lies in both Linn and Benton counties, divided by the Willamette River. In Linn County, Albany is the largest city (47,877 people[15]) and in Benton County, it is the second largest city. Slightly more than 16% of the City's population lives in Benton County totaling 9,322 people. Albany continues to be the most populated sub-area in Linn County and is projected to reach a population of 59,289 within its UGB in 2045 with an annual average growth rate of 0.9% between 2020 and 2045[16]. The map below shows population changes from 2010 to 2020 in the City of Albany and surrounding areas.

Figure 8. Population Change 2010-2020



Source: Population Research Center, Portland State University.

As the City of Albany grows over time, local decision makers will need to decide how to accommodate expected growth. Two common methods that are considered include revising local zoning regulations to promote increased population density within existing neighborhoods or expand the UGB to provide more developable land for the future, or a combination of both methods. As a result, changes in hazard

[13] Population Research Center | Portland State University (pdx.edu)

[14] The Oregon House of Representatives and Senate approved legislation in 2013 assigning coordinated population forecasting to the Population Research Center at Portland State University (PSU). This method of population forecasting replaces the county-coordinated 20-year population forecast used in previous NHMP updates. The Population Research Center produces the annual population estimates for Oregon and its counties and cities, as well as the estimates by age and sex for the state and its counties. These estimates are used by State and local governments, various organizations and agencies for revenue sharing, funds allocation, and planning purposes.

[15] Population Research Center | Portland State University (pdx.edu)

[16] Final_Report_Linn.pdf (pdx.edu)

vulnerability can be expected given the presence of more people per square mile over time or greater exposure to hazards over a larger geographic area. To reflect changes in population and development patterns, the City's Natural Hazards Mitigation Plan must be evaluated periodically to address changes in vulnerability to natural hazards due to growth.

The most recent demographic information available for this Community Profile is the 2020 Decennial Census[17]. That data shows 23,105 total housing units in Albany.

The average household size was 2.57 people. Of those who drive to work, about 21% travel less than 10 minutes, while more than 54% travel 10 to 29 minutes to work.[18] Slightly more than 27.6% of Albany residents 25 years of age or older have a Bachelor's degree or higher.[19] The median family income in the past 12 months (in 2020 inflation-adjusted dollars) was $72,850[20]. The poverty rate of Albany residents is slightly greater than that of residents in the whole state. Twelve percent (12%) of Albany residents lived below the poverty level in 2019, of these approximately 80% are renters[21]. Nearly 6% of Albany residents are foreign born about half of whom are naturalized U.S. citizens[22]. About 11.4% of residents older than five speak a language other than English at home and of those 5,742 who speak another language at home, about 33.5% of them (1,922 people older than five) speak English less than "very well"[23].

Land and Development

In the 1800s, commerce flourished in Albany as trade moved up and down the Willamette River. In the early to mid-1900s, this pattern continued along the railroads that passed through Albany. With the advent of the interstate highway system, Albany maintained its position, with two Interstate 5 interchanges, as the "Hub of the Willamette Valley."

In 1980, Albany adopted an Urban Growth Boundary (UGB) to contain urban development. At that time, 8.5 square miles of the 21.7 square miles urban growth area was inside the city limits. Today 17.7 square miles is in the city limits.

Periods of rapid growth, such as between 1960 and 1980 and in the mid-1990s and the annexation of North Albany in 1991, have brought about the need to provide urban services rapidly and efficiently. Portland State University Population Research Center estimates that by the year 2030 Albany will be home to 63,270 people.[24]

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[17] Census - Table Results Table H1
[18] 2020 American Community Survey 5-year estimates Table S1901
[19] Ibid.
[20] Ibid.
[21] Albany, Oregon (OR) profile: population, maps, real estate, averages, homes, statistics, relocation, travel, jobs, hospitals, schools, crime, moving, houses, news, sex offenders (city-data.com)
[22] 2020 ACS 5-year estimates, Table DP02
[23] Ibid.
[24] Population Forecasts | Portland State University (pdx.edu) Table of Current Forecast Summaries for All Areas

The following table describes how land inside the UGB is allocated for various uses.

Table 1. Summary of Land Use Allocations

Land Use Category	No. of Acres	Percent of UGB
Commercial - General	492.64	3.54%
Commercial - Light	112.11	0.81%
Industrial	253.08	1.82%
Lake	8.22	0.06%
Light Industrial	1,148.24	8.26%
Open Space	1,186.95	8.54%
Other	2,078.49	14.95%
Public and Semi-Public	951.68	6.85%
Residential – Low Density	4,669.61	33.59%
Residential – Medium Density	830.83	5.98%
Urban Residential Reserve	1,790.39	12.88%
Village Center	379.90	2.73%
Total Acres	13,902.15	100.00%

Source: City of Albany Community Development

Housing

The City of Albany has been considered the "Hub of the Willamette Valley" since its beginning in the mid- 1800s. The Albany is not far from the Salem, the capital of Oregon; Eugene; the Pacific Coast; and the Cascade Mountains. The city is convenient to and a short commute for many localemployers.

According to 2020 ACS 5-year Estimates Data Profile there were a total of 221,408 housing units in the city. Data from the ACS indicates that owner-occupied housing units were 61.2% of the total and renter-occupied housing units were 38.8 %. There has been a slight increase in the percentage of owner-occupied units and a decrease in the number of renter-occupied housing units since the 2010 Census. The number of mobile homes dropped from 1,212 in the 2010 Census to 1,116 according to the 2020 ACS 5-year estimates.

The 2020 ACS 5-year Estimates Data Profile estimates slightly fewer housing units than the 2020 Census data but provides a breakdown of year constructed. Homes built before 1974, when Oregon adopted its first statewide building code, will suffer the worst damage in a serious earthquake. Constructed to specific seismic standards, homes built after 1993 are the most likely to withstand earthquakes.

The majority of homes in Albany were built between 1960 and 1979. The year in which a structure is built is an important indicator of how well a structure will perform during an event. For example, in 1990, the Oregon Building Codes Division revised construction standards for new buildings to make them more resistant to seismic events. Therefore, homes built after 1990 are likely to perform better during an earthquake or related hazard. The table above provides information on the age of Albany housing units.

Figure 9. Housing Units by Year Constructed

Year Structure Built	Units
Total housing units	**21,408**
Built 2014 or later	746
Built 2010 to 2013	653
Built 2000 to 2009	3,774
Built 1990 to 1999	3,670
Built 1980 to 1989	1,353
Built 1970 to 1979	4,933
Built 1960 to 1969	1,826
Built 1950 to 1959	1,894
Built 1940 to 1949	1,131
Built 1939 or earlier	1,428

Source: 2020 American Community Survey 5-year estimates

The median value of an owner-occupied home in Albany has gone from $175,100 in the 2010 Census to $244,000 according to the 2020 ACS data and increase of 39.3%[25]. The increase from 2000 to 2010 was 24.2% in contrast to the major jump in median value of owner-occupied homes between 1990 and 2000. In 1990, the median value for owner-occupied homes was $56,825; in 2000, it was $132,600, a 133.4% increase.

As in many communities, affordable homes remain a major concern. [REVISE] The largest percentages of the houses being built are in the $160,000 to $250,000 range, with some in the $100,000 to $160,000 range. This is a concern when 26% of the total households in Albany have a reported income of below $25,000.

Employment and Industry

The city of Albany's per capita income according to the 2020 ACS 5-Year estimates is $28,802. Median earnings are $52,363 for full-time male workers, and $41,662 for full-time female workers. The median household income was $62,172. According to the 2020 ACS 5-Year estimates, there were 24,668 employed people over the age of 16 within the city. The chart below provides a breakdown of those employees, the occupations they hold, the industry in which they work and the class of work according to the US Census Bureau.

Table 2. Employment Distribution for Employees in Albany

	Total Estimate	Percent
Civilian employed population 16 years and over	**24,668**	**100.0**
OCCUPATION		
Management, business, science, and arts	8,684	35.2
Service	4,470	18.1
Sales and office	5,337	21.6
Natural resources, construction, and maintenance	2,413	9.8
Production, transportation, and material moving	3,764	15.3
INDUSTRY		
Agriculture, forestry, fishing and hunting, and mining	504	2.0

[25] 2020 ACS 5-Year Estimate Data Profile, Table DP02, Explore Census Bureau Data

	Total Estimate	Percent
Construction	1,731	7.0
Manufacturing	3,001	12.2
Wholesale trade	665	2.7
Retail trade	2,342	9.5
Transportation and warehousing and utilities	1,431	5.8
Information	230	0.9
Finance, insurance, real estate, rental and leasing	1,201	4.9
Professional, scientific, management, administrative, and waste management services	1,941	7.9
Educational, health and social services	6,632	26.9
Arts, entertainment, recreation, accommodation and food services	2,133	8.6
Other services (except public administration)	1,321	5.4
Public administration	1,536	6.2
CLASS OF WORKER		
Private wage and salary	19,547	79.2
Government	3,881	15.7
Self-employed	1,230	5.0
Unpaid family	10	0.0

Source: US Census 2020; American Community Survey 5-year Estimates

At one time Albany was primarily a wood-products town. Today Albany has a diverse employer base that can survive the ups and downs of a changing business climate.

Transportation and Commuting Patterns

The City of Albany has over 311 lane-miles of paved street and 13.7 lane-miles of graveled street. The city is served by Interstate 5, State Highway 20, State Highway 34, and State Highway 99E. In addition, there are a number of major county roads which provide links between major cities in Linn and Benton counties. Albany has local bus service which provides low-cost transportation within the city as well as the Linn- Benton Loop Bus which provides transportation to Corvallis and Benton County and the Linn Shuttle which provides service from Sweet Home and Brownsville to Albany. The city of Albany is an Amtrak stop which provides passenger rail service north to Vancouver, BC, south to San Diego and east to Spokane and, ultimately, Chicago. The table below is from the 2020 American Community Survey and provides commuting information about the citizens of Albany.

Table 3. Commuting Characteristics in Albany

	Total Estimate	Percent
Workers 16 years and over	24,231	100.0
Car, Truck, or Van; Drove Alone	19,724	81.4
Car, Truck, or Van; Carpooled	2,253	9.3
Public Transportation	73	0.3
Walked	509	2.1
Bicycle	170	0.7
Taxi, Motorcycle, or Other Means	242	1.0
Worked at Home; Telecommuted	1,284	5.3
Mean Travel Time to Work	20.7 Minutes	N/A

Source: US Census 2020, American Community Survey 5-year Estimates

Section 3: Risk Assessment

This section provides information on the natural hazard risk assessment process. It is general in scope and provides information on what a risk assessment entails, describes the sources of information and risk assessment exercise used to assess risk of natural hazard events in the City of Albany, and some of the related hazard vulnerability maps that are included in the natural hazard Sections 6-14 The OEM Hazard Vulnerability Assessment exercise allowed the Steering Committee to identify and evaluate the natural hazards that pose the greatest risk to the City of Albany and to evaluate the risk of each of those based on four factors (history, probability, vulnerability, and maximum threat).

Risk assessment information that addresses the requirements of the Disaster Mitigation Act of 2000 for each of the natural hazards identified in this plan can be found both in the Risk Assessment section as well as in the hazard specific sections listed below:

- Section 6: Flood
- Section 7: Earthquake
- Section 8: Severe Weather
- Section 9: Wildfire
- Section 10: Poor Air Quality
- Section 11: Landslide
- Section 12: Drought
- Section 13: Excessive Heat
- Section 14: Public Health Emergency/Pandemic

What is a risk assessment?

According to the FEMA Local Mitigation Planning Handbook[26], risk assessment is a product or process that collects information and assigns values to risks for the purpose of informing priorities, developing, or comparing courses of action, and informing decision making. Conducting a risk assessment can provide information on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events. FEMA identifies four steps in assessing risk.[27] The City of Albany NHMP identifies a fifth step that includes consideration of how development trends affect risk assessments. They are as follows:

1. **Hazard identification** identifies the geographic extent and intensity of the hazard and the probability of its occurrence. Maps are frequently used to display major hazards that consistently affect a geographic area.

In the 2016 NHMP the City of Albany identified seven major hazards that consistently affect this geographic area: floods; earthquakes; severe weather; wildfire; volcanic eruption; landslides; and drought. During the NHMP update process in 2021, the steering committee

[26] Local Mitigation Planning Handbook (fema.gov)
[27] intro-hazard_mitigation.indd (acac.org), Section 3-2 through 3-5

members identified two additional natural hazards, Excessive Heat and Public Health Emergency/Pandemic, and modified one other. Volcanic eruptions are not a natural hazard experienced in the City of Albany, however, Ash Fall and Poor Air Quality are natural hazards that affect the city.

Another change made to the list of natural hazards addressed in this plan was the reconsideration of the impact of Climate Change. The Steering Committee agreed that the impact of climate change is experienced in the increased severity and frequency of natural hazard events and will be addressed throughout the NHMP rather than as a discreet natural hazard.

2. **Profiling hazard events** describes the causes and characteristics of each natural hazard, how each has affected the City of Albany in the past, and what part of the City's population, infrastructure, and environment has historically been vulnerable to each specific hazard. A full profile of each hazard discussed in this plan is provided in each hazard section including a full description of the history of hazard-specific events. In this section below is a profile of those natural hazard events that have occurred since the 2016 City of Albany NHMP was adopted.
3. **Vulnerability assessment/inventory assets** combines hazard identification with an inventory of the existing or planned property and population exposed to a hazard. Critical facilities are of particular concern because these provide essential products and services to the general public that are necessary to preserve the welfare and quality of life in the city and fulfill important public safety, emergency response, and/or disaster recovery functions.

The critical facilities have been identified, listed in a table and mapped relative to flood, landslide, earthquake and wildfire risk at the end of this section.

4. **Risk analysis/estimating potential losses** involves estimating the damage, injuries, and financial losses likely to be sustained in a geographic area over a given period of time. This level of analysis involves using mathematical models. The two measurable components of risk analysis are the magnitude of the harm that may result, and the likelihood of the harm occurring. Describing vulnerability in terms of dollar losses provides the community and the state with a common framework in which to measure the effects of hazards on assets. Quantitative analysis of dollar losses is not included in the analysis. Risk analysis was accomplished by identifying exposure of critical facilities using mapping. Future analysis if potential losses will be part of future DOGAMI multi-hazard risk analysis for Linn County to include all of the City of Albany.

5. **Assessing vulnerability/analyzing development trends** provides a general description of land uses and development trends within the community so that mitigation options can be considered in land-use planning and future land-use decisions. This plan provides a comprehensive description of the character of the Albany community in Section 2: Community Profile. This description includes the

geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns. Analyzing these components of the Albany community can help in identifying potential problem areas and can serve as a guide for incorporating goals and ideas contained in this mitigation plan into other community development plans.

Hazard assessments are subject to the availability of hazard-specific data. Gathering data for a hazard assessment requires a commitment of resources on the part of participating organizations and agencies. Each hazard-specific section of the plan includes a section on hazard identification using data and information from city, county, or state agency sources.

Regardless of the data available for hazard assessments, there are numerous strategies the City of Albany can take to reduce risk. These strategies are described in the action items detailed in Volume I, Section 4 of this plan. Mitigation strategies can further reduce disruption of critical services, reduce the risk to human life, and alleviate damage to personal and public property and infrastructure. Action items provide recommendations to collect further data to map hazard locations and conduct hazard assessments.

Hazard Vulnerability Assessment

For the 2023 City of Albany NHMP update, the Steering Committee engaged in a Hazard Vulnerability Assessment (HVA) exercise based on methodology developed by the Oregon Emergency Management to identify the relative vulnerability of the people and assets in the City of Albany to natural hazards and to describe the aspects of the community that are most at risk.

The methodology produces scores that range from 24 (lowest possible) to 240 (highest possible); one order of magnitude from lowest to highest. Vulnerability and probability are the two key components of the methodology. Vulnerability examines both typical and maximum credible events, and probability endeavors to reflect how physical changes in the jurisdiction and scientific research modify the historical record for each hazard. Vulnerability accounts for approximately 60% of the total score, and probability approximately 40%.

For governments, conducting the hazard analysis described in this document is a useful early step in planning for hazard mitigation, response, and recovery. This method provides the jurisdiction with a sense of hazard priorities, or relative risk. It "quantifies" the risk of one hazard compared with another, and in doing so allows for the ranking of hazards. By doing this analysis, planning can first be focused where the risk is greatest.

Hazard Identification

The Oregon Statewide Land Use Planning Goals direct local governments to reduce risk from some particular natural hazards. In accordance with Statewide Planning Goal 7, “Local governments shall adopt comprehensive plans (inventories, policies and implementing measures) to reduce risk to people and property from natural hazards. Natural hazards for the purposes of this goal are: floods (coastal and riverine), landslides, earthquakes and related hazards, tsunamis, coastal erosion, and wildfires." Local governments are encouraged to plan for other natural hazards and the City of Albany has done so by including them in this Risk Assessment.

List of Recent Natural Hazard Events

Events within the past five years identified by the Steering Committee

- 2019 (April) Flooding event
- 2020 (All year through 2021) COVID-19 Pandemic
- 2020 (September) Wildfires/significant ash fall
- 2021 (February) Ice Storm
- 2021 (May) Excessive heat event

Vulnerability Assessment and Inventory of Assets

The City of Albany conducted a local hazard vulnerability assessment using the OEM Methodology and identified community assets including critical and essential facilities and infrastructure.

Vulnerability assessment endeavors to identify important community assets and system vulnerabilities. Vulnerabilities include both physical assets such as businesses, homes, roads and critical infrastructure like drinking water sources, and public service and health service establishments as well as community assets including people, historic places, and environmental assets.

These are discussed below.

Hazard Vulnerability Assessment - OEM Methodology[28]

Local assessment of relative hazard vulnerability was accomplished using a methodology developed by the Federal Emergency Management Agency (FEMA) in 1983. Although nearly every jurisdiction in Oregon uses this process, the range of values is subjective, and it is not meant to be used to compare one jurisdiction to another. It is useful to compare among hazards with a single group of participants.

In this local risk assessment methodology, four aspects characterizing risk – history, vulnerability, maximum threat, and probability – are assessed by a group or an individual by assigning a ranking as to severity based on the following:

[28] Oregon Military Department Office of Emergency Management (OEM) HAZARD ANALYSIS METHODOLOGY: This hazard analysis methodology was first developed by FEMA circa 1983, and gradually refined by OEM over many years. During 1984, the predecessor agency to OEM (the Emergency Management Division) conducted workshops around the State of Oregon that resulted in all of Oregon's 36 counties producing the first versions of analyses using this methodology. In addition, many cities have also conducted an analysis using this method. For a time, the Oregon Health Authority (OHA) was requiring local health departments to conduct an analysis based on this methodology.

LOW = choose the most appropriate number between 1 to 3 points
MEDIUM = choose the most appropriate number between 4 to 7 points
HIGH = choose the most appropriate number between 8 to 10 points

HISTORY is the record of previous occurrences. Events to include in assessing history of a hazard in your jurisdiction are events for which the following types of activities were required:

- The Emergency Operations Center (EOC) or alternate EOC was activated.
- Three or more Emergency Operations Plan functions were implemented, e.g., alert & warning, evacuation, shelter, etc.
- An extraordinary multi-jurisdictional response was required; and/or
- A local emergency was declared.

Low: score at 1 to 3 points based on… 0 - 1 event past 100 years
Medium: score at 4 to 7 points based on… 2 - 3 events past100 years
High: score at 8 to 10 points based on… 4 + events past100 years

PROBABILITY is the likelihood of future occurrence within a specified period of time.

Low: score at 1 to 3 points based on… one incident likely within 75 to 100 years
Medium: score at 4 to 7 points based on…one incident likely within 35 to 75 years
High: score at 8 to 10 points based on… one incident likely within 10 to 35 years

VULNERABILITY is the percentage of population and property likely to be affected under an "average" occurrence of the hazard.

Low: score at 1 to 3 points based on… < 1% affected
Medium: score at 4 to 7 points based on…1 - 10% affected
High: score at 8 to 10 points based on… > 10% affected

MAXIMUM THREAT is the highest percentage of population and property that could be impacted under a worst-case scenario.

Low: score at 1 to 3 points based on… < 5% affected
Medium: score at 4 to 7 points based on…5 - 25% affected
High: score at 8 to 10 points based on… > 25% affected

Each of these factors is assigned a weight. History is weighted by a factor of 2; Probability is weighted by a factor of 7; Vulnerability is weighted by a factor of 5; and Maximum Threat is weighted by a factor of 10. The rankings are multiplied by their assigned weighting factors and then combined resulting in a Risk Score for each hazard. This methodology produces Risk Scores that range from 24 to 240.

The HVA exercise was conducted during the November 8, 2021 and December 13, 2021 meetings. Both of these meetings were primarily in person with an option to attend online.

Table 1 below displays the ranking of each of these hazards according to the group present at these meetings.

Table 4. City of Albany 2021/2022 Natural Hazard Vulnerability Assessment

City of Albany 2021/2022 Natural Hazard Vulnerability Assessment
Based on the OEM methodology combining factors of History, Probability, Vulnerability and Maximum Threat to assess risk.
Further information upon request.

HAZARD	HISTORY WF = 2			PROBABILITY WF = 7			VULNERABILITY WF = 5			MAX THREAT WF = 10			RISK SCORE
Snow Storm	2 x	**10**	20	7 x	**10**	70	5 x	**10**	50	10 x	**10**	100	**240**
Ice Storm	2 x	**10**	20	7 x	**10**	70	5 x	**10**	50	10 x	**10**	100	**240**
Ash Fall/Poor Air Quality	2 x	**8**	16	7 x	**10**	70	5 x	**10**	50	10 x	**9**	90	**226**
Windstorm	2 x	**10**	20	7 x	**10**	70	5 x	**9**	45	10 x	**8**	80	**215**
Public Health Emergency/Pandemic	2 x	**8**	16	7 x	**8**	56	5 x	**8**	40	10 x	**10**	100	**212**
Earthquake	2 x	**5**	10	7 x	**6**	42	5 x	**10**	50	10 x	**10**	100	**202**
Excessive Heat	2 x	**10**	20	7 x	**10**	70	5 x	**4**	20	10 x	**8**	80	**190**
Riverine Flood	2 x	**10**	20	7 x	**10**	70	5 x	**4**	20	10 x	**4**	40	**150**
Wildfire (WUI Fire)	2 x	**7**	14	7 x	**8**	56	5 x	**6**	30	10 x	**4**	40	**140**
Tornado	2 x	**4**	8	7 x	**5**	35	5 x	**5**	25	10 x	**7**	70	**138**
Drought	2 x	**1**	2	7 x	**4**	28	5 x	**2**	10	10 x	**2**	20	**60**
Landslide	2 x	**1**	2	7 x	**3**	21	5 x	**1**	5	10 x	**2**	20	**48**

Completed by the City of Albany NHMP update Steering Committee during meetings held on November 8, 2021 and December 13, 2021

By multiplying the weight factors associated with the categories by the severity ratings, we can arrive at a subscore for history, vulnerability, maximum threat, and probability for each hazard. Adding the subscores will produce a total score for each hazard.

Critical facilities and infrastructure

Facilities critical to government response and recovery activities (i.e., life safety and property and environmental protection) include: 911 centers; emergency operations centers; police and fire stations; public works facilities; sewer and water facilities; bridges and roads; and shelters. Facilities that, if damaged, could cause serious secondary impacts may also be considered “critical.” A hazardous material facility is one example of this type of critical facility.

Critical and essential facilities are also those that are vital to the continued delivery of key government and private services or that may significantly impact the public’s ability to recover from the emergency. These facilities may include buildings such as clinics and hospitals, schools, elder care facilities, childcare facilities; the jail; law enforcement center; public services building; community corrections center; courthouse and juvenile services building; and other public service facilities. The list on the following pages identifies the critical facilities, essential facilities, public infrastructure, and social service facilities considered critical by the 2022-2023 City of Albany NHMP Steering Committee.

Table 5. Critical and Essential Facilities for the City of Albany

	Type of Facility	Facility	Address
Linn County			
	Public Works		
		Linn County Road Department	3010 Ferry St. SW
	Law Enforcement		
		Linn County Sheriff & Linn County Emergency Management	1115 Jackson St. SE
	County Administration		
		Linn County Courthouse	300 SW 4th Ave.
	Fairgrounds		
		Linn County Fair & Expo	3700 Knox Butte Rd. E
Albany	**Type of Facility**	**Facility**	**Address**
	Fire Department		
		Fire Station 11	611 Lyon St. SE
		Fire Station 12	120 34th Ave. SE
		Fire Station 13	1980 Three Lakes Rd. SE
		Fire Station 14	2850 Gibson Hill Rd. NW
		Fire Station 15	3215 Transition Parkway, Millersburg
	Law Enforcement		
		Albany Police Station	2600 Pacific Blvd SW
		Linn County Jail/Sheriff's Office	1115 Jackson St. SE
		Linn Benton County Juvenile Detention Center	4400 Lochner Rd.
		Oregon State Police Office	3400 Spicer Dr
	Hospital		
		Samaritan Albany General Hospital	1046 6th Ave. SW
	Clinics		
		Geary Street Clinic	1700 Geary St.
		Albany Family & Specialty Medicine	1705 Waverly Dr. SE

	Type of Facility	Facility	Address
		Albany Internal Medicine Group	400 NW Hickory St
		Mid Valley Children's Clinic	734 Elm St. SW
		Corvallis Clinic at North Albany Village	601 Hickory Ave. NW
		Samaritan North Albany Urgent Care/Medical Clinics	400 Hickory Ave. NW
		Linn County Mental Health	225 Washington St. SW
		North Albany Wellness Clinic	110 Hickory
	Emergency Coordination Center		
		Albany City Hall	333 Broadalbin St. SW
		Albany Public Library	2450 14th Ave SE
		Linn County Emergency Management	1115 Jackson St. SE
	Water Source(s)		
		City of Albany Water Treatment Plant	300 Vine St. SW
		Albany Millersburg Water Treatment Plant	33883 Berry Dr. NE
	Water Infrastructure		
		CAN - Albany Gates, Automated flow control structure	37295 Cemetary Rd
		CAN - CZ Gates, Automated flow control structure	100 Industrial Drive
		CAN - Headgates, Diversion dam, screens, flow control structure	38398 River Drive
		WRF Monitoring Site	405 Davidson St. NE
		TWG Flood Control Valve	577 Waverly Dr. NE
		WTD - Edgewood PRV Vault	890 Edgewood Dr. NW
		WTD - Pump Station Facility - 34th Street	475 34TH Ave SW
		WTD - Pump Station Facility - Gibson HIll	3400 Gibson Hill Rd. NW
		WTD - Pump Station Facility - Maple Street	732 4TH Ave SW
		WTD - Pump Station Facility - North Albany	1008 Gibson Hill Rd. NW
		WTD - Pump Station Facility - Queen Avenue	950 Queen Ave. SE
		WTD - Pump Station Facility - Valley View	3240 Valley View Dr. NW
		WTD - Reservoir Facility - 34th Street	475 34TH Ave. SW
		WTD - Reservoir Facility - AM Plant	33883 Berry Dr. NE

	Type of Facility	Facility	Address
		WTD - Reservoir Facility - Broadway Street	1501 Broadway St. NW
		WTD - Reservoir Facility - Maple Street	817 4TH Ave. SW
		WTD - Reservoir Facility - Queen St	1709 Hill St. SE
		WTD - Reservoir Facility - Valley View	2930 Valley View Dr. NW
		WTD - Reservoir Facility - Wildwood	890 Edgewood Dr. NW
		WTP2 - Albany Metering Vault	37989 Century Dr. NE
		WTP2 - Millersburg Metering Vault	36697 Berry Dr. NE
	Wastewater Treatment		
		City of Albany Wastewater Treatment Plant	310 Waverly Dr. NE
		Albany Public Works Operations	
	Water Wastewater Facilities		
		WWC - LS #03 Maple Street & Overflow	817 4th Ave SW
		WWC - LS #04 Queen Avenue	1150 Queen Ave SW
		WWC - LS #05 Umatilla	1098 29TH Ave. SW
		WWC - LS #06 Oak Creek	4567 Pacific Blvd. SW
		WWC - LS #07 College Green	1434 Belmont Ave. SW
		WWC - LS #08 34th Avenue	122 34TH Ave. SW
		WWC - LS #09 Marion Street	4322 Marion St. SE
		WWC - LS #10 14th and Oak	1324 Oak St. SE
		WWC - LS #12 Wah Chang	2570 Old Salem Rd. NE
		WWC - LS #13 Century Drive	813 Century Dr. NE
		WWC - LS #15 Burkhart Creek	908 Old Salem Rd. NE
		WWC - LS #17 Morningstar	38720 Morningstar Rd. NE
		WWC - LS #18 Millersburg	2599 Millersburg Dr. NE
		WWC - LS #19 North Albany	502 Springhill Dr. NW
		WWC - LS #20 Columbus Street & Overflow	5605 Columbus St. SE
		WWC - LS #23 Riverfront Wet Weather & Overflow	489 Water Ave. NW
		WWC - Bowman Park Overflow	1905 Linn Ave. NE
	Elementary School		

	Type of Facility	Facility	Address
		Clover Ridge Elementary School	2953 Clover Ridge Rd. NE
		Central Elementary School	336 9th Ave. SW
		Fairmount School	1005 Springhill Dr. NW
		Fir Grove Elementary School	5355 Scenic Dr. NW
		Lafayette Elementary School	3122 Madison St. SE
		Liberty Elementary School	2345 Liberty St. SW
		North Albany Elementary School	815 E Thornton Lk Dr. NW
		Oak Elementary School	3610 Oak St. SE
		Oak Grove Elementary School	1500 Oak Grove Dr. NW
		Periwinkle Elementary School	2196 21st Ave. SE
		Meadow Ridge Elementary School	385 Timber Ridge St. NE
		South Shore Elementary School	910 Bain St. SE
		Sunrise Elementary School	730 19th Ave. SE
		Takena Elementary School	1210 12th Ave. SW
		Waverly Elementary School	425 Columbus St. SE
	Middle School		
		Calapooia Middle School	830 24th Ave. SE
		Timber Ridge Middle School	385 Timber Ridge St. NE
		Memorial Middle School	1050 Queen Ave. SW
		North Albany Middle School	1205 North Albany Rd.
	High School		
		South Albany High School	3705 Columbus St. SE
		West Albany High School	2100 SW Elm St
		Albany Options School	701 19th Ave SE
	Community College		
		Linn Benton Community College	6500 Pacific Blvd SW
	Private Secondary & Elementary		
		Albany Christian School	420 3rd Ave. SE
	Preschool & Kindergarten		
		Albany Christian Preschool/Childcare	420 3rd Ave. SE
		Circle of Friends Learning Center	325 Pacific Blvd. SW

	Type of Facility	Facility	Address
		Faith Lutheran Preschool	930 Queen Ave. SW
		Good Shepherd Lutheran School	1910 34th Ave. SE
		The Learning Loft	6th Ave. & Ferry St.
		Maple Lawn Preschool	1950 Salem Ave. SE
		Montessori Sundborn Children's House	1015 7th Ave. SE
		North Albany Community Preschool	1273 W Thornton Lk Dr. NW
		Methodist Early Learning Center	1115 28th Ave. SW
	Child Care		
		Albany Christian Preschool/Childcare	420 3rd Ave. SE
		Good Shepherd Lutheran Pre-School ELCA	1910 34th Ave. SE
		Hey Diddle Diddle	553 Main St. SE
		Presbyterian Child Care Center & Preschool	330 5th Ave. SW
		South Albany Child Development Center	3705 Columbus St. SE
		Dragonfly Learners	135 Critendon Loop
		Dandelion Learners	2245 North Albany Rd.
		Mid-Willamette Valley YMCA, Growing Leaders ELC	3201 Pacific Blvd. SW
		Boys and Girls Club	1215 Hill St. SE
		Play and Wonder	345 SE Churchill Downs St.
	Nursing Home		
		Mennonite Village Nursing Home	5353 Columbus St. SE
		Regency of Albany Nursing Home	805 19th Ave. SE
		Timberview Care Center	1023 6th St. SW
	Residential Care Facilities		
		16th House Residential Care Facility	3010 16th Ave. SE
		Shortridge Home Residential Care Facility	4870 Shortridge St. SE
		Bain Home Residential Care Facility	2928 Bain SE
		Chamberlin House Residential Care Facility	808 Elm St. SW
		Mitchell Place Residential Care Facility	1927 Waverly Dr. SE
		Lehigh House Residential Care Facility	2238 30th Ave. SE
		Mitchell Place Residential Care Facility	1925 Waverly Dr. SE

	Type of Facility	Facility	Address
		Mitchell Place Residential Care Facility	1931 Waverly Dr. SE
		Robb House Residential Care Facility	1310 Powell Way SE
		Scheler House Residential Care Facility	1921 Waverly Dr. SE
		Sander House Residential Care Facility	2131 Salem Ave
		OMRS "Schantz House" Residential Care Facility	1440 Shortridge St. SE
		Thurston Place Residential Care Facility	704 38th Ave. SE
		Lydia's House Alzheimer's Care Residential Care Facility	5353 Columbus St. SE
		Bonaventure of Albany	420 Geri Street
		Timberwood Court Memory Care Community	2875 14th Ave. SE
	Retirement & Life Care Facility		
		Brookdale Senior Living Retirement & Life Care Facility	2445 Geary St. SE
		Brookdale Senior Living Retirement & Life Care Facility	1929 Grand Prairie Rd. SE
		Brookdale Senior Living Retirement & Life Care Facility	1560 Davison St. SE
		Avamere at Albany	2800 14th Ave. SE
		Mennonite Village Retirement & Life Care Facility	5353 Columbus St. SE
		Timberwood Court Memory Care Community	2875 14th Ave. SE
		Quail Run Assisted Living	5353 Columbus St SE
		Waverly Assisted Living	2853 Salem Ave SE
	Hospice		
		Samaritan Evergreen Hospice	4600 Evergreen Place SE
	Hazardous Facilities		
		Absorbent Technologies Inc.	140 Queen Ave. SW
		Oregon Freeze Dry Inc.	770 29th Ave. SW
		Oregon Freeze Dry Inc.	525 25th Ave. SW
		National Frozen Foods Corp	745 30th Ave. SW
		ATI Alivac	530 34th Ave. SW
		International Paper	3251 Old Salem Rd. NE

	Type of Facility	Facility	Address
		Georgia-Pacific Chemicals LLC	2190 Old Salem Rd. NE
		Synthetech Inc.	1290 Industrial Way.
		Keimira Water Solutions	2800 Old Salem Rd. NE
		Sno Temp Cold Storage	3815 Marion St. SW
		Wah Chang	1600 Old Salem Rd. NE
		C G Industries Inc.	1282 Commercial Way
		Target Distribution Center	875 Beta Dr. SW
		The Home Depot	3500 Spicer Rd. SE
		Pacific Cast Technologies Inc.	150 Queen Ave. SW
		Costco Wholesale	3130 Killdeer Ave.
		Absorbent Technologies Inc.	2930 Ferry St. SW
		International Paper	3160 Old Salem Rd. NE

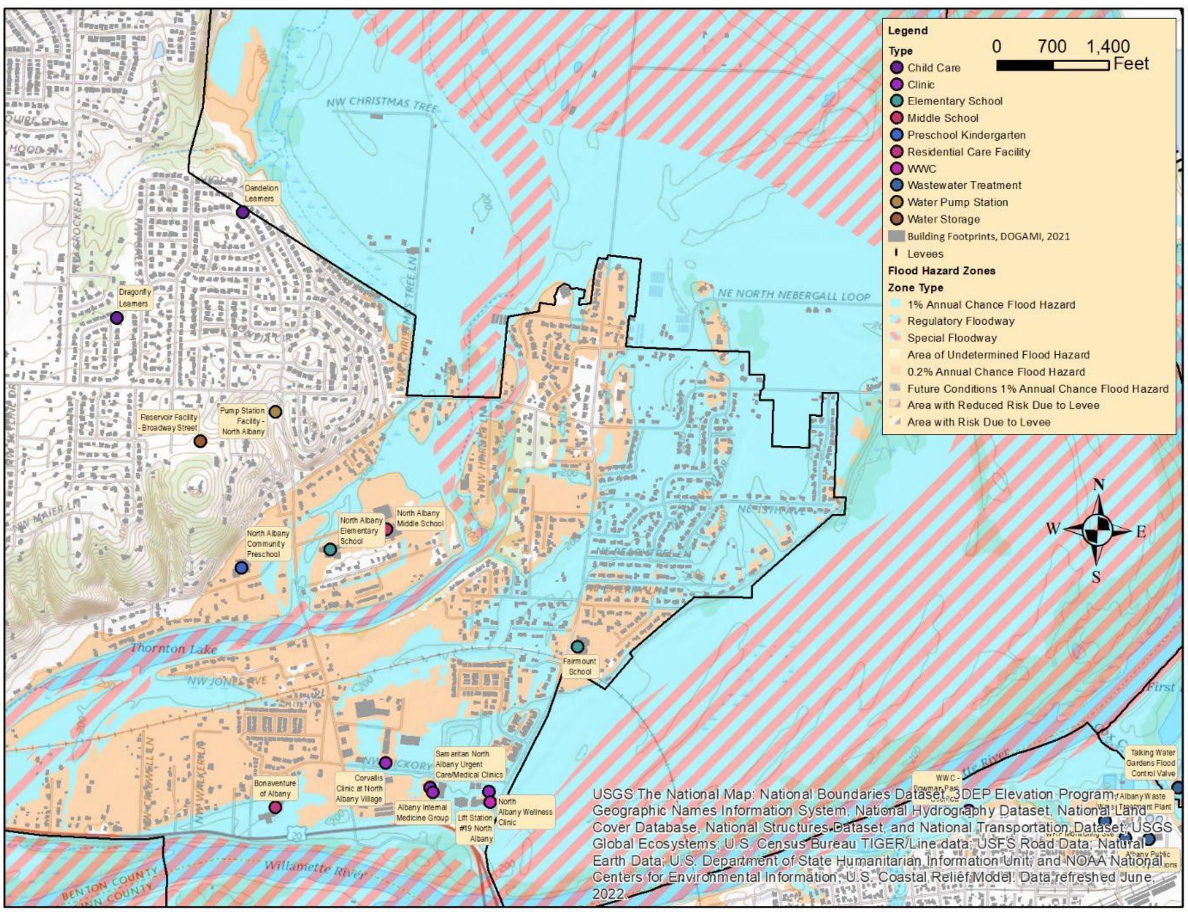
Risk Analysis and Loss Estimation

Risk analysis utilizing modeled damages and losses can be accomplished using FEMA's HAZUS model. This analysis for the City of Albany was developed using the critical facilities identified by the Steering Committee in 2016 and the hazard areas for natural hazards that can be mapped. These included earthquakes, flood, landslide, and wildfire. Unfortunately, this data was not available to 2022-2023 Steering Committee.

The Department of Geology and Mineral Industries will be preparing an analysis of exposure to and losses from these natural hazard events for the City of Albany as part of a county wide analysis for Linn County. When that data is available, the City of Albany should consider the data for inclusion in the NHMP.

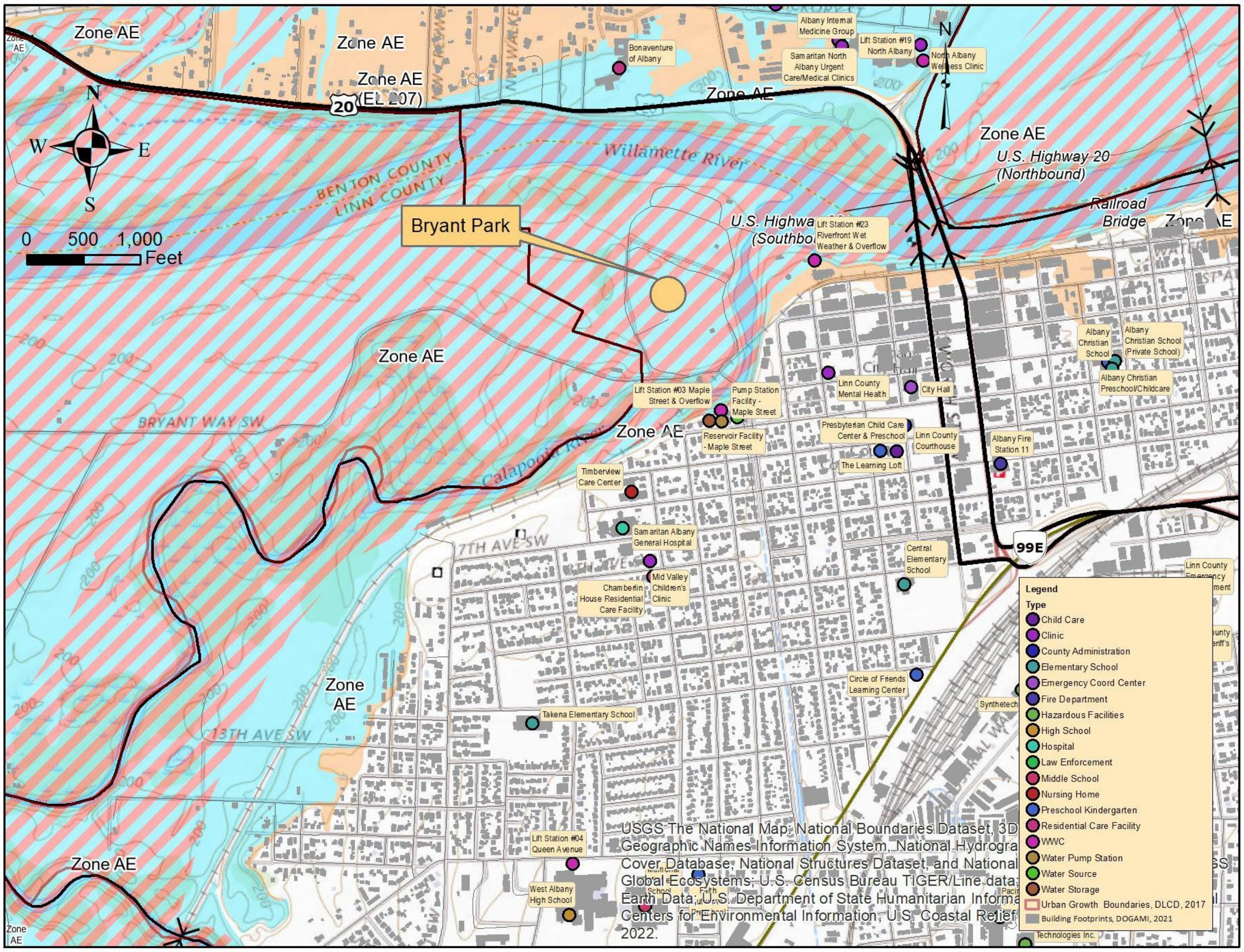
This report provides maps of the critical facilities and the mapped natural hazard areas for flooding, landslide, earthquake, and wildfire with the most recent available mapping of these areas and the list identified by the current NHMP update Steering Committee.

Figure 10. North Albany Special Flood Hazard Area and Critical Facilities



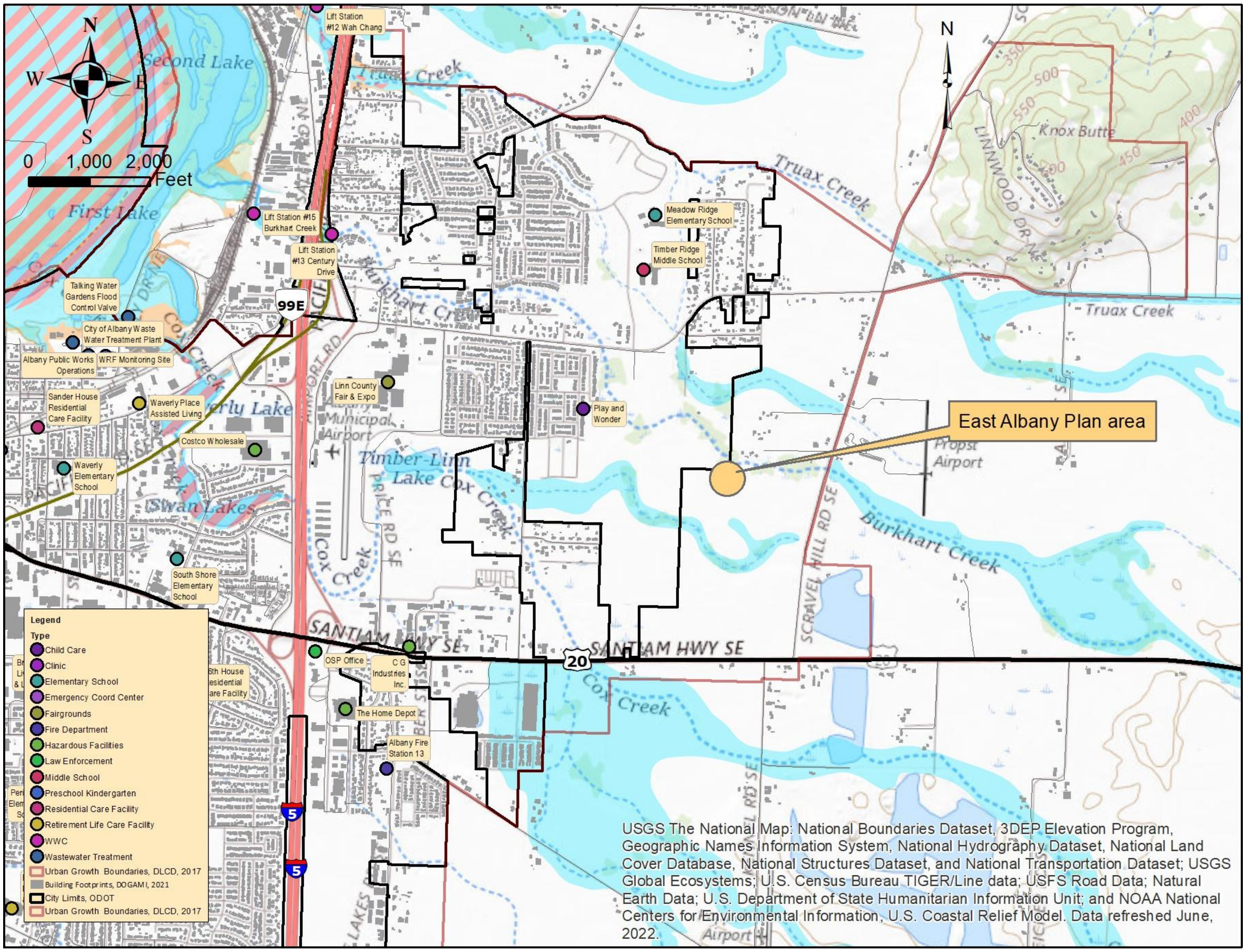
Source: National Flood Hazard Viewer and City of Albany Information Technology

Figure 11. Central Albany Special Flood Hazard Area and Critical Facilities



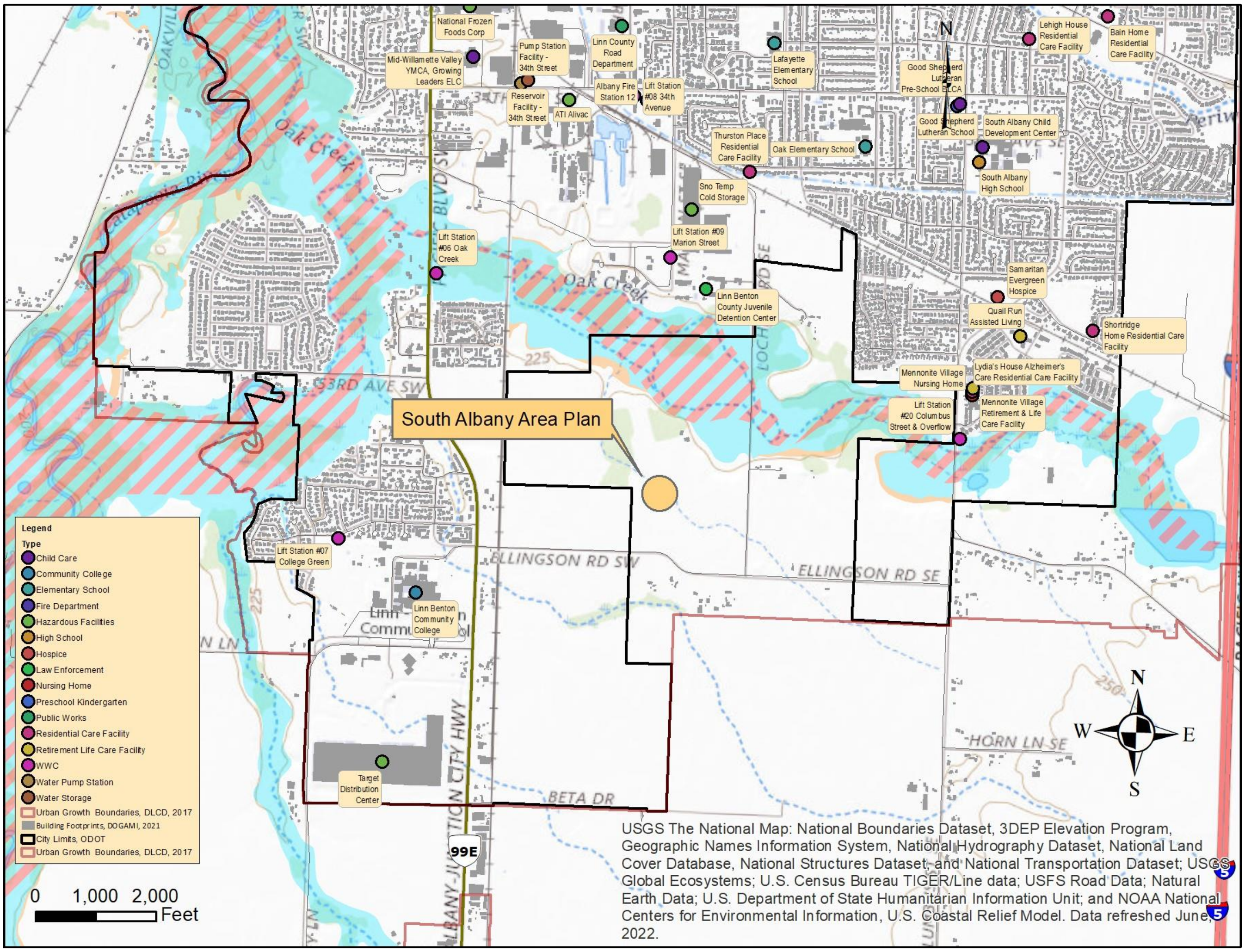
Source: National Flood Hazard Viewer and City of Albany Information Technology

Figure 12. East Albany Special Flood Hazard Areas and Critical Facilities



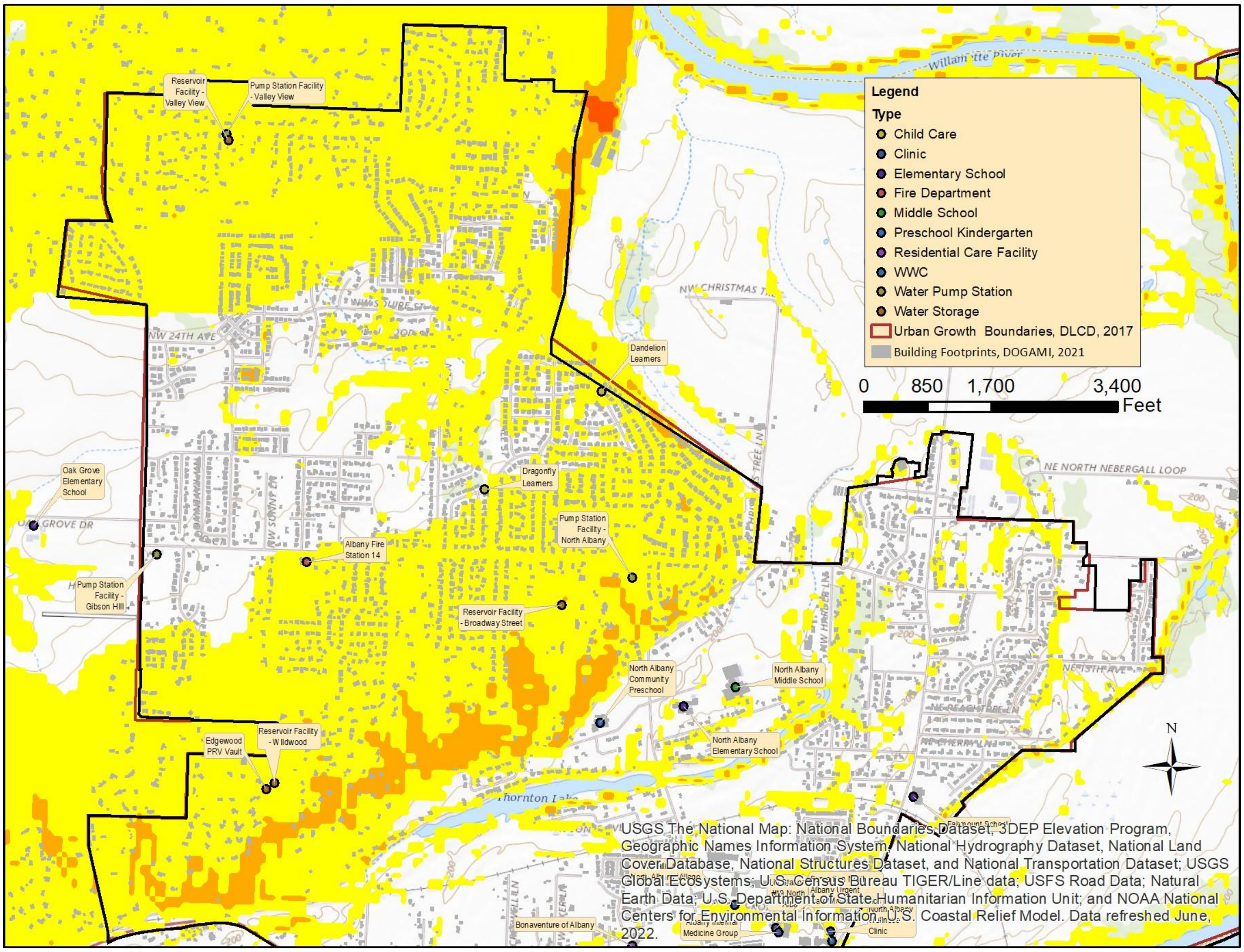
Source: National Flood Hazard Viewer and City of Albany Information Technology

Figure 13. South Albany Special Flood Hazard Areas and Critical Facilities



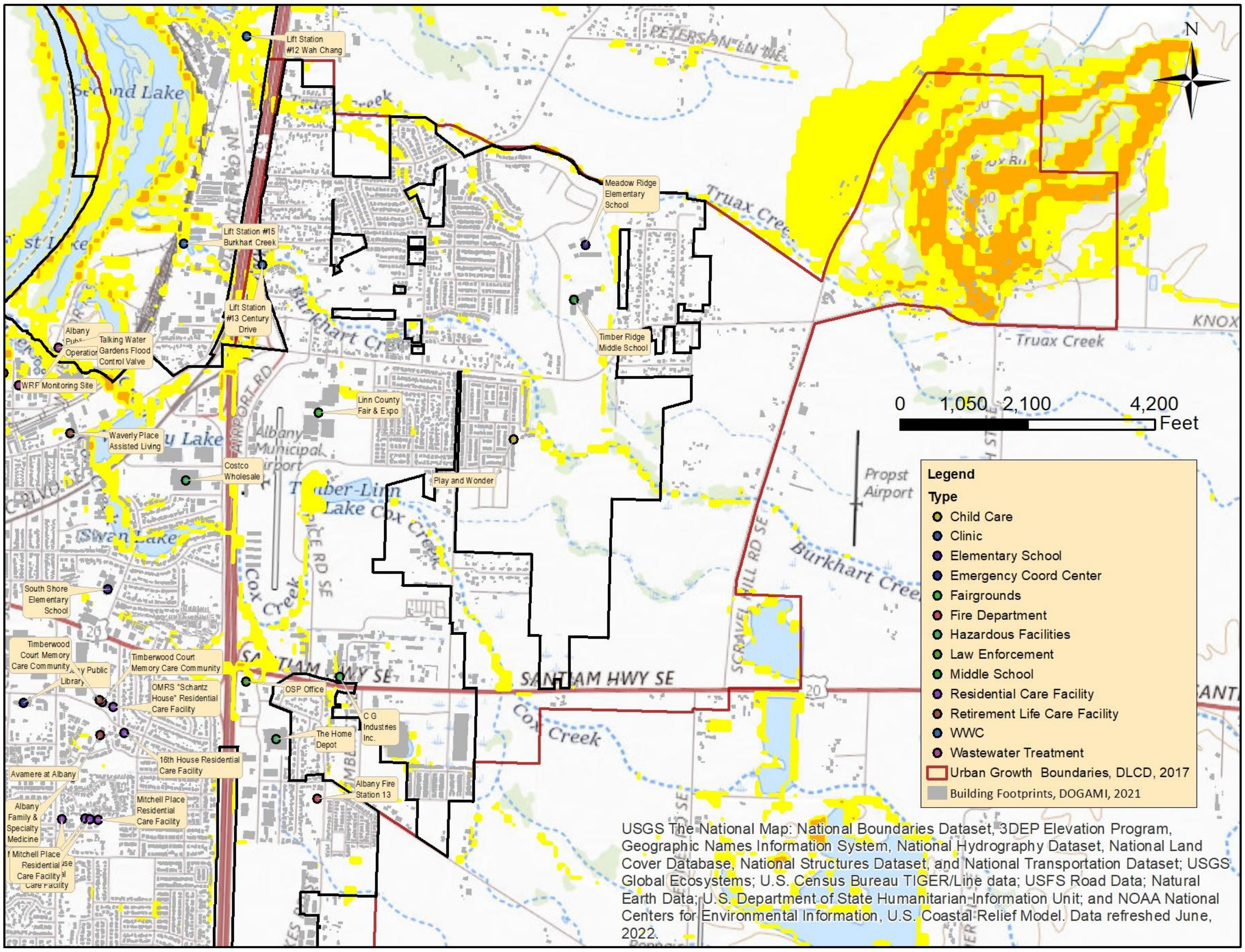
Source: National Flood Hazard Viewer and City of Albany Information Technology

Figure 14. North Albany Landslide Susceptibility and Critical Facilities



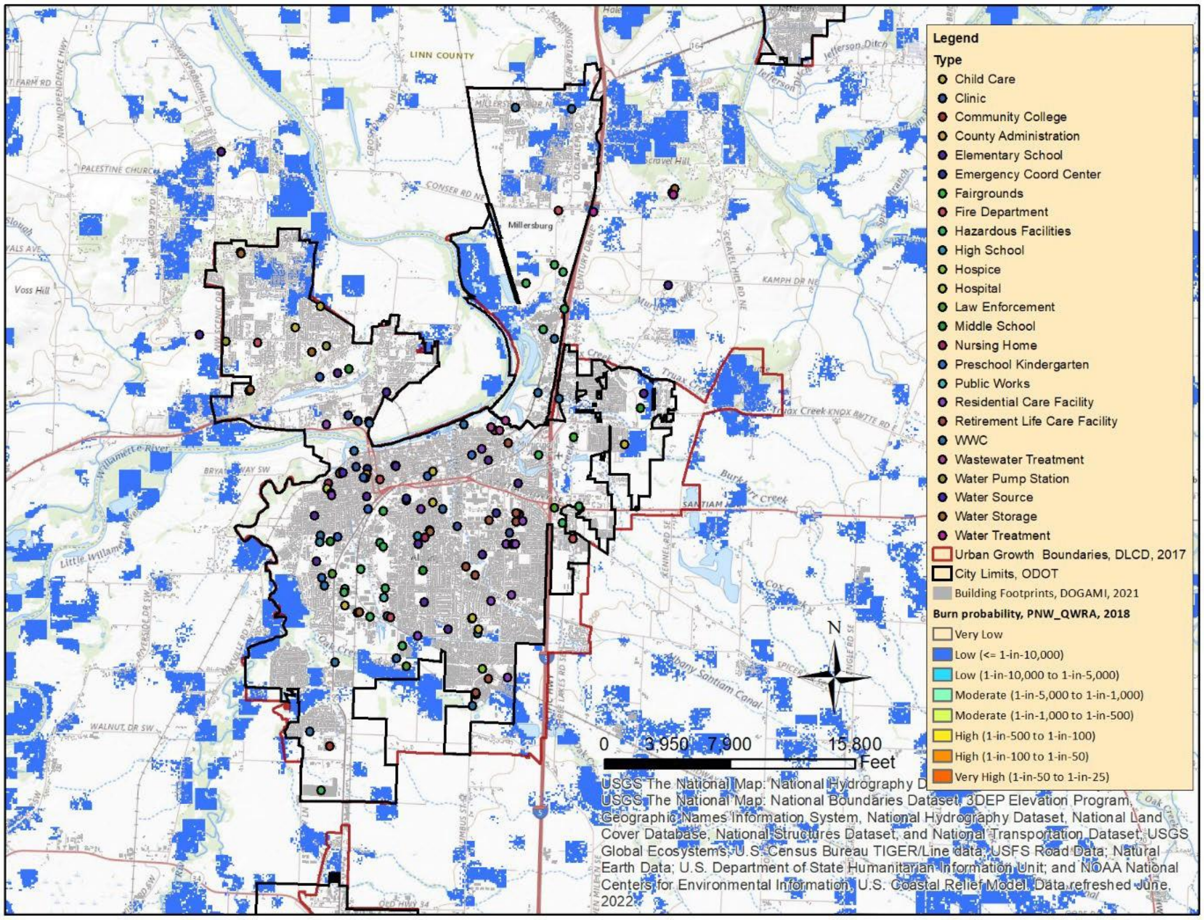
Source: DOGAMI SLIDO database and City of Albany Information Technology

Figure 15. East Albany Landslide Susceptibility and Critical Facilities



Source: DOGAMI SLIDO database and City of Albany Information Technology

Figure 16. Albany Wildfire Probability and Critical Facilities



Source: USFS Pacific Northwest Region Wildfire Risk Assessment (PNRA) and Albany Information Technology

Changes in Future Development or Conditions

FEMA requires that the plan describe the potential impacts of future development on participating jurisdictions and its identified assets. Impacts must include the effects of climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development.

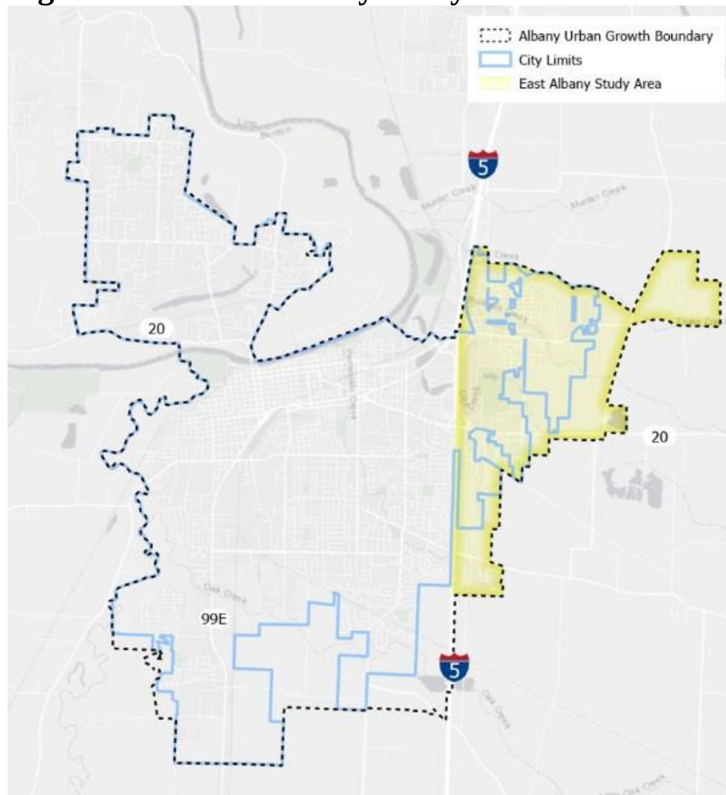
The City of Albany anticipates growth in the southern and eastern portions of the city. The South Albany Area Plan has been in place since 2013 and incorporates considerations for wetland and watercourse protections in areas with identified flood hazard.

The East Albany Plan proposed development in the area of the city east of I-5 as shown below. This plan is currently under consideration by the city and its citizens. Natural hazards identified within this project area include flood zones in the lowland areas, wildfire, and landslide susceptibility on Knox Butte.

Figure 17. South Albany Study Area

Source: City of Albany website

Figure 18. East Albany Study Area



Source: City of Albany website

Climate change impacts to the City of Albany are addressed in the Oregon Climate Change Research Institute's July 2022 report entitled Future Climate Projections Linn County, Oregon. Climate change is expected to increase the occurrence of many climate-related natural hazards. Confidence that the risk of heat waves will increase is very high (Table 1) given strong evidence in the peer-reviewed literature, consistency among the projections of different global climate models, and robust theoretical principles underlying increasing temperatures in response to ongoing emissions of greenhouse gases.

Figure 19. Projected direction and level of confidence in changes in the risks of climate-related natural disasters.

	Low Confidence	Medium Confidence	High Confidence	Very High Confidence
Risk Increasing ↑		Drought Expansion of Non-native Invasive Species Reduced Air Quality Loss of Wetlands	Heavy Rains Flooding Wildfire	Heat Waves
Risk Unchanging =	Windstorms			
Risk Decreasing ↓				Cold Waves

This report presents future climate projections for Linn County relevant to specified natural hazards for the 2020s (2010–2039) and 2050s (2040–2069) relative to the 1971–2000 historical baseline. The projections are presented for a lower greenhouse gas emissions scenario (RCP 4.5) and a higher greenhouse gas emissions scenario (RCP 8.5) and are based on multiple global climate models. All projections in this executive summary refer to the 2050s, relative to the historical baseline, under the higher emissions scenario. Projections for both time periods and emissions scenarios are included in the main report.

Heat Waves: The number, duration, and intensity of extreme heat events will increase as temperatures continue to warm.

In Linn County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios.

In Linn County, the number of days per year with temperatures 90°F or higher is projected to increase by an average of 17 days (range 5–29 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Linn County, the temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–10°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Cold Waves: Cold extremes will become less frequent and intense as the climate warms. In Linn County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 4 days (range -2– -5 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Linn County, the temperature on the coldest night of the year is projected to increase by an average of 6°F (range 1–11°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Heavy Rains The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor.

In Linn County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. However, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 14% (range -1–35%) and 10% (range -1–22%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Linn County, the number of days per year on which a threshold for landslide risk, which is based on prior 18-day precipitation accumulation, is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

River Flooding: Winter flood risk at mid- to low elevations in Linn 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.

Wildfire: Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Linn County by 12 days (range -6–31) by the 2050s, relative to the historical baseline, under the higher emissions scenario.

In Linn County, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 28 days (range 10–43) by the 2050s, compared to the historical baseline, under the higher emissions scenario.

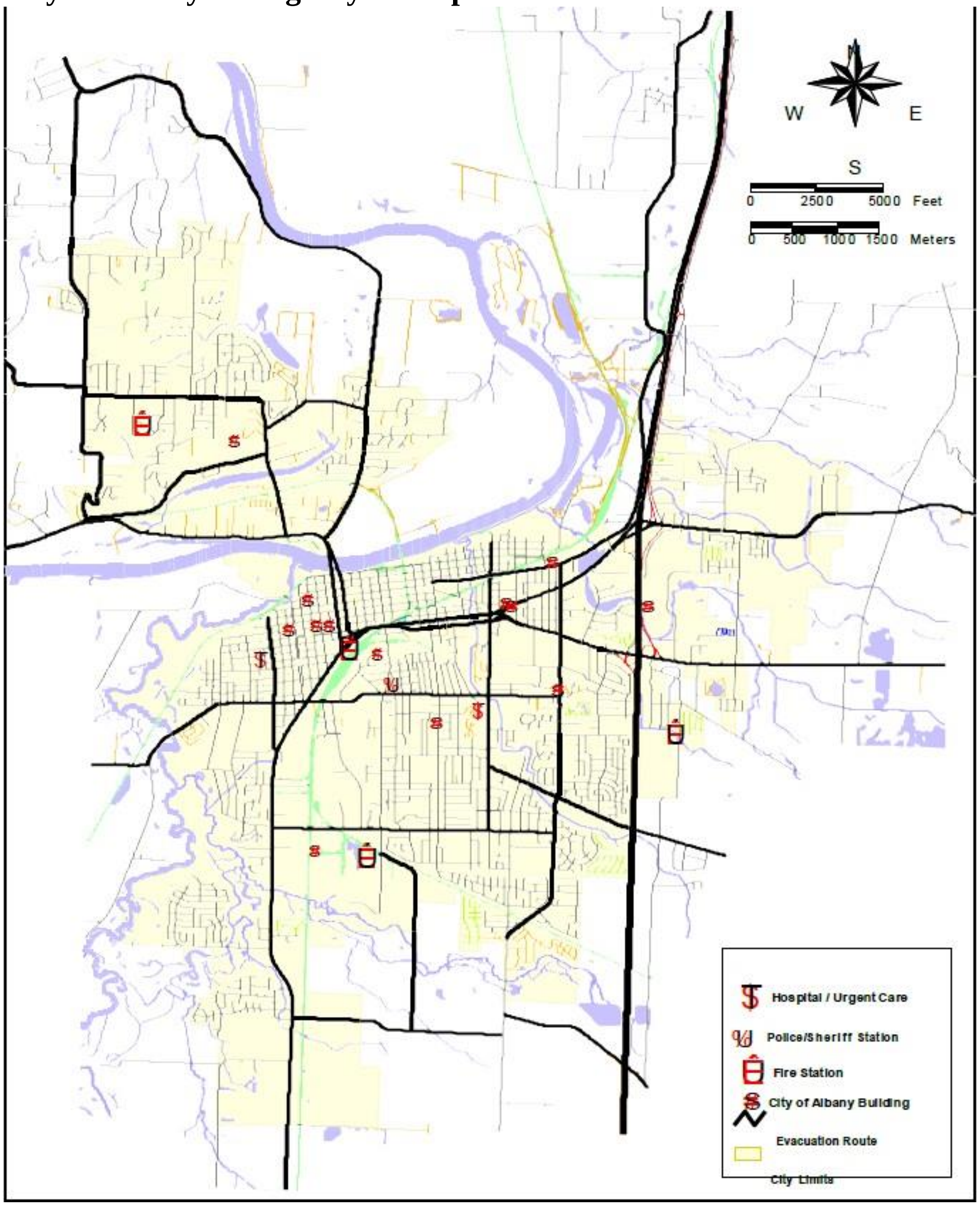
Summary

Natural hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. Natural hazard mitigation strategies with partners in local industries and local employers may include developing relationships with emergency management services and their employees before disaster strikes and establishing mitigation strategies together. Collaboration among the public and private sector to create mitigation plans and actions can reduce the impacts of natural hazards.

During the 2016 update, the City of Albany determined the number of residents that are within the 100-year flood plain. No critical facilities are located withing the 100-year flood zone. Similarly, no critical facilities are located within any high landslide susceptibility area. However, some structures, likely residential, are located in higher landslide susceptibility zones in both north Albany and on Knox Butte.

Identification of the location and extent of areas subject to natural hazards are further detailed in the Hazard Chapters that follow in Sections 6 through 13. Within each of these sections maps showing the location and extent of these areas of vulnerability are provided.

Figure 20. City of Albany Emergency Transportation Routes



Section 4: Mitigation Plan Mission, Goals, Objectives, and Action Items

This section provides information on the process used to develop the mission, goals, objectives, and action items that guide the 2023 City of Albany Natural Hazard Mitigation Plan update. It also describes the framework that focuses the plan on developing successful mitigation strategies. Before reviewing the Mitigation Strategy, the City of Albany Steering Committee reviewed the vision, mission statement and values for the plan and confirmed that the City's Strategic Plan, described below, will continue to align with the 2023 City of Albany Natural Hazard Mitigation Plan.

City of Albany Strategic Plan

The Strategic Plan identifies a vision, mission, and values to achieve the Strategic Plan goals. The plan also identifies four themes, each with its own set of goals, objectives, and actions. The themes under which natural hazard mitigation would fall in the Strategic Plan are *Great Neighborhoods*, a *Safe City,* a *Healthy Economy,* and an *Effective Government*. The goals within each of these themes are as follows:

Great Neighborhoods:

1. Create and sustain a city of diverse neighborhoods where residents feel good about where they live.
2. Provide an efficient transportation system with safe streets and alternative modes of transportation.
3. Provide effective stewardship of Albany's significant natural, cultural and historic resources.
4. Provide diverse recreational, educational, and cultural opportunities that enrich the lives of our citizens.

Safe City:

1. Ensure a safe community by protecting people and property.
2. Provide safe, sufficient, and reliable drinking water, sewage disposal, and drainage systems.

Healthy Economy:

1. Business – Enhance the value and diversity of Albany's economy by attracting, retaining, diversifying, and expanding local businesses.
2. Partnerships – Strengthen the area's role as a leading regional economic center through local and regional coordination and collaboration on economic development planning and projects.
3. Prosperity – Maintain and grow the income levels with a focus on living-wages jobs, training, and education opportunities of Albany residents consistent with Oregon and national trends. Work to increase the community's assessed value while working to achieve a healthy balance of housing and jobs.
4. Central Albany – Create a readily identifiable downtown core that is

unique and vibrant with a mixture of entertainment, housing, specialty shops, offices and other commercial uses.

Effective Government:

1. Effectively and efficiently deliver the services that Albany's citizens need, want, and are willing to support.

The vision of the City of Albany is: *a vital and diverse community that promotes a high quality of life, great neighborhoods, balanced economic growth, and quality public services.* The mission of the City of Albany is: *Providing quality public services for a better Albany community.*

The purpose of the City of Albany Natural Hazard Mitigation Plan is to assist in achieving the vision and mission of the Strategic Plan and, specifically, to aim to advance the four themes of the Strategic Plan. The objectives and actions identified in this plan meet the goals identified in the four themes of the plan.

Objectives of the Natural Hazard Mitigation Plan

The nine objectives of the Plan are:

1. Establish and maintain methods to ensure plan implementation.
2. Provide leadership to promote, communicate, and support disaster safety messages and activities.
3. Incorporate mitigation into planning and policy development.
4. Support the enhancement of the City of Albany vulnerability assessment activities.
5. Ensure continuity of City emergency services functions.
6. Implement structural and non-structural migration of publicly owned facilities and infrastructure.
7. Increase citizen awareness and promote risk reduction activities through education and outreach.
8. Develop collaborative programs that encourage local businesses to plan for disasters.
9. Develop partnerships with external partners to implement hazard-specific mitigation projects in the city.

Mitigation Plan Action Items

The 2023 City of Albany Natural Hazard Mitigation Plan identifies short- and long-term action items developed through review of the 2016 Mitigation Plan and discussion of the Steering Committee about what they felt needed to be addressed in the next five years. Mitigation Plan activities may be considered for funding through state and federal grant programs, including the Federal Emergency Management Agency's Hazard Mitigation Grant Program and Pre-Disaster Mitigation Competitive Grant Program, as funds are made available. Action items address both multi-hazard (MH) and specific natural hazards. To facilitate implementation, each action item includes information on timeline, coordinating and potential partner organizations, key issues addressed, ideas for implementation, and plan goals addressed. A complete list of all action items is included below. Numbering relates to the nine objectives of the NHMP listed above.

Sample Action Item Documentation

Which hazards do the action items address?
- Flood, landslides,wildfire, earthquakes, and volcanoes, among others.

What key issues does the action address?
- Administrative, Political, Financial, Structural

Sample Action Item:
Multi-hazard #1: Identify and pursue funding opportunities.

Key Issues Addressed:
- Lack of available funding to address natural hazards.

How will the action be accomplished?

Ideas for Implementation:
- Explore financial options that may support mitigation activities.

Who are the coordinating organizations?
- Public agencies
- Local organizations

Coordinating Organization: Emergency Management Department, Local
Partner Organization: County Planning Watershed Councils

Who are the partner organizations?
- Public and Private Sector Organizations

What resources are needed for implementation?

Timeline:	Short-term
Resources:	.5 FTE
Plan Goals Addressed:	Implementation

What is the timeline for implementation?
- Short-term - 1-2 yrs
- Long-term - ongoing, 2+ yrs

Which goals are met implementing this action item?

Source: Oregon Natural Hazards Workgroup. 2004. Oregon Pre-Disaster Mitigation Program Training Manual.

Lead Organization
The lead organization is the public agency with regulatory responsibility to address natural hazards or that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation.

Internal/External Partners
Internal partner organizations are departments within the city that may be able to assist in the implementation of action items by providing relevant resources to the coordinating organization. External partner organizations can assist the coordinating organization in implementing the action items in various functions and may include local, regional, state, or federal agencies, as well as local and regional public and private sector organizations. The internal and external partner organizations listed in the mitigation plan are potential partners recommended by the Steering Committee, but not necessarily contacted during the development of the plan. The lead organization should contact the identified partner organizations to see if they are capable of and interested in participation. This initial contact is also to gain a commitment of time and or resources towards completion of the action items.

Plan Themes Addressed
The plan themes, found in the City's Strategic Plan and addressed by each action item, are identified as means for monitoring and evaluating how well the Mitigation Plan is achieving its goals following implementation.

Timeline
Action items include both short- and long-term activities. Each action item includes an estimate of the timeline for implementation. *Short-term action items* (ST) are activities that may be implemented with existing resources and authorities within one to two years. *Long-term action items* (LT) may require new or additional resources and/or authorities, and may take two to five years or more to implement.

Key Issue Ideas for Implementation
These parts of the plan will be addressed after the implementation of the plan. Each lead organization will work with its partners to identify key issues and ideas for implementation as a method of assisting in tracking of the progress of each action item.

Multi-Hazard Mitigation Action Items
The following table identifies action items that have been discussed and detailed by the Steering Committee members. Full Action item worksheets can be found in Appendix F.

Table 6. City of Albany 2023 Mitigation Actions

Hazard	2023 Action Item Number	Action Title	Lead	2023 Status	Timeline
MH	1.1	Biennially, when the City of Albany's Strategic Plan is updated, the City Council incorporates and links the Natural Hazard Mitigation Plan Objectives into the Strategic Plan.	Emergency Management	Ongoing	ONGOING
WF	2.2a	Develop a public education strategy for households in identified high-risk areas in the City of Albany, the City of Millersburg and for households in contract rural fire districts.	Fire Department	Retain, revised	1-2 YEARS
WF	2.2b	Implement the public education strategy developed in WF2.2a.	Fire Department	New Action	3-4 YEARS
VO	2.3	Update emergency notification procedures for ash fall or poor air quality events	Emergency Management	Retain	1-2 YEARS
MH	2.4	Conduct evacuation exercises to promote and communicate disaster safety.	Emergency Management	New Action	1-2 Years
MH	3.1	Review Job Descriptions for relevant positions to ensure new staff are provided with NHMP awareness training to city staff to incorporate Natural Hazard Mitigation Planning aspect into their daily work	Human Resources	Retain, revised	

FL	3.2	Retain CRS rating of 5 by implementing activities 310, 320, 330, 340, 350, 360, 370, 420, 430, 440, 450, 502, 510, 540, 610, 630, and 710 per the Community Rating System	Community Development	Revised, Ongoing	
FL	3.4	Continue participation in the National Flood Insurance program	Community Development	Ongoing	CONTINUOUS
EQ	3.5	Explore development of a program to address seismically deficient buildings	Community Development	Retain, revised	LONGTERM
FL	3.6b	Update the Flood and Dam Failure Warning and Response Plan	Emergency Management	New Action	1-2 YEARS
MH	4.1	Review hazard maps, data, regulations and, state guidance, if any, and if mandated regulations are developed by the State of Oregon or the City finds regulatory updates are necessary, then the City will update natural hazard ordinances and vulnerability and risk assessments for hazards which affect the City by partnering with local, state and federal agencies.	Emergency Management	Retained, revised	CONTINUOUS
MH	4.2	Develop a Debris Management Plan including pre-storm strategies for coordinated debris removal following wind and winter storms.	Emergency Management	Retain, In Progress	2-4 YEARS

VO	4.3	Evaluate capability of water and wastewater treatment facilities to deal with ash fall and determine what changes may need to be made	Public Works Operations	Retain	
VO	4.4	Evaluate ash impact on storm water drainage system and develop mitigation action if necessary. Need to consider what to advise the public and for OPs to use in the event of ashfall on the street; perhaps a 2 pager that outlines what to do in the unusual emergency	Public Works Operations	Retain	
VO	4.5	Evaluate the impact of ash fall out on HVAC systems in city facilities. Building Maintenance (a part of Parks and Rec,) could benefit from a quick sheet on this topic as well as the two above; guidance to contractors for maintenance.	Public Works Operations	Retain	
LS	4.6	Participate in DOGAMI geohazard mapping project to identify any changes or amendments to future potential landslide areas within the city of Albany	Emergency Management	Retain, In Progress	
EQ	5.1	Develop specific emergency evacuation or shelter-in-place plans for residential areas that are near significant hazard material storage facilities and heavy industrial areas.	Emergency Management	Ongoing	
EQ	5.2	Evaluate city emergency transportation routes with City, County and State partners	Emergency Management	Ongoing	1-2 YEARS

VO	5.3	Update emergency response planning for ash fall event	Emergency Management	Complete	1-2 YEARS
SW	5.4	Identify options for safeguarding the aerial fiberoptic communications cable that connects the Courthouse with Albany Police Department because it is at risk for damage from high wind events.	Information Technology	New Action	
MH	6.1	Assist K-12 schools to develop vulnerability assessments and mitigation projects to improve safety in their most vulnerable buildings	Emergency Management	Deferred	
EQ	6.2	Develop and implement a non-structural retrofit program for City staff offices and workspaces	Emergency Management	Retain	
EQ	6.3a	Rerun GIS analysis performed in 2011 to evaluate neighborhoods and the number of wood-frame residential buildings that may be particularly vulnerable to earthquake damage, including pre-1950 homes. Also identify significant historic downtown structures that are vulnerable to earthquake damage. Consider how this analysis connects to EQ 9.2	Emergency Management	Retain, revised	
EQ	6.3b	Use the information collected in EQ 6.3a in outreach efforts on earthquake hazard.		New Action	

EQ	6.4	Evaluate City-owned bridges to determine which need to be seismically updated, and seek appropriate funds	Public Works Engineering	Retain, revised	
EQ	6.5a	Hire a contractor to conduct a vulnerability analysis of Albany’s wastewater collection system to identify elements with the potential for failure in an earthquake, and seek funding for alternatives to seismically retrofit them	Public Works Operations	Retain	
EQ	6.5b	Identify alternative methods for managing wastewater if system elements fail during earthquake.	Public Works Operations	New Action	
EQ	6.6a	Conduct a vulnerability analysis of Albany water distribution system to identify elements with the potential for failure and seek funding alternatives to seismically retrofit them. May be accomplished as part of a Master Plan update. A consultant would be needed to accomplish this work.	Public Works Operations	Retain	
EQ	6.6b	Identify alternative methods for managing water if system elements fail during earthquake.	Public Works Operations	New Action	
EQ	6.7	Evaluate the necessity for seismic valve protection for city of Albany reservoirs and, if determined necessary, seek funding to retrofit them		Completed	

MH	7.1	Provide educational awareness material to City employees. Provide information on how to develop emergency plans and assemble 14-day kits.	Emergency Management	Ongoing	
MH	7.2	Provide educational and outreach articles to explain how to develop an emergency plan and assemble 14-day kits to residents of Albany. Consider developing an annual public information program to include the multiple educational and outreach actions in the plan.	Emergency Management	Ongoing	
FL	7.3	Develop an educational and outreach program to provide residents awareness of the flood hazard in their area and the availability of flood insurance	Community Development	Ongoing	
EQ	7.4	Develop an education and outreach program to provide residents information about earthquake hazard and the availability of structural and non-structural mitigation	Emergency Management	Ongoing	
EQ	7.5	Provide five educational and outreach opportunities annually to residents on earthquake hazards and the availability of earthquake insurance	Emergency Management	Ongoing	
MH	8.1	Promote response, mitigation, and recovery planning for local businesses to continue operating after a disaster. Emergency Management and the Economic Development staff within Community Development work together to provide outreach and educational programs.	Emergency Management and Economic Development	Ongoing	

EQ	9.1	Develop a non-structural retrofit program aimed at making child care facilities, schools, City offices and local businesses more resistant to the impact of earthquake	Emergency Management	Retain	
EQ	9.2	Develop public/private partnerships to seek outside funding for retrofitting structures in the downtown and historic districts	Community Development	Retain	
FL	9.3	Implement Santiam-Albany Canal bank improvement projects		Remove; Completed	
WF	9.4	Work with Linn and Benton County to implement community wildland fire protection strategies necessary for the City of Albany and contract rural fire districts to reduce fire risk	Fire Department	Retain	
DR	9.5	Support local agency programs that promote measures to reduce water use during drought emergencies. City Manager can issue curtailment orders or to recommend voluntary measures. The city approved a water curtailment plan in city code, curtailment orders can be issued (mandatory or voluntary), drought is one of the triggers for this. Other things trigger it too. Maybe this action becomes a public messaging effort along with No Burn messages and other conservation methods during drought.	Public Works Operations	Retain	

Section 5: Plan Implementation and Maintenance

The plan maintenance section of this document details the formal process that will ensure the City of Albany's Natural Hazards Mitigation Plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the plan and producing a plan revision every 5 years. This section describes how the city will integrate public participation throughout the plan maintenance process. Finally, this section includes an explanation of how the City of Albany government intends to incorporate the mitigation strategies outlined in the plan into existing planning mechanisms such as the Comprehensive Plan, Capital Improvement Program (CIP), Central Albany Revitalization Area (CARA) Plan and State Building Codes.

Because the City tied this Mitigation Plan to the City's Strategic Plan, both will be reviewed and updated as closely as they can to ensure consistency. While the mission, vision, values, and themes of the Strategic Plan should remain constant, the objectives, and action items will need periodic review and refinement. Their progress will be tracked through regular reporting which will be incorporated into department, organization, and community publications. The annual budget and Capital Improvement Program will serve as reporting and implementing policy documents, identifying relationships with the Strategic Plan. Refer to Section 4: Mitigation Plan Mission, Goals, Objectives and Action Items for additional information about the role of the City's Strategic Plan.

Implementing the Plan

Plan Adoption
The Albany City Council is responsible for adopting and revising the City's Natural Hazards Mitigation Plan. This governing body has the authority to promote sound public policy regarding natural hazards. The City Emergency Program Manager and the DLCD Project Manager were responsible for submitting the draft 2023 City of Albany Natural Hazards Mitigation Plan update to the State Hazard Mitigation Officer at the Oregon Emergency Management (OEM). Following revisions as requested by OEM and as acceptable to the Steering Committee, they submitted the plan to the Federal Emergency Management Agency (FEMA) for review and approval. This review addressed the federal criteria outlined in FEMA Final Rule 44 CFR Part 201. Upon receiving the Approvable Pending Adoption (APA) letter from FEMA, the Albany City Council then adopted the plan by resolution. The project team provided the signed Resolution of Approval to FEMA which then issued an Approval Letter to the city for the plan. The plan is effective for five years. These documents were included in an appendix of the plan and relevant dates inserted on the cover page. This approved plan provides the city with eligibility to apply for Hazard Mitigation Assistance Program funds.

Coordinating Body for Implementation and Maintenance
The City's Hazard Mitigation Steering Committee is responsible for coordinating implementation of

plan action items and undertaking the formal review process. The Hazard Mitigation Steering Committee consists of members from City departments. As indicated above, the plan will be integrated into the Strategic Plan which will be a part of the CIP and budgeting process and where the actions will be identified and reviewed.

Staff positions represented on the Steering Committee included:

- City Manager
- Development Services Manager
- Emergency Manager
- Finance Director
- Fire Chief
- Fire Department Administrative Assistant
- Floodplain Manager, Planning Division
- Human Resources Director
- Information Officer
- Police Chief
- Public Information Officer
- Public Works Engineering/ Community Development Director
- Public Works Operations Director
- Public Works Operations Manager
- Parks & Recreation Director

Convener

Once the Albany City Council adopts the City's Natural Hazard Mitigation Plan, the Hazard Mitigation Steering Committee will take responsibility for implementing the plan. The Emergency Manager will serve as the Convener to facilitate the Steering Committee meetings, and will assign tasks such as updating and presenting updates to the members of the committee and elected officials. Plan implementation and evaluation will be a shared responsibility among all the Steering Committee members.

Implementation Through Existing Programs

The City of Albany Natural Hazard Mitigation Plan is directly tied to the City's Strategic Plan and, as a result of this connection, will be implemented through a number of existing plans, programs, and policies. The City of Albany addresses statewide planning goals and legislative requirements through its Comprehensive Plan, Capital Improvement Plan, Central Albany Revitalization Area (CARA) Plan and State Building Codes. The Natural Hazard Mitigation Plan provides a series of recommendations, many of which are closely related to the goals and objectives of these existing planning programs. The Steering Committee is responsible for determining how each individual action will be implemented through existing programs.

The action items in the mitigation plan may be achieved through activities recommended in the Capital Improvement Program (CIP). The CIP is updated annually. Upon review of the CIP, the Steering Committee will work with City departments to identify areas where the hazard mitigation action items are consistent with CIP goals and integrate them where appropriate.

After formal adoption of the Mitigation Plan, the action items in the plan will be incorporated into existing plans as is practical. The meetings of the Steering Committee will provide an opportunity for committee members to report back on the progress made on the integration of mitigation planning elements into City planning documents and procedures.

The Capital Improvement Program and a number of other existing plans, policies and programs have hazard mitigation connections. The Steering Committee will identify how best to implement individual actions into the appropriate existing plan, policy, or program. The following existing plans, programs and policies have been identified:

Development Plans, Programs, Codes, and Standards

Capital Improvements Program

- **Date of last revision:**2022-2026
- **Plan owner:** Public Works
- **Plan description:** The Capital Improvements Program is a planning document that identifies capital projects in the next five-year horizon for elected officials, citizens and staff. Hazard mitigation priorities will be considered during the CIP process
- **Plan cycle:** One-year cycle
- **Relation to hazard mitigation:** Action items may be inserted into the Capital Improvement Plan as approved by the City Council

The City of Albany's Capital Improvements Program (CIP) is a dynamic document that lists and prioritizes needed improvements and expansions of the City's infrastructure system to maintain adequate service levels to existing City of Albany residents and businesses, and to accommodate population growth and land development. The CIP reflects the needs and priorities established by the city and the resources available to the city. The CIP can be modified during the fiscal year through the supplemental budget process as needs, priorities, and resources change. The CIP can assist the City of Albany in mitigation against severe weather events by improving infrastructure most prone to damage. Winter Storm and Ice Storm were ranked the natural hazards to which the city is most at risk. Windstorms were fourth ranked among twelve named natural hazards.

Strategic Plan

- **Date of last revision:** FY 2019-2023
- **Plan owner:** Albany City Manager
- **Plan description:** This plan creates clearly defined goals, proactive strategies, committed leadership and effective management capabilities to achieve the City's mission statement and vision for the City of Albany
- **Plan cycle:** One-year cycle

- **Relation to hazard mitigation:** The Natural Hazard Mitigation Plan's purpose statement is to achieve the goals and mission set forth in the City's Strategic Plan as approved by the City Council
- **Integration:** The City of Albany has chosen to use the vision, mission, capital elements and themes of its Strategic Plan for the Mitigation Plan. This will provide a better tie between the two plans and provide each with additional credibility. Individual objectives and actions will be developed for the Mitigation Plan and then tied back to the Strategic Plan through the Natural Hazard Mitigation Plan matrix.

Comprehensive Plan

- **Date of last revision:** 2022
- **Plan owner:** Community Development Department
- **Plan description:** The City's Comprehensive Plan provides a framework for making better decisions about the land and its resources. The Plan identifies existing assets, problems, and needs in the community; it projects future conditions; and it sets forth City policy for dealing with these elements. The maps for zoning, parks and the Comprehensive Plan are a part of this document.
- **Plan cycle:** The Comprehensive Plan changes when the needs and desires of the public change, when development occurs at a different rate than predicted, and when corrections in a plan are needed, the plan needs to be revised.
- **Relation to hazard mitigation:** The Natural Hazard Mitigation Plan mission statement and goals should be cohesive with and align with the mission and goals of the City's Comprehensive Plan.

North Albany Refinement Plan

- **Date of last revision:** 2013
- **Plan owner:** City of Albany Community Development Department
- **Plan Description:** Increase the amount of livable neighborhoods with improved transportation and sustainability of growth
- **Plan cycle:** There currently is no date set for revision.
- **Relation to hazard mitigation:** Action items may be inserted into the Transportation System Plan and Capital Improvement Program with approval of the City Council

Central Albany Revitalization Area Plan

- **Date of last revision:** 2014
- **Plan owner:** City Manager's Office
- **Plan Description:** The Plan's goal is to revitalize the Central Albany Revitalization Area by implementing the Town Center Plan Developed through the Central Albany Land Use & Transportation study

(CALUTS) using a citizen-driven process.
- **Plan cycle:** Reviewed annually
- **Relation to hazard mitigation:** Action items may be inserted into the Transportation System Plan and Capital Improvement Program with approval of the City Council

South Albany Area Plan
- **Date of project:** Adopted 2/13/2013
- **Plan owner:** Community Development
- **Plan Description:** The plan sets the direction for future growth and development in this area including zoning and land use, streets and highways, railroads, natural areas and wildlife along Oak Creek, neighborhood services, and development standards. Additionally, the SAAP identifies how much development can be approved before the realignment of Ellingson Road is required. **Plan cycle:** Reviewed annually
- **Relation to hazard mitigation:** Among the goals of the project are to "Identify feasible patterns of land uses that are consistent with the City's goals for urbanization and environmental protection." and to "prepare recommendations for low-impact development for environmentally-sensitive areas within the vicinity of Oak Creek".

East Albany Plan
- **Date of project:** 2021-2023
- **Plan owner:** Community Development
- **Plan Description:** A project in partnership with DLCD and ODOT to create a new plan for East Albany focused on connectivity, transportation choices, housing variety, and vibrant mixed-use and employment centers around the area's natural resources and viewsheds
- **Plan cycle:** Reviewed annually
- **Relation to hazard mitigation:** Among the goals of the project are to "Protect and improve the area's watersheds, riparian and wildlife corridors, wetlands and drainage ways located within significant natural resource overlays as habitat areas and for stormwater functions to help mitigate and adapt to climate change".

Development Code
- **Date of last revision:** December 2021
- **Plan Owner**: Community Development Department
- **Plan Description:** The general purpose of this code is to set forth and coordinate City regulations governing the development and use of land
- **Plan cycle:** It is reviewed as needed by the Planning Commission and the City Council

- **Relation to hazard mitigation:** Action items initiated by the Natural Hazard Mitigation Plan that change the Development Code must be consistent with the goals of the city's Comprehensive Plan

Building Code

- **Date of last revision:** Residential, 2014; Commercial, 2014
- **Plan owner:** Building Division
- **Plan Description:** The State Building Code's purpose is to set forth and coordinates City regulations governing the construction of buildings and infrastructure
- **Plan cycle:** Every three years.
- **Relation to hazard mitigation:** Inspections of new construction are intended to ensure compliance with State Building Code, Albany Development Code and Albany Municipal Code provisions that relate to hazard mitigation

Engineering Design Standards

- **Date of last revision:** October 2019
- **Plan Owner:** Public Works Engineering
- **Plan description:** The purpose of these Engineering Standards documents is to provide a consistent policy for implementing design of public improvements and related facilities.
- **Plan Cycle:** There is no schedule for updates.
- **Relation to hazard mitigation:** Public improvements and related facilities are directly tied to mitigation efforts in a number of the natural hazards that can affect the city. By ensuring there are consistent policies, we improve the efforts to minimize natural hazard damage to property and loss of life.

Transportation System Plan

- **Date of last revision**: September 2015
- **Plan Owner:** Public Works
- **Plan Description:** It identifies the transportation improvements needed to accommodate existing and future development in the City of Albany through 2030. The City of Albany's adopted transportation plan is based on an analysis contained in the Transportation System Plan (TSP), which was developed through a public participation process. The development of the TSP and thereafter the more concise transportation element of the Comprehensive Plan are closely coordinated and intended to be consistent with other jurisdictions' transportation plans. These include the State of Oregon and Linn and Benton counties.

Response Plans

Emergency Operations Plan

- **Date of last revision:** 2018
- **Plan owner:** Emergency Management Coordinator
- **Plan description:** The Emergency Response Plan outlines the roles and responsibilities of the departments and personnel for the City of Albany during major emergencies or disasters. The Plan sets forth a strategy and operating guidelines adopted by the city for managing its response and recovery activities during disasters and emergencies.
- **Plan cycle:** Five-Year cycle.
- **Relation to hazard mitigation:** The city's Natural Hazard Mitigation Plan mission and goals support the Emergency Operations Plan to help achieve the mission set forth in the city's Strategic Plan. The plan consists of a Basic Plan that provides an overview of the city's emergency response organization and policies. It cites the legal authority for emergency operations, summarizes the situations addressed by the plan, explains the general concepts of operations, and assigns general responsibilities for emergency planning and operations.

The EOP also contains Functional Annexes, Support Annexes and Incident Annexes. The Function Annexes explains the roles that each individual department has in the response to emergencies that might occur. These responsibilities are outlined in appendices which provide for scope, direction, responsibilities and what is to be accomplished. These annexes are to be used in conjunction with the basic plan and appendices. The Support Annexes describe how agencies coordinate and execute common functional processes and administrative requirements necessary to ensure efficient and effective incident management.

The Incident Annex provides detailed information and special considerations that are applicable to specific hazards.

Flood Warning Response Plan

- **Date of last revision:** 2017
- **Plan owner:** Emergency Management
- **Plan Description:** Identifies triggers for flood response and areas of responsibility for city staff and departments.
- **Plan Cycle:** Not yet establised
- **Relation to hazard mitigation:** Key to flood hazard response; update identified as hazard mitigation action.

Public Water System #4100012 Emergency Response Plan

- **Date of last revision:** 2021
- **Plan owner:**
- **Plan description:** To provide the City of Albany with a standardized

response and recovery protocol to prevent, minimize, and mitigate injury and damage resulting from emergencies or disasters of man-made or natural origin within the water system.

Emergency Coordination Center (ECC)
The Emergency Coordination Center is an established location/facility from which City staff and officials can provide direction, coordination, and support to emergency operations in the event of an incident such as a natural disaster. City personnel who are assigned to and trained for specific positions within the ECC organizational structure staff the ECC. The structure is based on the National Incident Management System (NIMS) Incident Command System (ICS) as outlined in the National Response Framework (NRF).

The ECC staff provides information and recommendations to the ECC Manager through the Incident Commander, or as directed, to develop a course of action to respond to and contain, control, and recover from an emergency. Some of the primary functions performed at the ECC include: coordination, operations management, planning, information tracking and dissemination, logistical support, financial management and support, and emergency public information.

Goals and action items set forth in the Hazard Mitigation Plan are intended to address Statewide Planning Goal 7. Goal 7 assists the community in protecting life and property from natural disasters and hazards through planning strategies that restrict development in areas of known hazards. Goal 7 requires that local governments base development plans on inventories of known areas of natural disasters and hazards and that the intensity of development be limited by the degree to which the natural hazard occurs within the areas of proposed development.

The Albany Building Division is responsible for administering the building codes in the city. After the adoption of the Mitigation Plan, staff will work with the State Building Code Division to make sure that the City enforces the minimum standard established in the State Building Code. In addition, the Steering Committee will work with other agencies at the state level to review, develop and ensure building codes that are adequate to mitigate or prevent damage by natural hazards. This is to ensure life-safety criteria are met for new construction.

Plan Maintenance and Monitoring
Plan maintenance is a critical component of the Natural Hazard Mitigation Plan. Proper maintenance of the plan will ensure that it will benefit Albany’s efforts to reduce the risks posed by natural hazards. The Natural Hazard Mitigation Steering Committee (NHMSC) and local staff will be responsible for implementing this process in addition to maintaining and updating the plan through a series of meetings outlined in the maintenance schedule below.

Table 7. Plan Maintenance Meeting Schedule

Semi-annual Meeting	**Five-year Review**
<u>**Steering Committee**</u>	<u>**Steering Committee and City Council**</u>
Review current actions and department progress	Review plan update questions
Identify new issues, needs and develop agenda for annual meeting	Update plan sections as necessary
Prioritize potential projects and report progress to City Manager	Recommend approval of the updated to Albany City Council
Update risk assessment data and findings	
Discussion of methods of continued public involvement	
Documenting successes and failures of lessons learned	

Semi-Annual Meetings
The Steering Committee will meet semi-annually to:

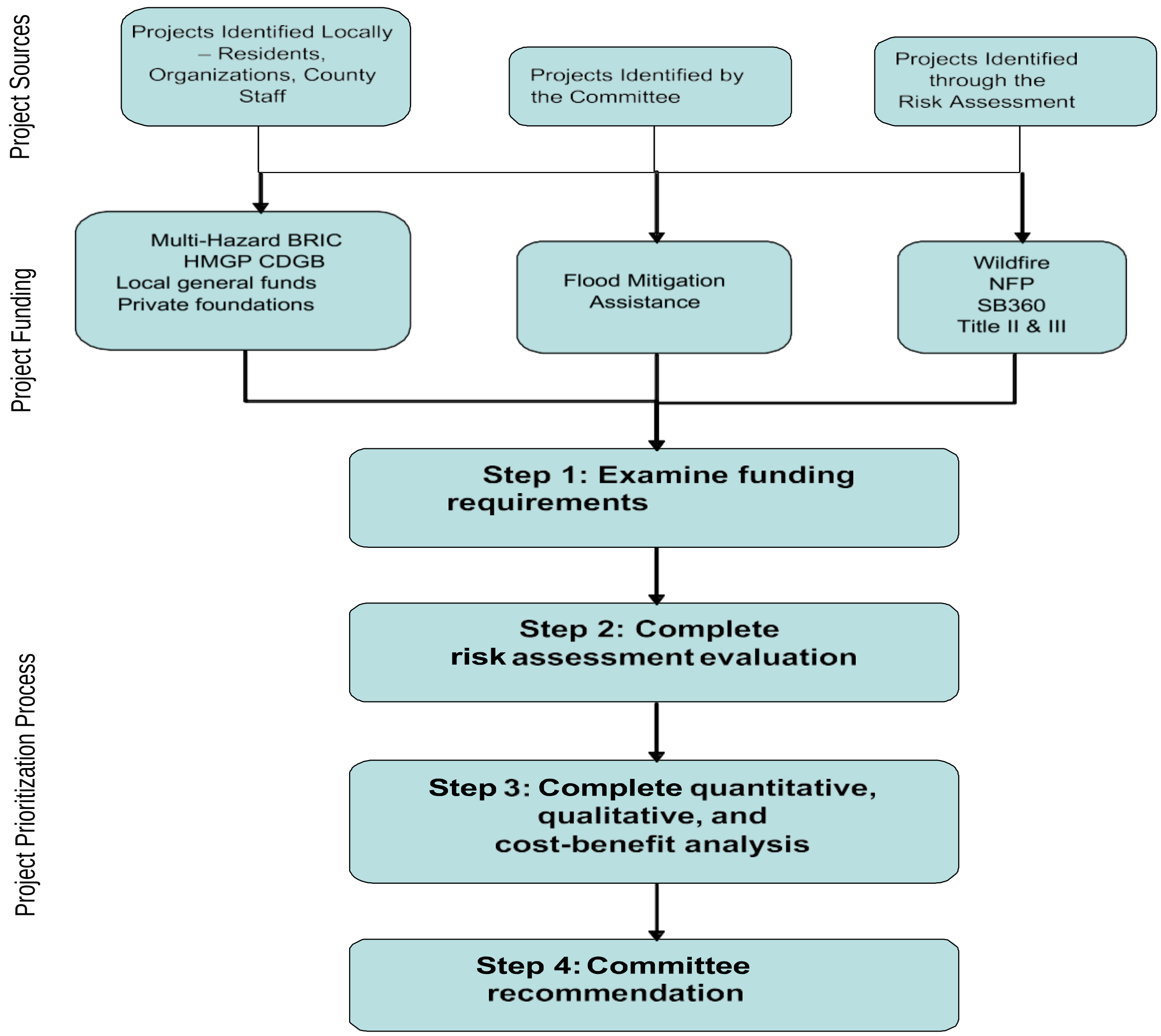
- Review current actions and department progress; Discuss methods of continued public involvement.
- Review existing action items to determine appropriateness for funding.
- Document successes and lessons learned based on actions that were accomplished during the previous year.
- Review updates on local planning efforts.
- Review updates of the risk assessment data and findings.
- Identify issues that may not have been identified when the plan was developed; and prioritize potential mitigation projects using the methodology described below.

The convener will be responsible for documenting the outcome of the semi-annual meetings. The process the Committee will use to prioritize mitigation projects is detailed in the section below.

Project Prioritization Process

The requirements of Disaster Mitigation Act of 2000 through the Pre-Disaster Mitigation Program state that the plan must identify a process for prioritizing potential actions. Potential mitigation activities will often come from a variety of sources; therefore, project prioritization process needs to be flexible. Projects may be identified by committee members, local government staff, other planning documents, or the risk assessment. Depending on the potential project's intent and implementation methods, several funding sources may be appropriate. Examples of mitigation funding sources include but are not limited to FEMA Hazard Mitigation Assistance (HMA) funding that includes three programs: Building Resilient Infrastructure & Communities (BRIC), formerly the Pre-Disaster Mitigation grant program, Hazard Mitigation Grant Program (HMGP), and the Flood Mitigation Assistance (FMA) program, National Fire Plan (NFP), Title II funds, Title III funds, Community Development Block Grants (CDBG), local general funds, and private foundations. Some of these examples are used in the figure below to illustrate the project prioritization process. The prioritization process utilizes four steps to prioritize activities to help ensure that mitigation dollars are used in a cost–effective manner.

Figure 21. Project Prioritization Overview



Source: ONHW/CPW, 2005

Step 1: Examine funding requirements

The Committee will examine the selected funding stream's requirements to ensure that the mitigation activity would be eligible through the funding source. The Committee should consult with the funding entity, Oregon Emergency Management, or other appropriate state or regional organization about the project's eligibility.

Step 2: Complete risk assessment evaluation
The second step in prioritizing the plan's action items is to examine which hazards they are associated with and where these hazards rank in terms of community risk. The committee will determine whether or not the plan's risk assessment supports the implementation of the mitigation activity. This determination will be based on the location of the potential activity and the proximity to known hazard areas, historic hazard occurrence, and the probability of future occurrence documented in the plan. To rank the hazards, the community's hazard analysis utilized. This risk assessment identified various hazards that may threaten community facilities and ranked High, Medium, and Low.

The rank ordering of natural hazards identified in the plan update by risk according to the Hazard Vulnerability Assessment using the OEM Methodology is:

1. Winter Storm
2. Ice Storm
3. Ash Fall/Poor Air Quality
4. Windstorm
5. Public Health Emergency/Pandemic
6. Earthquake
7. Excessive Heat
8. Riverine Flood
9. Wildfire
10. Tornado
11. Drought
12. Landslides

Each of the action items in the plan addresses risk from all of these hazards.

Step 3: Complete quantitative, qualitative assessment, and economic analysis
Depending on the type of project and the funding source, either a quantitative or qualitative assessment of cost effectiveness will be completed to assist in prioritizing potential actions. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now in order 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.

If the activity is seeking federal funding for a structural project, the committee will use a FEMA-approved cost-benefit analysis tool to evaluate the appropriateness of the activity. See *Appendix C: Economic Analysis of Natural Hazard Mitigation Projects* for a description of the FEMA- approved cost-benefit analysis. A project must have a benefit/cost ratio of greater than one in order to be eligible for FEMA funding.

For FEMA-funded nonstructural projects or projects funded through entities other than FEMA, a qualitative assessment will be completed to determine the project's cost effectiveness. The Committee may use a multivariable assessment technique called STAPLE/E to prioritizing 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. The STAPLE/E technique has been tailored for natural hazard action item prioritization by the University of Oregon's Oregon Natural Hazards Workgroup. See *Appendix C: Economic Analysis of Natural Hazard Mitigation Projects* for a description of the STAPLE/E evaluation methodology.

Step 4: Committee recommendation
Based on the steps above, the Committee will recommend whether or not the mitigation activity should be moved forward. If the Committee decides to move forward with the action, the coordinating organization designated for the activity will be responsible for taking further action and document success upon project completion. The Hazard Mitigation Advisory Committee will convene a meeting to review the issues surrounding grant applications and shared knowledge and or resources. This process will afford greater coordination and less competition for limited funds.

Economic Analysis of Mitigation Projects

For a complete outline of the City's approach to economic analysis, refer to Appendix C of this plan.

FEMA's approaches to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now in order 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 can provide 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.

Given federal funding, the Hazard Mitigation Steering Committee chose a FEMA-approved benefit/cost analysis approach to identify and prioritize mitigation action items. For other projects and funding sources, the Hazard Mitigation Steering Committee uses other approaches to understand the costs and benefits of each action item and develops a prioritized list.

The Natural Hazard Mitigation Steering Committee has the option to implement any of the action items at any time, regardless of the prioritized order. This allows the committee to consider mitigation strategies as new opportunities arise, such as funding for action items that may not be of highest priority. This methodology is used by the Hazard Mitigation Steering Committee to initially prioritize the plan's action items in addition to maintaining the action list during annual review and update.

Five-year Review of Plan

This plan will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. During this plan update, the following questions should be asked to determine what actions are necessary to update the plan. The convener will be responsible for convening the Committee to address the questions outlined below.

- Are the plan goals still applicable?
- Do the plan's priorities align with state priorities?
- Are there new partners that should be brought to the table?
- Are there new local, regional, state, or federal policies influencing natural hazards that should be addressed?
- Has the community successfully implemented any mitigation activities since the plan was last updated?
- Have new issues or problems related to hazards been identified in the community? Do existing actions need to be reprioritized for implementation?
- Are the actions still appropriate given current resources?
- Have there been any changes in development patterns that could influence the effects of hazards?
- Have there been any significant changes in the community's demographics that could influence the effects of hazards?
- Are there new studies or data available that would enhance the risk assessment?
- Has the community been affected by any disasters?
- Did the plan accurately address the impacts of this event?

The questions above will help the Committee determine what components of the Mitigation Plan need updating. The Committee will be responsible for updating any deficiencies found in the plan based on the questions above.

Continued public involvement

The City of Albany is dedicated to involving the public directly in the review and updates of the Hazard Mitigation Plan. The Hazard Mitigation Steering Committee members are responsible for Semi-annual reviews and update of the plan.

The public will have the opportunity to access the completed plan at the library, the Community Development Department and online. Copies of the plan will be catalogued and kept at the Main Library, in the Community Development Department and on the City's website. The existence and location of these copies will be publicized in the *City Bridges* e-newsletter twice a year. The plan also includes the address and phone number of the City's emergency management contact for questions or comments on the plan.

In particular the Mitigation Action Items will be among the documents the public will be provided an opportunity to review and provide input about. The Mitigation Action Items are reviewed during the city budgeting process, Capital Improvement Program review, Strategic Plan review and through Mitigation Actions undertaken by the individual departments. All public meetings where portions of the Mitigation Plan are discussed will provide a forum for members of the public to express concerns, opinions, or ideas about the plan and parts of it. The City Public Information Officer will be responsible for using City resources to publicize meetings where the public can provide input and to maintain public involvement through the city's web site and newspapers.

Volume II: Hazard Annexes

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Flood

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Flood

Why are floods a threat to the City of Albany?

The City of Albany is subject to flooding from several different sources which include:

1. The Willamette River, Calapooia River, Oak Creek, Periwinkle Creek, Cox Creek, Burkhart Creek, Truax Creek, and the Santiam-Albany Canal.
2. Local storm water drainage.

Flooding on streams and rivers in Albany generally results from large winter storms from the Pacific. Often the heavy rainfall comes at the same time as snow-melt runoff, a rain on snow event. These large winter storms often cause simultaneous flooding on all rivers and streams in an affected area. Historically, most major floods in Albany have occurred in the months of December, January, and February, although flooding in other months is possible.

Rain on snow events have not followed a regular pattern to create flood conditions. Heavy rains that saturate the ground and fill the rivers and creeks coupled with warming weather that melts heavy snow in the mountains and foothills create the major flooding that Albany has seen over the last 150 years. The last major flooding took place in 1964 and 1996. Before these floods, major events occurred in 1943 and 1945 and are the only examples of flooding to have occurred within a three-year period. These floods took place before the dams were built on the rivers upstream of the city.

The most recent flooding events in Albany took place in January 2006 and in April 2019. The Future Climate Projections Linn County, Oregon report prepared by the Oregon Climate Change Research Institute includes analysis of the threat of flooding to Linn County. Among the conclusions are that winter flood risk at mid- to low-elevations in Linn 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. [1]

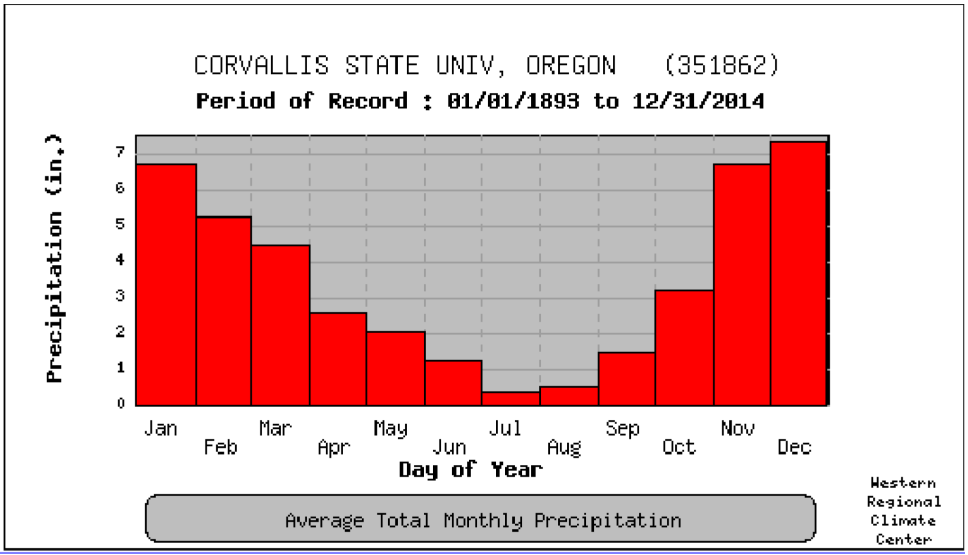
Flood Characteristics and Terminology

Precipitation

The climate of the Willamette Valley is relatively mild throughout the year, characterized by cool, wet winters and warm, dry summers. Albany is about 80 miles from the Pacific Ocean, which provides a modified marine climate. Extreme summer and winter temperatures are moderated by the airflow across the area from the Pacific Ocean. The Cascade Mountains to the east of Albany act as a barrier that prevents colder continental air masses originating in the arctic regions of Canada from reaching Albany. Occasionally, extreme temperatures can occur when the airflow comes from the east. Temperatures rarely exceed 95° F in the summer months (June–August) and rarely drop below 25° F in the winter months (November – March). The average growing season is about 150 – 180 days in the lower valley. Precipitation ranges from .36 inches in July to 7.05 inches in December, with an average yearly rainfall of 40-91 inches per year. Average snowfall since the mid-1960s has been 5.9 inches, occurring between November and March.

[1] Future Climate Projections Linn County, Oregon, 2022, OCCRI

Table 1. Average Total Monthly Precipitation in Albany: 1893 – 2014



Source: Western Regional Climate Center, retrieved July 2, 2015

Geography

The City of Albany has an area of 17.7 square miles with an urban growth boundary of 21.7 square miles. Its population is approximately 51,199 as calculated by Portland State University (July 2021) and is situated in both Linn and Benton counties. The city is located in the central Willamette Valley along Interstate 5, 25 miles south of Salem and 45 miles north of Eugene. Albany is located near the confluence of the Calapooia and the Willamette Rivers. Upstream, the Willamette River watershed drains approximately 4,840 square miles of mostly mountainous timberland.

The elevation of Albany ranges from 210 to 521 feet above sea level; the community is nestled between the Coast Range and the Cascade Mountains. Albany sits on mostly flat, level land with some hills located in the northern part, in Benton County. Bottomland hardwood forests once dominated much of the Willamette River floodplain. Native grasslands and prairie stretched out across the valley floor. Oak savannas and conifer forests covered the hills in North Albany and on Knox Butte.

Albany has a short, dry, temperate growing season which is ideal for many specialized crops such as seeds (grasses, flowers, and vegetables), tree fruits, nursery stock, nuts, berries, mint, and grains.

Soils

The majority of the soils west of Interstate 5 are loam and silty loam with poor drainage and a high water table. Soils immediately adjacent to Periwinkle and Oak creeks are clay and silty clay with severe construction limitations because of poor drainage, compressibility, and location in flood-prone areas.[2] The soils of North Albany are similar silty loams and silty clay loams with areas that are moderately deep and moderately well-drained to somewhat poorly-drained.[3] The soil pattern of the East Albany neighborhood is more complicate with linear strips of clay loam intermixed with gravelly and stony loam and some silty loam.[4] The clay-rich soils and generally flat topography found within the Albany urban growth boundary combine with the alternating wet/dry weather cycle to produce poor drainage conditions throughout the area. These soil conditions result in ponding, a perched water table, and some localized flooding during the winter, which limits construction methods and septic tank use. Disturbance of the natural drainage patterns and the removal of protective vegetative ground cover by urban development and upstream agricultural and forest practices have aggravated these soil conditions and have increased surface runoff.

Generally, soils within the Albany area are of low permeability. The infiltration rate of rainwater is slow and flat surfaces provide no natural gradient for the resulting overland runoff. Ponding occurs when soaked soils can no longer absorb heavy amounts of rainwater or when the rising groundwater table has actually surfaced.

Nearly all of the area soils are subject to severe shrink-swell limitations. These clay soils dry out and crack in summer months and then, with the first winter rains, swell shut and become impermeable, increasing surface runoff. These shrinking and expanding soils provide poor foundations for large structures and promote caving-in of deep excavations. Building foundations must be designed to resist swell pressures.

There are 14 drainage basins within the urban growth boundary area. Four of these basins are within the North Albany portion of the urban growth boundary, while the remaining 10 encompass the remainder of the urban growth boundary. The Oak Creek drainage area, containing four basins, extends into the foothills beyond the cities of Lebanon and Sodaville. Periwinkle Creek is one of the largest and most developed drainage areas within the urban growth boundary area. This area is divided into four basins. The Truax, Burkhart, and Cox Creek basins are currently largely undeveloped, with the majority of the basins outside the urban growth boundary. The Calapooia River Basin is located in the western portion of the city and Linn County.

Together, the bedrock structure and the alluvial deposits have given the Albany area a generally flat topography. Slopes south and east of the Willamette River are less than three percent. However, North Albany has more hilly terrain with ridges and valleys resulting from the underlying sandstone pediment. Twenty-five percent of the land in North Albany has slopes of more than 15 percent. Extensive development on these slopes could cause soil slippage and increased erosion. Such problems can be minimized through retention of vegetative cover, particularly trees, and by ensuring that any development uses good engineering practices such as following contours as much as possible and replacing lost vegetation around building sites.

Albany is centrally located on the broad alluvial plain of the Willamette Valley. The alluvial soils of the valley overlay thick bedrock of many mixed layers of consolidated volcanic material, basalt, and marine sandstone. Throughout most of the Albany area, the alluvial deposition consists predominantly of deep, silty loam and clay soils overlaying a number of old river terraces of pebbles and cobbles, gravels, sand and clay. These river terraces surface in the northeast portion of the urban growth boundary where the soils are much thinner than elsewhere.

Poor drainage caused by relatively flat topography, a high water table, and a clay-rich subsurface has determined soil capability. Drainage channels and land immediately adjacent to them are generally Class III and IV soils. Because of the many drainage ways in the Albany area, there are few large expanses of Class I and II soils except in North Albany.

Ninety-eight percent of the soils within the Albany urban growth boundary are classified by the Soil Conservation Service as I-IV soils, capable of supporting a wide variety of crops and forage for livestock. Most of the soils in Albany are distributed in a complex mottled pattern throughout the area.

Major Rivers

Willamette River

The Willamette River Basin has 13 major tributaries and drains approximately 12,000 square miles, almost one-eighth of Oregon's total area. It is the 10th largest river in the continental United States. The river originates at the confluence of the Middle and Coast Forks just upstream from Eugene and flows 187 miles before entering the Columbia River downstream from Portland. At Eugene, the river emerges from the foothills and meanders for many miles over a flat, extensive floodplain up to five miles wide, with numerous secondary changes, sloughs, and oxbow lakes. Upstream from Oregon City, the river flows through a breach in a low range of hills and then drops approximately 50 feet at Willamette Falls.[5]

Calapooia River

The Calapooia River originates in the Cascade Mountains and flows northwest for about 75 miles before joining the Willamette River at Albany. The basin is long and narrow in shape, and encompasses 374 square miles. Elevations in the basin range from about 200 feet above mean sea level at Albany to almost 5,200 feet above mean sea level on Tidbits Mountain. The stream gradient is about three feet per mile. The only major tributary to the river is Oak Creek.[6]

At one time, the Calapooia River provided extensive waterpower to many of the mills that were built in towns and villages along its 70 miles. Mills in Brownsville and Albany were but two examples. Today the river is less used because of the vegetation growing over the river banks and difficulty gaining access due to private property. In and around Albany, the river still causes flooding problems because of back-up when the Willamette River rises, and low-lying areas found next to the river.

Santiam River

The Santiam River flows into the Willamette River in Marion County approximately seven miles downstream from Albany. At a location approximately 10 miles upstream, where the North and South Santiam converge, the City of Albany and the City of Millersburg have constructed a drinking water intake and treatment plant for joint municipal use. For the City of Albany, this is the second treatment plant and for the City of Millersburg, its first. For both cities, this plant is the primary treatment plant.

The US Army Corps of Engineers (ACOE) operates and maintains 13 reservoirs in the Willamette Basin. These federal reservoirs in the middle and upper Willamette Basin were built in the late 1930s, principally for flood control. Flooding has always been an issue. Prior to the construction of dams upriver, flooding of the Albany area was quite significant, but the dams have reduced the threat.

US Army Corps of Engineers dams located above Albany on the Willamette and McKenzie Rivers

Hills Creek Dam, Middle Fork of the Willamette River[7]

This dam is located 40 miles southeast of Eugene and 26.5 miles upstream from Lookout Point Dam on the Middle Fork of the Willamette River. The dam was constructed between 1956 and 1961. It is an earth and gravel embankment 304 feet high and 2,235 feet long. Flood flows from a catastrophic failure of Hills Creek Dam would follow the Middle Fork Willamette River channel, breach Lookout Point and Dexter dams and continue to the main stem Willamette River, eventually affecting the city of Albany.

Lookout Point Dam, Middle Fork of the Willamette River[8]

Lookout Point Dam is located 22 miles upstream of Eugene on the Middle Fork of the Willamette River. The dam was constructed between 1948 and 1954. The dam consists of an earth fill embankment section, a concrete spillway section, and a concrete right abutment. The maximum height of the dam is 295 feet, with a length of 3,262 feet. A possible cause of failure of this dam would be breaching due to flood flows from failure of Hills Creek Dam, upstream of Lookout Point. Flood flows from a catastrophic failure of Lookout Point Dam would follow the Middle Fork Willamette River channel, breach Dexter Dam, and continue to the confluence with the main stem Willamette River, eventually affecting the city of Albany.

Dexter Dam, Middle Fork of the Willamette River[9]

Dexter Dam is located 20 miles upstream of Eugene on the Middle Fork of the Willamette River. The dam was constructed in 1955. The dam consists of an earth fill embankment and is 117 feet high. Flood flows from a catastrophic failure of Dexter Dam would follow the Middle Fork Willamette River channel and continue to the confluence with the main stem Willamette River, and eventually affect the city of Albany.

Cougar Dam, South McKenzie River[10]

Located on the South Fork of the McKenzie River, Cougar Dam is about 42 air miles east of Eugene. Construction of the dam occurred between 1956 and 1964. Cougar Dam is a rock fill embankment about 1,500 feet long and a maximum of 452 feet high. Flood flows from a catastrophic failure of the Cougar Dam would follow the South Fork of the McKenzie River into the McKenzie River channel and on into the Willamette River. Flooded area would include a small portion of Albany.

US Army Corps of Engineers dams located above Albany on the Santiam River

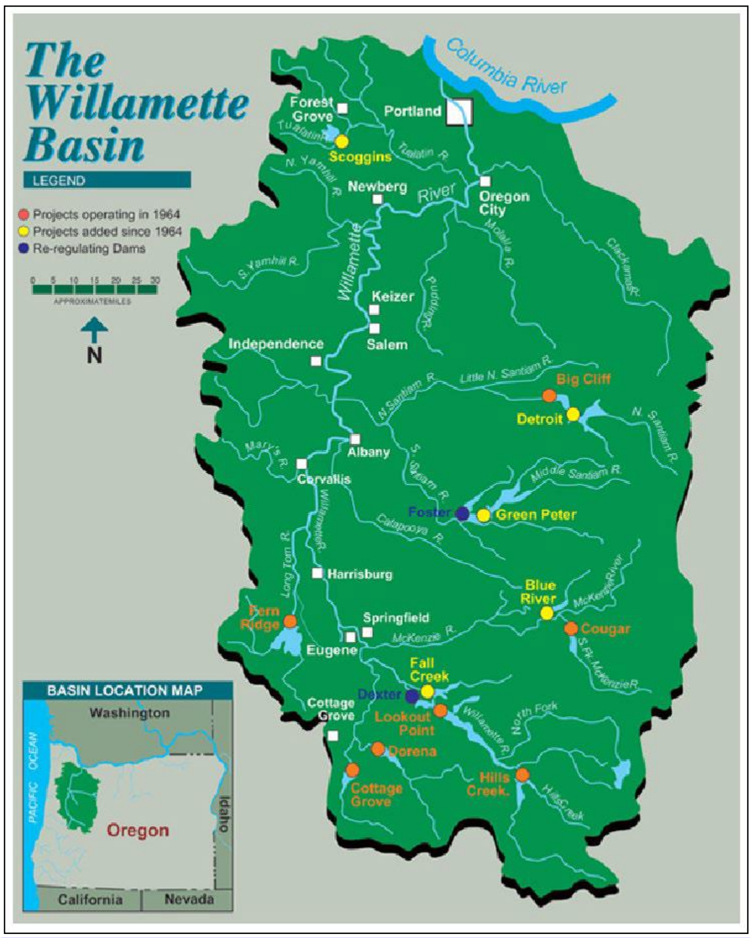
Green Peter Dam, Middle Santiam River[11]

Green Peter Dam is located on the Middle Santiam River about eight miles northeast of Foster. Dam construction was completed in 1967. The dam is a concrete gravity structure with a height of 327 feet and a crest length of 1,517 feet. Flood flows from a catastrophic failure of Green Peter dam would follow the Middle Santiam River channel, breach Foster Dam, and continue to the confluence with the South Santiam River. The flood would then continue down the Oak Creek and Burkhart Creek channels. The main flow would go down the South Santiam to the main stem Santiam River and would affect the outskirts of Albany.

Foster Dam, South Santiam River[12]

This dam is located at Foster, two miles below the junction of the Middle and South Santiam rivers, and eight miles below Green Peter Dam. Construction of the dam was completed in 1967. The dam is a rock fill embankment dam with a concrete spillway. The embankment is 126 feet high and 4,800 feet long. A possible cause of failure of this dam would be breaching due to flood flows from a failure of Green Peter Dam, eight miles upstream. Flood flows from a catastrophic failure of Foster Dam would follow the South Santiam River channel about to the town of Jefferson. Flood waters would also branch off from the main flow and follow Oak Creek and Burkhart Creek channels to the outskirts of Albany.

Figure 1. Location of Dams in the Willamette Basin



Source: US Army Corps of Engineers, retrieved July 11, 2015

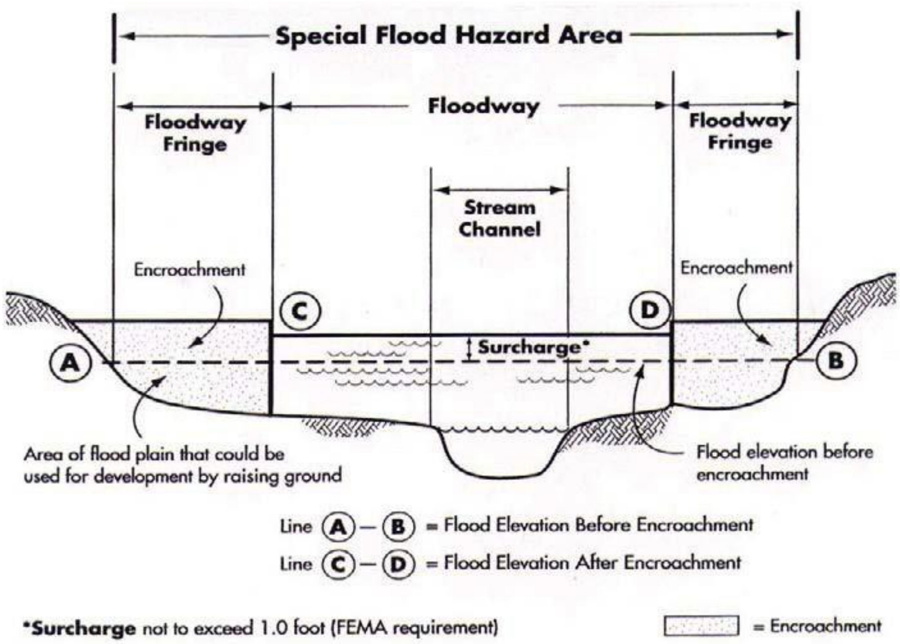
Floodplain Terminology

Base Flood

In Albany, the base flood is a major flood that has a one percent chance of being equaled or exceeded in magnitude in any given year. It is commonly referred to as a 100-year flood. However, it is not a flood occurring once every 100 years.

Floodplain
A floodplain is a land area adjacent to a river, stream, or lake that is subject to inundation by a minimum of one foot of water during the base flood. This area, if left undisturbed, acts to store excess floodwater. The floodplain is made up of two sections: the floodway and the floodway fringe. For regulatory purposes, the floodplain is also referred to as a Special Flood Hazard Area.

Figure 2. Floodplain Schematic



Source: Floodplain Management in Missouri. (March 1999) Missouri Emergency Management Agency

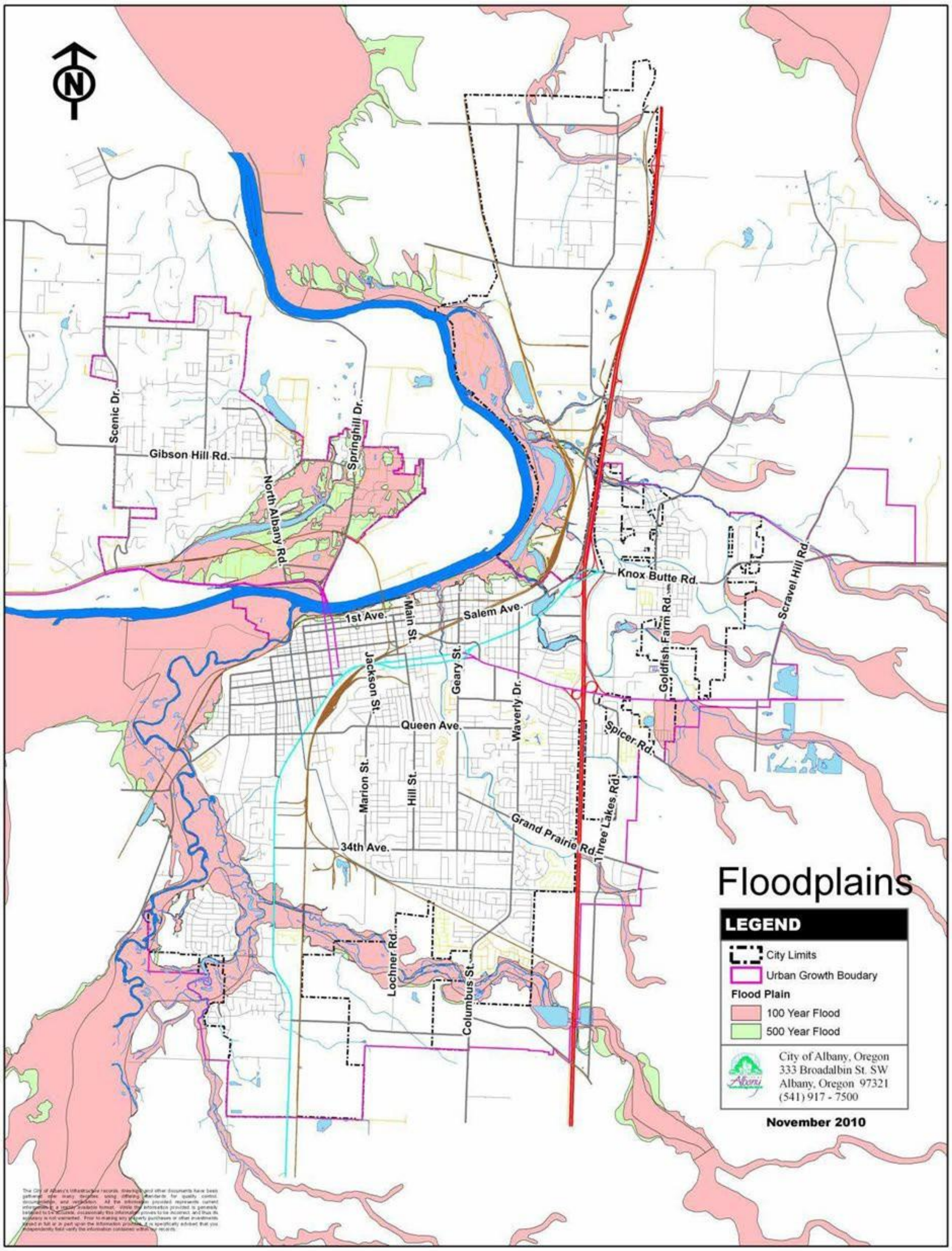
Floodway
The floodway is one of two main sections that make up the floodplain. Floodways are defined for regulatory purposes. Unlike floodplains, floodways do not reflect a recognizable geologic feature. Under the National Flood Insurance Program (NFIP), floodways are defined as the channel of a river or stream, and the overbank areas adjacent to the channel. The floodway carries the bulk of the floodwater downstream and is usually the area where water velocities and forces are the greatest. NFIP regulations require that the floodway be kept open and free from development of other structures that would obstruct or divert flood flows onto other properties.

Floodway Fringe
The floodway fringe refers to the outer portions of the floodplain, beginning at the edge of the floodway and continuing outward. NFIP regulations allow the floodway fringe to be completely filled and used for development. Albany has adopted this approach. However, in some areas of Albany, the floodway fringe has been set aside as open space and is not available for filling or development.

Base Flood Elevation (BFE)
The term "base flood elevation" refers to the height of the base flood, usually in feet, in relation to the North American Vertical Datum of 1988. In Albany, base flood elevations

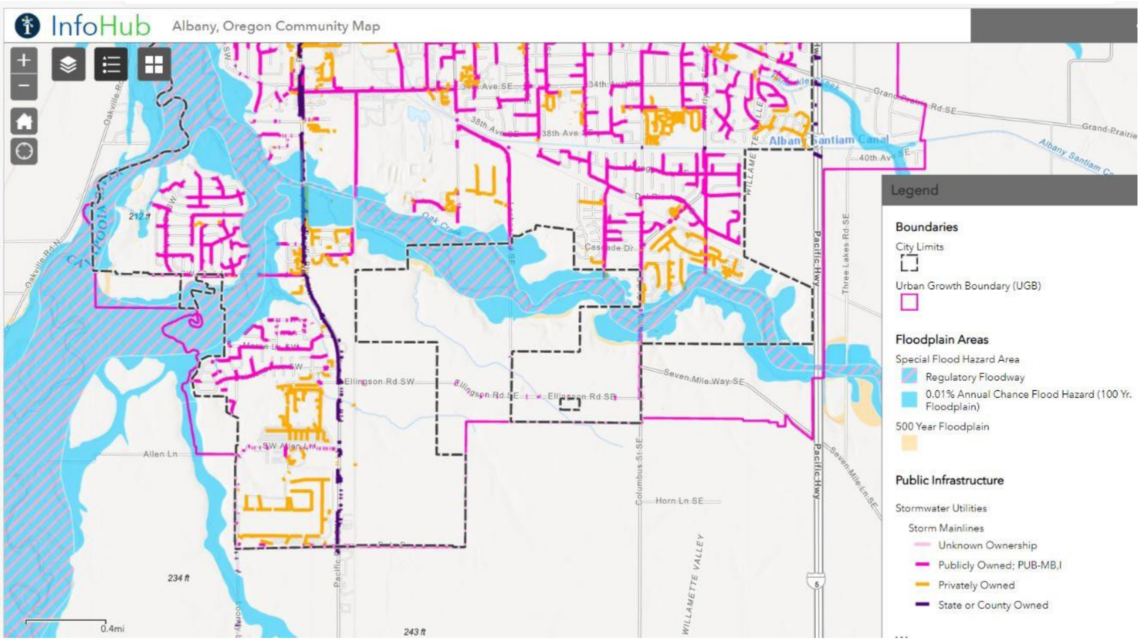
are set for the 100-year flood. Some communities choose to use higher frequency flood events as their base flood elevation for certain activities, while using lower frequency events for others. For example, for the purpose of storm water management, a 25-year flood event might serve as the base flood elevation, while the 500-year flood event may serve as base flood elevation for the tie-down of mobile homes. The regulations of the NFIP focus on development in the 100-year floodplain.[13]

Figure 3. City of Albany Floodplains



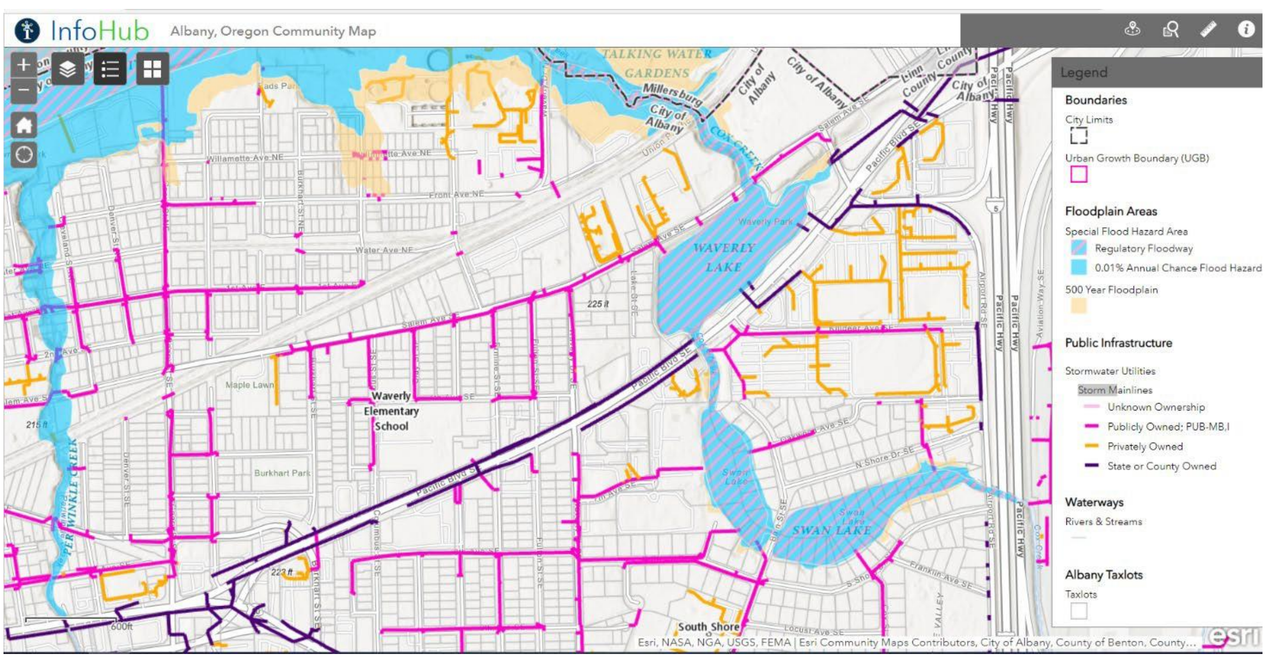
The regulatory floodplain of many of the city's drainage basins is shown in the maps below as served by the City of Albany's InfoHub. The stormwater infrastructure in place is also shown on these maps along with the FEMA floodplain and floodway.

Figure 4. Calapooia River and Oak Creek regulatory floodplains and stormwater infrastructure



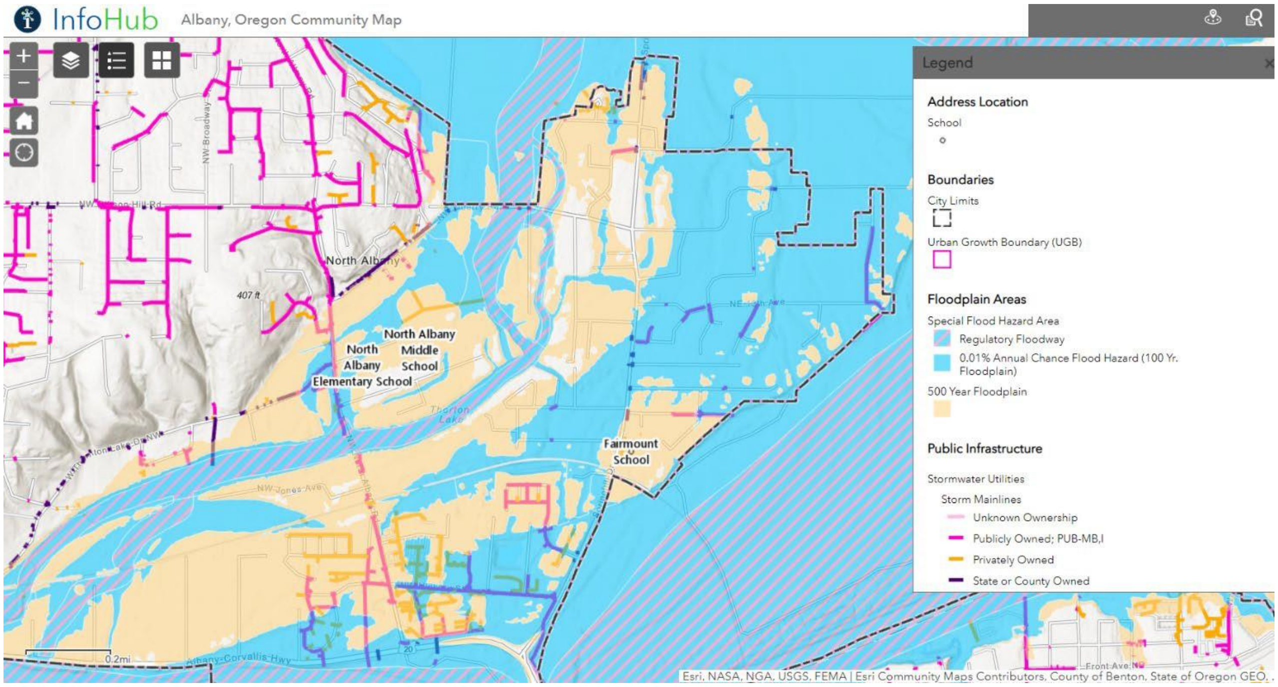
Source: City of Albany InfoHub, [InfoHub (cityofalbany.net)] consulted September 2022

Figure 5. Periwinkle Creek and Cox Creek regulatory floodplains and stormwater infrastructure



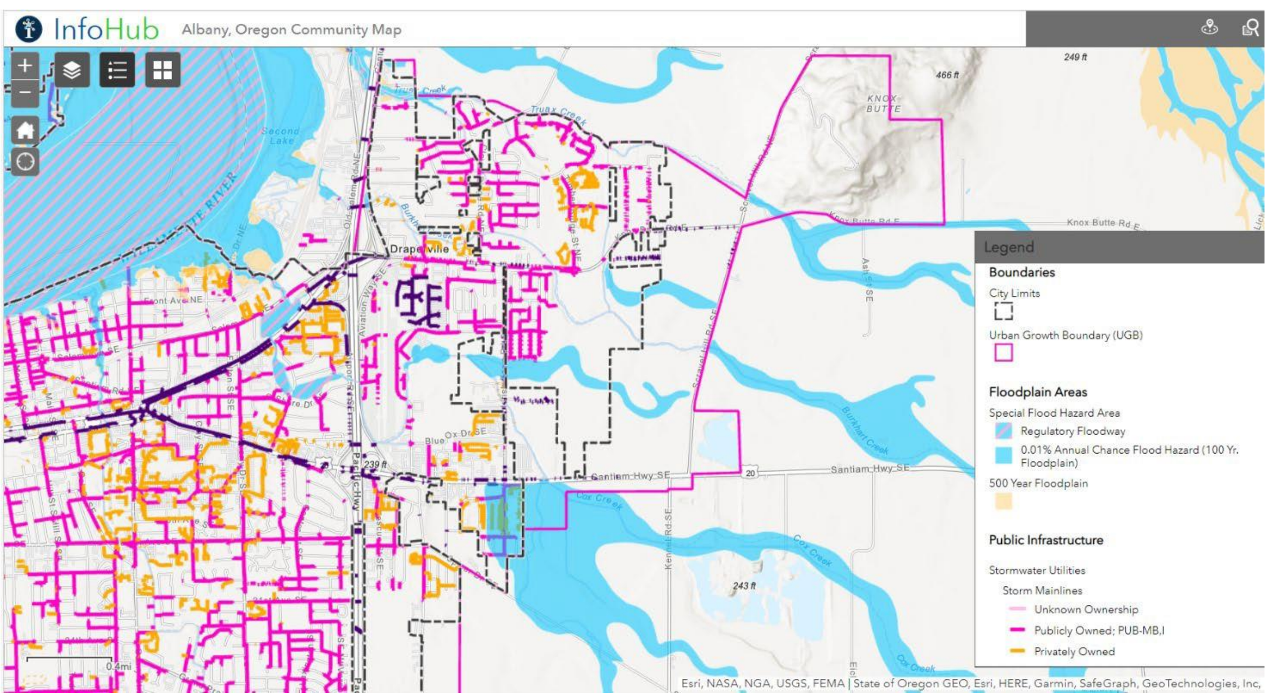
Source: City of Albany InfoHub, [InfoHub (cityofalbany.net)] consulted September 2022

Figure 6. North Albany regulatory floodplains and stormwater infrastructure



Source: City of Albany InfoHub, [InfoHub (cityofalbany.net)](cityofalbany.net) consulted September 2022

Figure 7. Truax, Brukhart and Cox Creeks regulatory floodplains and stormwater infrastructure



Source: City of Albany InfoHub, [InfoHub (cityofalbany.net)](cityofalbany.net) consulted September 2022

Types of Flooding in the City of Albany

Two types of flooding primarily affect the City of Albany: *riverine* flooding and *local* flooding.

Riverine Flooding

Rivers and creeks in Albany regularly overflow their banks and inundate low-lying areas. The natural processes of riverine flooding add sediment and nutrients to fertile floodplain areas. Flooding in large river systems typically results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing flooding in hundreds of smaller streams which then drain into the major rivers.

Riverine flooding along the Willamette River is a significant issue in Albany, particularly North Albany. The bank on the south side of the Willamette River is high enough to prevent over-bank flooding in most of downtown Albany during a 100-year flood. However, the bank on the north side is low enough to allow more frequent over-bank flooding. The floodplain extends north into North Albany across Thornton Lake to the base of Spring Hill. During high water events, flood water backs into the east end of Thornton Lake, causing a "reverse flow" through the lake from east to west. As flood waters continue to rise, it breaches the west end of Thornton Lake, reversing the flow from west to east. Much of the North Albany floodplain is developed for residential and commercial use. Development has relied on fill to avoid flood hazards.

Along the Calapooia River, over-bank flooding occurs most every winter. Urbanized areas of Albany are perched on a terrace above the 100-year floodplain. Most flooding occurs on rural farmland to the west of Albany.

Oak Creek has a shallow, wide floodplain, much of which is floodway. Periwinkle Creek, Cox Creek, Burkhart Creek, and Truax Creek were deepened and straightened as flood projects by the Grand Prairie Water Control District. The capacity of the creek channels was increased to contain the 100-year flood. Consequently, over-bank flooding along these four creeks is rare.

Local Flooding

Flood damage may occur in areas outside the 100-year floodplain and away from riverine flooding conditions. Local flooding problems are caused by blocked culverts, shallow ditches, or locally intense rainfall. In the terms of the National Flood Insurance Program, these are areas of one percent annual chance sheet-flow flooding where average depths are less than one foot, or areas of one percent annual chance stream flooding where the contributing drainage area is less than one square mile.

Flood Risk Assessment

Flood Hazard Profile

Section 201.6(c)(2)(*i*) of the Disaster Mitigation Action of 2000 requires that the risk assessment include a description of the location and extent of all natural hazards that can affect the jurisdiction. The plan must include information on previous occurrences of hazard events and on the probability of future hazard events.

Location and Extent of Flood Hazards

Albany relies on flood insurance rate maps and the Albany Flood Insurance Study to identify flood-prone areas. These were produced for Albany in conjunction with the National Flood Insurance Program (NFIP). The NFIP was established in 1968 as a means of providing low-cost flood insurance to the nation's flood-prone communities. The NFIP also reduces flood losses through regulations that focus on building standards and what we have come to know as "sound floodplain management."[14] In Albany, the NFIP and related building code regulations went into effect April 3, 1985. NFIP regulations (44 Code of Federal Regulations (CFR) Chapter 1, Section 60.3) require that all new construction in floodplains must be elevated at or above base flood level. Refer to figure 6-4 for a map of the floodplains in the city.

Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent.15 In the City of Albany, all homes and other buildings legally constructed in the floodplain after April 3, 1985 must be mitigated to NFIP standards with the first floor being elevated at least one foot above base flood level, or in the case of non-residential buildings, the first floor elevated or flood-proofed to at least one foot above the base flood level.

Flood Insurance Rate Maps and Flood Insurance Studies

Floodplain maps are the basis for implementing floodplain regulations and for delineating flood insurance purchase requirements. A flood insurance rate map (FIRM) is the official map produced by the Federal Emergency Management Agency (FEMA), which delineates special flood hazard areas or floodplains where National Flood Insurance Program regulations apply. The maps are also used by insurance agents and mortgage lenders to determine if flood insurance is required.

The City of Albany uses the FIRM to advise prospective homeowners of flood hazards; to locate zoning boundaries that separate developable land from open space; to make decisions for new development in floodplains; and to administer the terms of the NFIP during the issuance of building permits. The city received new digitized FIRM maps from FEMA in 2010. These are shown in Figures 1 through 5.

For mapped floodplain areas, the flood hazard data included in the flood insurance study (FIS) allow quantitative calculation of the frequency and severity of flooding for any property within the floodplain. Such calculations are very important for mitigation planning because they allow the level of flood risk for any structure to be evaluated quantitatively.

Standard hydrologic and hydraulic study methods were used to determine the flood hazard data contained in the FIS. Flood events of a magnitude expected to occur once on average every 10-, 50-, 100-, and 500-year period were studied for each of Albany's rivers and creeks.

For example, the data in Table 6-5 were computed for the Willamette River at the river gauge under the Ellsworth Street Bridge:

Table 2. Flood Hazard Data for the Willamette River at the Ellsworth Street Bridge

Flood Frequency (yrs)	Discharge (cfs)[3]	Elevation (feet)
10	117,000	199.3
50	172,000	203.5
100	200,000	205.6
500	272,000	209.4

Source: Flood Insurance Study, City of Albany, Oregon, p. 27 flood profile graph 62P for Willamette River stream gauge at river mile 119.33 (2010)

[3] Stream discharge means the volume of water flowing down the river and is typically measured in cubic feet of water per second (cfs)

The US Army Corps of Engineers operates eight flood control storage projects upstream from Albany on major tributaries of the Willamette River. These dams control runoff from approximately one-half of the drainage area upstream from Albany. The influence of these dams was taken into account when calculating river discharge figures above.

Quantitative flood hazard data, such as shown above, are very important for mitigation planning purposes because they allow quantitative determination of the frequency and severity (i.e., depth) of flooding for any building or other facility (e.g., road or water treatment plant) for which elevation data exist. For example, a building located on North Albany Road in this vicinity (Table 6-5 above), with a first-floor elevation of 199 feet is expected to flood about once every 10 years on average. Fifty-year, 100-year, and 500-year flood events would result in about 4.5 feet, 6.6 feet, and 10.4 feet of water above the first floor, respectively. Thus, such a structure would demonstrably be at significantly high flood risk. However, another structure in the same vicinity with a first-floor elevation of 20 feet would still be at flood risk, albeit at a much lower level of risk, with flooding above the first floor about once every 50 years, on average.

Such quantitative flood hazard data also facilitate detailed economic analysis (e.g., benefit-cost analysis) of mitigation projects to reduce the level of flood risk for a particular building or other facility.

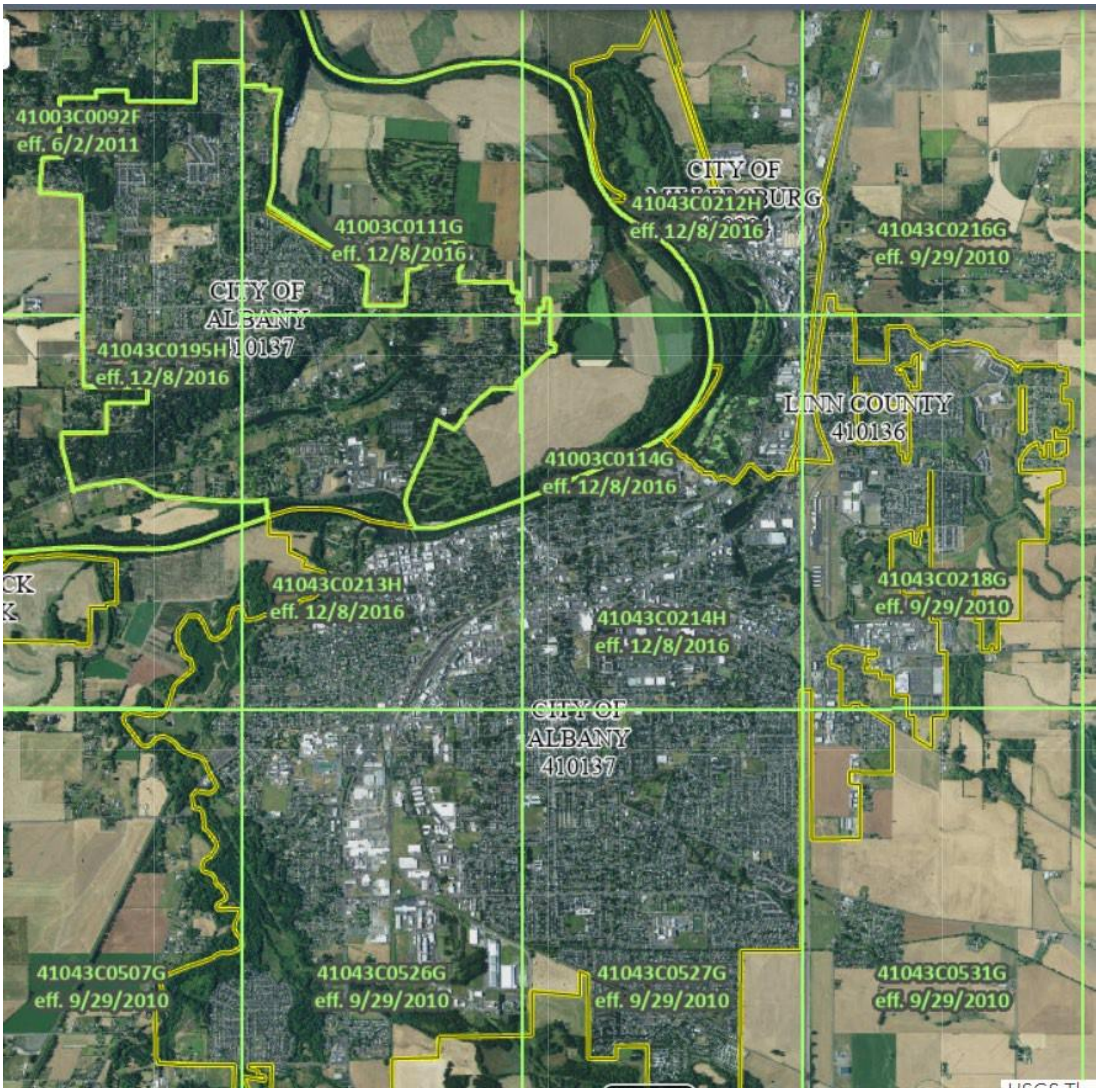
North Albany Floodplain Study

In early 2010, the city began a study to model the floodplain of the Willamette River in North Albany. The study was initiated because the current FEMA floodplain maps for North Albany appeared to be inaccurate. The most significant inaccuracy was an unmapped floodway. In order to adequately review future development proposals and for the development community to know what challenges might exist on an existing parcel prior to investing in development, it was important to have a more accurate assessment of floodplain characteristics throughout North Albany.

The North Albany floodplain study verified that there was a significant unmapped floodway through North Albany. This floodway is essentially an overflow channel from the Willamette River. It is estimated that, during a 100-year flood event, approximately 5,600 cfs of water flows through this floodway at a maximum speed in excess of five feet per second. To put that amount of water in perspective, it is what typically flows in the Willamette River itself in September. At five feet per second, water with very little depth can apply enough force to push a car off the road.

The study also unexpectedly identified significant differences in the amount of flooding throughout the study area. These differences were seen in both the extents and depths of flooding. When compared to FEMA's 2010 FIRMs, the study identified approximately 102 acres of property mapped as being in the floodplain that shouldn't be, and approximately 104 acres of property that should be shown in the floodplain but was not. Differences in depths of flooding ranged from more than four feet less than the 2010 FEMA maps to around two feet more than the 2010 FEMA maps. The new floodplain maps for North Albany were adopted by FEMA and the City and became effective December 8, 2016. Below is a map of the effective FIRMs.

Figure 8. Effective Flood Insurance Rate Map panels



Source: National Flood Hazard Layer, [FEMA's National Flood Hazard Layer (NFHL) Viewer (arcgis.com)]

Flood Mapping Methods and Techniques

The city uses Geographic Information Systems (GIS), an important tool for mapping flood hazard areas. The FIRM has been imported directly into the GIS mapping viewer called InfoHub on the city's website, which then allows for geographic analysis of flood hazard areas. Planners and residents find it particularly useful to overlay flood hazard areas on tax assessment parcel maps.

The original mapping efforts by FEMA in the 1980s did not contain adequate horizontal controls, any such overlay is subject to significant error. Local communities have found that the only useful mapping information from the flood studies is the water elevation and cross section locations. This information can be added to high resolution topographic maps that more accurately define the areas prone to flood hazard. This allows a planner or resident to clearly identify the flood hazard risk for a specific parcel during review of a development request.

The level of flood hazard (frequency and severity of flooding) is not determined simply by whether the footprint of a given structure is or is not within the 100-year floodplain. A common error is to assume that structures within the 100-year floodplain are at risk of flooding while structures outside of the 100-year floodplain are not. Some important guidance for interpreting flood hazard is provided below.

A. Being in the 100-year floodplain does not mean that floods happen once every 100 years. Rather, a 100-year flood simply means that the probability of a flood to the 100-year level or greater has a 1% chance of happening every year.

B. Occasional flooding happens outside of the mapped 100-year floodplain. First the 100-year flood is by no means the worst possible flood. For example, for flooding along the Willamette River in North Albany, the 500-year flood is nearly four feet higher than the 100-year flood (cf. data in Table 6-4 above). Thus, floods greater than the 100-year event will flood many areas outside the mapped 100-year floodplain. Second, many flood-prone areas flood because of local stormwater drainage conditions. Such flood-prone areas have nothing to do with the 100-year floodplain boundaries.

C. The key determinant of flood hazard and flood risk for a structure or other facility is the relationship of the elevation of the structure or facility to the flood elevations for various flood events. Thus, homes with first-floor elevations below or near the 10-year flood elevation have drastically higher levels of flood hazard and risk than other homes in the same neighborhood with first-floor elevations near the 50-year or 100-year elevation.

The FEMA FIRMs use a variety of nomenclature to describe different types of flood-prone areas and floodplain classifications have changed over time. For reference, definitions of some important floodplain terms commonly used on FIRMs are given below. On Albany FIRMs, the following terms are used:

A. **Zone AE**: within the 100-year floodplain with base flood elevation (100-year flood) and detailed flood hazard data.
B. **Zone X** (shaded): areas of 500-year flood, areas of 100-year flood with average depths less than one foot or with drainage areas less than one square mile, and areas protected by levees from 100-year flood.
C. **Zone X** (un-shaded): areas outside 500-year floodplain.

Previous Occurrences of Flood Events

The rainy season in western Oregon runs from October through May. Strong storm systems develop in the upper-level flow over the Pacific Ocean during the rainy season, bringing rain to the lower elevations and snow to the higher elevations. Occasionally, a subtropical feel of moisture, often referred to as the Pineapple Connection, will be tapped by the stronger storms. The Pineapple Connection is a term used to describe a continuous stream of upper-level moisture originating from the tropics, often near Hawaii. This stream of moisture is warm and, as a result, the air can hold more moisture. The subtropical moisture will enhance the precipitation process in the storms, producing more precipitation than would normally be expected. Flooding can occur if the storms move across the same area in succession, with heavy snow falling in the higher terrain. There is at least one subtropical connection that brings heavy rain to some part of the Pacific Coast nearly every year. The key to how much precipitation falls during a storm is closely related to how strong and persistent the subtropical connection is. The following Table 6- 6 identifies significant flood events in western Oregon since 1861.

Table 3. Significant Western Oregon Floods

Date	*Location*	*Characteristics*	*Flood Type*
Dec. 1861	Willamette Basin and coastal rivers	Preceded by two weeks of heavy rain. Every town on the Willamette flooded or washed away.	Rain on snow; snow melt
Feb. 1890	Willamette Basin and coastal rivers	Second largest known flood in the Willamette Basin. Almost every large bridge was washed downstream.	Rain on snow
Dec. 1937	Western Oregon	Flooding followed heavy rains. Considerable highway flooding; landslides.	Rain on snow
Jan. 1953	Western Oregon	Widespread flooding in western Oregon accompanied by windstorm.	Rain on snow
Dec. 1964-Jan. 1965	Willamette Basin	Record flooding throughout Willamette Basin. Two intense storms. Near-record early season snow depths. Largest flood in Oregon since dam construction on upper Willamette (1940s-50s)	Rain on snow
Jan. 1974	Western Oregon	Flooding followed heavy wet snow and freezing rain. Nine counties received Disaster Declaration.	Rain on snow
Dec. 1978	Western Oregon	Intense heavy rain, snowmelt, saturated ground. One fatality in Region 3 (Benton County).	Rain on snow
Feb. 1986	Entire State	Severe statewide flooding. Rain and melting snow. Numerous homes flooded and highways closed.	Snowmelt
Feb. 1987	Western Oregon	Willamette and tributaries: mudslides; damaged highways and homes.	Rain on snow
Feb. 1996	Entire State	Deep snow pack, warm temperatures, record-breaking rains. Flooding, landslides, power outages. (FEMA-1099-DR-OR)	Rain on snow
Nov. 1996	Entire State	Record-breaking precipitation; local flooding/landslides. (FEMA-1149-DR-OR)	Rain on snow
Dec. 2005	Polk, Marion, Linn, Lane and Benton	Heavy rains causing rivers to crest above flood stage in Polk, Marion, Linn, Lane and Benton	Riverine
Jan. 2006	Willamette Valley	Heavy rains caused many rivers to crest above flood stage in the Willamette Valley, causing damage to roads and bridges.	Riverine
Dec. 2007	Yamhill	South Yamhill River flooded near McMinville causing damage to roads and bridges, 120 homes.	Riverine
Dec. 2007	Polk	Major flooding in Suver and other areas in Polk County; total losses equal $1million for entire county.	Riverine

Jan. 2012	Polk, Marion, Yamhill, Lincoln, Linn, Lane and Benton Counties	Heavy rain and wind; ice (DR-4055); flooding in the Willamette Valley; 130 homes and seven businesses were damaged in the city of Turner; 29 streets were closed in the city of Salem; the state motor pool lost 150 vehicles and thousands of gallons of fuel; Thomas Creek in the city of Scio overtopped, damaging several buildings.	Riverine
April 9-12, 2019	Calapooia River and Willamette in Albany	A particularly strong atmospheric river took aim for the south Willamette Valley, sitting over areas south of Salem for two days, producing anywhere from 2.5 to 5 inches of rain over a 48-hour period. Heavy rain combined with snow melt from all the snow from a few weeks prior in this same area caused flooding along most of our rivers in this area as well as along the main-stem Willamette River up to around Oregon City. The Willamette River near Albany crested at 27.3 feet around 10 PM on April 11th, which is 2.3 feet above flood stage.	Riverine

Sources: Oregon Natural Hazard Mitigation Plan (2015) and Linn County Natural Hazards Mitigation Plan (2005), NOAA Storm Event Database, consulted September 2022

The U.S. Geological Survey gauging station is located on the Willamette River at Albany, Mile 119.3, under the Ellsworth Street Bridge. Bank full stage is at 21.2 feet, which equates to 188.4 feet (NGVD 1929) of elevation above sea level. Flood stage at this location is 25 feet or 192.2 feet (NGVD 1929) above sea level. One of the largest floods in Albany's history occurred in December 1861. The flood peaked at approximately 208 feet above sea level, 41 feet river stage. Between 1878 and 2012 seventy-six events occurred in Albany at or above bank full stage (21.2 feet). The 13 greatest observed floods during that time were:

Table 4. Significant Albany Flood Stages 1861-1996

Date	River Stage	Flood Elevation Feet (NGVD 1929)
December, 1861	41.0	208.2
February 4, 1890	39.1	206.3
January 14, 1881	38.0	205.2
January 26, 1903	36.5	203.7
January 15, 1901	36.4	203.6
November 24, 1909	36.1	203.3
February 6, 1907	35.8	203.2
January 2, 1923	35.7	202.9

January 8, 1923	35.7	202.9
December 30, 1945	35.0	202.2
February 22, 1927	34.2	201.3
December 24, 1964	33.9	201.1
February 9, 1996	30.0	197.2

The flood of 1964 is the one most residents alive at the time would remember. It crested at 201 feet elevation (NGVD 1929), which is 34 feet river stage. Had the upstream dams not been in place, the 1964 flood would have been as high as the December 1861 flood, 16 feet above flood stage.

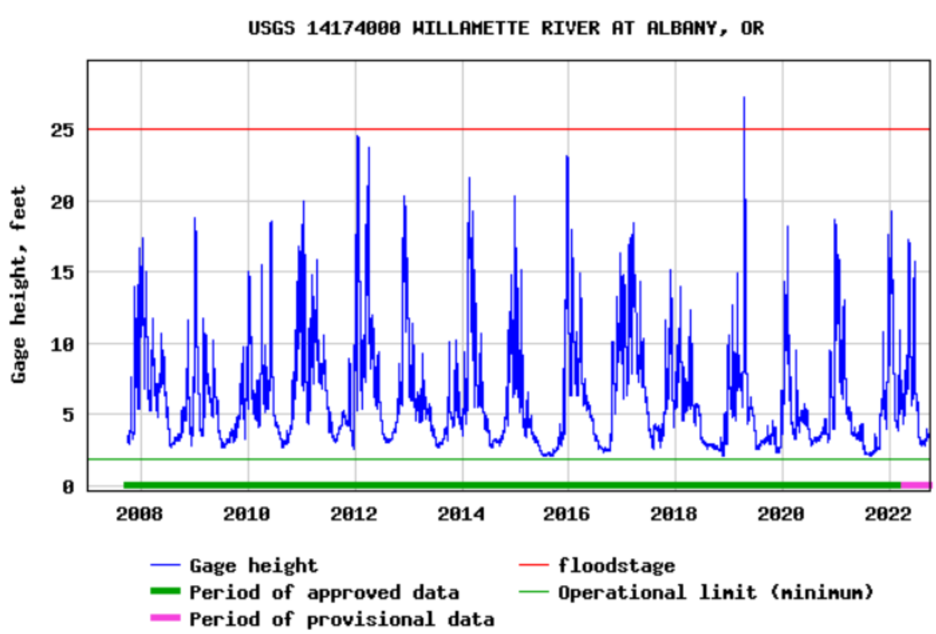
The most recent significant flood occurred in February 1996. At that time, the river crested at 30 feet river stage, or 197.2 feet (NGVD 1929) above sea level. This flood did damage to the low areas in the city, particularly in North Albany where it isolated a community by flooding all the roads into the area. This flood became a Presidential Declared Disaster that impacted most of Oregon. Since that time, there has not been a significant flooding in or around Albany. The US Army Corps of Engineers indicates that, without flood control on the river, the flood water would have been five to six feet higher. This would have put the flood waters at 36 feet flood stage, 203 feet elevation (NGVD 1929), or equivalent to the fourth fifth, or sixth greatest flood in Albany's history.

In 1861, the water level reached 41 feet at the Ellsworth Street Bridge. No upstream dams were in place at that time. In 1964, the water level at the Ellsworth Street Bridge reached 34 feet. The Corps' seven upstream dams reduced the flood's peak by six feet.

Since the floods of 1861 and 1964, a variety of mitigation efforts have helped to reduce the impact of floods, such as the dams at Foster and Green Peter. For example, without the dams:

In 1996, the Willamette River reached 30 feet at the Ellsworth Street Bridge. River levels would have been five feet higher without the US Army Corps of Engineers' nine dams upstream of the bridge.

Figure 9. Stream gauge on the Willamette River at Albany 2008-2022



To illustrate the difference in these flood heights and to promote awareness of flood hazards, the City of Albany and the US Army Corps of Engineers installed high-water mark signs at Monteith Riverpark in December of 2014. The timing of the installation was significant as it commemorated 50 years from the date of the 1964 Christmas Eve flood event. The signs are posted at the level flood waters reached Ellsworth Street on December 4, 1861; December 24, 1964; and February 9, 1996. The signs also list the number of upstream dams in place at the time of the latter two floods and how much those dams reduced flood levels (Figures 8 and 9).

Figure 10. Historical Flood Events

Figure 11. High Water Mark Signs

Probability of Future Flooding Events

The City's hazard analysis scores a flood event as high in the priority group listed as high, medium, and low. When you look at the list of floods back to 1861, you will find there is no regular schedule, such as once every 10 or 20 years, in which floods have occurred. Heavy rains that saturate the ground and fill the rivers and creeks coupled with warming weather that melts heavy snow in the mountains and foothills create the major flooding the city of Albany has seen over the last 150 years. The time between two major floods, 1964 and 1996, was 32 years. Two major floods occurred in 1943 and 1945 and are the only recent examples of flooding to have occurred within a three-year period. These floods took place before the dams were built on the rivers upstream of the city. Since then, only the 1964, 1996, and 2012 floods have occurred. It is very likely another flood will occur in the future that will equal either the 1964 or 1996 flood. When it will occur is very difficult to predict since many factors need to come together to create a major flood for this area.

Other Flood Hazards

Effect of Development on Floods

When structures or fill are placed in the floodplain, water is displaced. Development raises the base flood elevation by forcing the river to compensate for the flow space obstructed by the inserted structures and/or fill. If left unobstructed, the floodway is designed to compensate for fill in the flood fringe by carrying displaced floodwater. Careful attention must be paid to development that occurs within the floodway to ensure that structures are prepared to withstand base floods without exacerbating flood levels.

Dam Failure Inundation

The Emergency Operations Plan for the City of Albany, Benton, and Linn Counties (Sept. 2012), summarizes the impact and threat of dam failure: *"A dam failure can either be slow in nature or catastrophic, depending on a number of variables, such as the strength of containment structure, the amount and velocity of water released, and the distance of affected structures from the failure. The worst-case event for Albany would be a catastrophic failure of the Hills Creek Dam on the Middle Fork of the Willamette River, near Oakridge. Flood flows from such a failure would breach Lookout Point and Dexter Dams and continue down the Willamette River to Willamette Falls at Oregon City. Albany would be impacted by this type of event."*

The city has a mitigation action item pertaining to development of a flood and dam failure warning and response plan.

Climate Change

The Oregon Natural Hazard Mitigation Plan (2015) summarizes the anticipated impacts of climate change for the State: *"The state information indicates that hazards projected to be impacted by climate change in the Southern Willamette Valley Region include drought, wildfire, flooding and landslides. Climate models project warmer drier summers and a decline in mean summer precipitation for Oregon. Coupled with projected decreases in mountain snowpack due to warmer winter temperatures, all regions within Oregon are expected to be affected by an increased incidence of drought and wildfire. In addition, an increase in extreme precipitation is projected for some areas in this region and can result in a greater risk of flooding in certain basins; including an increased incidence of magnitude and return interval. Landslides in Oregon are strongly correlated with rainfall, so increased rainfall – in particular in extreme events – will likely trigger increased landslides. Flooding and landslides are projected to occur more frequently throughout western Oregon. Generally, western Oregon basins are projected to experience increased flood risk in future decades. Increased flood risk involves both an increased incidence of flooding of a* *certain magnitude and an increase in the magnitude of floods of a certain interval. Landslides in Oregon are strongly correlated with rainfall, so increased rainfall – particularly in extreme events – will likely trigger increased landslides."*

The executive summary of Oregon's Climate Change Adaptation Framework (Dec. 2010) provides a summary of challenges associated with both flooding and landslides: *"Extreme precipitation events have all the potential to cause localized flooding due partly to inadequate capacity of storm drain systems. Extreme events can damage or cause failure of dam spillways. Increased incidence and magnitude of flood events will increase damage to property and infrastructure and will increase the vulnerability of areas that already experience repeated flooding. Areas thought to be outside the floodplain may begin to experience flooding. Many of these areas have improvements that are not built to floodplain management standards and are not insured against flood damage; therefore, being more vulnerable to flood events. Finally, increased flooding will increase flood-related transportation system disruptions, thereby affecting the distribution of water, food, and essential services"*

Flood Hazard Vulnerability: Identifying Assets

Section 201.6(c)(2)(*ii*)(A) of the Disaster Mitigation Act of 2000 requires that the risk assessment include a description of the jurisdiction's vulnerability to the hazard. This description shall include an overall summary for the hazard and its impact on the community. If best data allows, vulnerability should be described in terms of the type and number of existing and future buildings, infrastructure, and critical facilities located in identified hazard areas.

City of Albany Vulnerability Summary

Since the dams were built upstream of the city of Albany, the community is less at risk of a major flood event. The 1964 flood did major damage to areas around the city of Albany. Since then, mitigation activities have been implemented to assure similar flooding does not take place in the future.

The south side of the Willamette River is quite high in relation to the north side. It would take a large flood to do any damage to the core of the city. The roads were the major problems during the 1996 flood. Some structures were affected by river flooding. Drainage flooding in the east and north part of the city did damage to quite a few homes in these areas. Since the 1996 flood, a number of mitigation projects have taken place that will assure these types of flooding do not occur in the future.

Even though the 1964 flood produced the greatest flood loss in the last 50 years in Albany, details of damage from the 1964 event are sketchy and unreliable for mitigation planning purposes. Instead we rely on our experience from the 1996 flood to give us some notion of our vulnerability to flood hazard, realizing that the 1996 event was something less than a 100-year event.

Public Health

The Centers for Disease Control and Prevention warn that floodwaters pose a variety of health risks, including exposure to infectious diseases, chemical hazards, and injuries. Flood waters can become contaminated with bacteria and hazardous chemicals which pose risk of disease through physical contact, ingestion, or open wounds. Floodwaters pose risk of physical injury from floating objects and damaged electrical power lines. Floodwaters, especially when rapidly moving, also pose risk of drowning. Floodwaters can also cause indirect health risks. Animals can be displaced during flooding and pose a risk to public health. Standing water during and after a flood can increase insect populations, posing an additional risk of insect-borne diseases. If clean-up efforts are delayed after flood events, water-damaged buildings can collect mold, which is a significant health concern to building occupants. Many of these indirect public health concerns can be reduced after flood events by expediting repair of water-damaged buildings and other clean-up efforts.

Community Flood Impacts

Property Loss Resulting from Flooding Events – The type of property damage caused by flood events depends on the depth and velocity of the floodwaters. Faster-moving floodwaters can wash buildings off their foundations and sweep cars downstream. Pipelines, bridges, and other infrastructure can be damaged when high waters combine with flood debris. Extensive flood damage can be caused by basement flooding and landslides related to soil saturation from flood events. Surface water entering into crawlspaces, basements, or daylight basements is common during flood events, not only in or near floodplains, but also on hillsides and other areas that are far removed from floodplains. Most flood damage is caused by water saturating materials susceptible to loss (e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings, and appliances). Most of the losses in the 1996 floods were due to saturation damage.

Homes

Housing losses accounted for the largest share of private property damage during the 1996 flood events.[16] Remembering that the 100-year flood will be five feet above the 1996 flood, it is likely that far more homes will be inundated when the 100-year flood occurs.

Table 5. Number of Buildings in the Floodplain by Zoning District

Number of Buildings in the Floodplain by Zoning District	
Zoning District	**Number of Buildings**
CB – Central Business	1
CC – Community Commercial	17
HD – Historic Downtown	1
HI – Heavy Industrial	19
HM – Hackleman Monteith	5
LI – Light Industrial	1
MUC – Mixed Use Commercial	11
OS – Open Space	33
RC – Regional Commercial	4
RM – Residential Medium Density	138
RR – Residential Reserve	548
RS-10 – Residential Single Family	62
RS-5 – Residential Single Family	27
RS-6.5 – Residential Single Family	125
TOTAL	**992**

Flood Insurance Claims

The City of Albany joined the National Flood Insurance Program in 1985. As of December 20, 2022, the City had 179 policies in force, with an insurance in-force whole amount of $49,212,600 and a written premium in-force amount of $128,266; of these policies, approximately 68% are for property in North Albany. Total losses in the City have been 17 residential property claims. Those claims have been paid out for a total payment of $124,681; of this total, $49,112 was paid out from damages due to the 1996 flood event.

Repetitive Flood Losses

Repetitive loss is a term that is usually associated with the National Flood Insurance Program (NFIP). Albany participates in the Community Rating System (CRS) which uses the term for any property on which the NFIP has paid two or more flood claims of at least $1000 in any 10-year period. Repetitive loss structures are important to the NFIP since structures that flood frequently put a strain on the flood insurance fund. On a local level, the structures are also important because residents' lives are disrupted and may be threatened by the continual flooding. As of December 2022, there were five repetitive loss structures in the community, all of which are residential properties located in North Albany.

Business and Industry

Flood events impact businesses by damaging property and by interrupting business. Flood events can cut off customer access to a business as well as close a business for repairs. In Albany, no businesses were inundated by flood waters in 1996, but business interruption was common because flooded roads and highways reduced the work force and stopped the movement of goods and supplies for several days. A quick response to the needs of businesses affected by flood events can help a community maintain economic vitality in the face of flood damage. Responses to business damages can include funding to assist owners in elevating or relocating flood-prone business structures.

Public Infrastructure

Publicly owned facilities are a key component of daily life for all residents of Albany. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Government can take action to reduce risk to public infrastructure from flood events, and to craft public policy that reduces risk to private property from flood events. During the 1996 flood, roads were the primary infrastructure affected by the flooding. The operation of the water treatment and wastewater treatment plants continued during the flooding. All public facilities continued to operate with only a few city parks, located in the floodplain, affected.

Critical Facilities

Of particular importance during flood events are critical facilities located in flood hazard areas. A critical facility is defined as a facility that needs to be operable during a flood, or for which even a slight chance of flooding might pose an unacceptable risk to health and safety. Critical facilities include schools, nursing homes, hospitals, police, fire, and other emergency responders, and installations that produce, use, or store hazardous materials. Based on this definition, there are four critical facilities that are on property in the floodplain; however, only a portion of these properties are within the special flood hazard area and most of the buildings are located outside of the floodplain boundary. These include: 1) Public Works Operations and Wastewater Treatment Plant (310 Waverly Drive NE); 2) Water Treatment Plant (300 Vine Street SW); 3) North Albany Elementary School (815 East Thornton Lake Drive NW); and 4) North Albany Middle School

(1205 North Albany Road NW). During the 1996 flooding event, no City of Albany public building was directly affected by the flooding.

Life Safety

Willamette River

The Willamette River has a river gauge that is located at the base of the Ellsworth Street Bridge and can be electronically read on the National Weather Service website. The electronic read provides for five days of actual river depth and flow history and five days of future forecast as reported by the National Weather Service. The gauge also has the action stage, flood stage, moderate flood stage, and major flood stage on the chart so you can see immediately where the river is in reference to potential flooding. This gauge provides the city with up-to-date river levels that it can use to determine the immediate impact to the community. Using the five-day forecast portion of the gauge provides the city the opportunity to plan for future impacts that flooding may have on specific portions of the city depending on river flood stages and city elevations.

Calapooia River and Local Creeks

Unlike the Willamette River, the Calapooia River, Periwinkle Creek, Oak Creek, Truax Creek, and Cathey Creek do not have gauges on them. Determination of the water levels on these waterways relies directly on observation at specific locations along the course of the river or creeks. Flow heights and rates depend on the amount of rain that falls in one hour or 12 hours. With heavy rains, the creeks can rise very quickly, but when the rain stops, the creek levels will also fall very quickly. Because of the variance of these creeks, it is very difficult for the City to predict to what levels they will rise, the impact they may have on the community and what response action the City should take. In some cases, the City has identified areas where the road is blocked to drivers when the water levels get to the edge of the road. Lochner Road is one such road where signs have been posted warning drivers “When Flooded, Turn Around, Don’t Drown.” Identification of the water levels is done by direct observation at specific locations, not by predicting future creek levels.

Notification of the Public

The city has put in place a preparedness team made up of Fire, Police, Public Works, Community Development, Parks & Recreation, Geographic Information Systems, and the Public Information Officer. For river flooding, we have identified two trigger points that will mark the need for this team to get together. The information we use to identify the trigger points is provided by the National Weather Service. The first trigger point is when 3.5 inches of rain may fall within a 48-hour period. The second is when the Willamette River level gets to the action stage, 21.6 feet. The purpose of the team is twofold: first, to coordinate any response that City departments may need to take; and second, to determine the information to release to the public to inform them of what to expect and how to be prepared.

Dissemination of information to the public will be done through Albany Alerts, the City’s website, Twitter, and Facebook. In extreme cases, where immediate notification to the public or to specific segments of the city are necessary, the city works with Linn County and uses the Linn-Benton Alert system which targets telephone landlines and cell phones to provide a message. In very extreme cases, door-to-door notification to evacuate is used.

Roads

During natural hazard events, or any type of emergency or disaster, dependable road connections are critical for providing emergency services. Emergency vehicles can be delayed because of restricted mobility in flooded areas. Bridges are key points of concern during flood events for two primary reasons: 1) They are often important links in road networks, crossing water courses, or other natural features; and 2) they can be obstructions in watercourses, inhibiting the flow of water during flood events.

During the 1996 flood, the City of Albany had no major problems with bridges creating obstructions in the watercourses; however, roads affected were located in North Albany along the Willamette River, west Albany along the Calapooia River, south Albany along Oak Creek, and in east Albany where Interstate 5 was shut down due to high water. Several roads outside the city flooded and did have an impact on traffic patterns in the local area but caused no major traffic problems. Streets that are likely to be closed during major flood events are identified in Table 6- 11.

Table 6. Major Streets Impacted by Flooding

Major Streets Impacted by Flooding		
Street Classification	**Street Name**	**Flooding Source**
Principal Arterial	Highway 20	Willamette River
Minor Arterial	Columbus Street Lochner Road Queen Avenue Riverside Drive Spring Hill Drive	Oak Creek Oak Creek Calapooia River Calapooia River Willamette River Overflow
Collector	Bryant Drive Oakville Road Quarry Road	Calapooia River Calapooia River Willamette River Overflow

During the flood of 1996, one overtopping took place on Interstate 5 where water backed up due to insufficient sizing of a drainage pipe under a railroad track. This problem was corrected after the flood with the cooperation of state and local governments and the railroad owners. Over the years, other mitigation projects have improved the threat of flood hazard in North Albany, including raising the height of the bridges over the Willamette River, raising portions of Highway 20 and North Albany Road, and by adding several culverts to Quarry Road. In 2015, North Albany Road was reconstructed between Quarry Road and the Portland & Western Railroad tracks in order to make this critical lifeline route passable to emergency vehicles during a 100- year flood. Meeting this goal required raising the roadway by approximately two feet between Thornton Lakes and West Thornton Lake Drive and replacing the bridge over Thornton Lakes.

Storm Water System

The City's storm water system is considered by the state as separated from the wastewater treatment system. Most storm water will run into local creeks, streams, and rivers in and around the city. All water from this system will ultimately end up in the Willamette River. The higher the river, the more difficult it is for storm water run-off to make it to the river. During significant rain events, the city typically experiences localized flooding first followed by river flooding after the rain event has passed. In 1996, because the Willamette River reached five feet above flood stage, some streets flooded with storm water back-up. This situation was not a major problem in the City's storm water infrastructure.

During heavy rains not necessarily associated with high river levels, sections of the storm system can become inundated and result in localized flooding. In general, these events do not cause damage to the City's storm water system and subside relatively quickly.

Water Treatment Facility

The City's historic Vine Street Water Treatment Plant is located high above the Calapooia River near where it enters the Willamette River. Because of this location, the facility is not prone to flooding. In the 1996 flood, the plant was affected by run-offs into the canal that brings water to the plant intake. Because water was coming in from urban settings in Lebanon and local farm fields, the water was extremely dirty, requiring adjustments in purification. At no time was the treatment plant shut down due to direct flooding. The City now has two water sources and treatment facilities that provide redundancy and alternatives during high-water situations. The City's second treatment plant was built in 2005, is co-owned with the City of Millersburg and located near Millersburg. The intake and pump station are at the confluence of the North and South Santiam rivers and the treatment facility is located above ground level. One-hundred-year flood considerations were taken into account when the intake, pump station, and treatment facility were designed.

Wastewater Treatment Facility

The City of Albany Wastewater Treatment Plant property is partially located within the 100-year floodplain. In the 1996 flood, the water did not get high enough to shut down the plant. However, a number of pumping stations were inoperable due to flooding in local vaults throughout the city. The treatment plant was completely updated in 2009 and was designed so that none of the buildings are located within the 100-year floodplain. Additionally, the location of the new plant resulted in the increase in head flow which allows water to flow into the Willamette River even during major flooding events.

During heavy rains not necessarily associated with high river levels, the City's sewer piping system can also be inundated, even though it is separated from the storm water system. This occurs through surface and groundwater inflow and infiltration into holes, cracks, and unknown inlets into an aging sewer piping network. When this occurs, like during the January 2012 event, sewage can back up in the system and spill out of sewer manholes onto the ground, into basements, or out of the sewer overflow pipes into the river. These sanitary sewer overflows do not generally cause major damage; however, they can impact human health and water quality as well as compliance with the City's wastewater discharge permit from the Oregon Department of Environmental Quality.

In 2010, the city constructed Talking Water Gardens, an engineered wetland designed to receive treated effluent from the City's Wastewater Treatment Plant to cool the water prior to its final discharge to the Willamette River. During heavy rains and high river levels, water can back up the discharge line into Talking Water Gardens. It is anticipated that during extreme conditions, the river will overtop the nearest berm, causing damage to the berm and the facility. The city is currently planning to install a valve in this discharge line to prevent water from backing up into the wetland and is identifying operating procedures to help minimize impacts during heavy rain and high river events.

Floods and Natural Systems

Maintaining and restoring natural systems helps mitigate the impact of flood events on the built environment. Flooding changes the natural environment and hydrology of an affected area. High water can be beneficial to the natural processes within a floodplain and can benefit riparian areas.

Parks and Open Space

Albany's Park, Recreation & Open Space Plan (2006), notes that natural open space areas "are important for a variety of reasons including flood storage, habitat protection, run-off reduction, etc." The Plan identifies open space resources along Horseshoe Lakes, Thornton Lakes, Truax Creek, Cox Creek, the Calapooia River, Oak Creek, and Burkhart Creek that should be preserved through acquisition. Albany has 271 acres of open space corridor along the Willamette River Greenway, at Takena Landing Park, and Periwinkle Creek. The Plan suggests that "natural open space should be designed and managed as a means of separation between uses or to protect and preserve the environment." The Plan advises that "improvements should be kept to a minimum, with the natural environment, interpretive, and educational features emphasized."

In the City of Albany, almost half of the land area in the floodplain is protected from development through open space zoning. Figure 6-12 identifies the land area in the floodplain within each zoning district. To summarize, there is a total of 1,431 acres of land that is located within the 100-year floodplain and 668 acres or 47% of that total is zoned open space. In addition, 229 acres or 16% of the total land area in the floodplain is zoned residential reserve, which limits development through a five-acre minimum lot size requirement. The majority of the remaining land area within the floodplain is zoned for residential single-family uses.

Table 7. Total Land Area in the Floodplain by Zoning District

Number of Buildings in the Floodplain by Zoning District		
Zoning District	**Area (Acres)**	**Percentage**
CB – Central Business	1	0%
CC – Community Commercial	16	1%
HD – Historic Downtown	1	0%
HI – Heavy Industrial	13	1%
HM – Hackleman Monteith	1	0%
LI – Light Industrial	17	1%
MUC – Mixed Use Commercial	27	2%
OP – Office Professional	0	0%
OS – Open Space	668	47%
RC – Regional Commercial	21	1%
RM – Residential Medium Density	49	3%
RMA – Residential Med. Density Attached	0	0%
RR – Residential Reserve	229	16%
RS-10 – Residential Single Family	68	5%
RS-5 – Residential Single Family	35	2%
RS-6.5 – Residential Single Family	284	20%
WF – Waterfront	1	0%
TOTAL	**1,431**	**100%**

Riparian Areas

Riparian areas are important transitional area that link water and land ecosystems. Vegetation in riparian areas is dependent on stream processes such as flooding and often is composed of plants such as willow and cottonwood trees that require large amounts of water. Healthy vegetation in riparian buffers can reduce streamside erosion. During flood events, high water can cause significant erosion. Well-managed riparian areas can reduce the amount of erosion and help to protect water quality during flooding events. Albany relies on Open Space zoning, riparian corridor overlay district, and natural area acquisition as the primary tools for protecting riparian areas. Restoration of riparian areas is often a condition of annexation.

Wetlands

Many floodplain and stream-associated wetlands absorb and store storm water flows, which reduces flood velocities and stream bank erosion. Preserving these wetlands reduces flood damage and the need for expensive flood control devices such as levees. When the storms are over, many wetlands augment summer stream flows by slowly releasing the stored water back to the stream system.[17] Wetlands are highly effective at removing nitrogen, phosphorous, heavy metals, and other pollutants from water. For this reason, artificial wetlands are often constructed for cleaning storm water runoff and for tertiary treatment (polishing) of wastewater. Wetlands bordering streams and rivers and those that intercept runoff from fields and roads provide this valuable service free of charge.[18] Significant wetlands found along rivers, lakes, and streams are protected as part of the riparian corridor and the significant wetland overlay district.

Water Quality

Long-term water quality monitoring is conducted by the Oregon Department of Environmental Quality (DEQ). Albany is located in the Upper Willamette sub-basin. DEQ indicates that bacteria, mercury, and temperature are significant concerns in this watershed. People can become sick if they ingest water that is contaminated with bacteria when they are swimming or otherwise in contact with the water. Both urban and rural/agricultural sources are major contributors to the high bacteria levels found in many of the rivers in the Upper Willamette. DEQ has set a goal to reduce bacterial loads by addressing direct discharges and runoff of bacterial sources. The Willamette River has fish consumption advisories due to elevated levels of mercury found in some fish species. DEQ is aiming for a reduction in the load of total mercury from point sources and non-point erosion. Waters in the Upper Willamette sub-basin are warmer than necessary to protect salmonid rearing and spawning. Reductions in stream temperature can be achieved by reducing solar radiation loading by planting vegetation to increase streamside shading and by improving base flows. DEQ is working with the City of Albany to monitor and to reduce inflow and infiltration problems that cause sewage bypasses that discharge untreated sewage to the Willamette River.

Flood Hazard Vulnerability: Estimating Potential Losses

Section 201.6(c)(2)(*ii*)(B) of the Disaster Mitigation Act of 2000 requires that the risk assessment include an estimate of the potential dollar losses to vulnerable structures.

Value of Vulnerable Structures

Residential: There are approximately 973 parcels in residential use that are located in the regulatory floodplain. The approximate improvement value on those parcels is $155 million. Of those parcels, 659 are pre-FIRM[19] structures (constructed in 1985 or earlier) with approximately $82 million in improvement value; 314 of those parcels are post-FIRM[20] structures (constructed in 1986 or later) with an approximate improvement value of $73 million. Although there are twice as many parcels with pre-FIRM structures in the floodplain than post-FIRM parcels, the improvement value of post-FIRM structures is almost equal to the pre-FIRM structures. It can be estimated that the potential dollar losses for residential structures from a 100-year flood event would be in the millions of dollars.

Non-Residential: Estimating the potential dollar losses for non-residential structures is less certain than for residential structures. Non-residential properties are often larger than residential properties, and the structures may not be located in the floodplain even though the parcel intersects with the floodplain. In addition, the improvement value of non-residential structures is often much higher than residential structures, particularly for public facilities. Consequently, a parcel may have only a portion of land located in the floodplain, an improvement value of $2 million but none of the structures are actually located in the floodplain. Therefore, the estimated potential dollar losses can be misleading for non-residential structures. With this understanding of the limitations for this analysis, there are more than 80 parcels in non-residential use that are located in the regulatory floodplain. The approximate improvement value on those parcels is just under $171 million.

Mitigation Plan Goals and Existing Activities

The Mitigation Plan goals, and action items are derived from meetings with the Steering Committee and Floodplain Management Planning Committee. It was the City's decision to use the mission, goals, and themes of the City's Strategic Plan to tie in with the Natural Hazard Mitigation Plan. More detail on this tie-in can be found in Section 4: Mitigation Plan Mission, Goals, and Action Items. Below find the existing mitigation activities the City has in place and a link to the action items applicable to flooding mitigation approved and adopted by the Floodplain Management Planning Committee and the Steering Committee.

Existing Mitigation Activities

Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies or organizations.

City of Albany Programs

National Flood Insurance Program
The City of Albany joined the National Flood Insurance Program (NFIP) in 1985. By participating in the program, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners within the community. The Albany Community Development Department administers the City's floodplain management program. The City's policy is to allow development in the floodplain to the extent permissible under NFIP, but City staff also works closely with developers to avoid or reduce exposure to flood hazards. Building inspectors, engineers, and planners make sure that new development meets the City's requirements for construction in the floodplain. In 2015, the City was in good standing with the NFIP; a mitigation action item supports continuation of the city's participation in the NFIP.

Community Rating System
The City also participated in the Community Rating System (CRS), which is a voluntary program that extends discounts on flood insurance to participating communities. The City joined the CRS program in 1990, with a classification rating of 9. They City's rating improved to a Class 7 by 2005, and to a Class 6 in 2011. The City's current Class 6 rating extends a 20% discount on flood insurance premiums to residents, business owners, and property owners with property in the special flood hazard area. In 2015, the City was in good standing with the CRS program. The Class 6 rating discount amounts to an annual savings of approximately $323 per insurance policy, or $55,150 for the community. The City has a mitigation action item related to researching ways to improve its CRS rating.

Parks and Recreation
The Albany Parks & Recreation Department acquires land for parks and open space conservation. Flood-prone areas like Bryant Park, Monteith Riverpark, Bowman Park, and Takena Landing Park have become desirable park land. The Department also acquires floodplain land to conserve open space natural areas such as Willamette River Greenway, Simpson Park, and East Thornton Lake Natural Area.

Comprehensive Plan
The Albany Comprehensive Plan, Flood Hazard goal is to protect life and property from natural disasters and hazards. The flood hazard policies in the plan guide regulation of development in flood hazard areas toward that goal. Risk reduction measures in areas subject to flood hazards are implemented through application of the Albany Development Code.

Development Code
The Albany Development Code (ADC) regulates land development in the city. A floodplain development permit is required for all development conducted in the Special Flood Hazard Area (also referred to as the 100-year floodplain).

The FEMA FIRMs are adopted as the city's flood hazard inventory. The floodplain overlay district standards in the ADC, Article 6 are intended to manage development in the floodplain in a way that promotes public and environmental health and safety and minimizes the economic loss and social disruption caused by impending flood events.

The open space zoning district is another tool to limit development in flood-prone areas. The open space zoning district is intended for the continuation and preservation of existing agricultural uses, park and recreation areas, wildlife habitats, wetlands, natural areas, flood conveyance, and uses that do not involve the construction of structures other than minor accessory facilities required to conduct the principal use. Approximately half of the land area in the city that is located within the 100-year floodplain is zoned open space.

Annexation agreements, riparian corridor and significant wetland overlay districts also protect new development from flood-prone natural areas.

Stormwater Management Program
The City of Albany has developed stormwater management engineering standards that apply to both public and private development and construction within the City. The main objectives of the standards are to design systems that provide safe and controlled management and conveyance of stormwater generated upstream and on-site to approved downstream channels and drainage facilities, considering existing and future development and capacity. The standards also aspire for developed properties to maintain the runoff characteristics of the original undeveloped drainage basin as well as improve overall stormwater quality, with the goal of reducing the overall impacts and volume of stormwater runoff. While volume control is not required, the City's recently adopted post-construction stormwater quality standards promote infiltration, but don't rely on it.

The City is in the process of updating its Stormwater Master Plan which evaluates existing system deficiencies, anticipated future needs, and regulatory requirements. While this plan will likely reference comprehensive land use planning and floodplain analysis, the scope of the Stormwater Master Plan is focused on mitigating routine storms and not large magnitude natural hazard flooding.

Erosion Prevention and Sediment Control Program

The City of Albany's Erosion Prevention and Sediment Control (EPSC) program has been established as a part of the City's comprehensive Stormwater Management Plan. This plan addresses federal water quality mandates and helps set local policies and procedures to protect the quality of our waterways. The EPSC program is designed to protect our local waterways and City's stormwater system from pollution generated by ground disturbing activities. An EPSC permit is needed for land-disturbing activities affecting an area of 2,000 square feet or greater.

Linn County Programs

Comprehensive Plan

The Linn County Comprehensive Plan includes an inventory of areas subject to natural hazards and a set of Plan policies to guide development within known hazard areas. The FEMA FIRMs are adopted as the county's flood hazard inventory. Risk reduction measures in areas subject to natural disasters and hazards are implemented through application of the county's Land Development and Floodplain Management Codes.

Land Development and Floodplain Management Codes

The Land Development Code protects public safety and restricts development activities within inventoried natural hazard areas. All development regulated by the Land Development Code must be located outside the mapped 100-year floodplain unless it is demonstrated that the use can be designed and engineered to comply with accepted hazard mitigation requirements. All development within the floodplain must conform to the requirements of the Linn County Floodplain Management Code (LCC Chapter 870). The purpose of the Floodplain Management Code is to promote public safety and welfare and to reduce the potential for loss of life and property damage. This is achieved by requiring construction in a manner that will reduce flood impacts; by managing the alteration of the floodplain, channels, and natural barriers that accommodate or channel flood waters; and other planning and site development measures. The FIRM floodplain information is incorporated into the county's GIS data. Grading permits and removal/fill regulations are also administered through the Floodplain Management Code.

Public Facilities

The Linn County Road Department maintains county roadways, bridges, culverts, and roadside drainage systems to reduce flood impacts.

Benton County Programs

Comprehensive Plan

The Benton County Comprehensive Plan, Goal 7 Natural Hazards includes policies that guide regulation of development in flood hazard areas. The FEMA FIRMs are adopted as the county's flood hazard inventory. Risk reduction measures in areas subject to natural disasters and hazards are implemented through application of the Benton County Land Development Code.

Development Code

The Benton County Development Code regulates land development in the county. A floodplain development permit is also required for all development conducted in the Special Flood Hazard Area (also referred to as the 100-year floodplain).

Stormwater Program

Benton County staff from Community Development, Environmental Health, and Public Works have developed and implemented a National Pollutant Discharge Elimination System (NPDES) program. The program requirements are part of the Clean Water Act that local governments and private organizations must comply with for discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The overall goal of the Benton County Stormwater Program is to reduce the volume of runoff from current development (for example parking lots and subdivisions) and the developing landscape, while reducing the amount of pollutants carried by stormwater runoff to our rivers and streams.

State Programs

Natural Hazard Planning

Goal 7 of the Statewide Planning Goals administered by the Department of Land Conservation and Development (DLCD) requires local governments to adopt flood protection policies and controls. The DLCD also administers the NFIP in Oregon, and every community with identified flood hazards is a member of this program. Thus, these local governments are required to adopt the NFIP's minimum requirements. The NFIP is comprised of a flood hazard mapping component, an enforcement component, technical assistance, and insurance which provides a financial safety net for owners of improved property. All four components of the NFIP work together to reduce flood losses.

Oregon Department of Emergency Management (OEM)

OEM is involved in many programs that mitigate the effects of flooding including the Hazard Mitigation Grant Program, the Flood Mitigation Assistance Program, co-sponsoring and participating in training workshops. Also, as part of its warning responsibilities, OEM notifies local public safety agencies and keeps them informed of potential and actual flood conditions so prevention and mitigation actions can be taken.

State of Oregon Removal/Fill Law

The Oregon Removal/Fill Law, which is administered by the Oregon Department of State Lands (DSL), requires a permit for activities that would remove or fill 50 cubic yards or more of material in waters of the state (e.g. streams, lakes, wetlands). The Albany Community Development Department is a cooperating partner with DSL by maintaining waterway and wetlands maps for public use, referring affected owners to DSL, and coordinating permit activities.

Oregon's Wetlands Protection Program

Oregon's Wetlands Protection Program was created in 1989 to integrate federal and state rules concerning wetlands protection with the Oregon Land Use Planning Program. The Wetlands Program has a mandate to work closely with local governments and the Oregon Department of State Lands (DSL) to improve land use planning approaches to wetlands conservation. A local wetlands inventory is one component of that program. DSL also develops technical manuals, conducts wetlands workshops for planners, provides grant funds for wetlands planning, and works directly with local governments on wetlands planning tasks. Albany has compiled a local wetlands inventory for lands where development is likely to occur. Using the Oregon Freshwater Assessment Manual, the City has identified those wetlands that provide the greatest benefit to the community. These significant wetlands are commonly found in flood-prone areas. City planners also use annexation agreements and the Open Space zoning district to protect significant wetlands from new development.

Oregon Wetlands Joint Venture

The Oregon Wetlands Joint Venture is a coalition of private conservation, waterfowl stewards, fisheries, and agricultural organizations working with government agencies to protect and restore important wetland Habitats.[21]

Federal Programs

National Weather Service

The Portland Office of the National Weather Service issues severe winter storm watches and warnings when appropriate to alert government agencies and the public of possible or impending weather events. The watches and warnings are broadcast over National Oceanic and Atmospheric Administration weather radio and are forwarded to the local news media for retransmission using the Emergency Alert System.

National Resources Conservation Service (NRCS), U.S. Department of Agriculture

NRCS provides a suite of federal programs designed to assist state and local governments and landowners in mitigating the impacts of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource or that experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance to clearing debris from clogged waterways, restoring vegetation, and stabilizing riverbanks. The measures taken under EWP must be environmentally and economically sound and generally benefit more than one property.

Federal Emergency Management Agency (FEMA) Programs

FEMA resulted from the consolidation of five federal agencies that dealt with different types of emergencies. Many states and local jurisdictions have accepted the same approach and changed the names of their organizations to include the words "emergency management." FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for flood mitigation projects, and technical assistance.

National Flood Insurance Program

Flood Insurance is available to citizens in communities that adopt and implement NFIP siting and building standards. The standards are applied to development that occurs within areas subject to inundation during a base flood event. These areas are depicted on federal Flood Insurance Rate Maps. Oregon's Department of Land Conservation and Development (DCLD) is the state's NFIP-coordinating agency. The Community Development Department is the local repository for floodplain information for the City of Albany.

The Community Rating System

The Community Rating System (CRS) is a voluntary program that recognizes community floodplain management efforts that go beyond the minimum requirements of the NFIP. When a community exceeds the minimum requirements, food insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the CRS goals. The three goals of the CRS program are: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance.

Property owners in Albany receive reduced NFIP flood insurance premiums in return for floodplain management practices that qualify the City for a CRS rating. CRS communities are rated on a scale of 10 to 1, where each number represents a five percent reduction in flood insurance premiums (10 = 0%, 1 = 45%). The City of Albany has been a CRS participant since 1990. Albany's current rating of 6 amounts to a 20 percent reduction in insurance premiums for Albany residents.

The U.S. Army Corps of Engineers

The Corps plays a major role in a coordinated and complex system to reduce flood risks and provide water for hydropower generation, fish and wildlife enhancement, navigation, recreation, and other uses. Portland District's primary water management mission is to save lives and reduce property damage by reducing flood risks with measures both structural (such as dams) and non- structural (such as improving the natural function of floodplains).

[1] Oregon Climate Service
[2] City of Albany Comprehensive Plan Background Report, 1980
[3] Ibid
[4] Ibid
[5] Ibid
[6] Ibid
[7] U.S. Army Corps of Engineer Guidelines for Flood Emergency Plans, Nov. 1981
[8] Ibid
[9] Ibid
[10] Ibid
[11] Ibid
[12] Ibid
[13] *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Department of Land Conservation and Development (July 2000), Ch. 4.
[14] *Floodplain Management: A Local Administrator's Guide to the National Flood Insurance Program*. FEMA, Region X
[15] Ibid
[16] Ibid
[17] *Department of State Lands, Wetlands Functions and Assessment* (May 2001)
[18] Ibid
[19] Pre-FIRM Building is a building for which construction or substantial improvement occurred on or before the effective date of an initial Flood Insurance Rate Map (FIRM). The City of Albany adopted initial FIRMs on April 3, 1985; Benton County adopted initial FIRMs on August 5, 1986; and Linn County adopted initial FIRMs on September 29, 1986.
[20] Post-FIRM Building is a building for which construction or substantial improvement occurred after the effective date of an initial FIRM.
[21] Oregon Wetlands Joint Venture, Website: http://www.dfw.state.or.us/ODFwhtml/Wetlands/about.htm (May 2001)

Section 7: Earthquake

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Earthquake

Why are earthquakes a threat to the City of Albany?

Oregon is rated third highest in the nation for potential loss due to earthquakes. This is due at least in part to the fact that, until recently, Oregon was not considered to be an area of high seismicity and the majority of its buildings and infrastructure were not designed for ground shaking at the magnitude now expected. Recent studies of geological records show that Oregon has a history of seismic events and that the Cascadia Subduction Zone is capable of producing magnitude (M) 9.0 earthquakes.

Projected losses in the Cascadia region could exceed $12 billion. The Oregon Department of Emergency Management Cascadia Playbook estimates $30+ billion in economic loss; tens of thousands of buildings could be damaged or destroyed, up to 25,000 fatalities resulting from combined effects of earthquakes and tsunami, and tens of thousands of people in need of shelter because of destroyed or damaged homes in the event of a magnitude 9.0 Cascadia Subduction Zone earthquake. Coastal counties will experience a devastating tsunami on top of severe ground shaking (up to five minutes). Shaking intensity will be less in the I-5 Corridor and Southern, Central, and Eastern Oregon, but older buildings may incur extended damage.[1]

Identifying locations susceptible to seismic activity generated by local faults or the Cascadia Subduction Zone, adopting strong policies and implementing measures, and using other mitigation techniques are essential to reducing risk from seismic hazards in the City of Albany.

Several crustal faults west of Albany in Benton County have been identified. Albany has 7,190 buildings, including residences and businesses, which were built before 1969; many are wood or non-reinforced masonry construction.

Earthquake Characteristics

Most large earthquakes in the Pacific Northwest are shallow crustal, deep intraplate, or subduction zone earthquakes. These earthquakes can have great impact on Oregon communities.

Crustal Fault Earthquakes

Crustal fault earthquakes are the most common and occur at relatively shallow depths of 6-12 miles below the surface.[1] While most crustal fault earthquakes are smaller than magnitude 4.0 and generally create little or no damage, some can produce earthquakes of magnitude 7.0 and higher and cause extensive damage. Crustal earthquakes within the North American plate are possible on faults mapped as active or potentially active as well as on unmapped (unknown) faults. The only mapped active fault in Benton County is the Corvallis Fault, which runs in a southwest to northeast direction through the center of the county.

Historically observed crustal earthquakes in Oregon from 1841 to 2002 are shown in Figure 10-3 (DOGAMI, Map of Selected Earthquakes for Oregon, 1841 through 2002, Open-File Report 03-02, 2003). During this time period, only six small earthquakes occurred in Linn and Benton County.

[1] Cascadia_Playbook_V3.PDF (oregon.gov)

Larger earthquakes in nearby counties are also shown.

However, 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 any place in western Oregon, including almost any place in Linn and Benton County. Such earthquakes would mostly be much smaller than the Scotts Mills earthquake, up to about the magnitude of that 1993 earthquake. The possibility of larger crustal earthquakes in the M6+ range cannot be ruled out. However, the probability of such events is likely to be very low.

Because the probability of large crustal earthquakes (M6 or greater) affecting Linn and Benton County is low and because any damage in smaller crustal earthquakes is likely to be minor and very localized, crustal earthquakes are not considered significant for hazard mitigation planning purposes. Therefore, our analysis focuses on the larger, much more damaging earthquakes arising from the Cascadia Subduction Zone.

The characteristics of the subduction zone earthquakes affecting Linn and Benton County are summarized in Table 7.1 below. The maximum magnitudes are estimated from the length and width of the mapped fault plane or from similar earthquakes elsewhere in the Pacific Northwest (for the intraslab earthquakes). Recurrence intervals are based on current best estimates.

Table 1. Seismic Sources Affecting Benton County

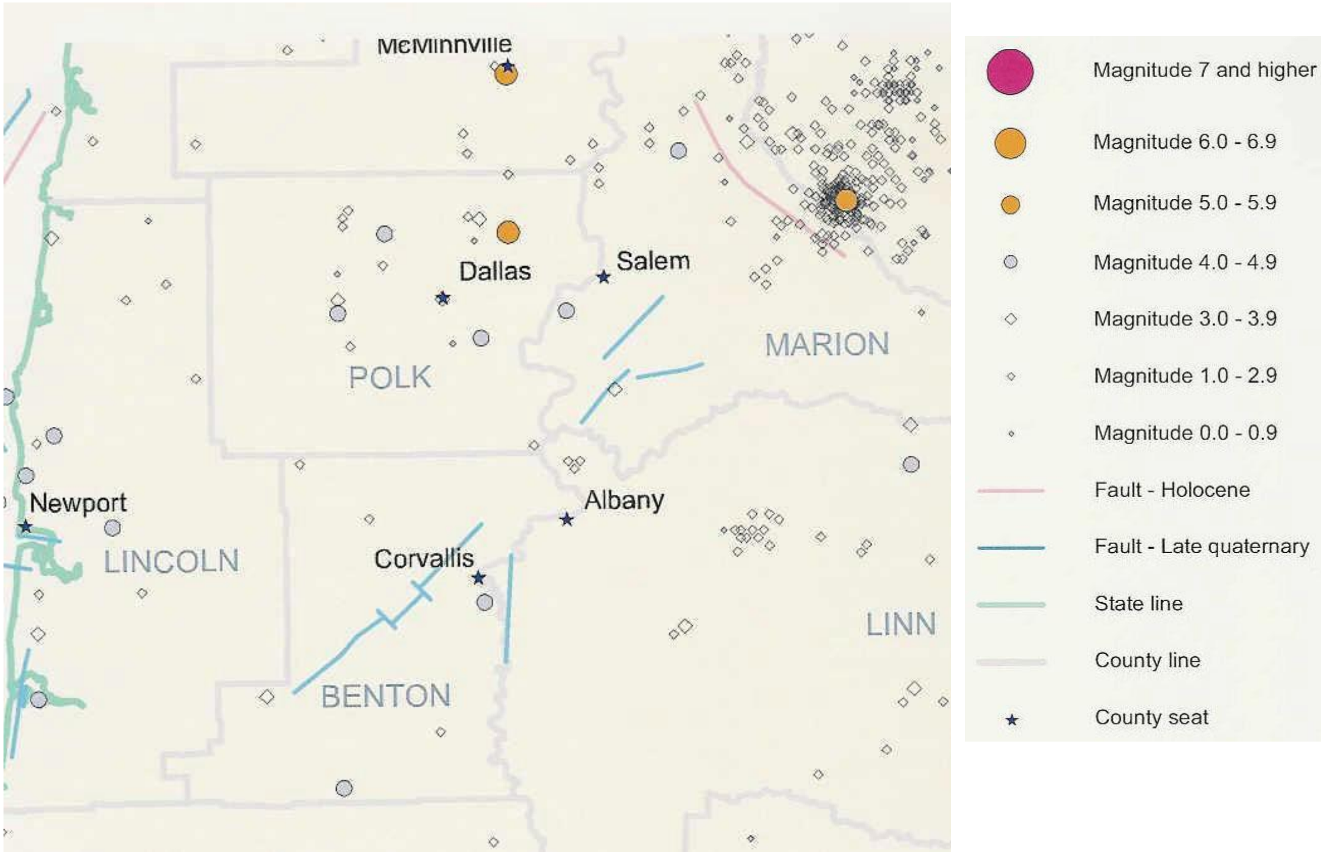
Fault	Maximum Magnitude	Probable Recurrence Interval (years)
Cascadia Subduction Zone (interface earthquake)	8.5	500 to 800
Cascadia Subduction Zone (intraslab earthquake)	7.5	500 to 1000

Source: Benton County Hazard Mitigation Plan; Earthquake Section

In addition to these large earthquakes, the Cascadia Subduction Zone also experiences smaller earthquakes such as the M6.8 Nisqually earthquake near Olympia, Washington on February 28, 2001. The Nisqually earthquake was an intraslab earthquake which occurred at a depth of 52 kilometers (about 30 miles). Other relatively recent similar Cascadia Subduction Zone earthquakes include the M7.1 Olympia earthquake in 1949 and the M6.5 Seattle-Tacoma earthquake in 1965. These earthquakes killed 15 people and resulted in over $200 million in damages (1984 dollars, www.dnr.wa.gov). Similar earthquakes are possible in Western Oregon, including in Linn and Benton County.

Figure 7.1 below shows a generalized geologic map of Benton County and includes the Corvallis Fault and other mapped faults. The mapped faults within or near Benton County are relatively small and not very active. Thus, seismic hazard for Benton County arises predominantly from major earthquakes on the Cascadia Subduction Zone. Smaller, crustal earthquakes in or near Benton County could be locally damaging but would not be expected to produce widespread or major damage.[2]

Figure 1. **Earthquake Epicenters from 1841 to 2002**



Source: Benton County Hazard Mitigation Plan; Earthquake Section

Deep Intraplate Earthquakes

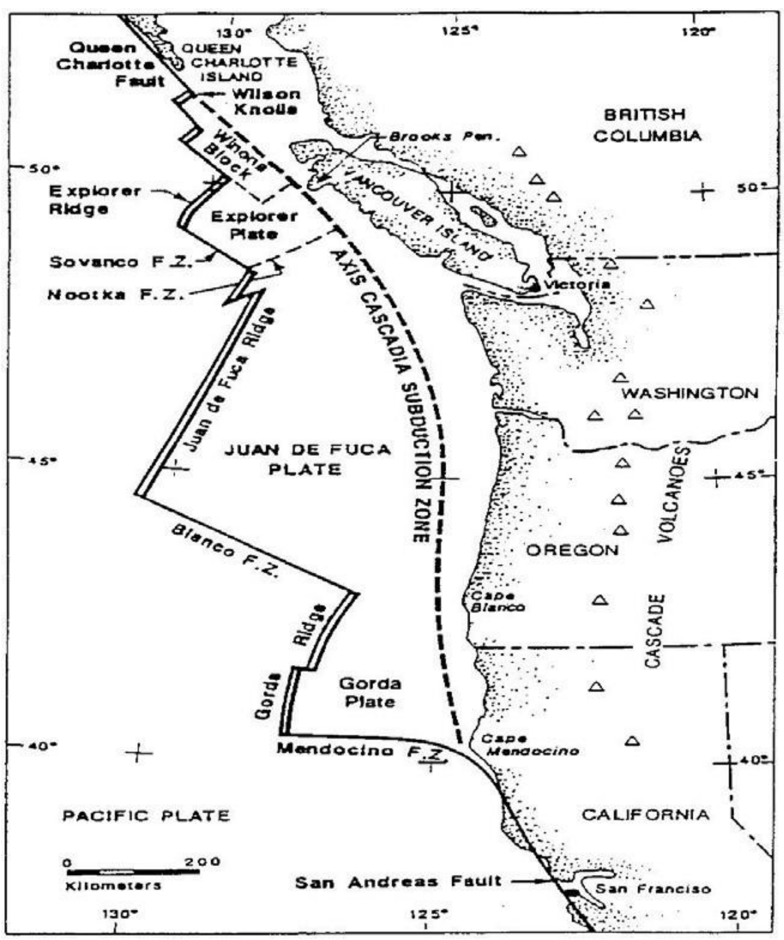
Occurring at depths from 25 to 40 miles below the earth's surface in the subducting oceanic crust, deep intraplate earthquakes can reach magnitude 7.5.[3] The February 28, 2001 earthquake in Washington State was a deep intraplate earthquake. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah. A 1965 magnitude 6.5- intraplate earthquake centered south of the Seattle-Tacoma International Airport caused seven deaths.[4]

Subduction Zone Earthquakes

The Pacific Northwest is located at a convergent plate boundary where the Juan de Fuca and North American tectonic plates meet. The two plates are converging at a rate of about 1-2 inches per year. This boundary is called the Cascadia Subduction Zone and extends from British Columbia to northern California. Subduction zone earthquakes are caused by the abrupt release of slowly accumulated stress. Subduction zones similar to the Cascadia Subduction Zone have produced earthquakes with magnitudes of 8.0 or larger. Historic subduction zone earthquakes include the 1960 Chile (magnitude 9.5) and the 1964 southern Alaska (magnitude 9.2) earthquakes. Geologic evidence shows that the Cascadia Subduction Zone has generated great earthquakes, most recently about 300 years ago. The largest is generally accepted to have been magnitude 9.0 or greater. The average recurrence interval of these great Cascadia earthquakes is approximately 500 years, with gaps between events as small as 200 years and as large as 1,000 years. Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes.

The December 26, 2005 Sumatra quake is an example of a subduction zone earthquake. This was the fourth largest earthquake in the world since 1900 and is the largest since the 1964 Prince William Sound, Alaska earthquake. In total, more than 283,100 people were killed and 126,900 were displaced by the earthquake and subsequent tsunami in 10 countries in south Asia and east Africa. The earthquake was felt at Banda Aceh, at Meulaboh and at Medan, Sumatra and in parts of Bangladesh, India, Malaysia, Maldives, Myanmar, Singapore, Sri Lanka and Thailand. The tsunami caused more casualties than any other in recorded history and was recorded nearly world-wide on tide gauges in the Indian, Pacific and Atlantic Oceans. Surface water oscillations were observed in India and the United States. Subsidence and landslides were observed in Sumatra.[5]

Figure 2. Cascadia Subduction Zone



Source: Benton County Hazard Mitigation Plan; Earthquake Section

Earthquake-related Hazards

Ground shaking

Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by an earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter (where the earthquake originates). Buildings on poorly consolidated and thick soils will typically see more damage than buildings on consolidated soils and bedrock.

Surface Fault Ruptures

Earthquakes are caused by the sudden movement, or rupture, of a fault. As the rupture zone progresses upward to the earth's surface, it can cause surface fault ruptures. The result is often displacement or offset of the ground surface. Generally, the larger the earthquake, the greater the potential for surface fault rupture. It is generally considered impractical to design structures to withstand damage under the stress of surface fault rupture. Additionally, once a structure is located astride a fault, it is impossible to mitigate the surface fault rupture hazard unless the structure is relocated.[6]

Earthquake-induced Landslides

Earthquake-induced landslides are secondary earthquake hazards that occur from ground shaking. They can destroy roads, buildings, utilities, and other critical facilities necessary to respond to and recover from an earthquake. Many communities in Oregon, including the city of Albany, are likely to encounter such risks. Albany's risk to landslide is minimal and restricted to the north part of the city in Benton County. It is here where the higher elevations are found, where buildings are constructed on the side of hills and where slides are likely.

Liquefaction

Liquefaction occurs when ground shaking causes wet granular soils to change from a solid to a liquid state. This results in the loss of soil strength and three potential types of ground failure: lateral spreading, flow failure, and loss of bearing strength. Buildings and their occupants are at risk when the ground can no longer support buildings and structures.[7] Areas of susceptibility to liquefaction include areas with high ground water tables and sandy soils.[8]

Amplification

Soils and soft sedimentary rocks near the earth's surface can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the magnitude of the seismic waves generated by the earthquake. Amplification depends on the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk.[9] Amplification can also occur in areas with deep, sediment filled basins.

The Department of Geology and Mineral Industries Interpretive Map Series-24 Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damages 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, published in 2008 by Burns, Hofmeister and Wang provides maps of susceptibility to earthquake-induced landslide areas. DOGAMI's HazVu Hazard map viewer provided the images of liquifiable soils and expected earthquake shaking provided below.

Figure 3. Liquefaction Potential in the Vicinity of Albany

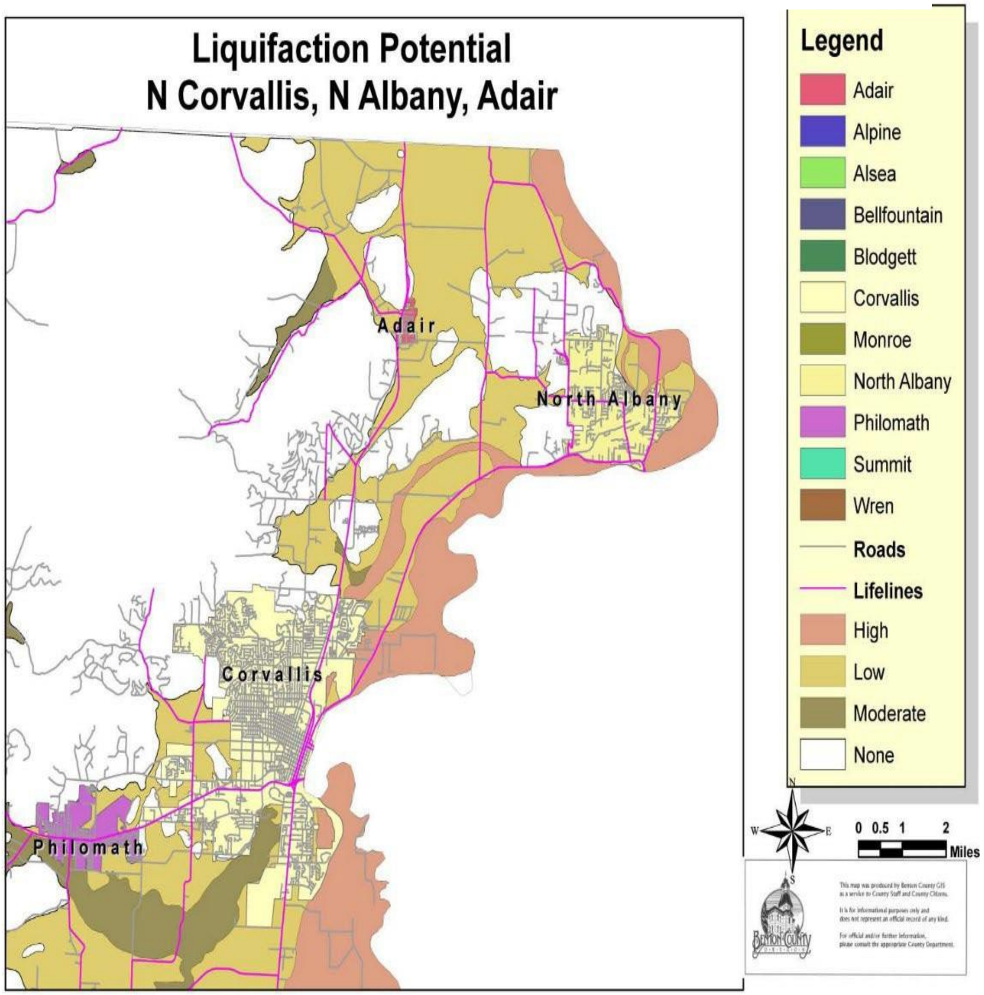


Figure 4. Relative Earthquake-Induced Landslide Susceptibility

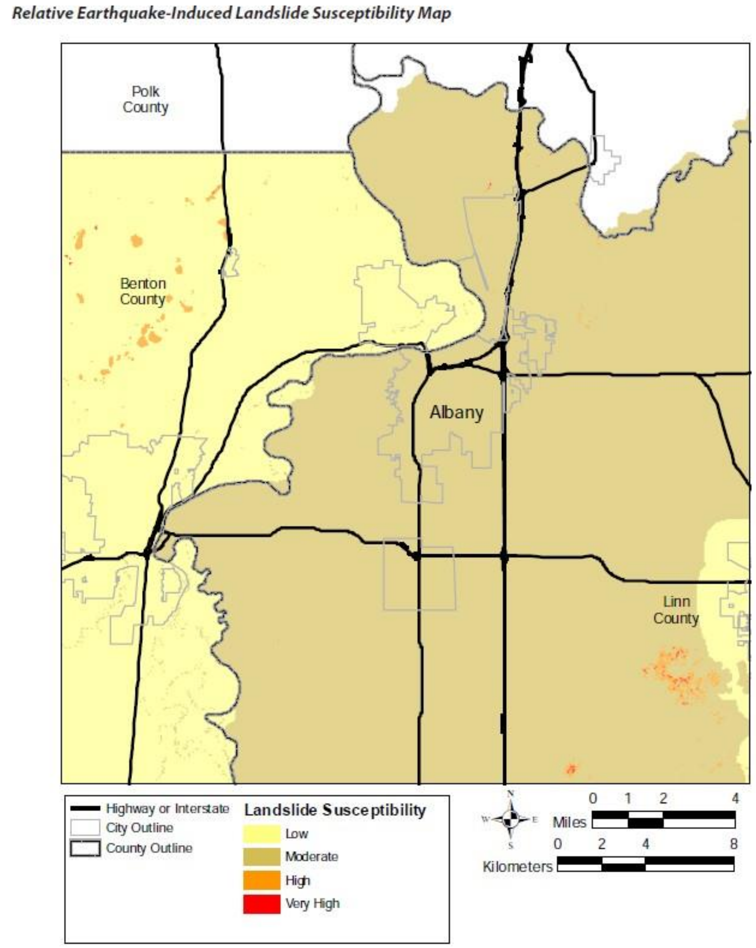
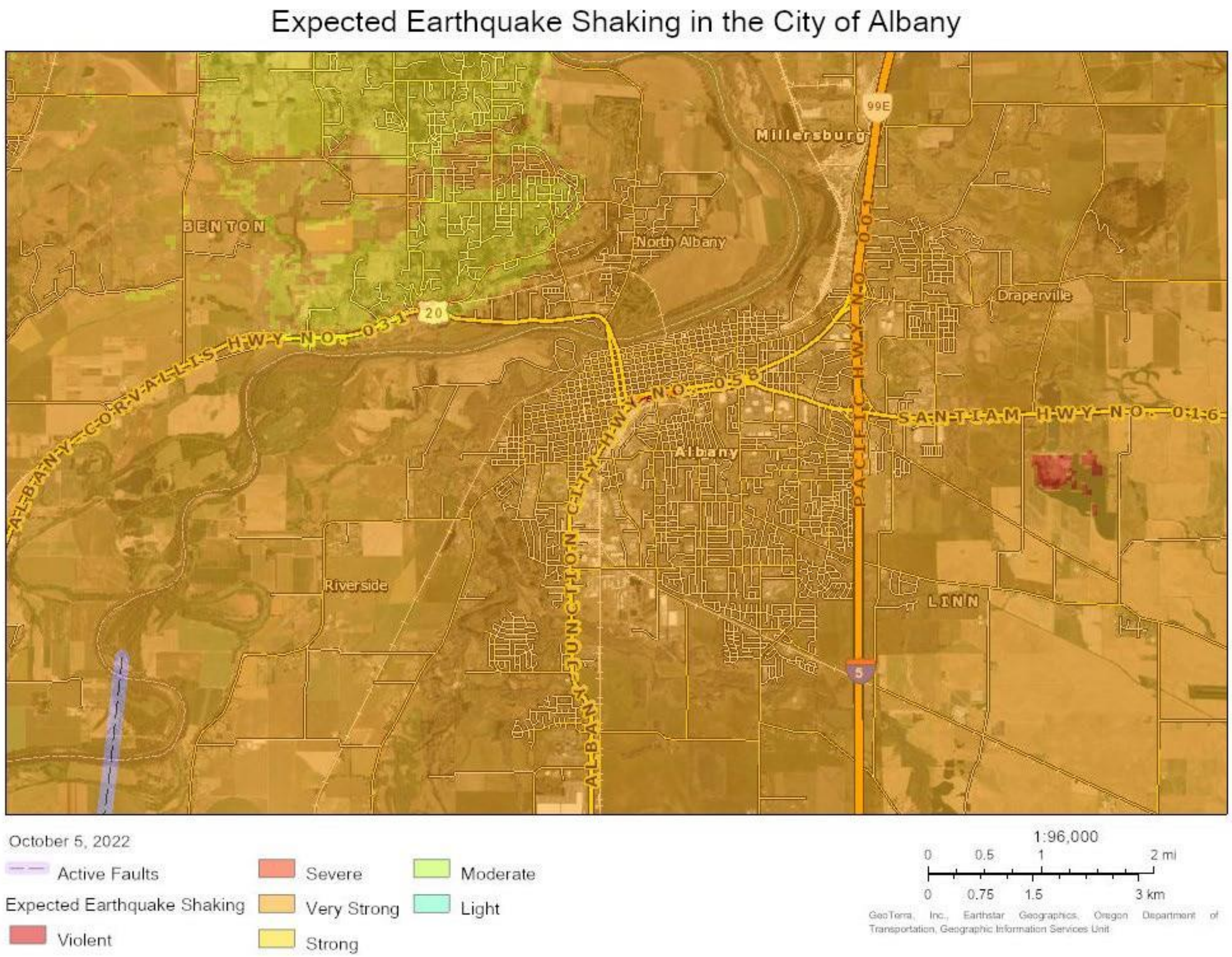


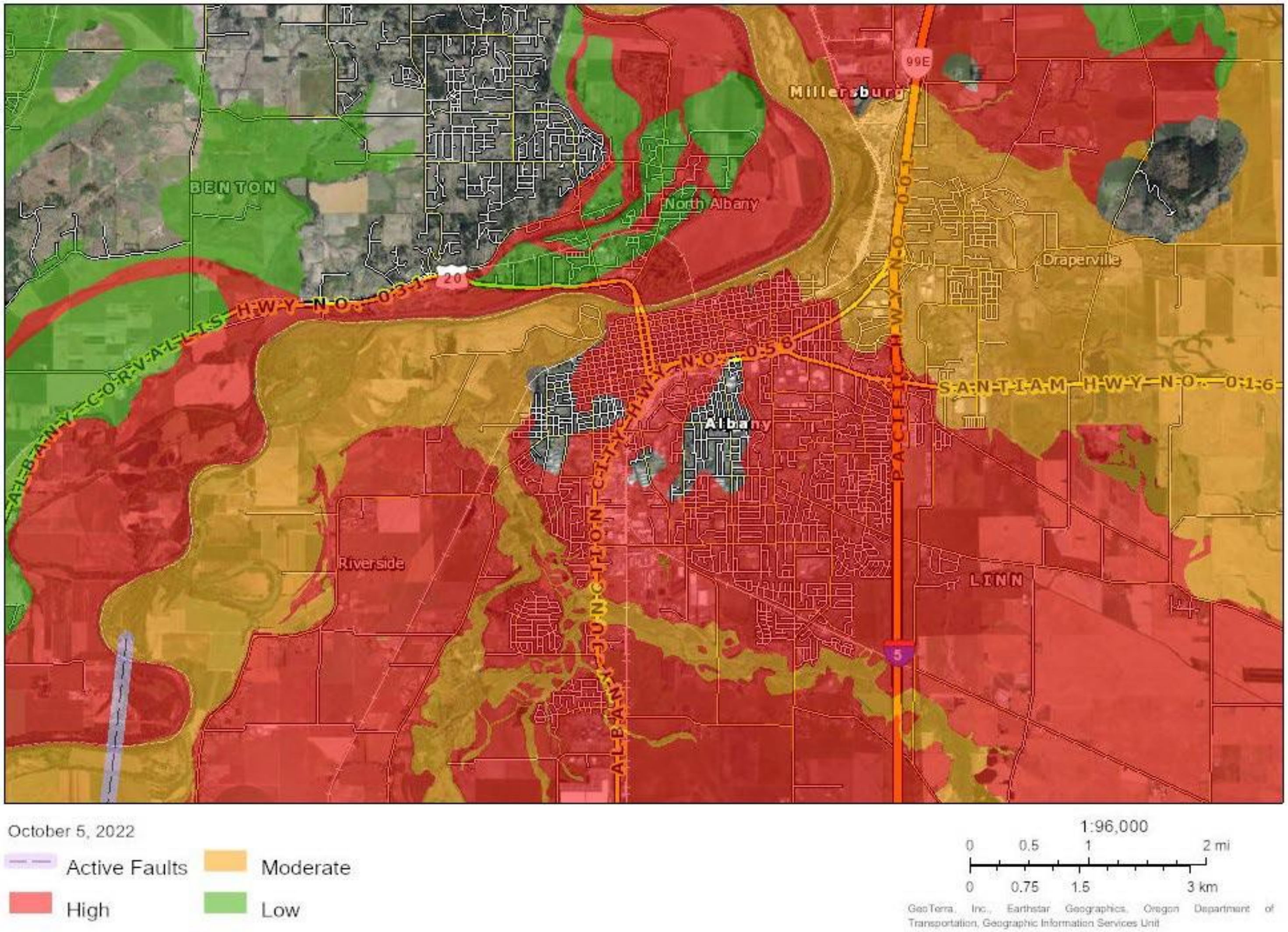
Figure B7. Relative earthquake-induced landslide susceptibility map for the City of Albany, Oregon. Benton County data we fied after Wang and others, 2001.

Figure 5. Expected Earthquake Shaking in the City of Albany



Source: DOGAMI HazVu hazards map viewer, consulted October 2022 [DOGAMI | Statewide Hazards Viewer - Introduction (oregongeology.org)]

Figure 6. Liquifiable Soils in the City of Albany



Source: DOGAMI HazVu hazards map viewer, consulted October 2022 [DOGAMI | Statewide Hazards Viewer - Introduction (oregongeology.org)]

Earthquake Risk Assessment and Hazard Profile

Section 201.6(c)(2)(*i*) of the Disaster Mitigation Act of 2000 requires that the risk assessment include a description of the location and extent of all natural hazards that can affect the jurisdiction. The Plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Location and Extent of Earthquake Hazard

The geographical position of the city of Albany makes it susceptible to earthquakes from four sources: (1) the off-shore Cascadia Fault Zone; (2) deep intraplate events within the subducting Juan de Fuca plate; (3) shallow crustal events within the North America Plate; and (4) earthquakes associated with renewed volcanic activity. All have some tie to the subducting or diving of the dense oceanic Juan de Fuca Plate under the lighter continental North America Plate. Stresses occur because of this movement and there appears to be a link between the subducting plate and the formation of volcanoes some distance inland from the offshore fault zone.

When crustal faults slip, they can produce earthquakes with magnitudes up to 7.0 and can cause extensive damage which tends to be localized in the vicinity of the area of slippage. Deep intraplate earthquakes occur at depths between 30 and 100 kilometers below the earth's surface. They occur in the subducting oceanic plate and can approach M7.5. Subduction zone earthquakes pose the greatest hazard. They occur at the boundary between the descending oceanic Juan de Fuca Plate and the overriding North American Plate. This area of contact, which starts off the Oregon coast, is known as the Cascadia Subduction Zone (CSZ). The CSZ could produce an earthquake up to 9.0 or greater.

The City of Albany has experienced a few historic earthquakes centered in the region. The area has been shaken historically by crustal and intraplate earthquakes and prehistorically by subduction zone earthquakes centered outside the area. The most devastating future earthquakes will probably originate along shallow crustal faults in the region and along the Cascadia Fault Zone. Deep-seated intraplate events, such as occurred near Olympia, Washington in 1949 and 2001, could generate magnitudes as large as M7.5.

Earthquake-associated hazards include severe ground shaking, liquefaction of fine-grained soils, and land sliding. The severity of these effects depend on several factors, including the distance from the earthquake source, the ability of soil and rock to conduct seismic energy and the degree (angle) and composition of slope materials. Earthquakes produced through volcanic activity could reach magnitudes of M5; however, the Cascade volcanoes are some distance away from populated centers, which tends to lessen the risk.

Previous Occurrences of Earthquakes

The earthquake which took place in 1961 was the only one to do minor damage in Albany out of the many earthquakes that have occurred in Oregon, Washington, California and in the Pacific Ocean. A strong earthquake in Del Norte County, California on November 22, 1873, was felt from Portland to San Francisco. On October 12, 1877, an earthquake apparently centered in the Cascade Mountains was felt in Portland. On February 3, 1892, another earthquake was felt from Astoria to Salem. In April 1896, three shock waves were felt from Portland to Salem. Other dates where quakes occurred and were felt in Oregon were April 19, 1906; October 4, 1913; May 18, 1915; April 14, 1920; February 25, 1921; January 10, 1923; April 8, 1927; July 15, 1936; December 29, 1941; December 15, 1953; November 16, 1957; August 18, 1961 (minor damage to Albany and Lebanon); November 6 1961; and May 26, 1968.The largest earthquakes in the state of Oregon were reported on August 8, 1910, and September 21, 1993, each a 5.7 magnitude. The 1910 earthquake was the largest historical shock within the state's boundaries but it occurred too far offshore to cause damage. The damaging 1993 earthquake was the largest historical earthquake beneath the land area of Oregon.

Since 1993, there have been 14 notable earthquakes in Oregon ranging in magnitude from 2.5 to 6.1. Most are in the 2.5 to 3.9 range. In 1993, Scotts Mills, had the distinction of having the largest earthquake in Oregon's history with a 5.7 on March 25. It was short lived as a record when on September 20, 1993, Klamath Falls, Oregon, reported magnitudes of 5.9 and 6.0 earthquakes.

February 28, 2001, Nisqually Earthquake- Magnitude 6.8
The most recent large earthquake to be felt in the Northwest was the Nisqually earthquake on February 28, 2001. This earthquake was centered northeast of Olympia, Washington, and measured a magnitude of 6.8 on the Richter scale. In the Puget Sound area, this quake caused 400 injuries, one quake-related death, and about $2 billion dollars in damage.[10] There was no damage in Albany from this earthquake; depending on where you lived in Albany, few people felt it.

March 25, 1993, Scotts Mills Earthquake- Magnitude 5.7
In 1993, the Scotts Mills earthquake (also known as the "Spring Break Quake") shook the northern Willamette Valley. It was a magnitude 5.7 on the Richter scale, and caused extensive damage primarily in the communities of Molalla, Woodburn, Newberg, McMinnville, and Salem. There was no damage created in Albany by this earthquake and depending on where you lived in Albany, few people felt it locally.

September 21, 1993, Klamath Falls Earthquakes – Magnitude 5.9
The most damaging far-inland earthquakes of the century occurred in the California-Oregon border region. These earthquakes occurred along faults which are part of the northernmost Basin and Range geologic province. Significant damage occurred in older unreinforced brick buildings in the Klamath Falls area, approximately 200 miles south of Linn County. Rock falls caused the death of one motorist. This sequence illustrates that inland communities, although not as frequently hit as coastal regions, are also vulnerable to strong earthquakes

November 5, 1962, Vancouver, Washington- Magnitude 5.2
Three and a half weeks after the devastating Columbus Day Storm, an earthquake that measured approximately 5.5 on the Richter scale shook northwest Oregon. It was the largest quake to be generated by a fault under Portland and Vancouver.[11] This earthquake disappeared quickly from headlines, most likely because residents were still recovering from the Columbus Day Storm.[12] This earthquake did not impact Albany.

April 13, 1949, Olympia, Washington- Magnitude 7.1
On April 13, 1949, residents of northwest Oregon felt an earthquake that was centered near Olympia, Washington. In Washington, this quake caused eight deaths and caused extensive damage to buildings and infrastructure. This earthquake did not impact Albany.

Probability of Future Earthquake Events
Though it is likely that another earthquake will occur which will either affect or be felt in the city, when it will occur is impossible to predict. The last earthquake to do damage in Albany was in 1961. Earthquakes have occurred in other parts of Oregon which have been felt in Albany but have done little or no damage. Given what appears as an increase in earthquake activity over the

last several years in Oregon and the United States as well as throughout the world, it is likely an earthquake will occur in the next 20 years.

Earthquake Vulnerability: Identifying Assets

Section 201.6(c) (2) (*ii)* (A) of the Disaster Mitigation Act of 2000 requires that the risk assessment include a description of the jurisdiction's vulnerability to the hazard. This description shall include an overall summary for the hazard and its impact on the community. If best available data allows, vulnerability should be described in terms of the type and number of existing and future buildings, infrastructure, and critical facilities located in identified hazard areas.

City of Albany Vulnerability Summary

Depending on the strength of the earthquake and the location to Albany, this type of event could affect all of the citizens in the community. If the earthquake is of any significant size, the downtown portion of Albany will likely have significant damage. The majority of the buildings in the downtown are unreinforced masonry ranging from one to five stories. At this time, most second stories and above are unoccupied, but there is a push to refurbish them into living space. Seismic retrofitting of these may not be possible. An earthquake during the day would create significantly higher deaths and injuries in this area than one that would occur in the evening.

Most homes in the city are single-story, built prior to seismic safety standards, so in a significant earthquake, many will be moved off their foundations. Most of Albany is located on flat land, but many homes in North Albany are built in multiple levels on sloped land. Many of these homes are newer and have been built to comply with seismic standards. Still, it would be expected that a large number of homes would be damaged not only from the earthquake, but from moving land they are built on.

Infrastructure damage to the water and sewer system would have a large impact on the citizens of Albany after an earthquake. The City's water piping system is old and a little is replaced each year. It would be expected that depending on the type of ground movement created from an earthquake, significant damage to underground pipes would occur as well as damage to the old treatment plant, established in 1912 and seismically updated in 2009. The wastewater treatment plant was substantially upgraded and expanded in 2009; all structures built or remodeled now meet current State of Oregon earthquake standards. Wastewater pipes are located in the same area as water pipes so significant damage to this system is expected also. A new intake, pumping and treatment facility was built in 2005 along the Santiam River north of Albany to serve the cities of Albany and Millersburg. These structures have been built to the State of Oregon's latest earthquake standards.

The City has several bridges that are not seismically upgraded, including the Lyon Street Bridge and the Ellsworth Street Bridge over the Willamette River. These bridges connect Linn and Benton counties. After a significant earthquake, these bridges will be out of service. In addition to these, many smaller bridges cross streams or canals and culverts underneath city streets. Depending on the size and type of earthquake event, these bridges and culverts will create significant transportation problems. Safe emergency traffic routes will need to be created to assure that emergency vehicles can get from each section of town to the othersafely.

Critical facilities will be impacted during an earthquake. At this time, two fire stations and City Hall have been built at the latest earthquake standard. The two remaining fire stations have been evaluated but not upgraded and the police station was built prior to the increased standards and has not been upgraded. Albany's hospital, which has four stories, was built prior to seismic standards and has not been upgraded. It can be expected that, if a significant earthquake occurs, major damage will take place at this facility.

The type and magnitude of an earthquake will have different effects on the city. Albany is not prepared to withstand a major event. The effect on the citizens and infrastructure will be catastrophic.

Earthquake Community Impacts

Earthquake damage occurs because structures cannot withstand severe shaking. Buildings, airports, schools, and lifelines including water, sewer, storm water and gas lines, transportation systems, electricity, and communication networks suffer damage in earthquakes and can cause death or injury to humans.

The welfare of homes, businesses, and public infrastructure is very important. Addressing the integrity of buildings, critical facilities, and infrastructure, and understanding the potential costs to government, businesses, and individuals as a result of an earthquake are challenges that the City of Albany must address.

Buildings

The built environment is susceptible to damage from earthquakes. Buildings that collapse can trap and bury people, putting lives at risk and creating great cost to clean up the damages. The Uniform Building Code classifies commercial buildings within categories A through F with residential buildings recognized as C, D1, and D2. All structures are assigned to a seismic design category based on their seismic use group, I - III, and the mapped spectral response acceleration coefficients: Ss and S1. In other words, would the failure of the building result in no real hazard as in Group I, a substantial public hazard as in Group II, or is it an essential facility as in use Group III. The response acceleration coefficients are short periods and one-second periods of ground movement shown as point values based on a percentage of gravity. The earthquake loads are based on energy dissipation in the structure designed to resist the earthquake's motion and accelerations. Seismic designs with a short period of 0.4g's or less do not need seismic design as in Categories A, B, and C. The maximum considered earthquake ground motions for the Albany area are approximately 0.933g for the short period and 0.4g for one second. Albany is in Seismic Design Category D which is comparable to the Seismic Zone 3.

In most Oregon communities, the majority of buildings were built before 1993, when seismic building codes were less strict. Upgrading existing buildings to present seismic levels can be very expensive. State code only requires seismic upgrades when there is significant structural alteration to the building or where there is a change in use which puts building occupants and the community at a greater risk. Therefore, approximately 7,000 buildings are at risk. The lack of funding for such activity is serious. For the City of Albany, the majority of older structures at risk to earthquakes are located in the downtown business district. This is where the multi-level buildings are located, most with unreinforced masonry. The east end of the city also has a large number of businesses built prior to the seismic code change and though they are at risk, nearly all are one-story buildings. The difference is that these buildings will have more people in them at any one time than the more dangerous downtown buildings, which do not have the volume of occupants.

Infrastructure and Communication

An earthquake can greatly damage bridges and roads, hampering the movement of people and goods. Damaged infrastructure strongly affects the economy of the community – it disconnects people from work, school, food, and leisure, and separates businesses from their employees, customers, and suppliers.

Bridge Damage

Even modern bridges can sustain damage during earthquakes, leaving them unsafe for use. Some bridges have failed completely due to strong ground motion. Bridges are a vital transportation link – with even minor damages making some areas inaccessible. Because bridges vary in size, materials, siting, and design, any given earthquake will affect them differently. Bridges built before the mid-1970s have a significantly higher risk of suffering structural damage during a moderate to large earthquake compared with those built after 1980 when design improvements were made. Much of the interstate highway system was built in the mid- to late 1960s.

The City of Albany has approximately 83 bridges within the city limits. The breakdown of ownership is: Benton County, one; Linn County, 15; City of Albany, 26; State of Oregon, 24; railroad, 17. The state bridges will have the highest priority for transportation. Two of the state-owned bridges cross the Willamette River as a part of Highway 20 between Albany and Corvallis. The loss of these bridges will have a significant impact on travel between North Albany and Benton County and the remainder of the City in Linn County. The next closest opportunity of getting to Benton County is Highway 34 about 10 miles south of Albany. Three additional bridges are located there, but they will be in the same condition as the ones in Albany. The remainder of the State-owned bridges is along the I-5 corridor and any damage to these bridges will have significant impacts on the city.

All bridges within the City have been identified in the City of Albany's emergency route maps so critical decisions can be made about potential traffic routes for both emergency and citizen movement.

Damage to Lifelines

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, electricity, and communication networks. Ground shaking and amplification can cause pipes to break, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after an earthquake to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public.

Disruption of Critical Facilities

Critical facilities include police stations, fire stations, hospitals, water and wastewater systems, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after an earthquake event. Many critical facilities are housed in older buildings that are not up to current seismic codes. For the City of Albany, City Hall and the two newest fire stations are built to present earthquake standards. Fire Station 12 has been seismically upgraded. Other City facilities are older buildings which do not meet current codes. Fire station 11 and the police station do not presently meeting current seismic code, but new stations are being built which will meet the new standards.

Businesses

Seismic activity can cause great loss to businesses, to large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Seismic activity can create economic loss that presents a burden to small shop owners who may have difficulty recovering from those losses. The downtown core business area has the oldest buildings in the city. Most are unreinforced masonry built in the early 1900s. These buildings meet no earthquake standards and are very susceptible to any earthquake that may occur. Even outside the core area, most commercial and industrial buildings were built 20 – 30 years ago under a different, less stringent, earthquake code. Even if the building housing a business is undamaged by an earthquake, the loss of bridges can disrupt employee access to work and the flow of raw materials and finished products that keep the company in business.

Earthquake Vulnerability: Individual Preparedness

A 1999 DOGAMI survey shows that about 39% of respondents thought an earthquake would occur in Oregon within the next 10 years. Only 28% of Oregon residents say they are prepared for an earthquake and 22% have earthquake insurance. In addition, only 24% correctly identified what to do during an earthquake.[13]

Because the potential for earthquake occurrences and earthquake-related property damage is relatively high, increasing individual preparedness is a significant need. Strapping down heavy furniture, water heaters, and expensive personal property, as well as being insured for earthquakes are just a few steps individuals can take to prepare. Because few individuals have experienced an earthquake and they occur infrequently, people do not prepare for an earthquake as seriously as they do for otherhazards.

Death and Injury

Death and injury can occur both inside and outside of buildings due to falling equipment, furniture, debris, and structural materials. Downed power lines and broken water and gas lines can also endanger human life. Deaths can be prevented with proper building design and individual preparedness.

Fire

Downed power lines or broken gas mains can trigger fires. When fire stations suffer structural or lifeline damage, quick response to suppress fires is less likely. Therefore, it is necessary for fire stations and critical facilities to be well protected from natural disasters. It is also necessary that the water system be well protected so that water for firefighting will be available if needed. In the San Francisco earthquake of 1906, 85% of the damage was caused by post-earthquake structural fires that could not be effectively fought because of earthquake damage to the water system.

Debris

Following damage to structures, much time is spent cleaning up brick, glass, wood, steel or concrete building elements, office and home contents, and other materials. Developing strong debris management strategies can assist in post-disaster recovery. The City is part of a regional debris management plan. One of our action items in the 2015 plan is to write a debris management annex as a part of the Emergency Operations Plan. This annex will be used after an event to assure debris management is handled in an effective manner.

Earthquake Vulnerability: Estimating Potential Losses

Two draft HAZUS-MH: Earthquake Event Reports were provided to the City of Albany at the April 21, 2005 meeting with ONHW and DOGAMI. One was for an Albany Crustal Event, Crustal Mill Creek M6.7 and the other was for an Albany Cascadia event, Cascadia M8.5. In 2008 the City of Albany received a grant from FEMA to collect specific information on commercial and residential buildings in the City and to add local utility information for more accurate estimates. In 2016, a new Cascadia HAZUS run will be added to the Plan.

General description of Albany area used in estimates

The earthquake loss estimates provided in these reports was based on a region that includes two counties, Linn and Benton in the State of Oregon. The geographical size of the region is 158.25 square miles and it contains 10 Census tracts. There are over 20,000 households in the region and a total population of 50,972 people (2000 Census Bureau data). There are an estimated 17,000 buildings in the region with a total building replacement value (excluding contents) of $3,155,000,000. Approximately 99% of the buildings (and 82% of the building value) are associated with residential housing. The replacement value of the transportation and utility lifeline systems is estimated to be between $350,000,000 and $1.9 billion, respectively.

HAZUS estimates there are 17,000 buildings in the region which have an aggregate total replacement value of $3,155,000,000. Wood frame construction makes up 85% of the building inventory. HAZUS identified the following critical facility inventory: one hospital, 26 schools, two fire stations, three police stations, no emergency operations facilities and 40 hazardous material sites. HAZUS identified seven transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six utility systems that include potable water, wastewater, natural gas, crude and refined oil, electric power and communications. The total value of the lifeline inventory is over $2,298,000. This inventory includes over 131 kilometers of highways, 52 bridges, and 1,880 kilometers of pipes.

Estimates of losses to structures, transportation, utilities and citizens:

Cascadia M8.5 Event

Building damage: HAZUS estimates that about 6,022 buildings will be at least moderately damaged. This is over 34% of the total number of the buildings in the region. An estimated 1,628 buildings will be completely destroyed. Building damage by occupancy and type are found in the draft report.

Essential facility damage: Before the earthquake, the region had 71 hospital beds available for use. On the day of the earthquake, the model estimates that only 63 hospital beds (90%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 90% of the beds will be back in service. By 30 days, 90% will be operational. On Day 1, all of the fire stations, police stations and 25 of the 26 schools are likely to be functional.

Transportation and utility lifeline damage: Estimates for transportation systems indicate four of the 52 bridges will be at least moderately damaged. One of the two potable water locations will be moderately damaged. There will be 166 leaks and 83 breaks in 940 kilometers of potable water pipelines; 131 leaks and 65 breaks in 564 kilometers of waste water pipelines; 140 leaks and 70 breaks in 376 kilometers of natural gas pipelines. Of the 20,002 households, 5,155 will be without potable water at Day 1.

Crustal Mill Creek M6.7 Event

Building Damage: HAZUS estimates that about 11,742 buildings will be at least moderately damaged. This is over 67% of the total number of the buildings in the region. There are an estimated 2,525 buildings that will be completely destroyed. Building damage by occupancy and type are found in the draft report.

Essential facility damage: Before the earthquake, the region had 71 hospital beds available for use. On the day of the earthquake, the model estimates that only three hospital beds (4%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 20% of the beds will be back in service. By 30 days, 62% will be operational. None of the two fire stations, three police stations and only three of the 26 schools will be functional on Day 1.

Transportation and Utility Lifeline Damage: Estimates for transportation systems indicate 11 of the 52 bridges will be at least moderately damaged. The railway facility will be moderately damaged. One bus facility will be moderately damaged and seven of nine airport facilities will be moderately damaged. Both of the potable water and wastewater locations will be moderately damaged. One electrical power location will be moderately damaged as will two communications locations. There will be 266 leaks and 192 breaks in 940 kilometers of potable water pipelines; 210 leaks and 152 breaks in 564 kilometers of waste water pipelines; 225 leaks and 162 breaks in 376 kilometers of natural gas pipelines. Of the 20,002 households, 13,645 will be without potable water at Day 1 and 10,780 at Day 3. For electrical power, 14,034 will be without service at Day 1; 9,312 at Day 3; 4,465 at Day 7; 1,125 at Day 30; and 18 at Day 90.

Cascadia M8.5 Event

The model provided by DOGAMI indicates that no fires will occur following a Cascadia earthquake. No debris will be generated. Shelter requirements indicated by the model estimates 2,166 households to be displaced; of these, 558 people will seek temporary shelter. HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four severity levels:

Level 1: Injuries will require medical attention but hospitalization is not needed;
Level 2: Injuries will require hospitalization but are not considered life-threatening;
Level 3: Injuries will require hospitalization and can become life-threatening if not promptly treated;
Level 4: Victims are killed by the earthquake.

Casualty estimates are provided at 2:00 a.m., 2:00 p.m. and 5:00 p.m. For the purpose of this section, the summary is not provided by category. For the full report, please see the DOGAMI event summary report.

		Level 1	Level 2	Level 3	Level 4
2 AM	Total	409	105	11	21
2 PM	Total	760	235	39	74
5 PM	Total	613	188	38	56

The total economic loss estimates for the earthquake is $1,000,460, which included building and lifeline related losses based on the region’s available inventory. The building losses are broken into two categories: direct building losses and business interruption losses. The total building-related losses were $890.63 million; 12 % of the estimated losses were related to the business interruption of the region. The largest loss was sustained by the residential occupancies which made up over 52% of the total loss.

For the transportation and utility lifelines system, HAZUS computes the direct repair cost for each component only. HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake.

	Inventory Value	Economic Loss
Highway	$1,509,300,000	$48,000,000
Railways	$101,300,000	$1,000,000
Bus	$1,200,000	$300,000
Airport	$336,000,000	$9,800,000
Total	$1,948,000,000	$59,000,000

Utility system economic losses:

	Inventory Value	Economic Loss
Potable Water	$94,060,000	$12,830,000
Waste Water	$161,800,000	$19,930,000
Natural Gas	$7,500,000	$1,960,000
Electrical Power	$124,300,000	$15,970,000
Communications	$230,000	$20,000
Total	$387,910,000	$50,700,000

Indirect economic impact with outside aid (employment as # of people and income in millions of $)

	Loss	Total	%
First Year	Employment impact Income impact	0 (33)	0 -7.14
Second Year	Employment impact Income impact	0 (49)	0 -10.45
Third Year	Employment impact Income impact	0 (55)	0 -11.83
Fourth Year	Employment impact Income impact	0 (55)	0 -11.83
Fifth Year	Employment impact Income impact	0 (55)	0 -11.83
Years 6 to 15	Employment impact Income impact	0 (55)	0 -11.83

Crustal Mill Creek M6.7 Event

For fires following a crustal earthquake, the model provided by DOGAMI indicates that seven fires that will burn about 0.07 sq miles (0.04% of the regional area). About 109 people will be displaced by fire and building damages will total about $6 million. No debris will be generated. The model estimates 3,569 households to be displaced; of these, 894 people will seek temporary shelter. HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four severity levels:

Level 1: Injuries will require medical attention but hospitalization is not needed.
Level 2: Injuries will require hospitalization but are not considered life-threatening.
Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
Level 4: Victims are killed by the earthquake.

Casualty estimates are provided at 2:00 a.m., 2:00 p.m. and 5:00 p.m. For the purpose of this section, the summary is not provided by category. For the full report, please see the DOGAMI event summary report.

		Level 1	Level 2	Level 3	Level 4
2 AM	Total	626	151	14	24
2 PM	Total	827	248	40	75
5 PM	Total	719	214	49	60

The total economic loss estimates for the earthquake is $1,626,160, which included building and lifeline related losses based on the region's available inventory. The building losses are broken into two categories: direct building losses and business interruption losses. The total building-related losses were $1,333,690; 10 % of the estimated losses were related to the business interruption of the region. The largest loss was sustained by the residential occupancies which made up over 68% of the total loss.

For the transportation and utility lifelines system, HAZUS computes the direct repair cost for each component only. HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake.

	Inventory Value	Economic Loss
Highway	$1,509,300,000	$122,800,000
Railway	$101,300,000	$1,210,000
Bus	$1,2000,000	$600,000
Airport	$336,000,000	$25,900,000
Total	$1,948,300,000	$152,100,000

Utility system economic losses in millions of dollars:

	Inventory Value	Economic Loss
Potable water	$94,060,000	$30,870,000
Waste water	$161,800,000	$50,610,000
Natural gas	$7,500,000	$4,140,000
Electrical power	$124,300,000	$54,750,000
Communications	$230,000	$70,000
Total	$387,910,000	$140,440,000

Indirect economic impact with outside aid (employment as # of people and income in millions of $)

	Loss	Total	%
First Year	Employment impact Income impact	0 (37)	0 -8.05
Second Year	Employment impact Income impact	0 (61)	0 -13.21
Third Year	Employment impact Income impact	0 (72)	0 -15.39
Fourth Year	Employment impact Income impact	0 (72)	0 -15.39
Fifth Year	Employment impact Income impact	0 (72)	0 -15.39
Years 6 to 15	Employment impact Income impact	0 (72)	0 -15.39

Mitigation Activities

Existing mitigation activities include current mitigation programs and activities that are being implemented by city, state, or federal agencies and organizations.

Local Programs

Regional All-Hazard Mitigation Plan for Benton, Lane, Lincoln and Linn Counties
Beginning in 1996, the City of Albany participated with Benton, Lane, Lincoln, and Linn counties in the development of a three-phase hazard mitigation program. The plan reviewed the principles of mitigation planning and presents a seven-step process for conducting a detailed, quantitative evaluation of prospective mitigation projects. Phase One of the programs was completed in December of 1998 and provided a flood hazard mitigation planning template for local government, a mitigation planning methodology and addressed flood and winter storm hazards. It also outlined the interface between mitigation planning and emergency planning.

Phase Two was completed in September 2001 and covered earthquake impacts for Benton, Lane, and Linn counties. Phase Three was completed September 2002 and addressed hazardous materials in Benton, Lane, and Linn counties.[14]

Capital Improvement Program

The City of Albany's Capital Improvement Program (CIP) is a dynamic document that lists and prioritizes needed improvements and expansions of the City's infrastructure system to maintain adequate service to existing City residents and businesses, and to accommodate population growth and land development. The CIP reflects the needs and priorities established by the City and the resources available to the City. The CIP can be modified during the fiscal year, through the supplemental budget process, as needs, priorities, and resources change. The CIP can assist the City of Albany in mitigating against severe weather events by improving infrastructure most prone to damage.

Emergency Operations Center (EOC)

The Emergency Operations Center is an established location/facility from which City staff and officials can provide direction, coordination, and support to emergency operations in the event of an incident such as a natural disaster. City personnel who are assigned to and trained for specific positions within the EOC organizational structure staff the EOC. The structure is based on the National Incident Management System (NIMS) Incident Command System (ICS). The EOC staff provides information and recommendations to the Mayor, through the Incident Commander or as directed, to develop a course of action to respond to and contain, control, and recover from an emergency. Some of the primary functions performed at the EOC include: coordination; operations management; planning; information tracking and dissemination; logistical support; financial management and support; and emergency public information.

Emergency Operations Plan (EOP)

The Emergency Operations Plan (EOP) was approved in September of 2012. It describes the roles and responsibilities of the departments and personnel for the City of Albany during major emergencies or disasters.

The Plan sets forth a strategy and operating guidelines using National Incident Management System (NIMS) Incident Command System which was adopted by the City for managing its response and recovery activities during disasters and emergencies.

The EOP consists of various sections and supporting materials. The development and maintenance of this plan is the basis of the City's emergency response and recovery operations.

1. **Basic Plan -** Provides an overview of the City's emergency response organization and policies. It cites the legal authority for emergency operations, summarizes the situations addressed by the plan, explains the general concept of operations, and assigns general responsibilities for emergency planning and operations.
2. **Functional Annexes -** Each annex focuses on one of the critical emergency functions that are typically common for all hazards that the City will perform in response to an emergency. The type and scope of an incident will dictate which functional annexes will be needed.
3. **Support Annexes** – These Annexes provide additional information on Donation and Resource Management.
4. **Incident Annexes** – The Incident Annexes provides a check list when responding

to a specific emergency. This list can be used by the on scene commander or the ECC director.

Incident Command System
The Incident Command System is a management system that may be used for any type of hazard event, and has three main components. The City of Albany has adopted the use of the National Incident Management System (NIMS), which included the Incident Command System for its method of responding to and recovering from any disaster or emergency. The NIMS components are:

1. Command and management
2. Preparedness
3. Resource management
4. Communications and information management
5. Support technologies
6. Ongoing management and maintenance

Transportation System Plan
The City of Albany's adopted Transportation System Plan (TSP) is the transportation element of the City's Comprehensive Plan. It identifies the transportation improvements needed to accommodate existing and future development in the Albany area. The plan identifies needs and improvements through 2030.

The TSP was developed through a public participation process. The development of the TSP and the transportation element of the Comprehensive Plan are closely coordinated and intended to be consistent with other jurisdictions' transportation plans.

Urban Forestry Program
Albany's Urban Forestry Program has a number of ongoing educational efforts designed to mitigate damage from downed trees during storms. The program also has authority to identify and eliminate known hazards. The following is a brief summary of related activities. Albany Municipal Code gives the City Forester authority to require permits for planting of trees on public rights of way. The permitting system provides an opportunity to specify failure resistant species of trees and to set standards that reduce losses from tree failure. The City Forester has the authority to remove trees that threaten public safety and to require property owners to perform street tree maintenance to correct hazardous situations.

The Urban Forestry Program also provides a free inspection service for public street trees. Property owners who request this service are visited by the City Forester who is trained to pre- identify many tree-related hazards and advise property owners.

Tree Inventory Map
The city has completed its comprehensive public tree inventory to help identify hazard trees. A map of hazardous trees in Albany will provide information useful for targeting measures that can be used to mitigate against the effects of falling trees. Further to this goal, "The City of Albany is currently working on long range tree preservation planning. This will help drive development away from hazard prone areas, and attempt to increase City's ability to mitigate for disasters."

PacifiCorp
Pacific Power's Right Tree, Right Place program educates homeowners, landscapers, and tree

propagators on tree species that will not be subject to ongoing stress by constant pruning. Pacific Power distributes posters and our *Small Trees for Small Places* booklet that list low-growing trees that fit within the utility right-of-way and are compatible with small urban planting strips. The poster includes information on how to select the correct tree, the energy-saving benefits of trees, and proper planting and pruning techniques. Pacific Power offers tree owners certificates to help defray the cost of a new tree that replaces one that is inappropriate. Pacific Power's foresters work with local government and the public to assess and identify situations in which trees or power lines put life and property at risk or endanger electric service reliability.

International Building Code
The State of Oregon and the City of Albany have adopted the International Building Code which includes earthquake standards.

Dangerous Building Code
Albany Municipal Code, Title 18 – Building & Construction, 18-16 Dangerous Buildings, defines "dangerous buildings" and requires abatement of them. Dangerous buildings are those with structures that are overstressed because of snow or wind loading or because they require extensive maintenance.

State Resources

State Building Codes[15]
The Oregon State Building Codes Division adopts statewide standards for building construction that are administered by the State, cities, and counties throughout Oregon. The codes apply to new construction and to the alteration of, or addition to, existing structures. The One- and Two-Family Dwelling Code and the Structural Specialty Code (both included in the State Building Code) prescribe seismic design requirements for new construction based on the seismology of the region. These codes are State of Oregon-amended additions of national model codes from the International Code Council. These codes are based on maps that identify the various seismic zones for Oregon.

The Structural Specialty Code is based on the 2014 International Building Code published by the International Code Council and amended by the State of Oregon. The International Building Code contains specific regulations for development within seismic zones.[16]

Within these standards are six levels of design and engineering specifications that are applied to areas according to the expected degree of ground motion and site conditions that a given area could experience during an earthquake (ORS 455.447). The Structural Code requires a site- specific seismic hazard report for projects including essential facilities such as hospitals, fire and police stations, emergency response facilities, and special occupancy structures such as large schools, and prisons.

The seismic hazard report required by the Structural Specialty Code for essential facilities and special occupancy structures must take into consideration factors such as the seismic zone, soil characteristics including amplification and liquefaction potential, any known faults, and potential landslides. The findings of the seismic hazard report must be considered in the design of the building. The Dwelling Code simply incorporates prescriptive requirements for foundation reinforcement and framing connections based on the applicable seismic zone for the area. The cost of these requirements is rarely more than a small percentage of the overall cost for a new building.[17]

The requirements for existing buildings vary depending on the type and size of the alteration and whether there is a change in the use of the building to house a more hazardous use. Oregon State

Building Codes recognize the difficulty of meeting new construction standards in existing buildings and allow some exception to the general seismic standards. Upgrading existing buildings to resist earthquake forces is more expensive than meeting code requirements for new construction.

State code only requires seismic upgrades when there is significant structural alteration to the building or where there is a change in use that puts building occupants and the community at a greater risk. The local building official is responsible for enforcing these codes. Although there is no statewide building code for substandard structures, local communities have the option of adopting one to mitigate hazards in existing buildings. The State has adopted regulations to abate buildings damaged by an earthquake in Oregon Administrative Rules (OAR) 918- 470. Oregon Revised Statutes (ORS) 455.020 and 455.390-400 also allow municipalities to create local programs to require seismic retrofitting of existing buildings within their communities. The building codes do not regulate public utilities and facilities constructed in public rights-of-way such as bridges that are regulated by the Department of Transportation.

Senate Bill 13: Seismic Event Preparation
Signed by Governor John Kitzhaber on June 14, 2001, Senate Bill 13 requires each state and local agency and persons employing 250 or more full-time employees to develop seismic preparation procedures and inform their employees about the procedures. Further, the bill requires agencies to conduct drills in accordance with Office of Emergency Management guidelines. The drills must include "familiarization with routes and methods of exiting the building and methods of duck, cover, and hold during an earthquake."

Senate Bill 14: Seismic Surveys for School Buildings
The Governor signed Senate Bill 14 on July 19, 2001. It requires the State Board of Higher Education to provide for seismic safety surveys of buildings that have a capacity of 250 or more persons and are routinely used for student activities by public institutions or departments under the control of the Board. A seismic safety survey is not required for any building that has previously undergone a seismic safety survey or that has been constructed to the State building code standards in effect for the seismic zone classification. If a building is found to pose an undue risk to life and safety during a seismic event, a plan shall be developed for seismic rehabilitation or other seismic risk-reducing activities. (Plans are subject to available funding.) All seismic rehabilitation or other actions to reduce seismic risk must be completed before January 1, 2032.

DOGAMI and the Oregon University System joined to design a pilot program to begin the process to fulfill ORS 455.400 (2001). Through University maintenance funds and FEMA Pre- Disaster Mitigation grants, they have initiated seismic safety surveys of university buildings and selected several particularly vulnerable buildings for seismic safety upgrades.

Senate Bill 15: Seismic Surveys for Hospital Buildings
Governor John Kitzhaber signed Senate Bill 15 on July 19, 2001. It requires the Health Division to provide for seismic safety surveys of hospital buildings that contain an acute inpatient care facility. Seismic surveys shall also be conducted on fire stations, police stations, sheriffs' offices, and similar facilities subject to available funding. The surveys should be completed by January 1, 2007. A seismic survey is not required for any building that has undergone a survey or that has been constructed to the state building code standards in effect for the seismic zone classification at the site. If a building is evaluated and found to pose an undue risk to life and safety during a seismic event, the acute inpatient care facility, fire department, fire district or law enforcement agency using the building shall develop a plan for seismic rehabilitation of the building or for other actions to reduce the risk. (Again, plans are subject to available funding.) All seismic rehabilitations or other actions to reduce the risk must have been completed before January 1, 2022.

Earthquake Awareness Month

April is Earthquake Awareness Month. During the month, the State Office of Emergency Management encourages individuals to strap down computers, heavy furniture, and bookshelves. In addition, the Oregon Natural Hazards Workgroup distributed a flyer with educational information about how to prepare for an earthquake.

Earthquake Education

Earthquake education in schools is ongoing in Oregon. Public schools are required to conduct periodic earthquake drills and educate students on how to respond when an earthquake event occurs (ORS 455.447 and 336.071).

Federal Resources

National Earthquake Hazards Reduction Program (NEHRP)

NEHRP's mission includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improved model building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improved mitigation capacity; and accelerated application of research results. FEMA is designated as the lead agency of the program and assigns several planning, coordinating, and reporting responsibilities.

National Earthquake Loss Reduction Program (NEP)

NEP was formed as a result of the report, "Strategy for National Earthquake Loss Reduction," prepared by the Office of Science and Technology Policy (OSTP) in April 1996. The NEP "aims to focus scarce research and development dollars on the most effective means for saving lives and property and limiting the social disruptions from earthquakes, coordinate federal earthquake mitigation research and development and emergency planning in a number of agencies beyond those in NEHRP to avoid duplication and ensure focus on priority goals, and cooperate with the private sector and with state and local jurisdictions to apply effective mitigation strategies and measures." The NEP does not replace NEHRP but encompasses a wider range of earthquake hazard reduction activities than those supported by the NEHRP agencies and provides a framework within which these activities can be more effectively coordinated.

The National Earthquake Technical Assistance Program (NETAP)

The NETAP is a technical assistance program created to provide ad hoc, short-term architectural and engineering support to state/local communities as they are related to earthquake mitigation. The program was designed to enhance the State/local communities' ability to become more resistant to seismic hazards. This assistance cannot be used for actions that are covered under the States/Territories Performance Partnership Agreement (PPA). This program assists in carrying out the statutory authorities of the National Earthquake Hazards Reduction Act of 1977, as amended.

Technical assistance under the NETAP is available for use by the State/local communities within the 45 eligible and or participating seismic states and U.S. territories. This assistance is provided at no cost to the requesting local community/state government.

Examples of NETAP projects are seismic retrofit/evaluation training, evaluation of seismic hazards critical/essential facilities, post earthquake evaluations of buildings, and development of retrofit guidance for homeowners.

National Seismic Hazard Mapping Project

National maps of the earthquake shaking hazard in the United States have been produced since 1948. Scientists revise these maps as new earthquake studies improve their understanding of this hazard. After thorough review, professional organizations of engineers in turn update the seismic risk maps and seismic design provisions contained in building codes. More than 20,000 cities, counties, and local government agencies use building codes such as the International Building Code to help establish the construction requirements necessary to preserve public health and safety in earthquakes.

The 1996 U.S. Geological Survey shaking-hazard maps for the United States are based on current information about the rate at which earthquakes occur in different areas and on how far strong shaking extends from quake sources.

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[8] City of Portland Natural Hazard Mitigation Plan, 2004

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Section 8:
Severe Weather

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Severe Weather

This section is concerned with severe weather events and focuses on ice and snowstorms, high winds, and extreme heat. Flooding is not included in this section as it has been covered in Section 6.

Why are severe weather events a threat to the City of Albany?

Severe weather events pose a significant threat to life, property, and the economy in the city of Albany by creating conditions that disrupt essential services such as public utilities, telecommunications, and transportation. Such storms can produce rain, freezing rain, ice, snow, and cold temperatures, extreme heat as well as high winds and tornadoes. Ice storms, freezing rain and high winds can destroy trees and power lines, interrupting utility services and transportation routes.

Severe Weather Event Characteristics

Weather Patterns

Severe storms affecting the city of Albany with snow and ice typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.[1] A majority of the destructive surface winds in Oregon and, specifically, Albany, are from the south and southwest off the Pacific Ocean.[2] Albany gets some winds from the east, but these normally occur during the summer and most often do not carry the same destructive force as those from the Pacific Ocean.

Albany's average rainfall is 40.91 inches. The National Climatic Data Center has established climate zones in the U.S. for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the Pacific Ocean give the state diversified climates. Albany is in Zone 2 as seen in Figure 2. The climate in Zone 2, including Albany and surrounding areas, is generally mild throughout the year, characterized by cool, wet winters and warm, dry summers.[3] As the climate changes, warming temperatures may have an effect on average rainfall amounts and temperatures.

Albany is about 70 miles from the Pacific Ocean, which provides a modified marine climate. Extreme summer and winter temperatures are moderated by the airflow moving across the area from the Pacific Ocean. Temperatures rarely exceed 95° F in the summer months (June – August) and rarely drop below 25° F in the winter months (November – March). Precipitation ranges from as low as .36 inches in July to as high as 7.05 inches in February. Average snowfall since the mid-1960s has been 5.9 inches, occurring between November and March.[4]

The Future Climate Projection report prepared for Linn County by the Oregon Climate Change Research Institute presents future climate projections for Linn County relevant to specified natural hazards for the 2020s (2010–2039) and 2050s (2040–2069) relative to the 1971–2000 historical baseline. The projections are presented for a lower greenhouse gas emissions scenario (RCP 4.5) and a higher greenhouse gas emissions scenario (RCP 8.5), and are based on multiple global climate models. The report is available in Appendix E.

The number, duration, and intensity of extreme heat events will increase as temperatures continue to warm.

In Linn County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios.

In Linn County, the number of days per year with temperatures 90°F or higher is projected to increase by an average of 17 days (range 5–29 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

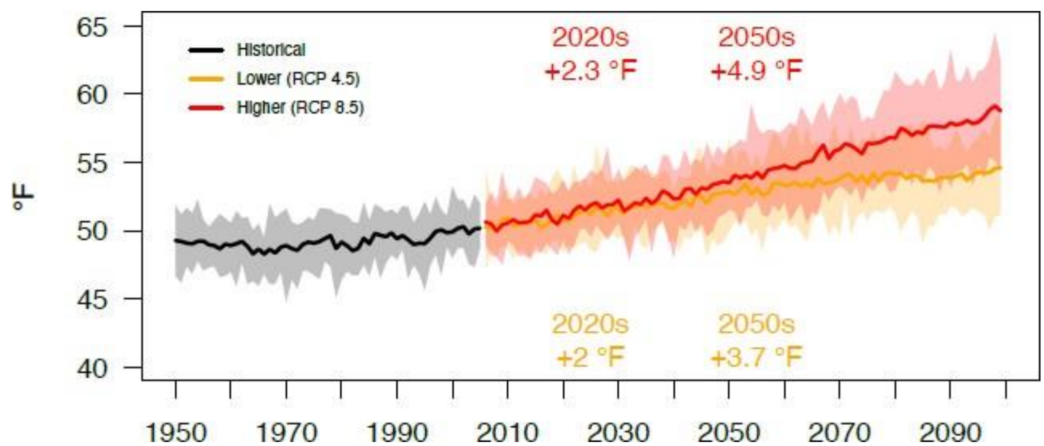
In Linn County, the temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–10°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario

Cold extremes will become less frequent and intense as the climate warms. In Linn County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 4 days (range -2– -5 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Linn County, the temperature on the coldest night of the year is projected to increase by an average of 6°F (range 1–11°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. [1]

These factors will have an impact on extreme weather particularly with respect to Extreme Heat. Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change.[2]

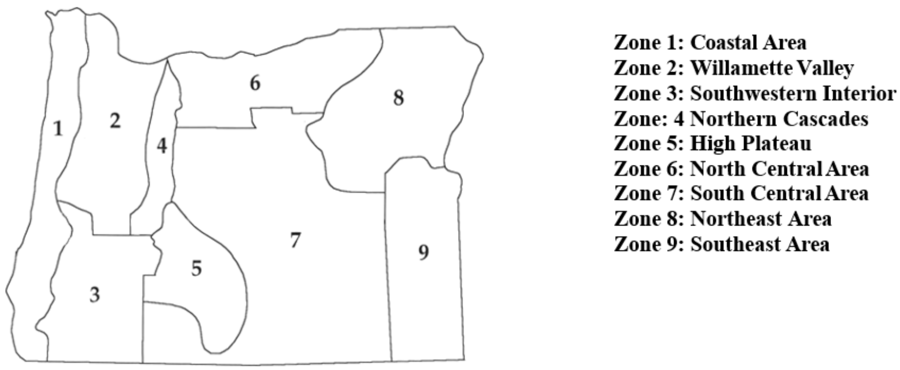
Figure 1. Average Annual Temperature Projections Linn County



Source: Future Climate Projections Linn County, Oregon, OCCRI, 2022

[1] Future Climate Projections Linn County, Oregon, OCCRI, 2022
[2] Ibid

Figure 2. Oregon Climate Zones



Source: Taylor, George H. and Hannan, Chris, *The Oregon Weather Book*, OSU Press (1999)

Winds

A windstorm is generally a short- duration event involving straight-line winds and/or gusts in excess of 50 mph (80 km/hour). Albany is relatively flat with some higher elevations in the northern portion of the city. There is no natural buffer around the city to cause a windstorm to be deflected or to turn the wind. A windstorm will generally affect all parts of the city equally when it occurs.

The most destructive winds are those that blow from the south parallel to the major mountain ranges.[5] Windstorms affect areas of Albany with significant tree stands as well as areas with exposed property, major infrastructure, and above-ground utility lines. Figures 8-2, and 8-3 and Table 8-1, below, provide an overview of the potential wind hazard that exists for the city of Albany. As can be seen from this data, the lower wind speeds typical in the valleys are still high enough to knock down trees, bring down power lines, and cause other property damage.

As is true for many Oregon communities, the Columbus Day Storm of 1962 was the most severe storm to occur in Albany in the last 60 years. Damage was widespread, downing trees and power lines, with winds that gusted as high as 90 mph (144 km/hour). Statistically, one high-wind storm occurs every 10 years.

In all 13 high-windstorms listed in Table 4, power was lost to a large segment of the community. Depending on the duration and wind speed of the event, it was four hours to several days before power to communities and neighborhoods was restored. In the earlier part of the last century, the impact of a power outage was not as important as it has been in the last 40 years, as far fewer people had electricity, and not as many critical facilities existed.

Each of the 13 storms caused significant damage to buildings, trees, and infrastructure. That damage potential has risen over the last 40 years as more buildings have been constructed in Albany

Data from the above maps is summarized below in Table 8-1

Figure 4. Wind Speed Contours for 2-Year Recurrence Interval (km/hour)

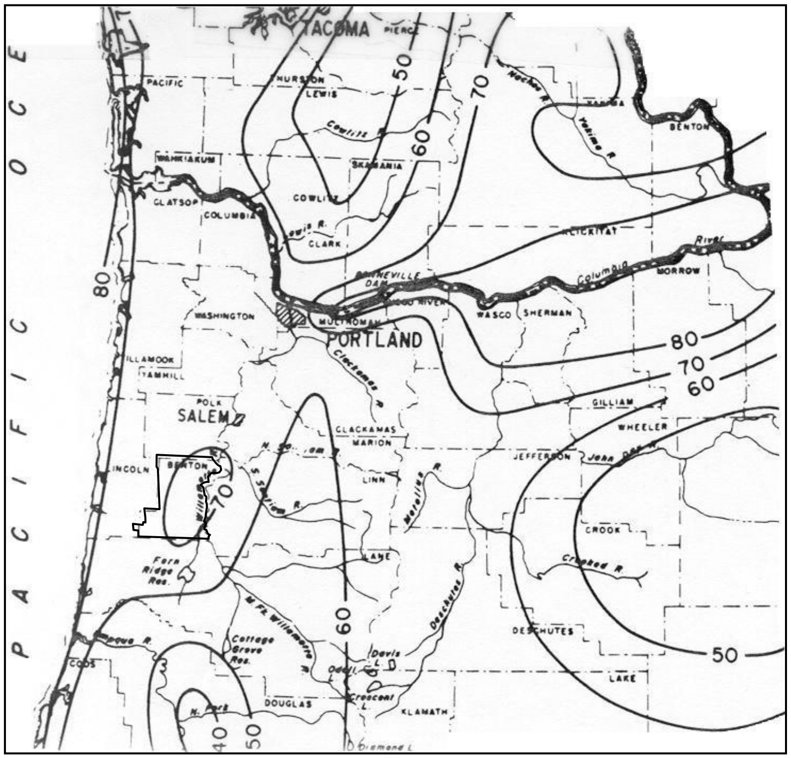


Figure 3. Wind Speed Contours for 50-Year Recurrence Interval (km/hr)

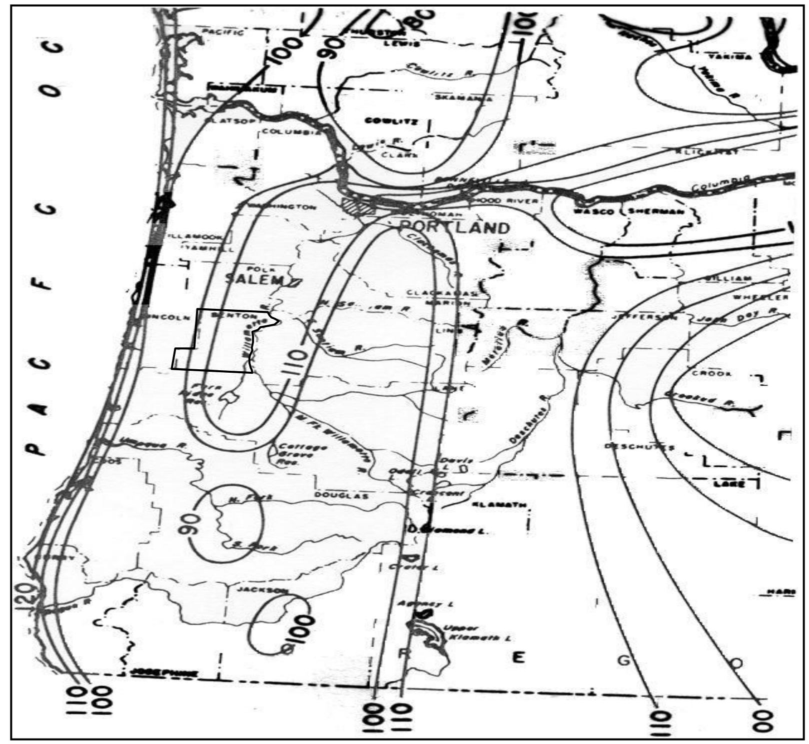


Table 1. Wind Speed Data for Benton County

Return Period	Sustained Wind Speeds (km/hr)	Sustained Wind speeds (miles/hr)*
2-Year	60 to 70	37 to 43
50-year	100 to 115	62 to 71

* Conversion from map contours in kilometers per hour is 0.6214 miles per kilometer

For Benton County and the city of Albany, the 2-year recurrence interval sustained wind speeds range from about 60 - 70 km/hour or about 37 - 43 miles per hour. These 2-year wind speeds are too low to cause widespread substantial damage. However, there may be significant local wind damage at sites where local wind speeds are higher or where there are exposed locations, such as the boundary between clear-cut and forestedareas.

For Benton County and the city of Albany, the 50-year recurrence interval wind speeds range from about 100 - 115 km/hour or about 62 - 71 miles per hour. These wind speeds are high enough to cause widespread damage. Damage may be severe at particularly exposed sites. Thus, for most regions of Benton County, winter storms with significant direct wind damage are not likely every year or every few years but perhaps once every decade or so, on average, with major windstorm events happening at intervals averaging a fewdecades.

The maps shown above have limited spatial resolution for Benton County and the city of Albany but suggest that the potential for damaging winds may be somewhat higher in eastern Benton County along the Willamette River than elsewhere.[6]

Tornadoes

Tornadoes occasionally occur in Oregon. However, Oregon is not among the 39 states with reported tornado deaths since 1950. A compilation of historical tornadoes in Oregon by the National Climatic Data Center includes 105 tornadoes statewide with several occurring in the Albany area.[7]

Snow

Snow events are not common in Albany and the Willamette Valley. They need two ingredients: cold air and moisture. Rarely do the two ingredients occur at the same time over western Oregon except in the higher elevations of the Coast Range and especially in the Cascades. But snowstorms do occur over eastern Oregon regularly during December through February. Cold arctic air sinks south along the Columbia River Basin, filling the valleys with cold air. Storms moving across the area drop precipitation, and if conditions are right, snow will occur. From 1884 to the present, there have been at least 16 significant snow events in Albany. Six of these have occurred since 1998. The last was on February 7, 2014.[8]

Ice

Like snow storms, ice storms are comprised of cold temperatures and moisture, but subtle changes can result in varying types of ice formation including freezing rain, sleet, and hail.[9] Freezing rain can be the most damaging of ice formations. While accumulated sleet and hail can create hazards for motoristss, freezing rain can cause the most dangerous conditions within a community. Much of the damage from ice storms occurs when the ice thaws: although some tree limbs fall from the weight of the ice, many broken tree limbs are held in place by the frozen ice structure. Residential water lines that have frozen in the storm will begin to leak as the ice melts. As a result, storm emergency periods often extend beyond the freeze to include the thaw.

Extreme Heat

Extreme heat can refer to days on which maximum or minimum temperatures are above a threshold, seasons in which temperatures are well above average, and heat waves, or multiple days on which temperature are above a threshold. OCCRI's report presents projected changes in three metrics of extreme daytime heat (maximum temperature) and nighttime heat (minimum temperature).[3]

Table 2. Metrics and Definitions of Heat Extremes

Metric	Definition
Hot Days	Number of days per year on which maximum temperature is 90°F or higher
Warm Nights	Number of days per year on which minimum temperature is 65°F or higher
Hottest Day	Highest value of maximum temperature per year
Warmest Night	Highest value of minimum temperature per year
Daytime Heat Waves	Number of events per year in which the maximum temperature on at least three consecutive days is 90°F or higher
Nighttime Heat Waves	Number of events per year in which the minimum temperature on at least three consecutive days is 65°F or higher

Source: Future Climate Projections Linn County, Oregon, OCCRI, 2022

In Linn County, the number of hot days and warm nights, and the temperature on the hottest day and warmest night, are projected to increase by the 2020s (2010–2039) and 2050s (2040–2069) under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. For example, by the 2050s under the higher emissions scenario, the number of hot days, relative to each Global Climate Model (GCM's) 1971–2000 historical baseline, is projected to increase by 5–29. The average number of hot days per year is projected to be 17 more than the average historical baseline of 4 days. The average number of warm nights per year is projected to be 4 more than the average historical baseline of virtually zero.

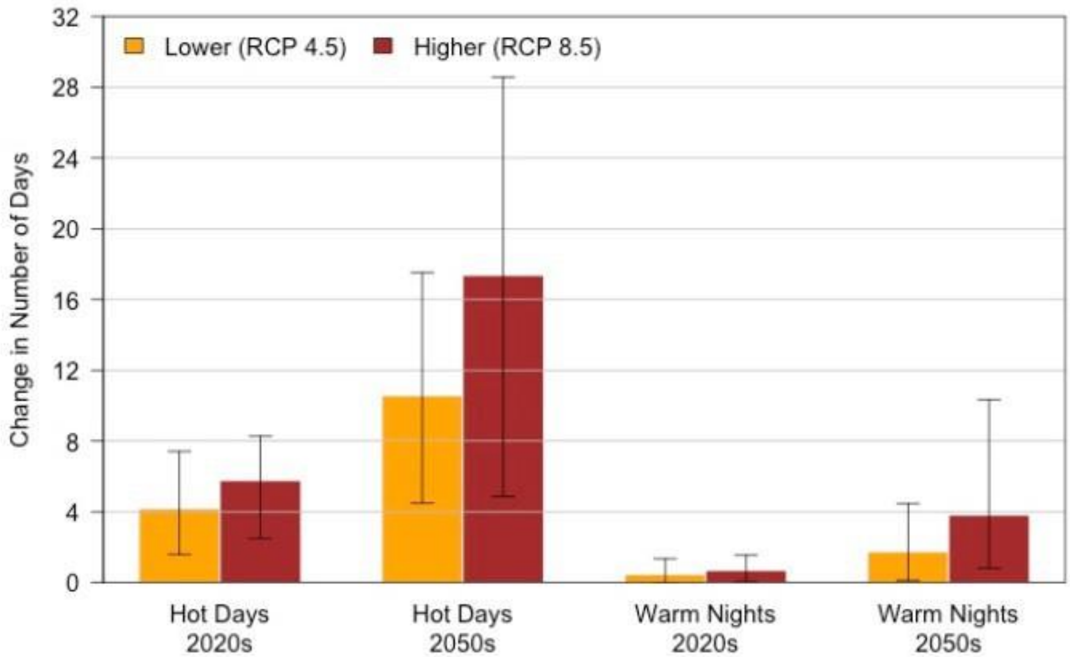
Similarly, under the higher emissions scenario, the temperature on the hottest day of the year is projected to increase by 1.9–9.8°F by the 2050s relative to the GCMs' historical baselines. The average projected increase in temperature on the hottest day is 6.8°F above the average historical

[3] Future Climate Projections Linn County, Oregon, OCCRI, 2022

baseline of 91.4°F. The average projected increase in temperature on the warmest night is 5.8°F above the average historical baseline of 61.3°F.

Under the higher emissions scenario, the numbers of daytime and nighttime heat waves are projected to increase by 0.8–3.4 and 0.0–1.8, respectively, by the 2050s relative to the GCMs' historical baselines. The average number of daytime and nighttime heat waves is projected to increase by 2.5 and 0.5, respectively, above the average historical baselines of 0.5 and zero.

Figure 5. Change Number of Extreme Heat Days in Linn County



Source: Future Climate Projections Linn County, Oregon, OCCRI, 2022

Location and Extent of Severe Weather Events

When severe weather, which includes ice, snow, and high winds, occurs, it impacts the entire city. Unlike a county or region where areas are miles apart, the City is 17.7 square miles where the terrain is relatively flat. Elevations range from 210 to 521 feet above sea level. Because of the similarity in topography, any ice or snow storm affects the entire city. In the northern part of the city in Benton County, the elevation does increase, and this will generally create hazardous driving conditions when ice and snow occur. Two bridges span the Willamette River in downtown Albany and carry traffic to the northern part of the city; the bridges are also part of a state highway taking traffic to Corvallis. When ice storms or snow occur, these bridges become impassable and create serious traffic problems. Because of the mild weather that generally occurs in Albany, the city does not have the equipment to handle ice or snow storms as effectively as regions where these events occur more often.

Previous Occurrences of Extreme Weather Events

Ice

Historical data on ice storms has been difficult to locate. Record searches indicate that, as far back as the 1880s, ice storms did occur in Albany with one actually freezing the Willamette River so individuals could walk from one bank to the other. Ice storms have also occurred in Albany and the surrounding area in 1942, 1950, 1963, 1970, 1973, 1993, 1995, 2003-2004, and twice in 2014.[10] Former State Climatologist George Taylor states that, on average, one ice storm occurs every 10 years. Ice storms have created widespread power outages due to iced power lines that have broken, trees that have fallen over power lines, branches that have fallen onto power lines, and traffic accidents that have damaged power lines. Secondary to the power problem is the transportation problem. The area is not set up to deal with routine ice problems like other areas of Oregon or the United States. No immediate de-icing program exists to make the roads usable. This leads to many accidents which creates increased difficulties for emergency responders. Generally, ice storms develop over a 1–4-hour period, and can last for 1-4 days.

The February 2014 winter storm was a Presidential Declared Disaster for Benton, Lane, Lincoln and Linn counties in Oregon (FEMA disaster #4169). According to the National Climatic Data Center, 5 to 9 inches of snow fell on the southern Willamette Valley. Snow turned to sleet, then freezing rain, resulting in downed limbs and power lines. The Oregon State Police warned drivers not to travel on Interstate 5 between Salem and Eugene due to icy roadways.

The February 2021 winter storm was also a Presidential Declared Disaster (DR-4599).

The "Oregon Weather Book" (1999), identified a number of ice storms in Oregon. Some were confined to the area near the Columbia Gorge, but others were much more widespread, affecting the entire Willamette Valley or most of western Oregon. The following described ice storm events are similar to the storm that occurred in February 2014. Information concerning the January 6 – 9, 2004 and February 11-13, 2021 storm events was provided by the National Climatic Data Center and the NOAA Storm Event database.[11]

Jan. 5-7, 1942. Moist, warm air from the south and southwest met cold air coming through the Columbia River Gorge. In some areas there was considerable sleet, followed by freezing rain. Throughout the middle and upper portions of the Willamette Valley the precipitation was mostly freezing rain, which resulted in heavy accumulations of ice on all exposed surfaces. Roads and streets became dangerous for travel, orchard and shade trees were damaged, and telephone, telegraph, and power wires and poles were broken down.

January 1950. Severe blizzard conditions on January 13 and a heavy sleet and ice storm on January 18-19 caused several hundred thousand dollars' worth of damage (1950 dollars) and virtually halted traffic for two to three days. The Columbia River Highway was closed between Troutdale and The Dalles, leaving large numbers of motorists stranded, then removed to safety by rail. Damage to orchard crops, timber, and power services was common, costing thousands of dollars.

Jan. 30-31, 1963. Substantial snowfall amplified by moderate to severe icing conditions produced hazardous highways. Large numbers of power lines were downed due to large amounts of ice or felled trees. Injuries, one reported death, and statewide school closures were due to the icy streets and highways.

Nov. 22-23, 1970. Freezing rain caused severe glazing across western Oregon, especially in Corvallis, Albany, Salem, Independence, and Dallas. Ice accumulations up to a half-inch thick broke thousands of tree limbs and telephone lines. Hazardous traffic conditions, power and phone outage, and felled trees were common.

Jan. 11-12, 1973. Rain glazed streets and highways, contributing to numerous car, bus and truck accidents and persons injured in falls. Most hospitals reported full-house conditions. Glaze of one-quarter to half an inch was common in the Willamette Valley, with up to three-quarters of an inch of ice covering all surfaces in the West Hills of Portland.

Jan. 6-9, 2004. A strong winter storm packing the powerful punch of a frigid arctic airmass, heavy snow, sleet and freezing rain, along with strong east winds through and near the Columbia River Gorge snarled travel, forced the closure of most schools and businesses, and resulted in widespread power outages and property damage in northwestern Oregon. Snowfall totals in the Willamette Valley ranged from 2 to 8 inches. Accumulations of up to 2 inches of sleet and freezing rain followed the snowfall.

Feb. 11-13, 2021. This was a major, widespread, multi-faceted winter storm that caused major problems across the northern Willamette Valley especially in the lowlands. Impacts were felt as far south as Albany. WFO Portland measured 10.1 of snow, followed by roughly 0.75 of ice. Significant impacts to infrastructure occurred, with over 400,000 people losing power at some point during the storm. The area impacted the hardest appears to be the southern portions of the Portland metro area from Oregon City and Silverton and as far south as Salem and Aumsville. Some people in these areas hard-hit by ice lost power for over a week.

Snow

Snow events are not common in Albany and the Willamette Valley. They need two ingredients: cold air and moisture. Rarely do the two ingredients occur at the same time over western Oregon, except in the higher elevations of the Coast Range and especially in the Cascades. Snowstorms do occur over eastern Oregon regularly during December through February. Cold arctic air sinks south along the Columbia River basin, filling the valleys with cold air. Storms moving across the area drop precipitation, and if conditions are right, snow will occur. From 1884 to the present, there have been at least 15 significant snow events in Albany. The last was in 2014. The following are the dates, one day amounts and total storm accumulations for previous storms in Albany:

Table 3. **Significant Past Winter Snow Storms**

	CITY OF ALBANY	
DATES	**1-DAY AMOUNT**	**STORM TOTAL**
December 16 – 18, 1884	16”	19”
December 20 – 23, 1892	9”	15”
January 5 – 10, 1909	3.5”	11.5”
January 11 – 15, 1916		5 – 8”
December 9 – 11, 1919	10”	25.5”
January 31 – February 4, 1937	16”	30”
January 9 – 18, 1950		54.7”

January 25 – 31, 1969		24 – 30”
December 29, 1971	1.3”	15”
February 1 – 8, 1989		6 – 8”
February 14 – 16, 1990		6 – 8”
February 1993	6”	10 – 12”
Winter 1998 – 1999		2 – 5”
December 2003 – January 2004	3.8”	2 – 8”
February 7 – 9, 2014		5 – 9”
February 24, 2019		1” – 4”

Sources: Data for City of Albany from Western Regional Climate Center Website: www.wrcc.dri.edu; National Climatic Data Center, 2015, NOAA Storm Event Database, consulted September 2022

High Winds

Since 1880, there have been 13 significant windstorms that have taken place in the Albany area. The wind speeds for these events ranged from as low as 40 mph to as high as 127 mph gust speed. In at least three local storms, people have been killed, and in a fourth, there were four injuries. The most significant high wind event was the Columbus Day Storm, October 12, 1962, the storm against which all subsequent storms are measured. In the 1960s, there were three high wind storms; in the 1970s, one; 1980s, one; 1990s, one; 2002, one; and 2012, one. The 1995 (FEMA disaster # 1107) and 2002 (FEMA disaster # 1405) high wind events were Presidential Declared Disasters.

Table 4. Significant Windstorms[12,13]

DATE	AFFECTED AREA	CHARACTERISTICS
April 1931	Western Oregon	Unofficial wind speeds reported at 78 mph. Damage to fruit orchards and timber.
Nov. 10-11, 1951	Statewide	Widespread damage; transmission and utility lines; wind speed 40-60 mph; gusts 75-80 mph.
December 1951	Statewide	Wind speed 60 mph in Willamette Valley. 75 mph gusts. Damage to buildings and utility lines.
December 1955	Statewide	Wind speeds 55-65 mph with 69 mph gusts. Considerable damage to buildings and utility lines.
November 1958	Statewide	Wind speeds at 51 mph with 71 mph gusts. Every major highway blocked by fallen trees.
October 1962	Statewide	Columbus Day Storm; Oregon’s most destructive storm to date. 116 mph winds in Willamette Valley. Estimated 84 houses destroyed with 5,000 severely damaged. Total damage estimated at $170 million.
March 1971	Most of Oregon	Greatest damage in Willamette Valley. Homes and power lines destroyed by falling trees. Destruction of timber in Lane Co.
November 1981	Most of Oregon	Highest winds since Oct. 1962. Wind speed 71 mph in Salem. Marinas, airports and bridges severely damaged.

DATE	AFFECTED AREA	CHARACTERISTICS
January 1990	Statewide	Heavy rain with winds exceeding 75 mph. Significant damage. One fatality.
December 1995	Statewide	Followed path of Columbus Day Storm. Wind speeds 62 mph in Willamette Valley. Damage to trees (saturated soil a factor) and homes. (FEMA-1107-DR-OR)
November 1997	Western Oregon	Wind speed 52 mph in Willamette Valley. Trees uprooted. Considerable damage to small airports.
February 7-8, 2002	Western Oregon	Strongest winds in 40 years in parts of Linn and eastern Lane counties. Wind gusts of 50 – 70 mph caused trees to fall, dama ged homes, cars and businesses. Extensive damage to utilities. Estimated damage costs: $6.14 million. (FEMA- 1405-DR-OR)
December 4, 2012	Western Oregon	A Pacific cold front brought strong southerly winds to the North and Central Oregon Coast. Weather spotter near Lebanon reported peak wind gust of 62 kts. (71 mph).

Tornadoes

Tornadoes have occurred in Albany and surrounding areas. Since 1925, from Eugene to McMinnville, there have been 26 reported tornadoes. Two tornadoes occurred in Albany during the 1990s, the first on May 23, 1990, and the second on March 22, 1994. The 1990 tornado produced three funnel clouds, but there was no confirmation that any of the three touched down. The 1994 tornado touched down near an Albany shopping area and blew out store windows and damaged some merchandise in the stores.[13]

Table 5. Recorded Tornadoes[14]

DATE	COUNTY	RESULT
January 1887	Lane	Fences damaged; livestock losses; trees uprooted.
November 1925	Polk	Buildings, barns, and fruit trees damaged.
February 1926	Polk	House and trees damaged.
September 1938	Linn	Observed in Brownsville. No damage.
December 1951	Lane	Barn destroyed.
January 1953	Benton	Observed. No damage.
March 1960	Marion	Several farms damaged near Aumsville. Trees uprooted.
May 1971	Yamhill	House and barn damaged near McMinnville.
August 1975	Lane	Metal building destroyed near Eugene.
August 1978	Yamhill	Minor damage near Amity.

DATE	COUNTY	RESULT
April 1984	Yamhill	Barn roof destroyed.
May 1984	Lane	Barn and shelter damaged near Junction City.
November 1989	Lane	Telephone poles and trees uprooted near Eugene.
May 1990	Linn	Three funnel clouds spotted near Albany; no confirmation of touch down.
November 1991	Marion	Barn damaged near Silverton.
March 1994	Linn	Damage to a shopping area in Albany.
December 1996	Lane	Damage to a residential area caused by fallen trees.
May 1997	Marion	Trees uprooted and barn damage near Keizer.
June 1997	Benton	Observed by pilot 15 miles west of Albany. No known damage.
September 1997	Marion	Minor fence and window damage near Turner.
October 1998	Marion	Observed in Silverton. No damage or injuries.
December 1999	Lane	Roof damage and mill slash burner tipped over in Creswell. One unconfirmed injury.
December 2006	Marion	Damage to barn and RV northeast of Salem.
September 2007	Linn	Six farm buildings damaged near Lebanon; 90 to 100 trees damaged.
June 2009	Linn	Damage to a shed near Peoria.
December 2010	Marion	An EF-2 rated tornado with 5-mile path 150 yards wide caused $1.2 million in damage in Aumsville. Two minor injuries.
June 2013	Yamhill	EF-1 tornado touched down in McMinnville. Tree damage and wind-thrown industrial equipment.
April 2015	Lane	Three vehicles damaged at Lane Community College in Eugene.
April 24, 2016	Linn	A brief funnel cloud was observed by a trained spotter along Interstate 5 around 10 miles south of Albany, Oregon.
May 15, 2016	Linn	A trained spotter reported seeing a funnel cloud near Albany, Oregon as an upper level trough moved over northwest Oregon.
May 21, 2019	Linn	An upper-level low pressure system generated several showers across the area. One of these stronger showers had enough environmental shear to produce a funnel cloud east of Albany that was reported by a

DATE	COUNTY	RESULT
		television viewer who sent a photo to the local media station.

Sources: Histories of severe weather storms for the City of Albany are found at the following websites.

- NOAA National Climatic Data Center database - http://www.ncdc.noaa.gov/stormevents/
- National Weather Service - http://www.wrh.noaa.gov/pqr/
- Oregon State University – Oregon Climate Service - http://www.ocs.oregonstate.edu/
- Climate of Oregon Narrative, NWS - http://www.wrcc.dri.edu/narratives/OREGON.htm
- State of Oregon Natural Hazard Mitigation Plan – http://www.oregon.gov/LCD/HAZ/pages/nhmp.aspx

Extreme Heat

During the period under review for this NHMP update there were two extreme heat events in the City of Albany.

June 26-29, 2021: A high pressure heat dome over the region led to stretch of extreme heat, shattering records from June 26 through June 29. All time max temperatures were broken by 8 to 10 degrees. Widespread fatalities occurred due to the heat (123 in total), as many were without air-conditioning, as well as an increase in the number of drownings. Widespread closures and postponements of businesses and events also occurred. There were two consecutive days with maximum temperatures greater than 100 degrees. The hottest day was June 27 where temperatures in the area peaked around 112 degrees in the Southern Willamette valley. Record breaking temperatures up to 111 degrees F in Eugene, OR. There was one heat related death reported in the Southern Willamette valley.

On July 29, 2021 a strong high pressure aloft brought a brief hot air mass to the region. Oregon Governor issued an Emergency Declaration due to forecasted heat across the State affecting 23 counties.

August 11-12, 2021: Hot weather began to develop August 9, peaking August 11-12, but temperatures continued above normal into the weekend. Peak afternoon temperatures of 100 to 105 degrees drove people to seek relief in or near bodies of water. Heat caused slowdowns on the MAX light rail in the Portland metro area, and some businesses closed due to the heat. Cooling shelters were opened in several counties.

Probability of Future Severe Weather Events

Snow Storms

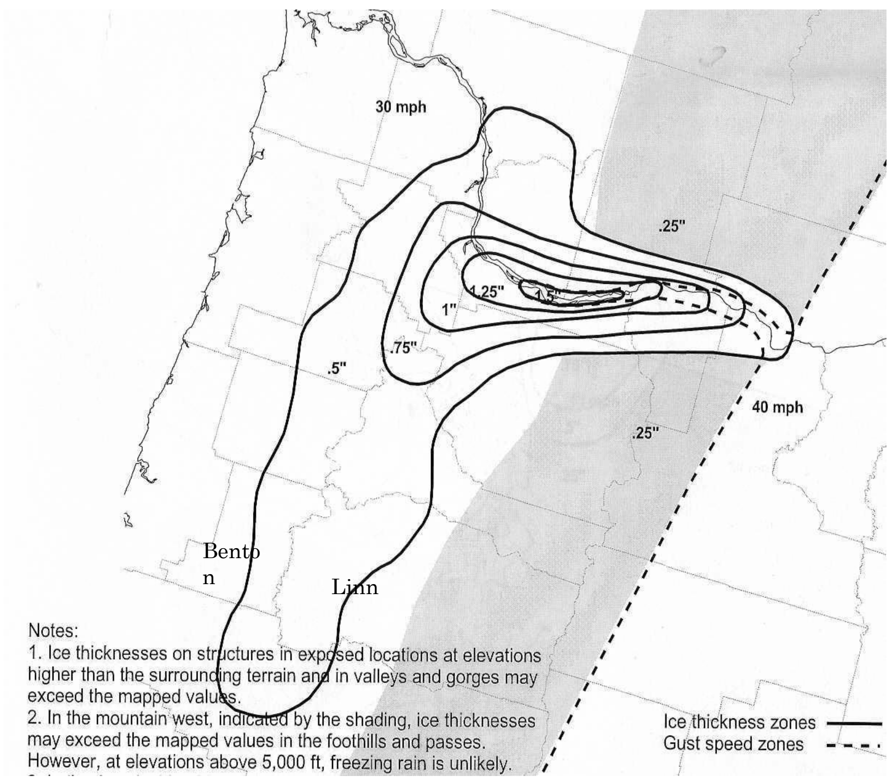
Winter snow storms are rare in this part of the valley. When they do occur, they are not usually severe. The interval for snow storms over the last 30 years has been one every six years. During this time, there have been small storms but generally not a significant amount of snow fall recorded or causing problems to people and property. Monthly recorded snow fall indicates that, on average, 2.2 inches will fall in January, 1.3” in February, 0.2” in March, 0.2” in November and 1.6” in December. There was a four-year span between the last two snow storms: one in 1998 - 1999 and the other in 2003. Before the 1993 snow storm, the valley saw a one to three-year gap between storms with an 18-year gap between 1971 and 1989. Since 2003 however, there have been four noteworthy snow storm events. In January 10 – 12, 2007, up to 4 inches of snow fell in the Willamette Valley, resulting in school closures and perilous driving conditions. Up to 10 inches of snow fell in parts of the Willamette Valley on January 27 – 28, 2008, and Corvallis saw up to 5 inches of snow on February 24 – 25, 2011. The most recent heavy snow event occurred on March 21, 2012. A total of 5 inches of snow was reported in Eugene, Lebanon, and Brownsville, and up to 4 inches of snow fell in Albany. This snowstorm resulted in road closures and power outages due to falling trees.

Ice Storms

Review of the historical data above indicates an average of one ice storm every 10 years. Given this information, it is most likely we will continue to have future ice storms at this same interval. Though they do not occur on regular intervals but within a certain time period, we can expect at least one to occur between 2015 and 2024.[16]

The National Climatic Data Center (NCDC) database shows four ice storms or freezing rain events for the Southern Willamette Valley between 1993 and 2014; two of which occurred in 2014. The February 8, 2014 storm began with 5 to 9 inches of snow followed by sleet and freezing rain, resulting in power outages and hazardous driving. The second 2014 event happened on November 13 – 14th, with reports of sleet and freezing rain in amounts upwards of ½ inch in Corvallis and Dallas.

Figure 6. 50-Year Ice Thickness from Freezing Rain



Probabilistic ice storm data showing ice thicknesses with return periods from 50 years to 400 years are given in a recent draft report for FEMA and the National Institute of Building Sciences, "Extreme Ice Thicknesses from Freezing Rain," (Kathleen F. Jones, US Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, May 28, 2004). The 50-year return period ice thickness map (Figure 8-4 below) shows about 0.5" of ice for Benton County, with ice thickness decreasing westward from the Willamette Valley. One hundred-year and 400-year ice thicknesses for Benton County are about 0.75" and 1.0," respectively.

For Benton County and the city of Albany, ice thicknesses in 50-year or more severe events are high enough (0.5" or greater) to cause substantial damage, especially to trees and utility lines.[17]

High Winds

In review of the historical occurrences, another high-wind storm will occur in the future. As with other winter storms, it is impossible to predict when but it appears that one every 10 years is likely and, since our last significant wind storm was in 2012, we can expect at least one more significant wind storm to occur by 2022.[18]

According to the Benton County Natural Hazard Mitigation Plan, the one-year recurrence interval sustains wind speeds range from 37 – 43 mph (59 – 68 km/hour) and can cause significant local wind damage at sites with especially exposed locations. The 50-year recurrence interval wind speeds range from about 62 – 71 mph (99 – 113 km/hour), high enough to cause widespread damage. For most regions of Benton County, direct wind damage is likely perhaps once every decade on average with major wind storm events happening at intervals averaging a few decades. The potential for damaging winds may be somewhat higher in eastern Benton County along the Willamette River where Albany sits.[19]

Figure 7. Benton County Wind Hazard: Locations with a History of Wind Damage[21]

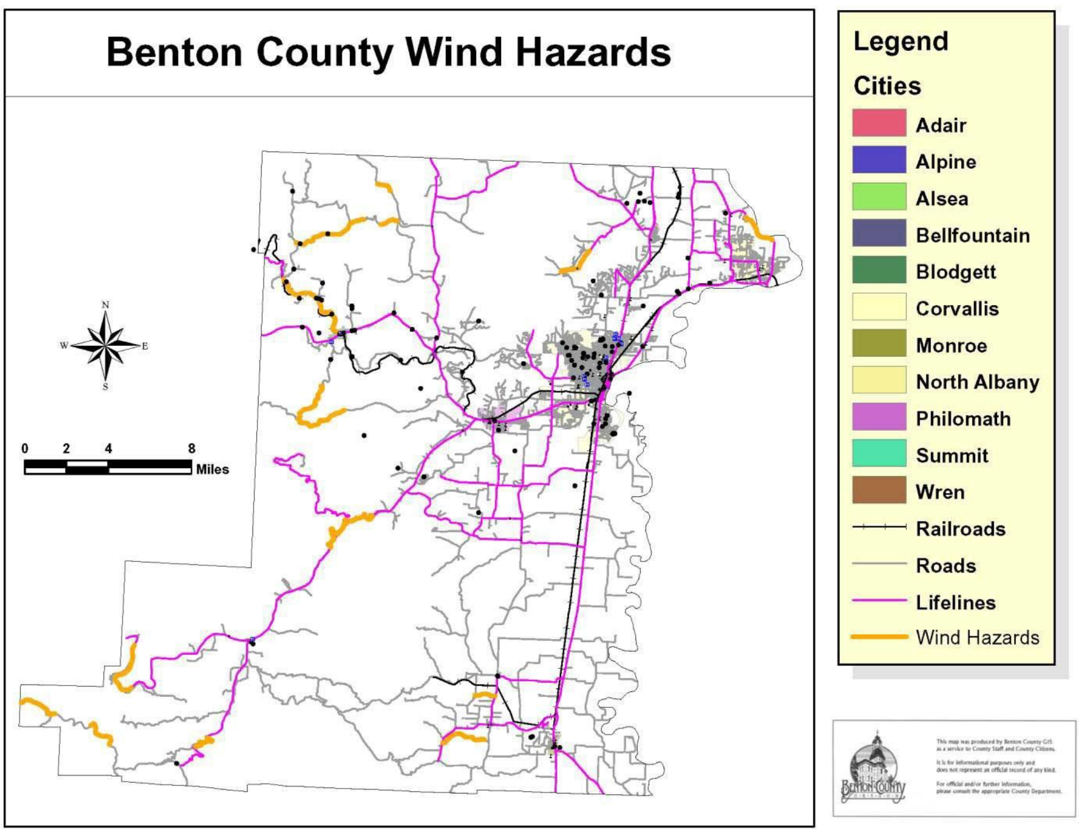


Table 6. Effects of Wind Speed [20]

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

Tornadoes

Tornadoes in the Albany area are relatively rare. In 1990 three funnel clouds were spotted in the Albany area; and in 1994, a weak tornado damaged a shopping center in the city. In general, tornadoes occur somewhere in the Willamette Valley about once every four years. The potential for tornadoes has increased in the last 15 years. The first documented EF-2 tornado in the southern Willamette Valley struck the community of Aumsville on December 14, 2010, causing $1.2 million in damage and two injuries. It is likely another tornado will occur in the vicinity of the city of Albany within the next 10 years.[22]

Climate and weather conditions in Oregon and specifically in Benton County make the occurrence of major tornadoes unlikely. The most practical mitigation actions for tornadoes are public warnings and takingshelter to minimize the potential for deaths and injuries.[23]

Extreme Heat

The OCCRI report on Future Climate Projections concludes that in Linn County, the number of days per year with temperatures 90°F or higher is projected to increase by an average of 17 days (range 5–29 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario. The temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–10°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Vulnerability: Identifying Assets

Section 201.6(c)(2)(*ii)*(A) of the Disaster Mitigation Act of 2000 requires that the risk assessment include a description of the jurisdiction's vulnerability to the hazard. This description shall include an overall summary for the hazard and its impact on the community. If best available data allows, vulnerability should be described in terms of the type and number of existing and future buildings, infrastructure, and critical facilities located in identified hazard areas. Below is the vulnerability summary for the City of Albany.

Snow Storms

When winter snow storms occur, they will affect the entire community's population. Unless freezing rain has accompanied the snowfall, power outages from snowfall alone are rare. The City has no snow-clearing equipment which means non-state roads will not be plowed as soon as state roads. This can lead to multiple accidents as drivers with little winter driving experience will tend to drive too fast and brake too quickly. This will put a strain on emergency services. Also, snowfall means lower temperatures which have a tendency to mean more structure fires created by using unsafe heating methods. In large snowfalls, businesses may suffer because of the inability of workers to get to work because of road conditions. This generally lasts for only a couple of days. Home owners are often not prepared for the cold weather associated with snowfall which means that water pipes often break. Snowfall typically does not have as significant an impact on the total population of the city as freezing rain or extreme cold weather.

Ice Storms

Historical records indicate that Albany and the surrounding area are vulnerable to power outages during ice storms. During one such storm, 18,000 customers were initially without power. After one day, the outage was isolated to a small geographic area which included North Albany. Power was out as long as 2½ days there. In addition to power concerns, the entire population is affected by road conditions and is susceptible to a higher rate of traffic accidents. Requests for emergency services generally increase by 100% during ice storms, putting a strain on emergency personnel.

High Winds

When a wind storm occurs, it will affect the entire population. The first effect will be power loss to the residences and businesses. As with ice events, power will be interrupted by downed lines as a result of trees blowing over or branches falling onto lines. Power companies have been proactive by implementing mitigation programs that cut back tree branches at least 10 feet from power lines. For wind events, this will help tree limbs falling on to the lines. Debris in the road causes driving hazards for the public and emergency service personnel. Rural areas are more at risk because of the number of trees, but the problem exists within the city as Albany strives to increase the tree inventory for beautification and livability. Debris clearing becomes a top priority for the City after high wind storms.[24]

Tornadoes

Tornadoes have a very narrow field of effect so if one does set down in Albany, it will affect a very small percentage of the population. Given local history, the number of people directly affected by a tornado would range from one to 25 depending on where the tornado touches down.[25]

Vulnerability: Community Impacts

Life and Property

Winter storms can have a significant impact on life and property. Many deaths in severe winter storms occur as a result of traffic accidents on icy roads, heart attacks while shoveling snow, and hypothermia from prolonged exposure to the cold. Debris carried along by extreme winds can contribute directly to loss of life and indirectly through the failure of protective structures (i.e. buildings) and infrastructure.

Property can also be damaged by flooding (see Section 6) and landslides (see Section 10) that result from heavy snowmelt. Ice, wind, and snow can affect the stability of trees, power lines, telephone lines, and television and radio antennae. Falling trees and limbs affected by these events and saturated soils can become hazards for houses, cars, utilities, and other property. These conditions can be major hindrances to emergency response and disaster recovery.

Extreme heat can result in death when residents seek relief in bodies of water. During the August 11-12, 2021 extreme heat event, a 22-year-old woman drowned after being swept away while wading in the Willamette River near the pedestrian bridge between the University of Oregon campus and Autzen Stadium in Eugene. The high temperature at Eugene (KEUG) was 102 degrees on the 11th and 104 degrees on the 12th. During the June 2021 extreme heat event Multnomah County had the largest number of fatalities in the state of Oregon with 73 deaths directly related to the heat.

Traffic

The importance of transportation is never more noticeable than where travel is difficult or dangerous. Both property damage and loss of life are risks to those who must drive. Traffic delays or blockages can seriously hinder emergency service providers.

Economic concerns rise during storms that cause dangerous road conditions since many people choose to stay home or are asked to leave work early to get home safely. This means businesses will suffer economically from not opening or, if they are open, no customer is able to get to them. For Albany, these situations have typically occurred every 5 to 10 years, depending on the type of event, i.e. snow or ice storm. Because of the infrequency of these events, Albany can provide the minimum of recovery response to the roads but generally will need to wait until the event has run its course. The Oregon Department of Transportation will serve the state highways that go through Albany, while Albany Public Works will keep emergency transportation routes open on local streets by sanding with City equipment and/or contracting with local vendors.

High winds can cause prolonged and extreme traffic disruptions.

Utilities

Historically, falling trees have been the major cause of power outages resulting in interruption of services and damaged property. The issue of weather-related power outages should be addressed as many Albany residents rely on electricity for heat. Even homes using natural gas typically require electricity for the system to operate and run circulation fans and thermostats. Natural gas distribution systems also rely in part on electrical service to keep the system operational; widespread power outages can interrupt that service.

Power loss is also a concern to businesses that may have to close during outages.

Many overhead wires are at risk from snow and ice accumulations that are beyond the design specifications. High winds can create flying debris and downed utility lines. For example, tree limbs breaking in winds of only 45 mph can be thrown more than 75 feet. As such, overhead power lines can be damaged even in relatively minor windstorm events.

Increasing population and new infrastructure in Albany mean that more lives and property are exposed to risk; this situation creates a higher probability that damage will occur from severe weather events.

Water Lines

The most frequent water system problem related to cold weather is broken home water lines. Breaks frequently occur during severe freeze events as well as during extreme cooling periods through October, November, and December. In almost every severe winter storm previously described, broken pipes led to the closures of schools and business throughout Albany. Pipe breakage also occurs in many older homes that are not properly insulated or of construction types with inadequate protection of water pipes under the house.

During freezes, the broken waterlines not only result in lost water service to customers but also cause extensive property damage from spilled water. Severe weather can also affect the water system in other ways. Power interruptions at distribution pump stations can have dramatic negative consequences to the water system. Another common problem during severe freeze events is the failure of commercial and residential water lines. Inadequately insulated potable water and fire sprinkler pipes can rupture and cause extensive damage to property.

Estimating Potential Losses and Vulnerable Assets

At the time this plan was developed, the City did not have sufficient data to identify the types and numbers of buildings, infrastructure, and critical facilities vulnerable to winter storms.

Existing Mitigation Activities

Existing mitigation activities include current mitigation programs and activities that are being implemented by city, state, or federal agencies and organizations.

City Programs

Regional All-Hazard Mitigation Plan for Benton, Lane, Lincoln and Linn Counties
Beginning in 1996, the City of Albany participated with Benton, Lane, Lincoln, and Linn counties in the development of a three-phase hazard mitigation program. The plan reviewed the principles of mitigation planning and presents a seven-step process for conducting a detailed, quantitative evaluation of prospective mitigation projects. Phase One of the program was

completed in December 1998 and provided a Flood Hazard Mitigation Planning Template for Local Government, a mitigation planning methodology and addressed flood and winter storm hazards. It also outlined the connectivity between mitigation planning and emergency planning.

Phase Two of the planning was completed in September 2001 and included earthquake impacts for Benton, Lane, and Linn counties. Phase Three of the program was completed in September 2002 and dealt with hazardous materials in Benton, Lane, and Linn counties.[26]

Capital Improvement Program
The City of Albany's Capital Improvement Program (CIP) is a dynamic document that lists and prioritizes needed improvements and expansions of the City's infrastructure to maintain adequate service to current residents and businesses and to accommodate population growth and land development. The CIP reflects the needs and priorities established by the City and the resources available to the City. The CIP can be modified during the fiscal year through the supplemental budget process as needs, priorities, and resources change. The CIP can assist the City of Albany in mitigating severe weather events by improving infrastructure most prone to damage.

Emergency Operations Center (EOC)
The Emergency Operations Center is an established location/facility from which City staff and officials can provide direction, coordination, and support to emergency operations in the event of an incident such as a natural disaster. City personnel who are assigned to and trained for specific positions within the EOC organizational structure staff the EOC. The structure is based on the National Incident Management System (NIMS) Incident Command System (ICS). The EOC staff provides information and recommendations to the Mayor through the Incident Commander or as directed to develop a course of action to respond to and contain, control, and recover from an emergency. Some of the primary functions performed at the EOC include: coordination, operations management, planning, information tracking and dissemination, logistical support, financial management and support, and emergency public information.

Emergency Operations Plan (EOP)
The Emergency Operations Plan (EOP) describes the roles and responsibilities of the departments and personnel for the City of Albany during major emergencies or disasters. The Plan sets forth a strategy and operating guidelines using NIMS ICS which have been adopted by the City for managing its response and recovery activities during disasters and emergencies. The EOP consists of various sections and supporting materials. The development and maintenance of this plan is the basis of the City's emergency response and recovery operations.

1. **Basic Plan -** Provides an overview of the City's emergency response organization and policies. It cites the legal authority for emergency operations, summarizes the situations addressed by the plan, explains the general concept of operations, and assigns general responsibilities for emergency planning and operations.
2. **Functional Annexes -** Each annex focuses on one of the critical emergency functions that are typically common for all hazards, which the City will perform in response to an emergency. The type and scope of an incident will dictate which functional annexes will be needed.
3. **Hazard Specific Appendices -** The appendices provide additional detailed information and special considerations that are applicable to specific hazards. The appendices are to be used in conjunction with the basic plan and the functional annexes.

4. **Resources** – The addenda include the Emergency Resource Guide, emergency call list, mutual aid agreements and memoranda of understanding, and Radio Frequency Communication Guide.

Incident Command System

The Incident Command System (ICS) is a management system that may be used for any type of hazard event and has three main components. The City of Albany has adopted the use of the National Incident Management System (NIMS), which includes the Incident Command System, for responding to and recovering from any disaster or emergency. The NIMS components are:

1. Command and management
2. Preparedness
3. Resource management
4. Communications and information management
5. Support technologies
6. Ongoing management and maintenance

Transportation System Plan

The City of Albany's adopted Transportation System Plan (TSP) is a supporting document of the transportation element of the City's Comprehensive Plan. It identifies the transportation improvements needed to accommodate existing and future development in the Albany area. The plan identifies needs and improvements through 2030. The TSP was developed through a public participation process. The development of the TSP and the transportation element of the Comprehensive Plan are closely coordinated and intended to be consistent with other jurisdictions' transportation plans.

Urban Forestry Program

Albany's Urban Forestry Program has a number of ongoing educational efforts designed to mitigate damage from downed trees during storms. The program also has authority to identify and eliminate known hazards. The following is a brief summary of related activities. Albany Municipal Code gives the City Forester authority to require permits for planting trees on public rights-of-way. The permitting system provides an opportunity to specify failure-resistant species and to set standards that reduce losses from tree failure. The City Forester has the authority to remove trees that threaten public safety and to require property owners to perform street tree maintenance to correct hazardous situations.

The Urban Forestry Program also provides a free inspection service for public street trees. Property owners who request this service are visited by an Urban Forestry Inspector who is trained to pre-identify many tree-related hazards and advise property owners.

Tree Inventory Map

The City has completed its comprehensive public tree inventory to help identify hazard trees. A map of hazardous trees in Albany will provide information useful for targeting measures that can be used to mitigate against the effects of falling trees. To further this goal, "The City of Albany is currently working on long- range tree preservation planning. This will help drive development away from hazard-prone areas, and attempt to increase the City's ability to mitigate for disasters."

PacifiCorp Right Tree, Right Place

Pacific Power's Right Tree, Right Place program educates homeowners, landscapers and tree propagators on tree species that will not be subject to ongoing stress by constant pruning. Pacific Power distributes posters and a *Small Trees for Small Places* booklet that list low-growing trees that fit within the utility right-of-way and are compatible with small urban planting strips. The poster includes information on how to select the correct tree, the energy-saving benefits of trees, and proper planting and pruning techniques. Pacific Power offers tree owners certificates to help defray the cost of a new tree that replaces one that is inappropriate. Pacific Power's foresters work with local government and the public to assess and identify situations in which trees or power lines put life and property at risk or endanger electric service reliability.

International Building Code

The City of Albany and the State of Oregon have adopted the International Building Code which includes specifications for new development to withstand snow and wind loads.

Dangerous Building Code

Albany Municipal Code, Title 18 – Building & Construction, 18-16 Dangerous Buildings, defines "dangerous buildings" and requires abatement of them. Dangerous buildings include those with structures that are overstressed because of snow or wind loading or because they require maintenance.

Federal Programs National Weather Service

The Portland Office of the National Weather Service issues severe winter storm watches and warnings when appropriate to alert government agencies and the public of possible or impending weather events. The watches and warnings are broadcast over National Oceanic & Atmospheric Administration (NOAA) weather radio and are forwarded to the local media for retransmission using the Emergency Alert System.

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[1] Interagency Hazard Mitigation Team, *State Hazard Mitigation Plan* (2000) Office of Emergency Management

[2] National Weather Service Web-Page, http://www.wrh.noaa.gov/pqr/pdxclimate/index/php
(Accessed 20 October 2004)

[3] Western Regional Climate Center

[4] Oregon Climate Service

[5] Ibid.

[6] Benton County Natural Hazard Mitigation Plan, Winter Storms chapter 7

[7] National Climatic Data Center, 2015.

[8] Ibid.

[9] Taylor, George H. and Hannon, Chris, *The Oregon Weather Book,* (1999) Oregon State University Press

[10] City of Albany Hazard Analysis 2004, Winter Ice Storms

[11] National Climatic Data Center, 2015.

[12] Linn County Natural Hazard Mitigation Plan, Section 9, Severe Weather Events

[13] National Climatic Data Center, 2015.

[14] City of Albany Hazard Analysis 2004, Tornadoes

[15] National Climatic Data Center, 2015.

[16] City of Albany Hazard Analysis 2004, Winter Ice Storms

[17] Benton County Natural Hazard Mitigation Plan, Winter Storms Chapter 7

[18] City of Albany Hazard Analysis 2004, High Wind Storm, Probability section

[19] Benton County Natural Hazard Mitigation Plan, Winter Storms Chapter 7

[20] Linn County Natural Hazard Mitigation Plan, Severe Weather, Section 9

[21] Benton County Natural Hazard Mitigation Plan, Winter Storms Chapter 7
[22] City of Albany Hazard Analysis 2004, Tornados, Probability section
[23] Benton County Natural Hazard Mitigation Plan, Winter Storms Chapter 7
[24] City of Albany Hazard Analysis 2004, High Wind Storm, Vulnerability section
[25] City of Albany Hazard Analysis 2004, Tornados, Vulnerability section
[26] Regional all Hazard Mitigation Master Plan for Benton, Lane, Lincoln and Linn Counties: Phases I, II, and III. Kenneth A. Goettel; Goettel & Associates Inc.

Section 9:
Wildfire

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Wildfire

Why is wildfire a threat to the City of Albany?

Wildfire is defined as an uncontrolled burning of wildland (forest, brush, or grassland). Although fire is a natural part of forest and grassland ecosystems, a wildfire can pose a significant risk to life and property in wildland/urban interface areas. The urban interface is the area at the urban-rural fringe where homes and other structures are built into a forested or natural landscape. If left unchecked, fires in these areas can threaten lives and property.

Albany's climate is characterized by warm dry summers. During the summer fire season, the danger of fire in the city increases as the trees, brush, and grassland dries, increasing the potential for a conflagration. The forest lands in eastern Linn County are subject to annual small to moderate fires caused by human and natural causes such aslightening.[1]

Much of the Willamette Valley in western Linn County is dominated by grass seed fields. In 1948, Oregon's grass seed farmers began burning their fields to control disease and dispose of straw. In 1988, grass smoke from a controlled burn in a field adjacent to Interstate 5 between Albany and Highway 34 intruded across the interstate, causing a 24-car pile-up. Thirty-eight people were injured and seven people died. Since then, legislation has been adopted restricting but not eliminating the burning of fields. Grass farmers have developed alternatives to burning and currently burn fewer acres than allowed by law. [2] In June of 2009, the Oregon Legislature passed Senate Bill 528[3], further reducing the acres growers are allowed to burn.

Burning of any kind is a potential threat to safety. Forest slash burns, grass field burns, and residential back yard burning in the wildland/urban interface all have the potential to ignite wildfire, threatening health, life, and property.

Causes and Characteristics of Wildfire Hazards

The characteristics of fire are important to understand when trying to mitigate its negative effects on humans and structures. In order for fire to exist, the three components of the fire triangle must be present: fuel, heat, and oxygen.[4]

Most naturally caused fires are initiated by lightning strikes. Human-caused fires, both accidental and deliberate, are produced in many ways, including campfires, chimneys, torches, matches, fireworks, cigarettes, vehicles, military ordnance, and smoldering slash piles.[5] Whether natural or human-caused, the ignition is started because the fire triangle exists. Fire occurring in natural ecosystems begins as a point of ignition, burns outward into circles and, if escalated, spreads in the direction toward which the wind is blowing.[6] Additionally, when burning occurs on uneven terrain, the fire spreads upslope to eventually form broad ellipses.[7]

Effects of fire on ecosystem resources can represent damages, benefits, or some combination of both, depending largely on the characteristics of the fire site, the severity of the fire, the time period of valuation, and the values placed on the resources affected by the fire.[8] The ecosystems of most forests depend upon fire to maintain various functions. The use of fire for beneficial purposes is considered for reducing fuel loads, disposing of slash, preparing seedbeds, thinning overstocked stands, increasing forage plant production, improving wildlife habitats, changing hydrologic processes, and improving aesthetic environments.[9] However, despite its beneficial values to ecosystems, fire has been suppressed for years because of its perceived effects on timber harvest and threat to human life. In addition, new development continues to push its way into what is termed as the “wildland/urban interface” or WUI.

Increased temperatures, the potential for reduced precipitation in summer months, and accumulation of fuels in forests due to insect and disease damage present high risk for catastrophic fires, particularly in forests east of the crest of the Cascade Range. An increase in frequency and intensity of wildfires will damage larger areas, and likely cause greater ecosystem and habitat damage. Larger and more frequent wildfires will increase human health risks due to exposure to smoke.

Increased risk of wildfire will result in increased potential for economic damage at the urban- wildland interface. Wildland fires destroy property, infrastructure, commercial timber, recreational opportunities, and ecosystem services. Some buildings and infrastructure subject to increased fire risk may not be adequately insured against losses due to fire. Increased fire danger will increase the cost to prevent, prepare for, and respond to wildfires.

The Interface

There are three categories of interface:[10]

- Classic wildland/urban interface exists where well-defined urban and suburban development presses up against open expanses of wildland areas;
- Mixed wildland/urban interface is characterized by isolated homes, subdivisions, and small communities situated predominantly in wildland settings; and
- Occluded wildland/urban interface exists where islands of wildland vegetation occur inside a largely urbanized area.

Unlike most other natural hazards, the wildland/urban interface is not designated by geography alone. 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).[11]

Once a fire has started, several conditions influence its behavior, including fuel, topography, weather, drought, and development. These combined conditions are key elements for increased wildfire risk. The severity of the wildfire is ultimately affected by the severity of these conditions. For example, if a steep slope is combined with extremely low humidity, high winds, and highly flammable vegetation, a high–intensity wildfire may develop.

Since the 1970s, Oregon's growing population has expanded further and further into traditional resource lands such as forestland. The “interface” between urban and suburban areas and the resource lands created by this expansion has produced a significant increase in threats to life and property from fires and has pushed existing fire protection systems beyond original or current design or capability.[12] Property owners in the interface are often unaware of the problems and threats they face. Therefore, many owners have done very little to manage or offset fire hazards or risks on their own property. Human activities also increase the incidence of fire ignition and potential damage.

The Oregon State Natural Hazards Mitigation Plan (OR-SNHMP) Region 3 Hazards Assessment identifies the following as wildland/urban interface communities in Linn County[13]:

- Albany
- Brownsville
- Clear Lake Resort
- Harrisburg
- Lebanon
- Marion Forks
- Mill City
- Idanha
- Scio
- Sweet Home East
- Sweet Home West

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

Fuel[14]

Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is classified by volume and by type. *Volume* is described in terms of "fuel loading," or the amount of available vegetative fuel. The *type* of fuel refers to the species of trees, shrubs, and grass that are present. Oregon, as a western state with prevalent conifer, brush, and rangeland fuel types, is subject to more frequent wildfires than other regions of the nation.

An important element in understanding the danger of wildfire is the availability of diverse fuels in the landscape, such as natural vegetation, manmade structures, and combustible materials. A house surrounded by brushy growth rather than cleared space allows for greater continuity of fuel and increases the fire's ability to spread. After decades of fire suppression, "dog-hair" thickets have accumulated. These enable high intensity fires to flare and spreadrapidly.

Structures that are made of combustible material such as shake roofs and wood siding are especially susceptible to fire. Untrimmed bushes near these structures often serve as "ladder fuels," enabling a slow-moving ground fire to climb onto rooftops and into the crowns of trees. A crown fire is significantly more difficult to suppress than a ground fire and is much more threatening to structures in the interface.

Wildfire at the upper end of the wildfire intensity spectrum is likely to spread into the tops of the tallest trees in violent and discontinuous surges.[15] Fire that occurs at this severe end of the spectrum responds to its own convective winds, spreading rapidly as sparks from exploding trees ignite other fires many meters away.[16] Because of the many different possible fuels found in the interface landscape, firefighters have a difficult time predicting how fires will react or spread.

Topography[17]

Topography influences the movement of air, thereby directing a fire's course. For example, if the percentage of uphill slope doubles, the rate of spread in wildfire will likely double. Gulches and canyons can funnel air and act as chimneys, which intensify fire behavior and cause the fire to spread faster. Solar heating of dry, south-facing slopes produces upslope drafts that can complicate fire behavior.

Unfortunately, hillsides with hazardous topographic characteristics are often desirable as residential areas. This underscores the need for wildfire hazard mitigation and increased education and outreach to homeowners living in interface areas.

The City of Albany's geography is characterized by mostly flat land with some hills in the North Albany in Benton County.

Weather[18]

Weather patterns combined with certain geographic locations can create a favorable climate for wildfire. Areas where annual precipitation is less than 30 inches are extremely fire susceptible.[19] High-risk areas in Oregon share a hot, dry season in late summer and early fall when high temperatures and low humidity favor fire activity. Predominant wind directions may guide a fire's path. In addition, many high intensity fires produce their own wind, which aids in the spread of fire.

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. The term *drought* is applied to a period in which an unusual scarcity of rain causes a serious hydrological imbalance.

Drought contributes to the frequency and intensity of fires. Unusually dry winters, or significantly less rainfall than normal, can lead to drier conditions and leave reservoirs and water tables lower. Drought leads to problems with irrigation and may contribute to additional fires, or additional difficulties in fighting fires. However, most fuel types, other than grasses, require two or three years of drought before the fuel becomes dangerously dry.

All areas of Linn County receive an average of more than 40 inches of rainfall per year. However, the county usually receives very little rainfall during the warm summer months, commonly going long periods with no measurable precipitation. During the summer fire season, the danger of fire in the forests and grasslands increases as the trees, brush and grassland dries and increases the potential for conflagration. The county is highly susceptible to lightning- induced fires during late summer thunderstorms.

Development

Growth and development in forested areas is increasing the number of structures in the interface. Wildfire affects development, and development can influence wildfire. While wildfires have always been part of the ecosystem in Oregon, homes in the interface often lead to human ignition of fire. The increase in human development and activity in the interface combined with the high fuels content from years of fire suppression can create a lethal combination.

Homeowners often prefer lots that are private and have scenic views nestled in vegetation. A private setting may be far from public roads, or hidden behind a narrow, curving driveway. These conditions, however, make evacuation and firefighting difficult. The scenic views found along mountain ridges can also mean areas of dangerous topography. Natural vegetation contributes to scenic beauty, but it may also provide a ready trail of fuel leading a fire directly to the combustible fuels of the home itself. [20]

Wildfire Hazard Assessment

The wildfire hazard assessment provides information on the location of wildfire hazards, the land and property characteristics within the hazard area, and an assessment of risks to life and property that may result from a wildfire. The three elements of hazard assessment are: hazard identification; vulnerability assessment; and risk analysis.

Section 201.6(c)(2)(*i*) of the Disaster Mitigation Act of 2000 (DMA-2000) requires that the risk assessment include a description of the location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and the probability of future hazard events.

Hazard Identification

The first phase of wildfire-hazard assessment is hazard identification. Hazard identification identifies: the geographic extent of areas subject to wildfire; the expected intensity of a wildfire event at different locations; and the probability of occurrence of wildfire events.

Wildfire hazard areas are commonly identified in areas of wildland/urban interface. The level of wildfire hazard is determined by the ease of fire ignition, from natural or human causes, and the difficulty of fire suppression. Wildfire hazard can be magnified by several fire suppression and control factors, such as the fuel load, weather, topography, and property characteristics. Hazard identification rating systems are based on weighted factors of fuels, weather, andtopography.[21]

To determine the base hazard factor of specific wildfire hazard sites and interface regions, several factors must be considered. Categories used to assess the base hazard factor include[22]:

- Topographic location, characteristics and fuels
- Site/building construction and design
- Site/region fuel profile (landscaping)
- Defensible space
- Accessibility
- Fire protection response and
- Water availability

The use of Geographic Information System (GIS) tools and improved data can assist in fire hazard assessment, allowing further integration of fuels, weather, topography, and development data for fire behavior prediction, watershed evaluation, developing mitigation strategies, and hazard mapping.

Wildfire in Oregon

Oregon has a very lengthy history of fire in the undeveloped wildland and in the developing wildland/urban interface. There have been many fires in Oregon, named and unnamed.[23]

Table 1 lists some of the major fires that occurred in Oregon from 1848 to 2002.

Table 1. Historic Oregon Wildfires (1848-2022)

Year	Fire	Number of acres burned
1848	Nestucca	290,000
1849	Siletz	800,000
1853	Yaquina	482,000
1865	Silverton	988,000
1868	Coos Bay	296,000
1933	Tillamook	240,000
1936	Bandon	143,000
1939	Saddle Mountain	190,000
1945	Wilson River/Salmonberry	180,000
1951	North Fork/Elkhorn	33,000
1966	Oxbow	44,000
1987	Silver	970,000
1992	Lone Pine	31,000
1996	Skelton	17,000
2002	Biscuit	500,000
2020	Labor Day wildfires	1,000,000

Source: "Atlas of Oregon," William G. Loy, et al, University of Oregon Books, 1976. Oregon Department of Forestry, "Tillamook Burn to Tillamook State Forest," revised 1993. Department of Forestry, http://www.odf.state.or.us/DIVISIONS/protection/fire_protection/stats/histfire.asp?id=3070105
Oregon Emergency Management, State Hazard Risk Assessment, 2003.

In 1990, Bend's Awbrey Hall Fire destroyed 21 homes, causing approximately $9 million in damage and costing over $2 million to suppress. In 1996, Bend's Skeleton Fire burned over 17,000 acres and damaged or destroyed 30 homes and structures. In that same year, 218,000 acres were burned, 600 homes were threatened, and 44 homes were lost statewide.[24] In 2002, the Biscuit Fire became one of Oregon's most destructive fires in recent history, impacting nearly 500,000 acres, destroying four homes, nine outbuildings, a lookout, and numerous recreational structures. The costs of fighting this fire totaled $153 million and included over 7,000 firefighters and support personnel.[25]

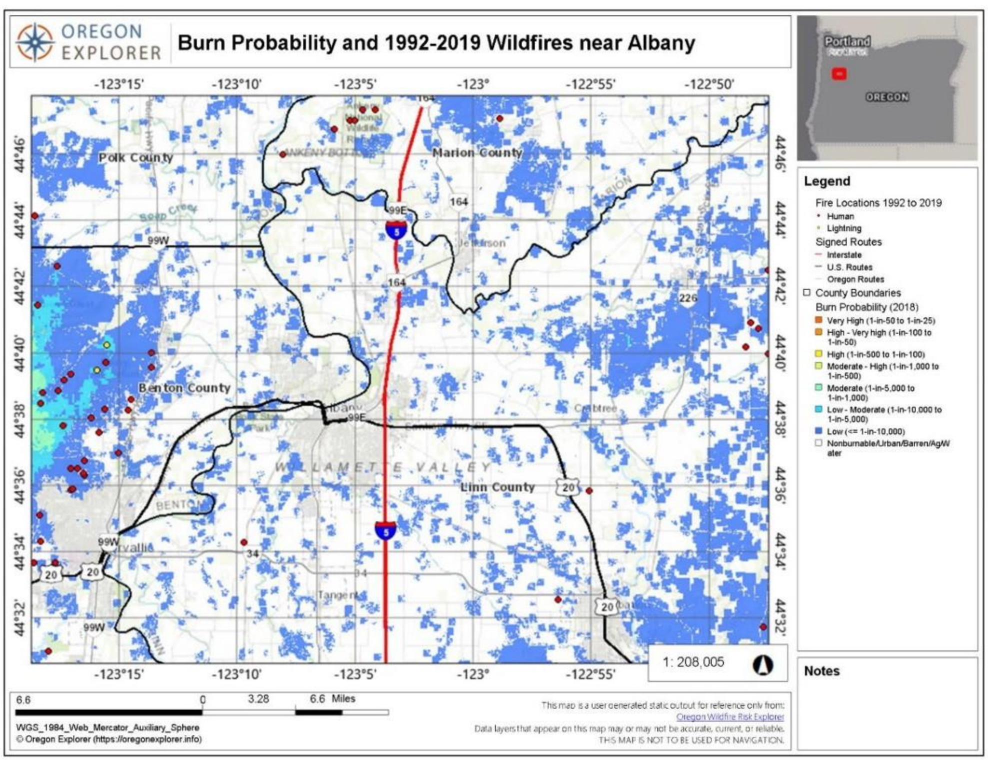
In September 2020, Marion County was impacted by the Beachie Creek and Lionshead fires which merged in Marion County burning approximately 400,000 acres and also by the Riverside Fire in the northern part of the county. The Beachie Creek fire burned 193,565 acres of land in Linn, Marion and Clackamas counties including portions of the City of Mill City before it merged with the Lionshead fire. The Beachie Creek wildfire started around 11:00 PDT on August 16, 2020 in the Opal Creek Wilderness, Marion County, OR at coordinates 44.821, -122.188. The fire remained in a remote location through the month then grew rapidly in September. It was not contained until December. The cause of the fire is unknown.

After a period of upper-level ridging brought a return to above normal temperatures in early September, very strong easterly downslope and offshore winds off the Cascades and Coastal Ranges occurred. Winds increased rapidly during the afternoon and evening of September 7 with the passage of an unseasonably strong backdoor cold front and persisted through much of the following day. This resulted in extremely critical fire weather conditions when the strong winds combined with extremely low relative humidity and exceptionally dry existing fuel conditions. The result was explosive growth of ongoing wildfires, and the new start and explosive spread of numerous new wildfires. Widespread wind gusts from 50-70 mph were common on ridge tops and numerous other in exposed areas, including portions of the greater Portland metro area, the Willamette Valley, and areas of the Oregon coast. Strong winds caused widespread damage to trees, and downed numerous power lines across the region, which started at least 13 additional wildfires. Large portions of the cities of Detroit, Mehama, and Gates were destroyed, and significant portions of Idanha, Mill City, and Lyons also burned.

Resultant large wildfires included these named incidents - In Oregon: Beachie Creek, Chehalem Mountain/Bald Peak, Riverside, and Lionshead, and in Washington: Big Hollow. Rapidly spreading wildfires resulted in multiple fatalities, hundreds of displaced persons for many weeks, and billions of dollars in damage. The 2020 Labor Day wildfires burned a total of 1,000,000 acres.[1]

The number of wildfires in Oregon varies from year to year. In 2004, Oregon had 918 wildfires that burned 5,940 acres. Data provided in the 2016 City of Albany NHMP for the period between 2000 and 2010 shows that Oregon averaged 1,098 wildfires a year burning an average of 24,236 acres for that time period. The cost of fire suppression for that time period varied accordingly, averaging $8.69 million annually over a 16 year period. Lightning accounts for approximately 30 percent of forest fires in Oregon, the remaining 70 percent are human-caused.[26]

Figure 1. Burn Probability and Location of Wildfires (1992-2019) near Albany



[1] 2020 Oregon wildfires - Wikipedia

Oregon wildfire data from the Oregon Department of Forestry (ODF) from the 2016 NHMP is summarized in Table 2.

Table 2. Oregon Seasonal Fire Occurrence State and Association Districts

Item	Summary
Number of Fires – All Causes (2009 season)	1,089
10-year Average – All Causes (1999-2008)	1,116
Number of Lightning Caused Fires Only (2008 season)	292
10-year Average (1999-2008)	319
Number of Human Caused Fires Only (2008 season)	695
10-year Average (1994-2003)	797
Acres Burned (2009 final)	7,033.94
10-year Average (1994-2003)	26,782.03
Average State Fire Suppression Costs* (1985-2000)	$8.69 million
Year 2000*	$5.75 million
Low year (1997)*	$1.21 million
High year (1987)*	$32.08 million

Source: Oregon Department of Forestry March 22, 2010 Retrieved March 22, 2010 from: http://egov.oregon.gov/ODF/FIRE/GenCause.pdf

Oregon Department of Forestry November 26, 2004 Retrieved February 18, 2005 from: www.odf.state.or.us/DIVISIONS/protection/Fire_protection/stats

*Figures apply to the 15.8 million acres of state, private and federal forest lands protected by the Oregon Department of Forestry

In recent years, the cost of fire suppression has risen dramatically. A large number of homes have been threatened or burned, more fire fighters have been placed at risk, and fire protection in wildland areas has been reduced. These factors prompted the passage of Oregon Senate Bill (SB) 360 (Forestland/Urban Interface Protection Act, 1997).[27] SB 360:

(1) Establishes legislative policy for fire protection;
(2) Defines urban/wildland interface areas for regulatory purposes;
(3) Establishes standards for locating homes in the urban/wildland interface; and
(4) Provides a means for establishing an integrated fire protectionsystem.

Passed in 2021, Senate Bill 762 is comprehensive legislation passed with bipartisan support that will provide more than $220 million to help Oregon modernize and improve wildfire preparedness through three key strategies: creating fire-adapted communities, developing safe and effective response, and increasing the resiliency of Oregon's landscapes. The bill is the product of years of hard work by the Governor's Wildfire Council, the Legislature, and state agencies.

The legislation provides direction and investment to many state agencies. For the Board of Forestry and the Department of Forestry the bill, among other things, provides legislative direction regarding the wildland-urban interface; statewide fire risk mapping; prescribed fire; directed the Department to review and clarify the enforcement of rules pertaining to forestland; baseline standards for unprotected and under-protected lands in Oregon; and establishes grant programs to improve forest restoration and resiliency.

Wildfire in Linn County

The eastern two-thirds of the county are forested. The forest lands are owned by the U. S. Forest Service, Bureau of Land Management, Oregon Department of Forestry, and private owners. The Western one-third of the county is primarily grassland or moderate to steep Cascade foothills. During the summer fire season, the danger of fire in the forests and grasslands increases as the trees, brush and grassland dries and increases wildfire potential.[28]

In 1988, a controlled burn in a field adjacent to Interstate 5 between Albany and Highway 34 caused a multi-vehicle accident when the smoke drifted across the highway. The forest land in eastern Linn County are subject to annual small to moderate fires caused by human intervention and natural causes, such as lightning.[29]

In 2006, the Santiam Unit of the Oregon Department of Forestry recorded 16 fires, which burned 9.73 acres. The main cause of these fires was debris burning. In the same time period, the Sweet Home Unit, 51 fires burned 1,181 acres. Lightning was the greatest cause of fire within the Sweet Home Unit. The largest fire was the Middle Fork Fire, which burned 1,070 acres September of 2006.

Linn and Benton County Community Wildfire Protection Plans (CWPP)

In November 2007, the Linn County Community Wildfire Protection Plan was adopted by the Linn County Board of Commissioners. Linn County is in the process of updating its CWPP in combination with an update to the county's Natural Hazard Mitigation Plan. In June 2009, the Benton County Community Wildfire Protection Plan was adopted by the Benton County Board of Commissioners and it was updated in 2016. Benton County is also in the process of updating its CWPP. Several Linn and Benton County and state agencies collaborated to develop the plans. These agencies included the Oregon Department of Forestry; U.S. Bureau of Land Management, Salem Office; Linn and Benton County Planning and Building Departments; Linn and Benton County Fire Defense Board; Willamette National Forest and Bureau of Land Management, Eugene Office; and other Linn and Benton County emergency services agencies. In addition, the CWPP draws upon the input and feedback provided by members of the public and other stakeholders who participated in a public workshop. The Linn and Benton County Community Wildfire Protection Plans build upon the section of the Natural Hazard Mitigation Plan.

Probability of Future Wildfire[30]

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

This document defines wildfire as an uncontrolled burning of forest, brush, or grassland. Wildfire has always been a part of these ecosystems with sometimes devastating effects. Wildfire results from natural causes (e.g., lightning strikes), mechanical failure (Oxbow Fire), or human causes (unattended campfire, debris burning, or arson). The severe fire season of 1987 resulted in a record-setting mobilization of fire-fighting resources. Most wildfires can be linked to human carelessness.

The intensity and behavior of wildfire depends on a number of factors including fuel, topography, weather, and density of development. There are a number of often-discussed strategies to reduce the negative impacts of these phenomena. They include land-use regulations, management techniques, site standards, building codes, and state legislation. All of these have a bearing on a community's ability to prevent, withstand, and recover from a wildfire event.

The City of Albany's Hazard Vulnerability Assessment indicated a medium probability of a wildfire occurring in the city. This probability is more likely to be limited to the northwest section of town. There have been no wildfires in the city of Albany in its history, which goes back to 1864.

Vulnerability Assessment

Vulnerability assessment is the second phase in wildfire hazard assessment. Vulnerability assessment inventories property development and populations that are located within wildfire hazard areas. Locating and understanding the population, property and facilities that are exposed to wildfires will assist in reducing risks and preventing losses from future wildfire events.

Section 201.6(c)(2)(ii)(A) of the DMA-2000 requires that the risk assessment include a description of the jurisdiction's vulnerability to the hazard. This description shall include an overall summary for the hazard and its impact on the community. If appropriate data is available, the vulnerability assessment should describe the type and number of existing and future buildings, infrastructure, and critical facilities located in identified hazard areas.

An understanding of risk begins with the knowledge that wildfire is a natural part of forest and grassland ecosystems. Past forest practices included the suppression of all forest and grassland fires. This practice, coupled with areas of dry brush or trees weakened or killed through insect infestation, has fostered a dangerous situation. Present state and national forest practices include the reduction of understory vegetation through thinning and prescribed (controlled) burning. [31]

The City of Albany's 2009 Hazard Analysis indicated a low vulnerability to the population if a wildfire were to occur in the city. This is because of the limited locations the city has for wildfire to occur.

Risk Analysis

Risk analysis builds on the hazard identification and vulnerability assessment to estimate the damage, injuries and economic losses that may be sustained within a hazard area over a given period of time. The risk analysis uses mathematical models based on the magnitude of the harm that may result and the likelihood of the harm occurring. Burn probability for the City of Albany is low according to the most recent Oregon Department of Forestry models. See Figure 1 above. Development of wildfire hazard maps has also been part of the Linn and Benton County Community Wildfire Protection Plans, which assists county fire districts and city fire departments in developing fire mitigation plans to address the areas most vulnerable to wildfires in the city.

The city of Albany has only one principal area of wildland fire threat located in North Albany which is located in Benton County. The boundaries for this area are the Willamette River on the south, north and east sides, and Independence highway on the west side.

Key factors in assessing wildfire risk include ignition sources, building materials and design, community design, structural density, slope, vegetative fuel, fire occurrence and weather, including occurrences of drought. At the time of publication of this plan, data was insufficient to conduct a risk analysis. The National Wildland/Urban Fire Protection Program has developed the Wildland/Urban Fire Hazard Assessment

Methodology tool for communities to assess their risk to wildfire. Information on wildfire hazard assessment is available at http://www.Firewise.org.[33]

When assessing the risks from natural hazards, established mitigation practices already provide benefits in reduced disaster losses. It is important to understand the benefits of past mitigation practices when assessing their risks, being mindful of opportunities to further reduce losses. Possible mitigation practices include[34]:

- Identify and map current hazardous forest conditions such as fuel, topography, etc.;
- Identify forest/urban interface communities (list of interface communities, Federal Register,08/17/01. V. 66, N. 160);
- Identify and map Forest Protection Districts; Identify and map water sources;
- Implement effective addressing system in rural forested areas; Clearly mark evacuation routes;
- Identify and locate seasonal forest users. Initiate information program through schools, summer camps, forest camping grounds, lodges, and similar facilities;
- Identify and map bridges that can and cannot support the weight of emergency vehicles. This is a basic requirement for fire suppression;
- Form committees to implement Oregon Senate Bill 360. This is required in Oregon Senate Bill 360; and
- Enforce existing county road standards in interface areas to reflect fire suppression needs. Roads must be wide enough for fire suppression vehicles to turn around. Road grades cannot be too steep for large, heavy vehicles.

Community Wildfire Issues

Growth and Development in the Interface

The forested hills where homes and structures are built are considered to be interface areas, as are residential developments surrounded by grasslands. The development of homes and other structures encroaching onto the forest wildland and other natural areas is expanding the wildland/urban interface. The interface areas are characterized by a diverse mixture of varying housing structures, development patterns, ornamental and natural vegetation, and natural fuels.

The vegetation in these interface areas consists of an assortment of grasses, shrubs, and deciduous and coniferous trees. Steep slopes may also be a consideration in determining wildfire-prone areas. In the event of a wildfire, vegetation, structures and other flammables can merge into unwieldy and unpredictable events. Factors germane to the fighting of such fires include access, firebreaks, proximity of water sources, distance from fire stations, and available firefighting personnel and equipment. Reviewing past wildland/urban interface fires shows that many structures are destroyed or damaged by wildfire for one or more of the following reasons:[35]

- Combustible roofing material
- Wood construction
- Structures with no defensible space
- Fire department with poor access to structures
  Subdivisions located in heavy natural fuel areas
- Structures located on steep slopes covered with flammable vegetation
  Limited water supply and
- Winds over 30 miles per hour

Road Access

Road access is a major issue for all emergency service providers. Of particular concern to firefighters are developments with narrow roadways and few routes of egress; routes with very limited accessibility; and houses without adequate turn-around space. Developments that do not allow rear access to homes can be a significant problem for firefighters and emergency services in defending the structure and ensuring the safety of its inhabitants.

City of Albany Streets

12.060 General Provisions. No development may occur unless it has frontage on or approved access to a public street currently open to traffic. A currently non-open public right-of-way may be opened by improving it to City standards.

Streets shall be connected to reduce travel distance, provide multiple travel routes, and promote the use of alternative modes. Street patterns have a greater long-range effect on land use patterns, than do parcel patterns or building location.

Streets (including alleys) within and adjacent to a development shall be improved in accordance with the standards in this Article. In addition, any new street or additional street width planned as a portion of an approved street plan shall be dedicated and improved in accordance with this Article.

12.100 Access to Public Streets. With the exceptions noted in Section 1.070, the location and improvement of an access point onto a public street shall be included in the review of a development proposal. In addition, the following specific requirements shall apply to all access points, curb cuts, and driveways:

(1) Approaches and driveways to City streets and alleys must be paved and constructed in accordance with the Standard Construction Specifications. Driveways serving more than one property shall be paved the full length of the shared portion. [Ord. 5720, 08/12/2009]

(2) Driveways for single- and two-family dwellings must have a minimum width of 10 feet and a maximum width of 24 feet (not to exceed the width of the driveway curb cut) and minimum separation of 5 feet.

Up to four multiple-family units that front on a public street may have separate driveways. The driveways shall meet the same standards as for single- and two-family dwellings.

Driveways for all other uses must have widths of 12-16 feet for one-lane (one-way) driveways, 24-32 feet for two-lane driveways, and 36 feet for three-lane driveways. Three-lane driveways must have designated lanes and turning movements. Industrial driveways shall have a width of 24-48 feet. There must be a minimum separation of 22 feet between all driveways except for single- and two-family dwellings. The width of a driveway will be determined by measuring at the curb line and will exclude the transitions which must conform to standards fixed by the City Engineer.

(3) All driveways must be located as far as practical from a street intersection, and in no instance shall the distance from an intersection be less than the following, as measured from the nearest curb return radius:
Arterial Street 40 feet Collector
Street 20 feet Local Street 10 feet

When different classes of streets intersect, the distance required is between an access point and the intersection of the street type that requires the greaterdistance.

(4) The location, width, and number of accesses to a public street may be limited for developments that are subject to site plan review. All development that proposes access to an arterial street is

subject to site plan review and the design requirements of 12.230.

(5) Access points to a public street shall be the minimum necessary to provide reasonable access while not inhibiting the safe circulation and carrying capacity of the street. [Ord. 5720. 8/12/2009]

(6) Properties with frontage on more than one street may be restricted to access on the street(s) of a lower classification through site plan, land division, or other review procedures.
Albany Development Code 12 – 4 August 2009

(7) A common access point at a property line is encouraged and may be required in order to reduce the number of access points to streets. Construction of common access points must be preceded by recording of joint access and maintenance easements.

(8) With the exception of single-family residential development, approach grades must not exceed 10 percent slope within 20 feet of a public street. Driveways for single-family residential development shall comply with applicable fire and building codes.

(9) Access to designated state highways is subject to the provisions of this Article in addition to requirements of the State Highway Division and State Department of Transportation. When regulations of the City and State conflict, the more restrictive requirements will apply.

(10) For developments on property larger than five acres in contiguous ownership fronting on an arterial street or limited access highway, a frontage road may be required in order to provide a single access determined by the review body to be the most appropriate location for safety and convenience.

(11) When access is allowed on an arterial street, efforts shall be made to locate it adjacent to the interior property line where it could be shared by the adjacent property. [Ord. 5338, 1/28/1998; Ord. 5445, 4/12/2000]

12.110 Street Location, Width and Grade. The location, width, and grade of all streets must conform to any approved transportation master plan or recorded subdivision plat. When location of a street is not shown in an approved street plan, the arrangement of streets in a development shall either provide for the continuation or appropriate projection of existing principal streets in the surrounding areas or conform to a plan for the neighborhood approved or adopted by the City to meet a particular situation where topographical or other conditions made continuance of or conformance to existing streets impractical or where no plan has been previously adopted.

In addition, new streets may be required to be located where the City Engineer determines that additional access is needed to relieve or avoid access deficiencies on adjacent or nearby properties. In determining the location of new streets in a development or street plan, consideration shall be given to maximizing available solar access for adjoining development sites.

Street grades must be approved by the City Engineer, who will consider drainage and traffic safety.

12.120 Rights-of-Way and Roadway Widths. Unless otherwise indicated on an approved street plan or in Section 12.130, the street right-of-way and roadway widths shall not be less than the minimum shown in the following table. Where a range is indicated, the width shall be determined by the City Engineer.

Minimum Rights-of-Way Minimum Roadway Type of Street Width
Arterial 70-120 feet 40-70 feet
Collector 60-80 feet 36-48 feet
Local* 42-56 feet 22-32 feet
Radius for turnaround at end of cul-de-sac 43 feet 36 feet Alley 14-20 feet 12-20 feet

When street rights-of-way are less than 60 feet wide, a parallel public utility easement 7- feet-wide shall be dedicated on both sides of the right-of-way unless waived by the City Engineer.
[Ord. 5445, 4/12/2000]

12.122(6) Residential Street Design for Constrained Sites. Natural features may constrain the standard local street design. Examples of such natural features include floodplains, steep slopes, drainage ways, wetlands, riparian corridors, and tree groves. Through the subdivision or planned development review process, the City will consider a narrower street section that does not compromise the goals for street design in a great neighborhood. For example, the sidewalks may be placed curbside and parking may be removed from the street in order to narrow the street paving and preserve natural areas.

Linn County Code
To ensure adequate ingress and egress for emergency vehicles, the Linn County Land Development Code at LCC 935.200 includes a number of roadway improvement standards. The Code requires that all access roadways and drives be constructed of an all-weather surface capable of supporting 50,000 pounds gross vehicle weight (GVW). Some rural fire protection districts may require a surface capable of supporting 80,000 pounds GVW. The roadway must be at least 12 feet in width and must be constructed of six-inches of crushed rock or gravel or six inches of quarry-run rock topped with four inches of one-inch-minus crushed gravel.

All roads and access drives must maintain an unobstructed vertical clearance of 13 feet, six inches and a horizontal clearance of 20 feet along their entire length. Roadways below 20 feet in width must have at least one vehicle turnout for emergency vehicles every 500 feet and provide a turnaround at the end of the access road. Additional access safety requirements are contained in *LCC 935.200*.

Minimum Fuel Break Standards
To reduce fire risks associated with development in forested areas, the Linn County Land Development Code requires all dwellings in the Farm/Forest (F/F) and Forest Conservation and Management (FCM) zones to maintain a 30-foot-wide primary fuel break around structures and a 100-foot wide secondary fuel break around the primary fuel break. The specific standards are described at *LCC 934.590(8).*

Fire Safety Construction Standards
In addition to the State Uniform Building Code (UBC) requirements for residential development, the Linn County Land Development Code contains additional fire safety construction requirements for dwellings in the F/F and FCM zones at LCC 934.590.

Water Supply
Water supply is a critical factor in the ability to fight wildland fires. Developments lacking an adequate water supply and hydrant taps create extra challenges for firefighting personnel. Another water supply issue is that of small-diameter pipe water systems, which are inadequate to provide sustained fire-fighting flows.

The majority of rural development in wildfire-prone areas is not connected to any sort of public water system and must rely on emergency services response, water trucks, and on-site water sources in the event of a fire or wildfire. The Land Development Code requires that a dwelling shall be located within a fire protection district or shall be provided structural fire protection by contract. If this is not practical, then alternative means for protecting the structure from fire hazards may be provided such as an on-site water storage system, pond, stream or lake subject to standards in LCC 934.590(B)(6).

Rural Services
People moving from more urban areas to secluded rural developments may not realize they are living outside of a fire protection district, or that the services provided are not the same as in an urban area. The diversity and amount of equipment and the number of personnel can be substantially limited in rural areas, and the response time may be increased. Fire protection may rely more on the landowner's personal initiative to take measures to reduce fire risk and protect their own property. Therefore, public education and awareness may play a greater role in rural or interface areas.[36]

Development in rural areas in Linn County influences the wildland/urban interface. Although structural losses from wildfires in Linn County have historically been relatively low, continued development, and, along with it, an increase in fuel loads, expands the public need for natural hazards mitigation planning in the county.

Vulnerable Assets – Estimating Potential Losses
Section 201.6(c)(2)(*ii*)(B) of the Disaster Mitigation Act of 2000 (DMA-2000) requires that the risk assessment include an estimate of the potential dollar losses to vulnerable structures. There is insufficient development and vulnerability data available to estimate potential dollar losses to vulnerable structures and facilities at this time. The collection and analysis of appropriate data would serve as an important mitigation item to be completed in the future. Needed data includes the location and ranking of hazard areas; the types and numbers of buildings, infrastructure, and critical facilities; and the location, construction, materials, and replacement value of buildings, infrastructure and critical facilities in hazard areas.

Wildfire Mitigation Programs

Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, or federal agencies and organizations.

Local Programs

All development within the City of Albany must comply with the fire protection construction standards in the Uniform Building Code (UBC) and the City of Albany Development Code, as well as additional standards set forth by the applicable rural fire protection districts.

Linn County Forestland Development Handbook
Linn County has developed a guide for development in the Farm/Forest (F/F) and the Forest Conservation and Management (FCM) zones. The *Linn County Forestland Development Handbook* was published in June 2003, funded by Title III. The forestland development handbook is a free publication given to property owners when they request information or a development permit in the F/F or FCM zones. The handbook describes the forestland structural siting standards contained in the Development Code including property line setbacks, building material requirements, road and access design standards, firebreaks and water supply standards.

State Programs

Oregon Revised Statute 215.730

ORS 215.730, Additional Criteria for Forestland Dwellings, provides criteria for approving dwellings located on lands zoned for forest and mixed agriculture/forest use. Under its provisions, county governments must require, as a condition of approval, that single-family dwellings on lands zoned as forestland meet the following requirements:

1. Dwelling has a fire retardant roof;
2. Dwelling will not be sited on a slope of greater than 40 percent;
3. Evidence is provided that the domestic water supply is from a source authorized by the Water Resources Department and not from a Class II stream as designated by the State Board of Forestry;
4. Dwelling is located upon a parcel within a fire protection district or is provided with residential fire protection by contract;
5. If dwelling is not within a fire protection district, the applicant provides evidence that the applicant has asked to be included in the nearest such district;
6. If dwelling has a chimney or chimneys, each chimney has a spark arrester; and
7. Dwelling owner provides and maintains a primary fuel-free break and secondary break areas on land surrounding the dwelling that is owned or controlled by the owner.

If a governing body determines that meeting the fourth requirement is impractical, local officials can approve an alternative means for protecting the dwelling from fire hazards.

Oregon Revised Statute 477.015-061

Provisions in *ORS 477.015-061*, Urban Interface Fire Protection, were established through efforts of the Oregon Department of Forestry, the Office of the State Fire Marshal, fire service agencies from across the state, and the Commissioners of Deschutes, Jefferson, and Jackson Counties. It is innovative legislation designed to address the expanding interface wildfire problem within Oregon Department of Forestry Fire Protection Districts. Full implementation of the statute will occur on or after January 1, 2002. The statute does the following:

1. Directs the State Forester to establish a system of classifying forestland-urban interface areas;
2. Defines forestland-urban interface areas;
3. Provides education to property owners about fire hazards in forestland-urban interface areas. Allows for a forestland- urban interface county committee to establish classification standards;
4. Requires maps identifying classified areas to be made public;
5. Requires public hearings and mailings to affected property owners on proposed classifications;
6. Allows property owners appeal rights;
7. Directs the Board of Forestry to promulgate rules that set minimum acceptable standards to minimize and mitigate fire hazards within forestland-urban interface areas; and
8. Creates a certification system for property owners meeting acceptable standards. Establishes a $100,000 liability limit for cost of suppressing fires, if certification requirements are not met.

Senate Bill 360

Senate Bill 360, passed in 1997, is state legislation put in place to address the growing wildland/urban interface problem. The bill has three purposes:

1. To provide an interface fire protection system in Oregon to minimize cost and risk and maximize effectiveness and efficiency;

2. To promote and encourage property owners' efforts to minimize and mitigate fire hazards and risks; and
3. To promote and encourage involvement of all levels of government and the private sector in interface solutions.[37]

The bill has a five-year implementation plan that includes public education and outreach, and the development of rules, standards, and guidelines that address landowner and agency responsibilities. The success of Senate Bill 360 depends upon cooperation among local and regional fire departments, fire prevention cooperatives, and the Oregon Department of Forestry, which means that interagency collaboration, is vital for successful implementation of the bill. This cooperation is important in all aspects of wildland firefighting. Resources and funding are often limited, and no single agency has enough resources to tackle a tough fire season alone. The introductory language of Senate Bill 360 states: "The fire protection needs of the interface must be satisfied if we are to meet the basic policy of the protection of human life, natural resources, and personal property. This protection must be provided in an efficient and effective manner, and in a cooperative partnership approach between property owners, local citizens, government leaders, and fire protection agencies."

Senate Bill 762

Senate Bill 762 passed in 2021 is in the process of being implemented. The legislation invokes action from multiple agencies, with the aim of providing long-term security for our state by minimizing loss of life and property, protecting the lives of wildland firefighters, protecting and managing Oregon's forest assets, and creating a more predictable and protected future for communities and development at risk to the impacts of wildfire.

Under Section 11 of SB 762, DLCD is responsible for writing a report for the State Wildfire Programs Advisory Council and Oregon Legislature that identifies updates to the statewide land use planning program and local comprehensive plans and zoning codes that are needed to incorporate wildfire risk maps and minimize wildfire risk, including the appropriate levels of state and local resources necessary for effective implementation. DLCD's report was completed by October 1, 2022.

Oregon Department of Forestry

The Oregon Department of Forestry (ODF) is involved with local fire chiefs and local fire departments to provide training. Local firefighters can get a range of experience from exposure to wildland firefighting. Local firefighters can also obtain their red card (wildland fire training documentation) and attend extensive workshops combining elements of structural and wildland firefighting, defending homes, and operations experience. [38] ODF has been involved with emergency managers to provide support during non-fire events and for years, ODF has worked with industrial partners (big timber companies) to share equipment in the case of extremely large fires. [39]

Federal Programs

The proposed role of the federal land managing agencies, such as the U.S. Forest Service and the Bureau of Land Management, in the wildland/urban interface is diverse. Their roles include: reducing fuel hazards on the lands they administer; cooperating in prevention and education programs; providing technical and financial assistance; and developing agreements, partnerships, and relationships with property owners, local protection agencies, states, and other stakeholders in wildland/urban interface areas. These relationships focus on activities before a fire occurs, which render structures and communities safer and better able to survive a fire.[40]

Federal Emergency Management Agency Programs
The Federal Emergency Management Agency (FEMA) is directly responsible for providing fire suppression assistance grants and, in certain cases, major disaster assistance and hazard mitigation grants in response to fires. The role of FEMA in the wildland/urban interface is to encourage comprehensive disaster preparedness plans and programs, increase the capability of state and local governments, and provide for a greater understanding of FEMA's programs at the federal, state, and local levels.[41]

Fire Suppression Assistance Grants
Fire Suppression Assistance Grants may be provided to a state only if the state has an approved hazard mitigation plan for the suppression of a forest or grassland fire that threatens to become a major disaster on public or private lands. These grants are provided to protect life and improved property, encourage the development and implementation of viable multi-hazard mitigation measures, and provide training to clarify FEMA's programs.

The grant may include funds for equipment, supplies, and personnel. A Fire Suppression Assistance Grant is the form of assistance most often provided by FEMA to a state for a fire. The grants are cost-shared with states. Once the federal grant money is provided to the state, it is passed along to local jurisdictions. This money would ultimately be passed along to Linn County to be applied to projects. FEMA's U.S. Fire Administration (USFA) provides public education materials addressing wildland/urban interface issues, and the USFA's National Fire Academy provides training programs.[42]

Hazard Mitigation Grant Program
Following a major disaster declaration, the FEMA Hazard Mitigation Grant Program provides funding for long-term hazard mitigation projects and activities to reduce the possibility of damages from all future fire hazards and to reduce the costs to the nation for responding to and recovering from the disaster.

National Wildland/Urban Interface Fire Protection Program
Federal agencies can use the National Wildland/Urban Interface Fire Protection Program to focus on wildland/urban interface fire protection issues and actions. The Western Governors' Association can act as a catalyst to involve state agencies, as well as local and private stakeholders, with the objective of developing an implementation plan to achieve a uniform, integrated national approach to hazard and risk assessment and fire prevention and protection in the wildland/urban interface. The program helps states develop viable and comprehensive wildland fire mitigation plans and performance-based partnerships.

U.S. Forest Service
The U.S. Forest Service (USFS) implements a fuel-loading program to assess fuels and reduce hazardous buildup on federal forestlands.

Firewise
Firewise is a program developed within the National Wildland/ Urban Interface Fire Protection Program and is the primary federal program addressing interface fire. It is administered through the National Wildfire Coordinating Group whose extensive list of participants includes a wide range of federal agencies. The program is intended to empower local planners and decision makers. Through conferences and information dissemination, Firewise increases support for interface wildfire mitigation by educating professionals and the general public about hazard evaluation and policy implementation techniques.

Firewise offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences. The interactive home page allows users to ask fire protection experts questions, and to register for new information as it becomes available.

For more information on the Firewise program, contact:

The Wildland/Urban Interface Fire Program C/o The National Fire Protection Association 1 Batterymarch Park, Quincy, MA 02269 http://www.firewise.org

FireFree Program

FireFree is a unique private/public program for interface wildfire mitigation involving partnerships among an insurance company and local government agencies. It is an example of an effective non-regulatory approach to hazard mitigation. Originating in Bend, the program was developed in response to that city's Skeleton Fire of 1996, which burned over 17,000 acres and damaged or destroyed 30 homes and other structures.[43] Bend sought to create a new kind of public education initiative that emphasized local involvement. SAFECO Insurance Corporation was a willing collaborator in this effort. Bend's pilot program included:

- A short video production featuring local citizens as actors, made available at local video stores, libraries, and fire stations;
- Two city-wide yard debris removal events;
- A 30-minute program on a model FireFree home, aired on a local cable television station; and;
- Distribution of brochures featuring a property owner's evaluation checklist and a listing of fire-resistant indigenous plants.

The success of the program helped to secure $300,000 in FEMA "Project Impact" matching funds. By fostering local community involvement, FireFree also has the potential for building support for sound interface wildfire policy. For information on FireFree,contact:

SAFECO Plaza T-8,
Seattle, WA 98185
(206) 545-6188

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[28] Hazard Analysis 2004, Linn County Emergency Management Agency, March 31, 2004, pg. 9

[29] Ibid.

[30] OR-SNHMP, Region 3, Mid/Southern Willamette Valley Hazards Assessment, Jan. 2009, pp R3-19, R3- 20

[31]Ibid. pg R3-20

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[33] Douglas County Natural Hazard Mitigation Plan – Section 8: Wildfire (2003), pp. 88

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Section 10: Volcano

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Volcano

Causes and Characteristics of the Hazard

The Cascade Range of the Pacific Northwest has more than a dozen active volcanoes. These familiar snow-clad peaks are part of a 1,000-mile-long chain of mountains that extend from southern British Columbia to northern California. Cascades volcanoes tend to erupt explosively, and eruptions have occurred at an average rate of one or two per century for the last 4,000 years. Future eruptions are certain. Seven Cascades volcanoes have erupted since the first U.S. Independence Day. Four of those eruptions would have caused considerable property damage and loss of life had they occurred today without warning. The most recent events were Mt. St. Helens in Washington (1980 and 1986) and Lassen Peak in California (1914-1917). The existence, position and recurrent activity of Cascades volcanoes are generally thought to be related to the convergence of shifting crustal plates. As the population increases in the Pacific Northwest, areas near volcanoes are being developed and recreational usage is expanding. As a result, more and more people and property are at risk from volcanic activity.

To identify the areas that are likely to be affected by future events, pre-historic rock deposits are mapped and studied to learn about the types and frequency of past eruptions at each volcano. This information helps scientists to better anticipate future activity at a volcano and provides a basis for preparing for the effects of future eruptions through emergency planning.

History of the Hazard in City of Albany

In the past 200 years, seven of the Cascade volcanoes in the United States have erupted, including: Mt. Baker, Glacier Peak, Mt. Rainier, Mount St. Helens, Mt. Hood, Mt. Shasta, and Mt. Lassen.

Over the past 4,000 years (a geologically short period of time), there have been three eruptions in Mt. Hood, four eruptions in the Three Sisters area, and two eruptions in the Newberry volcano area (see Figure V.1 below). Minor eruptions have occurred near Mt. Jefferson, at Blue Lake Crater, in the Sand Mountain Field (Santiam Pass), near Mt. Washington, and near Belknap Crater. During this time period, the most active volcano in the Cascades has been Mount St. Helens with about 14 major eruptions and many smaller eruptions.

Many other volcanoes are deemed active or potentially active. The Smithsonian Institution's Global Volcanism Project lists 20 active volcanoes in Oregon and seven in Washington. These volcanoes are listed below in Tables 1, and 2.

Figure 1. Active Volcanoes in Oregon

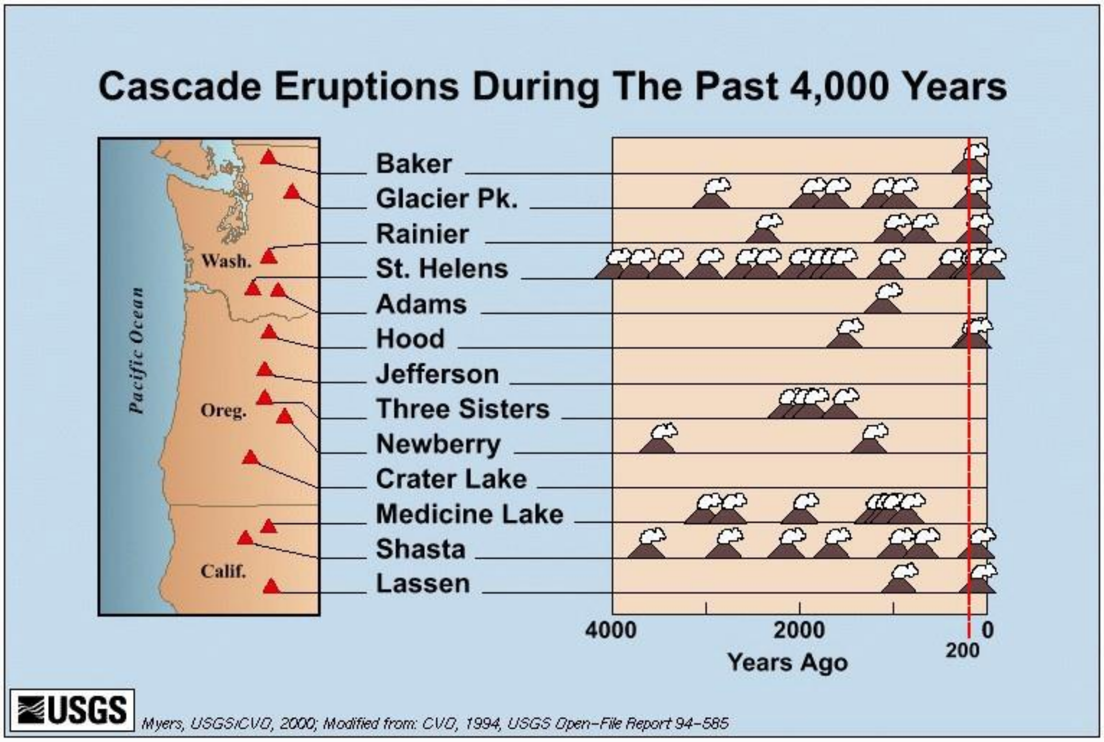


Table 1. Active Volcanoes in Washington

Volcano	**Type**	**Last Eruption**
Mt. Baker	Stratovolcano	1880
Glacier Peak	Stratovolcano	1700 +/- 100
Mt. Rainier	Stratovolcano	1825 (?)
Mt. Adams	Stratovolcano	950 AD (?)
Mount St. Helens	Stratovolcano	1991 (eruptions started in 1980)
West Crater	Volcanic field	5760 BC (?)
Indian Heaven	Shield volcanoes	6250 BC +/- 100

Table 2. Active Volcanoes in Oregon

Volcano	**Type**	**Last Eruption**
Mt. Hood	Stratovolcano	1866
Mt. Jefferson	Stratovolcano	950 Main volcano inactive for > 10,000 years
Blue Lake Crater	Crater	1490 BC
Sand Mountain Field	Cinder cones	1040 BC?

Mt. Washington	Shield volcano	620 Main volcano inactive
Belknap Field	Shield volcano	460?
North Sister Field	Complex volcano	350
South Sister	Complex volcano	50 BC?
Mt. Bachelor	Stratovolcano	5800 BC
Davis Lake	Volcanic field	2790 BC?
Newberry Volcano	Shield volcano	620 Crater formation 300,000 to 500,000 years ago
Devils Garden	Volcanic field	Unknown
Squaw Ridge Lava Field	Volcanic field	Unknown
Four Craters Lava Field	Volcanic field	Unknown
Cinnamon Butte	Cinder cones	Unknown
Crater Lake	Caldera	2290 BC Crater formation about 7,700 years ago
Diamond Craters	Volcanic field	Unknown
Saddle Butte	Volcanic field	Unknown
Jordan Craters	Volcanic field	1250 BC
Jackies Butte	Volcanic field	Unknown

On a longer geological time scale, volcanic activity in the Cascades has been very widespread. A report by the Oregon Department of Geology and Mineral Industries on prehistoric and historic volcanic eruptions in Oregon[1] (see website below) notes that over 3,000 large and small volcanoes in the Cascades have erupted in the past five million years. Between 1843 and 1860, there were a series of 21 eruptions in the Cascades; scientists have speculated that the Northwest may be entering another period of volcanic activity.

A great deal of general background information on Oregon and Washington volcanoes and volcanoes in general is available on several websites, including:

- United States Geological Survey
- (USGS) Volcano Hazards Program: Volcano Hazards | U.S. Geological Survey (usgs.gov) (http://volcanoes.usgs.gov/)
- Department of Geology and Mineral Industries (DOGAMI) Volcano Hazards in Oregon: DOGAMI Volcano Hazards | Oregon Department of Geology and Mineral Industries (oregongeology.org)

[1] Smithsonian Institution, Global Volcanism Program: Smithsonian Institution - Global Volcanism Program: Worldwide Holocene Volcano and Eruption Information (si.edu) http://www.volcano.si.edu/

Risk Assessment

How are hazard areas identified?

Several of the active volcanoes in Oregon and Washington are located relatively near Linn and Benton counties, including Mount St. Helens and Mt. Hood. Approximate distances from Albany to three relatively nearby volcanoes are shown below in Table V.3. Among these relatively nearby volcanoes, Mount St. Helens is the most active.

Table 3. Distances from Albany

Volcano	Distance (miles)
Mount St. Helens	102
Mt. Hood	82
Three Sisters	70

In May 2001, the USGS announced that it had detected a slight swelling or uplift of the west side of South Sister. This bulge, which occurred between 1996 and 2000, covers an area about nine to 12 miles in diameter with a maximum bulge in the center of about four inches. The cause of this uplift is most likely intrusion of a small amount of magma (molten rock) deep under the surface, probably at a depth of about four miles. This observation confirms that South Sister is still an active volcano, but the potential implications need to be interpreted cautiously. For comparison, a bulge was also observed on the north side of Mount St. Helens in the months prior to the May 18, 1980 eruption. However, the Mount St. Helens bulge was 450 feet high and growing at a rate of five feet per day prior to the eruption. Thus, the 4-inch South Sister bulge is certainly not an indication of imminenteruption.

The USGS analysis of volcano hazards in the Three Sisters region, Oregon was published in 1999 (Open-File Report 99-437). Its main conclusions are:

- The Three Sisters area includes two large composite volcanoes (Middle and South Sister). Large composite volcanoes in the Cascades (e.g., Mt. Hood, Mt. Jefferson, Newberry Volcano, and Crater Lake) are often active for hundreds of thousands of years and are subject to sometimes explosive eruptions (e.g., Mount St. Helens in 1980).
- Hazards from eruptions of composite volcanoes include all of the hazards listed below in "Community Hazard Issues." Between the major composite volcanoes, the crest of the Cascades is built up of hundreds of "mafic" volcanoes. Mafic volcanoes typically erupt for a few weeks to a few centuries, although some can be nearly as large as the composite volcanoes. Prominent mafic volcanoes in the Three Sisters area include North Sister, Mount Bachelor, Belknap Crater, Black Butte, and Mount Washington. Mafic volcanoes often form broad fields of volcanic vents such as in the Sand Mountain Field near the Santiam Pass, north of the Three Sisters.
- Mafic volcanoes typically erupt less explosively than do composite volcanoes, so that impacts of eruptions are less widespread. Most mafic eruptions in the Three Sisters areas have produced tephra deposits and lava flows that typically traveled three to nine miles from the vents and rarely nine to 12 miles from the vents. Tephra deposits rarely exceed four inches in thickness at distances six miles from the vent.
- Belknap Crater, about 1,500 years old, is one of the youngest mafic volcanoes in the Cascades. The Sand Mountain Field, a cluster of cones and lava flows west of Santiam Pass, was formed during three eruptive periods about 2,000 and 4,000 yearsago.

The USGS study of volcano hazards in the Three Sisters region includes three hazard zones: proximal hazards; distal hazards; and a regional lava flow hazard zone.

The proximal hazard zone is limited to the immediate area around the Three Sisters and is an oval area about eight miles east-west by 10 miles north-south. The proximal hazard area is the area subject to the most intense volcanic hazards including lava flows, tephra flows, pyroclastic flows, landslides, and debris flows and lahars. This area is predominantly wilderness with very low population.

The distal hazard zones are river valleys extending away from the proximal hazard zone that are subject to landslides, debris flows and lahars. The distal hazard zone has three levels for areas subjected to lahars and other flows of varying sizes. Areas subjected to lahars include Squaw Creek into Sisters, Tumalo Creek into Bend, the valley between Sparks Lake and Crane Prairie Reservoir, and the McKenzie River and tributaries west of the Three Sisters.

The regional lava flow hazard zone includes a band about 30 to 40 miles wide covering the entire crest of the Cascades. Locations throughout this zone, which includes Sisters, Bend, and the Santiam Pass, are subject to lava flows from mafic volcanism which could occur anywhere in this entire zone.

None of these Three Sisters volcanic hazard zones impact the city of Albany directly. Thus, the extent of volcanic hazards for the city of Albany appears largely limited to the possibility of minor ash falls from eruptions at Three Sisters, and other locations in the Cascades (e.g., Mount St. Helens). In all but the most extreme events, ash falls in the city of Albany are likely to be minor with an inch or less of ash likely. Volcanic events in the Three Sisters area or in the Santiam Pass area (Sand Mountain volcanic field) could close eastbound Highway 20 and thus affect transportation to/from Albany to a very limited extent.

Probability of Future Occurrence

The following maps show probabilistic data on ash fall in western Oregon, taking into account all of the active volcanoes (USGS Open File Report 9-437, Plate 1, 1999). Interpolating between the map contours of Figure V.2, the annual probability of one centimeter (about 0.4 inch) or more of volcanic ash is about 1/5000 in Albany. In other words, the return period for such ash falls is about 5,000 years for various locations within Albany.

Interpolating between the map contours of Figure V.3, the annual probability of 10 centimeters (about four inches) or more of volcanic ash is less than 1/10,000. In other words, the return period for such ash falls is greater than 10,000 years for various locations within Albany.

Figure 2. Annual Probability of 1 Centimeter (about 0.4 inch) or More of Volcanic Ash

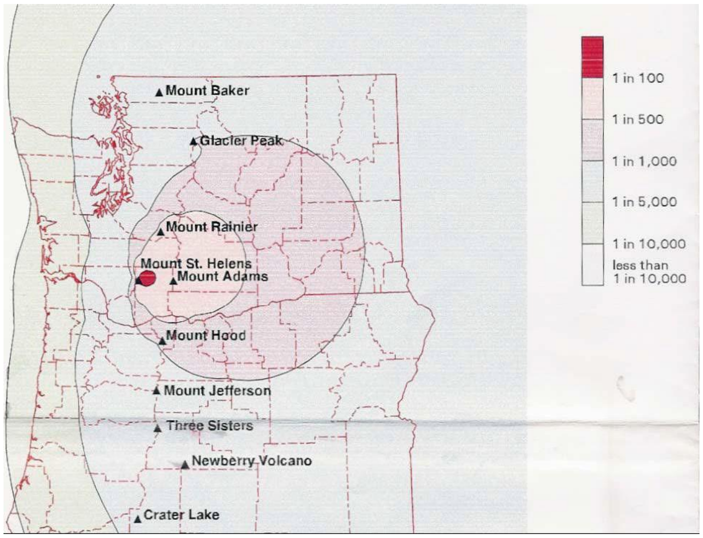
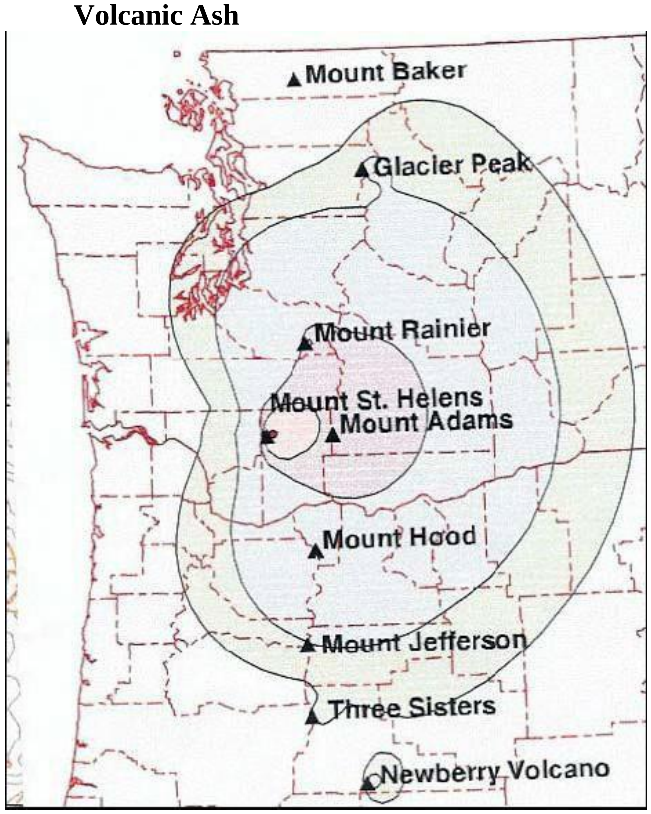


Figure 3. Annual Probability of 10 Centimeters (about 4 inches) or More of Volcanic Ash



The low probabilities of significant ash falls (i.e., long return periods) arise because ash falling in Albany requires volcanic eruptions producing ash and wind directions that deposit ash westward from the volcanoes.

The City of Albany estimates that one volcanic event is likely to occur within a 100-year period. This equates to a "low" probability estimate, as reflected in Albany's 2015 Hazard Analysis.

Vulnerability Assessment

To a very low extent, volcanic activity at Three Sisters could affect Albany in several ways:

1) Depending on the volume of volcanic ash ejected by an eruption and on prevailing wind directions at the time of eruption, various thicknesses of ash falls may affect Albany. Possible impacts of ash falls include:
   a. Clean-up and debris removal;
   b. Possible respiratory problems for at-risk populations such as the elderly, young children or others with respiratory problems;
   c. Possible impacts on public water supplies drawn from surface waters, including degradation of water quality (high turbidity) and possible increased maintenance requirements at water treatment plants; and
   d. Possible electric power outages from ash-induced short circuits in distribution lines, transmission lines, and substations.
2) Debris flows, landslides, and lahars into the river valleys near the Three Sisters may affect the McKenzie River and the Willamette River downstream and thus also affect public water supplies downstream.

The probable impacts of potential volcanic eruptions on Albany are summarized below in Table 4.

Table 4. Probable Impacts of Potential Volcanic Eruptions on Albany

Inventory	Probable Impacts
Portion of city of Albany Affected	Entire city and surrounding region may be affected by ash falls
Buildings	Negligible impact other than minor cleanup required
Streets within Albany	Negligible impact other than minor cleanup required
Roads to/from Albany	Negligible impact other than minor cleanup required
Electric power	Temporary power outages possible from short circuits caused by ash falls
Other utilities	Negligible impact other than minor cleanup required for most utilities. Potential to impact water treatment plants which may require additional maintenance to deal with high turbidity in water
Casualties	Some potential for health impacts, especially for people with respiratory problems

The City of Albany estimates that all of the population or property is likely to be affected by volcanic hazards, primarily ash fallout, but the impact would be minor. This equates to a" low" vulnerability estimate, as reflected within Albany's 2022 Hazard Vulnerability Assessment.

Risk Analysis

Estimates of potential losses (i.e., potential dollar losses to specific vulnerable structures, transportation systems, utilities, economic assets, etc. in Albany) are not available at this time.

Community Hazard Issues

What is susceptible to damage during a hazard event?

In Oregon, awareness of the potential for volcanic eruptions was greatly increased by the May 18, 1980 eruption of nearby Mount St. Helens in Washington that killed 57 people. In this eruption, lateral blast effects covered 230 square miles and reached 17 miles northwest of the crater, pyroclastic flows covered six square miles and reached five miles north of the crater, and landslides covered 23 square miles. Ash accumulations were about 10 inches at 10 miles downwind, one inch at 60 miles downwind, and ½ inch at 300 miles downwind. Lahars (mudflows) affected the North and South Forks of the Toutle River, the Green River, and ultimately the Columbia River as far as 70 miles from the volcano. Damage and reconstruction costs exceeded $1 billion.

Volcanic eruptions often involve several distinct types of hazards to people and property, as well evidenced by the Mount St. Helens eruption. Major volcanic hazards include eruption columns and clouds, volcanic gases, lava flows and domes, pyroclastic flows, volcanic landslides, and lahars. Some of these hazards (e.g., lava flows) only affect areas very near the volcano. Other hazards may affect areas 10 to 20 miles away from the volcano, while ash falls may affect areas many miles downwind of the eruption site.

Eruption Columns and Clouds
An explosive eruption blasts solid and molten rock fragments called tephra and volcanic gases into the air with tremendous force. The largest rock fragments, called bombs, usually fall back to the ground within two miles of the vent. Small fragments (less than 0.1 inch across) of volcanic glass, mineral and rock (ash) rise high into the air forming a huge, billowing eruption column. Eruption columns creating an eruption cloud can grow rapidly and reach more than 12 miles above a volcano in less than 30 minutes. Volcanic ash clouds can pose serious hazards to aviation. Several commercial jets have nearly crashed because of engine failure from inadvertently flying into ash clouds.

Large eruption clouds can extend hundreds of miles downwind resulting in ash fall over enormous areas. Ash from the May 18, 1980 Mt. St. Helens eruption fell over an area of 22,000 square miles in the western U.S. Heavy ash fall, particularly when mixed with rain, can collapse buildings and even a minor ash fall can damage crops, electronics, andmachinery.

Volcanic Gases
Volcanoes emit gases during eruptions. Even when a volcano is not erupting, cracks in the ground allow gases to reach the surface through small openings called fumaroles. More than 90 percent of all gas emitted by volcanoes is water vapor (steam), most of which is heated ground water. Other common volcanic gases are carbon dioxide, sulfur dioxide, hydrogen sulfide, hydrogen, and fluorine. In higher concentrations, these gases can cause corrosion, contaminate domestic water supplies, and harm or even kill vegetation, livestock, and people.

Lava flows and domes
Molten rock (magma) that pours or oozes onto the earth's surface is called lava and forms lava flows. The higher a lava's silica content, the less easily it flows. Low-silica basalt lava can form fast-moving (10 to 30 miles per hour) streams, or it can spread out into broad thin sheets up to several miles wide.

Pyroclastic flows
High-speed avalanches of hot ash, rock fragments and gas can move down the sides of a volcano during explosive eruptions or when the steep side of a growing lava dome collapses and breaks apart. Pyroclastic flows can be as hot as 1,500 degrees Fahrenheit and move at speeds of 100 to 150 miles per hour. Such flows tend to follow valleys and are capable of knocking down and burning everything in their paths. Lower-density pyroclastic flows called pyroclastic surges can easily overflow ridges hundreds of feet high. The climactic eruption of Mount St. Helens generated a series of explosions that formed a huge

pyroclastic surge which destroyed an area of 230 square miles and leveled trees six feet in diameter as far as 15 miles from the volcano.

Volcano landslides

A volcanic landslide or debris avalanche is a rapid downhill movement of rocky material, snow and/or ice. Volcano landslides range in size from small movements of loose debris on the surface of a volcano to massive collapses of the entire summit or sides of a volcano. Landslides on volcano slopes are triggered when eruptions, heavy rainfall or large earthquakes cause these materials to break free and move downhill.

Lahars

Lahars are mudflows or debris flows composed mostly of volcanic materials on the flanks of a volcano. These flows of mud, rock and water can rush down valley and stream channels at speeds of 20 to 40 miles per hour and can travel more than 50 miles. Some lahars contain so much rock debris (60 to 90% by weight) that they look like fast-moving rivers of wet concrete. Historically, lahars have been one of the deadliest volcano hazards. Close to their source, these flows are powerful enough to rip up and carry trees, houses and huge boulders miles downstream. Farther downstream, they can entomb in mud everything in their path. Lahars can occur during an eruption and when a volcano is quiet. The water that creates lahars can come from melting snow and ice (especially water from a glacier melted by a pyroclastic flow or surge), intense rainfall, or the breakout of a summit crater lake. Large lahars are potential hazards to many communities downstream from glacier-clad volcanoes.

Existing Hazard Mitigation Activities

Mitigation of volcanic hazards is predominantly in the areas of monitoring volcanic activity, warnings and evacuation, and emergency response. That is, there are few, if any, practical physical measures to mitigate the direct impacts of volcanic activity.

The USGS actively monitors volcanic activity in the Cascades via networks of seismic sensors which can detect earthquakes related to magma movements as well as very accurate ground surface measurements, such as that which has detected the very small bulge on South Sister. The USGS also has a volcanic warning system with several levels of alert as a potential eruption becomes more likely and more imminent.

For the Cascades, the USGS volcano warning system (www.usgs.gov) has three levels. Level One (Volcanic Unrest) indicates that anomalous conditions could be indicative of an eventual volcanic eruption. Level Two (Volcanic Advisory) indicates that processes are underway that have a significant likelihood of culminating in hazardous volcanic activity. Evidence would not indicate, however, that a life- or property-threatening event is imminent. Level Three (Volcano Alert) means that precursory events have escalated to the point where a volcanic event with attendant volcanological or hydrologic hazards is underway and will likely be threatening to life andproperty.

For most of Albany, which is located well outside of any of the likely direct hazard zones for any Cascades volcanic events, mitigation for volcanic activity is likely a low priority. In the event of a minor ash fall, public warnings directing people, especially those with respiratory problems, to remain indoors, and minor cleanup are most likely the only necessary responses for most volcanic effects impacting Albany.

Section 11: Landslide

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Landslide

Why are landslides a threat to the City of Albany?

Landslides are a serious geologic hazard in many states, including Oregon. Nationally, landslides cause 25 to 50 deaths each year.[1] The best estimates of the direct and indirect costs of landslide damage in the United States range between $1 and $2 billion annually.[2] Although not all landslides result in private property damage, many impact transportation corridors, fuel and energy conduits, and communication facilities.[3]

Landslides and debris flows have helped shape the landscape in some of the city of Albany. Development, road building, and logging can cause or contribute to the severity of landslides. Landslides become hazardous when buildings and infrastructure are placed within their path. In general, slopes that are over 25 percent or have a history of landslides might signal a problem. However, landslides can also occur in areas of generally low relief in the form of cut-and-fill failures, river bluff failures, lateral-spreading landslides, and mining slope failures.

Table 1 describes some of the major landslides that have occurred in Oregon over the last 75 years. The list is not all-inclusive but focuses on slides that caused loss of life or significant damage. Although most of the listed events were outside of Albany, all serve as indicators of the type of landslide events likely to occur in the region.

Table 1. Major Landslides in Oregon

February 1926	A landslide closed Roosevelt Highway between Coos Bay and Coquille, causing at least $25,000 in damage.
November 1928	A landslide killed two workmen working on a railroad tunnel near Baker.
August 1957	A rockslide killed two quarry workers near Westfir.
February 1961	A large section of Ecola State Park, including the parking lot, slid into the Pacific Ocean near Cannon Beach.
March 1972	Three motorists were injured in a mud and rockslide on Interstate 5 near Portland.
January 1974	Nine employees working in a telephone company building were killed when the building was pushed by a mudslide into Canyon Creek near Canyonville.
October 1984	Two children were killed in a rockslide along Interstate 84 near Cascade Locks. The cost of stabilizing the slide area eventually reached $4 million.
September 1990	Four highway workers were injured in a landslide near Troutdale.
February 1996	Heavy rains and rapidly melting snow contributed to hundreds of landslides across the state, many occurring on clear cuts that damaged logging roads.
November 1996	Heavy rain triggered mudslides in Lane and Douglas counties that resulted in eight fatalities.
February 1999	Two timber workers were killed in a mud and rockslide south of Florence.
January 2000	A landslide north of Florence closed Highway 101 for three months, resulting in major social and economic disruption to nearby communities.

Source: Department of Land Conservation and Development, Natural Hazards Program website, http://www.lcd.state.or.us

There are several categories of landslides, based on configuration (slide mechanism), slide materials, and rate of movement. Some slides are ancient, deep-seated, and slow-moving. Others move rapidly as a mass of rock, mud, and large woody debris. All can be hazardous when in the vicinity of buildings and infrastructure. Oregon counties with the highest percentage of reported landslides are: Lane (24%), Douglas (11%), Linn (10%), Tillamook (9%), Lincoln (8%), and Multnomah (7%).[4]

Landslides and debris flows usually accompany the major storm systems that impact western Oregon. Particularly noteworthy landslides accompanied storms in 1964, 1982, 1986, and 1996. Two major landslide-producing winter storms occurred in Oregon during 1996. Intense rainfall triggered over 9,500 landslides and debris flows, some of which resulted directly or indirectly in eight fatalities. Highways were closed and a number of homes were lost. The fatalities and losses resulting from the 1996 landslides led to the passage of Oregon Senate Bill 12, which authorized the mapping of areas subject to rapidly- moving landslides and the development of model landslide ordinances.[5]

Causes and Characteristics of Landslide Hazards

This section provides information about landslide types and causes. Much of the information was gathered from the Department of Land Conservation and Development (DLCD) Natural Hazards Program website; the United States Geologic Survey (USGS) Landslide Hazard Fact Sheet 2004-3072; Oregon Department of Geology and Mineral Industries (DOGAMI) Bulletin 84; the Oregon Natural Hazards Mitigation Plan (OR-SNHMP) Region 3 Hazards Assessment; and the Regional All-Hazard Mitigation Plan for Benton, Lane and Linn Counties (RAHMP).

What is a landslide?

The term "landslide" is used to describe the down slope movement (sliding or falling) of slope-forming materials composed of rock, soil, artificial fill, or a combination of these. The materials may move by falling, toppling, sliding, spreading, or flowing. The term is also applied to the mass of soil or rock material that results from one of these events.[6]

The various types of landslides can be differentiated by the kinds of materials involved and the mode of movement. Although landslides are primarily associated with mountainous regions, they can also occur in areas of generally low relief.[7]

Landslides are natural processes but can be triggered or accelerated by: changes in groundwater levels, usually from intense rainfall or rapid snow melt; undercutting of a slope or cliff by erosion or excavation; shocks or vibrations from earthquakes or construction; vegetation removal; or the placing of fill on steep slopes.[8]

Landslide Types

Some of the processes that are referred to as landslides are shown in Figure 1 and include:

- **Debris Flow**: Rapidly-moving landslides that can travel long distances, often within confined channels, and often involving significant amounts of water and mud. Debris flows (mudslides, mudflows, debris avalanches) are common and generally occur during intense rainfall on previously saturated ground. They usually begin on steep hillsides as slumps or slides that liquefy, accelerate to speeds as great as 35 mph, and flow down slopes and channels onto gently sloping ground.[9]

  The consistency of debris flows ranges from watery mud to thick, rocky, mud-like wet cement, dense enough to carry boulders, trees, and automobiles. Debris flows from different sources can combine in canyons and channels, where their destructive power is greatly increased.[10] Generally speaking, five conditions must be present for a debris flow to occur:

1. Steep slopes;
2. Loose rock and soil materials;
3. Clay minerals;
4. Saturated soils; and
5. Rainfall or snowmelt generated runoff of high intensity and duration.

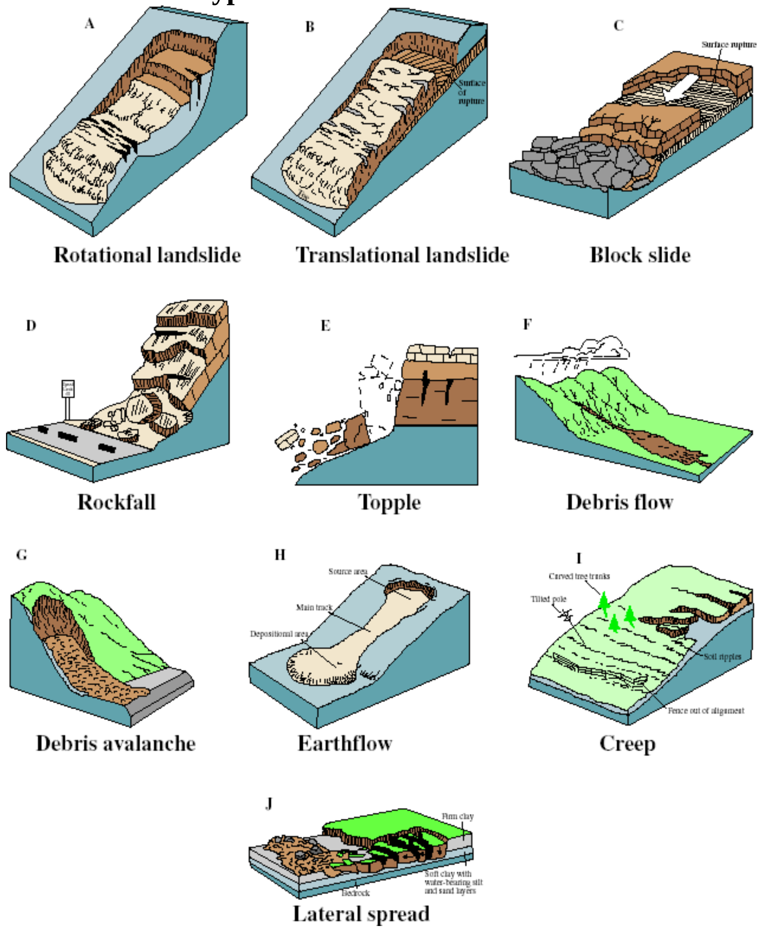
Debris flow areas are associated with steep gullies. A **debris avalanche** is a type of very rapid to extremely rapid debris flow. A debris avalanche is generally long and narrow and often leaves a V-shaped scar tapering uphill at the head. A **mudflow** is an earth flow consisting of material that is wet enough to flow rapidly and contains at least 50 percent sand, silt and clay-sized particles.[11]

- **Rockfalls**: The abrupt movement of masses of geologic materials that become detached from steep slopes or cliffs. Separation occurs along fractures, joints, and bedding surfaces, and movement occurs by free-fall, bouncing, and rolling. Falls are strongly influenced by gravity, mechanical weathering, and the presence of interstitial water. Depending on the type of materials involved, the result is a rock fall, soil fall, debris fall, boulder fall, and so on. All types of falls are promoted by undercutting, differential weathering, excavation, or stream erosion. Rock falls are common along Oregon highways where roads are cut through bedrock.[12]

- **Rockslides**: The rapid down-slope movement of rock material along a plane of separation within the bedrock, which could be a fault surface, a fracture surface, or the depositional surfaces found in some sedimentary rocks. These slides can occur on relatively gentle slopes and cause serious damage.[13]

Figure 1 illustrates the major types of landslides described in this section.

Figure 1. Landslide Types

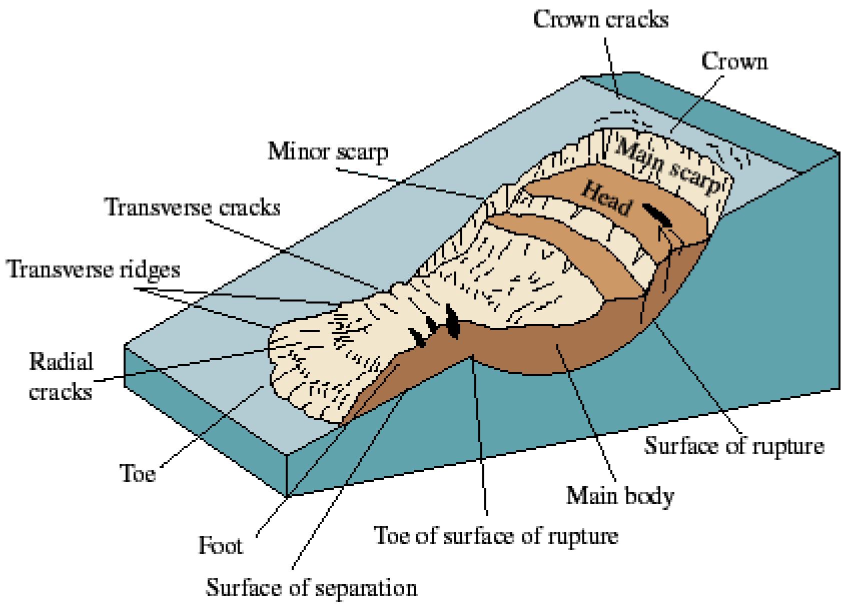


Source: USGS Landslide Hazard Fact Sheet 2004-3072

- **Rotational slides**: Slides in which the surface of the rupture is curved concavely upward and the slide movement is rotational about an axis that is parallel across the slope. The scarp formed at the head of the slope may be almost vertical. The toe usually bulges upward, but sometimes flows outward. **Slumps** are examples of small rotational slides.

  The head of a rotational slide can sometimes be located in the fill side of a road. The axis of the road would generally follow the contour of the hill. Many older hillside roads were built without proper design of the "fill" side of the road. The head of the slide would damage the fill side of the road; and the foot of the slide would damage any buildings located below the road surface, commonly for a distance of 20 to 80 feet below the road surface.[14]

Figure 2. Rotational Landslide Features



Source: USGS Landslide Hazard Fact Sheet 2004-3072

Figure 2 shows a graphic illustration of a rotational landslide, with the commonly accepted terminology describing its features.

- **Translational Slides**: Slides in which the mass moves out or down and out along a more or less planar surface and has little rotational or backward tilting. The mass commonly slides out on the original ground surface. Such a slide may progress over great areas if the conditions are right. The movement of translational slides is commonly controlled by surfaces of weakness such as faults, bedding planes, and variations in shear strength between layers of bedded deposits, or by contact between firm bedrock and overlying loose soils.[15]

Landslide Causes

Factors contributing to landslides and other mass movement include climate, rock type, slope, and natural or human caused changes to any of these factors. Albany's moist, moderate climate promotes deep weathering which breaks down the rock, increases pore pressures, and decreases shear strength.[16]

Landslides are typically triggered by periods of heavy rainfall or rapid snowmelt. Earthquakes, volcanic activity, and erosion may also trigger landslides. Human activities, including excavation, locating development near steep slopes, and removing vegetation can increase susceptibility to landslide events. Grading for roads and construction can decrease the stability of a hill slope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content. Landslides on steep slopes are more dangerous because movements can be rapid.[17]

Certain geologic formations are more susceptible to landslides than others. Rocks which weather to clay- rich soils are the least stable and the most prone to failure.

Types of landslides on steep slopes (slopes greater than 50 percent) include rock falls, rockslides, and shallow earthflow or mudflow. Unlike deep failures, such as those involved in mass movement topography, failures on steep slopes do not penetrate to great depths. Slope maps may be used to define general areas especially prone to these forms oflandslide.

In the City of Albany, failures on steep slopes might be most common north of Thornton Lake Drive NW and along Spring Hill Drive.

Human-induced causes of steep slope failures include: undercutting steep slopes; placing excessive fill; indiscriminate blasting; improper handling of runoff in construction areas; removal of vegetation; and the diversion of streams against steep canyon walls that have poorly engineered, valley-bottomroads.

The primary causes of landslides are listed in Table 2.

Table 2. Landslide Causes

Geological causes	Morphological causes	Human causes
Weak or sensitive materials	Tectonic or volcanic uplift	Excavation of slope or its toe
Weathered materials	Glacial rebound	Loading of slope or its crest
Sheared, jointed, or fissured materials	Fluvial, wave, or glacial erosion of slope toe or lateral margins	Drawdown (of reservoirs)
Discontinuous orientation of materials (unconformity, schistosity, layering, faults)	Subterranean erosion (solution, piping)	Deforestation
Contrast in permeability and/or stiffness of materials	Deposition loading on slope or its crest	Irrigation; altering ground water table
	Vegetation removal (fire, drought)	
	Thawing	
	Freeze-and-thaw weathering	
	Shrink-and-swell weathering	

Source: USGS Landslide Hazard Fact Sheet 2004-3072

Natural Causes

Natural processes can cause landslides or re-activate historical landslide sites. The undercutting of shoreline material along bodies of water by currents and waves causes many small slides each year. Seismic tremors can trigger landslides on slopes historically known to have landslide movement. Earthquakes can also cause lateral spreading on gentle slopes above steep streams and riverbanks. Heavy precipitation and rainfall can cause landslides by erosion, soil saturation or the combination of both.

Landslides are particularly common along stream banks, reservoir shorelines, and large lakes. Steep, concave-shaped slopes with larger drainage areas appear to be more susceptible to landslides than other landforms of over one cubic mile of material. All soil types can be affected by natural landslide triggering conditions.[18]

Human Causes

Human impacts can affect the potential for landslide failures in Albany. Proper planning can protect people, property and infrastructure. Three major human causes of landslides in Albany are: (1) excavation and grading; (2) drainage and groundwater alterations; and (3) changes in vegetation.

Excavation and Grading
Slope excavation is common in the development of home sites or roads on sloping terrain. Grading these slopes can result in some slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes can be at increased risk for landslides. The added weight of fill placed on slopes can also result in an increased landslide hazard. Small landslides can be fairly common along roads, in either the road cut or the road fill.[19]

Drainage and Groundwater Alterations
Water flowing through or above ground is often a trigger for landslides. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. A high groundwater table results in increased pore pressure and decreased shear strength of the soil, thus increasing the chance of slide movement. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. However, even lawn irrigation and minor alterations to small streams in landslide prone locations can result in damaging landslides. Ineffective storm water management and excess runoff can also cause erosion and increase the risk of landslide hazards.

Development that results in an increase in impervious surface impairs the ability of the land to absorb water and may redirect water to other areas. Channels, streams, ponding, and erosion on slopes all indicate potential slope problems. Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides.[20]

Changes in Vegetation
Removing vegetation from very steep slopes can increase landslide hazards. The *Storm Impacts Study* conducted by the Oregon Department of Forestry found that landslide hazards in three out of four steeply sloped areas were highest for a period of roughly 10 years after timber harvesting. Areas that have experienced wildfire and land clearing for development may have long periods of increased landslide hazard. In addition, woody debris in stream channels (both natural and man- made from logging) may cause the impacts from debris flows to be more severe.[21]

Major Landslide Hazards[22]

The three most damaging landslide causes around the world are: (1) water; (2) seismic activity; and (3) volcanic activity.

Landslides and Water

Slope saturation by water is a primary cause of landslides in the city of Albany. This effect can occur in the form of intense rainfall, snowmelt, changes in groundwater levels, and water-level changes along coastlines, earth dams, and the banks of lakes, reservoirs, canals, and rivers.

Landsliding and flooding are closely allied because both are related to precipitation, runoff, and the saturation of ground by water. In addition, debris flows and mudflows usually occur in small, steep stream channels and often are mistaken for floods; in fact, these two events often occur simultaneously.

Landslides can cause flooding by forming landslide dams that block valleys and stream channels, allowing large amounts of water to back up. This causes backwater flooding and, if the dam fails, subsequent downstream flooding. Also, solid landslide debris can "bulk" or add volume and density to an otherwise normal stream flow or cause channel blockages and diversions creating flood conditions or localized erosion. Landslides can also cause overtopping of reservoirs and/or reduced capacity of reservoirs to store water.

Landslides and Seismic Activity

Many mountainous areas that are vulnerable to landslides have also experienced at least moderate rates of earthquake occurrence. The occurrence of earthquakes in steep landslide-prone areas greatly increases the likelihood that landslides will occur, due to ground shaking alone or shaking-caused dilation of soil materials, which allows rapid infiltration of water.

The 1964 Great Alaska Earthquake caused widespread land sliding and other ground failure, which caused most of the monetary loss due to the earthquake. Other areas of the United States, such as California and the Puget Sound region in Washington, have experienced slides, lateral spreading, and other types of ground failure due to moderate to large earthquakes. Widespread rock falls also are caused by loosening of rocks as a result of ground shaking. Worldwide, landslides caused by earthquakes kill people and damage structures at higher rates than in the United States.

Landslides and Volcanic Activity

Landslides due to volcanic activity are some of the most devastating. Volcanic lava may melt snow at a rapid rate, causing a deluge of rock, soil, ash, and water that accelerates rapidly on the steep slopes of volcanoes, devastating anything in its path. These volcanic debris flows, (also known as lahars), reach great distances once they leave the flanks of the volcano and can damage structures in flat areas surrounding the volcanoes. The 1980 eruption of Mount St. Helens in Washington triggered a massive landslide on the north flank of the volcano, the largest landslide in recorded time.

Landslide Hazard Assessment

The landslide hazard assessment provides information on the location of landslide hazards, the land and property characteristics within the hazard area, and an assessment of risks to life and property that may result from a landslide event. The three elements of hazard assessment are: (1) hazard identification; (2) vulnerability assessment; and (3) risk analysis.

Section 201.6(c)(2)(*i*) of the *Disaster Mitigation Act of 2000* (DMA-2000) requires that the risk assessment include a description of the location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Hazard Identification

The first essential step of landslide hazard assessment is hazard identification. Hazard identification identifies: (1) the geographic extent of areas that are known to be subject to landslides; (2) the characteristics of potential landslides at different locations; and (3) the probability of occurrence of landslide events.

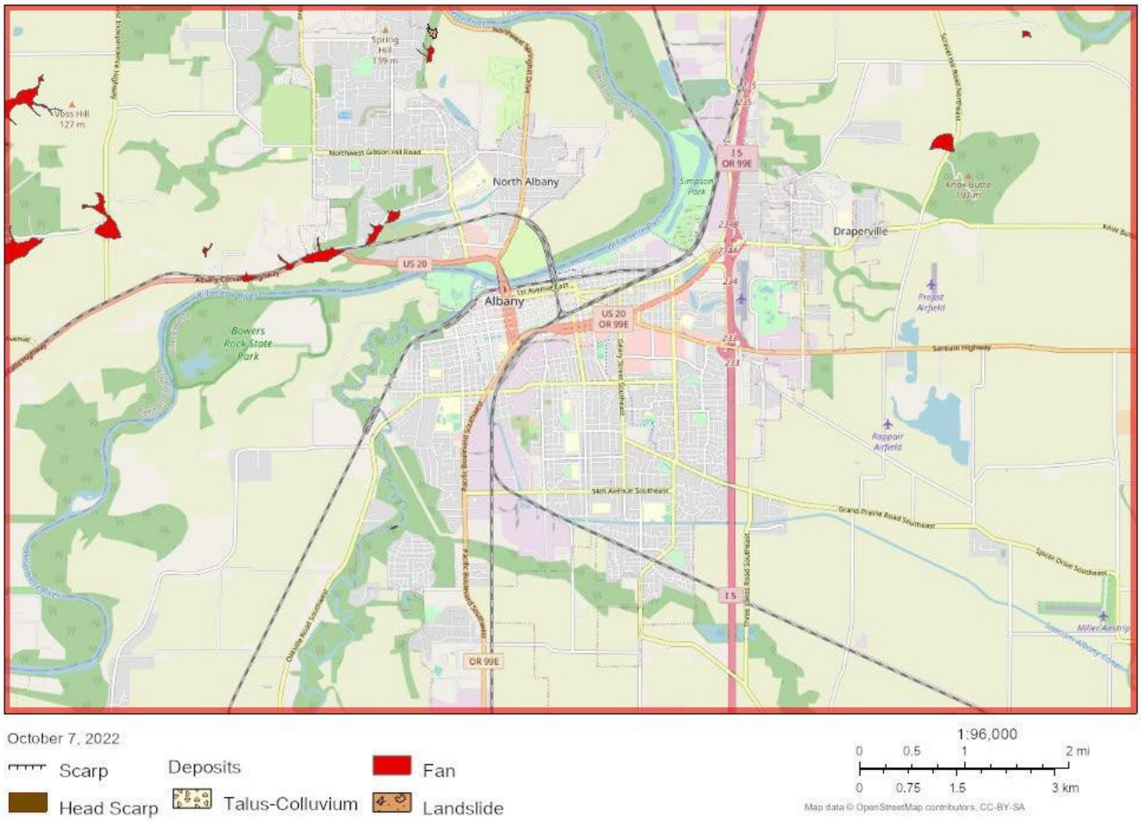
Landslide Hazard Areas

Locations at risk from landslides or debris flows include areas with one or more of the following conditions[23]:

- On or close to steep hills;
- Steep road-cuts or excavations;
- Existing landslides or places of known historic landslides;
- Steep areas where surface runoff is channeled, such as below culverts, V-shaped valleys, canyon bottoms, and steep stream channels; and
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons.

The city of Albany has only a few small areas where landslide debris fans have been identified by DOGAMI. One is located in North Albany which is solely located in Benton County. The first location is on West Thornton Lake Drive NW between the West end of NW Thornton Lake Place and NW Kouns Drive. Four separate locations are identified. There have been no significant landslides in the city in its recorded history, which goes back to 1864. The second location is on the Calapooia River on the North East bank north of the 53rd Street developments. Another location is on Knox Butte. A map of landslide susceptibility including the location of essential and critical facilities is included in Volume I: Basic Plan.

Figure 3. Landslide Features in Albany



Preliminary Debris Flow Hazard Maps

In response to the catastrophic landslides that occurred in Oregon in 1996, the State of Oregon adopted Senate Bill 12 in 1999 to address rapidly moving landslides (debris flows). Among other requirements, Senate Bill 12 directs DOGAMI to identify areas potentially prone to debris flows on further-review-area maps.

The Oregon Department of Forestry (ODF) has developed preliminary debris flow maps for western Oregon. While the debris flow maps are generally good for steep slope areas where landslides typically initiate, they are less accurate for identifying the down-slope impacts of these landslides, and may not capture many areas that are of public safety concern. They are not intended to be used as the final further-review areas as defined by Senate Bill 12, but they are available to local governments to provide an initial indication of debris flow hazards. These maps can be used to show areas where further on-the-ground investigation is needed, but should not be used to determine the actual hazard at any specific location. The preliminary debris flow hazard maps can help analyze vulnerability and risk and identify landslide mitigation action items.[24]

Further Review Area Maps

DOGAMI is refining the ODF debris-flow maps to identify further-review areas as required by Senate Bill 12. DOGAMI has performed preliminary field investigations throughout western Oregon to improve the delineation of the downslope run-out areas – the most critical areas in terms of public safety. Findings from those field investigations are being used to develop and evaluate improved methods for GIS modeling of debris flow hazards. Several models have been identified and are currently being tested.[25]

DOGAMI is also inventorying and consolidating slope failure information from the three major storms of February 1996, November 1996, and December 1996/January 1997. The final inventory identified 9,582 known landslide locations. For each documented landslide, up to 15 descriptive items are reported. From this study, DOGAMI found that counties with the highest percentage of total landslides reported are Lane (24 %), Douglas (11 %), Linn (10 %), Clackamas (9 %), Tillamook (9 %), Lincoln (8 %), and Multnomah (7 %)."[26]

Vulnerability Assessment

Vulnerability assessment is the second phase in landslide hazard assessment. Vulnerability assessment inventories development and populations that are located within identified landslide hazard areas.

Section 201.6(c)(2)(*ii*)(A) of the DMA-2000 requires that the risk assessment include a description of the jurisdiction's vulnerability to the hazard. This description shall include an overall summary for the hazard and its impact on the community. If appropriate data is available, the vulnerability assessment should describe the type and number of existing and future buildings, infrastructure, and critical facilities located in identified hazard areas.

Landslides can impact important transportation routes, impeding commerce and blocking residents from reaching essential services, businesses and places of employment. Locating and understanding the population, property, and facilities that are exposed to landslide and debris flow hazards will assist in reducing risks and preventing losses from future landslides.

Information on landslide-prone and debris flow-prone locations in the city can be used to assess the value of property and the population at risk from future landslides. The amount of property within landslide- prone areas and the value of those properties can be calculated to estimate potential losses. Calculating a community's vulnerability to landslides is difficult because site-specific vulnerability data is difficult and costly to obtain.

A property-specific assessment of the number of lives or amount of property exposed to landslide hazards has not yet been conducted for the City of Albany. However, Phase I of the *Regional All Hazard Mitigation Master Plan (RAHMP) for Benton, Lane and Linn Counties* estimated vulnerability and losses due to winter storm-induced landslides using the small-scale landslide data available in 1998.[27] Unfortunately, the results of this study are not useful on a site-specific scale. An updated vulnerability analysis for landslides in the City of Albany will be developed using the debris flow hazard maps being prepared by ODF and DOGAMI.

Probability

Most of the Cascade Range in eastern Linn County is classified as having "moderate" landslide incidence and susceptibility. **Susceptibility** is defined as the probability of landslides. **Incidence** is defined as the observed rate of landslides. Parts of the Cascades east side of the Willamette Valley are considered to have high landslide incidence and susceptibility. Within the Willamette Valley, including the City of Albany, the landslide susceptibility and incidence is low. For the City of Albany, our highest opportunity for landslide is in North Albany in Benton County. This is not to say that no landslides can occur elsewhere in the community but that the incidence rate is less than 1.5 percent.[28] The Oregon Department of Forestry estimates widespread landslide activity will occur about every 20 years. The City of Albany has not had a widespread landslide since it was incorporated in 1864. The probability of a rapidly moving landslide occurring depends on a number of factors. These include 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). Consequently, the ODF tracks storms during the rainy season, monitors rain gauges and snow melt, and issues warnings as conditions warrant.[29]

Vulnerability

The probability that Albany will experience landslides is very low given the fact the city has not had a widespread landslide in over 150 years and Albany only has a few locations where landslides might occur. Albany's overall probability score is low and its overall vulnerability score is low for landslides.

Risk Analysis

Risk analysis builds on the hazard identification and vulnerability assessment to estimate the damage, injuries and economic losses that may be sustained within a hazard area over a given period of time. The risk analysis uses mathematical models based on the magnitude of the harm that may result and the likelihood of the harm occurring.

Section 201.6(c)(2)(*ii*)(B) of the Disaster Mitigation Act of 2000 (DMA-2000) requires that the risk assessment include an estimate of the potential dollar losses to vulnerable structures. A landslide risk analysis for City of Albany would include at least two components: the life and value of property and critical facilities that may incur losses from a landslide event; and the number and type of landslide events expected to occur over time. A risk analysis would predict the severity of damage from a range of events and the probability of those events occurring at specific locations.

Factors included in assessing landslide risk include population and property distribution in the hazard area, the frequency of landslide or debris flow occurrences, slope steepness, soil characteristics, and precipitation intensity. This type of analysis could generate estimates of the damage to the area due to a specific landslide or debris flow event. At the time of publication of this plan, data was insufficient to conduct a risk analysis.[30]

Minor amounts of landslide-induced ground movement are not normally life-threatening. For example, settlements of 0.5 inches may occur due to landslide, and such settlements will generally cause some damage in buildings, but such damage is not likely to cause severe injury. Given that a site experiences some permanent ground movement, the extent of building damage depends on where the structure is located within the zone of permanent ground deformation. For example, if the structure straddles the area where the ground moves to where the ground does not move, the structure will experience major damage. On the other hand, if the structure is located within a large land mass that moves, more or less, as a unified mass, the structure may experience very little or no damage, other than loss of buried utilities.

For roads, it is assumed that minor landslides are repaired by coning off the affected section and repaving with asphalt. For major movements of 60 inches, it is assumed that the fill-side lane of a two-lane road will be rebuilt at about 70 percent of the cost of a new two-lane road. For ground movements over 100 inches, it is assumed that the road will be rebuilt.

The DOGAMI SLIDO, Statewide Landslide Information Layer for Oregon, website identifies three locations within the city of Albany that has the potential for landslides. One is on Thornton Lake Drive between the west entrance to Thornton Lake Place and Scenic Drive; the second immediately east of the end of Bloom Lane and the third is along the Calapooia River, west of 39th avenue SW.

Community Landslide Issues

What is susceptible to damage from a landslide event?

Landslides can affect utility services, transportation systems, and critical lifelines. In addition to the immediate damages and loss of service that communities may suffer, the 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 electricity are all essential to the community. Loss of electricity has the most widespread impact on the whole community and can even affect other utilities. For example, landslide movements as small as an inch or two increases the potential for natural gas pipelines to break.[31]

Roads and Bridges

Roads are subject to closure during landslide events and constitute the largest losses incurred from landslide hazards in Albany. The City of Albany Public Works Department, Linn and Benton County road departments and the Oregon Department of Transportation are responsible for responding to slides that inhibit the flow of traffic and/or damage a road or bridge.

Since many of Albany residents depend on roads for commuting to work, delays and detours generated by a landslide will likely have an economic impact on residents and businesses. Bridges are a critical part of road connections that may suffer extensive damage in landslide events. A transportation analysis will be conducted to determine which of the City of Albany's roads and bridges should be classified as critical to the transportation network.

It is not cost effective to mitigate for all slides, since some historical slides are likely to become active again even after mitigation measures have been implemented. The Public Works Department can alleviate problem areas by grading slides, and by installing new drainage systems on the slopes to divert water from the landslides. This type of response activity is often the most cost-effective in the short term.

Lifelines and Critical Facilities

It is important to identify facilities determined to be critical to life and safety, such as hospitals, emergency services, and public utilities that are subject to direct impacts from landslides. Critical facilities may also be indirectly impacted by landslides. Lifelines and critical facilities must remain accessible during a natural hazard event. The impact of closed transportation arteries is increased if the closed road or bridge is the access to a hospital or other emergency facility or if populations are cut off from emergency services or utilities. Inspection and repair of critical transportation facilities and routes is essential and should be a high priority. Loss of power and/or phone service is also potential consequences of landslide events. In hillside areas, soil erosion can be accelerated by heavy rains, resulting in loss of soil support beneath high-voltage transmission towers.

Landslide Loss Potential

Landslides are a significant hazard to life and property. In some cases, it is cost-effective to mitigate existing infrastructure against landslides. More often, the most cost-effective approach to landslides is zoning regulations, where landslide hazard areas are identified prior to construction, and planned facilities are relocated or the landslide is mitigated prior to construction. If the cost to mitigate a landslide is high, and the risk of landslide loss is suitably small, in some cases it may be worthwhile to accept the risk and consequences from unmitigated landslides. Landslides should also be considered in the development of emergency response plans.[32]

How to Reduce the Effects of Landslides[33]

Vulnerability to landslide hazards is a function of location, type of human activity, use, and frequency of landslide events. The effects of landslides on people and structures can be lessened by total avoidance of landslide hazard areas or by restricting, prohibiting, or imposing conditions on hazard-zone activity. Local governments can reduce landslide effects through land-use policies and regulations. Individuals can reduce their exposure to hazards by educating themselves on the past hazard history of a site and by making inquiries to planning and engineering departments of local governments. They can also obtain the professional services of an engineering geologist, a geotechnical engineer, or a civil engineer, who can properly evaluate the hazard potential of a site.

The hazard from landslides can be reduced by avoiding construction on steep slopes and existing landslides, or by stabilizing the slopes. Stability increases when ground water is prevented from rising in the landslide mass by:

(1) Covering the landslide with an impermeable membrane;
(2) Directing surface water away from thelandslide;
(3) Draining ground water away from the landslide; and
(4) Minimizing surface irrigation.

Slope stability is also increased when a retaining structure and/or the weight of a soil/rock berm are placed at the toe of the landslide, or when mass is removed from the top of the slope.

Landslide Mitigation Programs City of Albany Codes

As part of the City's commitment to environmental stewardship and responsibility, the City of Albany has implemented an Erosion Prevention and Sediment Control (EPSC) program. This program will assist the City in meeting requirements set forth by the Oregon Department of Environmental Quality and the federal Environmental Protection Agency for compliance with standards established by the federal Clean Water Act.

This EPSC program will be authorized and established through these revisions to Title 12 of the Albany municipal Code. The EPSC program has been developed to support the objectives of Title 12, which are to "provide for the health, safety, and general welfare of the citizens of the City of Albany and to protect and enhance the water quality and natural functions of watercourses and water bodies through the regulation of stormwater discharges; to set forth uniform requirements for direct and indirect contributors to the stormwater system; and to enable the City of Albany to comply with applicable state and federal laws."

State Programs and Activities

Statewide Planning Goal 7[34]

Statewide Planning Goal 7 is one of 14 original statewide planning goals adopted by the Land Conservation and Development Commission in 1974. Goal 7 seeks to protect life and property from natural disasters and hazards such as floods, landslides, and earthquakes. To help accomplish this protection, the goal requires that local plans be based on an inventory of known areas subject to natural hazards and disasters and advises that "developments subject to damage or that could result in loss of life shall not be planned nor located in known areas of natural disasters and hazards without appropriate safeguards."

Senate Bill 12[35]

In response to the catastrophic landslide events that occurred in Oregon in 1996, the state of Oregon adopted Senate Bill 12 in 1999 to address rapidly moving landslides (debris flows). Among other requirements, Senate Bill 12 requires local governments to:

Regulate through mitigation measures and site development standards the siting of dwellings and other structures designed for human occupancy in further review areas where there is evidence of substantial risk for rapidly moving landslides.

In brief, Senate Bill 12 (Source: DLCD Natural Hazards Program website):

- Directs the Oregon Department of Geology and Mineral Industries to identify areas potentially prone to debris flows on "further review area"maps;
- Directs the Oregon Department of Land Conservation and Development to assist local governments in implementing the bill;
- Requires the Oregon Board of Forestry to adopt regulations that reduce therisks associated with rapidly moving landslides;
- Requires the Oregon Department of Forestry and DOGAMI to provide technical assistance to local governments;
- Requires the Oregon Department of Transportation to provide warnings to motorists during periods determined to be of the highest risk of rapidly moving landslides along areas of state highways with a history of being most vulnerable to rapidly moving landslides; and
- Directs the Office of Emergency Management of the Department of State Police to coordinate state resources for rapid and effective response to landslide-related emergencies.

Department of Geology and Mineral Industries

DOGAMI has created an Oregon HazVu: Statewide Geohazards Viewer which the city uses to identify landslide areas within the city. At this time there are no official maps that have been provided specifically to the City showing our landslide areas of concern.

Department of Land Conservation and Development

The DLCD awarded a grant to Douglas County for the development of a model program to help in the mitigation of rapidly moving landslide hazards. Douglas County agreed to produce four main products: (1) a model landslide hazards ordinance; (2) model documents to support implementation of Senate Bill 12; (3) a model Transfer of Development Rights program; and (4) procedures to integrate DOGAMI's further-review-area maps into local tax parcelmaps.

Oregon Department of Forestry

Senate Bill 1211 and Senate Bill 12, passed in 1997 and 1999 respectively, contain provisions to be addressed by the ODF. These provisions include the interim prohibition of forest operations in certain areas and the development of certain forest practices requirements. The interim prohibitions authorized by Senate Bill 1211 will eventually be replaced by the forest practice rules to be adopted by the Oregon Board of Forestry as required by Senate Bill 12.

Interim Prohibitions[36]

Senate Bill 1211, a precursor to Senate Bill 12, authorized ODF to prohibit forest operations on steep, landslide-prone sites above homes and busy roads in the interest of public safety. Specifically, the State Forester is authorized to prohibit operations if all of the following conditions exist:

- The operation location includes high-risk sites;
- Homes and other buildings where people are likely to be present during periods of intense rainfall or where county or state highways are in such close proximity to the potential path of a landslide or debris torrent that there is significant risk to human life; and
- The farthest expected extent of a potential landslide or debris torrent that might originate in the operation area, based on physical features of the landslide or debris torrent path, will reach the residences, buildings or highways.

Forest Practices Requirements

Senate Bill 12 required ODF to adopt and enforce forest practice rules to reduce the risk of serious bodily injury or death from rapidly-moving landslides (Oregon Revised Statutes 527.630). ORS 527.710(11) sets forth the criteria the Board of Forestry should consider in adopting such rules, including the exposure of the public to these safety risks and appropriate practices to reduce the occurrence, timing, or effects of rapidly moving landslides.

Landslide Warnings

DOGAMI is developing a slope-failure database to study the relationship between rainfall events and debris flows. Records from the four major storms that hit western Oregon during 1996 and 1997 confirm that the occurrence of many landslides and debris flows can be related to rainfall intensity and duration. The relationships between rainfall intensity and debris flows are useful in helping to determine areas where debris-flow warning systems are appropriate. A debris-flow hazard warning system has been developed and a current alert message can be found at ODF.[37]

Oregon’s landslide/debris flow warning system primarily involves three state and one federal agency: ODF, DOGAMI, ODOT, and the National Oceanic and Atmospheric Administration (NOAA). The warning system is triggered by rainfall and monitored in areas that have been determined to be hazardous.

As the lead agency, ODF is responsible for forecasting and measuring rainfall from storms that may trigger debris flows. Advisories and warnings are issued as appropriate. Information is broadcast over NOAA weather radio and on the Law Enforcement Data System. DOGAMI provides additional information on debris flows to the media. ODOT provides information concerning the location of landslides/debris flows and alternate transportation routes.[38]

House Bill 3375

House Bill 3375 (2003) directs local governments to adopt new land use regulations for siting dwellings and other structures once DOGAMI issues final maps of rapidly moving landslide hazard areas. The bill clarifies that local governments may deny a request for a building permit if a geotechnical report discloses information about landslide hazards. This bill repeals the mitigation threshold requirements and transferable development rights program in landslide areas in Senate Bill 12.

Oregon State Building Code Standards

The Oregon Building Codes Division adopts statewide standards for building construction that are administered by state and local municipalities throughout Oregon. The One- and Two-Family Dwelling Code and the Structural Specialty Code contain provisions for lot grading and site preparation for the construction of building foundations.

Both codes contain requirements for cut, fill, and sloping of a building lot in relationship to the location of the foundation. There are also building setback requirements from the top and bottom of slopes. The codes specify foundation design requirements to accommodate the type of soils, the soil bearing pressure, and the compaction and lateral loads from soil and ground water on sloped lots. The Building Official has the authority to require a soils analysis for any project where it appears the site conditions do not meet the requirements of the code, or that special design considerations must be taken. ORS 455.447 and the Structural Code require a seismic site hazard report for projects that include essential facilities such as hospitals, fire and police stations, emergency response facilities, and special occupancy structures, such as large schools and prisons.[39]

---

[1] Interagency Hazard Mitigation Team, *State Hazard Mitigation Plan* (2000) Oregon State Police – Office of Emergency Management.

[2] Robert Olson Associates, *Metro Regional Hazard Mitigation Policy and Planning Guide* (June 1999) Metro.

[3] Ibid.

[4] Oregon State Natural Hazard Mitigation Plan (OR-SNHMP) (Region 3) Mid/Southern Willamette Valley Hazards Assessment, Nov. 2003, pp R3-22

[5] Ibid.

[6] Department of Land Conservation and Development (DLCD) Natural Hazards Program Website, http://www.lcd.state.or.us

[7] Regional All Hazard Mitigation Plan for Benton, Lane, Lincoln and Linn Counties (RAHMP) July 27, 1998, pg. 25

[8] DLCD Natural Hazards Program Website, http://www.lcd.state.or.us

[9] Ibid.

[10] Ibid.

[11] RAHMP, July 27, 1998, pg. 26

[12] Ibid. pg. 25

[13] Ibid.

[14] Ibid.

[15] Ibid.

[16] DOGAMI Bulletin 84 (1974), pg. 62

[17] Douglas County Natural Hazard Mitigation Plan (NHMP), 2003, pp. 105

[18] Douglas County NHMP (2003), pp. 105

[19] Ibid. pg.106

[20] Ibid. pg.106

[21] Ibid. pg.105

[22] USGS Landslide Hazard Fact Sheet 2004-3072 (July 2004)

[23] Douglas County NHMP (2003), pp. 105

[24] DLCD Natural Hazards Program Website, http://www.lcd.state.or.us

[25] Ibid.

[26] Ibid.

[27] RAHMP July 27, 1998, pg. 32

[28] RAHMP July 27, 1998, pp 29-30

[29] OR-SNHMP Region 3 Hazard Assessment, pp R3-23

[30] Douglas County NHMP (2003), pp 107

[31] Regional All Hazard Mitigation Master Plan for Clackamas County (February 1998) Goettel & Associates.

[32] Source: RAHMP, July 27, 1998, Page 25

[33] USGS Landslide Hazard Fact Sheet 2004-3072 (July 2004)

[34] Source: DLCD Natural Hazards Program Website, http://www.lcd.state.or.us

[35] Ibid.

[36] Ibid.

[37] Ibid.

[38] OR-SNHMP Region 3 Hazard Assessment, pp R3-23

[39] *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Department of Land Conservation and Development (July 2000), Chapter 5.

Section 12: Drought

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Drought

Causes and Characteristics of the Hazard

Drought is a normal, recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region. Defining drought is therefore difficult; it depends on differences in regions, needs, and disciplinary perspectives.[1] Based on the many definitions that have appeared in the literature, drought can be categorized and defined in the following ways:[2]

> **Meteorological or climatological droughts** usually are defined in terms of the departure from a normal precipitation pattern, and the duration of the event. Drought is a slow-onset phenomenon that usually takes at least three months to develop and may last for several seasons or years.
>
> **Agricultural droughts** link the various characteristics of meteorological drought to agricultural impacts. The focus is on precipitation shortages and soil-water deficits. Agricultural drought is largely the result of a deficit of soil moisture. A plant's demand for water is dependent of the specific plant, its stage of growth, and the physical and biological properties of the soil.
>
> **Hydrological droughts** refer to deficiencies in surface water and sub-surface water supplies. It is measured as stream flow, and as lake, reservoir, and ground water levels. Hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, the shortage will be reflected in declining surface and subsurface water levels.
>
> **Socioeconomic droughts** occur when a physical water shortage begins to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with supply, demand, and economic good. One could argue that a physical water shortage with no socioeconomic impacts is a policy success.

History of the Hazard in City of Albany

Oregon records dating back to the late 1880s clearly associate drought with a departure from expected rainfall. Concern for mountain snowpack, which feeds the streams and rivers, came later. Droughts were particularly noteworthy during the following years:

Table 1. Partial History of Drought in Oregon

Date	Description
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
1939-1941	A three-year intense drought in Oregon
1976-1981	Intense drought in western Oregon; 1976-77 single driest year of century
1985-1997	Generally a dry period, capped by statewide droughts in 1992 and 1994
2000-2001	Klamath drought intensifies; low snow pack in mountains worsens conditions Draw-down at Detroit Lake, Oregon, all but curtails lake recreation

Additionally, the Drought Impact Reporter[i] identified the following reported drought impacts for the city of Albany:[3]

- **Oct. 4, 1986**: Due to losses incurred from sustained drought conditions, farmers and producers in several Oregon counties are eligible to apply for low-interest loans. The loans are a form of drought disaster assistance provided by the U.S. Department of Agriculture. (Kadera, Jim. "Drought Aid Begins, Feed Plan Expanded." The Oregonian. Oct. 4, 1988.)

- **Oct. 22, 1987**: Sustained drought conditions contributed to job losses in the Pacific Northwest timber industry. As the continued drought and related increased fire danger led to forest closures, thousands of loggers and truck drivers were forced out of work. According to an official with the Washington Forest Protective Association, drought-related state restrictions affected about 7,000 forest products employees.

- **Jan. 1, 1990 – Dec. 31, 1990**: According to an official with the U.S. Department of Agriculture, in 1990, $4,464,000 was provided to Oregon farmers impacted by drought conditions to purchase emergency feed supplies. (Oregon Emergency Management Drought Council. Meeting minutes. October 17, 1991. pg. 2)

- **Jan. 1, 2009 – Sept. 17, 1991**: According to an official with the U.S. Department of Agriculture, to date in 1991, $313,000 was provided to Oregon farmers impacted by drought conditions to purchase emergency feed supplies. (Oregon Emergency Management Drought Council. Meeting minutes. October 17, 1991. pg. 2)

- **Dec. 14, 1999**: Non-farm businesses and agricultural cooperatives became eligible to receive low-interest disaster loans in 15 counties in Oregon due to this year's drought. These businesses can receive loans for up to $1.5 million to help with financial obligations. (12/14/99, Drought News Headline)

- **April 10, 2001**: Due to lack of hydropower from drought, along with increased demand, Bonneville Power Administration asked approximately 12 factories in the Pacific Northwest, mostly aluminum plants, to shut down for up to two years in an attempt to conserve power and limit the rise of energy prices. This would cut the power demand on the company 5% to 10%, approximately 2,100 megawatts. They also asked residential users in the area to limit their power use.

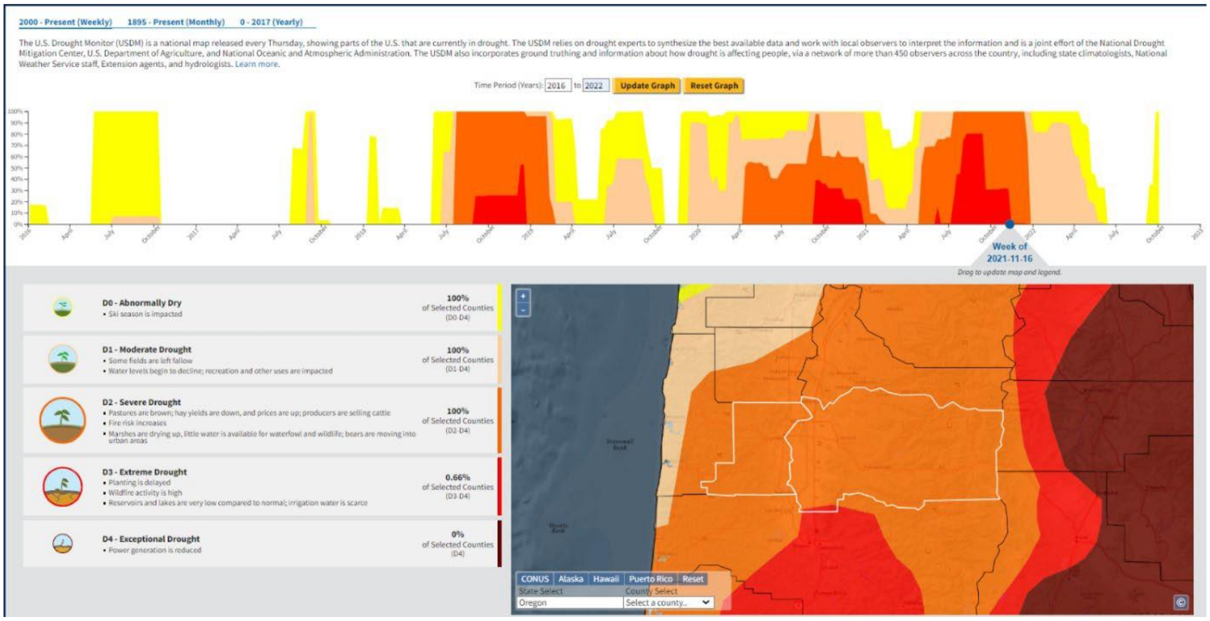
- **April 22, 2005**: Due to water rationing, farmers in both Oregon and Washington cut back significantly on planting certain crops, including wheat and hay.

- **July 23, 2007**: Farmers in Oregon were allowed to cut hay and graze their livestock on land in the U.S. Department of Agriculture's Conservation Reserve Program. This allowed farmers access to use land within 210 miles of counties that had been declared to be drought disaster areas, instead of being able to use CRP lands only within the affected counties.

- **August 19, 2015**: For the first time ever, Linn County Commissioners have approved a drought declaration for the county. Snow packs have been at record lows for the year and the last rainfall in the mid-valley was in June.

[i] The National Drought Mitigation Center developed the Drought Impact Reporter in response to the need for a national drought impact database for the United States. Drought impacts are inherently hard to quantify, therefore there has not been a comprehensive and consistent methodology for quantifying drought impacts and economic losses in the United States. The Drought Impact Reporter is intended to be the initial step in creating a comprehensive database. The principal goal of the Drought Impact Reporter is to collect, quantify, and map reported drought impacts for the United States and provide access to the reports through interactive search tools

Figure 1. Drought Conditions in Linn and Benton counties 2016-2022

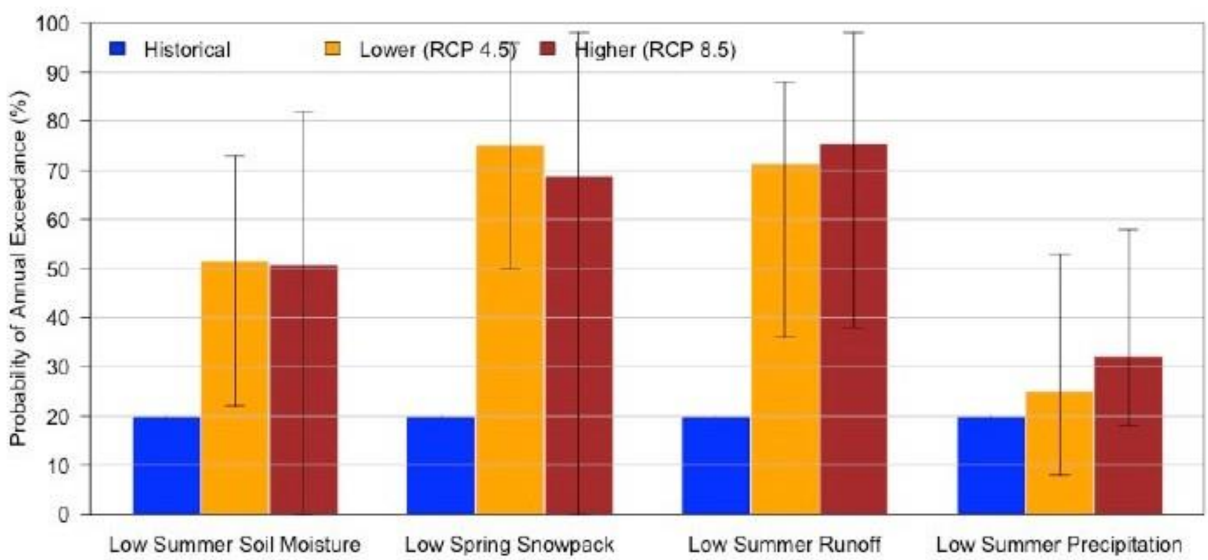


National Integrated Drought Information System, consulted September 2022

The National Integrated Drought Information System indicates that periods of Severe to Extreme drought occurred in Linn and Benton counties during the period from 2016 to 2022.

The Future Climate Projections Linn County, Oregon report prepared by the Oregon Climate Change Research Institute identifies increased projections for drought as the climate warms. 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 Linn County by the 2050s.

Figure 2. Projected Future Drought in Linn County



Source: Future Climate Projections Linn County, Oregon, OCCRI, 2022

Risk Assessment

How are hazard areas identified?

Drought is typically measured in terms of water availability within 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. It is not believed to provide a very accurate indication of drought conditions in Oregon and the Pacific Northwest.[4]

The Oregon Drought Severity Index is the most commonly used drought measurement in the state because it incorporates both local conditions and mountain snow pack. It is considered to be a better indicator of drought severity because it incorporates both local conditions and mountain snowpack. The Oregon Drought Severity Index categorizes droughts as mild, moderate, severe, and extreme. The index is available from the Oregon Drought Council.[5]

The Surface Water Supply Index (SWSI) is an index of current water conditions throughout the state, designed for areas that rely on snow melt as the primary source of surface water. This index utilizes parameters derived from snow pack, mountain precipitation, streamflow, reservoir storage, and soil moisture conditions.

The National Weather Service's Climate Prediction Center produces operational predictions of climate variability, real-time monitoring of climate and the required data bases, and assessments of the origins of major climate anomalies. In Southern Oregon, drought is likely to persist or intensify. Linn and Benton County's appears to be following normal trends.

City of Albany residents receive water from two sources on the Santiam River. One location is near the City of Lebanon, and the other near the City of Jefferson.

Probability of future occurrence

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It is a temporary condition and differs from aridity because the latter is restricted to low rainfall regions and is a permanent feature of climate. It is rare for drought not to occur somewhere in North America each year. Despite impressive achievements in the science of climatology, estimating drought probability and frequency continues to be difficult. This is because of the absence of long historic databases, and the many variables that contribute to weather behavior and climate change. Nevertheless, progress is being made, particularly in the area of cyclic climatic variations.[8]

The City of Albany estimates that one drought event is likely to occur within a 100-year period. It occurs so infrequently that drought is not a part of the City's hazard analysis, although for the first time ever, as of August 2015, the County issued a drought declaration for all of Linn County. [9]

Vulnerability assessment

The City of Albany estimates that less than 1% of the City's population or property is likely to be affected by drought conditions. This equates to a "low" vulnerability estimate.

At this time, no full vulnerability assessment for the City of Albany drought hazard is available (i.e., inventories of existing structures in hazard areas, and potential impacts of future land development).

The drought mitigation actions listed below were identified in response to this need. A general description of the community's vulnerabilities is listed in the "Community Hazard Issues" section below.

Risk analysis

The impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be $6-8 billion annually in the United States and occur primarily in agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts.[10]

Estimates of potential losses (i.e., potential dollar losses to specific vulnerable structures, transportation systems, utilities, economic assets, etc. in Linn and Benton Counties) are not available at this time.

Community Hazard Issues

What is susceptible to damage during a drought hazard event?

The following information addresses the impact of a severe or prolonged drought on Linn and Benton County's population, infrastructure, facilities, economy, and environment:

Population: Drought can affect all segments of the City's population, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). Also, domestic water users may be subject to stringent conservation measures (e.g., rationing) and could be faced with significant increases in electricity rates.

Infrastructure: In general, infrastructure such as highways, bridges, energy conveyance systems, etc., are unaffected by drought, which can, but seldom does, produce structural damage.[ii] An exception would include areas of severe soil shrinkage. In these uncommon situations, soil shrinkage would affect the foundation upon which the infrastructure was built. In addition, water- borne transportation systems (e.g., ferries, barges, etc.) could be impacted by periods of low water.

Critical/essential facilities: Facilities affected by drought conditions include communications facilities, hospitals, and correctional facilities that are subject to power failures. Storage systems for potable water, sewage treatment facilities, water storage for firefighting and hydroelectric generating plants also are vulnerable. Low water also means reduced hydroelectric production especially as the habitat benefits of water compete with other beneficial uses.

State-owned or -operated facilities: There are a variety of state-owned or -operated facilities that could be affected by a prolonged drought. The most obvious include schools, universities, office buildings, and health-care facilities. Power outages always are a concern. Maintenance activities (e.g., grounds, parks, etc.) may be curtailed during periods of drought.

[ii] Some clay soils (e.g., those containing bentonite) have significant shrink-swell properties. Prolonged drought can shrink these soils resulting in structural damage. Although these soils occur in Oregon, their geographical extent is limited.

Economy: Drought has an impact on a variety of economic sectors. These include water-dependent activities and economic activities requiring significant amounts of hydroelectric power. The agricultural sector is especially vulnerable as are some recreation-based economies (e.g., boating, fishing, etc).

Environment: Oregon has several fish species listed as threatened or endangered pursuant to the Endangered Species Act (ESA) of 1973. Some of these species have habitat requirements that often conflict with the needs or desires of the human environment. For example, in times of scarcity, the amount of water necessary to maintain certain fish species may conflict with the needs of the local agricultural community.

[1] National Drought Mitigation Center, *What is Drought?* University of Nebraska, Lincoln. http://drought.unl.edu/index.htm.

[2] State of Oregon Enhanced Natural Hazards Mitigation Plan, Part 3: Hazard Chapters, *Drought*. 2009.

[3] National Drought Mitigation Center, *Drought Impact Reporter*. http://droughtreporter.unl.edu/map.jsp.

[4] State of Oregon Enhanced Natural Hazards Mitigation Plan, Part 3: Hazard Chapters, *Drought*. 2009.

[5] State of Oregon Enhanced Natural Hazards Mitigation Plan, Part 3: Hazard Chapters, *Drought*. 2009.

[6] United States Department of Agriculture, Natural Resources Conservation Service. *Surface Water Supply Index; Current SWSI.* http://www.or.nrcs.usda.gov/snow/watersupply/swsi.html (accessed May 4, 2010).

[7] National Weather Service Climate Prediction Center. *U.S. Seasonal Drought Outlook*. http://www.cpc.noaa.gov/products/expert_assessment/seasonal_drought.html (accessed May 3, 2010).

[8] State of Oregon Enhanced Natural Hazards Mitigation Plan, Part 3: Hazard Chapters, *Drought*. 2009.

[9] Lathrop, Steve. "Commissioners approve drought declaration for Linn County." Albany Democrat-Herald. http://democratherald.com/commissioners-approve-drought-declaration-for- linn-county/article_8c81242a-62ad-5a0c-88b2-b42c2c926f72.html (accessed August 19, 2015).

[10] National Drought Mitigation Center, *Planning for Drought*. University of Nebraska, Lincoln. http://drought.unl.edu/index.htm.

Section 13:
Poor Air Quality

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Poor Air Quality

Causes and Characteristics

The hazard of Poor Air Quality has been named for inclusion in several recent NHMP updates as communities recognize the impacts of inversion layers trapping particulates in smoke from wood stoves, prescribed fire, wildfire, field burning, and leaf burning.

Geographic Causes

The nature of air movement or stagnation in a valley causes inversion layers to form. At the valley floor daytime temperatures heat the air. In the evening, air further up the slope of the mountains cools faster than the air lower down the slope. Because cool air is slightly heavier than warm air, the cool air sinks in to the valley which displaces the warm air above it to form a "lid". If the weather creates stagnant conditions this inversion "lid" may persist trapping air pollutant discharges to create poor air quality.

Air quality issues can occur widely across Wallowa County, affecting the unincorporated rural areas and the incorporated cities. There are many microclimates throughout the county which result in localized issues.

Sources of Pollutants

Wildfires[1] tend to provide a wide-ranging source of smoke that can blanket large areas and be detrimental to the health of people, animals, and plants. Wood burning stoves tend to be a more concentrated, point source type of pollution that decreases air quality. Field burning is an agricultural technique that can contribute to air quality issues. Diesel emissions, often from vehicles on roads, also contribute to lower air quality. If a volcano were to erupt, ashfall could inundate the areas sufficiently to impact transportation and cause widespread health concerns.

Regulatory Framework

Federal Regulations

The Clean Air Act of 1970 and the U.S. Environmental Protection Agency (EPA) established health-based National Ambient Air Quality Standards (NAAQS) for six air pollutants: carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and lead (Pb). The areas that fail to meet the standards are designated "non-attainment" and are required to develop plans to come into compliance with the standards. Once compliance with the standard is achieved, a maintenance plan is developed to ensure that air quality will not be compromised in the future. Wallowa County is not an Air Quality Maintenance Area (AQMA).[2]

[1] See the Wildfire Hazard Annex for more information about wildfire impacts.

[2] Peter Brewer, DEQ, personal communication, 8/5/19.

The Clean Air Act established two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings. The Clean Air Act requires periodic review of the science upon which the standards are based and the standards themselves.

Oregon Regulations

The Oregon Department of Environmental Quality (DEQ) is a regulatory agency with the responsibility to protect and enhance the quality of Oregon's environment. DEQ is responsible for providing accurate scientific data concerning the State of Oregon's air quality "to ensure that the state meets the National Ambient Air Quality Standards (NAAQS) as required by the Federal Clean Air Act." [4]

Air Quality Pollutants

Oregon DEQ operates the ambient monitoring network for the entire state with the exception of Lane County which is operated by the Lane Regional Air Protection Authority (LRAPA). These air quality monitoring networks measure ambient concentrations of the criteria pollutants - ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, lead. Air quality pollutants are monitored at the locations shown on Figure 4.[5] There are monitors in Enterprise, Cove, La Grande, Hermiston, and Pendleton. Enterprise and Pendleton are annual monitoring sites and Hermiston and Cove are summer monitoring sites. The full range of air toxics is measured at the monitoring site in La Grande.

DEQ collects data on air quality pollutant trends for Ozone, $PM_{2.5}$, PM_{10}, carbon monoxide, sulfur dioxide, nitrogen dioxide, air toxics, and greenhouse gases. Each of these trends is described below.

<u>Ozone</u>

DEQ describes that

> "Ozone is a secondary pollutant formed when there are elevated levels of nitrogen dioxide (NO2) and volatile organic compounds (VOCs) that undergo chemical reactions in high temperatures, and sunlight. In Oregon, elevated ozone occurs in the summer and can be formed by human-caused pollution from fossil fuel combustion and also by naturally caused pollution from wildfire smoke, which contains NO_2 and. In 2017, most of the state experienced elevated ozone because the wildfire smoke introduced natural precursors on top of the human-caused emissions. With global warming we expect more fires in the Northwest and higher temperature days; this will result in more elevated ozone days."[6]

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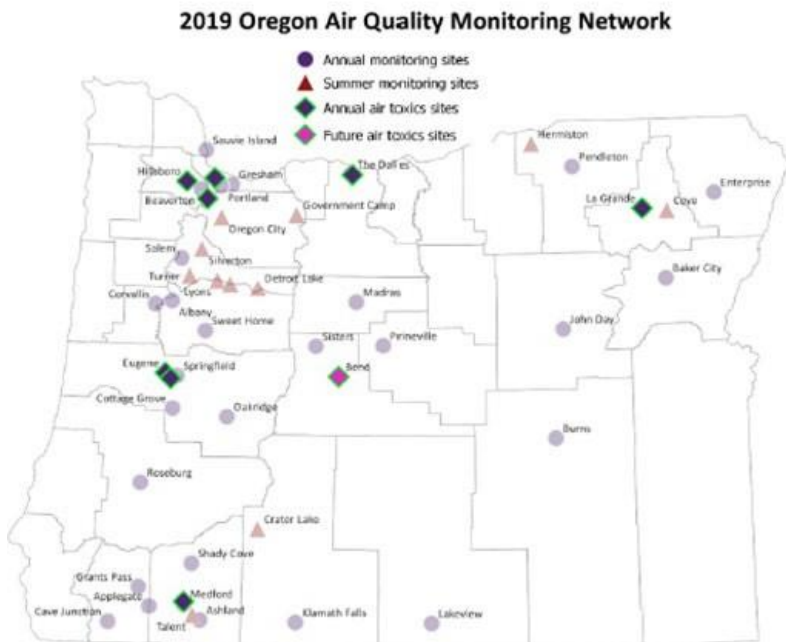
[4] DEQ, *Air quality home*, retrieved September 1, 2016 from http://www.oregon.gov/DEQ/aq/Pages/default.aspx.

[5] DEQ, 2019 *Oregon Annual Ambient Criteria Pollutant Air Monitoring Network Plan,* https://www.oregon.gov/deq/FilterDocs/AQmonitoringplan.pdf. Remains the same in the *2020 Plan*.

[6] DEQ, *Oregon Air Quality Annual Report: 2017,* https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf.

DEQ states that "data with wildfire contributions is included because it is very difficult to determine if the ozone would have exceeded the NAAQS without the smoke from wildfires."[7] DEQ notes that the wildfire smoke in 2017 contributed to the elevated ozone levels most likely caused Portland to violate the NAAQS. However, it is very difficult to determine what the ozone level would have been but for the wildfire smoke.

Figure 1. Oregon's 2020 Ambient Air Monitoring Network (ODEQ and LRAPA sites)



Source: DEQ, 2019 *Oregon Annual Ambient Criteria Pollutant Air Monitoring Network Plan*, https://www.oregon.gov/deq/FilterDocs/AQmonitoringplan.pdf.

The *2020 Oregon Annual Ambient Criteria Pollutant Air Monitoring Network Plan* describes the 10 Oregon DEQ and LRAPA monitoring sites for ozone. The closest one to Wallowa County is in Hermiston.

$PM_{2.5}$

Fine particulate matter ($PM_{2.5}$) is a concern due to smoke impacts from woodstoves, fireplaces and other wood burning appliances besides wildfire smoke in the summer. Other sources of $PM_{2.5}$ include open burning, prescribed burning, wildfires, smoke from industrial stacks, and some road dust from vehicle travel.

The *Future Climate Projects* report prepared by the Oregon Climate Change Research Institute for Umatilla County's NHMP update stated that with the increasing wildfires and $PM_{2.5}$ levels, there is a greater risk of wildfire smoke exposure through increasing frequency, length, and intensity of "smoke waves". "Smoke waves" are two or more consecutive days with high levels of $PM_{2.5}$ from wildfires.[8]

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[7] Ibid.

[8] OCCRI, *Future Climate Projections: Umatilla County,* October 2020, https://www.oregon.gov/lcd/CL/Documents/Umatilla_County_FutureClimateProjectionsReport_Oct2020.pdf

DEQ notes that it is useful to understand how much wildfire smoke contributed to particulate levels above the NAAQS standard, because this shows the effectiveness of local air quality improvement in communities with particulate reduction plans to promote such actions as wood stove efficiency programs.

There are harmful effects from breathing particles measuring less than 10 microns in diameter (PM_{10}). Most recent research indicates that even smaller particles, those measuring less than 2.5 microns in diameter ($PM_{2.5}$) may be responsible for the most significant health effects, like premature mortality, hospital admissions, and respiratory illness. These particles can be inhaled deeply into the lungs where they enter the bloodstream or can remain for years. The health effects of particulate matter vary with the size, concentration, and chemical composition of the particles."[9]

PM_{10}

The PM_{10} trend chart shows the values in the city with the highest concentration, the average, concentration, and the lowest concentration. All cities are well below the standard, but EPA requires DEQ to continue monitoring in PM_{10} maintenance areas and in cities over 500,000 people.[10]

Carbon Monoxide, Sulfur Dioxide, Nitrogen Dioxide

The carbon monoxide, sulfur dioxide, and nitrogen dioxide trends for cities in Oregon as compared to the federal standards are measured.

Air Toxics

Oregon DEQ and LRAPA began sampling for air toxics in Oregon in 1999. This section of the *Oregon Air Quality Annual Report: 2017* describes data for the toxics of concern: benzene, acetaldehyde, arsenic, cadmium, lead, and manganese.

The information is for neighborhood monitoring only; it does not include monitoring next to industrial facilities. That information is presented in separate reports issued by the Oregon Health Authority, specific to the monitoring project and facility.[11]

Greenhouse Gases

Information about greenhouse gas emissions in Oregon are presented on DEQ's website at https://www.oregon.gov/deq/aq/programs/Pages/GHG-Inventory.aspx. According to this page, "Oregon's sector-based inventory measures human-caused greenhouse gas emissions produced within Oregon by economic sector. It also includes the emissions associated with the electricity used in Oregon regardless of where that electricity is generated." [12] Figure 5 is excerpted from that report and

[9] *Air Quality in Pendleton Documen*t, Greg Lacquement, personal communication with T. Sears, DLCD, 2/4/21.

[10] DEQ, *Oregon Air Quality Annual Report: 2017,* https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf

[11] DEQ, *Oregon Air Quality Annual Report: 2017,* https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf

[12] DEQ, *Oregon Greenhouse Gas Sector-Based Inventory Data*, https://www.oregon.gov/deq/aq/programs/Pages/GHG-Inventory.aspx, accessed 2/26/21

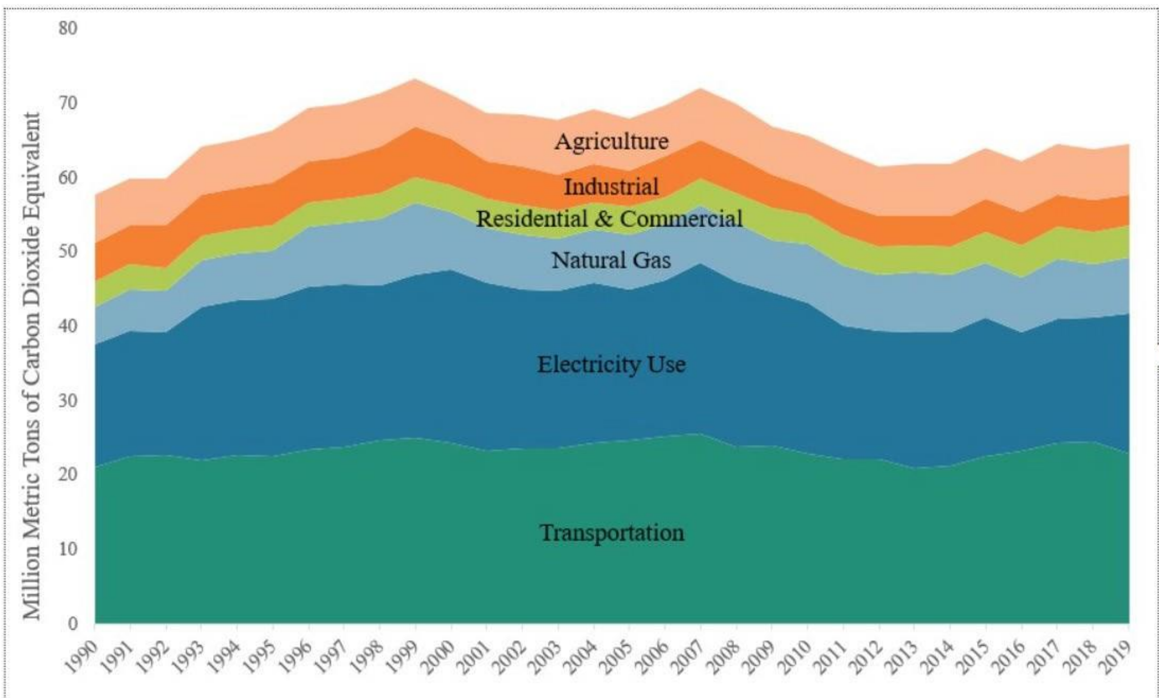
shows Oregon’s greenhouse gas emissions from 1990 through 2019 by sector. Emissions from transportation and electricity use are Oregon's largest sources of greenhouse gas emissions.

Identifying Poor Air Quality

Both specific measures of components of poor air quality and a general Air Quality Index are methods for determining the quality of the air.

Standards for air quality as determined by the US Environmental Protection Agency (EPA) have changed over time. In 1987 particulate matter was measured using the national PM_{10} levels as 24-hour concentrations and as average annual concentrations. The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards. In 1996 the impact of 2.5-micron particles was recognized and the national $PM_{2.5}$ 24-hour National Ambient Air Quality Standard (NAAQS) was established at 65 ug/m^3, and the annual average NAAQS set at 15 ug/m^3. In 2006 the national $PM_{2.5}$ 24-hour standard was reduced to 35 ug/m^3. In 2012 the national $PM_{2.5}$ annual average NAAQS was further reduced to 12 ug/m^3. The PM_{10} annual average was revoked.

Figure 2. Oregon Greenhouse Gas Emissions 1990-2019



Source: DEQ, Oregon Greenhouse Gas Sector-Based Inventory Data, https://www.oregon.gov/deq/aq/programs/Pages/GHG-Inventory.aspx, accessed 2/26/21

The Air Quality Index is a daily index of air quality that reports how clean the air is and provides information on potential health risks. Oregon’s index is based on three pollutants regulated by the federal Clean Air Act: ground-level ozone, particle pollution and nitrogen dioxide. The highest of the AQI values for the individual pollutants becomes the AQI value for that day. For example, if values are 90 for ozone and 88 for nitrogen dioxide, the AQI reported would be 90 for the pollutant ozone on that day. A rating of good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy, and hazardous are designated for the AQI providing a daily air quality rating (Table 6). EPA provides all states with the AQI equation for national uniformity. DEQ and Lane County Regional Air Protection Authority (LRAPA) report the AQI for cities in Oregon. The *Oregon Air Quality Annual Report* provides a review of the health levels over the past year.[13]

Table 1. Air Quality Index Ranges and Episode Stages

Air Quality Rating	Air Quality Index (AQI)	$PM_{2.5}$ 24-hour Average ($\mu g/m^3$)	Ozone 8-hour Average (ppm)
GOOD	0 - 50	0.0 - 12.0	0.000 - 0.054
MODERATE	51 - 100	12.1 - 35.4	0.055 - 0.070
UNHEALTHY FOR SENSITIVE GROUPS	101 - 150	35.5 - 55.4	0.071 - 0.085
UNHEALTHY	151 - 200	55.5 - 150.4	0.086 - 0.105
VERY UNHEALTHY	201 - 300	150.5 - 250.4	0.106 - 0.200
HAZARDOUS	>300	>250.5	>0.200

Source: DEQ, *Oregon Air Quality Monitoring Annual Report: 2019*, https://www.oregon.gov/deq/FilterDocs/aqMonitorAnnualRep2019.pdf

For 2020, the air pollutants of greatest concern in Oregon were[14]:

- Fine particulate matter (mostly from combustion sources) known as **$PM_{2.5}$** (2.5 micrometers and smaller diameter).
- **Air Toxics -** pollutants that cause or may cause cancer or other serious health effects.
- Ground-level **ozone**, a component of smog.
- **Greenhouse gas** (GHG) emissions and global climate change are also concerns in Oregon. Oregon state agencies track GHG emissions from a wide variety of products, services, utilities, and fuel providers. These emissions data are available on DEQ's web site under Air Quality/ AQ Programs / Greenhouse Gas Reporting Home. This is an overall issue across all of Oregon but more considered in the higher population density areas.

History of Air Quality in the City of Albany

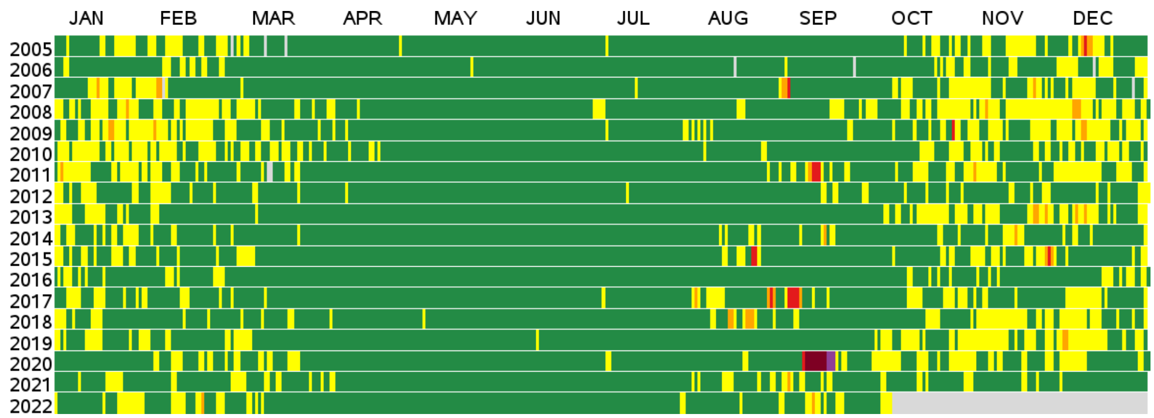
The data available to track poor air quality conditions in the City of Albany are limited to a three monitoring stations measuring $PM_{2.5}$. Figure 6 below shows a pattern of periods of the year where the

[13] DEQ, *Oregon Air Quality Annual Report: 2020*, https://www.oregon.gov/deq/FilterDocs/AQmonitoringplan.pdf

[14] Peter Brewer, DEQ, personal communication, 3/11/21 and the *Oregon Air Quality Annual Report: 2017*, https://www.oregon.gov/deq/FilterDocs/2017aqannualreport.pdf.

likelihood of high levels of particulate matter of this diameter (2.5 microns) have been present at that station.

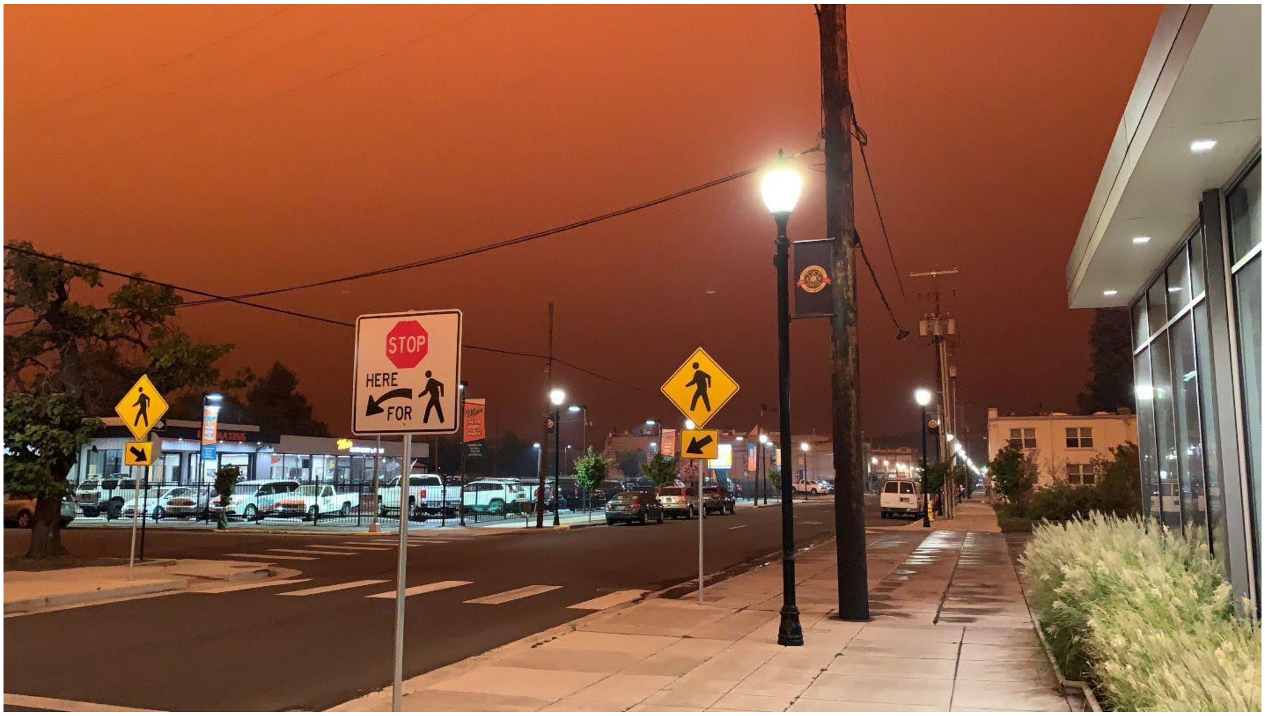
Figure 3. PM2.5 Daily AQI Values, 2005 to 2022, City of Albany, Oregon



Source: [Air Data - Multiyear Tile Plot | US EPA](), consulted September 2022

The City of Albany experienced extremely poor air quality during the September 2020 wildfires. Below is a photo of the air in Albany at 9 am on September 9, 2020.

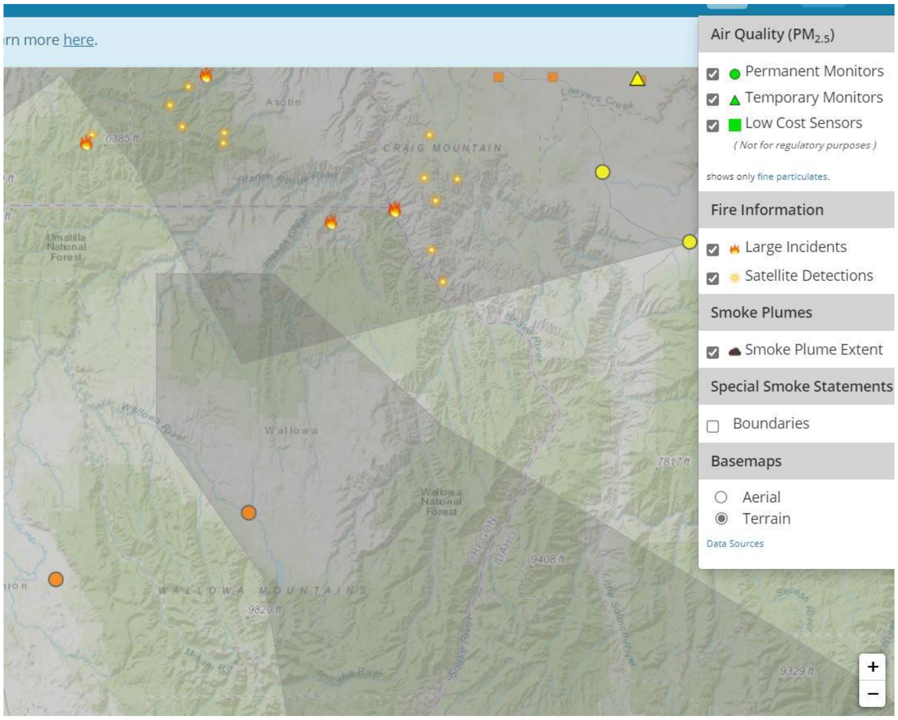
Figure 4. City of Albany Poor Air Quality September 9, 2020



Source: City of Albany staff

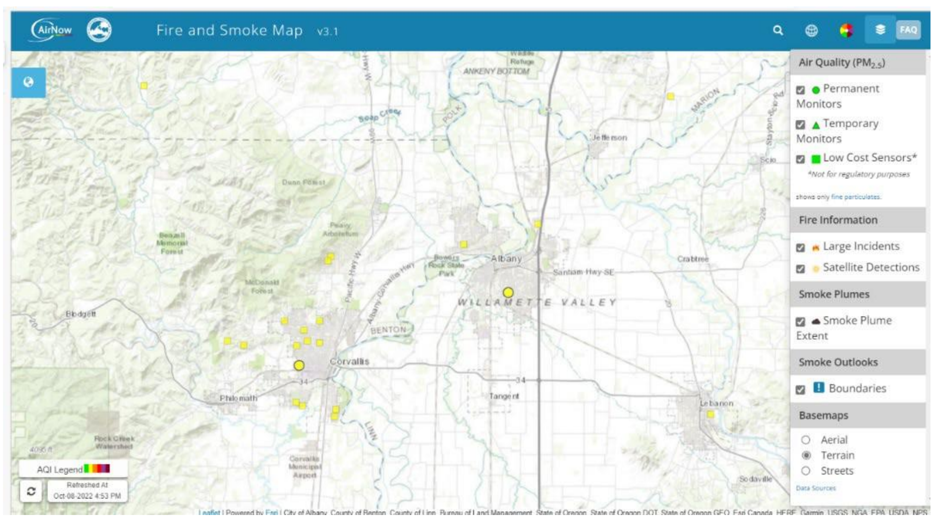
The EPA maintains a real time Fire and Smoke monitoring map that map provide useful for NHMP plan holders to use in using the plan.[15] Below is an example of output from this real time mapping tool on July 14, 2021 in Wallowa County.

Figure 5. AirNow Fire and Smoke Map of Wallowa County on 7/14/2021



Source: [Fire and Smoke Map (airnow.gov)]

Figure 6. Air Quality Monitoring Station Types



Source: [Fire and Smoke Map (airnow.gov)]

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15 [Fire and Smoke Map (airnow.gov)]

The figure above shows locations of both regulatory and Low Cost Air Quality monitors not valid for regulatory purposes, but represented on the map in the interest of public health.

Determination of the severity of the hazard of poor air quality and collecting data demonstrating the problem may provide support for mitigation actions aimed at managing prescribed burning to reduce the risk of high intensity wildfire and support for mitigation actions aimed at providing relief for vulnerable people during poor air quality conditions. The EPA Ambient Monitoring Technology Information Center (AMTIC) provides information on monitoring programs and methods, quality assurance and control procedures, and federal regulations.[16]

Future climate projections are for reduced outdoor air quality. Warmer temperatures may increase ground-level ozone concentrations, increases in the number and size of wildfires may increase concentrations of smoke and particulate matter, and increases in pollen abundance and the duration of pollen seasons may increase aeroallergens. Such poor air quality is expected to exacerbate allergy and asthma conditions and increase the incidence of respiratory and cardiovascular illnesses and death (Fann *et al.*, 2016).[17]

[16] Ambient Monitoring Technology Information Center (AMTIC) | US EPA

[17] Future Climate Projections Wallowa County, Oregon, OCCRI, 2022

Volume III: Resources

Volume III

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Appendix A: Resource Directory

City

Albany Emergency Management (AEM)
AEM coordinates citywide emergency management programs including citizens, businesses, employees, and partners of the city. To be effective, the City partners collaborate across the region to ensure that activities of mitigation, preparedness, response, and recovery are intertwined with citizen protection, economic stability, and in-depth coverage of our assets.

Contact: Emergency Manager
Address: 611 Lyon Street SE, Albany, OR 97321
Phone: 541-917-7725

Albany Fire Department
Albany Fire & Rescue is the responding agency in charge of plan development for the coordination of an earthquake event. With 4 stations and many regional partners in the fire service, the fire department lends a trained force that has familiarized itself with the buildings' plans, the street network, and the neighborhood of their fire management areas. With this knowledge they know where vulnerable people live and can work with the community to save lives and property expediently.

Contact: Fire Chief
Address: 611 Lyon Street SE, Albany, OR 97321
Phone: 541-917-7700

Building Division
Building Division issues building permits, performs land use reviews, and promotes compliance with the zoning codes and the state adopted construction codes.

Contact: Building Official
Address: 333 Broadalbin SW, Albany, OR 97321
Phone: 541-917-7550

County

Benton County Emergency Management
The Emergency Services unit of the Benton County Sheriff's Office coordinates emergency preparedness and response efforts throughout the county. Emergency Services also provides preparedness training for natural and manmade disasters and coordinates search and rescue efforts in the county (a significant portion of the county is located in the coastal mountain range).

Contact: Emergency Program Manager
Address: 553 NW Monroe Street, Corvallis, OR 97330
Phone: 541-766-6864
Website: http://www.co.benton.or.us/sheriff/ems

Linn County Emergency Management
The Emergency Services unit of the Linn County Sheriff's Office coordinates emergency preparedness and response efforts throughout the county. Emergency Services also provides preparedness training for natural and manmade disasters and coordinates search and rescue efforts in the county (a significant portion of the county is located in the Cascadia mountain range).

Contact: Emergency Services Coordinator
Address: 1115 Jackson St. S.E, Albany, Oregon 97321
Phone: 541-812-2272

State

Department of Land Conservation and Development (DLCD)
DLCD administers the State's Land Use Planning Program. The program is based on 19 statewide Planning Goals, including Goal 7, related to flood and other natural hazards. DLCD serves as the federally designated agency to coordinate floodplain management in Oregon. They also conduct various landslide related mitigation activities. In order to help local governments address natural hazards effectively, DLCD provides technical assistance and conducts workshops, reviews local land use plan amendments, and works interactively with other agencies.

Contact: Natural Hazards Program & Floodplain Specialist
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
NHMP Coordinator: **Marian Lahav**
Phone: 503-689-2522
Website: **https://www.oregon.gov/lcd/Pages/index.aspx**
Oregon NFIP Floodplain Coordinator: **Deanna Wright**
Phone: 971-718-7473

Oregon Emergency Management (OEM)
OEM administers FEMA's Hazard Mitigation Grant Program to provide post-disaster monies for acquisition, elevation, relocation, and demolition of structures located in the floodplain as well as for other mitigation work. OEM also administers FEMA's Flood Mitigation Assistance Program. This program provides assistance for NFIP- insured structures only. OEM also helps local jurisdictions to develop hazard mitigation plans. OEM is heavily involved in flood damage assessment and works mainly with disaster recovery and hazard mitigation programs. OEM provides training for local governments through workshops on recovery and mitigation. OEM also helps implement and manage federal disaster recovery programs.

Contact: Oregon Emergency Management
Physical Location: 3930 Fairview Industrial Drive SE, Salem, OR 97302-1166
Mailing Address: P.O. Box 14370, Salem OR 97309-5062
Phone: 503-378-2911
Fax: 503-373-7833
Website: http://www.oregon.gov/oem

Oregon Department of Fish and Wildlife (ODFW)
ODFW's mission is to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations. ODFW regulates stream activity and engages in stream enhancement activities.

Contact: ODFW
Address: 4034 Fairview Drive SE, Salem, OR 97302
Phone: 503-947-6000
Website: http://www.dfw.state.or.us

Oregon Department of State Lands (DSL)
DSL is a regulatory agency responsible for administration of Oregon's Removal-Fill Law. This law is intended to protect, conserve, and make the best use of the state's water resources. It generally requires a permit from DSL to remove, fill, or alter more than 50 cubic yards of material within the bed or banks of state waters. Exceptions are in state scenic waterways and areas that are designated essential salmon habitat; in these areas, a permit is required for all in-stream activity regardless of volume. DSL and the U.S. Army Corps of Engineers may issue these permits jointly.

Contact: Department of State Lands
Address: 775 Summer Street NE, Suite 100, Salem, OR 97301-1279
Phone: 503-986-5200
Fax: 503-378-4844
Website: http://www.oregon.gov/dsl

Oregon Water Resources Department (WRD)

The Oregon Water Resources Department's mission is to serve the public by practicing and promoting wise long-term water management. The WRD provides services through 19 water master offices throughout the State. In addition, five regional offices provide services based on geographic regions. The Department's main administration is performed from the central office in Salem.

Contact: WRD
Address: 725 Summer Street NE, Suite A, Salem, OR 97301
Phone: 503-986-0900
Website: http://www.oregon.gov/owrd

Oregon Department of Consumer and Business Services

The Building Codes Division of Oregon's Department of Consumer and Business Services is responsible for administering statewide building codes. Its responsibilities include adoption of statewide construction standards that help create buildings able to resist flood, wildfire, wind, foundation instability, and seismic hazards.

Contact: Building Codes Division
Address: 1535 Edgewater St. NW, P.O. Box 14470, Salem, OR 97309
Phone: 503-373-4133
Fax: 503-378-2322
Website: http://www.cbs.state.or.us

Oregon Climate Service

The Oregon Climate Service (OCS) collects, manages, and maintains Oregon weather and climate data. OCS provides weather and climate information to those within and outside the State of Oregon and educates the citizens of Oregon on current and emerging climate issues. OCS also performs independent research related to weather and climate issues.

Contact: Oregon Climate Service
Address: Oregon Climate Service, Oregon State University
32 6 Strand Ag Hall, Corvallis, OR 97331
Phone: 541-737-8927
Website: http://www.ocs.orst.edu

Oregon Department of Geology and Mineral Industries (DOGAMI)

The mission of the Department of Geology and Mineral Industries is to serve a broad public by providing a cost-effective source of geologic information for Oregonians and to use that information to reduce the future loss of life and property due to potentially devastating earthquakes, tsunamis, landslides, floods, and other geologic hazards. The Department has mapped earthquake hazards in most of western Oregon.

Contacts: DOGAMI
Address: 800 NE Oregon St., Suite 965, Portland, Oregon 97232
Phone: 971-673-1555
Fax: 971-673-1562
Website: www.oregongeology.org

Oregon Department of Consumer & Business Services-Building Codes Division
The Building Codes Division (BCD) sets statewide standards for design, construction, and alteration of buildings that include resistance to seismic forces. BCD is active on several earthquake committees and funds construction-related continuing education programs. BCD registers persons qualified to inspect buildings as safe or unsafe to occupy following an earthquake and works with OEM to assign inspection teams where they are needed.

Contact: Building Codes Division
Address: 1535 Edgewater St. NW, P.O. Box 14470, Salem, Oregon 97309
Phone: 503-378-4133
Fax: 503-378-2322
Website: http://www.cbs.state.or.us

Federal

Federal Emergency Management Agency (FEMA)
FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for flood mitigation projects, and technical assistance. FEMA also operates the National Flood Insurance Program. FEMA's mission is "to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery." FEMA Region X serves the northwestern states of Alaska, Idaho, Oregon, and Washington.

Contact: FEMA, Federal Regional Center, Region 10
Phone: 202-646-2500
Website: http://www.fema.gov
To obtain FEMA publications:
Phone: 800-480-2520
To obtain FEMA maps:
Contact: Map Service Center
Phone: 1-877-336-2627

United States Geological Survey (USGS)
The USGS website provides current stream flow conditions at USGS gauging stations in Oregon and throughout the Pacific Northwest. The Oregon USGS office is responsible for water-resources investigations for Oregon and part of southern Washington. Their office cooperates with more than 40 local, state, and federal agencies in Oregon. Cooperative activities include water-resources data collection and interpretive water-availability and water-quality studies.

Contact: USGS Oregon District Office
Address: 2130 SW 5th Ave., Portland, OR 97201
Phone: 503-251-3200
Fax: 503-251-3470
Website: http://www.usgs.gov

Army Corps of Engineers
The Corps of Engineers administers a permit program to ensure that the nation's waterways are used in the public interest. Any person, firm, or agency planning to work in waters of the United States must first obtain a permit from the Army Corps of Engineers. In Oregon, joint permits may be issued with the Division of State Lands. The Corps is responsible for the protection and development of the nation's water resources including navigation, flood control, energy production through hydropower management, water supply storage, and recreation.

Contact: U.S. Army Corps of Engineers-Portland District
Address: 333 SW First Avenue, Tenth Floor, Portland, OR 97204
Phone: 503-808-4510
Website: http://www.usace.army.mil

National Resources Conservation Service (NRCS), US Department of Agriculture (USDA)
NRCS provides a suite of federal programs designed to assist state and local governments and landowners in mitigating the impacts of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems related to watershed. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource or experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance for clearing debris from clogged waterways, restoring vegetation, and stabilizing riverbanks. The measures taken under the EWP must be environmentally and economically sound and generally benefit more than one property.

Contact: Tangent Service Center
Address: 31978 N. Lake Creek Dr., Tangent, OR 97389
Phone: 503-648-3174
Fax: 503-640-1332
Tangent Field Office Phone: 541-967-5925
Website: www.nrcs.usda.gov

Building Seismic Safety Council (BSSC)
The Building Seismic Safety Council (BSSC) established by the National Institute of Building Sciences (NIBS), deals with complex regulatory, technical, social, and economic issues and develops and promotes building earthquake risk mitigation regulatory provisions for the nation.

Address: 1090 Vermont Avenue, NW, Suite 700, Washington, DC 20005
Phone: 202-289-7800
Fax: 202-289-1092
Website: http://www.nibs.org

Western States Seismic Policy Council (WSSPC)
The WSSPC is a regional organization that includes representatives of the earthquake programs of 12 states (Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming), three U.S. territories (American Samoa, Commonwealth of the Northern Mariana Islands and Guam), one Canadian Province (British Columbia), and one Canadian territory (Yukon). The organization has primarily sought to improve public understanding of seismic risk, to improve earthquake preparedness, and to provide a cooperative forum to enhance transfer of mitigation technologies at the local, state, interstate, and national levels. The mission of the Council is to provide a forum to advance earthquake hazard reduction programs throughout the western region and to develop, recommend, and present seismic policies and programs through information exchange, research and education.

Contact: WSSPC
Address: 801 K Street, Suite 1236, Sacramento, CA 95814
Phone: 916-444-6816
Fax: 916-444-8077
Website: http://www.wsspc.org

The National Flood Insurance Program

The National Flood Insurance Program (NFIP) Website is a subsection of the Federal Emergency Management Agency (FEMA) site (http://www.fema.gov). The NFIP information is intended for both the general public and the many organizations and agencies participating in the program. It includes information about the NFIP and other flood disaster assistance available from the Federal Government. It also provides access to the newly revised NFIP booklet: *Answers to Questions about the National Flood Insurance Program*.

Contact: National Flood Insurance Program Region X
Phone: 360-658-8188
Website: http://www.fema.gov/national-flood-insurance-program

USGS Water Resources

This web page offers current US water news; extensive current (including real-time) and historical water data, numerous fact sheets and other publications, various technical resources, descriptions of ongoing water survey programs, local water information, and connections to other sources of water information.

Contact: USGS Water Resources
Phone: 503-251-3200
Website: http://www.usgs.gov

Office of Hydrology, National Weather Service

The National Weather Service's Office of Hydrology (OH) and its Hydrological Information Center offer information on floods and other aquatic disasters. This site offers current and historical data including an archive of past flood summaries, information on current hydrologic conditions, water supply outlooks, an Automated Local Flood Warning Systems Handbook, Natural Disaster Survey Reports, and other scientific publications on hydrology and flooding.

Contact: Office of Hydrology, National Weather Service
Website: http://www.nws.noaa.gov

National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.

Contact: National Oceanic and Atmospheric Administration
Address: 1401 Constitution Avenue, NW, Room 5128, Washington, DC 20230
Website: http://www.noaa.gov

National Weather Service, Portland Bureau

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, and adjacent waters for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure that can be used by other governmental agencies, the private sector, the public, and the global community.

Contact: National Weather Service
Address: 5241 NE 122nd Ave, Portland, Oregon 97230
Phone: 503-261-9246
Website: http://www.wrh.noaa.gov

Additional

American Red Cross
The American Red Cross is a volunteer-led humanitarian organization that provides relief to victims of disasters and helps people prevent, prepare for, and respond to emergencies. The Oregon Pacific Chapter serves the residents of Benton, Coos, Curry, Douglas, Lane, Lincoln and Linn counties. The Oregon Pacific Chapter provides a variety of community services which are consistent with the Red Cross mission and meet the specific needs of this area including disaster planning, preparedness, and education.

Contact: Oregon Pacific Chapter
Address: 862 Bethel Dr., Eugene, OR
Phone: 541-344-5244
Website: http://www.oregonpacific.redcross.org

Institute for Business & Home Safety (IBHS)
IBHS was created by the insurance industry to reduce damage and losses caused by natural disasters. The IBHS website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 4775 East Fowler Ave - Tampa, FL 33617
Phone: 813-286-3400
Fax: 813-286-9960
Website: http://www.disastersafety.org

The Floodplain Management Association
The Floodplain Management website was established by the Floodplain Management Association (FMA) to serve the entire floodplain management community. It includes full-text articles, a calendar of upcoming events, a list of positions available, an index of publications available free or at nominal cost, a list of associations, a list of firms and consultants in floodplain management, an index of newsletters dealing with flood issues (with hypertext links if available), a section on the basics of floodplain management, a list of frequently asked questions (FAQs) about the Website, and, of course, an extensive catalog of Web links.

Contact: Floodplain Management Association
Website: http://www.floodplain.org

Northwest Regional Floodplain Managers Association (NORFMA)
This site is a resource for floodplains, fisheries, and river engineering information for the Northwest. This site provides technical information, articles, and Internet links in the field of floodplain and fisheries management.
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Contact: Northwest Regional Floodplain Managers Association
Website: http://www.norfma.org/

Association of State Floodplain Managers
The Association of State Floodplain Managers (ASFPM) is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning, and recovery. ASFPM fosters communication among those responsible for flood hazard activities, provides technical advice to governments and other entities about proposed actions or policies that will affect flood hazards, and encourages flood hazard research, education, and training. The ASFPM Web site includes information on how to become a member, the organization's constitution and bylaws,

directories of officers and committees, a publications list, information on upcoming conferences, a history of the association, and other useful information and Internet links.

Contact: Association of State Floodplain Managers **Address:** 575 D'Onofrio Drive, Suite 200, Madison, WI 53719
Phone: 608-828-3000
Website: http://www.floods.org

Appendix B:
Planning and Public Process

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List of Figures

Planning and Public Process

The components of an effective natural hazard mitigation action plan include vision statement, mission statement, goals, objectives, and action items. The **vision statement** describes the preferred or desired future for the community with regard to natural hazards. The **mission statement** is a philosophical or value statement that answers the question "Why develop a plan?" In short, the mission states the purpose and defines the primary function of the plan. The mission is an action-oriented statement of the plan's reason to exist. It should be broad enough that it need not change unless the community environment changes.

Goals are designed to drive actions and they are intended to represent the general end toward which the community's effort is directed. Goals identify how the community intends to work toward mitigating its risk from natural hazards. They should not specify how the community is to achieve the level of performance. The goals are guiding principles for the specific recommendations that are outlined in the action items.

City of Albany Natural Hazard Mitigation Plan: Mission, Vision, Values and Goals

The Steering Committee reviewed the goals of the 2016 plan at a meeting January 24, 2022. They confirmed that it was very important to continue to use it as the basis for the mission, vision, values, and goals for the mitigation plan. At the January 24th meeting, the Committee approved using of the Strategic Plan mission, vision, values and themes in the Natural Hazard Mitigation Plan.

The vision of the City of Albany is: *a vital and diverse community that promotes a high quality of life, great neighborhoods, balanced economic growth, and quality public services.*

The mission of the City of Albany is: *Providing quality public services for a better Albany community.*

The purpose of the City of Albany Natural Hazard Mitigation Plan is to assist in achieving the vision and mission of the Strategic Plan and, specifically, to aim to advance the four themes of the Strategic Plan. The objectives and actions identified in this plan meet the goals identified in the four themes of the plan.

Within the four themes of the Strategic Plan, the 2016 NHMP update Steering Committee identified six of the nine goals that align with the hazard mitigation action items:

- Create and sustain a city of diverse neighborhoods where residents feel good about where they live.
- Provide effective stewardship of Albany's significant natural, cultural, and historic resources.
- Ensure a safe community by protecting people and property.
- Provide safe, sufficient systems, sufficient, and reliable drinking water, sewage disposal and drainage systems.
- Create a readily identifiable downtown core that is unique and vibrant with a mixture of entertainment housing, specialty shops, offices, and other commercial uses.
- Effectively and efficiently deliver the services that Albany's citizens need, want, and are willing to support.

City of Albany Natural Hazard Mitigation Steering Committee

City of Albany Steering Committee	Department Representing
Chuck Perino	Emergency Manager, Convener
Alison Crow	Planning Department, Floodplain Management
Chris Bailey	Public Works Operations Director
David Martineau	Community Development
Holly Roten	Human Resources Director
Jeanna Yeager	Finance Director
Kate Hennessy	Administrative Assistant, Fire Dept.
Kim Lyddane	Parks & Recreation Director
Kristin Preston	City of Albany Operations Manager
Marcia Harnden	Police Chief
Matt Harrington	Management Assistant/Public Information Officer
Matthew Ruettgers	Development Services Manager
Peter Troedsson	City Manager & Emergency Program Manager
Rick Barnett	Parks & Recreation Department
Sean Park	Chief Information Officer
Shane Wooton	Fire Chief
Staci Belcastro	Public Works Engineering & Community Dev. Director

Steering Committee Meetings

DLCD staff worked with the City of Albany's Emergency Manager, to form the City of Albany NHMP Steering Committee (the Steering Committee) intended to represent the whole community. The Steering Committee included representatives from all relevant departments of city government.

The DLCD Natural Hazards Planner, Katherine Daniel, managed the project and met with members of the Steering Committee ten times and conducted individual phone conversations and email conversation to guide Steering Committee work on the plan update. A multi-hazard risk analysis was not performed specifically for the City of Albany by the Oregon Department of Geology and Mineral Industries but is forthcoming for Linn County and includes the entirety of the City of Albany. An analysis of the potential future climate impacts to natural hazards was performed by the Oregon Climate Change Research Institute for Linn County and was available for this NHMP update.

Public Engagement

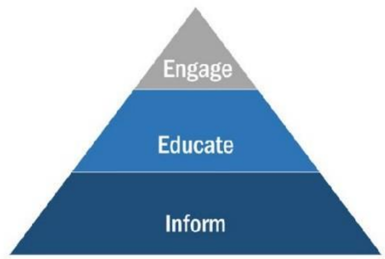
The City of Albany NHMP Steering Committee used portions of the early Steering Committee meetings to develop a Engagement and Outreach Plan for the NHMP process. This plan identified a variety of tools for informing the public, educating residents, and engaging them in the development of the plan. The image below represents this Public Engagement and Outreach Plan.

Figure 1. City of Albany Engagement and Outreach plan

City of Albany
Natural Hazard Mitigation Plan
Engagement and Outreach

Goal: Increase community awareness and preparedness by providing information describing all types of hazards, methods for preventing damage and how to respond.

Inform: Set base level of information through utilizing project information flyers, social media posts, and newspaper articles. Aim to familiarize the public with the planning process, opportunities to provide input, and what they could expect out of the plan. Community groups should be invited to get direct information on the plan and planning process. By targeting a cross-section of community groups with a vested interest in this plan, we can leverage the personal connections within these groups to help disseminate the outreach material.



Educate: Higher level of understanding about the plan and process by promoting constructive dialog between the public and the planning committee. If the public sees their input as valued and being incorporated into the plan update it should increase overall community buy-in.

Engage: The most detailed level of engagement allows for a direct, interactive dialogue with members of the community through planning committee meetings, workshops, and open house events.

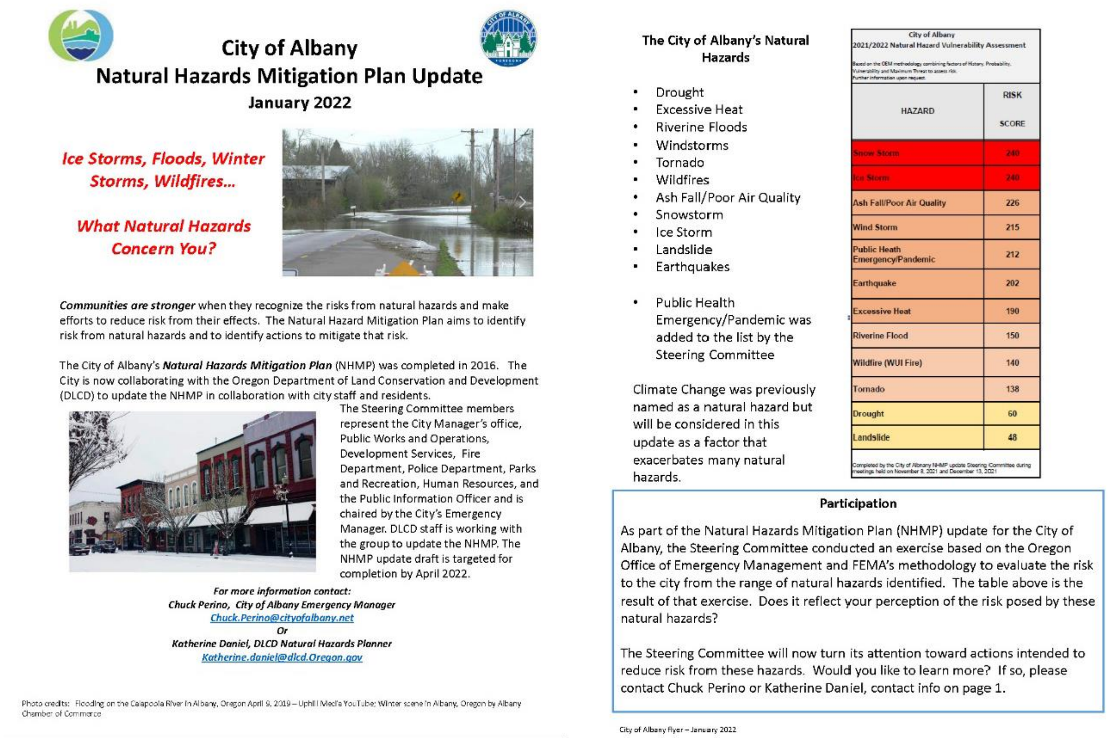
Tools utilized:

- **Website** - Project information website should be prepared and hosted by the City of Albany for the duration of the planning process with the primary purpose to share specific resources including:
    - Meeting schedule, agendas, presentations, and minutes;
    - Project information flyers for introduction, risk assessment, and notification of draft document;
    - Link to online questionnaires
    - Draft Natural Hazard Mitigation Plan update for review/comment; and
    - Reference documents and links to planning resources.
- **Informational graphics** – Project information graphics should be developed and distributed throughout the planning process to provide information on the hazard mitigation planning and opportunities for public involvement. These resources should be available on the project information website as well as distributed in flier format to City libraries and other appropriate, high visibility locations as well as at public meetings. The City's social media platforms (Facebook, Instagram, Twitter, and Nextdoor) should be utilized to publish these graphics. Information to be provided may include:
    - What is a Natural Hazard Mitigation Plan?
    - Why is it important to me?
    - What can I do to participate? (online survey, open house events)
    - Planning status
    - Mitigation success stories
- **Newspaper** – Press releases to local media to generate interest and support in the planning process.

- **Presentations** — Information distribution for stakeholder groups (Rotary, Chamber, etc) as time allows, elected officials, partner agencies/jurisdictions, and City staff (All Hands).
- **Survey** — Public participation survey to solicit input from the public regarding hazards of concern, areas of mitigation interest, and related preparedness. The survey will be made available through web links posted on City websites, circulated via email, and social media platforms. Hard copies will be distributed upon request to save on costs and staff resources.
- **Open House/Workshop Events** — Community Conversations, Farmer's Market booths, etc. to obtain public input on natural hazards, problems, and possible solutions. (Could be augmented by virtual events as well.)

The City of Albany NHMP Steering Committee provided information to the public and also solicited input on the development of the NHMP through website and social media postings as well as through a survey. These engagement activities were timed to follow the development of the Hazard Vulnerability Assessment and also to follow the consideration of the Mitigation Strategy. A flyer was developed for use as a handout and as a source for web and social media postings.

Figure 2. NHMP update flyer, January 2022



City of Albany
Natural Hazards Mitigation Plan Update
January 2022

Ice Storms, Floods, Winter Storms, Wildfires...

What Natural Hazards Concern You?

Communities are stronger when they recognize the risks from natural hazards and make efforts to reduce risk from their effects. The Natural Hazard Mitigation Plan aims to identify risk from natural hazards and to identify actions to mitigate that risk.

The City of Albany's ***Natural Hazards Mitigation Plan*** (NHMP) was completed in 2016. The City is now collaborating with the Oregon Department of Land Conservation and Development (DLCD) to update the NHMP in collaboration with city staff and residents.

The Steering Committee members represent the City Manager's office, Public Works and Operations, Development Services, Fire Department, Police Department, Parks and Recreation, Human Resources, and the Public Information Officer and is chaired by the City's Emergency Manager. DLCD staff is working with the group to update the NHMP. The NHMP update draft is targeted for completion by April 2022.

For more information contact:
Chuck Perino, City of Albany Emergency Manager
Chuck.Perino@cityofalbany.net
Or
Katherine Daniel, DLCD Natural Hazards Planner
Katherine.daniel@dlcd.Oregon.gov

Photo credits: Flooding on the Calapooia River in Albany, Oregon April 9, 2019 – Uphill Media YouTube; Winter scene in Albany, Oregon by Albany Chamber of Commerce

The City of Albany's Natural Hazards

- Drought
- Excessive Heat
- Riverine Floods
- Windstorms
- Tornado
- Wildfires
- Ash Fall/Poor Air Quality
- Snowstorm
- Ice Storm
- Landslide
- Earthquakes

- Public Health Emergency/Pandemic was added to the list by the Steering Committee

Climate Change was previously named as a natural hazard but will be considered in this update as a factor that exacerbates many natural hazards.

City of Albany
2021/2022 Natural Hazard Vulnerability Assessment

Based on the OEM methodology combining factors of History, Probability, Vulnerability and Maximum Threat to assess risk.
Further information upon request.

HAZARD	RISK SCORE
Snow Storm	240
Ice Storm	240
Ash Fall/Poor Air Quality	226
Wind Storm	215
Public Heath Emergency/Pandemic	212
Earthquake	202
Excessive Heat	190
Riverine Flood	150
Wildfire (WUI Fire)	140
Tornado	138
Drought	60
Landslide	48

Completed by the City of Albany NHMP update Steering Committee during meetings held on November 8, 2021 and December 13, 2021

Participation

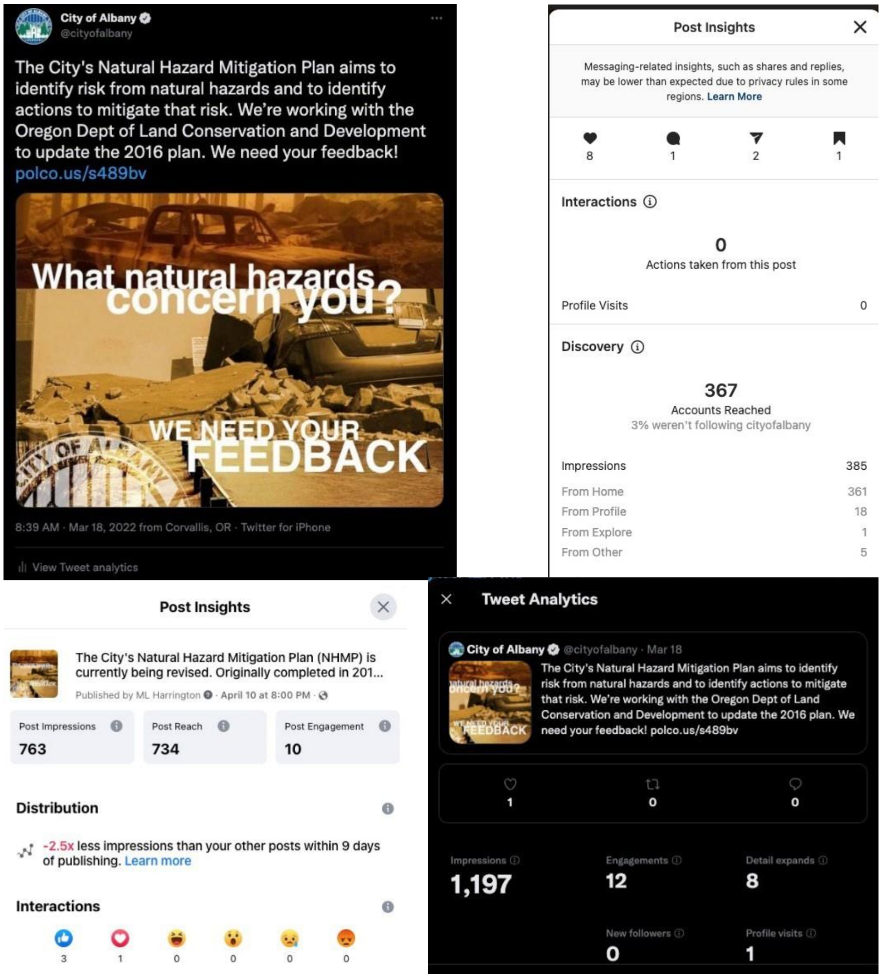
As part of the Natural Hazards Mitigation Plan (NHMP) update for the City of Albany, the Steering Committee conducted an exercise based on the Oregon Office of Emergency Management and FEMA's methodology to evaluate the risk to the city from the range of natural hazards identified. The table above is the result of that exercise. Does it reflect your perception of the risk posed by these natural hazards?

The Steering Committee will now turn its attention toward actions intended to reduce risk from these hazards. Would you like to learn more? If so, please contact Chuck Perino or Katherine Daniel, contact info on page 1.

City of Albany Flyer – January 2022

The City of Albany Public Information Officer posted this information during the month of March and into early April both on the City's website and through its Twitter account. He analyzed the response generated from the posts as the images below show. Webposting analytics identified 365 reactions to the City of Albany web posting on March 18th. Analytics on April 10th showed that the web post had reached 734 users and had generated 10 engagements. Tweet Analytics identified 1,197 Impressions, 12 Engagements and 8 Detail Expands and on visit to the city's profile as a result of the Twitter post on March 18, 2021. Comments collected through these means included concerns about flooding, ice storms and their impact on power and transportation

Figure 3. Web and Twitter posting analytics



The City of Albany Public Information Officer developed and launched a survey to inform the public about the NHMP update process that allowed the city to learn more about how the public is prepared for emergencies and allowed the city to encourage participation in the process. Results of the survey are provided in this appendix. The principal change made to the plan due to this public input was to develop a more digestible and engaging Executive Summary for the plan. The length of the document made it difficult for the public to engage with the content. In addition, the city was able to learn from the public why some residents have not been able to compile a "Go Bag" or to develop an emergency plan. This public input will inform the city's multiple mitigation strategies that deal with public information and education. Details of the survey results are included at the end of this appendix.

Steering Committee Meeting Agendas and Meeting Notes

Figure 4. April 14, 2021 Steering Committee meeting #1 Agenda

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Understanding the process
and forming the Steering Committee

OREGON
Department of Land Conservation & Development

April 14, 2021
10:00 am – 11:00 am
on Teams at:

Microsoft Teams meeting

Join on your computer or mobile app
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,363303775# United States, Portland
Phone Conference ID: 363 303 775#

AGENDA

Introduction and Meeting Objectives	**10:00 -10:10**
• Introductions • Meeting Objectives · Discuss the purpose and process · Understand the roles of all participants · Floodplain Management and CRS integration in to NHMP update · Discuss the schedule and set expectations for future meetings	
NHMP Purpose and Process/Role of DLCD	**10:10 – 10:15**
• Purpose of NHMP updates (good planning, plan integration, access to FEMA funding); • Role of DLCD	
Roles of participants	**10:15 – 10:25**
• Participation is open to all; Teams meeting link will be on agendas • Steering Committee will include City of Albany department heads and others • Who will represent community stakeholders and community members? • Expectations of Steering Committee members	
Floodplain management/CRS Program involvement	**10:25 – 10:40**
Ideas for updating the flood portion of the plan as well as doing other CRS items	
Draft Schedule	**10:40 – 10:50**
Questions/Comments	**10:50 – 11:00**

Figure 5. April 14, 2021 Steering Committee meeting #1 meeting notes

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Understanding the process
and forming the Steering Committee

OREGON
Department of Land Conservation & Development

April 14, 2021
10:00 am – 11:00 am
on Teams at:
Microsoft Teams meeting

Join on your computer or mobile app
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,363303775# United States, Portland
Phone Conference ID: 363 303 775#

Approved Minutes

Present: Chuck Perino, Melissa Anderson, Peter Troedsson, Shane Wooton, Chris Bailey, Matt Harrington

The first Steering Committee meeting was held during the regular Executive Leadership Team (ELT) meeting and was convened by the City Manager.

Katherine Daniel, the DLCD Natural Hazards Planner who will provide project management services and technical writing and Steering Committee meeting work sessions was present and provided a brief overview of the Natural Hazard Mitigation Plan (NHMP) update process for the City of Albany.

The purpose of bringing the topic to the ELT was to discuss the purpose of updating the city's NHMP and process that is proposed to accomplish the update; to describe the roles of the participants on the ELT; to discuss the schedule and set expectations for future meetings.

Katherine described the purpose of updating the City of Albany 2016 Natural Hazard Mitigation Plan which includes creating public awareness of natural hazard impacts to the city's infrastructure and people, integrating the city's plans that involve mitigation of natural hazards, and making the city eligible for FEMA hazard mitigation grant funding. DLCD's role will be to manage the project and produce the proposed updates in collaboration with city staff and steering committee members. Steering Committee members will participate in work session meetings and are expected to engage with the public to inform them of the process and ways for the public to provide input when sections of the update are drafted and made available for public review.

A draft schedule was provided, but no further discussion was had at this meeting. The ELT concluded this section of the meeting and proceeded with other business.

Figure 6. November 8, 2021 Steering Committee meeting #2 Agenda

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Review of the purpose, process, and roles
and
Hazard Vulnerability Assessment

OREGON
Department of
Land Conservation
& Development

November 8, 2021
2:30-4:00 pm

In person at:
City of Albany, Santiam Room
333 Broadalbin St SW, Albany, OR

on Teams at: **Join on your computer or mobile app**
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,869993572# Portland
Phone Conference ID: 869 993 572#

AGENDA

Introduction and Meeting Objectives	**2:30 – 2:40**
• Introductions • Establish a review and approval procedure for minutes; consideration of draft 4/14/21 minutes • Meeting Objectives · Briefly review the purpose and process of the NHMP update, the roles of Steering Committee members, Floodplain Management and CRS integration in to NHMP update · Conduct Hazard Vulnerability Assessment · Discuss the schedule and set expectations for future meetings	
Brief review of purpose, process, and roles	**2:40 – 2:45**
• Purpose of NHMP updates (good planning, plan integration, access to FEMA funding); roles of participants and the public; note about representing the Floodplain Administrator perspective in the process	
Hazard Vulnerability Assessment	**2:45 – 3:40**
• History • Probability • Vulnerability • Maximum Threat	
Draft Schedule	**3:40 – 3:50**
Discuss regular meeting schedule for December through April; draft schedule; please "read in" a secondary person to attend if you are unable	
Questions/Comments	**3:50 – 4:00**

Figure 7. November 8, 2021 Steering Committee meeting #2 meeting notes

NHMP Steering Committee Meeting Approved Minutes

November 8, 2021, Santiam Room

Meeting called to order at 1430 hours.

Present:

Katherine Daniel, DCLD	Chuck Perino, Albany Emergency Mgmt
Marcia Harnden, Albany Police	Shane Wooton, Albany Fire
Kim Lyddane, Parks & Recreation	Jeanna Yeager, Finance
Chris Bailey, Public Works	Kristin Preston, Public Works Operations
Holly Roten, HR	Matthew Ruettgers, Community Dev.
Matt Harrington, City Manager's Office	Kate Hennessy, Albany Fire

Nota Bene:

- Melissa Anderson has left the City; Matthew Ruettgers will serve in her stead until a new Floodplain Manager is hired.

Purpose:

To review the purpose and process of updating the NHMP, Floodplain management, and the CRS rating.

Meeting:

- Members of the public responded to a survey (via Survey Monkey) about their perceptions of natural hazards in the community. Data gathered will be used to update the NHMP.
- Daniel noted several natural hazard events that have occurred within the last several years that will impact the NHMP:
  - 2019 (April) Flooding event
  - 2020 (All year through 2021) COVID-19 Pandemic*
  - 2020 (September) Wildfires/significant ash fall
  - 2021 (February) Ice Storm
  - 2021 (May) Excessive heat event

* FEMA considers this a natural hazard

<u>Discussion</u>:

1) Should the pandemic be included as a natural hazard?
   Con: it can't be mitigated.
   Pro: FEMA considers it a natural hazard (the City can use it to apply for FEMA mitigation monies); maybe it can be reclassed as a Public Health Emergency or Infectious Disease Outbreak.
2) Should the Volcanic Event category be eliminated?
   Answer: Since there is unlikely to be a volcanic event within the next update period, the body suggested that the category be changed to Significant Ash Fall or Poor Air Quality (since this could come in the form of volcanic ash from another area or from wildfires in this area).
3) What about Severe Weather, Drought, and Earthquake?
   Answer: the Severe Weather category requires more specificity when conducting the HVA (i.e., Snow, Ice, Wind/ Tornado). Drought shall be included in the NHMP. Earthquake shall be included as to severity and not as to type.
4) Should Climate Change be retained as a separate hazard?
   Answer: No, but it does exacerbate many natural hazards. Climate change information will be included at it exacerbates natural hazards like flood intensity, extreme temperatures and storm severity.

Daniel presented a PowerPoint illustrating the different categories of hazard and including a spreadsheet for the group to update with ratings on the history and probability of the identified hazards.

The group reviewed and rated several of the different hazards, allowing Daniel to update the spreadsheet. In the interest of time, the group was able to get through only half of the hazards mentioned and agreed to rate the remaining hazards at the next meeting.

Meeting adjourned at 1600 hours.

Action Items:

- Ruettgers will look into inviting members of the community and the insurance community to participate in the process.
- Perino will send out a survey to establish best meeting dates for the steering committee.
- Perino will schedule future NHMP Steering Committee meetings.

Respectfully submitted,

Kate Hennessy
Administrative Assistant I

Figure 8. December 13, 2021 Steering Committee meeting #3 Agenda

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Hazard Vulnerability Assessment – Part 2

December 13, 2021
2:30-4:00 pm

OREGON
Department of
Land Conservation
& Development

In person at:
City of Albany, Santiam Room
333 Broadalbin St SW, Albany, OR

on Teams at: **Join on your computer or mobile app**
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,972646496#
Phone Conference ID: 972 646 496#

Draft AGENDA

Introductions, Minutes, and Meeting Objectives	**2:30 – 2:40**

• Introductions, just one more time so that I can be sure to know who's who
• Review and approval of 11/8/21 and 4/14/21 minutes
• Meeting Objectives
  · Complete the Hazard Vulnerability Assessment
  · Discuss public outreach and schedule for outreach efforts	

Hazard Vulnerability Assessment	**2:40 – 3:40**
• Review History and Probability scores • Complete Vulnerability and Maximum Threat scores • Review final results	
Public Outreach schedule and methods	**3:40 – 3:50**
Questions/Comments	**3:50 – 4:00**

Figure 9. December 13, 2021 Steering Committee meeting #3 meeting notes

NHMP Steering Committee Meeting Minutes

December 13, 2021, Santiam Room

(and via Teams)

Meeting called to order at 1435 hours.

Minutes: Wooton moved and Preston seconded that the minutes from the November meeting be approved with the following correction: Matthew Ruettgers is in Community Development and not Engineering.

Present:

Katherine Daniel, DCLD
Marcia Harnden, Albany Police (via Teams)
Kim Lyddane, Parks & Recreation
Chris Bailey, Public Works
Holly Roten, HR (via Teams)
Matt Harrington, City Manager's Office
Sean Park, IT (via Teams)

Chuck Perino, Albany Emergency Mgmt
Shane Wooton, Albany Fire
Peter Troedsson, City Mgr (via Teams)
Kristin Preston, Public Works Ops
Matthew Ruettgers, Comm Dev
Kate Hennessy, Albany Fire

Purpose:

To complete the Hazard Vulnerability Assessment for the NHMP.

Meeting:

Steering Committee members worked out the rest of the Hazard Vulnerability matrix. The group discussed and completed the Vulnerability factor ranking and the ranking for Maximum Threat.

Discussion:

- There is an aerial fiberoptic communications cable that connects the Courthouse with APD (this is at risk for wind damage). Might burying this be a good project for a mitigation grant?
- Public Outreach: How to best accomplish this to get the community involved?
  - Social Media/City Website (Harrington and Roberts from AFD)
  - Citizen Advisory Groups
  - Mid-Valley LEPC
  - Civic Groups (Rotary, etc.)
  - City of Millersburg (maybe)

Meeting adjourned at 1600 hours.

Action Items:

- Daniel will complete the 4/14/21 minutes with a list of attendees.
- Daniel will sort and present the vulnerability matrix at the January meeting.

Respectfully submitted,

Kate Hennessy
Administrative Assistant I

Figure 10. January 24, 2022 Steering Committee meeting #4 agenda

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Mitigation Goals and Strategy – Part 1

OREGON
Department of Land Conservation & Development

January 24, 2022
2:30-4:00 pm

In person at:
City of Albany, Santiam Room
333 Broadalbin St SW, Albany, OR

on Teams at: **Join on your computer or mobile app**
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,972646496#
Phone Conference ID: 972 646 496#

AGENDA

Welcome, Minutes, and Meeting Objectives	**2:30 – 2:40**
• Review and approval of 12/13/21 minutes • Meeting Objectives · Discuss Mitigation Goals · Review Mitigation Strategy · Establish Public Outreach objectives for HVA flyer distribution and use	
Mitigation Strategy Goals and Strategy	**2:40 – 3:40**
• Review Mitigation Strategy Goals • Mitigation Strategy Action review	
Public Outreach – HVA results	**3:40 – 3:50**
Questions/Comments	**3:50 – 4:00**

Figure 11. January 24, 2022 Steering Committee meeting #4 meeting notes

NHMP Steering Committee Meeting Minutes

January 24, 2022 Via Teams

Meeting called to order at 1435 hours.

Present:

Katherine Daniel, DLCD	Shane Wooton, Fire
Kim Lyddane, Parks & Recreation	Peter Troedsson, City Manager
Chris Bailey, Public Works	Kristin Preston, Public Works Operations
Matt Harrington, City Manager's Office	Matthew Ruettgers, Community Development
Staci Belcastro, Engineering Group	Kate Hennessy, Fire

Minutes:

Wooton moved, and Bailey seconded, and the minutes were approved as submitted.

Purpose:

To discuss public outreach, mitigation goals, and review the mitigation strategy.

Discussion:

The committee discussed the flyer that Daniel had produced for public outreach. The committee decided to let Harrington divide the document into sections that can be broadcast to the community for input from them on the different topics and hazards contained therein. Bailey suggested the development of a City NHMP webpage where citizens can be directed to learn more about natural hazards, mitigation efforts, and take a brief survey by means of offering input into the process of updating this cycle's NHMP.

The committee then discussed a variety of ways to help mitigate the hazards identified in the NHMP and went over the nine mitigation strategy goals.

The committee reviewed (a portion of) the Mitigation Actions spreadsheet. The committee did not finish this review, which will be taken back up at the next meeting.

Meeting adjourned at 1600 hours.

Figure 12. February 14, 2022 Steering Committee meeting #5 agenda

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Mitigation Goals and Strategy – Part 2

OREGON
Department of Land Conservation & Development

February 14, 2022
2:30-4:00 pm

In person at:
City of Albany, Santiam Room
333 Broadalbin St SW, Albany, OR

on Teams at: **Join on your computer or mobile app**
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,972646496#
Phone Conference ID: 972 646 496#

AGENDA

Welcome, Minutes, and Meeting Objectives • Review and approval of 1/24/22 minutes • Meeting Objectives · Discuss Mitigation Goals · Review Mitigation Strategy · Consider New Mitigation Actions · Review plans for public outreach	**2:30 – 2:40**
Mitigation Strategy Goals and Strategy • Review Mitigation Strategy Goals • Mitigation Strategy Action review • Consider New Mitigation Actions	**2:40 – 3:40**
Public Outreach planning	**3:40 – 3:50**
Questions/Comments	**3:50 – 4:00**

Figure 13. February 14, 2022 Steering Committee meeting #5 meeting notes

NHMP Steering Committee Meeting Minutes

February 14, 2022

Meeting called to order at 1435 hours.

Present:

Chuck Perino, Emergency Management
Peter Troedsson, City Manager
Chris Bailey, Public Works
Matthew Ruettgers, Community Development
Matt Harrington, City Manager's Office
Marcia Harnden, Police
Kate Hennessy, Fire
Katherine Daniel, DLCD
Holly Roten, Human Resources
Kristen Preston, Public Works – Ops
David Martineau, Community Development
Kim Lyddane, Parks & Recreation
Shane Wooton, Fire

Minutes:

Lyddane moved, Ruettgers seconded, and the minutes were approved as submitted.

Discussion:

The committee reviewed the nine Mitigation Goals and discussed the Hazard Vulnerability Assessment.

The committee then went over the Mitigation Strategy Action plan, deciding to use the terms "in progress" in lieu of "partially complete," and "ongoing" for events that are repetitive in nature (such as an annual update).

The committee discussed mitigation for the highest risk events listed on the Hazard Vulnerability Assessment: snow and ice storms. Suggestions included having an annual assessment of the city's trees (in parks and downtown areas, and right of way especially). This could include a PR campaign encouraging residents to look to their trees and report them if dangerous/ill, and the use of forestry students to assist. Public Works also suggested development of a debris removal plan. Issues surrounding such a plan include: cost; weight/size of debris piles; transportation of said piles; temporary and permanent storage options for the debris; and partners to assist (such as Republic Services).

Another issue discussed was the need to safeguard the Wi-Fi cable that goes from the Courthouse to the police department. This was listed as a new mitigation action to pursue.

Daniel asked whether or not the City pretreats roads in advance of a snow/ice storm. The answer is no, but ODOT treats major routes in advance of ice storms (these routes tend to mirror evacuation routes). Questions also centered on acquiring plows for snow events. Discussion on this dealt with liability, feasibility, and priority (such as City facilities like the fire stations).

The committee moved on to discussion about sheltering. The City does have options (as approved by the Red Cross), and the Expo was also listed as a likely location (having all necessary facilities). City Hall could serve as a respite location (although it lacks the facilities and trained staff to serve as a full shelter). The Riverfront Community Center was also suggested, although it would lack generators should the power go out. Grant opportunities to fund a connect/disconnect for a portable generator for that location were discussed.

The next topic of discussion was the feasibility of incorporating the NHMP into the Comprehensive Plan. Merits and disadvantages were discussed and this topic will be given further consideration.

The last topic under discussion was about updating City maps based on DOGAMI updates and what responsibilities and obligations the City has (if any) to enforce any changes to the flood plains, etc.

<u>Action Items</u>:

- Bailey (Public Works) will evaluate city/county maps with an eye toward sanding, evacuation, priority routes, and transit routes.
- Perino will follow up with the Red Cross for a list of potential shelter sites within the city.
- Ruettgers will work with Daniel on wording for the action item referring to DOGAMI map updates.

Respectfully submitted,

Kate Hennessy
Administrative Assistant I

Figure 14. March 11, 2022 Steering Committee meeting #6 agenda

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

Mitigation Strategy and Plan Maintenance

March 11, 2022
2:30-4:00 pm

In person at:
City of Albany, Santiam Room
333 Broadalbin St SW, Albany, OR

on Teams at: **Join on your computer or mobile app**
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,972646496#
Phone Conference ID: 972 646 496#

AGENDA

Welcome, Minutes, and Meeting Objectives	**2:30 – 2:40**
• Review and approval of 2/14/22 minutes • Meeting Objectives · Schedule review · Summarize Mitigation Strategy; Review Critical Facilities list · Review plans for public outreach · Discuss Plan Maintenance · Document Topics	
Schedule Review	**2:40 – 2:45**
Risk Assessment public comment period; documents for review coming up	
Mitigation Strategy Summary; Critical Facilities list review	**2:45 – 3:10**
Materials for review will be provided Wednesday before the meeting	
Public Outreach planning	**3:10 – 3:25**
Identify outreach efforts for Risk Assessment and Mitigation Strategy	
Plan Maintenance	**3:25 – 3:35**
Review strategies for plan implementation	
Document development topics	**3:35 – 3:50**
Process for SC comments prior to making draft public Method for collecting comments/review from the public	
Questions/Comments	**3:50 – 4:00**

Next meeting scheduled for April 25, 2022 @ 2:30-4:00

Figure 15. March 11, 2022 Steering Committee meeting #6 meeting notes

NHMP Steering Committee Meeting Minutes

March 11, 2022

Meeting called to order at 1430 hours.

Present:

Chuck Perino, Emergency Management
Peter Troedsson, City Manager
Kristen Preston, Public Works - Ops
Matt Harrington, City Manager's Office
Marcia Harnden, Police
Kim Lyddane, Parks & Recreation
Katherine Daniel, DLCD
Chris Bailey, Public Works
Matthew Ruettgers, Community Development
David Martineau, Community Development
Shane Wooton, Fire
Kate Hennessy, Fire

Minutes:

Perino moved, Ruettgers seconded, and the minutes of the February meeting were approved as submitted.

Discussion:

The committee discussed requesting public review of the risk assessment. Daniel will create a matrix to reflect comments made by the public. When the draft is complete, the committee will need to go back to the public for official comments. The publishing schedule needs to be moved back some; mitigation action and plan maintenance work will be done in March, Volume 1/draft 1 to come in April. The final draft of the NHMP update is due in April but needs to be moved to May. This amendment was approved by the committee members.

The committee continued to review the Mitigation Actions spreadsheet. The next topic for discussion was evaluating bridges for seismic update and seeking funding. Bailey suggested that the City can prioritize those used for evacuation routes, and then seek funding sources to upgrade them.

The committee discussed outreach as an ongoing part of the NHMP update process. When it was suggested that all the different outreaches be rolled into one activity/action item, Martineau asked that the floodplain outreach remain its own separate activity, to fulfil special reporting requirements that he has.

Daniel asked about the HAZUS run from 2015 to determine all critical facilities within the city; she needs it to update and flesh out the critical facilities for FEMA for the update. Lisa Kirk (Public Works – Ops) can do HAZUS GIS mapping for critical facilities. Preston said she would help coordinate this (see Action Items).

The committee then discussed community engagement. Harrington has drafted an outreach plan (saved on Teams in Outreach folder). The options of using surveys and open houses were floated, and Wooton suggested inviting members of the citizen's advisory groups (CAGs) to attend, opine, and participate. Daniel offered to send out the flyer she did and invite public opinion/ participation. Hennessy reminded the group that last time there was a survey that was sent out to members of the public about the NHMP. Perino located this survey and will put it on Teams for the group.

Daniel proposed putting the update procedure in the back of the document behind the NHMP (as opposed to the 2016 plan, where it's in the front of the document before you get to the actual NHMP). The committee agreed to this proposal. Members of the committee also agreed to each take time to review the NHMP update materials.

Action Items:

- Perino will send Daniel HAZUS studies from 2015 (through Lisa Kirk).
- Preston will coordinate with Kirk to provide HAZUS GIS mapping for critical facilities.
- Harrington will take the list of hazards from the 2016 plan and update it, develop a rudimentary survey, involve the CAGs and augment this with a general information blast to the public for their response.
- Harrington will also launch some public surveys next week with an end-of-March deadline.
- Daniel will put the update of Volume 1 in Teams with a deadline for comments.

Meeting adjourned at 1540 hours.

Respectfully submitted,
Kate Hennessy, Administrative Assistant I

Figure 16. May 16, 2022 Steering Committee meeting #7 agenda

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

May 16, 2022
2:30-4:00 pm

OREGON
Department of Land Conservation & Development

In person at:
City of Albany, Santiam Room
333 Broadalbin St SW, Albany, OR

on Teams at: **Join on your computer or mobile app**
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,972646496#
Phone Conference ID: 972 646 496#

AGENDA

Welcome, Minutes, and Meeting Objectives • Review and approval of 3/11/22 minutes; revision of 1/24/22 minutes • Meeting Objectives · Survey results and Outreach response · Critical Facilities list · Mitigation Strategy priorities	**2:30 – 2:40**
Survey results and Outreach response	**2:40 – 3:00**
Critical Facilities list review In preparation for the HAZUS analysis to be prepared by Lisa Kirk, we will identify the City of Albany's critical and essential facilities.	**3:00 – 3:15**
Mitigation Strategy priorities	**3:15 – 3:40**
Questions/Comments	**3:40 – end of meeting**

Next meeting TBD

Figure 17. May 16, 2022 Steering Committee meeting #7 meeting notes

NHMP Steering Committee Meeting Minutes

May 16, 2022

Meeting called to order at 1430 hours.

Present:

Chuck Perino, Emergency Management
Kristen Preston, Public Works - Ops
Matt Harrington, City Manager's Office
Marcia Harnden, Police
Kim Lyddane, Parks & Recreation
Katherine Daniel, DLCD
Chris Bailey, Public Works
Cynthia Smidt, DLCD
Shane Wooton, Fire
Kate Hennessy, Fire

Minutes:

Wooton moved, Harnden seconded, and the minutes of the March meeting were approved as submitted. The January minutes were amended to show that Holly Roten was in attendance at the January 2022 meeting of the steering committee.

Discussion:

Harrington reported on the public response to the survey that was sent out. It reported how people rated the hazards and how they get their information. Approximately 66% of the population feel that the City is doing a fair to poor job of making citizens aware of the natural hazards they may face. Most people have or are working on putting together emergency kits, and most have some sort of emergency plan. The chief reason for not having a kit or plan centered on not knowing how/what to do. There was interest in a "slimmed down" version of the plan for the public (most felt that, at 400 pages, it's too unwieldy).

Lisa Kirk (Public Works) needs a list of critical facilities to do her HAZUS run on. Daniel reported that DOGAMI is doing a limited run for the area (it should be done in a few months and available for the City to use). Perino displayed the list in Teams and committee members suggested a few facilities that had not been included.

Daniel wants to prioritize the plan of mitigation strategy priorities. She may start with the Executive Summary (which covers all hazards), and she will solicit comments on the document, which resides in Teams.

Action Items:

- Daniel will put out an abridged version of the NHMP, slimmed down and in plain language for the public.
- Perino will give the list of residential care facilities to Kimberly and/or Hillary at AFD to verify they're all included/accurate.
- Perino will verify the list of HazMat facilities through the LEPC.
- Daniel will send out an updated schedule for mitigation strategy priorities.

Meeting adjourned at 1545 hours.

Respectfully submitted,
Kate Hennessy, Administrative Assistant I

Figure 18. July 25, 2022 Steering Committee meeting #8 agenda

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

July 25, 2022
2:30-4:00 pm

In person at:
City of Albany, Santiam Room
333 Broadalbin St SW, Albany, OR

on Teams at: **Join on your computer or mobile app**
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,972646496#
Phone Conference ID: 972 646 496#

AGENDA

Welcome, Minutes, and Meeting Objectives • Review and approval of 5/16/22 minutes • Meeting Objectives · Project updates (HAZUS analysis) · Review Basic Plan Draft · Plan public and city council review of Basic Plan draft	**2:30 – 2:40**
Project updates	**2:40 – 2:45**
Review Basic Plan draft	**2:45 – 3:30**
Public review and City Council update on NHMP update progress	**3:30 – 3:45**
Questions/Comments	**3:45 – end of meeting**

Next meeting TBD

Figure 19. July 25, 2022 Steering Committee #8 meeting notes

NHMP Steering Committee Meeting Minutes

July 25, 2022

Meeting called to order at 1435 hours.

Present:

Chuck Perino, Emergency Management
Kristen Preston, Public Works - Ops
Matt Harrington, City Manager's Office
Marcia Harnden, Police
David Martineau, Comm Dev
Matthew Ruettgers, Comm Dev
Holly Roten, HR
Rick Barnett, Parks & Rec
Katherine Daniel, DLCD
Chris Bailey, Public Works
Peter Troedsson, City Manager
Shane Wooton, Fire
Kate Hennessy, Fire
Alison Crow, Comm Dev
Jeanna Yeager, Finance

Minutes:

Perino moved, Bailey seconded, and the minutes of the May meeting were approved as submitted.

Discussion:

The draft is currently on Teams. Daniel requested that attending members of the Steering Committee please review the draft and make any necessary changes/comments.

What to do for maintenance of the NHMP? Perino will meet with the Executive Leadership Team quarterly to work on this. Perino and Wooton recently went to an evacuation exercise in Corvallis that turned out to be an effective outreach and exercise. Ruettgers stated that one local group of HOAs might be good to get in touch with to conduct something similar by means of public outreach.

Referring to the draft (Sections 3 through 5): the critical facilities are not complete (HAZUS is down). Daniel said she might be able to use publicly available resources to overlay a map of critical facilities to gather the information needed for these sections.

Referring to Section 4 (the mitigation table): Daniel stated that she needed committee members to add notes and timeframes on when and how to accomplish tasks. Daniel reminded the group to be mindful of potential grant projects when filling out the table.

The Committee agreed to meet again August 29, 2022, at 1430 hours (Santiam Room/Teams) to go over their comments, determine if the NHMP is ready for review, and draft a summary of the NHMP to be released to the public.

Action Items:

- Daniel will put out an abridged version of the NHMP, slimmed down and in plain language for the public.
- Daniel will use public maps to overlay and do a risk estimate for critical facilities.
- Perino will work with Ruettgers to contact local HOAs to set up and conduct an evacuation exercise.
- Bailey will gather Public Works personnel for meetings on the topics addressed to them in the table in Section 4.
- Bailey or Perino will attend meetings for the Benton County NHMP and Wildfire Protection Plan.

Meeting adjourned at 1535 hours.

Respectfully submitted,
Kate Hennessy, Administrative Assistant I

Figure 20. August 29, 2022 Steering Committee meeting #9 agenda

City of Albany Natural Hazard Mitigation Plan Update
Steering Committee Meeting

August 29, 2022
2:00-3:45 pm

In person at:
City of Albany, Santiam Room
333 Broadalbin St SW, Albany, OR

on Teams at: **Join on your computer or mobile app**
Click here to join the meeting
Or call in (audio only)
+1 971-319-5185,,972646496#
Phone Conference ID: 972 646 496#

AGENDA

Welcome, Minutes, and Meeting Objectives	**2:00 – 2:10**
• Review and approval of 7/25/22 minutes • Meeting Objectives · NHMP Summary document – Prioritizing Mitigation Actions for inclusion · Future Development and Conditions – OCCRI report and hazard map review · Appendices review · Plan public and city council review of Basic Plan draft	
NHMP Summary Document (30-40 minutes)	**2:10 – 2:50**
Question to consider: Which mitigation actions to include?	
Future Development and Conditions (20 minutes)	**2:50 – 3:10**
OCCRI Report for Linn County East and South Albany- So Albany 2013 plan Geotech report for bearing capacity, floodplain zones East Albany plan takes into account floodplain areas	
Appendices Review (15 minutes)	**3:10 – 3:25**
Cover and front matter Divide into 3 volumes for easier navigation? Appendices 6-13: Updates are limited; add new events since 2016 and updated data sources Appendix A: Resource	

Appendix B: Public Process Appendix C: Approaches for Economic Analysis Appendix D: List of Acroyms Appendix E: Master list of Action Items – part of Basic Plan Appendix F: Action Items by Hazard – part of Basic Plan; provide in Excel for sorting Appendix G: HAZUS run – Not relevant in this update; wasn't available in 2016 plan Appendix H: Hazard Analysis – incorporated into Basic Plan Appendix I: Floodplain Management Planning Committee – not relevant to this update Appendix J: Flood information and Insurance Promotion – relevance?	
Plan public review and City Council update on project progress (15 minutes)	**3:25 – 3:40**

KD will finalize Basic Plan and update Hazard Sections by DATE__________
Plan for public review of completed plan DATE________

Next meeting TBD – following OEM review if there are comments?

Figure 21. August 29, 2022 Steering Committee meeting #9 meeting notes

NHMP Steering Committee Meeting Minutes

August 29, 2022

Meeting called to order at 1412 hours.

Present:

Chuck Perino, Emergency Management
Kristen Preston, Public Works - Ops
Alison Crow, Comm Dev
Marcia Harnden, Police
David Martineau, Comm Dev
Matthew Ruettgers, Comm Dev
Katherine Daniel, DLCD
Chris Bailey, Public Works
Kate Hennessy, Fire

Minutes:

Bailey moved, Perino seconded, and the minutes of the July meeting were approved as submitted.

Discussion:

Daniel prepared a summary document of the NHMP. She is requesting that Harrington help to edit it for public release. The Committee suggested that the summary be written for comprehension by the City Council and members of the public, and create links to the full document if people want to explore further.

The Steering Committee discussed the nine mitigation goals and mitigation actions in the EOP (get GIS help with this), as well as the survey results from the public. Those results suggest that there is a need for outreach on how to compose emergency kits and on emergency planning.

The committee discussed the draft of the NHMP (more pictures are needed) and mitigation strategy actions (encourage use of capital investments to mitigate; educate the public; create policy/code to protect the public; promote the continuum of work currently being done toward those ends).

Referring to mitigation strategies, the committee discussed ongoing efforts and what to prioritize. Perino suggested shelter in place and evacuation routes, in addition to emergency kits. Also discussed were the Debris Management Plan, water system evaluation (planning for water/sewer mitigation), alternative management for water and sewer (especially how multi-hazards can affect water distribution), contingency plans (ref: EQ 6.5a/b and EQ 3.5), prioritization of fiberoptic cable to facilitate emergency communications with law enforcement, and evaluation of bridges as transportation/evacuation routes.

The committee also discussed the future development of the city (moving east and south) and how this might impact natural hazard mitigation, emergency response, and continuity of operations.

Daniel brought up the OCCRI report which addresses how increased temperatures are driving natural hazards (heat and cold waves, flooding, etc.).

With regard to the draft, Daniel suggested chopping the volumes into actual volumes, changing the cover, and discarding appendices E, F, G, H, and possibly I and J (does CRS require these?).

Action Items:

- Crow will check on CRS requirements (in re: appendices I and J).
- Perino will schedule presentation of the NHMP to City Council in October.
- Perino will send Daniel drone flood pictures and smoke pictures.
- Bailey will send Daniel ice storm and smoke pictures.
- Crow will send Daniel smoke at the carousel picture.

Meeting adjourned at 1553 hours.

Respectfully submitted,
Kate Hennessy, Administrative Assistant I

Public Engagement Survey

Below is a summary of the results from the City of Albany survey on the NHMP. This summary includes all of the comments provided, but does not include the breakdown by demographic group or the email address provided for those who would like more information. This detail is held by the city's Public Information Officer.

Polco

Albany Natural Hazard Mitigation Plan Survey

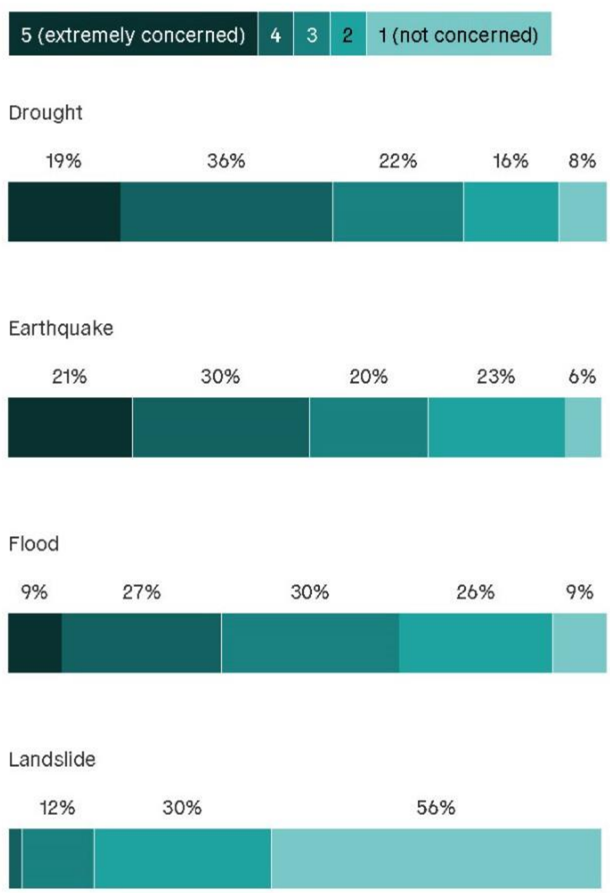
Survey Results
FINAL

04/18/2022

What natural hazard concerns you and your family the most?

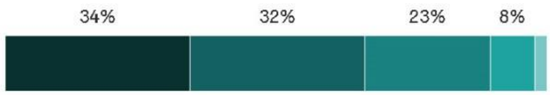
Question	5 (extremely concerned)	4	3	2	1 (not concerned)
Drought	19%	36%	22%	16%	8%
Earthquake	21%	30%	20%	23%	6%
Flood	9%	27%	30%	26%	9%
Landslide	0%	2%	12%	30%	56%
Volcanic event	0%	6%	14%	21%	59%
Wildfire	34%	32%	23%	8%	2%
Wind storm	3%	33%	30%	23%	10%
Ice or snow storm	3%	21%	36%	30%	10%

Expand all / **Collapse all**



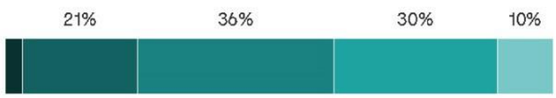
Volcanic event

Wildfire



Wind storm

Ice or snow storm

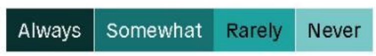


How do you presently receive information on how to protect your household and property from damage due to natural disasters?

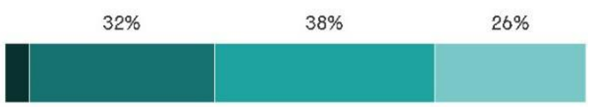
Question	Always	Somewhat	Rarely	Never
City website (www.cityofalbany.net)	4%	32%	38%	26%
City social media accounts	18%	41%	19%	22%
AlbanyAlerts (formerly Nixle) or Linn-Benton Alerts (reverse 911)	43%	31%	9%	17%
Community-run Facebook groups	14%	34%	17%	34%
Other websites	10%	48%	28%	14%

Question	Always	Somewhat	Rarely	Never
Local newspaper	7%	29%	28%	37%
TV	11%	21%	31%	37%
Radio	6%	30%	29%	36%
My child's school	1%	17%	7%	76%
Mail	0%	12%	39%	49%
Fact sheets/brochures	1%	27%	39%	33%
Extension service	0%	20%	24%	56%
Workshops/meetings	0%	18%	26%	56%

Expand all / Collapse all

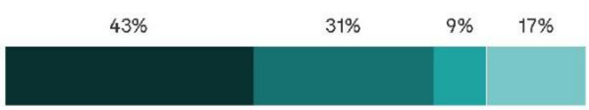


City website (www.cityofalbany.net)

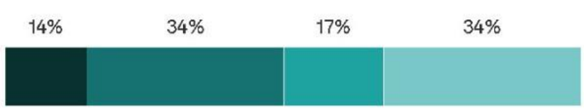


City social media accounts

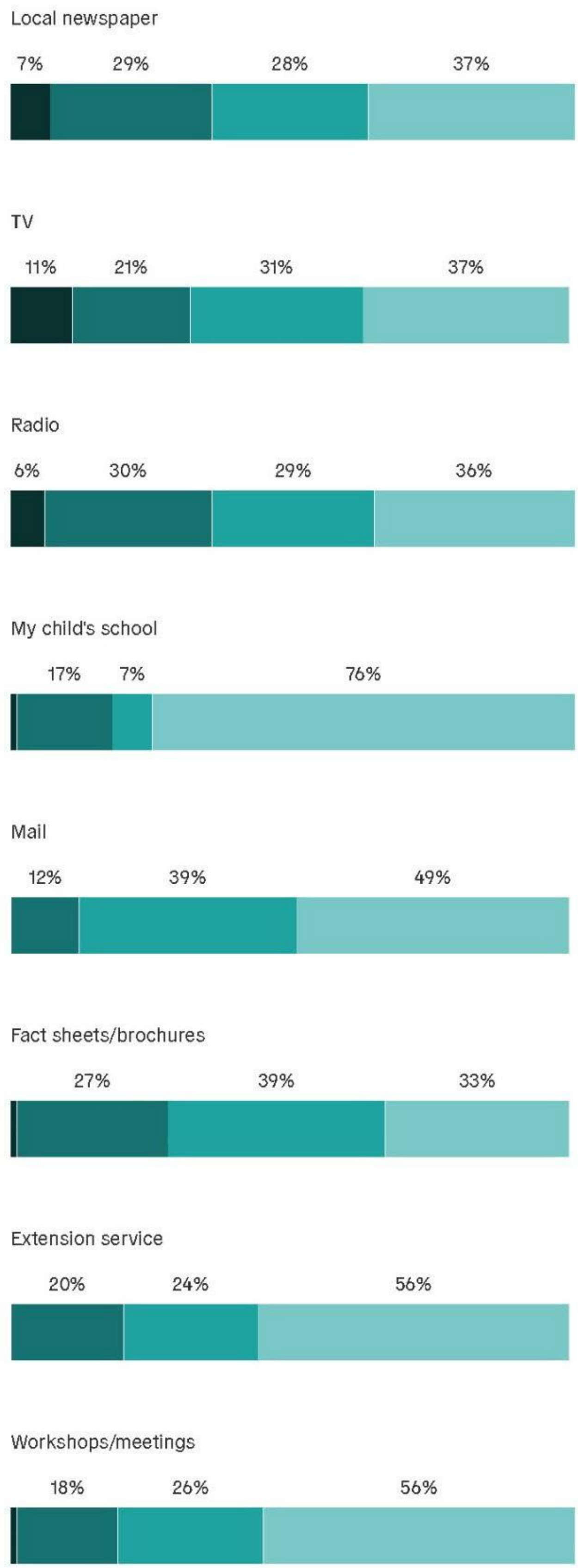
AlbanyAlerts (formerly Nixle) or Linn-Benton Alerts (reverse 911)



Community-run Facebook groups



Other websites


Local newspaper
7%
29%
28%
37%
TV
11%
21%
31%
37%
Radio
6%
30%
29%
36%
My child's school
17%
7%
76%
Mail
12%
39%
49%
Fact sheets/brochures
27%
39%
33%
Extension service
20%
24%
56%
Workshops/meetings
18%
26%
56%

If there are other ways you currently receive information on how to protect your household and property from damage due to natural disasters, please let us know.

no

Family / Friends

I work for Samaritan and our disaster management team sends out info

Red cross trainings

No

Traveler's Insurance Co. news and alerts. AAA news and alerts.

Acquired wisdom over time.

I watch the fire maps and CDC information. I read email from "CNN"S 5 Things"

I am a retired claims manager from USAA, and am very aware of hazards.

brochures I could download from your website, maybe? I learn best by reading but I realize not everyone does.

YouTube

I read books and listen to podcasts on resiliency and general preparedness.

Oregon State University

Albany Police and Fire social media outlets

FEMA Alerts and website

I felt a concern. So I looked for the information on the internet. Trusted academic sources.

A member of our household works in Emergency Management

Other local governments, state and federal agencies (e.g., National Weather Service)

Friends & neighbors. Nextdoor.com

None but the ones listed above

Mennonite Village staff & resident coalition

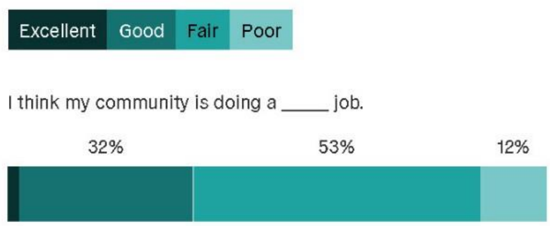
State Farm Insurance

Discussions with friends and family

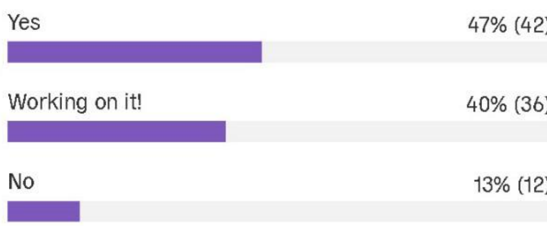
Mostly social media

How do you feel your community is doing to make people aware of the natural hazards that they may face?

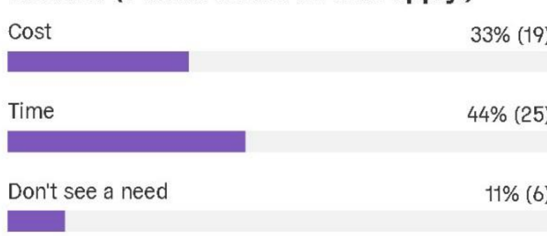
Question	Excellent	Good	Fair	Poor
I think my community is doing a _____ job.	2%	32%	53%	12%



Do you and your family have an emergency kit?



If you do not have a kit, what is the reason? (Please check all that apply.)



Not sure what to put in a kit 42% (24)

Someone else will help me in an emergency 11% (6)

Do you or your family have an emergency plan?

Yes 37% (33)

Working on it! 43% (39)

No 20% (18)

If you do not have a plan, what is the reason why? (Please check all that apply.)

No interest 4% (2)

Don't see a need 15% (8)

I'm not sure how to make a plan 74% (40)

Someone else will help me if there is a need 11% (6)

If you don't currently have an emergency plan or kit, what would it take to get you

and your family to work on one? (Please check all that apply.)

A disaster	13% (8)
More time and money	40% (25)
More educational materials about what to do	62% (39)
Someone to show me what to do	27% (17)
If I knew my friends were doing the same thing	17% (11)

The City of Albany is currently updating our Natural Hazards Mitigation Plan. The plan will help you and city leaders better understand your risk of natural hazards and help to reduce that risk. To see a copy of the existing plan visit cityofalbany.net/nhmp Please describe any questions or comments that you have about the plan.

I'm hoping there is a shorter version for the public and that it shares plans in plain language?

Is this really necessary?

Um, this document is almost 400 pages long. Do you actually expect community members to read it?

The plan is a start. What needs to happen next is that the City of Albany needs to learn from previous disasters and focus on how to mitigate from the effects so that when it happens again they will be prepared. For example: Several years ago Albany sold all of their snow plows (due to lack of use). Within a year or two Albany had a huge snowstorm that caused the city to rely on County and State plows. Albany was not a priority and suffered several days of 10" or more snow on city streets until County/ State crews were able to help. Has Albany purchased any snow plows since then? After EVERY disaster the City of Albany needs to purchase equipment, update plans and train on their short comings. Your Emergency Manager is doing a great job! Just needs the support from senior leadership.

The plan is 397 pages long. I recommend an abbreviated summary report for those residents that want to easily identify risks and what actions we can take.

One of the biggest concerns for this area that needs to be addressed is evacuation routes

None

No. You touched my into taking a2 question duvet

Please let me know if volunteers are needed to help get the word out to my fellow citizens.

If citizens of Albany ever had to leave town, where are locations/resources we should head to? Example: the fires last year had the linn county fair grounds to go to.

None

Since emergencies and priorities are always changing, our emergency kit is always changing. What is the consensus for what should always be in the emergency kits and what is the things other people change in and out of their kits?

It would be interesting if a member of this team could do inspections of yards to help people understand what they need to do.

The plan is 397 pages. Could I get just the facts-brief and to the point? Please.

... Guys. SERIOUSLY. That thing is 400 pages long and written in a way to guarantee slumber. I'm interested in natural disaster prep, but whoa. That whine aside, it is totes thorough. Doesn't really tell me, as a citizen, what I can and should do to prepare, but it definitely covers the waterfront, so to speak. Glad to see y'all have spent so much time looking deeply into the issues involved (I cannot imagine how much time that took) and hope the relevant staff are familiar with its conclusions so they can help residents cope with disasters.

Frankly, that is an absurd 397 page document. Normal people do not have the time or motivation/interest to read 400 pages about this in the middle of answering a poll, or after answering the poll, or ever. I have a degree in English Literature and a master's degree in Education, and still have very little desire to read something on this topic that is only slightly smaller in page count than a Stephen King novel. If you want this information to be accessible and useful for residents of this city, you need to create a resident-friendly version that highlights the important elements in a few pages or less. If it can't be read in 10 minutes or less while also stirring a pot on the stove or sitting in the waiting room at the doctor's office, no one is going to read it, and your mission to have an informed and prepared population will not be successful. Consider taking those few pages and making a video explainer narrated by someone with an engaging demeanor. Then make a fun quiz or two about the content, and an accompanying social media campaign challenging residents to become know-it-alls about natural hazards plans, and prove their know-how in those quizzes. Engage people.

I don't have any friends or family so I don't know how to come up with a plan. Is there someone at the city or county that could be the person I check in with during an emergency? I don't think I'm the only person that is in this situation.

I have a fairly large property (10+ acres) in city limits that is near a year round creek. Under state laws, I cannot build a pond(s) on my property and fill from the creek when it's overflowing in the winter without filing expensive permits that may or may not get approved. If the city were to assist with permitting and construction of ponds for water storage (not irrigation) , it might be possible to build a number of water sources for fire fighting around the city perimeter.

Will it come with a tangible tool kit for actual how to instruction and resources?

Communication, what's the plan?!

I'm just happy someone's looking out for Albanys future. (Context I'm 21 so I don't have kids in school)

Would like to see more engagement with underrepresented communities (migrant farm workers, unhoused people)

This document is a beast. I really hope there is an abbreviated version for general public reading.

My primary crisis concern is local governments' preparedness for alternative river and waterway crossings, in the event of impassibility of bridge(s). I would like to see emergency preparedness communications approach from a lifestyle perspective rather than compartmentalized approach. E.G: Living in a way that you have several days' nonperishable good on hand, the means to purify water, sufficient medications for supply chain disruption, etc... rather than having a compartmentalized "kit" prepared and tucked away.

Too long and too complicated

Too long and too complicated

Please include capability of seniors living singly in their own homes.

None at this time
Need places (schools?) ready for evacuations, esp. if mass failure of electricity or major earthquake
...would appreciate emergency plan/kit advice
Community solar/battery systems are the cheapest and most resilient systems available.
This looks very complicated and bureaucratic. What is the practical outcome of this plan?
We are also concerned about extreme heat events.

Appendix C: Approaches for Economic Analysis

This appendix outlines approaches for conducting economic analysis of proposed hazard mitigation strategies, measures, or projects. Evaluating the cost effectiveness of hazard mitigation can be a complex and difficult task which is influenced by a number of variables. First, natural disasters affect all segments of the communities they strike, including individuals, families, businesses, and public services such as fire, police, utilities, and schools. Second, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are not easily measured and are difficult to quantify in dollars. Third, many of the impacts of such events produce "ripple-effects" throughout a community, thus increasing the variables to be considered.

While not easily accomplished, there is value, from a public policy perspective, in assessing the economic value of impacts avoided by implementing hazard mitigation measures, and obtaining an objective benefit/cost comparison. Otherwise, the decision to pursue or not pursue various hazard mitigation options would not be based on an objective understanding of the net benefit associated with those actions.

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit/cost analysis (b/ca) and cost- effectiveness analysis. The distinction between the two methods is the way in which the relative costs and benefits are measured. In the first method, 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 (i.e.: if net benefits exceed net costs, the project is worth pursuing). By contrast, the second method, cost-effectiveness analysis, evaluates how best to spend a given amount of money to achieve a specific goal; this type of analysis 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.

Public Investment Decisions

Developing and evaluating a policy mandating mitigation of natural hazards is a difficult process. After determining that a sufficient risk exists and that effective hazard mitigation alternatives are possible, knowing whether hazard mitigation is economically feasible is useful in selecting a strategy. If a public decision is being made, economic feasibility takes on a definition that differs from economic feasibility decisions made in the private sector. Economic feasibility in the private sector is defined as an owner's benefits (monetary profits, satisfaction, etc.) exceeding the owner's costs. The benefits and costs that are included in the decision are entirely up to the private decision-maker, but the calculation can usually be made directly by the decision maker using prices and costs provided by the marketplace.

The economic question in the public sector is complicated because it involves estimating all of the economic benefits and costs regardless of to whom they shall accrue, possibly to a large number of persons and economic entities. Economic benefits and costs are defined as true changes in economic efficiency. In addition, some of the benefits are not evaluated through normal "markets" but still affect the public in profound ways.

Economists have developed methods to evaluate the economic feasibility of public decisions that involves a diverse set of beneficiaries and non-market benefits. One such procedure was published by FEMA, whose models were developed in conjunction with industry economists, engineers, and public officials, and are generally accepted regarding making public decisions on mitigating natural hazards.

The selection of hazard mitigation projects to be funded in the public sector can be made using three sets of criteria; maximum present value, benefit/cost ratio, and internal rate of return.

The Maximum Present Value Criterion

The maximum present value criterion states that the optimal investment strategy is to select the set of projects that maximize present value of future revenues subject to the available budget. In benefit/cost analysis, those projects with the greatest benefits minus costs calculates this value. All projects or public investment alternatives must be evaluated simultaneously in this procedure. Where projects have different, discrete sizes, and different values for present value, there is no simple decision rule to determine, in isolation, whether a particular proposed project should be included in the optimal public investment strategy. All proposed projects must be considered together, in terms of present value, and the package of projects that maximizes social wealth subject to the funds constraint in the initial time period must be selected simultaneously.

Benefit/Cost Ratio

Selecting projects for public investment using the benefit/cost ratio criteria is similar to the maximum present value criteria if unlimited funds are available. The set of projects for which benefits exceed costs would be the same as the projects selected by maximizing present value criterion. However, if a budget constraint exists on investment funds in the initial time period and the benefit/cost ratio criterion is satisfactory under certain conditions but not others, select discrete-sized projects, one by one, starting with that project for which the benefit/cost ratio is highest, and working down, until the investment funds constraint in the initial time period is exhausted.

This strategy is quite effective when the candidate projects are of approximately similar size and when the total investment funds far exceed the investment cost of any project. Such a decision strategy will be inadequate however, when candidate projects are of vastly different discrete sizes and when the size of some candidate projects is quite large relative to the total investment budget. In that case, it is best to revert to a procedure that maximizes the present value of the set of discrete-sized projects, given a constraint on the availability of investment funds in the initial time period.

Internal Rate of Return

The internal rate of return for a project or set of projects is that rate of discount that yields a present value of zero. With unlimited capital, all projects that have an internal rate of return equal to or greater than the social rate of discount should be funded. This criterion yields the same results as the maximum present value criterion if capital is unlimited. If the supply of capital is limited, optimal project selection is attained by selecting those projects with the highest internal rate of return and that the internal rate of return is greater or equal to the social discount rate.

<u>Private Investment Decisions</u>

An individual must make consumption and production decisions regarding the current time period and future time periods. Economists have developed criteria for individuals to make optimal consumption and production decisions over time. Consumers maximize their current utility by making purchasing and saving decisions given observed prices and interest rates. Producers maximize current profits by making production and investment decisions given observed prices and interest rates.

Investing by the private sector in a hazard mitigation measure may occur on the basis of one of two incentives: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. These very different investment decisions are covered in the following subsections.

Conforming to a Hazard Mitigation Standard

A building or land owner, whether a private entity or a public agency, required conforming to a mandated standard may consider the following options:

- Request cost sharing from public agencies;
- Dispose of the building or land either by sale or demolition;
- Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
- Evaluate the feasible alternatives to meet the standard 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 purchasers. 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.

Economic Feasibility of Mitigating Natural Hazards

A building or land owner may decide to reduce the risk of natural hazards through mitigation based only on economic criteria. This decision is usually based on the results of an investment or capital budgeting analysis. Capital budgeting analysis is a seven-step process:

- <u>Identify All Relevant Investment Alternatives.</u> Typical investment alternatives for building owners can include the reduction of natural hazards risk, income enhancing equipment, or expansion of the facility. All of these investments can improve the income derived from the use of building.

- <u>Select the economic criteria.</u> Alternative criteria include the simple rate of return, the payback period, the expected net present value, and internal rate of return. The internal rate of return is preferred because the results are directly comparable and alternative projects can be ranked directly.

- <u>Estimate the capital requirements.</u> The capital requirements include the initial cost of the investment and the repair and maintenance of the investment over its productive life
.

- <u>Estimate the cash flow.</u> Projecting cash flow that results from the investment is difficult. Expected future returns from the mitigation depend on the correct specification of the risk and the effectiveness of the investment which is not 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 commercialloans.

- Determine the correct interest rate. Determination of the interest rate can just be the risk-free cost of capital, but it may include the decision maker's time preference and also a risk premium. The inclusion of inflation should also be considered.

- Define the planning horizon. The planning horizon is usually defined by the decision maker's projected interest in the building. This determination has a substantial effect on the results of the analysis.

- Analyze and rank the investment alternatives. Time dependent parameters such as risk, project effectiveness, economic returns, and costs should be defined over the time horizon and not on an annual basis. Once the investments are ranked on the basis of economic criteria, the decision-maker can bring other parameters into the selection process.

Economic Returns of Hazard Mitigation

The estimation of economic returns which accrue to the building or land owner as a result of natural hazards mitigation is difficult. Owners deciding the economic feasibility of hazard mitigation should consider reductions in physical damages and financial losses. A partial list is as follows:

- Building damages avoided
- Contents damage avoided
- Inventory damages avoided
- Rental income losses avoided
- Relocation and disruption expenses avoided
- Proprietor 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 and the resulting reduction in damages and losses. 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.

The Cost of Hazard Mitigation

Hazard mitigation projects have initial investment cost and recurring costs over the period of the investment. The project may also deteriorate or be subject to destruction over the relevant time horizon. Expected loss of the investment is approximated by multiplying the annual probability of destroying the effectiveness of the investment by the value of the investment. Estimating deterioration can be captured by normal depreciation schedules.

The Total Economic Impacts of Natural Disasters

In addition, the building or land owner should also assess changes in a broader set of parameters that can change as a result of a large natural disaster. These are usually termed “indirect” effects, but they can have a very direct effect on the economic life 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

This set of parameters is more difficult to estimate and requires models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy.

Two Specific Economic Analysis Models

VSP Associates, Inc. has produced a number of economic analysis models for FEMA, some of which are noted under references on page Appendix C-7.

Publicly-Owned Buildings

It may seem appropriate for public agencies to use traditional benefit/cost analysis to make decisions regarding rehabilitation but that is usually not the case. An agency rightfully includes only those benefits and costs that the agency is responsible for and excludes those parameters that are the responsibility of other agencies or the private sector. Only when the agency is directed to perform a true benefit/cost calculation does it make sense for the agency to perform such an analysis. With this in mind, FEMA contracted to derive a benefit/cost model for publicly-owned buildings based on the earlier benefit/cost model for privately-owned buildings. The resulting model for publicly-owned buildings is very similar to the private building model, with the addition of the value of lost public services avoided.

Data on the cost of service, payroll, and a post-earthquake continuity premium are used to estimate the value of lost public services. This model was the result of a two-year effort advised by a panel of economics, engineers, and geologists. The model was also extensively tested. Analyses were performed on eight buildings owned by various federal agencies located throughout the United States.

Privately-Owned Buildings

A benefit/cost model was developed to aid local and state planners in determining the economic feasibility of seismic rehabilitation programs. The development was funded by FEMA's National Earthquake Hazards Reduction Program. The model estimates the expected net present value of benefits of seismic rehabilitation derived from the following parameters:

- Building damages prevented
- Rental income losses avoided
- Relocation expenses avoided
- Personal and proprietors' income losses avoided
- Business inventory damages prevented
- Personal property losses prevented
- Value of casualties avoided

Procedures were developed to analyze a single building or a building inventory. The model was the result of an extensive two year research and development effort: a multidisciplinary advisory panel of economists, engineers, and other experts played an important review and guidance role throughout the project.

The model was also extensively tested. Nine seismic rehabilitation projects located in different cities throughout the country were analyzed using the single building model. A 67 building inventory located in the Pioneer Square area of Seattle was also analyzed.

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.

- 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 Olson Associates, Prepared for Oregon State Police, Office of Emergency Management, July 1999.

- Risk Management Solutions, Inc., *Development of a Standardized Earthquake Loss Estimation Methodology,* National Institute of Building Sciences, Volume I and II, 1994.

- VSP Associates, Inc., *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings, Volumes 1 & 2*, Federal Emergency Management Agency, FEMA Publication Numbers 227 and 228, 1991.

- VSP Associates, Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects*, 1993.

- VSP Associates, Inc., *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model, Volume 1*, Federal Emergency Management Agency, FEMA Publication Number 255, 1994.

Appendix D: List of Acronyms and Definitions

Acronyms

Oregon

AGC	Associated General Contractors
AOC	Association of Oregon Counties
BCD	Building Codes Division (Department of Consumer and Business Services)
BPA	Bonneville Power Administration
CPW	Community Planning Workshop (University of Oregon)
DAS	Department of Administrative Services
DCBS	Department of Consumer and Business Services
DEQ	Department of Environmental Quality
DLCD	Department of Land Conservation and Development
DOGAMI	Department of Geology and Mineral Industries
DSL	Division of State Lands
ESD	Education Service District
GIHMT	Governor's Interagency Hazard Mitigation Team
GNRO	Governor's Natural Resources Office (State of Oregon)
LCDC	Land Conservation and Development Commission (State of Oregon)
LOC	League of Oregon Cities
OCS	Oregon Climate Service
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OEM	Office of Emergency Management
OEMA	Oregon Emergency Management Association
OERS	Oregon Emergency Response System
OHIRA	Oregon Hazard Identification and Risk Assessment
ONHW	Oregon Natural Hazards Workshop (University of Oregon)
ORS	Oregon Revised Statues
OSFM	Office of State Fire Marshal
OSP	Oregon State Police
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
OSU	Oregon State University
OUS	Oregon University System
OWEB	Oregon Watershed Enhancement Board
PSU	Portland State University
PUC	Public Utility Commission
SEAO	Structural Engineers Association of Oregon
SHMO	State Hazard Mitigation Officer
WRD	Water Resources Department

Federal

AASHTO	American Association ofState Highway and Transportation Officials
ATC	Applied Technology Council
b/ca	benefit/cost analysis
BFE	Base Flood Elevation
BLM	Bureau of Land Management
BSSC	Building Seismic Safety Council
CDBG	Community Development BlockGrant
CFR	Code of Federal Regulations
CRS	Community Rating System
CVO	Cascade Volcano Observatory (USGS)
EDA	Economic Development Administration
EPA	Environmental Protection Agency
ER	Emergency Relief
EWP	Emergency Watershed Protection (NRCS Program)
FAS	Federal Aid System
FEMA	Federal Emergency ManagementAgency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance (FEMA Program)
FTE	Full Time Equivalent
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Sciences (International)
GSA	General Services Administration
HAZUS	Hazards U.S.
HMGP	Hazard Mitigation Grant Program
HMST	Hazard Mitigation Survey Team
HUD	Housing and Urban Development (United State, Department of)
IBHS	Institute of Business and Home Safety
ICC	Increased Cost of Compliance
IHMT	Interagency Hazard MitigationTeam
NCDC	National Climate Data Center
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NHMP	Natural Hazard Mitigation Plan (also known as “409 plan”)
NIBS	National Institute of Building Sciences
NIFC	National Interagency Fire Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Services
NWS	National Weather Service
SBA	Small Business Administration
TDR	Transfer of Development Rights
UGB	Urban Growth Boundary
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFA	United States Fire Administration
USGS	United States Geological Survey
WSSPC	Western States Seismic Policy Council

Definitions

“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. See “base flood elevation” and “National Flood Insurance Program” below.

“409 Plan” means the state natural hazards mitigation plan that was called for by Section 409 of the Stafford Act. This requirement has been superseded by Section 322 of the Stafford Act as created by the Disaster Mitigation Act of 2000.

Base flood elevation, for National Flood Insurance Program purposes, most often means the flood having a one percent chance of being equaled or exceeded in any given year. It is also referred to as the "100-year” flood. The base flood elevation is the elevation (normally in feet above mean sea level) that the base flood is expected to reach. For certain critical and essential facilities the base flood elevation is determined from the 500-year flood.

Disaster Mitigation Act of 2000 (DMA2K) amended the Stafford Act, making both sweeping and minor changes and additions to it, 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 (see Part IV, Appendices 1 and 10 of this plan); and other amendments.

Disaster Resistant Community is a concept whereby individuals, businesses, private nonprofit organizations, and government work in partnership by preparing in advance and taking actions to reduce the impact of natural hazards that will likely occur. In Oregon the key initiative towards disaster resistant community is *Partners for Disaster Resistance and Resilience*.

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.

Floodplain Administrator means 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.

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.

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.

State Interagency Hazard Mitigation Team means that team of state agency officials whom, in 1997, former Governor Kitzhaber directed the Office of Emergency Management to make a permanent body and establish regular meeting dates in order to understand losses arising from natural hazards and coordinate recommended strategies to mitigate loss of life, property, and natural resources.

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

Hazard mitigation means "any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards." (44 CFR 201.2)

Hazard Mitigation Grant Program means "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)

High risk sites are specific landslide locations determined by the State Forester within high risk areas. A high risk site may include but is not limited to: slopes greater than 65 percent; steep headwalls; highly dissected land formations; areas exhibiting frequent high intensity rainfall periods; faulting, slumps; slides; or debris avalanches. (OAR 629-600-100[28])

Major disaster means 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)

National Flood Insurance Program means 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.

Natural Hazards Mitigation Plan means 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.

Public Assistance is that 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.

Stafford Act means the Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 93-288, as amended by PL 100-707 and by PL 106-390, the Disaster Mitigation Act of 2000).

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 the Office of Emergency Management.

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

Appendix E:
Future Conditions Projections
Linn County, Oregon
Oregon Climate Change Research Institute

Future Climate Projections
Linn County, Oregon

July 2022

Oregon Climate Change Research Institute

Crabtree Creek, Linn County, Oregon
Photograph by Rick Obst, CC BY 2.0, via flickr.com

OCCRI DLCD

Future Climate Projections: Linn County, Oregon

Report to the Oregon Department of Land Conservation and Development

Meghan Dalton, Erica Fleishman, Dominique Bachelet
Oregon Climate Change Research Institute
College of Earth, Ocean, and Atmospheric Sciences
104 CEOAS Admin Building
Oregon State University
Corvallis, OR 97331

July 2022

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Executive Summary

Climate change is expected to increase the occurrence of many climate-related natural hazards. Confidence that the risk of heat waves will increase is very high (Table 1) given strong evidence in the peer-reviewed literature, consistency among the projections of different global climate models, and robust theoretical principles underlying increasing temperatures in response to ongoing emissions of greenhouse gases. Confidence that the risk of many other natural hazards will increase as climate changes is high or medium (Table 1), reflecting moderate to strong evidence and consistency among models, yet these risks are influenced by multiple secondary factors in addition to increasing temperatures. Confidence in changes in risks is indicated as low if projections suggest relatively few to no changes or evidence is limited.

Table 1. Projected direction and level of confidence in changes in the risks of climate-related natural hazards. Very high confidence means that the direction of change is consistent among nearly all global climate models and there is robust evidence in the peer-reviewed literature. High confidence means that the direction of change is consistent among more than half of models and there is moderate to robust evidence in the peer-reviewed literature. Medium confidence means that the direction of change is consistent among more than half of models and there is moderate evidence in the peer-reviewed literature. Low confidence means that the direction of change is small compared to the range of model responses or there is limited evidence in the peer-reviewed literature.

	Low Confidence	Medium Confidence	High Confidence	Very High Confidence
Risk Increasing ↑		Drought Expansion of Non-native Invasive Species Reduced Air Quality Loss of Wetlands	Heavy Rains Flooding Wildfire	Heat Waves
Risk Unchanging =	Windstorms			
Risk Decreasing ↓				Cold Waves

This report presents future climate projections for Linn County relevant to specified natural hazards for the 2020s (2010–2039) and 2050s (2040–2069) relative to the 1971–2000 historical baseline. The projections are presented for a lower greenhouse gas emissions scenario (RCP 4.5) and a higher greenhouse gas emissions scenario (RCP 8.5), and are based on multiple global climate models. All projections in this executive summary refer to the 2050s, relative to the historical baseline, under the higher emissions scenario. Projections for both time periods and emissions scenarios are included in the main report.

Heat Waves

The number, duration, and intensity of extreme heat events will increase as temperatures continue to warm.

In Linn County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios.

In Linn County, the number of days per year with temperatures 90°F or higher is projected to increase by an average of 17 days (range 5–29 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Linn County, the temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–10°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Cold Waves

Cold extremes will become less frequent and intense as the climate warms.

In Linn County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 4 days (range -2– -5 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Linn County, the temperature on the coldest night of the year is projected to increase by an average of 6°F (range 1–11°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Heavy Rains

The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor.

In Linn County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. However, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 14% (range -1–35%) and 10% (range -1–22%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

In Linn County, the number of days per year on which a threshold for landslide risk, which is based on prior 18-day precipitation accumulation, is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

River Flooding

Winter flood risk at mid- to low elevations in Linn 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.

Drought

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 Linn County by the 2050s.

Wildfire

Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Linn County by 12 days (range -6–31) by the 2050s, relative to the historical baseline, under the higher emissions scenario.

In Linn County, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 28 days (range 10–43) by the 2050s, compared to the historical baseline, under the higher emissions scenario.

Reduced Air Quality

The risk of wildfire smoke in Linn County is projected to increase. The number of days per year on which the concentration of wildfire-derived fine particulate matter results in poor air quality is projected to increase by 13%, and the concentration of fine particulate matter is projected to increase by 88%, from 2004–2009 to 2046–2051 under a medium emissions scenario.

Loss of Wetlands

In Linn County, losses of wetlands in recent decades largely were caused by conversion to agriculture. Projected effects of climate change on wetlands in the Northwest include reductions in water levels and hydroperiod duration. If withdrawals of ground water do not increase, then wetlands that are fed by ground water rather than surface water may be more resilient to climate change.

Windstorms

Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change.

Expansion of Non-native Invasive Species

In general, non-native invasive plants in Linn County are likely to become more prevalent in response to projected increases in temperature and the frequency, duration, and severity of drought. However, many of these responses are uncertain, are likely to vary locally, and may change over time.

Introduction

Industrialization has increased the amount of greenhouse gases emitted worldwide, which is causing Earth's atmosphere, oceans, and lands to warm (IPCC, 2021). Climate change and its effects already are apparent in Oregon (Dalton *et al.*, 2017; Mote *et al.*, 2019; Dalton and Fleishman, 2021). Climate change is expected to increase the likelihood of natural hazards such as heavy rains, river flooding, drought, heat waves, wildfires, and episodes of poor air quality, and to decrease the likelihood of cold waves.

Oregon's Department of Land Conservation and Development (DLCD) contracted with the Oregon Climate Change Research Institute (OCCRI) to analyze the influence of climate change on natural hazards. The scope of the analysis that yielded this report is limited to the geographic area encompassed by Marion, Linn, Lane, and Tillamook Counties, Oregon, which are the focus of the Pre-Disaster Mitigation (PDM) 19 grants that DLCD received from the Federal Emergency Management Agency. Products of OCCRI's analysis include county-specific data, graphics, and narrative summaries of climate projections related to ten climate-related natural hazards (Table 2). This information will be integrated into the Natural Hazards Mitigation Plan (NHMP) updates for the four counties, and can be used in other county plans, policies, and programs. In addition to the county reports, OCCRI will share data and provide other technical assistance to the counties. This report covers climate change projections related to natural hazards relevant to Linn County.

Table 2. Selected natural hazards and related climate metrics.

Heat Waves Hottest Day, Warmest Night Hot Days, Warm Nights	**Cold Waves** Coldest Day, Coldest Night Cold Days, Cold Nights
Heavy Rains Wettest Day, Wettest Five Days Wet Days, Landslide Risk Days	**River Flooding** Annual Maximum Daily Flows Atmospheric Rivers Rain-on-Snow Events
Drought Summer Flow, Spring Snow Summer Soil Moisture Summer Precipitation	**Wildfire** Fire Danger Days Extremely Dry Air Days
Reduced Air Quality Days with Unhealthy Smoke Levels	**Loss of Wetlands**
Windstorms	**Expansion of Non-native Invasive Species**

Future Climate Projections Background

Introduction

The county-specific future climate projections presented here are derived from 10–20 global climate models and two scenarios of future global emissions of greenhouse gases. The spatial resolution of projections from global climate models has been refined to better represent local conditions. County-level summaries of changes in climate metrics (Table 2) are projected to the beginning and middle of the twenty-first century relative to a historical baseline. More information about the data sources is in the Appendix.

Global Climate Models

Global climate models (GCMs) are computer models of Earth's atmosphere, ocean, and land and their interactions over time and space. The models are grounded in the fundamental laws of physics. Over time the spatial resolution of the models has increased and more physical, chemical, and biological processes, such as wildfire emissions and dynamic vegetation change, have been included (Figure 1). The latest GCMs from the sixth phase of the Coupled Model Intercomparison Project (CMIP6), the climate modeling foundation of the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report, generally have higher resolution, better represent Earth system processes, and improve simulation of recent mean values of climate change indicators relative to older GCMs or versions of GCMs (IPCC, 2021). However, some CMIP6 models overestimate temperatures in the twentieth century, likely due to the difficulty of accurately simulating cloud dynamics. Consequently, the IPCC ranked climate models on the basis of their ability to reproduce twentieth-century temperatures, and used only the most accurate models to produce its official warming projections given different fossil fuel emissions scenarios (Hausfather *et al.*, 2022).

Differences in simulations of Oregon's projected average temperature between the fifth phase of the Coupled Model Intercomparison Project (CMIP5) and CMIP6 were estimated in the Fifth Oregon Climate Assessment (Dalton and Fleishman, 2021). The CMIP6 models generally projected greater warming over Oregon than the CMIP5 models, largely because temperature in the CMIP6 models was more sensitive to a doubling of atmospheric carbon dioxide. The latter outcome reflected a larger amplification of temperature increases by clouds within the CMIP6 models (Dalton and Fleishman, 2021; IPCC, 2021), which may or may not be realistic (Hausfather *et al.*, 2022). In view of this uncertainty, and because downscaled data from CMIP6 are not yet widely available, this report presents the more conservative projections from CMIP5 GCMs.

GCMs are the most sophisticated tools for understanding Earth's climate, but they still simplify the climate system. Because there are several ways to implement such simplifications, different GCMs yield somewhat different projections. Accordingly, it is best practice to average and report the range of projections from at least ten GCMs that simulate the historical climate well (Mote *et al.*, 2011; Hausfather *et al.*, 2022). More information about GCMs and uncertainty is in the Appendix.

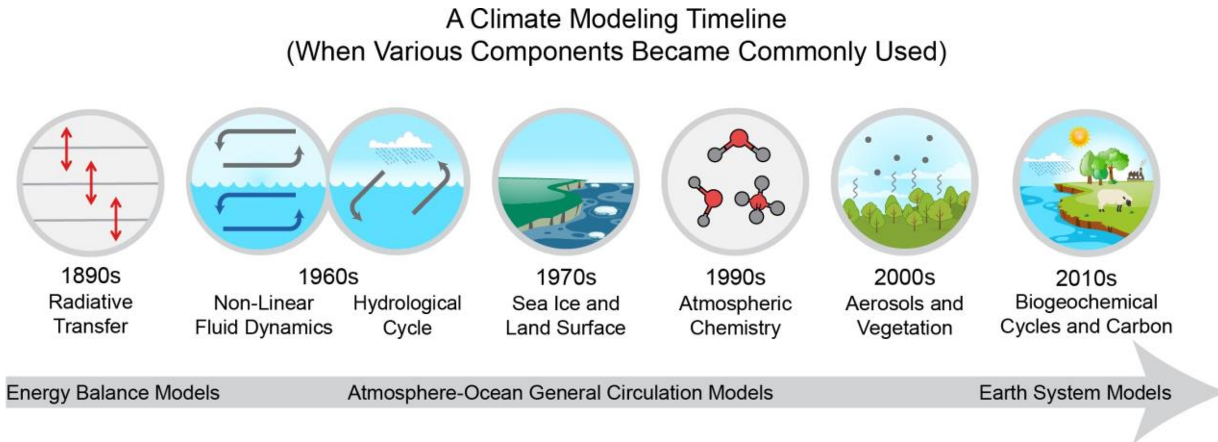

Figure 1. As scientific understanding of climate has evolved over the last 120 years, increasing amounts of physics, chemistry, and biology have been incorporated into global climate calculations, and over the second half of the twentieth century as computing resources became available, into global climate models. (Source: science2017.globalchange.gov)

Greenhouse Gas Emissions

When scientists use GCMs to project climate, they make assumptions about the quantity of future global emissions of greenhouse gases. The GCMs then simulate the effects of those emissions on the air, ocean, and land over the coming centuries. Because the precise amount of greenhouse gases that will be emitted in the future is unknown, scientists use multiple scenarios of greenhouse gas emissions that correspond to plausible societal trajectories. The CMIP5 models on which future climate projections in this report are based used Representative Concentration Pathways (RCPs) that describe different levels of radiative forcing. Radiative forcing is the total amount of energy retained in the atmosphere via changes in incoming solar radiation, reflectivity of the Earth's surface, and concentrations of heat-trapping greenhouse gases, and usually is estimated to the year 2100. A fixed greenhouse gas emissions trajectory was associated with each pathway. The higher the volume of global emissions, the greater the projected increase in global temperature (Figure 2). CMIP6 models used Shared Socio-economic Pathways (SSPs) that reflect sets of social and economic assumptions and can be associated with the different levels of emissions of CMIP5 RCPs (IPCC, 2021). Projections in this report assume a lower emissions pathway (RCP 4.5) and a higher emissions pathway (RCP 8.5). These are the most commonly used pathways, or scenarios, in the peer-reviewed literature, and downscaled data representing the effects of these scenarios on local climate are available. More information about emissions scenarios is in the Appendix.

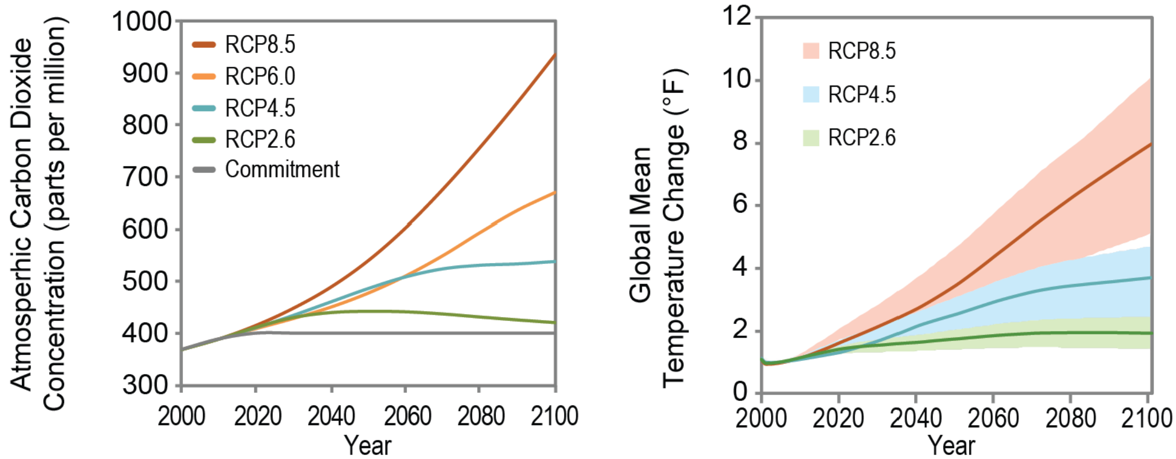

Figure 2. Future scenarios of atmospheric carbon dioxide concentrations (left) and projections of global temperature change (right) resulting from several different emissions scenarios, called Representative Concentration Pathways (RCPs), that were considered in the fourth National Climate Assessment. In the left plot, the gray line represents a scenario in which atmospheric carbon dioxide concentrations remain constant upon reaching 400 parts per million. In the right plot, the solid line and shading represent the mean and range of CMIP5 GCM simulations. (Source: science2017.globalchange.gov)

Downscaling

Global climate models simulate the climate across contiguous grid cells at coarse spatial resolutions, such that only one to three grid cells cover the state of Oregon. To make these coarse-resolution simulations more locally relevant, GCM outputs are combined statistically with historical observations, yielding higher-resolution projections. This process is called statistical downscaling. The future climate projections in this report were statistically downscaled to a resolution of about 2.5 by 2.5 miles (Abatzoglou and Brown, 2012). More information about downscaling is in the Appendix.

Future Time Periods

When analyzing GCM projections, it is best practice to compare the average of simulations across at least 30 future years to the average of simulations across at least 30 recent past years. The average over the 30 recent past simulated years is called the *historical baseline*. This report presents projections averaged over two future 30-year periods, 2010–2039 (2020s) and 2040–2069 (2050s), relative to the historical baseline from 1971–2000 (Table 3).

Because each of the 20 GCMs is based on slightly different assumptions, each yields a slightly different value for the historical baseline. Therefore, this report does not present the average and range of projected absolute values of variables. Instead, it presents the average and range of projected *changes* in values of climate variables relative to each model's historical baseline. The average of the 20 historical baselines, the *average historical baseline*, is also presented to aid in understanding the relative magnitude of projected changes. The 20-model average projected future change that appears in the tables can be added to the 20-model average historical baseline, which also appears in the tables, to infer the 20-model average projected future value of a given variable.

Table 3. Historical and future time periods over which projections were averaged.

Historical Baseline	2020s	2050s
1971–2000	2010–2039	2040–2069

How to Use the Information in this Report

Because the observational record may not include many values of climate variables nor the frequency of some extreme conditions that are projected to occur in the future, one cannot reliably anticipate future climate by considering only past climate. Future projections from GCMs enable exploration of a range of plausible outcomes given the climate system's complex response to increasing atmospheric concentrations of greenhouse gases. Projections from GCMs should not be interpreted as predictions of the weather on a given date, but rather as projections of climate, which is the long-term statistical aggregate of weather.[1]

The projected direction and magnitude of change in values of climate variables in this report are best interpreted relative to the historical climate conditions under which a particular asset or system was designed to operate. For this reason, considering the projected changes between the historical and future periods allows one to envision how natural and human systems will respond to future climate conditions that are different from past conditions. In some cases, the projected change may be small enough for the existing system to accommodate. In other cases, the projected change may be large enough to require adjustments, or adaptations, to the existing system. However, engineering or design projects would require an analysis that is more detailed than the analyses described in this report.

The information in this report can be used to

- Explore a range of plausible future outcomes that take into consideration the climate system's complex response to increasing concentrations of greenhouse gases
- Envision how current systems may respond under climate conditions different from those under which the systems were designed to operate
- Inform evaluation of potential mitigation actions within hazard mitigation plans to accommodate future conditions
- Inform a risk assessment in terms of the likelihood of occurrence of a particular climate-related hazard

[1] Read more: https://nca2014.globalchange.gov/report/appendices/faqs#narrative-page-38784

Average Temperature

Oregon's average temperature warmed at a rate of 2.2°F per century from 1895 through 2019 (Dalton and Fleishman, 2021). Average temperature is expected to continue increasing during the twenty-first century if global emissions of greenhouse gases continue; the rate of warming depends on the level of emissions (IPCC, 2021). By the 2050s (2040–2069), relative to the 1970–1999 historical baseline, Oregon's average temperature is projected to increase by 3.6°F (range of 1.8–5.4°F) under a lower emissions scenario (RCP 4.5) and by 5.0°F (range of 2.9–6.9°F) under a higher emissions scenario (RCP 8.5) (Dalton *et al.*, 2017; Dalton and Fleishman, 2021). Furthermore, summers are projected to warm more than other seasons (Dalton *et al.*, 2017; Dalton and Fleishman, 2021).

During the twenty-first century, average temperature in Linn County is projected to warm at a rate similar to that of Oregon as a whole (Figure 3). Projected increases in average temperature in Linn County, relative to the 1971–2000 historical baseline in each global climate model (GCM), range from 1.0–3.4°F by the 2020s (2010–2039) and 1.5–6.6°F by the 2050s (2040–2069), depending on emissions scenario and GCM (Table 4).

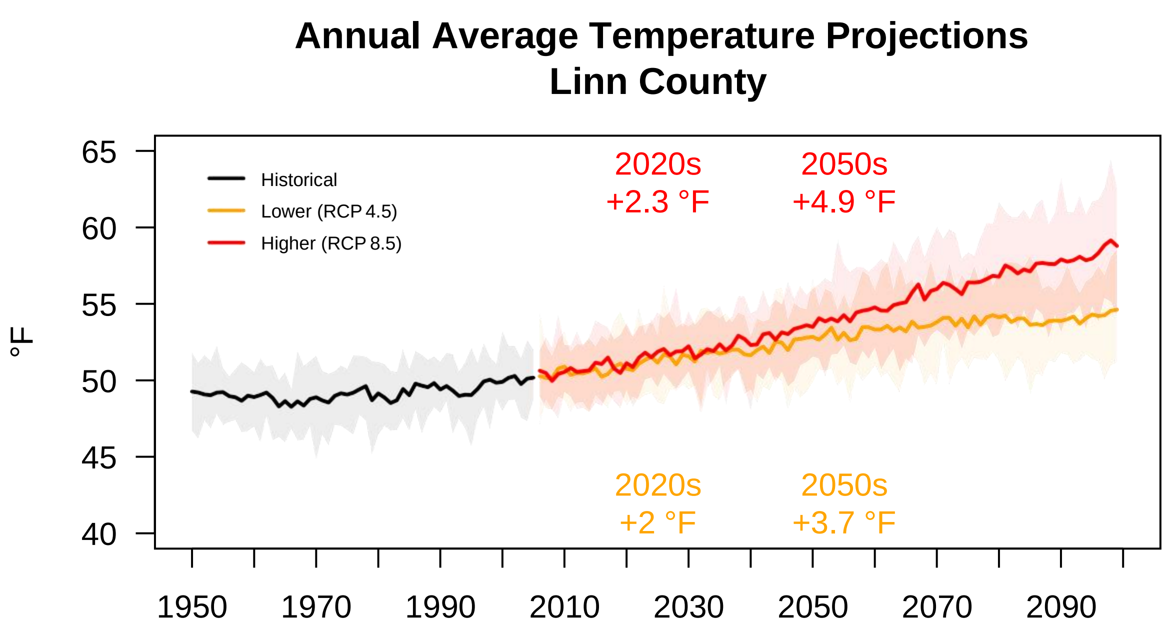

Figure 3. Projected annual average temperature in Linn County as simulated by 20 downscaled global climate models under a lower (RCP 4.5) and a higher (RCP 8.5) greenhouse gas emissions scenario. Solid lines and shading represent the 20-model mean and range, respectively. The figure shows the multiple-model mean differences between the average historical baseline (1971–2000 average) and the 2020s (2010–2039 average) and the 2050s (2040–2069 average).

Table 4. Projected future changes between the 1971–2000 baseline annual temperature in Linn County and annual temperature projected by each of 20 global climate models. Values are changes averaged across the 20 models (range in parentheses) for two emissions scenarios and two future time periods.

Emissions Scenario	2020s (2010–2039 average)	2050s (2040–2069 average)
Higher (RCP 8.5)	+2.3°F (1.4–3.4)	+4.9°F (2.8–6.6)
Lower (RCP 4.5)	+2.0°F (1.0–3.1)	+3.7°F (1.5–5.2)

Heat Waves

Extreme heat has become more frequent and intense worldwide since the 1950s, largely due to human-caused climate change (IPCC, 2021). The number, duration, and intensity of extreme heat events in Oregon is projected to increase due to continued warming temperatures. In fact, the temperature on the hottest days in summer is projected to increase even more than the mean summer temperature in the Northwest (Dalton *et al.*, 2017). Heat waves occur periodically as a result of natural variability in temperature, but human-caused climate change is increasing their severity (Vose *et al.*, 2017). In addition, evidence of increases in the number of summer extreme heat events that are defined by nighttime minimum temperatures is stronger than evidence of increases in the number of extreme heat events that are defined by maximum temperatures (Dalton and Fleishman, 2021).

Extreme heat can refer to days on which maximum or minimum temperatures are above a threshold, seasons in which temperatures are well above average, and heat waves, or multiple days on which temperature are above a threshold. This report presents projected changes in three metrics of extreme daytime heat (maximum temperature) and nighttime heat (minimum temperature) (Table 5).

Table 5. Metrics and definitions of heat extremes.

Metric	Definition
Hot Days	Number of days per year on which maximum temperature is 90°F or higher
Warm Nights	Number of days per year on which minimum temperature is 65°F or higher
Hottest Day	Highest value of maximum temperature per year
Warmest Night	Highest value of minimum temperature per year
Daytime Heat Waves	Number of events per year in which the maximum temperature on at least three consecutive days is 90°F or higher
Nighttime Heat Waves	Number of events per year in which the minimum temperature on at least three consecutive days is 65°F or higher

In Linn County, the number of hot days and warm nights, and the temperature on the hottest day and warmest night, are projected to increase by the 2020s (2010–2039) and 2050s (2040–2069) under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 6, Figure 4, Figure 5). For example, by the 2050s under the higher emissions scenario, the number of hot days, relative to each GCM's 1971–2000 historical baseline, is projected to increase by 5–29. The average number of hot days per year is projected to be 17 more than the average historical baseline of 4 days. The average number of warm nights per year is projected to be 4 more than the average historical baseline of virtually zero.

Similarly, under the higher emissions scenario, the temperature on the hottest day of the year is projected to increase by 1.9–9.8°F by the 2050s relative to the GCMs' historical baselines. The average projected increase in temperature on the hottest day is 6.8°F above the average historical baseline of 91.4°F. The average projected increase in temperature on the warmest night is 5.8°F above the average historical baseline of 61.3°F.

Under the higher emissions scenario, the numbers of daytime and nighttime heat waves are projected to increase by 0.8–3.4 and 0.0–1.8, respectively, by the 2050s relative to the GCMs' historical baselines. The average number of daytime and nighttime heat waves is projected to increase by 2.5 and 0.5, respectively, above the average historical baselines of 0.5 and zero (Table 6, Figure 6).

Table 6. Projected future changes in extreme heat metrics in Linn County. Changes from the 1971–2000 baseline were calculated for each of 20 global climate models and averaged across the 20 models (range in parentheses) for a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario and for the 2020s (2010–2039 average) and 2050s (2040–2069 average). The 20-model average projected future change can be added to the 20-model average historical baseline to infer the average projected future value of a given variable.

	Average Historical Baseline	2020s		2050s	
		Lower	Higher	Lower	Higher
Hot Days	3.7 days	4.2 days (1.6-7.4)	5.8 days (2.5-8.3)	10.6 days (4.5-17.5)	17.4 days (4.9-28.6)
Warm Nights	0.3 days	0.5 days (0-1.3)	0.7 days (0-1.5)	1.7 days (0.1-4.5)	3.8 days (0.8-10.3)
Hottest Day	91.4°F	2.5°F (0.6-4)	3.2°F (1.1-5.4)	5.1°F (2.1-8.6)	6.8°F (1.9-9.8)
Warmest Night	61.3°F	2°F (0-3.8)	2.5°F (0.9-3.6)	4°F (1.2-6.8)	5.8°F (2.6-8.8)
Daytime Heat Waves	0.5 events	0.7 events (0.2-1.2)	0.9 events (0.4-1.4)	1.6 events (0.8-2.5)	2.5 events (0.8-3.5)
Nighttime Heat Waves	0 events	0 events (0-0.2)	0.1 events (0-0.2)	0.2 events (0-0.5)	0.5 events (0-1.3)

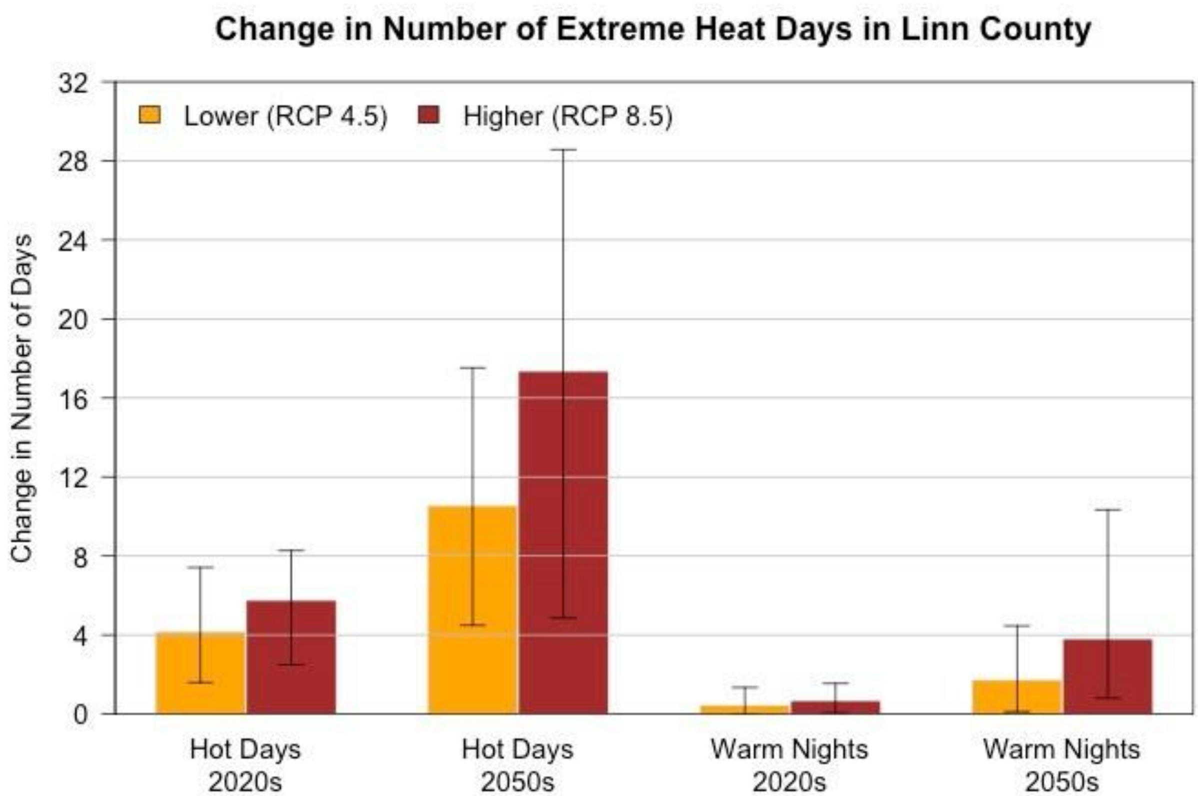

Figure 4. Projected changes in the number of hot days (left two sets of bars) and warm nights (right two sets of bars) in Linn County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged across the 20 models. Whiskers represent the range of changes across the 20 models. Hot days are those on which the maximum temperature is 90°F or higher; warm nights are those on which the minimum temperature is 65°F or higher.

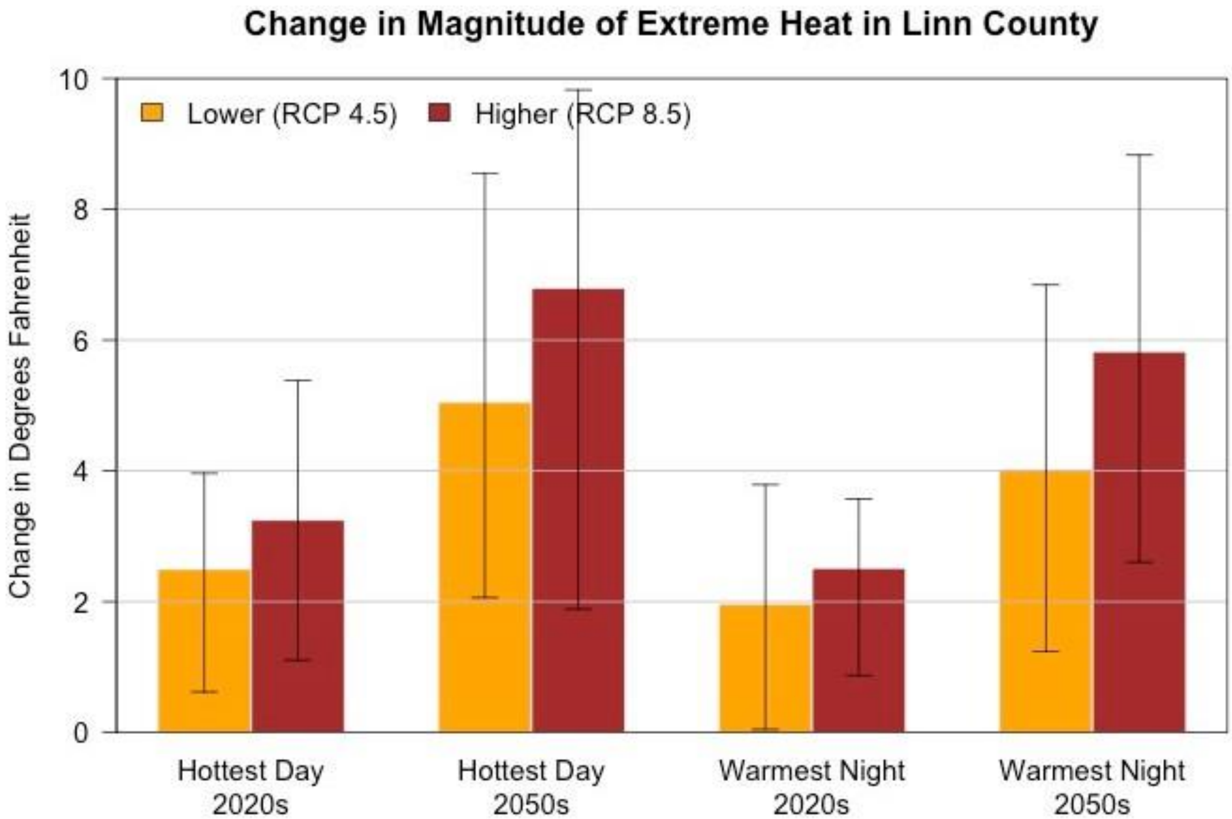

Figure 5. Projected changes in the temperature on the hottest day of the year (left two sets of bars) and warmest night of the year (right two sets of bars) in Linn County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged across the 20 models. Whiskers represent the range of changes across the 20 models.

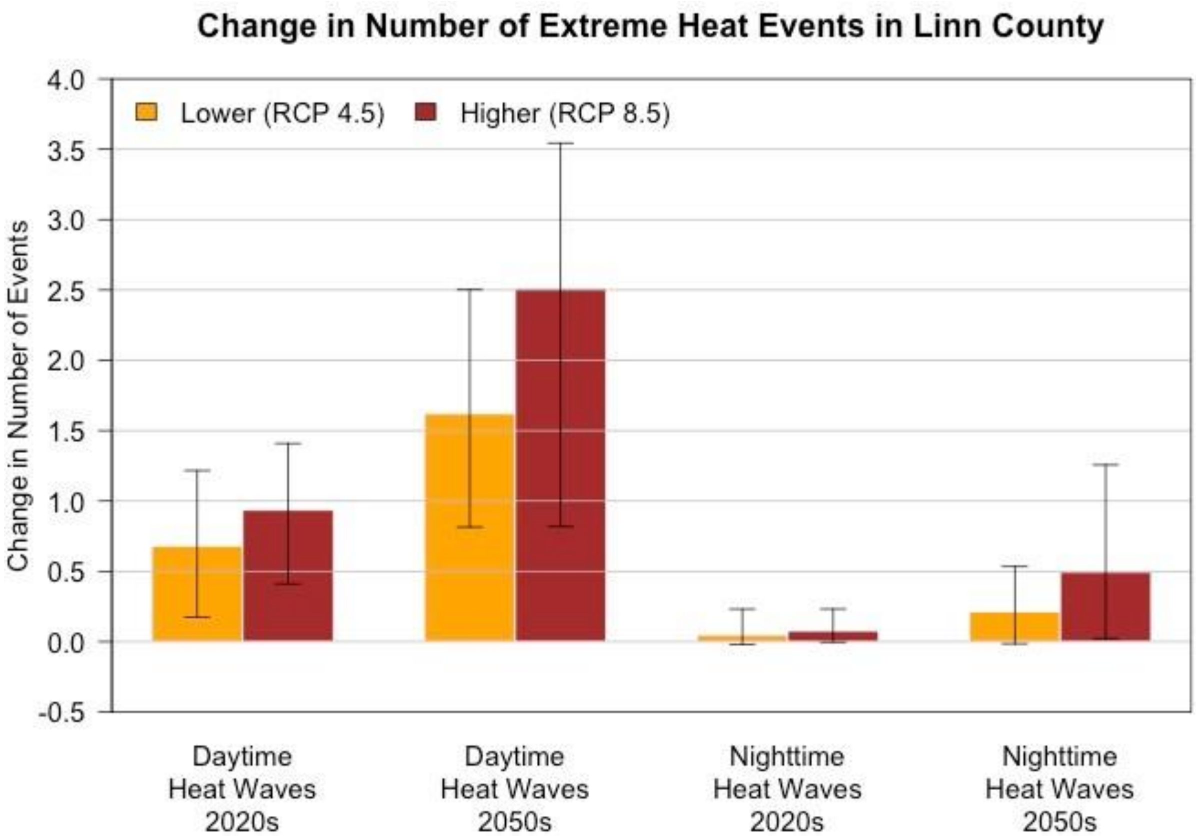

Figure 6. Projected changes in the number of daytime heat waves (left two sets of bars) and nighttime heat waves (right two sets of bars) in Linn County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged across the 20 models. Whiskers represent the range of changes across the 20 models. Daytime heat waves are defined as three or more consecutive days on which the maximum temperature is 90°F or higher; nighttime heat waves are three or more consecutive days on which the minimum temperature is 65°F or higher.

Key Messages

⇒ The number, duration, and intensity of extreme heat events will increase as temperatures continue to warm.

⇒ In Linn County, the number of extremely hot days (days on which the temperature is 90°F or higher) and the temperature on the hottest day of the year are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios.

⇒ In Linn County, the number of days per year with temperatures 90°F or higher is projected to increase by an average of 17 days (range 5–29 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

⇒ In Linn County, the temperature on the hottest day of the year is projected to increase by an average of about 7°F (range 2–10°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Cold Waves

Over the past century, cold extremes have become less frequent and severe in the Northwest and worldwide. This trend is driven by human-caused climate change and is expected to continue (Vose *et al.*, 2017; IPCC, 2021). This report presents projected changes in three metrics of extreme daytime cold (maximum temperature) and nighttime cold (minimum temperature) (Table 7).

Table 7. Metrics and definitions of cold extremes.

Metric	Definition
Cold Days	Number of days per year on which the maximum temperature is 32°F or lower
Cold Nights	Number of days per year on which the minimum temperature is 0°F or lower
Coldest Day	Lowest value of maximum temperature per year
Coldest Night	Lowest value of minimum temperature per year
Daytime Cold Waves	Number of events per year in which maximum temperature on at least three consecutive days is 32°F or lower
Nighttime Cold Waves	Number of events per year in which minimum temperature on at least three consecutive days is 0°F or lower

In Linn County, the number of cold days and nights is projected to decrease by the 2020s (2010–2039) and 2050s (2040–2069) under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 8, Figure 7). For example, climate models projected that by the 2050s under the higher emissions scenario, the number of cold days will decrease by 2–5 relative to each GCM's 1971–2000 historical baseline. The average projected number of cold days per year is 4 less than the average historical baseline of 5 days. Nighttime temperatures rarely are lower than 0°F in Linn County.

Similarly, the temperatures on the coldest day and night are projected to increase by the 2020s and 2050s under both emissions scenarios (Table 8, Figure 8). For example, by the 2050s under the higher emissions scenario, the temperature on the coldest night of the year is projected to increase by 0.6–10.5°F relative to the GCMs' historical baselines. The average projected increase in the temperature on the coldest night is 6.0°F above the average historical baseline of 13.4°F. The average projected increase in the temperature on the coldest day is 4.9°F above the average historical baseline of 29.1°F. However, daytime and nighttime cold waves are rare in Linn County (Table 8, Figure 7, Figure 9).

Table 8. Projected future changes in extreme cold metrics in Linn County. Changes from the 1971–2000 baseline were calculated for each of 20 global climate models and averaged across the 20 models (range in parentheses) for a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario and for the 2020s (2010–2039 average) and 2050s (2040–2069 average). The 20-model average projected future change can be added to the 20-model average historical baseline to infer the average projected future value of a given variable.

	Average Historical Baseline	2020s		2050s	
		Lower	Higher	Lower	Higher
Cold Days	5 days	-1.6 days (-3.3 - 0.6)	-2.3 days (-3.7 - -0.8)	-3 days (-4.2 - -1.3)	-3.5 days (-5 - -1.6)
Cold Nights	0.2 days	0 days (-0.1 - 0.3)	0 days (-0.1 - 0.2)	-0.1 days (-0.2 - 0.1)	-0.1 days (-0.2 - 0)
Coldest Day	29.1°F	1.2°F (-2.8 - 3.3)	2.4°F (-1.4 - 4.8)	3.8°F (0.3 - 7.2)	4.9°F (1.3 - 8.2)
Coldest Night	13.4°F	1.6°F (-1.6 - 5.4)	3.2°F (-0.5 - 7.4)	4.8°F (0.8 - 8.8)	6°F (0.6 - 10.5)
Daytime Cold Waves	0.6 events	-0.2 events (-0.4 - 0.1)	-0.3 events (-0.5 - -0.1)	-0.4 events (-0.5 - -0.1)	-0.4 events (-0.6 - -0.2)
Nighttime Cold Waves	0 events	0 events (0 - 0.1)	0 events (0 - 0)	0 events (0 - 0)	0 events (0 - 0)

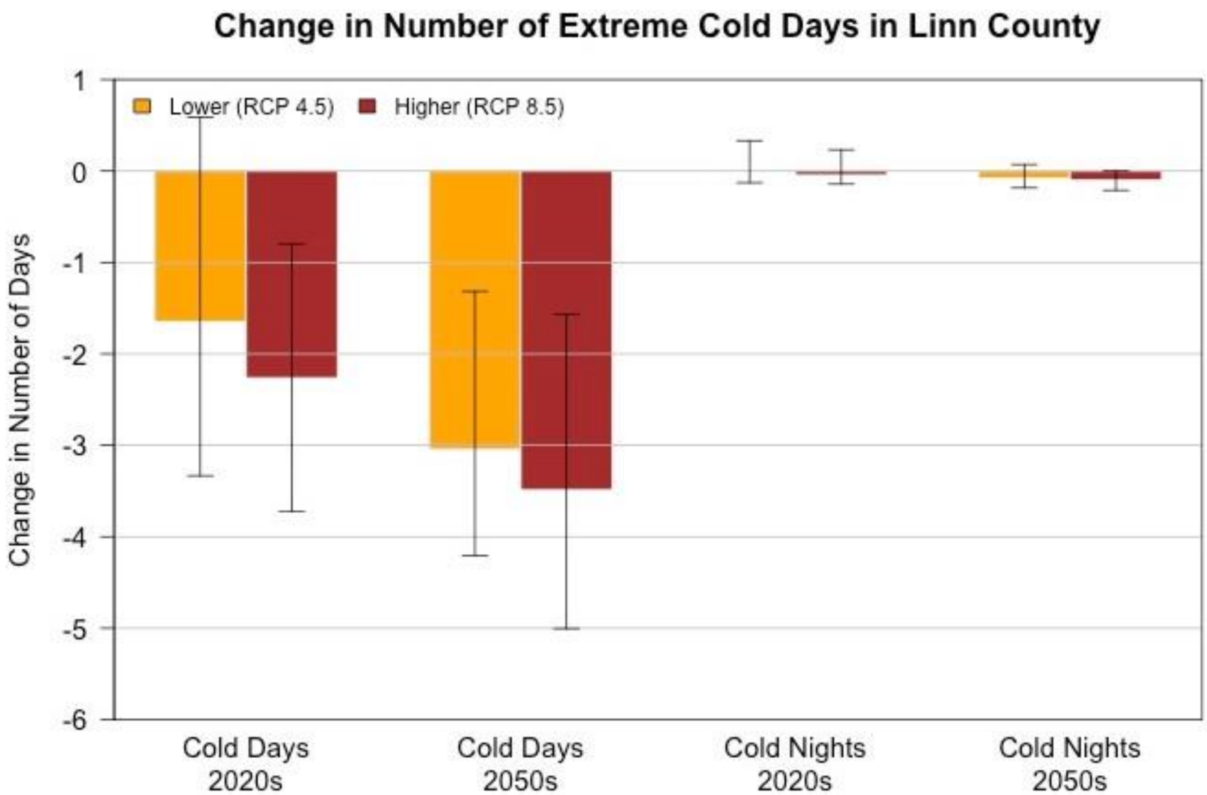

Figure 7. Projected changes in the number of cold days (left two sets of bars) and cold nights (right two sets of bars) in Linn County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged across the 20 models. Whiskers represent the range of changes across the 20 models. Cold days are those on which the maximum temperature is 32°F or lower; cold nights are those on which the minimum temperature is 0°F or lower.

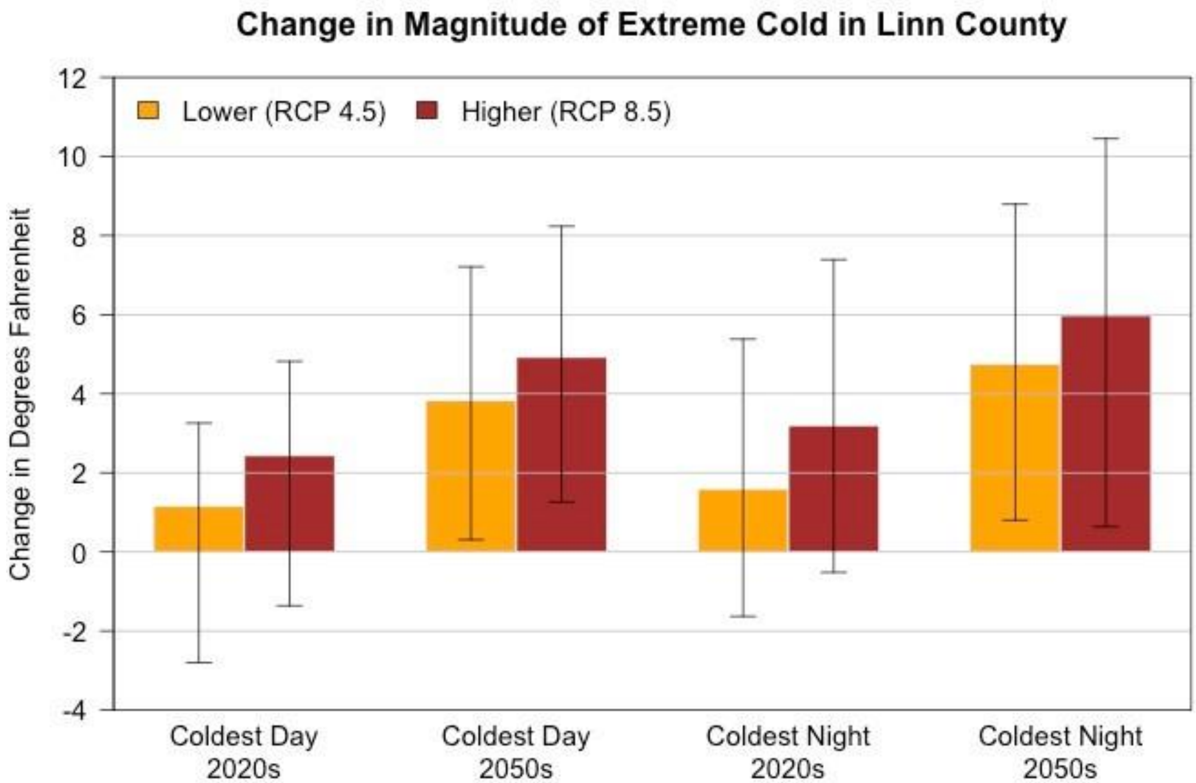

Figure 8. Projected changes in the temperature on the coldest day of the year (left two sets of bars) and coldest night of the year (right two sets of bars) in Linn County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged across the 20 models. Whiskers represent the range of changes across the 20 models.

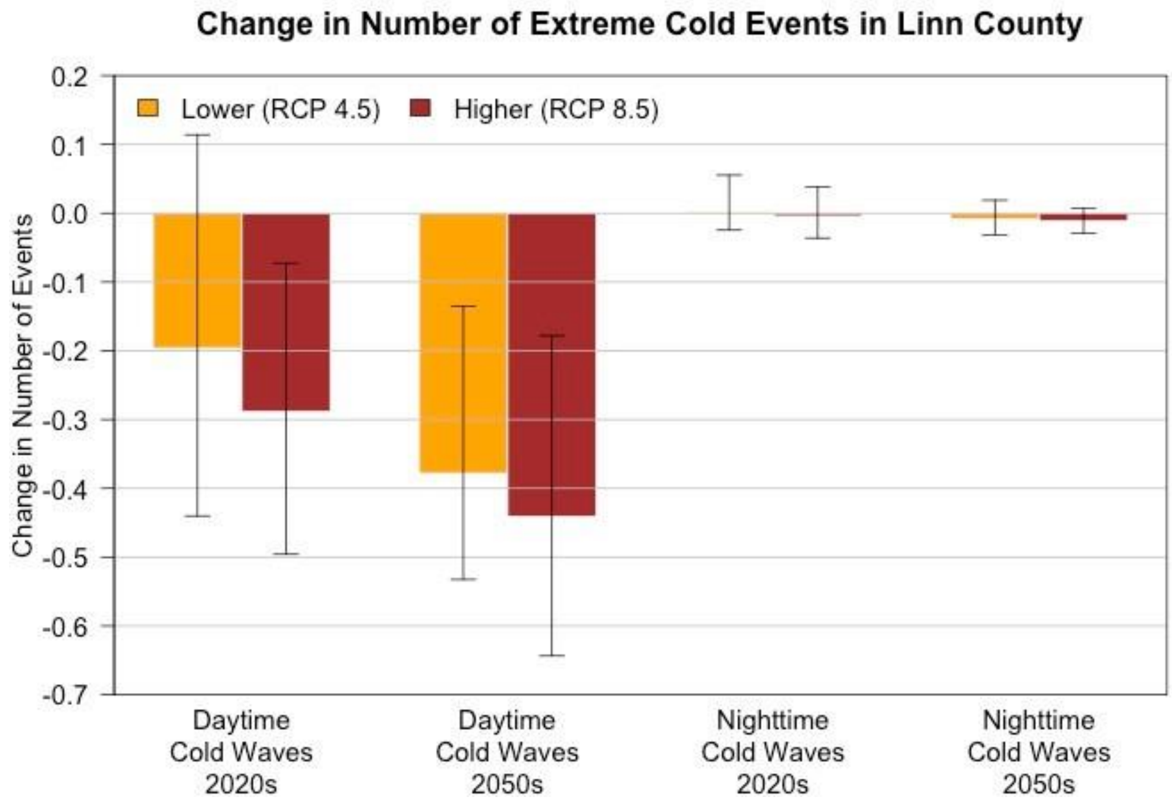

Figure 9. Projected changes in the number of daytime cold waves (left two sets of bars) and nighttime cold waves (right two sets of bars) in Linn County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged across the 20 models. Whiskers represent the range of changes across the 20 models. Daytime cold waves are defined as three or more consecutive days on which the maximum temperature is 32°F or lower; nighttime cold waves are three or more consecutive days on which the minimum temperature is 0°F or lower.

Key Messages

⇒ Cold extremes will become less frequent and intense as the climate warms.

⇒ In Linn County, the number of cold days (maximum temperature 32°F or lower) per year is projected to decrease by an average of 4 days (range -2– -5 days) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

⇒ In Linn County, the temperature on the coldest night of the year is projected to increase by an average of 6°F (range 1–11°F) by the 2050s, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

Heavy Rains

There is greater uncertainty in projections of future precipitation than projections of future temperature. Precipitation has high natural variability, and the atmospheric patterns that influence precipitation are represented differently among GCMs. Globally, mean precipitation is likely to decrease in many dry regions in the subtropics and mid-latitudes and to increase in many mid-latitude wet regions (IPCC, 2013; Stevenson *et al.*, 2022). Because the location of the mid-latitude boundary between mid-latitude increases and decreases in precipitation varies among GCMs, some models project increases and others decreases in precipitation in Oregon (Mote *et al.*, 2013).

Observed annual precipitation in Oregon has high year-to-year variability and has not changed significantly over the period of record; future changes in annual precipitation are expected to be dominated by natural variability (Dalton *et al.*, 2017; Dalton and Fleishman, 2021). On average, summers in Oregon are projected to become drier and other seasons to become wetter, resulting in a slight increase in annual precipitation by the 2050s. However, some models project increases and others decreases in each season (Dalton *et al.*, 2017). In addition, regional climate models project larger increases in winter precipitation east of the Cascade Range than west of the Cascade Range, which suggests a weakened rain shadow effect in winter (Mote *et al.*, 2019).

Extreme precipitation events in the Northwest are governed by atmospheric circulation and its interaction with complex topography (Parker and Abatzoglou, 2016). Atmospheric rivers—long, narrow swaths of warm, moist air that carry large amounts of water vapor from the tropics to mid-latitudes—generally result in extreme precipitation events across large areas west of the Cascade Range, and are associated with the majority of fall and winter extreme precipitation events in Oregon. By contrast, low pressure systems that are not driven by westerly flows from offshore often lead to locally extreme precipitation east of the Cascade Range (Parker and Abatzoglou, 2016).

The frequency and intensity of heavy precipitation has increased across most land areas worldwide since the 1950s (IPCC, 2021). Observed trends in the frequency of extreme precipitation events across Oregon vary among locations, time periods, and metrics, but overall, the frequency has not changed substantially. As the atmosphere warms, it holds more water vapor. As a result, the frequency and intensity of extreme precipitation, including atmospheric rivers, is expected to increase (Dalton *et al.*, 2017; Kossin *et al.*, 2017; Dalton and Fleishman, 2021). Regional climate models project a larger increase in precipitation extremes east of the Cascade Range than west of the Cascade Range (Mote *et al.*, 2019). Climate models project an increase in the number of days on which an atmospheric river is present, and that atmospheric rivers will account for an increasing proportion of total annual precipitation across the Northwest (Dalton and Fleishman, 2021). This report presents projected changes in four metrics of precipitation extremes (Table 9).

Table 9. Metrics and definitions of precipitation extremes.

Metric	Definition
Wettest Day	Highest one-day precipitation total per water year (1 October–30 September)
Wettest Five Days	Highest consecutive five-day precipitation total per water year
Wet Days	Number of days per water year on which precipitation exceeds 0.75 inches
Landslide Risk Days	Number of days per water year that exceed the landslide threshold developed by the US Geological Survey for Seattle, Washington (see https://pubs.er.usgs.gov/publication/ofr20061064). P3/(3.5-.67*P15)>1, where P3 = Precipitation accumulation on prior days 1–3 ▪ P15 = Precipitation accumulation on prior days 4–18

In Linn County, the amount of precipitation on the wettest day and wettest consecutive five days is projected to increase on average by the 2020s (2010–2039) and 2050s (2040–2069), relative to the 1971–2000 historical baseline, under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 10, Figure 10). However, some models project decreases in these metrics for certain time periods and scenarios.

Climate models project that by the 2050s under the higher emissions scenario, the amount of precipitation on the wettest day of the year, relative to each GCM's 1971–2000 historical baseline, will change by -0.6–34.9% (Figure 10). The average projected amount of precipitation on the wettest day of the year is 13.7% greater than the average historical baseline of 2.7 inches.

Climate models project that by the 2050s under the higher emissions scenario, the amount of precipitation on the wettest consecutive five days of the year will change by -0.9–21.5% (Figure 10). The average projected amount of precipitation on the wettest consecutive five days is 9.6% above the average historical baseline of 6.9 inches.

The average number of days per year on which precipitation exceeds 0.75 inches is not projected to change substantially (Figure 11). For example, by the 2050s under the higher emissions scenario, the number of wet days per year is projected to increase by 0.5 (range -4.5–3.7). The historical baseline is an average of 27 days per year.

Landslides are often triggered by rainfall when the soil becomes saturated. As a surrogate measure of landslide risk, this report presents a threshold based on recent rainfall (cumulative precipitation over the previous 3 days) and antecedent precipitation (cumulative precipitation on the 15 days prior to the previous 3 days). By the 2050s under the higher emissions scenario, the average number of days per year in Linn County on which the landslide risk threshold is exceeded is projected to remain about the same, with a change of -0.5 days (range -3.1–3.5 days) (Figure 11). The historical baseline is an average of 31 days per year. Landslide risk depends on multiple site-specific factors, and this metric does not reflect all aspects of the hazard. The landslide risk threshold was developed for Seattle, Washington, and may be less applicable to other locations.

Landslide risk also can become high when heavy precipitation falls on an area that burned within approximately the past five to ten years. The probability that an extreme rainfall event will occur within one year after an extreme fire-weather event in Oregon or Washington was projected to increase by 700% from 1980–2005 to 2100 under the higher emissions scenario (Touma *et al.*, 2022). Similarly, projections suggest that by 2100, 90% of extreme fire-weather events across Oregon and Washington are likely to be succeeded within five years by three or more extreme rainfall events (Touma *et al.*, 2022). Although fire weather is not synonymous with wildfire, these results highlight the increasing likelihood of compounded climate extremes that elevate the risk of natural hazards.

Table 10. Projected future changes in extreme precipitation metrics in Linn County. Changes from the 1971–2000 baseline were calculated for each of 20 global climate models and averaged across the 20 models (range in parentheses) for a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario and for the 2020s (2010–2039 average) and 2050s (2040–2069 average). The 20-model average projected future change can be added to the 20-model average historical baseline to infer the average projected future value of a given variable.

	Average Historical Baseline	2020s		2050s	
		Lower	Higher	Lower	Higher
Wettest Day	2.7 inches	7.9% (-6-21.4)	5.7% (-5.4-21.2)	11.6% (2.4-23.3)	13.7% (-0.6-34.9)
Wettest Five-Days	6.9 inches	5.2% (-7.8-17.9)	3.4% (-7.3-17.9)	8.2% (-3.4-24.8)	9.6% (-0.9-21.5)
Wet Days	27.4 days	0.3 days (-2.3-2.6)	-0.3 days (-3.6-1.6)	0.6 days (-3.4-3.4)	0.5 days (-4.5-3.7)
Landslide Risk Days	31 days	-0.2 days (-3.5-3.2)	-0.5 days (-3-1.7)	-0.7 days (-3.8-1.9)	-0.5 days (-3.1-3.5)

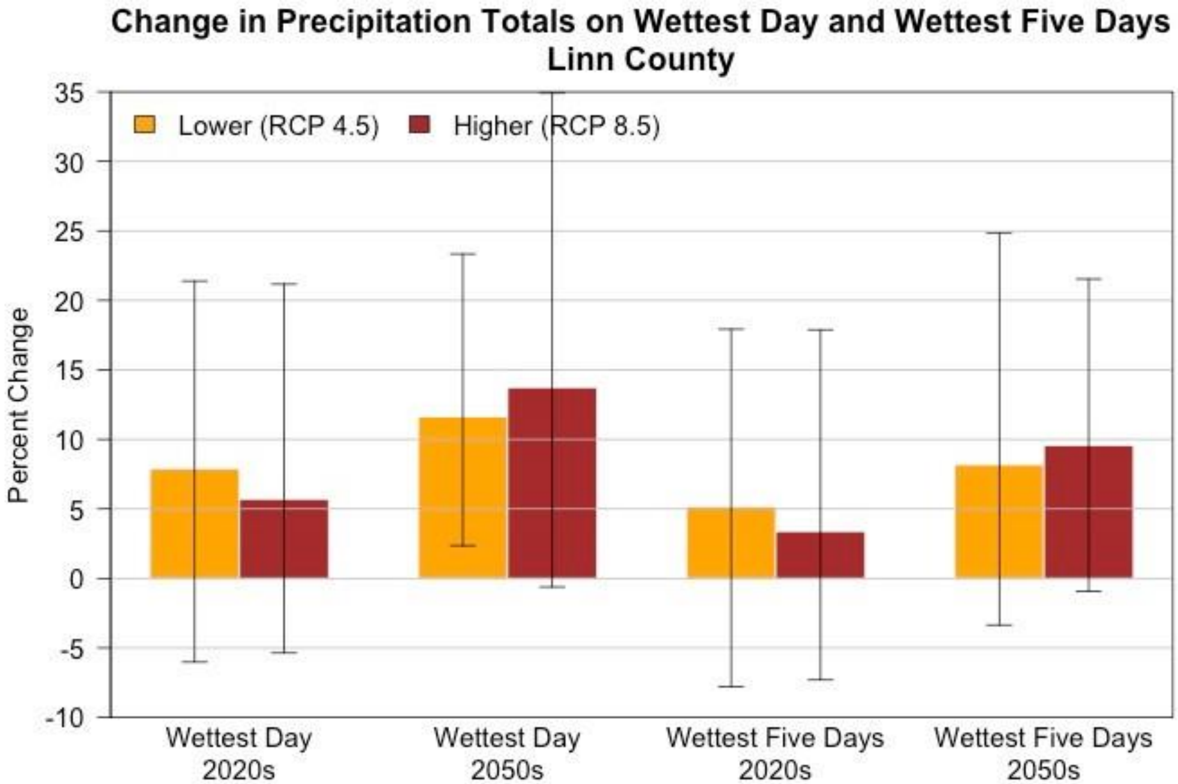

Figure 10. Projected percent changes in the amount of precipitation on the wettest day of the year (left two sets of bars) and wettest consecutive five days of the year (right two sets of bars) in Linn County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged across the 20 models. Whiskers represent the range of changes across 20 models.

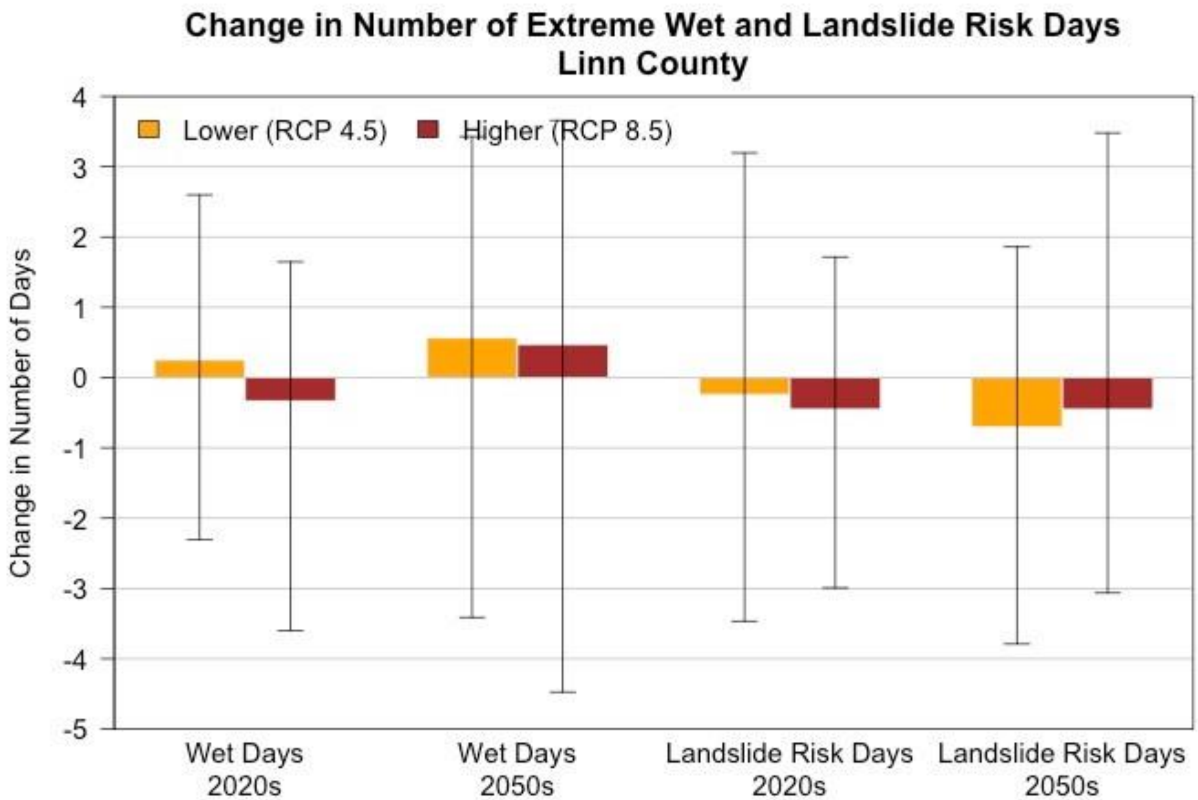

Figure 11. Projected changes in the number of wet days (left two sets of bars) and landslide risk days (right two sets of bars) in Linn County by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the historical baseline (1971–2000 average), under two emissions scenarios. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged across the 20 models. Whiskers represent the range of changes across the 20 models.

Key Messages

⇒ The intensity of extreme precipitation is expected to increase as the atmosphere warms and holds more water vapor.

⇒ In Linn County, the number of days per year with at least 0.75 inches of precipitation is not projected to change substantially. However, by the 2050s, the amount of precipitation on the wettest day and wettest consecutive five days per year is projected to increase by an average of 14% (range -1–35%) and 10% (range -1–22%), respectively, relative to the 1971–2000 historical baselines, under the higher emissions scenario.

⇒ In Linn County, the number of days per year on which a threshold for landslide risk, which is based on prior 18-day precipitation accumulation, is exceeded is not projected to change substantially. However, landslide risk depends on multiple factors, and this metric does not reflect all aspects of the hazard.

Streams in the Northwest are projected to shift toward higher winter runoff, lower summer and fall runoff, and earlier peak runoff, particularly in snow-dominated regions (Raymondi *et al.*, 2013; Naz *et al.*, 2016). These changes are expected to result from increases in the intensity of heavy precipitation; warmer temperatures that cause more precipitation to fall as rain and less as snow, in turn causing snow to melt earlier in spring; and increasing winter precipitation and decreasing summer precipitation (Dalton *et al.*, 2017; Mote *et al.*, 2019; Dalton and Fleishman, 2021).

Warming temperatures and increasing winter precipitation are expected to increase flood risk in many basins in the Northwest, particularly mid- to low-elevation mixed rain-and-snow basins in which winter temperatures are near freezing (Tohver *et al.*, 2014). The greatest projected changes in peak streamflow magnitudes are at intermediate elevations in the Cascade Range and Blue Mountains (Safeeq *et al.*, 2015). Recent regional hydroclimate models project increases in extreme high flows throughout most of the Northwest, especially west of the Cascade crest (Salathé *et al.*, 2014; Najafi and Moradkhani, 2015; Naz *et al.*, 2016). One study, which used a single climate model, projected an increase in flood risk in fall due to earlier, more extreme storms, including atmospheric rivers; and an increase in the proportion of precipitation falling as rain rather than snow (Salathé *et al.*, 2014). Rainfall-driven floods are more sensitive to increases in precipitation than snowmelt-driven floods. Therefore, the projected increases in total precipitation, and in rain relative to snow, likely will increase flood magnitudes in the region (Chegwidden *et al.*, 2020).

This report presents monthly hydrographs of the Santiam River at Detroit Dam (Figure 12), the Middle Fork Santiam River at Green Peter Reservoir (Figure 13), and the South Santiam River at Foster Reservoir (Figure 14). All three locations are within mixed rain-and-snow basins in which flow peaks during winter and, to a lesser degree, during spring snowmelt. By the 2050s (2040–2069), under both emissions scenarios, the monthly hydrographs are projected to shift as the basins become rain-dominated. Winter streamflow is projected to increase due to increased winter precipitation, and the snowpack will melt earlier as temperatures increase and a greater percentage of precipitation falls as rain rather than snow. Mean monthly flows do not translate directly to flood risk because floods occur over shorter periods of time. However, increases in monthly flow may imply increases in flood likelihood, particularly if increases are projected to occur during months in which flood occurrence historically has been high.

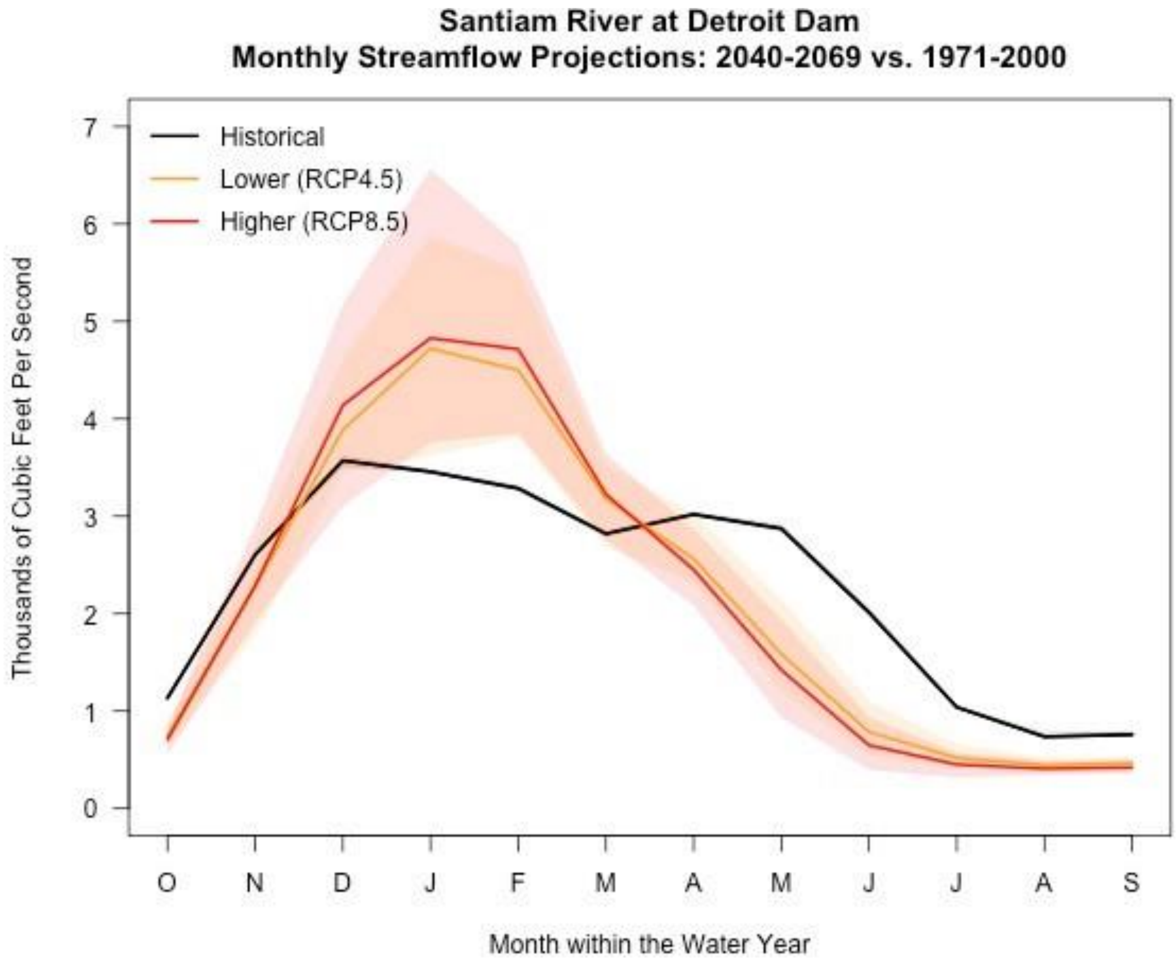

Figure 12. Simulated monthly, bias-corrected, non-regulated streamflow at the Santiam River at Detroit Dam in 2040–2069 compared to 1971–2000. Solid lines and shading represent the mean and range across ten global climate models. (Data source: Integrated Scenarios of the Future Northwest Environment, https://climatetoolbox.org/tool/future-streamflows)

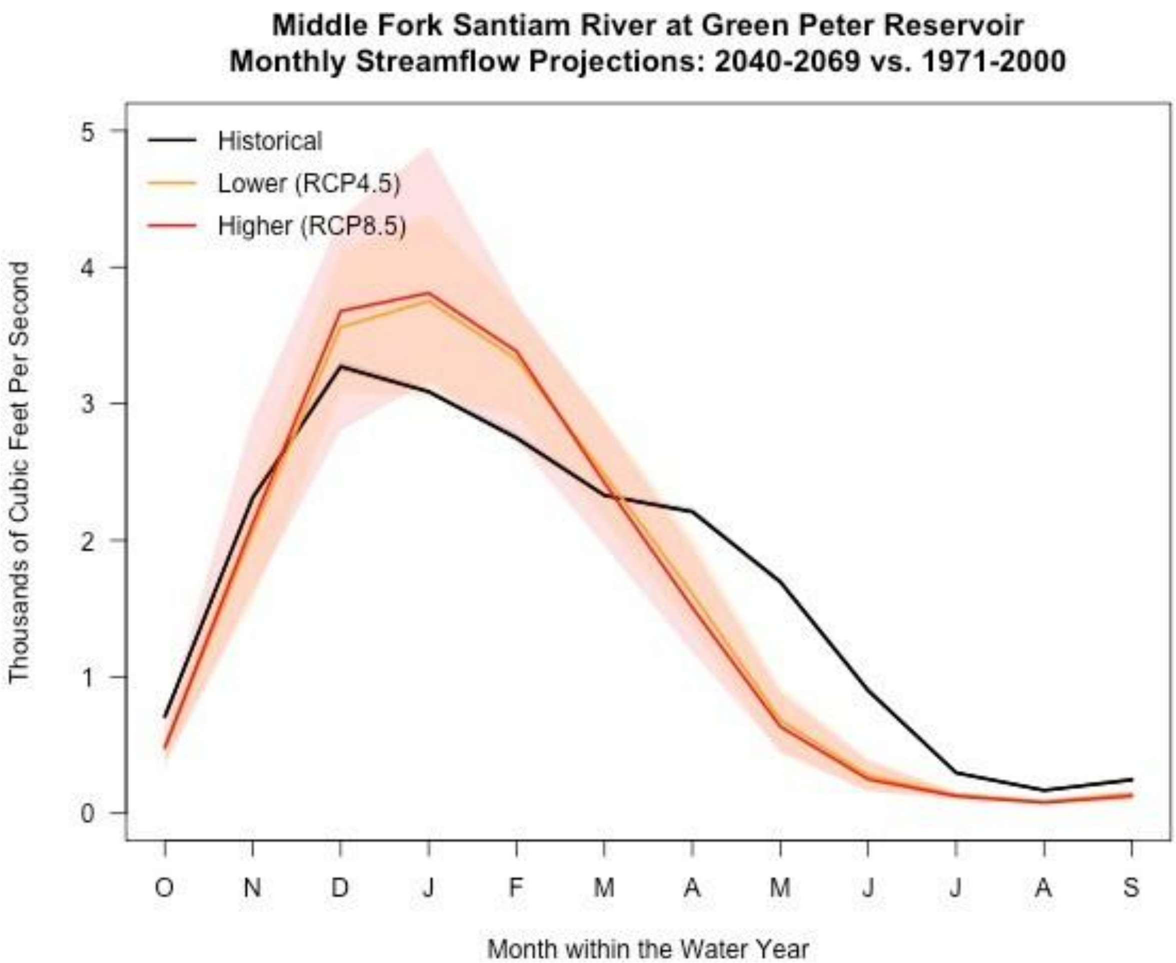

Figure 13. Simulated monthly, bias-corrected, non-regulated streamflow at the Middle Fork Santiam River at Green Peter Reservoir in 2040–2069 compared to 1971–2000. Solid lines and shading represent the mean and range across ten global climate models. (Data source: Integrated Scenarios of the Future Northwest Environment, https://climatetoolbox.org/tool/future-streamflows)

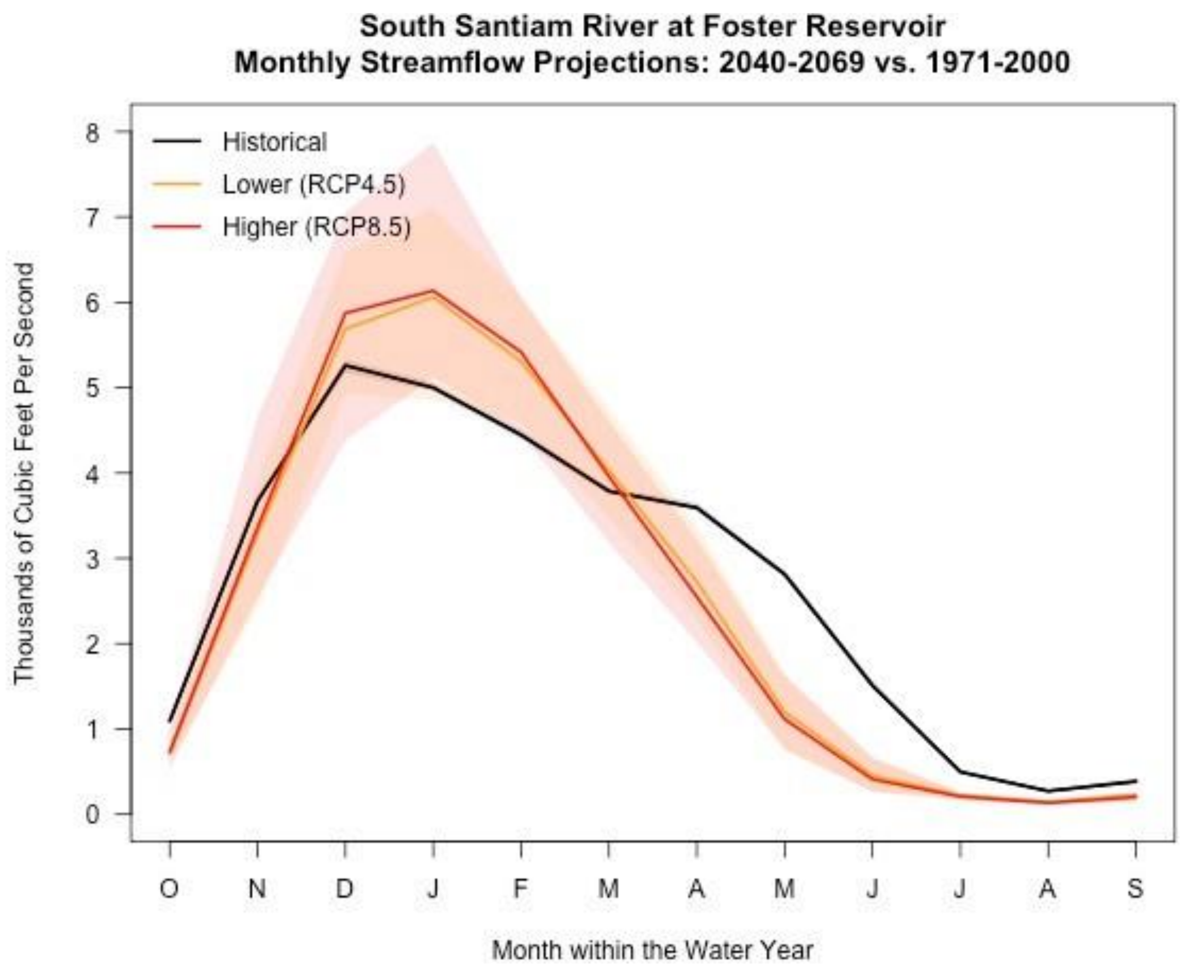

Figure 14. Simulated monthly, bias-corrected, non-regulated streamflow at the South Santiam River at Foster Reservoir in 2040–2069 compared to 1971–2000. Solid lines and shading represent the mean and range across ten global climate models. (Data source: Integrated Scenarios of the Future Northwest Environment, https://climatetoolbox.org/tool/future-streamflows)

Averaged across the western United States, major floods are projected to increase by 14–19% by the 2020s, 21–30% by 2040–2069, and 31–43% by 2070–2099, compared to the 1971–2000 historical baseline, under the higher emissions scenario (Maurer *et al.*, 2018). Major floods are defined as daily peak flow magnitudes that are associated with 100-year to 10-year return periods (1–10% probability that this daily flow magnitude will be exceeded in a given year). This report describes projected changes in single-day flood levels for three locations in Linn County in terms of the magnitude of water-year maximum daily flows with 2-year, 10-year, and 25-year return periods (50%, 10%, and 4% probability, respectively, that this daily flow magnitude will be exceeded in a given year) (Table 11). Flood magnitudes are compared between a historical baseline period (1961–2010 or 1950–1999) and the 2050s (2031–2080). The results of the flood analysis can be interpreted as either an increase in flood magnitude given a flood frequency, or an increase in flood frequency given a flood magnitude. These analyses are exploratory and should not be applied to engineering or design.

Table 11. Percent change in peak flow associated with multiple return periods for three locations in Linn County by 2031–2080, relative to 1961–2010, under the higher emissions scenario. (Source: David Rupp, Oregon Climate Change Research Institute)

Return Period (Probability that this level will be exceeded in a given year)	Average Percent Change in Flow		
	Santiam River at Detroit Dam	Middle Fork Santiam River at Green Peter Reservoir	South Santiam River at Foster Reservoir
2-year (50%)	11.2	3.7	2.5
10-year (10%)	9.4	5.0	5.2
25-Year (4%)	8.9	11.7	11.0

On the Santiam River at Detroit Dam, the average magnitudes of single-day floods with 2-year, 10-year, and 25-year return periods were projected to increase by 11%, 9%, and 9%, respectively, by the 2050s, compared to 1961–2010, under the higher emissions scenarios (RCP 8.5) (Figure 15, Table 11). On the Middle Fork Santiam River at Green Peter Reservoir, the average magnitudes of single-day floods with 2-year, 10-year, and 25-year return periods were projected to increase by 4%, 5%, and 12%, respectively, by the 2050s, compared to 1961–2010, under the higher emissions scenarios (RCP 8.5) (Figure 16, Table 11). On the South Santiam River at Foster Reservoir, the average magnitudes of single-day floods with 2-year, 10-year, and 25-year return periods were projected to increase by 3%, 5%, and 11%, respectively, by the 2050s, compared to 1961–2010, under the higher emissions scenarios (RCP 8.5) (Figure 17, Table 11). However, a few models projected no change or decreases in the magnitude of maximum daily flows for each return period.

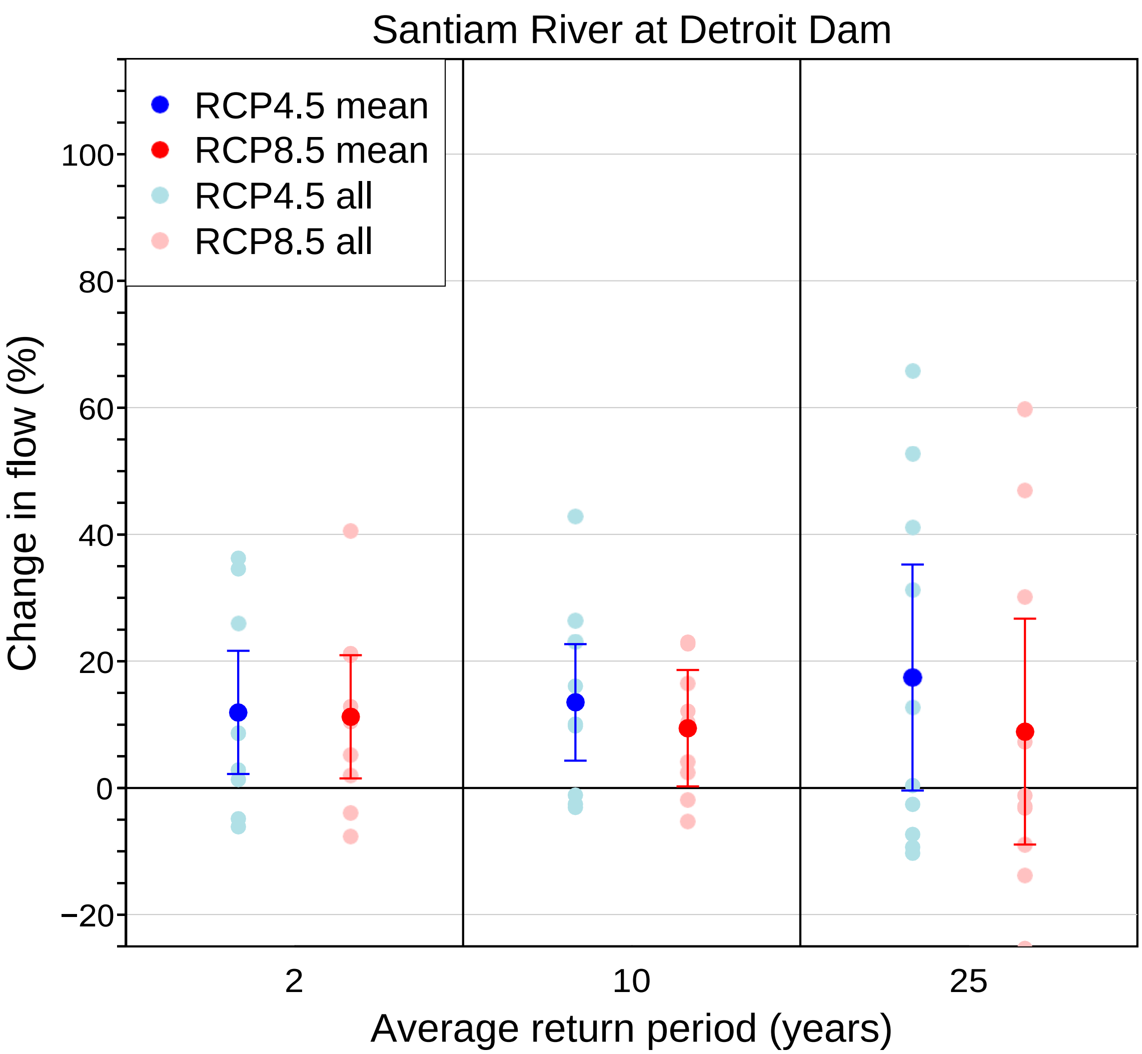

Figure 12. Projected change in water-year maximum daily, non-regulated streamflows with 2-year, 10-year, and 25-year return periods along the Santiam River at Detroit Dam from 1961–2010 to 2031–2080 under lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. Larger blue and red dots and bars represent the mean and two standard errors across ten global climate models. Only ten models simulated future hydrology out of the full set of 20 models that were used to project temperature and precipitation (see Appendix). Smaller light blue and light red dots represent projections from individual models. (Data source: Integrated Scenarios of the Future Northwest Environment, https://climate.northwestknowledge.net/IntegratedScenarios/; Figure source: David Rupp, OCCRI)

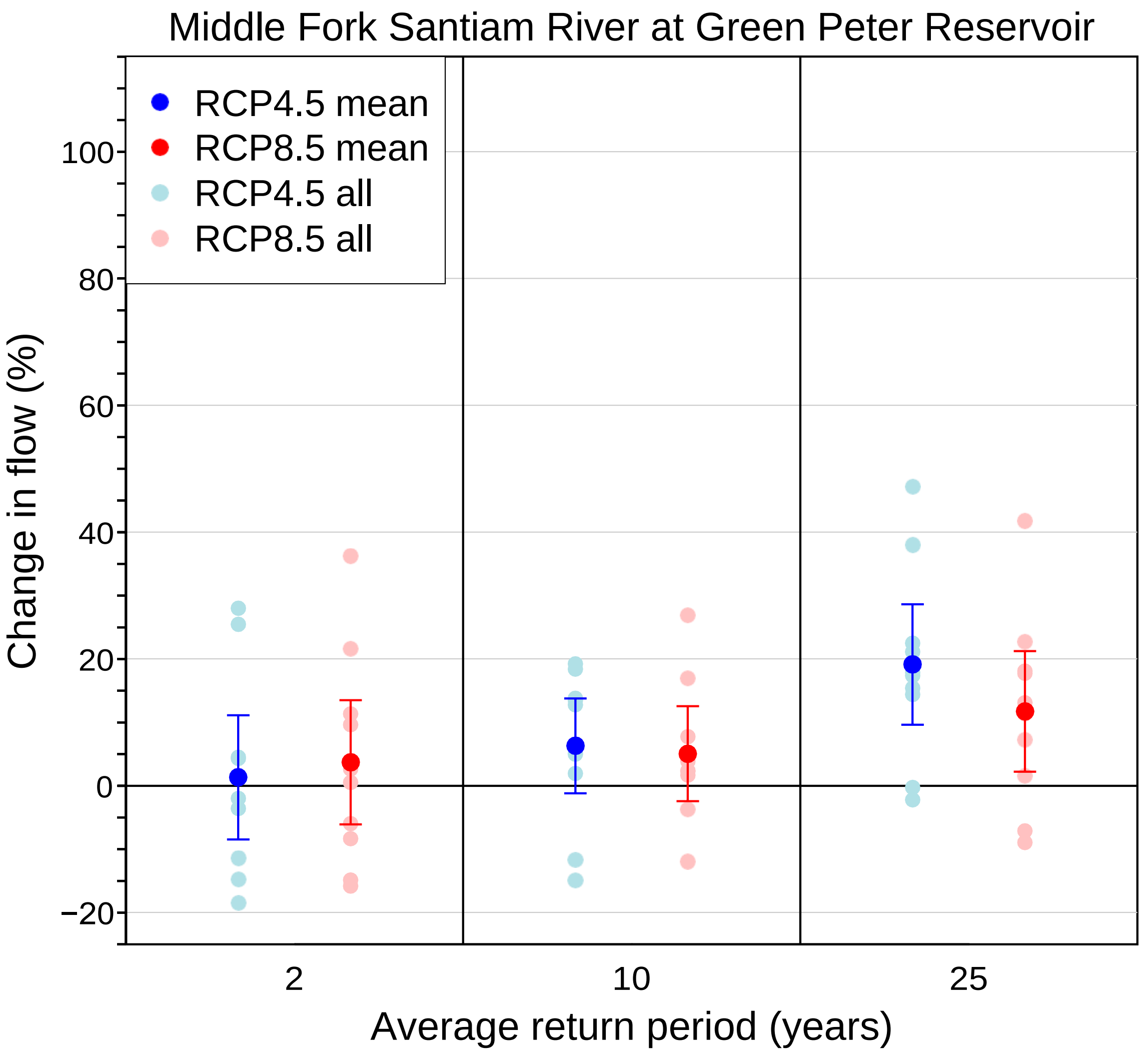

Figure 16. Projected change in water-year maximum daily, non-regulated streamflows with 2-year, 10-year, and 25-year return periods along the Middle Fork Santiam River at Green Peter Reservoir from 1961–2010 to 2031–2080 under lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. Larger blue and red dots and bars represent the mean and two standard errors across ten global climate models. Only ten models simulated future hydrology out of the full set of 20 models that were used to project temperature and precipitation (see Appendix). Smaller light blue and light red dots represent projections from individual models (Data source: Integrated Scenarios of the Future Northwest Environment, https://climate.northwestknowledge.net/IntegratedScenarios/; Figure source: David Rupp, OCCRI)

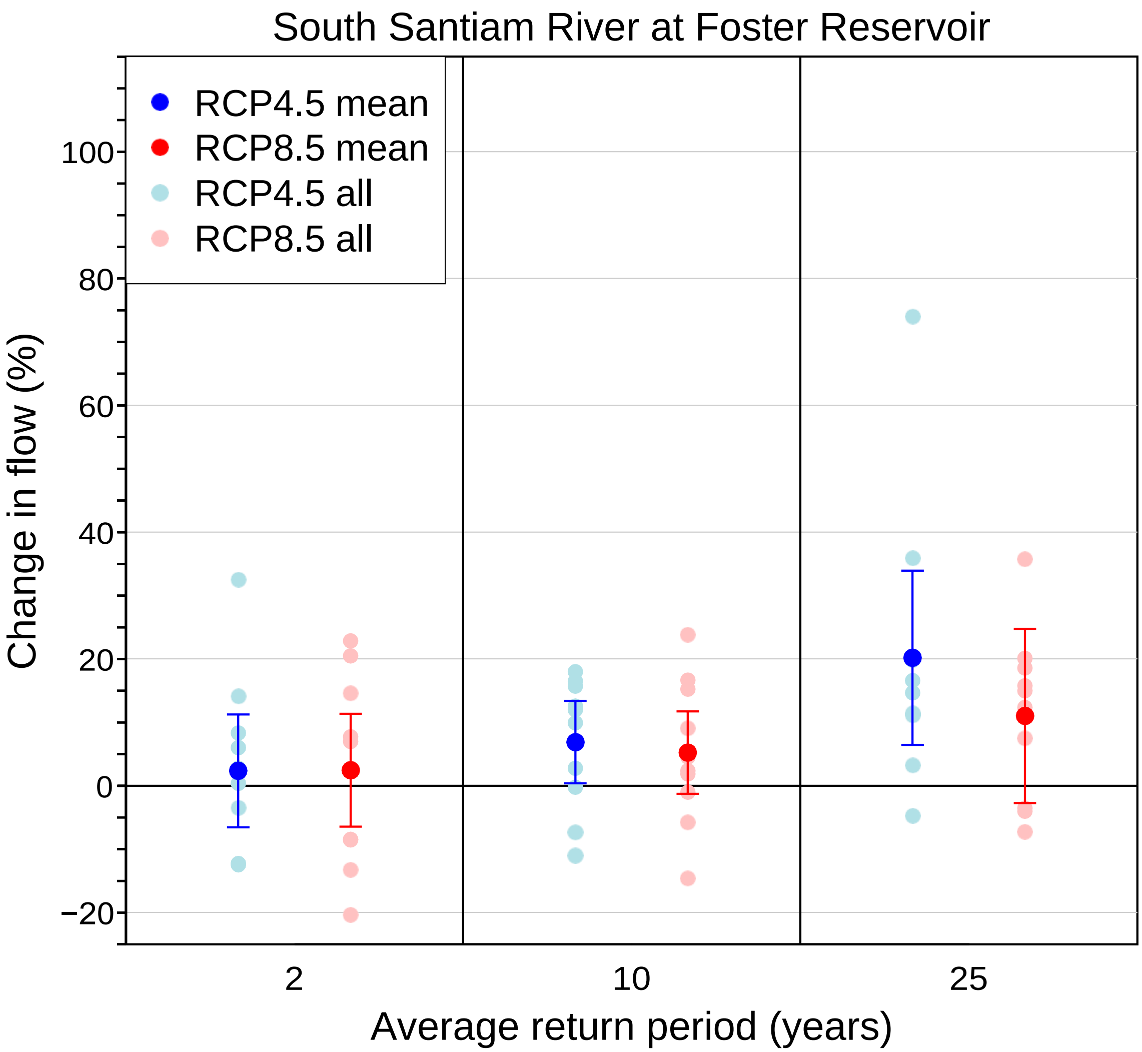

Figure 17. Projected change in water-year maximum daily, non-regulated streamflows with 2-year, 10-year, and 25-year return periods along the South Santiam River at Foster Reservoir from 1961–2010 to 2031–2080 under lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. Larger blue and red dots and bars represent the mean and two standard errors across ten global climate models. Only ten models simulated future hydrology out of the full set of 20 models that were used to project temperature and precipitation (see Appendix). Smaller light blue and light red dots represent projections from individual models. (Data source: Integrated Scenarios of the Future Northwest Environment, https://climate.northwestknowledge.net/IntegratedScenarios/; Figure source: David Rupp, OCCRI)

Some of the Northwest's highest floods occur when large volumes of warm rain from atmospheric rivers fall on a deep snowpack, resulting in rain-on-snow floods (Safeeq *et al.*, 2015). The frequency and amount of moisture transported by atmospheric rivers is projected to increase along the West Coast in response to increases in air temperature (Kossin *et al.*, 2017), which in turn increase the likelihood of flooding (Konrad and Dettinger, 2017).

Future changes in the frequency of rain-on-snow events likely will vary along an elevational gradient. At lower elevations, the frequency is projected to decrease due to decreasing snowpack, whereas at higher elevations the frequency is projected to increase due to the shift from snow to rain (Surfleet and Tullos, 2013; Safeeq *et al.*, 2015; Musselman *et al.*, 2018). How such changes in frequency of rain-on-snow events are likely to affect streamflow varies. For example, projections for the Santiam River, Oregon, indicate an increase in annual peak daily flows at return intervals less than 10 years, but a decrease in annual peak daily flows at return intervals greater than or equal to 10 years (Surfleet and Tullos, 2013). Average runoff from rain-on-snow events in watersheds in northern coastal Oregon is projected to decline due to depletion of the snowpack (Musselman *et al.*, 2018), which may imply that the driver of floods in these areas shifts from rain-on-snow events to extreme rainfall that exceeds soil capacity (Berghuijs *et al.*, 2016; Musselman *et al.*, 2018). Shifts in vegetation and wildfire occurrences that affect soil properties also will likely affect water transport, but hydrological models generally have not accounted for these processes (Bai *et al.*, 2018; Wang *et al.*, 2020; Williams *et al.*,2022).

Key Messages

⇒ Winter flood risk at mid- to low elevations in Linn 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.

Drought

Drought is common in the Northwest. 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 under future climate change (Dalton and Fleishman, 2021). Drought can be defined in many ways (Table 12), but most fundamentally is insufficient water to meet needs (Redmond, 2002; Dalton and Fleishman, 2021).

Table 12. Definitions and characteristics of various drought classes. (Source: Dalton and Fleishman, 2021; Fleishman *et al*., unpublished)

Drought Class	Definition and Characteristics
Meteorological	• lack of precipitation • evaporative demand that exceeds precipitation • minimum period of time for consideration operationally is 90 days
Hydrological	• prolonged meteorological drought affects surface or subsurface water supply, such as streamflow, reservoir and lake levels, or groundwater levels • tends to evolve more slowly than meteorological drought, with extents longer than six months
Agricultural	• occurs when meteorological and hydrological drought impacts agricultural production • reflects precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced availability of irrigation water
Socioeconomic	• occurs when meteorological, hydrological, or agricultural drought reduces the supply of some economic or social good or service • often affects state and federal drought declarations
Ecological	• undesirable changes in ecological state caused by deficits in water availability • usually caused by meteorological or hydrological drought • sensitivity to water limitation varies among species and life stages
Flash	• relatively short periods of warm surface temperatures, low relative humidities and precipitation deficits, and rapidly declining soil moisture • tends to develop and intensify rapidly within a few weeks, and may be generated or magnified by prolonged heat waves
Snow	• snowpack—or snow water equivalent (SWE)—is below average for a given point in the water year, traditionally 1 April • often followed by summers with low river and stream flows • warm snow drought—low snowpack with above average precipitation and temperature • dry snow drought—low snowpack and low precipitation

Summers in Oregon are expected to become warmer and drier, and mountain snowpack is projected to decline due to warmer winter temperatures (Dalton and Fleishman, 2021). Across the western United States, the decline in mountain snowpack is projected to reduce summer soil moisture in the mountains (Gergel *et al.*, 2017). Climate change is expected to result in lower summer streamflows in snow-dominated and mixed rain-and-snow basins across the Northwest as snowpack melts earlier due to warmer temperatures and decreases in summer precipitation (Dalton *et al.*, 2017; Mote *et al.*, 2019). For example, summer flow is projected to decrease in the Santiam River and its tributaries (Figures 12–14) by the 2050s (2040–2069). As mountain snowpack declines, seasonal drought will become less predictable and snow droughts will increase the likelihood of meteorological and hydrological drought in subsequent seasons (Dalton and Fleishman, 2021).

This report presents projected changes in four variables indicative of drought: low spring snowpack (snow drought), low summer soil moisture from the surface to 55 inches below the surface (agricultural drought), low summer runoff (hydrological drought), and low summer precipitation (meteorological drought). Drought is presented in terms of a change in the probability of exceeding the magnitude of seasonal drought conditions for which the historical annual probability of exceedance was 20% (5-year return period) (Figure 18).

In Linn County, summer (June–August) soil moisture, spring (April 1) snowpack, summer runoff, and summer precipitation are projected to decline by the 2050s under both lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. Therefore, seasonal drought conditions will occur more frequently by the 2050s (Figure 18). By the 2050s under the higher emissions scenario, the annual probability of low summer soil moisture is projected to be about 51% (2-year return period). The annual probabilities of low spring snowpack, low summer runoff, and low summer precipitation are projected to be about 69% (1.5-year return period), 75% (1.3-year return period), and 32% (3.1-year return interval), respectively. Drought projections for the 2020s were not evaluated due to data limitations, but drought magnitudes in the 2020s likely will be smaller than those in the 2050s.

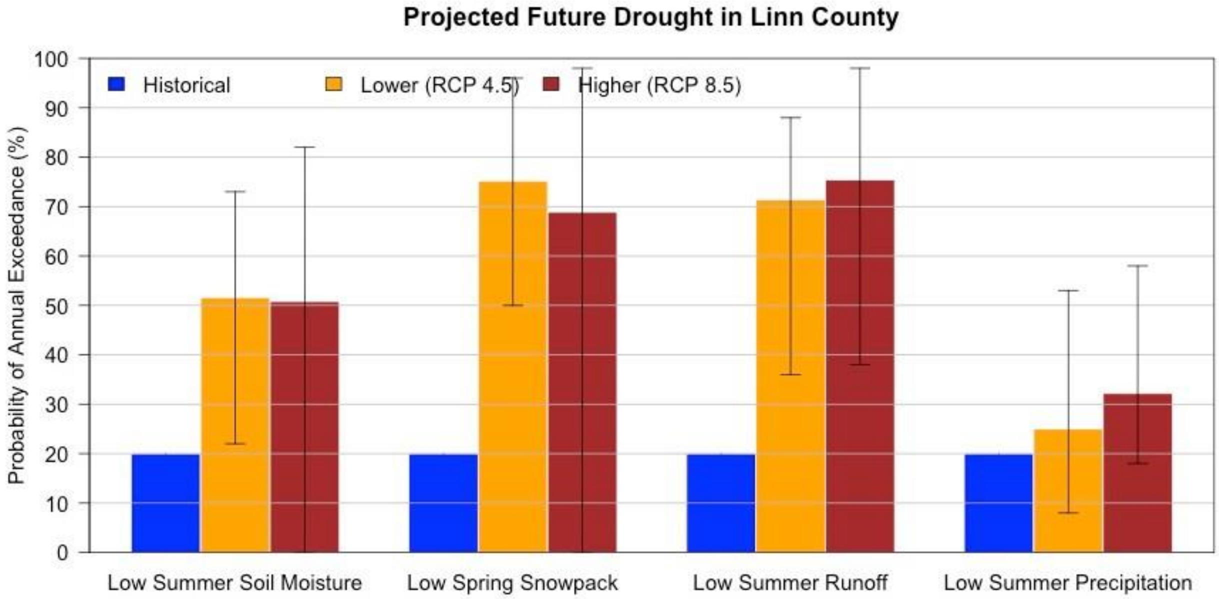

Figure 18. Projected probability of exceeding the magnitude of seasonal drought conditions for which the historical annual probability of exceedance was 20%. Projections are for the 2050s (2040–2069), relative to the historical baseline (1971–2000), under two emissions scenarios. Seasonal drought conditions include low summer soil moisture (average from June through August), low spring snowpack (April 1 snow water equivalent), low summer runoff (total from June through August), and low summer precipitation (total from June through August). The bars and whiskers represent the mean and range across ten global climate models. (Data Source: Integrated Scenarios of the Future Northwest Environment, https://climate.northwestknowledge.net/IntegratedScenarios/)

Key Messages

⇒ 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 Linn County by the 2050s.

Wildfire

Human activities have modified fire dynamics in the western United States through clearance of native vegetation for agriculture and urbanization, fragmentation and exploitation of forests and other natural land-cover types, human population growth and increased recreational activities, introduction of highly flammable, non-native annual grasses, and replacement of indigenous or natural fires by extensive fire suppression and vegetation management. From 1985 through 2017, the annual area burned by high-severity fires across forests in the western United States increased eightfold (Parks and Abatzoglou, 2020). However, area burned did not increase in naturally cool rainforests on the west side of the Cascade Range. Historically, wildfires in these rainforests occurred every few centuries due to the lack of ignitions and moist vegetation.

Over the last several decades, warmer and drier summers across the western United States have contributed to an increase in vegetation dryness and outbreaks of native insect herbivores, which contribute to increases in the volume of dead vegetation. Concurrently, the duration of the wildfire season has increased across the region (Dennison *et al.*, 2014; Jolly *et al.*, 2015; Westerling, 2016; Williams and Abatzoglou, 2016), largely due to warmer springs that cause earlier snowmelt and to an overall decline in mountain snowpack, mostly in response to warmer winters (Westerling, 2016).

Vegetation dryness is often caused by dry air. Vapor pressure deficit (VPD) corresponds to the difference in atmospheric pressure between water vapor in the air and the air's saturation point, which is the maximum amount of water the air can carry at a given temperature (dew point). This pressure difference drives transpiration by the plants' stomata. VPD and other measures of atmospheric dryness, such as evaporative demand, are more strongly associated with forest area burned than precipitation, drought indices, or temperature (Sedano and Randerson, 2014; Williams *et al.*, 2014; Seager *et al.*, 2015; Rao *et al.*, 2022). The area of forest burned annually is expected to increase exponentially with projected increases in VPD across the western United States (Zhuang *et al.*, 2021; Juang *et al.*, 2022).

CMIP6 climate model results suggest that human emissions of greenhouse gases can explain a large percentage of the observed VPD increase (Zhuang *et al.*, 2021). In the western United States from 1984 through 2015, about half of the observed increase in vegetation dryness—driven mainly by the dryness of the air—and 4.2 million hectares (16,000 square miles) of burned area were attributable to human-caused climate change (Abatzoglou and Williams, 2016).

Fire danger is generally evaluated on the basis of daytime conditions that may cause wildfires to spread. Historically, wildfires were less active overnight. However, nights have become hotter and drier, and the temperature and duration of wildfires is expected to increase as a result (Balch *et al.*, 2022). In the western United States, the number of nights during which atmospheric conditions are conducive to burning has increased by 45% since 1979 (Balch *et al.*, 2022).

Vegetation can also amplify or dampen the effect of aridity on wildfires. The geographic co-occurrence of plants with high water sensitivity (e.g., plants that do not close their stomata, shallow-rooted plants on porous soils) and high VPD suggests that the distribution of vegetation in the western United States has amplified the effect of climate change on wildfire hazard (Rao *et al.*, 2022).

High temperatures contribute to the drying of dead vegetation, and high VPD reduces moisture in live vegetation (e.g., the tree canopy), increasing the likelihood that any source of ignition will create a wildfire. The interaction between continued development in areas with flammable vegetation and increases in VPD suggests that projections of changing wildfire risk in the western United States may be conservative (Rao *et al.*, 2022), especially given that over 80% of all ignitions in the United States are now human-caused (Balch *et al.*, 2017) and that human activities have extended both the temporal and geographic extent of the fire season (Balch *et al.*, 2017; Bowman *et al.*, 2020). Furthermore, extreme wildfires may correspond to concurrent weather extremes, including high temperatures, aridity, and wind speeds. Coincidence among these extremes is becoming more common (Abatzoglou *et al.*, 2021a).

In 2020, the Santiam Fire became an exemplar of such a combination of extreme fire danger conditions that were unprecedented in the contemporary data record—a late summer that was warm and dry, extremely dry live and dead vegetation, and strong and dry east winds. These fires causes widespread loss of structures and the loss of five human lives (Abatzoglou *et al.*, 2021b). Management practices also likely affected the severity of the fire (Reilly *et al.*, 2017). For example, uniform canopy structure, which is common in forest plantations, can lead to subcanopy winds that transport moisture out of the watershed (Drake *et al.*, 2022). These wind patterns are relevant to forest water use and climate change over large areas of the montane, forested Pacific Northwest.

Projecting wildfire risk across the western United States in response to changes in climate and land use requires understanding the interactions among biology, climate, and human activity. The probability of wildfire occurrence in the Cascade Range of Oregon as a function of temperature and precipitation is projected to increase by 63% under the lower emissions scenario (RCP 4.5) and 122% under the higher emissions scenario (RCP 8.5) (Gao *et al.*, 2021). Multiple modeling approaches indicate future increases in forest area burned in the western United States (Abatzoglou *et al.*, 2021a). Similarly, model simulations of a common fire index based on precipitation and temperature, the Keetch–Byram Drought Index, and a proxy for fuel availability suggest that the number of days on which fire risk is extremely high will increase through the end of the twenty-first century (Brown *et al.*, 2021). Overall, wildfire frequency, intensity, and area burned are projected to continue increasing in the Northwest, even in climatologically wet areas in western Oregon (Dalton *et al.*, 2017; Mote *et al.*, 2019; Dalton and Fleishman, 2021)

This report considers the number of days with extreme values of 100-hour fuel moisture (FM100) and VPD as a proxy for wildfire risk. FM100 is a measure of the percentage of moisture in the dry weight of dead vegetation with 1–3 inch diameter, and commonly is used by the Northwest Interagency Coordination Center (https://gacc.nifc.gov/nwcc/) to predict fire danger. A majority of climate models project that 100-hour fuel moisture will decline across Oregon by the 2050s (2040–2069) under the higher emissions scenario (Gergel *et al.*, 2017). As explained above, drying of vegetation leads to greater wildfire risk, especially when coupled with decreases in summer soil moisture and increases in evaporative demand. CMIP6 model simulations given a higher emissions scenario projected that warm season VPD over the next 30 years will increase at a rate similar to that observed across the western United States from 1980 through 2020 (Zhuang *et al.*, 2021). Increases in VPD also were projected by CMIP5 models to contribute substantially to wildfire risk in Oregon (Ficklin and Novick, 2017; Chiodi *et al.*, 2021). Furthermore, observed increases in nighttime temperatures (Balch *et al.*, 2022) and nighttime VPD (Chiodi *et al.*, 2021) have been linked to fires burning longer into the night and increasing in intensity much earlier in the morning, which reduces the window of opportunity for suppression.

In this report, the future change in wildfire risk is expressed as the increase in the average annual number of days on which fire danger is very high and VPD is extreme. Projections are presented for two future periods under two emissions scenarios compared to the historical baseline. A day on which fire danger is very high is defined as a day on which FM100 is lower (i.e., vegetation is drier) than the historical 10th percentile value. Historically, fire danger was very high on 36.5 days per year. A day on which VPD is extreme is defined as a day on which VPD exceeds the historical warm season (March–November) 90th percentile value.

In Linn County, the average number of days per year on which fire danger is very high is projected to increase by 12 days (range -6–31) by the 2050s, compared to the historical baseline, under the higher emissions scenario (Figure 19). The average number of days per year on which VPD is extreme is projected to increase by 28 days (range 10–43) by the 2050s, compared to the historical baseline, under the higher emissions scenario (Figure 20). The impacts of wildfire on air quality are discussed in the following section, Reduced Air Quality.

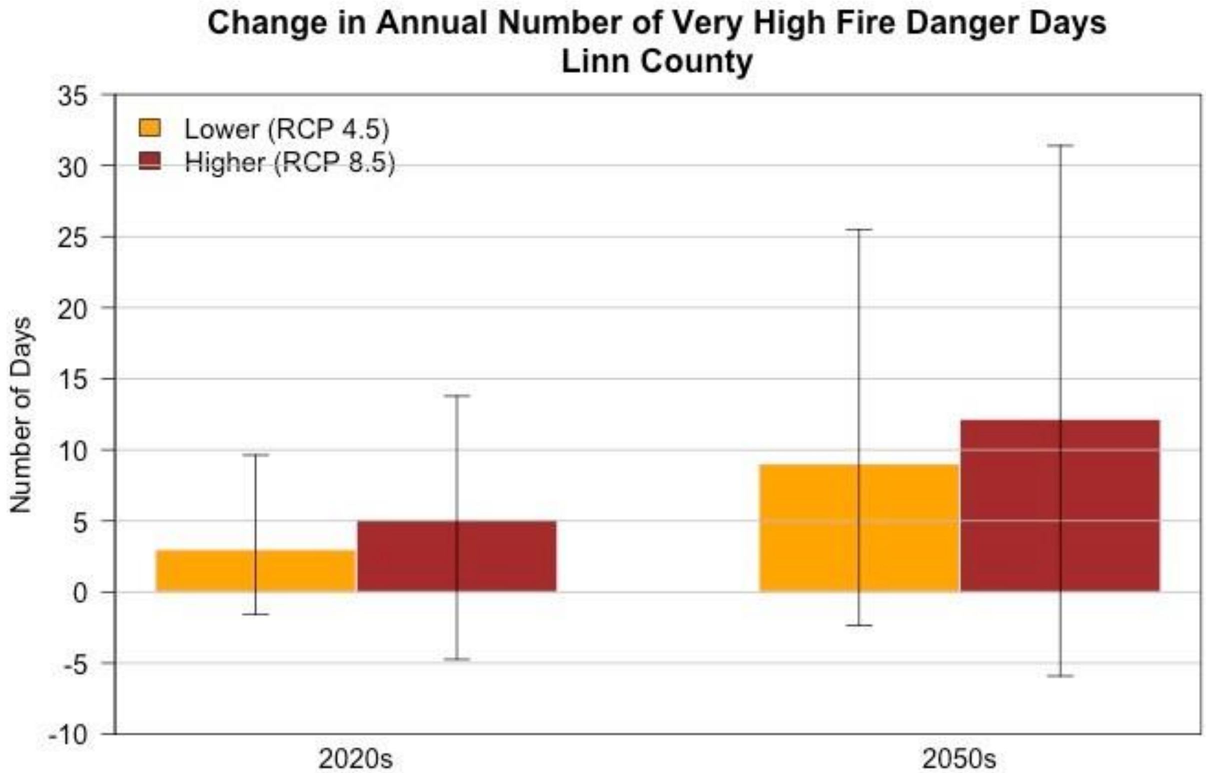

Figure 19. Projected changes by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the 1971–2000 historical baseline and under two emissions scenarios, in the number of days on which fire danger in Linn County is very high. Changes were calculated for each of 18 global climate models relative to each model's historical baseline, then averaged across the 18 models. Whiskers represent the range of changes across the 18 models. Only 18 models included the data necessary to estimate fire danger out of the full set of 20 models that were used to project temperature and precipitation. (Data Source: Climate Toolbox, climatetoolbox.org/tool/Climate-Mapper)

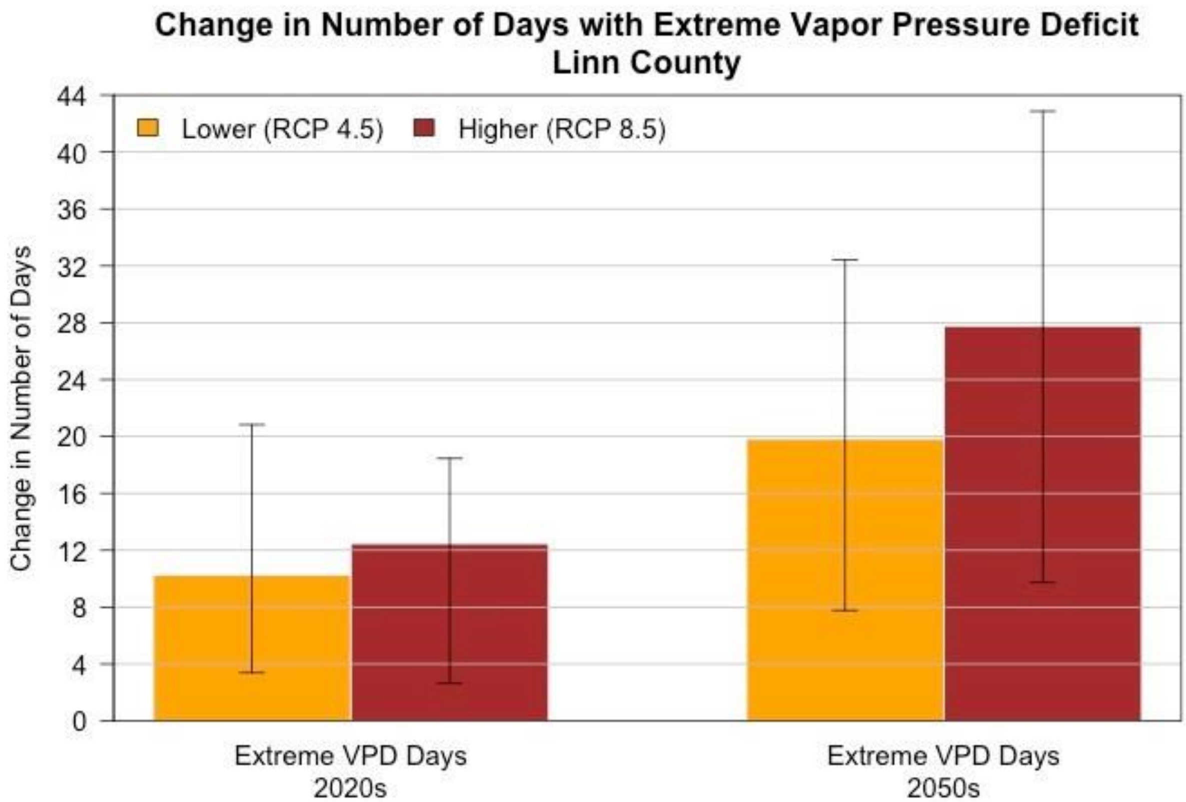

Figure 20. Projected changes by the 2020s (2010–2039 average) and 2050s (2040–2069 average), relative to the 1971–2000 historical baseline and under two emissions scenarios, in the number of days on which vapor pressure deficit in Linn County is extreme. Changes were calculated for each of 20 global climate models relative to each model's historical baseline, then averaged across the 20 models. Whiskers represent the range of changes across the 20 models. (Data Source: Climate Toolbox, climatetoolbox.org/tool/Climate-Mapper)

Key Messages

⇒ Wildfire risk, expressed as the average number of days per year on which fire danger is very high, is projected to increase in Linn County by 12 days (range -6–31) by the 2050s, relative to the historical baseline, under the higher emissions scenario.

⇒ In Linn County, the average number of days per year on which vapor pressure deficit is extreme is projected to increase by 28 days (range 10–43) by the 2050s, compared to the historical baseline, under the higher emissions scenario.

Reduced Air Quality

Climate change is expected to reduce outdoor air quality. Warmer temperatures may increase ground-level ozone concentrations, increases in the number and size of wildfires may increase concentrations of smoke and fine particulate matter, and increases in pollen abundance and the duration of pollen seasons may increase aeroallergens. Such poor air quality is expected to exacerbate allergy and asthma conditions and increase the incidence of respiratory and cardiovascular illnesses and death (Fann *et al.*, 2016).

Over the past several decades, fire seasons have increased in length, and the intensity and severity of wildfires have increased. This trend is expected to continue as a result of complex factors including traditional forest management practices, increasing population density in fire risk zones, and climate change (Sheehan *et al.*, 2015). Large wildfires in the western United States can create extensive smoke plumes that travel at high altitudes over long distances and affect air quality not only near to but far from those wildfires. Hazardous levels of air pollution are most common near wildfires. Fires emit fine particulate matter (less than 2.5 micrometers in diameter [$PM_{2.5}$]), which exacerbates chronic cardiovascular and respiratory illnesses (Cascio, 2018). In addition, because exposure to $PM_{2.5}$ increases susceptibility to viral respiratory infections, exposure to wildfire smoke is likely to increase susceptibility to and the severity of reactions from Covid-19 (Henderson, 2020). Wildfire smoke also impairs visibility and can disrupt outdoor recreational and social activities, in turn affecting physical and mental health (Nolte *et al.*, 2018).

From 2000 through 2020, the frequency, duration, and area of co-occurrence of two air pollutants related to wildfire smoke, $PM_{2.5}$ and ozone, increased in the western United States (Kalashnikov *et al.*, 2022) and in the Pacific Northwest in particular (Buchholz *et al.*, 2022). Wildfires emit ozone precursors that in hot and sunny conditions react with other pollutants to increase the concentration of ozone. The area in which $PM_{2.5}$ and ozone co-occurred more than doubled during the past 20 years.

Wildfires are the primary cause of exceedances of air quality standards for $PM_{2.5}$ in western Oregon and parts of eastern Oregon (Liu *et al.*, 2016), although woodstove smoke and diesel emissions also contribute (Oregon DEQ, 2016). Fine particulate matter from vehicles, woodstoves, and power plants can be regulated, but it is much more difficult to control wildfires. Therefore, the incidence of chronic smoke exposure that has potentially severe health consequences is increasing (Liu *et al.*, 2016). Across the western United States, $PM_{2.5}$ concentrations from wildfires are projected to increase 160% by 2046–2051, relative to 2004–2009, under a medium emissions scenario (SRES A1B) (Liu *et al.*, 2016). The SRES A1B scenario, which is from an earlier generation of emissions scenarios, is most similar to RCP 6.0 (Figure 2). CMIP6 models integrated with an empirical statistical model projected that $PM_{2.5}$ concentrations in August and September in the Northwest will double to triple by 2080–2100 under lower (SSP5-4.5) and higher (SSP5-8.5) emissions scenarios (Xie *et al.*, 2022).

This report presents projections of future air quality that are based on $PM_{2.5}$ from wildfire smoke. Smoke wave days are defined as two or more consecutive days on which simulated, county-averaged, wildfire-derived $PM_{2.5}$ values are in the highest 2% of simulated daily values from 2004 through 2009 (Liu *et al.*, 2016). Smoke wave intensity is defined as the concentration of $PM_{2.5}$ on smoke wave days. Mean number of smoke wave days and mean smoke wave intensity are projected for two six-year periods, 2004–2009 and 2046–2051, under a medium emissions scenario. More information about these methods of projecting future air quality is in the Appendix. In Linn County, the number of smoke wave days is projected to increase by 13% and the intensity of smoke wave days is projected to increase by 88% (Figure 21).

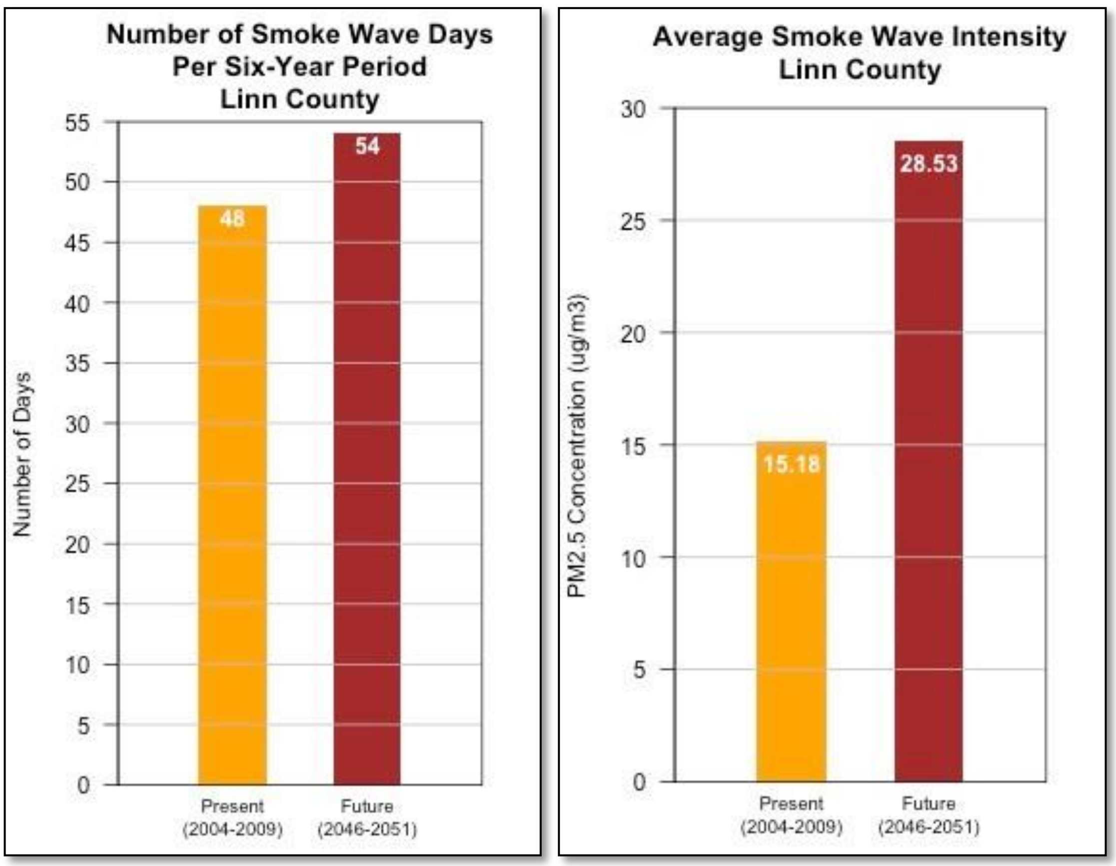

Figure 21. Simulated present (2004–2009) and future (2046–2051) number (left) and intensity (right) of smoke wave days in Linn County under a medium emissions scenario. Values represent the mean among 15 global climate models. (Data source: Liu et al. 2016, https://khanotations.github.io/smoke-map/)

Plants also are responding to changes in climate and atmospheric concentrations of carbon dioxide by producing more pollen, and by producing pollen earlier in spring and for longer periods of time (Ziska *et al.*, 2009). From 1990 through 2018, pollen seasons increased by about 20 days and pollen concentration increased by 21% in the conterminous United States (Anderegg *et al.*, 2021), including northern California (Paudel *et al.*, 2021).

Fungal spores also could become more abundant following extreme floods or droughts, which are expected to become more common with climate change. The period during which outdoor airborne mold spores are detectable increased in the last 20 years as a result of increasing concentrations of carbon dioxide and changes in climate and land use (Paudel *et al.*, 2021). Furthermore, because both ozone and fine particulates affect the sensitivity of respiratory systems to airborne allergens, the combined effects of climate change, air pollution, and changes in vegetation phenology will likely increase the severity of respiratory diseases and allergies (D'Amato *et al.*, 2020).

Key Messages

⇒ The risk of wildfire smoke in Linn County is projected to increase. The number of days per year on which the concentration of wildfire-derived fine particulate matter results in poor air quality is projected to increase by 13%, and the concentration of fine particulate matter is projected to increase by 88%, from 2004–2009 to 2046–2051 under a medium emissions scenario.

Loss of Wetlands

In the United States, wetlands are defined under the Clean Water Act as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." Wetlands also may be associated with the edges of lakes and with streams and rivers (Halofsky *et al.*, 2019).

The extent of historic wetlands in the Willamette Valley has been reduced by an estimated 57–95% by agriculture, urbanization, timber harvest, and channelization of the Willamette River (Baker *et al.*, 2004; Christy and Alverson, 2011; Fickas *et al.*, 2016). About 4.3% of emergent, lacustrine, riparian, and riverine wetland area within the two-year floodplain inundation zone along the main stem Willamette River changed (became larger or smaller or changed among the latter four classes) from 1972 through 2012 (Fickas *et al.*, 2016). The majority of losses resulted from conversion to agriculture (Daggett *et al.*, 1998; Bernert *et al.*, 1999; Fickas *et al.*, 2016), and the greatest proportion of change reflected conversion of riparian to riverine wetland (Fickas *et al.*, 2016). Some of the gains and losses in area related to agriculture may have been prompted by drought—creation of ponds in the former case, and farming of newly dry lands in the latter—and may not be permanent (Bernert *et al.*, 1999).

Wetlands and their associated plants and animals are likely to be affected by increases in air temperature, which generally are correlated with increases in freshwater temperature; decreases in snowpack and summer stream flows; and increases in evapotranspiration (Lee *et al.*, 2015). Projected effects in the Northwest include reductions in water levels and hydroperiod duration, and may be most pronounced in wetlands that become temporary in dry years (Lee *et al.*, 2015). Wetlands along low-gradient, wide valley bottoms that are dominated by riparian trees and understory species may be most susceptible to decreases in flow and water volume, in part because recruitment of some riparian species depends on seasonal flooding (Dwire *et al.*, 2018). Systems that are fed primarily by ground water may have more consistent temperature, water chemistry, and water levels than wetlands that are fed primarily by surface water (Halofsky *et al.*, 2019). However, effects of climate change on ground water aquifers that are recharged by snowpack are uncertain (Dwire *et al.*, 2018). Moreover, where increasing aridity leads to greater demand for ground water, decreases in ground water availability may affect wetlands. Withdrawals of groundwater were identified as a concern in the Natural Resources Conservation Service's 2016 strategic plan for conservation in Linn County, as were release of toxicants into groundwater and surface water (NRCS, 2016). Additionally, changes in vegetation at the perimeter of wetlands that result from land use or changes in climate, such as replacement of riparian hardwoods to conifers and shrubs (Dwire *et al.*, 2018), may affect water temperatures (Halofsky *et al.*, 2019), chemistry, and nutrient cycles. If increases in temperature or decreases in water availability increase use of wetlands by domestic livestock, habitat quality for native species likely will decrease.

As of 2001, 17,532 acres (1.2%) in Linn County was estimated to be wetland (NRCS, 2016). Analysis and classification of soils estimated that historically, 156,300 acres (16%) of the county may have been wetland, including but not limited to wet prairies, vernal pool, and riparian areas (NRCS, 2016). Wet prairies, wet meadows, and other wetlands along the Lower and North Santiam Rivers and Central Cascades Crest and in the Willamette River floodplain, Kingston Prairie, One Horse Slough and Beaver Creek, and Coburg Ridge were among the locations in Linn County designated as Wildlife Conservation Opportunity areas by the Oregon Department of Fish and Wildlife (NRCS, 2016). Prairies southeast of Scio are particularly high-priority targets for conservation and restoration (NRCS, 2016).

The Natural Resources Conservation Service restored about 1500 acres distributed among nine wetlands, primarily wet prairies, in Linn County through Wetland Reserve Program easements. These voluntary easements provide landowners and Tribes with technical and financial support for wetland protection, restoration, and enhancement. Wet prairies in Linn County traditionally have been a high priority for conservation in part because they provide habitat for Bradshaw's lomatium (*Lomatium bradshawii*), a species previously listed as endangered under the U.S. Endangered Species Act that was delisted in March 2021 due to recovery.

Key Messages

⇒ In Linn County, losses of wetlands in recent decades largely were caused by conversion to agriculture. Projected effects of climate change on wetlands in the Northwest include reductions in water levels and hydroperiod duration. If withdrawals of ground water do not increase, then wetlands that are fed by ground water rather than surface water may be more resilient to climate change.

Windstorms

Climate change has the potential to alter surface winds through changes in the global free atmospheric circulation and storm systems, and through changes in the connection between the free atmosphere and Earth's surface. West of the Cascade Range, changes in surface wind speeds tend to follow changes in upper atmosphere winds associated with extratropical cyclones (Salathé *et al.*, 2015). The trend in winter extratropical storm frequency in the northeast Pacific since 1950 was positive, although not statistically significant (Vose *et al.*, 2014). However, uncertainty in projections of future extratropical cyclone frequency is high (IPCC, 2013).

Future projections indicate a slight northward shift in the jet stream and extratropical cyclone activity in the North Pacific. Over the northern hemisphere, the frequency of the most intense extratropical cyclones generally is projected to decrease, although in the northern North Pacific the frequency is projected to increase (IPCC, 2021) Therefore, there is no consensus on whether extratropical storms (Vose *et al.*, 2014; Seiler and Zwiers, 2016; Chang, 2018) and associated extreme winds (Kumar *et al.*, 2015) will intensify or become more frequent in the Northwest under a warmer climate.

Key Messages

⇒ Limited research suggests little if any change in the frequency and intensity of windstorms in the Northwest as a result of climate change.

Expansion of Non-native Invasive Species

Changes in climate and atmospheric concentrations of carbon dioxide can affect the distribution and population dynamics of native and non-native species of animals and plants that are considered to be invasive or pests in natural and agricultural systems. Species-environment relations are not static (MacDonald, 2010; Walsworth *et al.*, 2019). Therefore, even when the current ecology of a species is well understood, it often is difficult to predict with confidence how the species will respond to projected changes in climate, especially when climate change interacts with land-use change or other environmental changes. Species adapt not only in response to climate change but in response to all types of environmental change, including management actions (Thomas *et al.*, 1979; Skelly *et al.*, 2007; Winter *et al.*, 2016). These responses may be rapid, on the order of years or decades, especially when organisms have short generation times (Boughton, 1999; MacDonald *et al.*, 2008; Willis and MacDonald, 2011; Singer, 2017). Adaptive capacity also is affected by whether individuals can move freely or whether habitat fragmentation and other barriers impede movement (Thorne *et al.*, 2008; Willis and MacDonald, 2011; Fleishman and Murphy, 2012). Monocultures, dense populations, and even-aged populations of animals or plants generally are more susceptible to pests and pathogens than individuals in areas with higher species richness or populations with greater demographic diversity.

The Oregon Conservation Strategy lists 31 non-native invasive species of terrestrial and aquatic animals that have been documented in the Willamette Valley (ODFW, 2016) (Table 13); these species may occur in Linn County. Climate change is unlikely to have a major effect on the status of non-native invasive animals in Linn County given that most are widespread generalists that exploit human-dominated environments and compete effectively with native species. Aquatic species may be adversely affected if the amount or quality of their habitat declines as a function of aridification and human appropriation of surface water and ground water, but it is unclear whether their competitive interactions with native species will change. There is some evidence that as temperature increases, increases in metabolic rate in turtles, such as red-eared and yellow bellied sliders (*Trachemys scripta elegans*, *T. scripta scripta*), will reduce their survival and fitness (Willette *et al.*, 2005). Sex ratios of reptiles with temperature-dependent sex determination also may become skewed as temperatures increase (Mitchell and Janzen, 2010). Again, however, these effects will not be limited to non-native taxa.

Table 13. Non-native invasive species of animals with documented occurrences in the Willamette Valley (Oregon Conservation Strategy 2016).

Mammals
Black rat (*Rattus rattus*)
Brown rat (*Rattus norvegicus*)
Eastern fox squirrel (*Sciurus niger*)
Eastern gray squirrel (*Sciurus carolinensis*)
Feral swine (*Sus scrofa*)
Nutria (*Myocastor coypus*)

Red fox (*Vulpes vulpes*)
Virginia opossum (*Didelphis virginiana*)
Reptiles and amphibians
American bullfrog (*Lithobates catesbeianus*)
Common snapping turtle (*Chelydra serpentina*)
Red-eared slider (*Trachemys scripta elegans*)
Yellow bellied slider (*Trachemys scripta scripta*)
Birds
Eurasian Collared Dove (*Streptopelia decaocto*)
European Starling (*Sturnus vulgaris*)
House Sparrow (*Passer domesticus*)
Mute Swan (*Cygnus olor*)
Rock Pigeon (*Columba livia*)
Fishes
Amur goby (*Rhinogobius brunneus*)
Common carp (*Cyprinus carpio*)
Fathead minnow (*Pimephales promelas*)
Golden shiner (*Notemigonus crysoleucas*)
Goldfish (*Carassius auratus*)
Grass carp (*Ctenopharyngodon idella*)
Western mosquitofish (*Gambusia affinis*)
Molluscs
Asian clam (*Corbicula fluminea*)
Chinese mysterysnail (*Cipangopaludina chinensis malleata*)
New Zealand mudsnail (*Potamopyrgus antipodarum*)
Invertebrates
Freshwater jellyfish (*Craspedacusta sowerbyi*)
Red swamp crayfish (*Procambarus clarkii*)
Ringed crayfish (*Orconectes neglectus*)
Siberian prawn (*Exopalaemon modestus*)

Linn County is part of the Upper Willamette Cooperative Weed Management Area. The Oregon Department of Agriculture weed mapper (https://www.oregon.gov/oda/programs/weeds/pages/weedmapper.aspx) indicates that more than 40 plants designated by the agency as noxious weeds occur within Linn County (Table 14). Although little is known about how many of these species may to respond to climate change, some evidence suggests how others may be affected. In general, non-native invasive plants in Linn County are likely to become more prevalent in response to projected changes in climate. However, many of these responses are uncertain, and are likely to vary locally. Moreover, the responses may change over time.

Table 14. Noxious weeds reported to occur within Linn County.

Species	Growth form
Armenian blackberry (*Rubus armeniacus*)	Perennial vine
Bull thistle (*Cirsium vulgare*)	Biennial forb
Butterfly bush (*Buddleja davidii*)	Perennial shrub
Canada thistle (*Cirsium arvense*)	Perennial forb
Dalmatian toadflax (*Linaria dalmatica*)	Perennial forb
Diffuse knapweed (*Centaurea diffusa*)	Biennial forb
English hawthorn (*Crataegus monogyna*)	Shrub or small tree
Eurasian watermilfoil (*Myriophyllum spicatum*)	Perennial aquatic
False brome (*Brachypodium sylvaticum)*	Perennial grass
Field bindweed (*Convolvulus arvensis)*	Perennial forb
Giant knotweed (*Fallopia sachalinensis*)	Shrub
Herb Robert (*Geranium robertianum)*	Annual forb
Italian thistle (*Carduus pycnocephalus)*	Annual or biennial forb
Ivy (*Hedera* spp.)	Perennial vine
Japanese knotweed (*Fallopia japonica*)	Shrub
Large-flower primrose-willow (*Ludwigia grandiflora*)	Perennial aquatic
Meadow hawkweed (*Hieracium pratense*)	Perennial forb
Meadow knapweed (*Centaurea pratensis*)	Perennial forb
Mediterranean sage (*Salvia aethiopis*)	Biennial forb
Medusahead rye (*Taeniatherum canput-medusae*)	Annual grass
Milk thistle (*Silybum marianum*)	Biennial or annual forb
Parrots feather (*Myriophyllum aquaticum*)	Annual aquatic
Paterson's curse (*Echium plantagineum)*	Annual forb
Perennial peavine (*Lathyrus latifolius)*	Perennial vine
Perennial pepperweed (*Lepidium latifolium*)	Perennial forb
Poison hemlock (*Conium maculatum)*	Biennial forb
Portuguese broom (*Cytisus striatus)*	Shrub
Primrose-willow (*Ludwigia* spp.)	Perennial aquatic
Purple loosestrife (*Lythrum salicaria*)	Perennial forb
Russian knapweed (*Acroptilon repens*)	Perennial forb
Scotch broom (*Cytisus scoparius*)	Shrub
Shiny leaf geranium (*Geranium lucidum*)	Annual forb
Small broomrape (*Orobanche minor*)	Annual forb
South American waterweed (*Egeria densa*)	Perennial aquatic
Spotted knapweed (*Centaurea stoebe*)	Short-lived perennial forb
St. Johnswort (*Hypericum perforatum*)	Perennial forb
Sulfur cinquefoil (*Potentilla recta*)	Perennial forb
Tansy ragwort (*Senecio jacobaea*)	Biennial or short-lived perennial
Ventenata (*Ventenata dubia*)	Annual grass
Water primrose (*Ludwigia hexapetala*)	Perennial aquatic
Yellow archangel (*Lamiastrum galeobdolon*)	Perennial forb

Yellow flag iris (*Iris pseudocorus*)	Perennial aquatic
Yellow toadflax (*Linaria vulgaris*)	Perennial forb

Increasing concentrations of carbon dioxide not only lead to increases in global temperature, but affect some plants' primary productivity, water-use efficiency, and nutrient content. Increases in photosynthesis in response to increases in carbon dioxide are more common in plants with C3 metabolism than in plants with C4 metabolism. C4 metabolism has evolved multiple times, usually as an adaptation to hot, dry climate. Plants with C4 metabolism lose considerably less water per unit of carbon dioxide absorbed, and tend to photosynthesize more efficiently, than plants with C3 metabolism. By contrast, tolerance of the herbicide glyphosate tends to increase more in C4 than in C3 plants as carbon dioxide increases (Chen *et al.*, 2020). English ivy can benefit from increases in carbon dioxide concentrations, especially when temperatures are relatively warm (Manzanedo *et al.*, 2018). Experiments suggested that the photosynthetic rate and biomass of Canada thistle, and the number and length of the species' spines also are likely to increase as ambient concentrations of carbon dioxide increase throughout the twenty-first century, and may have increased during the previous century (Ziska, 2002). Whether the root biomass of Canada thistle responds positively to increases in carbon dioxide concentrations, especially independent of increases in temperature, is unclear (Ziska *et al.*, 2004; Tørresen *et al.*, 2020), and may vary in space. Furthermore, both bull thistle and Canada thistle can establish readily in soils that have been disturbed by high-severity wildfires, which may become more common as climate changes, or by logging (Reilly *et al.*, 2020).

Changes in climate, ongoing human additions of nitrogen to the environment, and their interactions also affect the growth and competitive relations among plant and animal species (Greaver *et al.*, 2016). The competitive advantage of non-native forbs and grasses over native taxa may be strongest in relatively warm and dry microclimates, which often coincide with lower elevations (Dodson and Root, 2015). Furthermore, non-native invasive plants generally gain a competitive advantage from nitrogen deposition. For example, Japanese knotweed may be more likely to outcompete native species when nitrogen availability is variable or episodic (Parepa *et al.*, 2013). However, how field experiments with supplemental nitrogen relate to changes in nitrogen deposition or availability as a result of climate change is uncertain. Japanese knotweed also is fairly tolerant of high temperatures, drought, saturated soils, and fire (Clements and DiTommaso, 2012).

Responses of non-native invasive plants to increases in temperature are diverse, even within the same species. For example, photosynthesis in Japanese knotweed currently is constrained by temperatures below freezing (Baxendale and Tessier, 2015). The range of Japanese knotweed is expanding northward, perhaps reflecting evolution of frost tolerance (Clements and DiTommaso, 2012), and the species may continue to become more widespread or abundant as minimum temperatures increase. Warming also increased seed mass of diffuse knapweed independent of increases in carbon dioxide (Li *et al.*, 2018). By contrast, reproduction of false brome along a latitudinal gradient in Europe was independent of temperature (growing degree hours above 41˚F after 1 January) (De Frenne *et al.*, 2009). The flowering phenology of purple loosestrife, which readily colonizes wetlands, is adapted to the duration of the growing season. At northern latitudes, including Oregon, purple loosestrife flowers early, at a small size; at southern latitudes, it flowers later, at a larger size (Colautti and Barrett, 2013). Early flowering limits reproductive growth of purple loosestrife, and northern plants generally produce fewer seeds and have less population-level genetic variation than southern plants (Colautti *et al.*, 2010). Climate change is expected to prolong the growing season, and therefore to increase the long-term viability of purple loosestrife, although local adaptation may be relatively slow due to genetic constraints of flowering time (Colautti *et al.*, 2010, 2017).

Butterfly bush, Scotch broom, and English ivy (*Hedera helix*) usually are not highly tolerant of frost in autumn, although populations can become more frost-tolerant over time (Ebeling *et al.*, 2008; Strelau *et al.*, 2018; Winde *et al.*, 2020). There is some evidence that heat stress impairs photosynthesis and therefore growth of English ivy (Strelau *et al.*, 2018).

Changes in the amount and timing of precipitation may contribute to expansion or contraction of different non-native invasive plants. Some species that occur in Linn County tend to have high drought tolerance. For example, following experimental drought treatment in a seasonally flooded area, percent cover of bull thistle increased five to 13 times (Hogenbirk and Wein, 1991), and in forests in western Oregon, cover of English ivy was associated negatively with summer precipitation (Strelau *et al.*, 2018). By contrast, spotted knapweed may be outcompeted by some native grasses (e.g., bluebunch wheatgrass [*Pseudoroegneria spicata*]) during drought, but may have a competitive advantage when precipitation is closer to average (Pearson *et al.*, 2017). Monocultures of spotted knapweed appear to be less affected by drought (Pearson *et al.*, 2017). Evidence of drought tolerance in Scotch broom is equivocal, especially in the field rather than in greenhouse experiments (Potter *et al.*, 2009; Hogg and Moran, 2020). The growth and survival of Scotch broom in relatively open woodlands and forests may increase as snow depths decrease, especially during the winter after germination (Stevens and Latimer, 2015).

Normal to high precipitation can decrease the viability of certain non-native invasive plants, at least in some contexts. For example, in mixed-grass prairie, addition of snow increased aboveground biomass and density of diffuse knapweed, perhaps conferring a competitive advantage over native plants (Blumenthal *et al.*, 2008). Whether drought limits vegetative growth of purple loosestrife is unclear. Increased spring temperatures and decreased precipitation associated with the El Niño–Southern Oscillation in some parts of the species' range were associated with early flowering and aboveground biomass accumulation, but not with total aboveground biomass, inflorescence lengths (an indicator of reproductive output), timing of senescence (Dech and Nosko, 2004).

The density and distribution of weedy plants tends to increase in response to ground disturbance, whether from wildfire, livestock grazing, recreational activities, or removal of overstory trees and shrubs. Some non-native plants also contribute to a positive feedback cycle by increasing the probability of disturbances that facilitate their population growth. To illustrate, the rapid expansion of non-native invasive grasses, such as ventenata grass, has increased fine-fuel biomass and spatial continuity of fuels (Balch *et al.*, 2013; Kerns *et al.*, 2020; Tortorelli *et al.*, 2020).

Key Messages

⇒ In general, non-native invasive plants in Linn County are likely to become more prevalent in response to projected increases in temperature and the frequency, duration, and severity of drought. However, many of these responses are uncertain, are likely to vary locally, and may change over time.

Appendix

Future Climate Projections Background

Read more about global climate models, emissions scenarios, and uncertainty in the Climate Science Special Report—Volume 1 of the Fourth National Climate Assessment (https://science2017.globalchange.gov).

Global climate models (GCMs) and downscaling: https://science2017.globalchange.gov/chapter/4#section-3

Emissions scenarios: https://science2017.globalchange.gov/chapter/4#section-2

Uncertainty: https://science2017.globalchange.gov/chapter/4#section-4

Coupled Model Intercomparison Project phase 6 (CMIP6) climate models and emissions scenarios: see section B. Possible Climate Futures, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf.

Climate and Hydrological Data

Statistically downscaled GCM outputs from the fifth phase of the Coupled Model Intercomparison Project (CMIP5) were the basis for projections of future temperature, precipitation, and hydrology in this report. The coarse resolution of the GCMs outputs (100–300 km) was downscaled to a resolution of about 6 km with the Multivariate Adaptive Constructed Analogs (MACA) statistical downscaling method, which is skillful in complex terrain (Abatzoglou and Brown, 2012). The MACA approach uses gridded observational data to train the downscaling. It applies bias corrections and matches the spatial patterns of observed coarse-resolution to fine-resolution statistical relations. For a detailed description of the MACA method see https://climate.northwestknowledge.net/MACA/MACAmethod.php.

MACA data are the inputs to integrated models of climate, hydrology, and vegetation run by the Integrated Scenarios of the Future Northwest Environment project (https://climate.northwestknowledge.net/IntegratedScenarios/). Snow dynamics were simulated by the Integrated Scenarios project, which applied the Variable Infiltration Capacity (VIC) hydrological model (VIC version 4.1.2.l; Liang *et al.*, 1994 and updates) to a 1/16 x 1/16 degree (6 km) grid.

Simulations of daily maximum temperature, minimum temperature, and precipitation from 1950 through 2099 for 20 GCMs (Table 13) and two emissions scenarios (Representative Concentration Pathway [RCP] 4.5 and RCP 8.5) are available. Hydrological simulations of snow water equivalent (SWE) are available for the 10 GCMs used as input to VIC. All available modeled outputs were obtained from the Integrated Scenarios data archives and included in this report to represent the mean and range of projections among the largest possible ensemble of GCMs.

Table 13. The 20 global climate models (GCMs) from the firth phase of the Coupled Model Intercomparison Project (CMIP5) represented in this report. Asterisks indicate the ten GCMs used as inputs to the Variable Infiltration Capacity hydrological model.

Model Name	Modeling Center
BCC-CSM1-1 BCC-CSM1-1-M*	Beijing Climate Center, China Meteorological Administration
BNU-ESM	College of Global Change and Earth System Science, Beijing Normal University, China
CanESM2*	Canadian Centre for Climate Modeling and Analysis
CCSM4*	National Center for Atmospheric Research, USA
CNRM-CM5*	National Centre of Meteorological Research, France
CSIRO-Mk3-6-0*	Commonwealth Scientific and Industrial Research Organization/Queensland Climate Change Centre of Excellence, Australia
GFDL-ESM2G GFDL-ESM2M	NOAA Geophysical Fluid Dynamics Laboratory, USA
HadGEM2-CC* HadGEM2-ES*	Met Office Hadley Center, UK
INMCM4	Institute for Numerical Mathematics, Russia
IPSL-CM5A-LR IPSL-CM5A-MR* IPSL-CM5B-LR	Institut Pierre Simon Laplace, France
MIROC5* MIROC-ESM MIROC-ESM-CHEM	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies, Japan
MRI-CGCM3	Meteorological Research Institute, Japan
NorESM1-M*	Norwegian Climate Center, Norway

All simulated climate data and the streamflow data, with the exception of snow water equivalent, were bias-corrected with quantile mapping by the Integrated Scenarios project. Quantile mapping adjusts simulated values by comparing the cumulative probability distributions of simulated and observed values. In practice, the simulated and observed values of a variable (e.g., daily streamflow) over the historical time period are sorted and ranked, and each value is assigned a probability of exceedance. The bias-corrected value of a given simulated value is assigned the observed value that has the same probability of exceedance as the simulated value. The historical bias in the simulations is assumed to be constant. Therefore, the relations between simulated and observed values in the historical period were applied to the future scenarios. Climate data in the MACA data reflect quantile mapping relations for each non-overlapping 15-day window in the calendar year. Streamflow data reflect quantile mapping relations for each calendar month.

The Integrated Scenarios project simulated hydrology with VIC (Liang *et al.*, 1994) run on a 1/16 x 1/16 degree (6 km) grid. To generate daily streamflow estimates, daily runoff from VIC grid cells was routed to selected locations along the stream network. Where records of naturalized flow were available, the daily streamflow estimates were bias-corrected so their statistical distributions matched those of the naturalized streamflows.

Vapor pressure deficit and 100-hour fuel moisture were computed by the Integrated Scenarios project with the same MACA climate variables according to the equations in the National Fire Danger Rating System (NWCG, 2019).

Smoke Wave Data

Data from Liu et al. (2016) are available at https://khanotations.github.io/smoke-map/. Variables used in this report included "Total # of SW days in 6 yrs" and "Average SW Intensity". The former is the number of days within each time period on which the concentration of fine particulate matter ($PM_{2.5}$), averaged within each county, exceeded the 98th quantile of the distribution of daily, wildfire-specific $PM_{2.5}$ values from 2004 through 2009 (smoke wave days). The latter is the average concentration of $PM_{2.5}$ across smoke wave days within each time period. Liu et al. (2016) used 15 GCMs from the third phase of the Coupled Model Intercomparison Project under a medium emissions scenario (SRES-A1B) as inputs to a fire prediction model and the GEOS-Chem three-dimensional global chemical transport model. The available data include only the multiple-model mean value (not the range), which should be interpreted as the direction of projected change rather than the actual expected value.

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Master List – 2023 Action Items

Appendix F
2023 Plan – Albany Action Item Proposal Forms

Note: Yellow highlighted Action Items are 2023 Priority items

2016 Action Item Number	**Hazard**	**2023 Action Item Number**	**Action Title**	**Lead**	**2023 Status**	Timeline
MH 1.1	MH	1.1	Biennially, when the City of Albany's Strategic Plan is updated, the City Council incorporates and links the Natural Hazard Mitigation Plan Objectives into the Strategic Plan.	Emergency Management	Ongoing	ONGOING
MH 2.1	~~MH~~	~~2.1~~	~~Develop and implement six communications and outreach opportunities to inform the community on the status of the Natural Hazard Mitigation Plan~~		Removed from Action Items; Outreach is part of plan maintenance rather than a mitigation action; included in Volume I: Basic Plan	
WF 2.2	WF	2.2a	Develop a public education strategy for households in identified high-risk areas in the City of Albany, the City of Millersburg and for households in contract rural fire districts.	Fire Department	Retain, revised	1-2 YEARS
	WF	2.2b	Implement the public education strategy developed in WF2.2a.	Fire Department	New Action	3-4 YEARS
VO 2.3	VO	2.3	Update emergency notification procedures for ash fall or poor air quality events	Emergency Management	Retain	1-2 YEARS
MH 3.1	MH	3.1	Provide with NHMP awareness training to (when onboarding relevant new staff?) city staff to incorporate Natural Hazard Mitigation Planning aspect into their daily work.	Human Resources	Retain, Ongoing	

2016 Action Item Number	Hazard	2023 Action Item Number	Action Title	Lead	2023 Status	Timeline
FL 3.2	FL	3.2	Retain CRS rating of 5 by implementing activities 310, 320, 330, 340, 350, 360, 370, 420, 430, 440, 450, 502, 510, 540, 610, 630, and 710 per the Community Rating System	Community Development	Ongoing, revised	CONTINUOUS
FL 3.3	FL	3.3	Look at the need to update applicable city codes to reduce risk and prevent flood impacts		Completed	
FL 3.4	FL	3.4	Continue participation in the National Flood Insurance program	Community Development	Ongoing	CONTINUOUS
EQ 3.5	EQ	3.5	Explore development of a program to address seismically deficient buildings	Community Development	Retain, revised	LONGTERM
FL 3.6	FL	3.6a	Develop a Flood and Dam Failure Warning and Response Plan		Completed	
	FL	3.6b	Update the Flood and Dam Failure Warning and Response Plan	Emergency Management	New Action	1-2 YEARS
MH 4.1	MH	4.1	Review hazard maps, data, regulations and, state guidance, if any, and if mandated regulations are developed by the State of Oregon or the City finds regulatory updates are necessary, then the City will update natural hazard ordinances and vulnerability and risk assessments for hazards which affect the City by partnering with local, state and federal agencies.	Emergency Management	Retained, revised	CONTINUOUS
MH 4.2	MH	4.2	Develop a Debris Management Plan including pre-storm strategies for coordinated debris removal following wind and winter storms.	Emergency Management	Retain, In Progress	2-4 YEARS
VO 4.3	VO	4.3	Evaluate capability of water and wastewater treatment facilities to deal with ash fall and determine what changes may need to be made	Public Works Operations	Retain	

2016 Action Item Number	**Hazard**	**2023 Action Item Number**	**Action Title**	**Lead**	**2023 Status**	Timeline
VO 4.4	VO	4.4	Evaluate ash impact on storm water drainage system and develop mitigation action if necessary. Need to consider what to advise the public and for OPs to use in the event of ashfall on the street; perhaps a 2 pager that outlines what to do in the unusual emergency	Public Works Operations	Retain	
VO 4.5	VO	4.5	Evaluate the impact of ash fall out on HVAC systems in city facilities. Building Maintenance (a part of Parks and Rec,) could benefit from a quick sheet on this topic as well as the two above; guidance to contractors for maintenance.	Public Works Operations	Retain	
LS 4.6	LS	4.6	Participate in DOGAMI geohazard mapping project to identify any changes or amendments to future potential landslide areas within the city of Albany	Emergency Management	Retain, In Progress	
EQ 5.1	EQ	5.1	Develop specific emergency evacuation or shelter-in-place plans for residential areas that are near significant hazard material storage facilities and heavy industrial areas.	Emergency Management	Ongoing	
EQ 5.2	EQ	5.2	Evaluate city emergency transportation routes with City, County and State partners	Emergency Management	Ongoing	1-2 YEARS
VO 5.3	VO	5.3	Update emergency response planning for ash fall event	Emergency Management	Complete	1-2 YEARS
	SW	5.4	Identify options for safeguarding the aerial fiberoptic communications cable that connects the Courthouse with Albany Police Department because it is at risk for damage from high wind events.	Information Technology	New Action	
MH 6.1	MH	6.1	Assist K-12 schools to develop vulnerability assessments and mitigation projects to improve safety in their most vulnerable buildings	Emergency Management	Deferred	
EQ 6.2	EQ	6.2	Develop and implement a non-structural retrofit program for City staff offices and workspaces	Emergency Management	Retain	

2016 Action Item Number	Hazard	2023 Action Item Number	Action Title	Lead	2023 Status	Timeline
EQ 6.3	EQ	6.3a	Rerun GIS analysis performed in 2011 to evaluate neighborhoods and the number of wood-frame residential buildings that may be particularly vulnerable to earthquake damage, including pre-1950 homes. Also identify significant historic downtown structures that are vulnerable to earthquake damage. Consider how this analysis connects to EQ 9.2	Emergency Management	Retain, revised	
	EQ	6.3b	Use the information collected in EQ 6.3a in outreach efforts on earthquake hazard.	Emergency Management	New Action	
EQ 6.4	EQ	6.4	Evaluate City-owned bridges to determine which need to be seismically updated, and seek appropriate funds. Especially as relates to the primary transportation routes.	Public Works Engineering	Retain, revised	
EQ 6.5	EQ	6.5a	Hire a contractor to conduct a vulnerability analysis of Albany's wastewater collection system to identify elements with the potential for failure in an earthquake, and seek funding for alternatives to seismically retrofit them	Public Works Operations	Retain	
	EQ	6.5b	Identify alternative methods for managing wastewater if system elements fail during earthquake.	Public Works Operations	New Action	
EQ 6.6	EQ	6.6a	Conduct a vulnerability analysis of Albany water distribution system to identify elements with the potential for failure and seek funding alternatives to seismically retrofit them. May be accomplished as part of a Master Plan update. A consultant would be needed to accomplish this work.	Public Works Operations	Retain	
	EQ	6.6b	Identify alternative methods for managing water if system elements fail during earthquake.	Public Works Operations	New Action	
EQ 6.7	EQ	6.7	Evaluate the necessity for seismic valve protection for city of Albany reservoirs and, if determined necessary, seek funding to retrofit them		Completed	
MH 7.1	MH	7.1	Provide educational awareness material to City employees. Provide information on how to develop emergency plans and assemble 14-day kits.	Emergency Management	Ongoing	

2016 Action Item Number	Hazard	2023 Action Item Number	Action Title	Lead	2023 Status	Timeline
MH 7.2	MH	7.2	Provide educational and outreach articles to explain how to develop an emergency plan and assemble 14-day kits to residents of Albany. Consider developing an annual public information program to include the multiple educational and outreach actions in the plan.	Emergency Management	Ongoing	
MH 7.3	FL	7.3	Develop an educational and outreach program to provide residents awareness of the flood hazard in their area and the availability of flood insurance	Community Development	Ongoing	CONTINUOUS
MH 7.4	EQ	7.4	Develop an education and outreach program to provide residents information about earthquake hazard and the availability of structural and non-structural mitigation	Emergency Management	Ongoing	
EQ 7.5	EQ	7.5	Provide five educational and outreach opportunities annually to residents on earthquake hazards and the availability of earthquake insurance	Emergency Management	Ongoing	
MH 8.1	MH	8.1	Promote response, mitigation and recovery planning for local businesses to continue operating after a disaster. Emergency Management and the Economic Development staff within Community Development work together to provide outreach and educational programs.	Emergency Management and Economic Development	Ongoing	
EQ 9.1	EQ	9.1	Develop a non-structural retrofit program aimed at making child care facilities, schools, City offices and local businesses more resistant to the impact of earthquake	Emergency Management	Retain	
EQ 9.2	EQ	9.2	Develop public/private partnerships to seek outside funding for retrofitting structures in the downtown and historic districts	Community Development	Retain	LONGTERM
FL 9.3	FL	9.3	Implement Santiam-Albany Canal bank improvement projects		Completed	
WF 9.4	WF	9.4	Work with Linn and Benton County to implement community wildland fire protection strategies necessary for the City of Albany and contract rural fire districts to reduce fire risk	Fire Department	Retain	

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="4">Proposed Action Item Identification:</th></tr>
<tr><td colspan="4">MH 1.1: Objective 1: Establish and maintain methods to ensure plan implementation.</td></tr>
<tr><th colspan="4">Proposed Action Title/Description:</th></tr>
<tr><td colspan="4">Biennially, when the City of Albany’s strategic plan is updated, the City Council incorporates and links the Natural Hazard Mitigation Plan objectives into the Strategic Plan.</td></tr>
<tr><th colspan="4">Rationale for Proposed Action:</th></tr>
<tr><td colspan="4">Having links between the mitigation plan and other applicable city plans provides the opportunity for discussion about mitigation. This assures that mitigation opportunities are in everyone’s thoughts and there are discussions that will take place on events that can help in reducing the effects of natural hazards on the community.</td></tr>
<tr><th colspan="4">Ideas for Implementation:</th></tr>
<tr><td colspan="4">
Identify a list of city plans that should be linked to the hazard mitigation plan.
Provide that list to the Steering Committee at one of their meetings for review and approval.
Have the Steering Committee discuss how this process will be implemented.
Have the Steering Committee develop a time frame for implementation given the different review times for each plan.
Implement the Steering Committee’s plan.
</td></tr>
<tr><th colspan="2">Lead Organization:</th><td colspan="2">Emergency Management</td></tr>
<tr><th colspan="2">Internal Partners:</th><th colspan="2">External Partners:</th></tr>
<tr><td colspan="2">All City Departments</td><td colspan="2"></td></tr>
<tr><th colspan="2">Timeline:</th><th colspan="2">If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
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2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="4">Proposed Action Item Identification:</th></tr>
<tr><td colspan="4">WF 2.2a: Objective 2: Provide leadership to promote, communicate, and support disaster safety messages and activities.</td></tr>
<tr><th colspan="4">Proposed Action Title/Description:</th></tr>
<tr><td colspan="4">Develop and implement a public education strategy for those households within identified high-risk areas in the City of Albany and contract rural fire districts.</td></tr>
<tr><th colspan="4">Rationale for Proposed Action:</th></tr>
<tr><td colspan="4">Linn and Benton Counties have wildfire plans that provide information pertaining to hazards in our city and contract fire areas. It is important for the city to work with the counties and contract fire districts to make people aware of the hazard that exists and what they can do to mitigate it.</td></tr>
<tr><th colspan="4">Ideas for Implementation:</th></tr>
<tr><td colspan="4">Identify those locations in Linn and Benton Counties where wildfire problems exist.
Develop a plan on how information can be shared with the homeowners who live in these areas about the problem.
Work with our partners at the County and Fire District levels to develop strategies for implementation.</td></tr>
<tr><th colspan="2">Lead Organization:</th><td colspan="2">Fire Department</td></tr>
<tr><th colspan="2">Internal Partners:</th><th colspan="2">External Partners:</th></tr>
<tr><td colspan="2">Emergency Management, PIO</td><td colspan="2">Linn & Benton Counties’ Planning Departments and Emergency Management, Linn & Benton Counties Fire Defense Boards</td></tr>
<tr><th colspan="2">Timeline:</th><th colspan="2">If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>1-2 years</td></tr>
<tr><th>Status</th><td colspan="3">Retained and revised.</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:		
WF 2.2b: Objective 2: Provide leadership to promote, communicate, and support disaster safety messages and activities.		
Proposed Action Title/Description:		
Implement the public education strategy developed in WF2.2a.		
Rationale for Proposed Action:		
Linn and Benton Counties have wildfire plans that provide information pertaining to hazards in our city and contract fire areas. It is important for the city to work with the counties and contract fire districts to make people aware of the hazard that exists and what they can do to mitigate it.		
Ideas for Implementation:		
• Work with our partners at the County and Fire District levels to implement strategies for implementation. • Record the contacts so that follow-up can be made to see what the homeowner's progress hasbeen.		
Lead Organization:	Fire Department	
Internal Partners:		**External Partners:**
Emergency Management, PIO		Linn & Benton Counties' Planning Departments and Emergency Management, Linn & Benton Counties Fire Defense Boards
Timeline:		**If available, estimated cost:**
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)	
	3-4 years	
Status	New Action	

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
VO 2.3: Objective 2: Provide leadership to promote, communicate, and support disaster safety messages and activities.			
Proposed Action Title/Description:			
Update emergency notification procedures for ash fall events.			
Rationale for Proposed Action:			
Because volcano ash can have such a devastating impact on many aspects of emergency response, the City needs to review and develop specific response plans for its emergency personnel. This includes Police, Fire, and Public Works personnel.			
Ideas for Implementation:			
• Identify where the source of the volcano ash could come from. • Identify what the impact of the ash might be on emergency responders, i.e. vehicles, personnel, and equipment. • Develop strategies for how to deal with each of the impacts and how we need to be prepared. • Develop a draft plan for departmental review. • Modify and finalize as necessary.			
Lead Organization:	Emergency Management		
Internal Partners:		**External Partners:**	
All City Departments		Linn & Benton Counties' Emergency Management	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
1-2 years			
Status	Retain		

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><td colspan="3">Proposed Action Item Identification:</td></tr>
<tr><td colspan="3">MH 3.1: Objective 3: Incorporate mitigation into planning and policy development.</td></tr>
<tr><td colspan="3">Proposed Action Title/Description:</td></tr>
<tr><td colspan="3">Provide NHMP awareness training to City staff to incorporate Natural Hazard Mitigation Planning aspects into their daily work.</td></tr>
<tr><td colspan="3">Rationale for Proposed Action:</td></tr>
<tr><td colspan="3">Improve the ability of staff to respond to emergencies.
Integration.
Identify areas to apply mitigation.</td></tr>
<tr><td colspan="3">Ideas for Implementation:</td></tr>
<tr><td colspan="3">Identify the City staff, by department, who should receive the training and also the positions that should be trained when there are staff changes.
Develop a training program, stressing the point the Steering Committee wants to make to the staff.
Conduct training and overview of the hazard mitigation plan.
Consider refresher training or training for new employees and during on boarding for new employees in key positions.</td></tr>
<tr><td>Lead Organization:</td><td colspan="2">Emergency Management</td></tr>
<tr><td colspan="2">Internal Partners:</td><td></td></tr>
<tr><td colspan="2">All City Departments</td><td></td></tr>
<tr><td colspan="2">Timeline:</td><td>If available, estimated cost:</td></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td rowspan="2"></td></tr>
<tr><td></td><td>Ongoing</td></tr>
<tr><td>Status</td><td colspan="2">Retain</td></tr>
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2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="3">Proposed Action Item Identification:</th></tr>
<tr><td colspan="3">FL 3.2: Objective 3: Incorporate mitigation into planning and policy development.</td></tr>
<tr><th colspan="3">Proposed Action Title/Description:</th></tr>
<tr><td colspan="3">Retain CRS rating of 5 by implementing activities 310, 320, 330, 340, 350, 360, 370, 420, 430, 440, 450, 502, 510, 540, 610, 630, and 710 per the Community Rating System.</td></tr>
<tr><th colspan="3">Rationale for Proposed Action:</th></tr>
<tr><td colspan="3">City’s present participation in the National Flood Insurance Program’s Community Rating System with a rating of 6 mean a savings in flood insurance premium costs for residents. The City had a rate improvement in 2006 from an 8 to a 7. The City was reviewed again in September 2010, which resulted in a rate improvement from a 7 to a 6. The mitigation action was revised to reflect the city’s intention of retaining this CRS rating.</td></tr>
<tr><th colspan="3">Ideas for Implementation:</th></tr>
<tr><td colspan="3">Evaluate the procedures and actions which would assist in retaining the City’s rate and determine how and when they might be implemented.
Determine any cost associated with each of the procedures or actions.
Establish a plan to implement procedures or actions that are determined appropriate for the City.</td></tr>
<tr><th>Lead Organization:</th><td colspan="2">Community Development</td></tr>
<tr><th colspan="2">Internal Partners:</th><th>External Partners:</th></tr>
<tr><td colspan="2">All City Departments</td><td>Community Rating System-Insurance Services Office (CRS-ISO)</td></tr>
<tr><th colspan="2">Timeline:</th><th>If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td rowspan="2"></td></tr>
<tr><td></td><td>Ongoing</td></tr>
<tr><th>Status</th><td colspan="2">Retain; revised.</td></tr>
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2023 Plan – Albany Action Item Proposal Forms

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<tr><th colspan="4">Proposed Action Item Identification:</th></tr>
<tr><td colspan="4">FL 3.4: Object 3: Incorporate mitigation into planning and policy development.</td></tr>
<tr><th colspan="4">Proposed Action Title/Description:</th></tr>
<tr><td colspan="4">Continue participation in the National Flood Insurance Program</td></tr>
<tr><th colspan="4">Rationale for Proposed Action:</th></tr>
<tr><td colspan="4">Participation in the National Flood Insurance Program (NFIP) is important to the city because it ensures residents can purchase flood insurance and it helps reduce the risk of flood by following the standards of the NFIP. The city has been a participant in this program since 1985. The last evaluation of the city’s administration of the NFIP was conducted in 2011, and the city was found to be in good standing with the requirements of the program.</td></tr>
<tr><th colspan="4">Ideas for Implementation:</th></tr>
<tr><td colspan="4">The Steering Committee made a commitment in one of its meetings to continue its participation in the National Flood Insurance Program.</td></tr>
<tr><th colspan="2">Lead Organization:</th><td colspan="2">Community Development</td></tr>
<tr><th colspan="2">Internal Partners:</th><th colspan="2">External Partners:</th></tr>
<tr><td colspan="2">Emergency Management, Public Works Engineering</td><td colspan="2">Federal Emergency Management Agency, Region X, National Flood Insurance Program, Oregon Department of Land Conservation and Development</td></tr>
<tr><th colspan="2">Timeline:</th><th colspan="2">If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>Ongoing</td></tr>
<tr><th>Status</th><td colspan="3">Retained</td></tr>
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2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><td colspan="4">Proposed Action Item Identification:</td></tr>
<tr><td colspan="4">EQ 3.5: Objective 3: Incorporate mitigation into planning and policy development.</td></tr>
<tr><td colspan="4">Proposed Action Title/Description:</td></tr>
<tr><td colspan="4">Explore development of a program to address seismically deficient buildings.</td></tr>
<tr><td colspan="4">Rationale for Proposed Action:</td></tr>
<tr><td colspan="4">Having a program that would assist private land owners to address seismically deficient buildings would be very useful. The problem is the impact it has on a community or the property owner, and what the risk benefit might be. The Building Division has had discussions on this subject but has been reluctant to develop any ordinance language that might impact the development of the downtown area.</td></tr>
<tr><td colspan="4">Ideas for Implementation:</td></tr>
<tr><td colspan="4">Identify all buildings that would be impacted by an ordinance or program.
Continue discussions through the Building Division with the Planning Division and other City departments about programs such as a revolving loan program that might assist private property owners to seismically retrofit their buildings.
Have discussions with the community and potential funders.</td></tr>
<tr><td colspan="2">Lead Organization:</td><td colspan="2">Community Development</td></tr>
<tr><td colspan="3">Internal Partners:</td><td>External Partners:</td></tr>
<tr><td colspan="3">Emergency Management, Building Division</td><td></td></tr>
<tr><td colspan="3">Timeline:</td><td>If available, estimated cost:</td></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td colspan="2"><u>Long Term</u> (2-5 or more yrs)</td><td rowspan="2"></td></tr>
<tr><td></td><td colspan="2">2 – 5 years</td></tr>
<tr><td>Status</td><td colspan="3">Retained, revised</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="4">Proposed Action Item Identification:</th></tr>
<tr><td colspan="4">MH 4.1: Objective 4: Support the enhancement of the City vulnerability assessment activities.</td></tr>
<tr><th colspan="4">Proposed Action Title/Description:</th></tr>
<tr><td colspan="4">Review hazard maps, data, regulations and, state guidance, if any, and if mandated regulations are developed by the State of Oregon or the City finds regulatory updates are necessary, then the City will update natural hazard ordinances and vulnerability and risk for hazards which affect the City, partnering with local, state, and federal agencies.</td></tr>
<tr><th colspan="4">Rationale for Proposed Action:</th></tr>
<tr><td colspan="4">It is important to know and understand all the hazard maps we have and make sure they are the most current. In many cases, after the initial receipt of a map, if it is not used on a regular basis you forget the maps exist. To make sure we have the most current information, we need to develop a schedule to review our information.</td></tr>
<tr><th colspan="4">Ideas for Implementation:</th></tr>
<tr><td colspan="4">Identify all hazard maps the City has.
Identify what department uses each map.
Determine which is the most recent copy of each map.
Find out what local, state, or federal partner provided each map.
Develop a schedule to review the maps.</td></tr>
<tr><th colspan="2">Lead Organization:</th><td colspan="2">Emergency Management</td></tr>
<tr><th colspan="2">Internal Partners:</th><th colspan="2">External Partners:</th></tr>
<tr><td colspan="2">IT (GIS), Public Works, Building Division, Community Development</td><td colspan="2">Linn & Benton Counties’ Emergency Management</td></tr>
<tr><th colspan="2">Timeline:</th><th colspan="2">If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>Ongoing</td></tr>
<tr><th>Status</th><td colspan="3">Retained, revised.</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
SW 4.2: Objective 4: Support the enhancement of the City vulnerability assessment activities.			
Proposed Action Title/Description:			
Develop a Debris Management Plan including pre-storm strategies for coordinated debris removal following wind and winter storms.			
Rationale for Proposed Action:			
• Developing pre-storm strategies for debris removal after wind and winter storms can assist the City in coordinating its response efforts • Coordinating resources assists the City in more efficiently and effectively using resources and responding when a wind or winter storm does happen. • Pre-planning debris locations and strategies will assure quicker response to the removal of debris and assist the public in their efforts to remove debris from their property.			
Ideas for Implementation:			
• Identify and prioritize areas most likely to have debris to be removed following a wind or winter storm. • Identify departments and agencies that would assist with debris removal. • Work with departments, agencies, and private organizations that can assist in developing coordinated strategies for removing debris after a wind or winter storm. • Identify tasks and responsibilities for each department and agency. • Identify routes to respond to prioritized areas. • Identify locations for depositing collected debris, or methods for dealing with collected debris. • Identify a method of separating debris picked up, and where each type will go. • Identify methods for responding to reports of debris caused by wind and winter storms. • Work with Linn and Benton Counties' Road Department to coordinate responses and collection sites.			
Lead Organization:	Emergency Management		
Internal Partners:		**External Partners:**	
Public Works		IT (GIS), Linn & Benton Counties' Road Departments, OEM, FEMA, Utilities	
Timeline:		**If available, estimated cost:**	
<u>Short Term</u> (0-2 yrs)	<u>Long Term</u> (2-5 or more yrs)		
	2 –4 years		
Status	Retained, In progress		

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="3">Proposed Action Item Identification:</th></tr>
<tr><td colspan="3">VO 4.3: Objective 4: Support the enhancement of the City vulnerability assessment activities.</td></tr>
<tr><th colspan="3">Proposed Action Title/Description:</th></tr>
<tr><td colspan="3">Evaluate the capability of water and wastewater treatment facilities to deal with ash fall and determine what changes may need to be made.</td></tr>
<tr><th colspan="3">Rationale for Proposed Action:</th></tr>
<tr><td colspan="3">Because volcano ash has not affected Albany since the 1980’s, no planning has occurred on the effect itmight have on the water and wastewater treatment facilities. The wastewater treatment plant has had a major remodel that was completed in 2010, a new water treatment plant was built in 2009, and the old plant is still in use. Public Works feels it is important to understand what the impact of ash might be on thesefacilities.</td></tr>
<tr><th colspan="3">Ideas for Implementation:</th></tr>
<tr><td colspan="3">
Identify where volcano ash might most likely come from.
Determine when it might most likely take place.
Evaluate each facility to determine where ash might most likely impact thatfacility.
Determine what mitigation action might need to be taken for each facility.
Perhaps prepare a 2 pager that outlines what the public, PW Operations; Buildings Maintenance (Parks and Rec), or contractors maintaining the city’s facilities should do in this sort of emergency.
</td></tr>
<tr><th>Lead Organization:</th><td colspan="2">Public Works Operations</td></tr>
<tr><th colspan="2">Internal Partners:</th><th>External Partners:</th></tr>
<tr><td colspan="2">Emergency Management</td><td>DOGAMI</td></tr>
<tr><th colspan="2">Timeline:</th><th>If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td rowspan="2"></td></tr>
<tr><td></td><td>2 – 5 years</td></tr>
<tr><th>Status</th><td colspan="2">Retained</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
VO 4.4: Objective 4: Support the enhancement of the City vulnerability assessment activities.			
Proposed Action Title/Description:			
Evaluate ash impact on the storm water drainage system and develop mitigation if necessary.			
Rationale for Proposed Action:			
Because we have not had an ash problem since 1980, Public Works would like to have a better understanding of what effect it might have on the City's storm water drainage system. Storm water runs directly to the Willamette River, and the City is responsible for this run-off. To be better prepared for response and recovery we need to understand what effect ash might have on the system and the river.			
Ideas for Implementation:			
• Identify where volcano ash might most likely come from. • Determine when it would most likely take place. • Evaluate how the ash might get into the storm water drainage system. • Determine what mitigation action might need to be taken on each facility. • Need to consider what to advise the public and how PW Operations will respond in the event of ashfall on the street • Perhaps prepare a 2 pager that outlines what the public, PW Operations; Buildings Maintenance (Parks and Rec), or contractors maintaining the city's facilities should do in this sort of emergency.			
Lead Organization:	Public Works Operations		
Internal Partners:		**External Partners:**	
Emergency Management		State DEQ, DOGAMI	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
	2 – 5 years		
Status	Retained		

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
VO 4.5: Objective 4: Support the enhancement of the City vulnerability assessment activities.			
Proposed Action Title/Description:			
Evaluate the impact of ash fall-out on HVAC systems in City facilities.			
Rationale for Proposed Action:			
Because volcano ash has not affected Albany since the 1980's, no planning has occurred on the effect it might have on the water and wastewater treatment facilities. The use of HVAC systems is extensive throughout the City. These systems are much more complicated today than they were in the 1980's, and for the most part cannot be shut down with the pull of a switch. We need to have a better understanding of our response procedures at each facility and then how we will recover from an event.			
Ideas for Implementation:			
• Identify where volcano ash might most likely come from. • Determine when it might most likely take place. • Evaluate each facility to determine where ash might most likely impact that facility. • Determine what mitigation action might need to be taken for each facility. • Perhaps prepare a 2 pager that outlines what the public, PW Operations; Buildings Maintenance (Parks and Rec), or contractors maintaining the city's facilities should do in this sort of emergency.			
Lead Organization:	Parks & Recreation/Facility Maintenance		
Internal Partners:		**External Partners:**	
Emergency Management, All City Departments		DOGAMI	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
	2 – 5 years		
Status	Retain		

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
LS 4.6: Objective 4: Support the enhancement of the City vulnerability assessment activities.			
Proposed Action Title/Description:			
Continue reviewing DOGAMI hazard maps to identify any changes or amendments to future potential landslide areas within the city of Albany			
Rationale for Proposed Action:			
According to DOGAMI landslide maps the city of Albany two locations where potential landslide could occur. One location is on the Calapooia river on the North East bank North of the 53 street developments. No buildings are location in the immediate area. The second location is on West Thornton Lake Drive NW between the West end of NW Thornton Lk Pl and NW Kouns D. Four separate locations are identified. Homes are located in these areas along with public infrastructure.			
Ideas for Implementation:			
• Identify the areas within the city where landslide concerns have been located • Continue to monitor DOGAMI Oregon HazVu: Statewide Geohazards viewer to determine if any changes in locations have been identified • Monitor actual events that may have occurred during the year to see if they are in areas different than what DOGAMI has show • Make any reports to the Steering Committee to keep them updated			
Lead Organization:	Emergency Management		
Internal Partners:		**External Partners:**	
Community Development		DOGAMI	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
	2 – 5 years		
Status	Retain, In Progress		

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><td colspan="4">Proposed Action Item Identification:</td></tr>
<tr><td colspan="4">EQ 5.1: Objective 5: Ensure continuity of City emergency functions.</td></tr>
<tr><td colspan="4">Proposed Action Title/Description:</td></tr>
<tr><td colspan="4">Develop specific emergency evacuation or shelter-in-place plans for residential areas that are near significant hazardous material storage facilities and heavy industrial areas.</td></tr>
<tr><td colspan="4">Rationale for Proposed Action:</td></tr>
<tr><td colspan="4">Having written plans for each of the hazardous materials facilities in Albany will help to implement any required evacuation or shelter-in-place order, allowing us to train for and exercise what we need to do. It will also allow us to do preparedness training with the residents and businesses in the hot zones.</td></tr>
<tr><td colspan="4">Ideas for Implementation:</td></tr>
<tr><td colspan="4">
Identify all the hazardous material sites in the City.
Determine what distances will be used to draw the circles for each of the facilities.
Identify the number and location of residents, businesses, and the vulnerable people.
Work with partners to develop preparedness messages.
Work on response plans with the first responders.
Work with GIS to develop maps.
Put the plans together.
Train and exercise the plans with the first responders.
During the previous plan cycle there had been some maps developed with evacuation circles, and the Mid-Valley LEPC was putting out an evacuation plan to meet this action.
</td></tr>
<tr><td colspan="2">Lead Organization:</td><td colspan="2">Emergency Management</td></tr>
<tr><td colspan="2">Internal Partners:</td><td colspan="2">External Partners:</td></tr>
<tr><td colspan="2">All City Departments, GIS</td><td colspan="2">Linn & Benton Counties’ Emergency Management, Mid-Valley LEPC, Linn-Benton Vulnerable Population Committee</td></tr>
<tr><td colspan="2">Timeline:</td><td colspan="2">If available, estimated cost:</td></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>Ongoing</td></tr>
<tr><td>Status</td><td colspan="3">Retained:</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
EQ 5.2: Objective 5: Ensure continuity of City emergency services functions			
Proposed Action Title/Description:			
Evaluate City emergency transportation routes with City, County, and State partners.			
Rationale for Proposed Action:			
In order to have an evacuation plan that will work, the City needs to have a good understanding of which routes will work best. We also need to know which programs might occur for each hazard. A windstorm event will have different road hazards than will an earthquake, snow or ice event. We need to be ready for each type of natural hazard event.			
Ideas for Implementation:			
• Identify the hazards that might require evacuation. • Determine what major routes will need to be used to move the large volume of vehicles required for an evacuation. • Identify and map bridges, culverts, and other obstacles which might hamper a street being used as an emergency route. • Develop a plan on the use of the routes and provide an outline of responsibilities for all the participants. • Finalize the plan, train on it, and exercise it. • Update it as needed. • During the prior plan cycle emergency routes had been identified, as well as bridges, culverts, train track locations, and intersections.			
Lead Organization:	Emergency Management		
Internal Partners:		**External Partners:**	
Public Works, Police, Fire		Linn & Benton Counties’ Road Departments, ODOT	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
1-2 years			
Status	Ongoing		

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="4">Proposed Action Item Identification:</th></tr>
<tr><td colspan="4">MH 6.1: Objective 6: Implement structural and non-structural mitigation of private residences and businesses, and publicly-owned facilities and infrastructure.</td></tr>
<tr><th colspan="4">Proposed Action Title/Description:</th></tr>
<tr><td colspan="4">Assist K-12 schools develop vulnerability assessments and mitigation projects to improve safety in their most vulnerable buildings</td></tr>
<tr><th colspan="4">Rationale for Proposed Action:</th></tr>
<tr><td colspan="4">Schools may function as shelters.
High concentration of vulnerable populations.
Minimize emergency response and recovery action.</td></tr>
<tr><th colspan="4">Ideas for Implementation:</th></tr>
<tr><td colspan="4">Review and assess most recently available information.
Develop partnership with school district to identify hazards and potential corrective actions.
Identify Key Facilities.
Identify vulnerable facilities.</td></tr>
<tr><th colspan="2">Lead Organization:</th><td colspan="2">Emergency Management</td></tr>
<tr><th colspan="2">Internal Partners:</th><th colspan="2">External Partners:</th></tr>
<tr><td colspan="2">Police, Fire</td><td colspan="2">GAPS</td></tr>
<tr><th colspan="2">Timeline:</th><th colspan="2">If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>2 – 5 years</td></tr>
<tr><th>Status</th><td colspan="3">Deferred</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="4">Proposed Action Item Identification:</th></tr>
<tr><td colspan="4">EQ 6.2: Objective 6: Implement structural and non-structural mitigation of private residences and businesses, and publicly owned facilities and infrastructure.</td></tr>
<tr><th colspan="4">Proposed Action Title/Description:</th></tr>
<tr><td colspan="4">Develop and implement a non-structural retrofit program for city staff offices and workspaces.</td></tr>
<tr><th colspan="4">Rationale for Proposed Action:</th></tr>
<tr><td colspan="4">Inexpensive methods are available to lessen the damage earthquakes can cause to private homes and businesses, and public facilities. Widespread implementation of these measures would reduce earthquake losses, which would reduce the impact on emergency services after an earthquake event.</td></tr>
<tr><th colspan="4">Ideas for Implementation:</th></tr>
<tr><td colspan="4">
Seek private and public funds to support a mitigation program to non-structurally retrofit residences and businesses to reduce potential damage should an earthquake occur.
From existing mitigation materials available at the Federal and State levels, identify ideas and concepts which would work in our community.
Develop the best method of providing information to the Community, both residents and businesses, the examples of non-structural projects which might work for them.
Develop a plan to provide workshops to show residents and businesses how they can provide protection to themselves at little-to-no cost.
Develop a plan to provide and implement non-structural mitigation idea in City of Albanyfacilities.
</td></tr>
<tr><th colspan="2">Lead Organization:</th><td colspan="2">Emergency Management</td></tr>
<tr><th colspan="2">Internal Partners:</th><th colspan="2">External Partners:</th></tr>
<tr><td colspan="2">Community Development</td><td colspan="2">Insurance companies, Utilities</td></tr>
<tr><th colspan="2">Timeline:</th><th colspan="2">If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>2 – 5 years</td></tr>
<tr><th>Status</th><td colspan="3">Retain</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:		
EQ 6.3a: Objective 6: Implement structural and non-structural mitigation of private residences and businesses, and publicly owned facilities and infrastructure.		
Proposed Action Title/Description:		
Rerun GIS analysis performed in 2011 to evaluate neighborhoods and the number of wood-frame residential buildings that may be particularly vulnerable to earthquake damage, including pre-1950 homes. Also identify significant historic downtown structures that are vulnerable to earthquake damage. Consider how this analysis connects to EQ 9.2		
Rationale for Proposed Action:		
Homes built pre-1950 and with cripple walls are more susceptible to earthquake damage because earthquake building requirements were less strict. This means these homes will be especially susceptible to earthquake damage, meaning to more injuries and greater property loss.		
Ideas for Implementation:		
• Evaluate neighborhoods and the number of wood-frame residential buildings that may be particularly vulnerable to earthquake damage, including pre-1950 homes and homes with cripple walls. Develop a plan to identify the general areas of the City where residences of this age and type are located. • During the previous plan cycle over 1/3 of the residential buildings had been evaluated; intended to continue to look for opportunities to complete the work • Work with GIS to develop a method of plotting homes on a map layer for future use. • Look for funding sources to pay for someone to conduct a survey to find these types of homes and record their addresses. • Look for funding sources to retrofit these homes to lessen their vulnerability during an earthquake. • Create an intern program to conduct the work that needs to be done for this project.		
Lead Organization:	Emergency Management	
Internal Partners:		**External Partners:**
Community Development, GIS		
Timeline:		**If available, estimated cost:**
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)	
	2 – 5 years	
Status	Retained, revised	

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
EQ 6.3b: Objective 6: Implement structural and non-structural mitigation of private residences and businesses, and publicly owned facilities and infrastructure.			
Proposed Action Title/Description:			
Use the information collected in EQ 6.3a in outreach efforts on earthquake hazard.			
Rationale for Proposed Action:			
Homes built pre-1950 and with cripple walls are more susceptible to earthquake damage because earthquake building requirements were less strict. This means these homes will be especially susceptible to earthquake damage, meaning to more injuries and greater property loss.			
Ideas for Implementation:			
• Evaluate neighborhoods and the number of wood-frame residential buildings that may be particularly vulnerable to earthquake damage, including pre-1950 homes and homes with cripple walls. Develop a plan to identify the general areas of the City where residences of this age and type are located. • During the previous plan cycle over 1/3 of the residential buildings had been evaluated; intended to continue to look for opportunities to complete the work • Work with GIS to develop a method of plotting homes on a map layer for future use. • Look for funding sources to pay for someone to conduct a survey to find these types of homes and record their addresses. • Look for funding sources to retrofit these homes to lessen their vulnerability during an earthquake. • Create an intern program to conduct the work that needs to be done for this project.			
Lead Organization:	Emergency Management		
Internal Partners:		**External Partners:**	
Community Development, GIS			
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
Status	New Action		

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="4">Proposed Action Item Identification:</th></tr>
<tr><td colspan="4">EQ 6.4: Objective 6: Implement structural and non-structural mitigation of private residences and businesses, and publicly owned facilities and infrastructure.</td></tr>
<tr><th colspan="4">Proposed Action Title/Description:</th></tr>
<tr><td colspan="4">Evaluate city owned bridges to determine which need to be seismically updated and seek appropriate funds especially as relates to the primary transportation routes.</td></tr>
<tr><th colspan="4">Rationale for Proposed Action:</th></tr>
<tr><td colspan="4">Acquiring funds to repair the City-owned structures, bridges, and infrastructure needing to be updated can assist the City in reducing the damage from an earthquake and ensure the City can recover more quickly.</td></tr>
<tr><th colspan="4">Ideas for Implementation:</th></tr>
<tr><td colspan="4">
Create a list of all City-owned bridges and infrastructure.
Determine ownership of the bridges and infrastructure from the created list.
Determine whether the bridges and infrastructure have had assessments completed on them.
List those with completed assessments, and those without assessments.
Prioritize the bridges and infrastructure without assessments.
Determine the cost of conducting an assessment.
Determine draft cost of upgrading any of the bridges and infrastructure assessed.
A constraint identified in the previous plan cycle was that the City has no ability to go after funds for State and County Bridges.
</td></tr>
<tr><th colspan="2">Lead Organization:</th><td colspan="2">Public Works Engineering</td></tr>
<tr><th colspan="2">Internal Partners:</th><th colspan="2">External Partners:</th></tr>
<tr><td colspan="2">Emergency Management</td><td colspan="2">ODOT, Linn & Benton Counties’ Road Departments, Linn & Benton Counties’ GIS Departments, Linn & Benton Counties’ Emergency Management</td></tr>
<tr><th colspan="2">Timeline:</th><th colspan="2">If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>2 – 5 years</td></tr>
<tr><th>Status</th><td colspan="3">Retained, revised</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
EQ 6.5a: Objective 6: Implement structural and non-structural mitigation of private residences and businesses, and publicly owned facilities and infrastructure.			
Proposed Action Title/Description:			
Hire a contractor to conduct a vulnerability analysis of Albany's wastewater collection system to identify elements with the potential for failure and seek funding alternatives to seismically retrofit them.			
Rationale for Proposed Action:			
The City recently upgraded its wastewater treatment plant and brought it up to current standards. It now needs to conduct an evaluation of the collection system which will include everything outside of the treatment facility. This will help to identify potential problems the system could have after an earthquake and allow us to work toward mitigating those problems.			
Ideas for Implementation:			
• Identify all the elements of the collections system that need to be evaluated. • Determine what will be evaluated within the system. • Identify how the system will be evaluated. • Identify who will evaluate the system. • Implement a program to conduct the evaluation.			
Lead Organization:	Public Works Operations		
Internal Partners:		**External Partners:**	
Emergency Management, Building Department		FEMA, OEM	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
	2 – 5 years		
Status	Retain		

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:

EQ 6.5b: Objective 6: Implement structural and non-structural mitigation of private residences and businesses, and publicly owned facilities and infrastructure.

Proposed Action Title/Description:

Identify alternative methods for managing wastewater if system elements fail during earthquake.

Rationale for Proposed Action:

The City recently upgraded its wastewater treatment plant and brought it up to current standards. It now needs to conduct an evaluation of the collection system which will include everything outside of the treatment facility. This will help to identify potential problems the system could have after an earthquake and allow us to work toward mitigating those problems.

Ideas for Implementation:

- Identify all the elements of the collections system that need a backup alternative.
- Identify how alternatives to the wastewater system will be evaluated.
- Identify who will evaluate the alternatives and implement the alternatives analysis.

Lead Organization:	Public Works Operations
Internal Partners:	**External Partners:**
Emergency Management, Building Department	FEMA, OEM

Timeline:		**If available, estimated cost:**
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)	
Status	New Action	

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:		
EQ 6.6a: Objective 6: Implement structural and non-structural mitigation of private residences and businesses, and publicly-owned facilities and infrastructure.		
Proposed Action Title/Description:		
Conduct a vulnerability analysis of Albany's water distribution system to identify elements with the potential for failure and seek funding alternatives to seismically retrofit them.		
Rationale for Proposed Action:		
The City purchased the water system from Pacific Power in the 1980's. It has made great strides in upgrading that system over the last 30 years, but has not conducted a seismic evaluation of the system. They City now needs to conduct an evaluation of this collection system to identify potential problems the system could have after an earthquake and allow us to work toward mitigating those problems.		
Ideas for Implementation:		
• Identify all the elements of the distribution system that need to be evaluated. • Determine what will be evaluated within the system. • Identify how the system will be evaluated. • Identify who will evaluate the system. • Implement a program to conduct the evaluation.		
Lead Organization:	Public Works Operations	
Internal Partners:		**External Partners:**
Emergency Management, Building Department		FEMA, OEM
Timeline:		**If available, estimated cost:**
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)	
	2 – 5 years	
Status	Retain	

Proposed Action Item Identification:			
EQ 6.6b: Objective 6: Implement structural and non-structural mitigation of private residences and businesses, and publicly owned facilities and infrastructure.			
Proposed Action Title/Description:			
Identify alternative methods for managing water if system elements fail during earthquake.			
Rationale for Proposed Action:			
The City recently upgraded its wastewater treatment plant and brought it up to current standards. It now needs to conduct an evaluation of the collection system which will include everything outside of the treatment facility. This will help to identify potential problems the system could have after an earthquake and allow us to work toward mitigating those problems.			
Ideas for Implementation:			
• Identify all the elements of the distribution system that need a backup alternative. • Identify how alternatives to the drinking water system will be evaluated. • Identify who will evaluate the alternatives and implement the alternatives analysis.			
Lead Organization:	Public Works Operations		
Internal Partners:		**External Partners:**	
Emergency Management, Building Department		FEMA, OEM	
Timeline:		**If available, estimated cost:**	
<u>Short Term</u> (0-2 yrs)	<u>Long Term</u> (2-5 or more yrs)		
Status	New Action		

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="4">Proposed Action Item Identification:</th></tr>
<tr><td colspan="4">MH 7.1: Objective 7: Increase citizen awareness and promote risk reduction activities through education and outreach.</td></tr>
<tr><th colspan="4">Proposed Action Title/Description:</th></tr>
<tr><td colspan="4">Provide educational material on how to develop emergency plans and assemble 14-day kits to City employees.</td></tr>
<tr><th colspan="4">Rationale for Proposed Action:</th></tr>
<tr><td colspan="4">Conducting outreach to educate the public and special needs groups on the importance of having emergency kits, supplies, and plans better prepares the citizens for natural hazard events, helping reduce the City’s overall risks.
Citizens who are better prepared to personally deal with a natural hazard reduce the need for emergency services, are able to assist their neighbors, and will decrease damage to the City’s infrastructure.
Citizens who are better prepared for a natural hazard emergency have a greater survival rate.</td></tr>
<tr><th colspan="4">Ideas for Implementation:</th></tr>
<tr><td colspan="4">Encourage the development of 14 day kits.
Encourage elderly and special needs populations to make plans for emergency supplies and care before an event occurs.
Partner with others in the promotion of 14 day kits.
Set up a meeting with City employees to promote 14 day kits.
Much of the material has been collected and some classes actually presented. A formal five year plan will be developed to get more employees to participate in family preparedness.</td></tr>
<tr><th colspan="2">Lead Organization:</th><td colspan="2">Emergency Management</td></tr>
<tr><th colspan="2">Internal Partners:</th><th colspan="2">External Partners:</th></tr>
<tr><td colspan="2">PIO, Fire Department</td><td colspan="2">Red Cross, Utilities, Linn & Benton Counties’ Emergency Management, FEMA, OEM</td></tr>
<tr><th colspan="2">Timeline:</th><th colspan="2">If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>Ongoing</td></tr>
<tr><th>Status</th><td colspan="3">Retained</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><th colspan="4">Proposed Action Item Identification:</th></tr>
<tr><td colspan="4">MH 7.2: Objective 7: Increase citizen awareness and promote risk reduction activities through Education and outreach.</td></tr>
<tr><th colspan="4">Proposed Action Title/Description:</th></tr>
<tr><td colspan="4">Provide eight educational and outreach articles to explain how to develop an emergency plan and assemble 14 day kits to Albany residents.</td></tr>
<tr><th colspan="4">Rationale for Proposed Action:</th></tr>
<tr><td colspan="4">Providing preparedness education to our residents is a long-term, ongoing process. The key is getting them to understand they need to be responsible for themselves and their families. They need to develop a family plan and both home and travel kits. Over the last several years we have provided written material to our residents in the City’s quarterly newsletter. We have also participated in preparedness fairs put on by our partners. We are committed to getting the word out to our residents about personal responsibilities.</td></tr>
<tr><th colspan="4">Ideas for Implementation:</th></tr>
<tr><td colspan="4">Identify what we want the message to be at each presentation.
Collect and provide examples of plans and kits.
Identify partners we want to work with.
Develop a plan for the next two years.
Implement the plan.
Consider developing an annual public information program to include the multiple educational and outreach actions in the plan.</td></tr>
<tr><th colspan="2">Lead Organization:</th><td colspan="2">Emergency Management</td></tr>
<tr><th colspan="2">Internal Partners:</th><th colspan="2">External Partners:</th></tr>
<tr><td colspan="2">PIO, Fire Department</td><td colspan="2">Red Cross, Utilities, Linn & Benton Counties’ Emergency Management, Samaritan Albany General Hospital</td></tr>
<tr><th colspan="2">Timeline:</th><th colspan="2">If available, estimated cost:</th></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td>Ongoing</td><td></td></tr>
<tr><th>Status</th><td colspan="3">Retained</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
FL 7.3:	Objective 7: Increase citizen awareness and promote risk reduction through education and outreach.		
Proposed Action Title/Description:			
Develop an education and outreach program to provide awareness to residents of the flood hazard in their area and the availability of flood insurance.			
Rationale for Proposed Action:			
The City participates in the National Flood Insurance Program and because of that has a responsibility to educate our residents about flood awareness and flood insurance. The City has done a good job of getting the message out to residents, but needs to take a more active role in the future, and identify more specifically who is in the floodplain and what do they need to do to be more aware of flood hazards. We need to increase the number of people who purchase flood insurance. Pursuing this action item will assist with improving the City's rating in the Community Rating System (CRS), which in turn provides discounts on flood insurance for residents in the City.			
Ideas for Implementation:			
• Identify who is in the floodplain or floodway. • Try to determine who has purchased flood insurance. • Provide education and outreach on flood hazards and what homeowners can do. • Provide information about flood insurance, including dam failure, to those in the floodplain. • Follow the Community Rating System guidelines for creating a program for public information and flood insurance promotion. • Identify potential grant programs to assist residents and mitigate impacts of flooding.			
Lead Organization:	Community Development		
Internal Partners:		**External Partners:**	
PIO, Emergency Management, PW Engineering and Operations		FEMA, Linn & Benton Counties' Emergency Management, CRS-ISO, FEMA-NFIP, Region X, Local businesses	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
Ongoing			
Status	Retained, continuous implementation		

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
EQ 7.4:	Objective 7: Increase citizen awareness and promote risk reduction activities through education and outreach.		
Proposed Action Title/Description:			
Develop an education and outreach program to give residents information about earthquake hazards and the availability of structural and non-structural mitigation opportunities.			
Rationale for Proposed Action:			
Though the City ranks earthquakes as a high priority, we have not had an earthquake we could feel since 1993. We still need to provide preparedness information to our residents because if an earthquake does occur, it will have the most devastating long-term effect on city families. In the past we talked about the potential of a local earthquake, its long-term effects, and the need for homeowners to be prepared. We will continue to work with partners to spread this message.			
Ideas for Implementation:			
• Identify partners to work with to provide preparedness information about earthquakes. • Identify potential problem areas within the City, both residential and commercial. • Develop messages for businesses and homeowners. • Develop a plan of when and where to present the preparedness message. • Implement the plan.			
Lead Organization:	Emergency Management		
Internal Partners:		**External Partners:**	
PIO, Community Development		FEMA, Red Cross, Linn & Benton Counties' Emergency Management	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
Ongoing			
Status	Retained		

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
EQ 7.5: Objective 7: Increase citizen awareness and promote risk reduction activities through education and outreach.			
Proposed Action Title/Description:			
Provide five education and outreach opportunities to residents on earthquake hazards and the availability of earthquake insurance.			
Rationale for Proposed Action:			
Though the City ranks earthquakes as a high priority, we have not had an earthquake we could feel since 1993. We still need to provide preparedness information to our residents because if an earthquake does occur, it will have the most devastating long-term effect on city families. In the past we talked about the potential of a local earthquake, its long-term effects, and the need for homeowners to be prepared. We will continue to work with partners to spread this message.			
Ideas for Implementation:			
• Look for partners to work with to provide education about earthquakes. • Develop two messages, one each for businesses and residents. • Develop kits to use as examples. • Look for non-structural examples that can be used in both businesses and homes.			
Lead Organization:	Emergency Management		
Internal Partners:		**External Partners:**	
PIO, Community Development		FEMA, Red Cross, Linn & Benton Counties' Emergency Management	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
	Ongoing		
Status	Retained		

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><td colspan="4">Proposed Action Item Identification:</td></tr>
<tr><td colspan="4">MH 8.1: Objective 8: Develop collaborative programs that encourage local businesses to plan for disasters.</td></tr>
<tr><td colspan="4">Proposed Action Title/Description:</td></tr>
<tr><td colspan="4">Promote response, mitigation, and recovery planning for local businesses to continue operating after a disaster.</td></tr>
<tr><td colspan="4">Rationale for Proposed Action:</td></tr>
<tr><td colspan="4">Working with local businesses is important because many businesses impacted by a natural hazard will not reopen. The City of Albany comprises some 80% of small businesses that can be seriously affected by a severe hazard, therefore we need to make as much information available as possible so businesses have the opportunity to provide information to their employees and reopen after a significant event.</td></tr>
<tr><td colspan="4">Ideas for Implementation:</td></tr>
<tr><td colspan="4">Identify partners the City can work with.
Locate existing preparedness information from outside sources to assist businesses and their employees.
Develop a plan on how best to share preparedness information.</td></tr>
<tr><td colspan="2">Lead Organization:</td><td colspan="2">Emergency Management</td></tr>
<tr><td colspan="2">Internal Partners:</td><td colspan="2">External Partners:</td></tr>
<tr><td colspan="2">PIO</td><td colspan="2">Red Cross, Chamber of Commerce, Downtown Association, FEMA, Linn & Benton Counties' Emergency Management, Mid-Valley LEPC</td></tr>
<tr><td colspan="2">Timeline:</td><td colspan="2">If available, estimated cost:</td></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>Ongoing</td></tr>
<tr><td>Status</td><td colspan="3">Retained</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:	
EQ 9.1:	Objective 9: Develop partnerships with external partners to implement hazard-specific mitigation projects in the City.

Proposed Action Title/Description:

Develop a non-structural retrofit program aimed at making child care facilities and schools, city offices and local businesses more resistant to the impact of an earthquake.

Rationale for Proposed Action:

- Assisting schools and childcare facilities to develop vulnerability assessments and mitigation projects for tier facilities can improve the safety of the children using the facilities and mitigate the effect that a natural hazard would have on the City.
- Vulnerability assessments and mitigation projects can assist in reducing the City's overall earthquake risk.
- Non-structural retrofits will reduce or eliminate injuries to children if an earthquake occurs.

Ideas for Implementation:

- Develop a list of all K-12 schools, childcare facilities, and other schools within the City of Albany.
- Determine if any schools have already had their seismic vulnerability analyzed.
- For facilities which have had an assessment, find out when the assessment was done to determine if a new assessment should be completed to address new seismic standards.
- For facilities which have had no seismic vulnerability analysis completed, work with each facility to perform an analysis.
- Use vulnerability assessments to identify mitigation projects.
- Create programs to cover the costs of the projects or to cost-share the costs of the projects with facilities (i.e. the City pays for 75% and the facility pays for 25% of identified projects).

Lead Organization:	Emergency Management
Internal Partners:	**External Partners:**
PIO, Fire Department, Building Department	GAPS, State of Oregon, Linn & Benton Counties' Emergency Management, Local Red Cross, OEM, FEMA, Private schools and childcare facilities

Timeline:		**If available, estimated cost:**
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)	
	2 – 5 years	
Status	Retain	

2023 Plan – Albany Action Item Proposal Forms

Proposed Action Item Identification:			
EQ 9.2: Objective 9: Develop partnerships with external partners to implement hazard-specific mitigation projects in the City.			
Proposed Action Title/Description:			
Develop public/private partnerships to seek outside funding for retrofitting structures in the downtown and historic districts.			
Rationale for Proposed Action:			
The City downtown area is made up of many older, non-reinforced masonry buildings. There is the potential for extensive damage to many of the buildings and injury to employees and shoppers if an earthquake were to occur. We have responsibility to provide an opportunity for businesses to be aware of structural changes to the building that can help mitigate this damage. The cost for this mitigation is quite high, and in order to be successful some type of financial assistance is normally necessary. Presently for the downtown area, the City has a program through CARA that has provided assistance on two projects.			
Ideas for Implementation:			
• Determine which buildings might be at risk in the downtown and historic districts. • Evaluate the cost of mitigating these buildings. • Provide information to CARA. • List the benefits to taking structural retrofitting. • The previous plan noted that two buildings in the downtown area had been assisted with seismic upgrading when they remodeled.			
Lead Organization:	CARA		
Internal Partners:		**External Partners:**	
Emergency Management		SHIPO, Economic Development, Downtown Association, Chamber of Commerce	
Timeline:		**If available, estimated cost:**	
Short Term (0-2 yrs)	Long Term (2-5 or more yrs)		
	2 – 5 years		
Status	Retained		

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><td colspan="4">Proposed Action Item Identification:</td></tr>
<tr><td colspan="4">WF 9.4: Objective 9: Develop partnerships with external partners to implement hazard-specific mitigation projects in the City.</td></tr>
<tr><td colspan="4">Proposed Action Title/Description:</td></tr>
<tr><td colspan="4">Work with Linn and Benton Counties to implement the community wildland fire protection strategies necessary for the City of Albany and contract rural fire districts to reduce fire risk.</td></tr>
<tr><td colspan="4">Rationale for Proposed Action:</td></tr>
<tr><td colspan="4">Linn and Benton Counties have wildfire plans that provide information pertaining to hazards in our city and contract fire areas. It is important for the City to work with the Counties and the contract fire districts to make people aware of the hazard that exists, and what they can do to mitigate it. The wildland fire problem in the City is very small when compared to either Linn or Benton County's potential.</td></tr>
<tr><td colspan="4">Ideas for Implementation:</td></tr>
<tr><td colspan="4">Identify where the risk is for the City of Albany and the Rural Fire Districts.
Determine through evaluation of both the Linn and Benton Wildfire Plans what their preparedness message is.
Develop a plan to implement these preparedness messages to the homeowners in each of the counties.
Map the action taken and record the preparedness action for future reference.
Develop a plan to follow up and continue to provide preparedness information to homeowners.</td></tr>
<tr><td colspan="2">Lead Organization:</td><td colspan="2">Fire Department</td></tr>
<tr><td colspan="2">Internal Partners:</td><td colspan="2">External Partners:</td></tr>
<tr><td colspan="2">Emergency Management</td><td colspan="2">Linn & Benton Planning Departments, Rural Fire Districts</td></tr>
<tr><td colspan="2">Timeline:</td><td colspan="2">If available, estimated cost:</td></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td colspan="2" rowspan="2"></td></tr>
<tr><td></td><td>2 – 5 years</td></tr>
<tr><td>Status</td><td colspan="3">Retained.</td></tr>
</table>

2023 Plan – Albany Action Item Proposal Forms

<table>
<tr><td colspan="3">Proposed Action Item Identification:</td></tr>
<tr><td colspan="3">DR-LT Action 9.5: Objective 9: Develop partnerships with external partners to implement hazard-specific mitigation projects in the City.</td></tr>
<tr><td colspan="3">Proposed Action Title/Description:</td></tr>
<tr><td colspan="3">Support local agency programs that promote measures to reduce water use during drought emergencies.</td></tr>
<tr><td colspan="3">Rationale for Proposed Action:</td></tr>
<tr><td colspan="3">Drought has not been and will likely not be a problem for the City of Albany. The City still has a responsibility to be prepared should a drought occur. Therefore it will develop a plan and work with agencies in both Linn and Benton Counties so it can respond to a drought disaster.</td></tr>
<tr><td colspan="3">Ideas for Implementation:</td></tr>
<tr><td colspan="3">Identify agencies in both Linn and Benton Counties who work on water projects.
Identify at the State level which agencies work drought problems and what the State of Oregon drought plan is.
Evaluate the impact a drought might have on the City.
Draft a Drought Plan.</td></tr>
<tr><td>Lead Organization:</td><td colspan="2">Public Works Operations</td></tr>
<tr><td colspan="2">Internal Partners:</td><td>External Partners:</td></tr>
<tr><td colspan="2">PIO, Emergency Management</td><td>Water districts, State of Oregon</td></tr>
<tr><td colspan="2">Timeline:</td><td>If available, estimated cost:</td></tr>
<tr><td><u>Short Term</u> (0-2 yrs)</td><td><u>Long Term</u> (2-5 or more yrs)</td><td rowspan="2"></td></tr>
<tr><td></td><td>2 – 5 years</td></tr>
<tr><td>Status</td><td colspan="2">Continued: No work has been done on this action.</td></tr>
</table>

Appendix F: 2023 Action Items by Hazard

City of Albany: Natural Hazard Mitigation Plan Matrix						Alignment with City of Albany Strategic Plan Themes				Alignment with City of Albany Strategic Plan Goals					
Objectives	**Action Items**					Great Neighborhoods	Safe City	Healthy Economy	Effective Government	Create diverse neighborhoods	Effective Stewardship	Ensure a safe community	Provide safe, sufficient systems	Create an identifiable downtown core	Effectively deliver city services
Multi-Hazard (MH) Action Items		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #1: Establish and maintain methods to ensure plan implementation.															
MH-Long Term	Action 1.1. As the City of Albany's Strategic Plan is updated, incorporate and link the Natural Hazard Mitigation Plan Objectives into the Strategic Plan.	Emergency Management	Steering Committee	2 – 5 years	High/City staff funding										
Objective #2: Provide leadership to promote, communicate, and support disaster safety messages and activities.															
MH-Long Term	Action 2.1. Develop and implement six communications and outreach opportunities to inform the community on the status of the Natural Hazard Mitigation Plan.	City PIO	All Departments	2 – 5 years	Medium/ City staff funding										
Objective #3: Incorporate mitigation into planning and policy development.															
MH-Long Term	Action 3.1. Provide NHMP awareness training to City staff to incorporate Natural Hazard Mitigation Planning aspects into their daily work.	Emergency Management	All Departments	2 – 5 years	Medium/ City staff funding										
Objective #4: Support the enhancement of the City vulnerability assessment activities.															
MH-Short Term	Action 4.1. Review hazard maps and update vulnerability and risk for hazards which affect the city, partnering with local, state, and federal agencies.	Emergency Management	Community Development & GIS	1 – 2 years	Medium/ City staff funding										

City of Albany: Natural Hazard Mitigation Plan Matrix						Alignment with City of Albany Strategic Plan Themes				Alignment with City of Albany Strategic Plan Goals					
Objectives	**Action Items**					Great Neighborhoods	Safe City	Healthy Economy	Effective Government	Create diverse neighborhoods	Effective Stewardship	Ensure a safe community	Provide safe, sufficient systems	Create an identifiable downtown core	Effectively deliver city services
Multi-Hazard (MH) Action Items (cont'd)		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #6: Implement structure and non-structural mitigation of publicly owned facilities and infrastructure.															
MH-Long Term	Action 6.1. Assist K-12 schools to develop vulnerability assessments and mitigation projects to improve safety in their most vulnerable buildings.	Emergency Management	GAPS	2 – 5 years	Low/City staff funding										
Objective #7: Increase citizen awareness and promote risk reduction activities through education and outreach.															
MH-Short Term	Action 7.1. Provide educational awareness material on how to develop emergency plans and assemble 14 day kits to residents of Albany.	Emergency Management	All Departments Red Cross	1 – 2 years	High/City staff funding										
MH-Short Term	Action 7.2. Provide eight educational and outreach articles to explain how to develop an emergency plan and assemble 14 day emergency kits to residents of Albany.	Emergency Management	PIO, Red Cross, Fire Department, Utilities	1 – 2 years	High/City staff funding										
Objective #8: Develop collaborative programs that encourage local businesses to plan for disasters.															
MH-Long Term	Action 8.1. Promote response, mitigation, and recovery planning for local businesses to continue operating after a disaster.	Emergency Management	Red Cross, Chamber of Commerce, PIO, Downtown Association, FEMA	2 – 5 years	Medium/ City staff funding										

City of Albany: Natural Hazard Mitigation Plan Matrix						Alignment with City of Albany Strategic Plan Themes				Alignment with City of Albany Strategic Plan Goals					
Objectives	**Action Items**					Great Neighborhoods	Safe City	Healthy Economy	Effective Government	Create diverse neighborhoods	Effective Stewardship	Ensure a safe community	Provide safe, sufficient systems	Create an identifiable downtown core	Effectively deliver city services
Flood (FL) Action Items		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #3: Incorporate mitigation into planning and policy development.															
FL-Short Term	Action 3.2. Evaluate what can be done to improve the city's current rating in the National Flood Insurance Program's Community Rating System.	Community Development	All Departments	1 – 2 years	High/City staffing funding										
FL-Long Term	Action 3.3. Look at the need to update applicable city codes to reduce risk and prevent flood impacts.	Community Development	All Departments	2 – 5 years	Medium/ City staff funding										
FL-Long Term	Action 3.4. Continue participation in the National Flood Insurance Program	Community Development	Emergency Management, Public Works, Engineering	2 – 5 years	Medium/ City staff funding										
FL-Short Term	Action 3.6. Develop a Flood and Dam Failure Warning and Response Plan.	Emergency Management	All Departments	1 – 2 years	High/City staff funding										
Objective #7: Increase citizen awareness and promote risk reduction activities through education and outreach.															
FL-Short Term	Action 7.3. Develop an education and outreach program to give residents awareness of the flood hazard in their area and the availability of flood insurance.	Community Development	PIO, Emergency Management, FEMA	1 – 2 years	High/City staff funding										
Objective #9: Develop partnerships with external partners to implement hazard-specific mitigation projects in the city.															
FL-Long Term	Action 9.3. Implement Santiam-Canal bank improvement projects.	Public Works Operations	State of Oregon	2 – 5 years	High/City staff funding										

City of Al bany: Natural Hazard Mitigation Plan Matrix						Alignm nt with City of Albany Stra tegic Pl n Theme s				Alignment with City of Albany Strategic Plan Goals					
Objectives	**Action Items**					Great Neighborhoods	Safe City	Healthy Economy	Effective Government	Create diverse neighborhoods	Effective Stewardship	Ensure a safe community	Provide safe, sufficient systems	Create an identifiable downtown core	Effectively deliver city services
Earthquake (EQ) Action Items		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #3: Incorporate mitigation into planning and policy development.															
FL-Long Term	Action 3.5. Explore development of an ordinance/program to address seismically deficient buildings.	Community Development	All Departments	2 – 5 years	Low/City staff funding										
Objective #5: Ensure continuity of City emergency services function.															
EQ-Long Term	Action 5.1. Develop specific emergency evacuation or shelter-in-place plans for residential areas that are near significant hazardous material storage facilities and heavy industrial areas.	Emergency Management	GIS, Mid-Valley LEPC, Linn Benton Emergency Management	2 – 5 years	High/City staff funding										
EQ-Long Term	Action 5.2. Evaluate City Emergency Transportation routes with city, county, and state partners.	Emergency Management	GIS, Public Works, Linn Benton Road Departments	2 – 5 years	High/City staff funding										

City of Albany: Natural Hazard Mitigation Plan Matrix						Alignment with City of Albany Strategic Plan Themes				Alignment with City of Albany Strategic Plan Goals					
Objectives	**Action Items**					Great Neighborhoods	Safe City	Healthy Economy	Effective Government	Create diverse neighborhoods	Effective Stewardship	Ensure a safe community	Provide safe, sufficient systems	Create an identifiable downtown core	Effectively deliver city services
Earthquake (EQ) Action Items (cont'd)		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #6: Implement structural and non-structural mitigation of publicly owned facilities and infrastructure.															
EQ-Long Term	Action 6.2. Develop and implement a non-structural retrofit program for City staff offices and workspaces.	Emergency Management	Community Development, Insurance Companies, Utilities	2 – 5 years	Medium/ City staff funding										
EQ-Long Term	Action 6.3. Evaluate neighborhoods and the number of wood-frame residential buildings that may be particularly vulnerable to earthquake damage, including pre-1950 homes.	Emergency Management	Community Development, GIS	2 – 5 years	Low/City staff funding										
EQ-Long Term	Action 6.4. Evaluate city-owned bridges to determine which need to be seismically updated and seek appropriate funds.	Public Works, Engineering	Emergency Management, Linn & Benton Counties, State of Oregon, FEMA	2 – 5 years	Medium/ City staff funding										
EQ-Long Term	Action 6.5. Conduct a vulnerability analysis of Albany's wastewater collection system to identify elements with the potential for failure and seek to find alternatives to seismically retrofit it.	Public Works Operations	Emergency Management	2 – 5 years	Medium/ City staff funding - Grants										
EQ-Long Term	Action 6.6. Conduct a vulnerability analysis of Albany's water distribution system to identify elements with the potential for failure and seek funding alternatives to seismically retrofit it.	Public Works Operations	Emergency Management	2 – 5 years	Medium/ City staff funding - Grants										

EQ-Long Term	Action 6.7. Evaluate the necessity for seismic valve protection for City of Albany reservoirs and if determined necessary, seek funding to retrofit them.	Public Works Operations	Emergency Management	2 – 5 years	High/City staff & capital funding										
Objective #7: Increase citizen awareness and promote risk reduction activities through education and outreach.															
EQ-Short Term	Action 7.4. Develop an education and outreach program to give residents information about earthquake hazards and the availability of structural and non-structural mitigation opportunities.	Emergency Management	Community Development, PIO, FEMA, Red Cross	1 – 2 years	Medium/ City staff funding										
EQ-Long Term	Action 7.5. Provide five educational and outreach opportunities to residents on earthquake hazards and the availability of earthquake insurance.	Emergency Management	Community Development, PIO, FEMA, Red Cross	2 – 5 years	Medium/ City staff funding										
Objective #9: Develop partnerships with external partners to implement hazard-specific mitigation projects in the City.															
EQ-Long Term	Action 9.1. Develop a non-structural retrofit program aimed at making child care facilities, schools, city offices, and local businesses more resistant to the impact of earthquake.	Emergency Management	Red Cross, Schools, PIO, Chamber of Commerce, Downtown Association, FEMA	2 – 5 years	Medium/ City staff funding										
EQ-Long Term	Action 9.2. Develop public/private partnerships to seek outside funding for retrofitting structures in the downtown and historic districts.	CARA	SHIPO, Emergency Management, Downtown Association, Chamber of Commerce	2 – 5 years	Low/City staff funding										

City of Albany: Natural Hazard Mitigation Plan Matrix						Alignment with City of Albany Strategic Plan Themes				Alignment with City of Albany Strategic Plan Goals					
Objectives	**Action Items**					Great Neighborhoods	Safe City	Healthy Economy	Effective Government	Create diverse neighborhoods	Effective Stewardship	Ensure a safe community	Provide safe, sufficient systems	Create an identifiable downtown core	Effectively deliver city services
Severe Weather (SW) Action Items		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #4: Support the enhancement of the City vulnerability assessment activities.															
SW-Long Term	Action 4.2. Develop pre-storm strategies for coordinated debris removal following wind and winter storms.	Emergency Management	Public Works, GIS, Linn & Benton Road Department, OEM, FEMA, Utilities	2 – 5 years	High/City staff funding - grants										

City of Albany: Natural Hazard Mitigation Plan Matrix						Alignment with City of Albany Strategic Plan Themes				Alignment with City of Albany Strategic Plan Goals					
Objectives	**Action Items**					Great Neighborhoods	Safe City	Healthy Economy	Effective Government	Create diverse neighborhoods	Effective Stewardship	Ensure a safe community	Provide safe, sufficient systems	Create an identifiable downtown core	Effectively deliver city services
Wildfire (WF) Action Items		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #2: Provide leadership to promote, communicate, and support disaster safety messages and activities.															
WF-Long Term	Action 2.2. Develop and implement a public education strategy for those households within identified high risk areas in the city of Albany and contract rural fire districts.	Fire Department	Emergency Management, Linn & Benton Counties	2 – 5 years	High/City staff funding										
Objective #9: Develop partnerships with external partners to implement hazard-specific mitigation projects in the City.															
WF-Long Term	Action 9.4. Work with Linn and Benton counties to implement community wildland fire protection strategies necessary for the City of Albany and contract rural fire districts to reduce fire risk.	Fire Department	Linn Benton Counties, Rural Fire Boards	2 – 5 years	Medium/ City staff funding										

City of Albany: Natural Hazard Mitigation Plan Matrix						Alignment with City of Albany Strategic Plan Themes				Alignment with City of Albany Strategic Plan Goals					
Objectives	**Action Items**					Great Neighborhoods	Safe City	Healthy Economy	Effective Government	Create diverse neighborhoods	Effective Stewardship	Ensure a safe community	Provide safe, sufficient systems	Create an identifiable downtown core	Effectively deliver city services
Volcano (VO) Action Items		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #2: Provide leadership to promote, communicate, and support disaster safety messages and activities.															
VO-Long Term	Action 2.3. Update emergency notifications procedures for ash fallevents.	Emergency Management	All Departments	2 – 5 years	Low/City staff funding										
Objective #4: Support the enhancement of the City vulnerability assessment activities.															
VO-Long Term	Action 4.3. Evaluate capability of water and wastewater treatment facilities ability to deal with ash fall and determine what changes may need to be made.	Public Works Operations	Emergency Management	2 – 5 years	Low/City staff funding										
VO-Long Term	Action 4.4. Evaluate ash impact on storm water drainage system and develop mitigation action if necessary.	Public Works Operations	Emergency Management	2 – 5 years	Low/City staff funding										
VO-Long Term	Action 4.5 Evaluate the impact of ash fall-out on HVAC systems in the City facilities.	Parks & Recreation	All Departments	2 – 5 years	Low/City staff funding										
Objective #5: Ensure continuity of City emergency services function.															
VO-Long Term	Action 5.3. Update emergency response planning for ash fall events.	Emergency Management	All Departments	2 – 5 years	Low/City staff funding										

City of Albany: Natural Hazard Mitigation Plan Matrix						Alignment with City of Albany Strategic Plan Themes				Alignment with City of Albany Strategic Plan Goals					
Objectives	**Action Items**					Great Neighborhoods	Safe City	Healthy Economy	Effective Government	Create diverse neighborhoods	Effective Stewardship	Ensure a safe community	Provide safe, sufficient systems	Create an identifiable downtown core	Effectively deliver city services
Landslide (LS) Action Items		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #4: Support the enhancement of the City vulnerability assessment activities.															
LS-Long Term	Action 4.6. Continue reviewing DOGAMI hazard maps to identify any changes or amendments to future potential landslide areas within the city of Albany	Emergency Management	Community Development, DOGAMI	2 – 5 years	Low/City staff funding										
Drought (DR) Action Items		**Lead Organization**	**Internal/ External Partners**	**Timeline**	**Priority/ Funding Source**										
Objective #9: Develop partnerships with external partners to implement hazard-specific mitigation projects in the City.															
DR-Long Term	Action 9.5. Support local agency programs that promote measures to reduce water use during drought emergencies.	Public Works Operations	Emergency Management, Linn & Benton Counties, Water sheds, State of Oregon	2 – 5 years	High/City staff funding										

Appendix G:

Flood Information and Insurance Promotion Public Outreach Plan

Introduction

This Flood Information and Insurance Promotion Public Outreach Plan is intended to meet the criteria for a Program for Public Information and Coverage Improvement Plan under FEMA's Community Rating System. This program coordinates all flood-related public information and outreach programs citywide. Outreach projects are coordinated so that key flood-related messages are delivered where public information is needed and so that messages are consistent as they are delivered to various target audiences within the city.

This plan includes a flood hazard assessment and flood insurance assessment, identifies target areas and audiences, provides an inventory of existing public outreach efforts, outlines flood information messages and flood response messages, identifies a list of outreach projects, and concludes with plan implementation.

This plan was created by the Floodplain Management Planning Committee and City staff in 2016 and updated through the Natural Hazard Mitigation Planning Committee in 2021 and 2022. The Floodplain Management Planning Committee was created to update the flood hazard section and its related action items for the Natural Hazard Mitigation Plan and create a Flood Information and Insurance Promotion Public Outreach Plan. The committee formed in 2015 and dissolved into the Natural Hazard Mitigation Plan Steering Committee for 2023 Plan update. Reinstatement of the Floodplain Management Planning Committee will take place in 2023.

Flood Hazard Assessment

An in-depth assessment of flood risk and flood hazard vulnerability is included in the Flood Hazard Section of this Natural Hazard Mitigation Plan. That analysis describes how flooding can affect the whole community in terms of transportation, public health, critical facilities, infrastructure, the economy, and natural areas. It also identifies how residential properties are most at risk to flood hazards, in particular the North Albany area. These findings are described within.

Developable Land in the Floodplain is Primarily Residential: In the City of Albany, almost half of the land area in the floodplain is protected from development through open space zoning, while the majority of the remaining land area within the floodplain is zoned for residential single-family uses. There is a total of 1,879 acres of land that is located within the 100-year floodplain and 42% of that total is zoned open space, while 51% is zoned for residential development. Therefore, the majority of land that could be developed within the floodplain is zoned for residential uses. Table 1 identifies the land area in the floodplain within each zoning district.

Table 1: Total Land Area in the Floodplain by Zoning District*

Zoning District	Acres	Percentage
CB -- Central Business	1	0%
CC -- Community Commercial	21	1%
DMU – Downtown Mixed Use	0	0%
HD -- Historic Downtown	1	0%
HI -- Heavy Industrial	13	1%
HM -- Hackleman Monteith	1	0%
LI -- Light Industrial	17	1%
MUC - Mixed Use Commercial	37	2%
OP -- Office Professional	0	0%
OS -- Open Space	796	42%
RC -- Regional Commercial	22	1%
RM -- Residential Medium Density	62	3%
RMA -- Residential Med. Density Attached	0	0%
RR -- Residential Reserve	467	25%
RS-10 -- Residential Single Family	89	5%
RS-5 -- Residential Single Family	40	2%
RS-6.5 -- Residential Single Family	310	16%
WF -- Waterfront	1	0%
TOTALS	**1,879**	**100%**

* Data collected in October, 2022

Ninety Percent of Existing Buildings in the Floodplain are Residential: In Albany, there are 868 buildings located in the floodplain and 806 of those buildings are located in residentially zoned land. Table 2 below illustrates this fact by listing the number of buildings located in the floodplain within each zoning district.

The Majority of Existing Residential Buildings in the Floodplain are in North Albany: Of the 868 residential buildings in the floodplain, 597 are in the Residential Reserve (RR) zoning district. The RR zoning district is only located in the North Albany area; therefore, approximately 69% of the existing residential buildings are in North Albany. Table 2 below shows the number of buildings located in the floodplain within each zoning district.

Table 2: Number of Buildings in the Floodplain by Zoning District*	
Zoning District	**No. of Buildings**
CB -- Central Business	1
CC -- Community Commercial	11
HD -- Historic Downtown	1
HI -- Heavy Industrial	6
HM -- Hackleman Monteith	4
LI -- Light Industrial	1
MUC - Mixed Use Commercial	11
OS -- Open Space	29
RC -- Regional Commercial	2
RM -- Residential Medium Density	48
RR -- Residential Reserve	597
RS-10 -- Residential Single Family	19
RS-5 -- Residential Single Family	38
RS-6.5 -- Residential Single Family	100
TOTAL	**992**

* Data collected in October, 2022

Summary: Based on this information, one can conclude that flood hazards are primarily a residential issue in the City of Albany, with North Albany residents and property owners most likely to be impacted by flooding. Therefore, ***target audiences are residents and property owners in the floodplain, with target areas in the North Albany residential zones***.

Flood Insurance Assessment

Since flooding primarily impacts residential properties in the City, the flood insurance assessment focuses on flood insurance policies for residential properties.

Only 22% of Residential Assessed Improvement Value is Covered by Flood Insurance: There are approximately 868 parcels in residential use that are located in the regulatory floodplain. As of December 20, 2022, the City had 179 policies in force.

The Majority of Flood Insurance Policies are in North Albany: Of the 179 flood insurance policies in the City, approximately 68% are for property in North Albany. A distribution of the flood insurance policies in the City is illustrated in Figure 3, National Flood Insurance Policies Map.

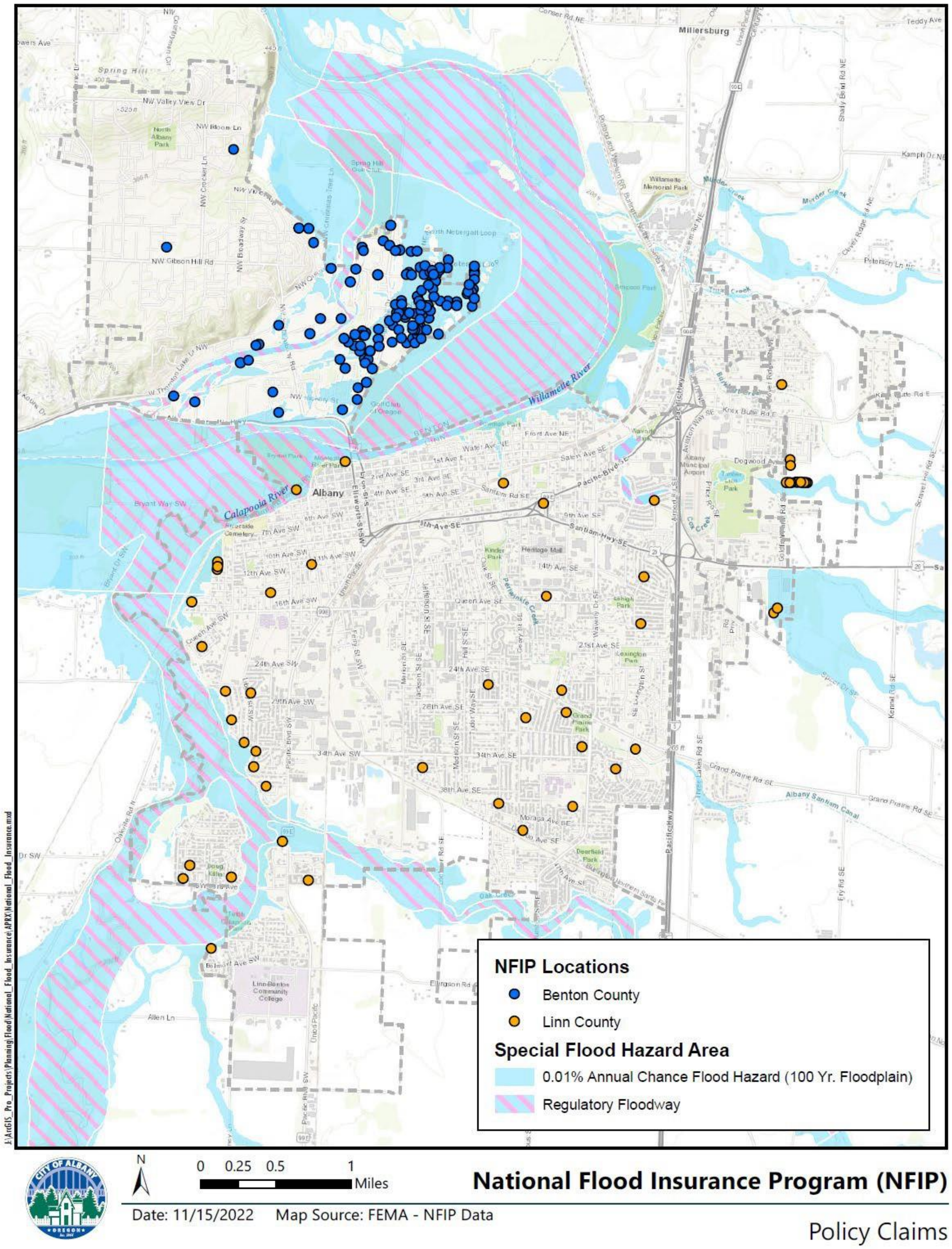

Figure 3: National Flood Insurance Policies Map

Repetitive Loss Properties are in North Albany: Repetitive loss is a term for any property on which the National Flood Insurance Program (NFIP) has paid two or more flood claims of at least $1,000 in any 10-year period. Repetitive loss structures are important to the NFIP since structures that flood frequently put a strain on the flood insurance fund. On a local level, the structures are also important because residents' lives are disrupted and may be threatened by the continual flooding. In 2022, there are five repetitive loss structures in the community, all of which are residential properties located in North Albany.

Summary: Less than half of the assessed improvement value of residential properties located in the floodplain is covered by flood insurance, and most of the flood insurance policies are in North Albany. The properties that have suffered repetitive losses are also in North Albany. Therefore, ***target audiences for promoting flood insurance are residents and property owners in the floodplain, with target areas in the North Albany residential zones***.

Inventory of Public Outreach

Table 4 describes the existing public outreach efforts that are being conducted within the City of Albany, target audiences, City departments responsible for the outreach effort, and the potential for new public outreach efforts.

Target Audiences

In order to reach the entire community, existing target audiences and outreach efforts were evaluated against the potential for new outreach projects, the flood hazard assessment, and the flood insurance assessment. Existing and new target audiences were identified to create a more comprehensive public outreach program.

Existing Target Audiences:

- General public
- Visitors to City Hall
- Property owners and residents in the 100-year floodplain
- Repetitive loss property owners
- Real estate professionals
- Motorists
- Park users
- Media

New Target Audiences:

- Residents and property owners in the 500-year floodplain in North Albany
- Title companies
- Home builders and retrofit specialists
- Property Managers
- Neighborhood associations
- School teachers
- Youth

Audience	Existing Outreach Effort	Assignment	Potential New Outreach
General City Population	Floodplain web pages Links to Keep It Clean webpage	Floodplain Manager	
General City Population	Keep It Clean webpage	Public Works	Floodplain information and links to other pages
General City Population	Emergency Response Information before, during and after a flood event	Emergency Management Floodplain Manager	Flood response messages and links to other pages
Visitors to City Hall: Community Development, Public Works and Fire Depts.	City Hall display case Floodplain newsletter FEMA floodplain brochures Emergency preparedness brochures	Floodplain Manager Emergency Management	List of professional contractors skilled in retrofitting and restoration
Properties owners in the SFHA	Annual floodplain newsletter to all properties in the SFHA. Farmer's Market Booth	Floodplain Manager	Expand outreach to 500-year floodplain in N. Albany /Spanish language newsletter Booth at home shows
Repetitive loss property owners	Annual letter to property owners	Floodplain Manager	
Real estate professionals	Annual presentation / letter	Floodplain Manager	Invite homebuilders to event Prepare handout for real estate agents
Motorists	Signs at Lochner Road: "When Flooded, Turn Around. Don't Drown"	Emergency Manager Floodplain Manager	Add a picture under the sign illustrating a car floating in the water
Parks users	High water mark signs at Monteith Riverpark	Floodplain Manager	Locate brochure next to high water mark signs and replenish during summer concert season Place signs or brochures with historic flood pictures at picnic shelter in Bryant Park and at softball diamonds
Youth	Safety Camp	Police and Fire	Flood Hazard Education w/mascot
Youth	Fire Dept. Treasure Hunt	Fire	Flood Hazard Education w/mascot
Youth	Watershed health education	Public Works	Floodplain education w/mascot
Youth	Eco Rangers water education	Public Works	Floodplain education w/mascot
Teachers	Teacher newsletter	Public Works	Floodplain education
Neighborhood Assoc.	Watershed Health Education	Public Works	Floodplain education
General City Population	Stormwater curb markers and signs at catch basins	Public Works	

Table 4: Existing Outreach Efforts

Flood Information and Insurance Promotion Messages

The Community Rating System recommends that flood information be delivered based on specific topics and desired outcomes. Flood information and insurance promotion messages are presented in Table 5. This table shows the applicable Community Rating System topic, key messages, and desired outcome for each flood information message that will be delivered at times of low flood hazard. Expanded public outreach messages are included in Table 8 at the end of this plan.

CRS Topic	Public Outreach Message	Outcome
1. Know your flood hazard	A. Water knows no boundaries	Increase the number of flood inquiries and the number of people using the website
	B. Know your flood risk	
	C. Learn more about the flood hazard in your area: contact Community Development at 541-917-7550 or go to www.cityofalbany.net/flood	
2. Insure your property for flood hazard	D. Make sure you have contents coverage	Increase flood insurance coverage
	E. Everyone is eligible to obtain flood insurance	
	F. Are you covered? Protect your investment	
3. Protect people from the hazard	G. Avoid flood waters	Reduce injuries during flood events
	H. Are you ready? Prepare yourself before a flood	
	I. Turn Around, Don't Drown	
4. Protect your property from the hazard	J. Retrofitting your home could save you money	Reduce property damage during flood events
	K. Don't wait: mitigate	
	L. Keep flood vents under your home open	
5. Build responsibly	M. Get a permit before you build	Mitigate negative impacts of flooding on development
	N. Use flood-resistant materials and proper vents	
	O. Build high, stay dry	
6. Protect natural floodplain functions	P. Preserve and restore native vegetation and trees to reduce flood damage	Reduce negative impacts of development on natural floodplain function
	Q. Keep It Clear, Keep It Clean	
	R. If you see dumping or debris in ditches, creeks, or drains, contact Public Works at 541-917-7600	

Table 5: Flood Information and Insurance Promotion Messages

Flood Response Messages

The Community Rating System provides credit for Flood Response Preparation that develops a plan for public information to be implemented during and after a flood. Table 6 identifies messages that will be delivered during or after a flood.

CRS Topic	Flood Response Message	Outcome
1. Know your flood hazard	A. Stay informed	Widely disseminate information about the flood event
	B. Identify high flood risk and areas of actual flooding	
	C. In emergency, call 911	
2. Insure your property for flood hazard	D. If your home has suffered flood damage, call your insurance agent to file a claim	Increase efficiency of flood insurance claims after flood events
	E. After the flood, call the City if you have flood damage	
3. Protect people from the hazard	F. Check for structural damage before re-entering your home	Reduce injuries during flood events
	G. Avoid flood waters – it's NEVER safe to swim, walk or drive through flood waters	
	H. Turn Around, Don't Drown	
	I. Stay away from power lines and electrical wires	
	J. Get to higher ground and avoid areas subject to flooding	
4. Protect your property from the hazard	K. Mitigate flood risks when doing repairs	Reduce property damage during flood events
	L. Report debris blockages by calling Public Works at 541-917-7600	
	M. Sandbags are available at Public Works Operations (405 Davidson Street NE)	
5. Build responsibly	N. Get a permit for repairs	Reduce future negative impacts of flooding on development
	O. Use flood-resistant materials	
	P. Substantially damaged properties may need to be mitigated when repaired	

Table 6: Flood Response Messages

Outreach Projects

Table 7 summarizes proposed outreach projects and flood response messages. Outreach projects are intended for distribution during periods of low flood hazard. Flood response messages are to be made ready during periods of high flood hazard and delivered during and after a flood.

Code	Outreach Project	CRS Topics						Audience	Responsibility	Timing
		1	2	3	4	5	6			
OP1	Information flyer – direct mailing	✓	✓	✓	✓	✓	✓	Property owners and residents in the 100-year floodplain	City (CD)	Annual
OP2	Information flyer – direct mailing	✓	✓	✓	✓	✓	✓	Property owners and residents in the North Albany 500-year floodplain	City (CD)	Annual
OP3	Letter – direct mailing, with retrofit info	✓	✓		✓	✓		Repetitive loss property owners	City (CD)	Annual
OP4	Information flyer for real estate professionals to hand to clients	✓	✓		✓	✓		Real estate professionals, residents and property owners	Stakeholder	Annual
OP5	Training for industry professionals	✓	✓	✓	✓	✓		Real estate and building industry professionals	City (CD)	Annual
OP6	*City Bridges* newsletter/other articles	✓	✓	✓	✓	✓	✓	General city population, Media	City (PIO, PW, EM, CD)	Paused
OP7	Window display at City Hall	✓	✓	✓	✓	✓	✓	General city population	City (CD)	Annual
OP8	Information flyer at City Hall	✓	✓	✓	✓	✓	✓	General city population	City (CD)	Ongoing
OP9	FEMA brochures at City Hall	✓	✓	✓	✓	✓	✓	General city population	City (CD)	Ongoing
OP10	City website floodplain information	✓	✓	✓	✓	✓	✓	General city population	City (CD)	Ongoing
OP11	City website “Keep It Clean” program						✓	General city population	City (PW)	Ongoing
OP12	Turn Around Don’t Drown signs			✓				Motorists	City (Fire)	Ongoing
OP13	High watermark signs	✓		✓				Park users	City (CD & Parks)	Ongoing
OP14	Information flyer next to high watermark signs	✓	✓	✓	✓	✓	✓	Park users	City (CD & Parks)	Summer Concert Season
OP15	Stormwater curb markers and catch basin Signs						✓	General city population	City (PW)	Ongoing
OP16	Safety Camp	✓		✓			✓	Youth	City (Police and Fire)	Annual
OP17	Fire Dept. Treasure Hunt	✓		✓			✓	Youth	City (Fire)	Annual
OP18	Watershed health education	✓					✓	General City Population, Youth	City (PW)	Annual
OP19	City website Eco Rangers water education	✓					✓	General City Population, Youth, Teachers	City (PW)	Annual

Code	Outreach Project	CRS Topics						Audience	Responsibility	Timing
		1	2	3	4	5	6			
OP20	Teachers newsletter	✓		✓			✓	Teachers	City (PW & CD)	Annual
OP21	Community events (America's Night Out, Home Show, Farmers' Market)	✓	✓	✓	✓	✓	✓	General City Population, property owners and residents in the floodplain, Neighborhood associations	City (PW & CD)	Annual
FR1	Main City web page during flood event	✓		✓	✓			All, Media	City: Public Information Officer (PIO), Emergency Management (EM) and Floodplain Mgr. (FPM)	N/A
FR2	Main City web page after flood event		✓		✓	✓		All, Media	PIO, EM & FPM	N/A
FR3	Radio PSAs during flood event	✓		✓	✓			All, Media	PIO	N/A
FR4	Radio PSAs after flood event		✓		✓	✓		All, Media	PIO	N/A
FR5	Social media messages during flood event	✓		✓	✓			All, Media	PIO	N/A
FR6	Social media messages after flood event		✓		✓	✓		All, Media	PIO	N/A

Table 7: Outreach Projects and Flood Response Messages

Implementation

In order for this plan to be effective and sustainable, it needs to be monitored and evaluated on a regular basis. The Community Development Department's Floodplain Manager / Community Rating System Coordinator will oversee the implementation and evaluation of the plan with the assistance of the Floodplain Management Planning Committee. This planning committee will meet at least once a year (and may meet more if needed), to evaluate the progress of the plan implementation and to make recommended changes as warranted. An annual evaluation report will be prepared to summarize the progress of plan implementation and to make recommendations.

CRS Topic	Expanded Public Outreach Messages
1. Know your flood hazard	***Water knows no boundaries:*** 25% of claims are located outside of the 100-year floodplain. Flooding can happen anywhere, but certain areas are especially prone to serious flooding.
	Know your flood risk: In a high-risk area, your home is more likely to be damaged by flood than by fire; 100-year flood event is a flood that has a 1% chance of occurring every year (not just every 100 years)
	Learn more about the flood hazard in your area: Contact the Community Development Department for more information at 541-917-7550. Floodplain Maps, Elevation Certificates and LOMCs are available on the City website.
2. Insure your property for flood hazard	***Make sure you have contents coverage:*** Just a few inches of water can cause major damage to your home and its contents.
	Everyone is eligible to obtain flood insurance: Flood insurance is available for everyone in the City of Albany, within and outside of floodplains. The City participates in NFIP and CRS to make sure everyone can get flood insurance and at improved rates.
	Are you covered? Protect your investment: Most homeowners' insurance does not cover flood damage. Flood insurance will protect you from the financial devastation caused by floods.
3. Protect people from the hazard	***Avoid flood waters.*** It is NEVER safe to swim or walk through flood waters. Moving water can move a car; imagine what it can do to you.
	Are you ready? Prepare yourself before a flood*:* Being prepared for a flood will help keep your family safe and help minimize flood damage.
	Turn Around. Don't Drown: More than half of the deaths from flooding each year occur in vehicles. It takes just 12 inches of rushing water to carry away a small car.
4. Protect your property from the hazard	***Retrofitting or elevating your home could save you money:*** Retrofitting with flood vents or elevating your home could save on flood insurance.
	Don't wait: Mitigate: Retrofitting your home will protect your investment and reduce flood damage
	Keep flood vents and flow through area under your home open: *Open vents = less flood damage. Open flood vents equalize water pressure to reduce damage from floods.*
5. Build responsibly	***Get a permit before you build:*** *For more information, contact Community Development at 541-917-7550*
	Use flood-resistant materials and proper vents: *Examples include "Smart Vents," Concrete, Cement Board, Metal Doors and Cabinets, etc.*
	Build high, stay dry: *Building above the base flood elevation is not only a requirement, but will protect your investment, facilitate financing and reduce flood insurance*
6. Protect natural floodplain functions	***Preserve and restore native vegetation and trees to reduce flood damage.*** Find out more about the natural benefits of floodplains on the City website
	Keep It Clear, Keep It Clean: Keep storm drains, ditches and waterways clean from debris and pollutants to reduce damage from floods
	If you see dumping or debris in ditches, creeks or drains, contact the Public Works Department at 541-917-7600

Table 8: Expanded Outreach Messages

Appendix H:

FEMA APA Letter, City Resolution of Approval, FEMA Approval Letter, and FEMA Review Tool

U.S. Department of Homeland Security
FEMA Region 10
130 228th Street, SW
Bothell, WA 98021-8627

FEMA

March 2, 2023

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

Dear Ms. Feigum:

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

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

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

Sincerely,

WENDY L SHAW Digitally signed by WENDY L SHAW
Date: 2023.03.06 11:16:27 -08'00'

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

Enclosures

WS:v1

www.fema.gov

RESOLUTION NO. 7196

A RESOLUTION APPROVING AND ADOPTING THE CITY OF ALBANY, OREGON, NATURAL HAZARD MITIGATION PLAN DATED APRIL 2023.

WHEREAS, The Albany City Council approved and adopted the City of Albany Natural Hazard Mitigation Plan (Resolution 6539) on September 28, 2016; and

WHEREAS, the City of Albany is required to review, update, and provide City Council adoption of the City of Albany Natural Hazard Mitigation Plan every five years to continue eligibility for federal mitigation grant funding; and

WHEREAS, the City's Natural Hazard Mitigation Steering Committee performed a review in 2022 and has updated the City of Albany Natural Hazard Mitigation Plan.

NOW, THEREFORE, BE IT RESOLVED the Albany City Council approves and adopts the City of Albany, Oregon, Natural Hazard Mitigation Plan dated April 2023.

DATED AND EFFECTIVE THIS 12TH DAY OF APRIL 2023.

Mayor

ATTEST:

City Clerk

U.S. Department of Homeland Security
FEMA Region 10
130 228th Street, SW
Bothell, WA 98021-8627

FEMA

April 18, 2023

The Honorable Alexander D. Johnson II
City of Albany
333 Broadalbin Street SW
Albany, Oregon 97321

Dear Mayor Johnson:

The United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10, approved the City of Albany Natural Hazards Mitigation Plan effective April 13, 2023, through April 12, 2028, in accordance with the planning requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended, the National Flood Insurance Act of 1968, as amended, the Water Infrastructure Improvements for the Nation Act and Title 44 Code of Federal Regulations Part 201.

A FEMA-approved local mitigation plan is a condition of receiving certain non-emergency Stafford Act assistance and FEMA mitigation grants from the following programs:

- Hazard Mitigation Grant Program
- Building Resilient Infrastructure and Communities
- Flood Mitigation Assistance

FEMA individually evaluates all application requests for funding according to the specific eligibility requirements of the applicable program. Though a specific mitigation activity or project identified in the plan may meet the eligibility requirements, it may not automatically receive approval for FEMA funding under any of the programs.

Approved mitigation plans may be eligible for points under the National Flood Insurance Program's Community Rating System. For additional information regarding the Community Rating System, please visit: www.fema.gov/national-flood-insurance-program-community-rating-system or contact your local floodplain manager.

Over the next five years, we encourage your communities to follow the plan's schedule for monitoring and updating, and to develop further mitigation actions. To continue eligibility, jurisdictions must review, revise as appropriate, and resubmit the plan within five years of the original approval date.

www.fema.gov

If you have questions regarding your plan's approval or FEMA's Mitigation Grant Programs, please contact Joseph Murray, Planner with Oregon Office of Emergency Management, at (503) 378-2911, who coordinates and administers these efforts for local entities.

Sincerely,

KRISTEN C MEYERS Digitally signed by KRISTEN C MEYERS
Date: 2023.04.19 07:39:50 -04'00'

Kristen Meyers, Director
Mitigation Division

cc: Anna Feigum, Oregon Department of Emergency Management

LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: City of Albany, Oregon	**Title of Plan: 2022 City of Albany Natural Hazard Mitigation Plan**	**Date of Plan: November 2022**
Local Point of Contact: **Chuck Perino**	**Address:** **611 Lyon St. SE** **Albany, Oregon 97321**	
Title: Emergency Manager		
Department: Fire		
Phone Number: **541-917-7725**	**E-Mail:** **chuck.perino@cityofalbany.net**	

State Reviewer: Janine Mayer	**Title: Mitigation Program Representative**	**Date: 11-17-22**

FEMA Reviewer: Josh Vidmar	**Title: CERC Planner**	**Date: March 1, 2023**
Erin Cooper	**FEMA Community Planner 3/2/23**	
Jennifer Adleman	**FEMA Community Planner 4/13/2023**	
Date Received in FEMA Region 10	3/2/23	
Plan Not Approved		
Plan Approvable Pending Adoption	3/2/23	
Plan Approved	4/13/23	

SECTION 1:
REGULATION CHECKLIST

INSTRUCTIONS: The second column of the Regulation Checklist is typically pre-completed by the local jurisdiction seeking FEMA approval; the third and fourth columns must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Volume I: pp. iv, 5-6 Volume III: App. B pp. B-2 to B-44	X	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Volume III: App. B pp. B-3 to B-4	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Volume III: App. B pp. B-3 to B-6, B-33 to B-44	X	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Footnotes throughout the plan	X	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Volume I: Sec. 5 pp. 77-78	X	
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a five-year cycle)? (Requirement §201.6(c)(4)(i))	Executive Summary p. 4 Volume I: Sec. 5 pp. 64-77	X	
ELEMENT A: REQUIRED REVISIONS None			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Executive Summary p. 3 Volume II: Flood pp. 3-14; Earthquake pp. 2-10; Severe Weather pp. 2-8; Wildfire pp. 2-6; Volcano pp. 2;	X	

	Landslides pp. 3-8; Drought pp. 2; Poor Air Quality pp. 2-7		
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Executive Summary p. 1 Volume I: Sec. 2 pp. 9-11 Volume II: Flood pp. 17-22; Earthquake pp. 10-12; Severe Weather pp. 9-17; Wildfire pp. 6-11; Volcano pp. 2-4, 6-7; Landslides pp. 2-3; Drought pp. 2-5; Poor Air Quality pp. 7-10	X	
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Volume II: Flood pp. 23-27; Earthquake pp. 12-20; Severe Weather pp. 19-20; Wildfire pp. 11-16; Volcano pp. 8-10; Landslides pp. 9-12; Drought pp. 5-7; Poor Air Quality p. 10	X	
B4. Does the Plan address (National Flood Insurance Program (NFIP) insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Volume II: Flood p. 25 Volume III: App. G pp. 1-5	X	
ELEMENT B: REQUIRED REVISIONS None			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Volume I: pp. 65-70 Volume III: App. A pp. 1-10	X	
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Volume II: Flood pp. 13-17, 34-35 Volume III: App. G pp. 1-11	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Volume I: Sec. 4 pp. 52-53	X	
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Volume I: Sec. 4 pp. 57-63	X	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Executive Summary p. 4 Volume I: pp. 73-76 Volume III: App. C pp. 1-6	X	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as	Volume I: pp. 2, 64-72 Volume III: App. E pp. 1-59	X	

comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))			
ELEMENT C: REQUIRED REVISIONS None			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Volume I: pp. 22-25, 47-51	X	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Volume I: pp. 56-62 Volume III: App. F	X	
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Volume I: pp. 56-62 Volume III: App. F	X	
ELEMENT D: REQUIRED REVISIONS None			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Volume I p. 4; to be updated after adoption	X	
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	n/a – single jurisdiction	NA	
ELEMENT E: REQUIRED REVISIONS None			
OPTIONAL: HIGH HAZARD POTENTIAL DAM (HHPD) RISKS	Note: There are no high hazard potential dams in the City of Albany. The city is at risk from other dams upstream as identified in Volume I, page 23.		
HHPD1. Did Element A4 (planning process) describe the incorporation of existing plans, studies, reports, and technical information for high hazard potential dams?		NA	
HHPD2. Did Element B3 (risk assessment) address HHPDs?		NA	
HHPD3. Did Element C3 (mitigation goals) include mitigation goals to reduce long-term vulnerabilities from high hazard potential dams that pose an unacceptable risk to the public?		NA	
HHPD4. Did Element C4-C5 (mitigation actions) address HHPDs prioritize mitigation actions to reduce vulnerabilities from high hazard potential dams that pose an unacceptable risk to the public?		NA	
REQUIRED REVISIONS		NA	
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
The State of Oregon imposes no additional requirements upon local mitigation plans.			

SECTION 2:
PLAN ASSESSMENT

INSTRUCTIONS: The purpose of the Plan Assessment is to offer the local community more comprehensive feedback to the community on the quality and utility of the plan in a narrative format. The audience for the Plan Assessment is not only the plan developer/local community planner, but also elected officials, local departments and agencies, and others involved in implementing the Local Mitigation Plan. *The Plan Assessment must be completed by FEMA*. The Assessment is an opportunity for FEMA to provide feedback and information to the community on: 1) suggested improvements to the Plan; 2) specific sections in the Plan where the community has gone above and beyond minimum requirements; 3) recommendations for plan implementation; and 4) ongoing partnership(s) and information on other FEMA programs, specifically RiskMAP and Hazard Mitigation Assistance programs. The Plan Assessment is divided into two sections:

1. Plan Strengths and Opportunities for Improvement
2. Resources for Implementing Your Approved Plan

Plan Strengths and Opportunities for Improvement is organized according to the plan Elements listed in the Regulation Checklist. Each Element includes a series of italicized bulleted items that are suggested topics for consideration while evaluating plans, but it is not intended to be a comprehensive list. FEMA Mitigation Planners are not required to answer each bullet item and should use them as a guide to paraphrase their own written assessment (2-3 sentences) of each Element.

The Plan Assessment must not reiterate the required revisions from the Regulation Checklist or be regulatory in nature and should be open-ended and to provide the community with suggestions for improvements or recommended revisions. The recommended revisions are suggestions for improvement and are not required to be made for the Plan to meet Federal regulatory requirements. The italicized text should be deleted once FEMA has added comments regarding strengths of the plan and potential improvements for future plan revisions. It is recommended that the Plan Assessment be a short synopsis of the overall strengths and weaknesses of the Plan (no longer than two pages), rather than a complete recap section by section.

Resources for Implementing Your Approved Plan provides a place for FEMA to offer information, data sources and general suggestions on the plan implementation and maintenance process. Information on other possible sources of assistance including, but not limited to, existing publications, grant funding or training opportunities, can be provided. States may add state and local resources, if available.

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

Plan Strengths

- The plan included various methods of public participation.
- Having a Public Information Officer is a good way to keep track of the participation. They can make sure the information about public participation is available.

Opportunities for Improvement

- Consider using the same public participation methods that were used during the planning process for continued public involvement.
- It is not clear if outside stakeholders were invited to the planning process. If they were not, include how they will be included in the plan maintenance process.

Element B: Hazard Identification and Risk Assessment

Plan Strengths

- The plan does a great job using county and state data when local data was unavailable. The plan also provides a detailed description of why this data was used.
- The plan identifies the effects of climate change on the identified hazards.

Opportunities for Improvement

- Additional information on the history of past events would provide context for some hazards. Infrequent events like earthquakes may have longer gaps between events.

Element C: Mitigation Strategy

Plan Strengths

- The plan identifies multiple themes and a variety of goals within each. This is a good way to establish goals that are unique to the planning area.
- The plan has a detailed analysis of how the planning committee prioritized the proposed mitigation actions.

Opportunities for Improvement

- Some of the action in Appendix E do not have all the complete information. This information can also be found in Appendix F. For consistency, include this information where it applies in Appendix E, as well.

Element D: Plan Update, Evaluation, and Implementation (*Plan Updates Only*)

Plan Strengths

- Volume 1 does a good job of explaining the history of the mitigation plan. This includes a general review of what changed in the 2022 version.

Opportunities for Improvement

- Think about including a section for successful mitigation actions. Including this can help explain that the plan is meant to be a living document that is necessary for community planning.

B. Resources for Implementing Your Approved Plan

- ***Funding Resources***

This comprehensive FEMA website provides a list of resources and information on key elements of the **Building Resilient Infrastructure and Communities (BRIC)** program. Resource List for the BRIC Grant Program | FEMA.gov

The **Region 10 Wildfire Mitigation Funding Opportunity Guides** provide state, tribes, and local officials with a wide range of application development resources for hazard mitigation grants. Mitigation Funding Opportunity Guides | FEMA.gov

This factsheet provides information on **Planning related activities from the Hazard Mitigation Grant Program (HMGP)** . State, Tribal, and/or local governments may use planning-related funding to reduce risk and include hazard mitigation with planning. Take a look at this guide for information on what types of mitigation activities may help you implement your projects.

Rehabilitation Of High Hazard Potential Dam (HHPD) Grant Program: The President signed the Water Infrastructure Improvements for the Nation Act or the "WIIN Act," on December 16, 2016, which adds a new grant program under FEMA's National Dam Safety Program (33 U.S.C. 467f). Section 5006 of the Act, Rehabilitation of High Hazard Potential Dams, provides technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. High Hazard Potential is a classification standard for any dam whose failure or mis-operation will cause loss of human life and significant property destruction. Learn more at - https://www.fema.gov/emergency-managers/risk-management/dam-safety/grants

- ***Plan Integration Resources***

The **Region 10 Coffee Break Webinar on Integrating Natural Hazard Mitigation into Comprehensive Planning** is a resource specific to Region 10 states and provides examples of how communities are integrating natural hazard mitigation strategies into comprehensive planning. You can find it on FEMA's youtube page at Integrating Natural Hazard Mitigation Plans into Local Planning - YouTube along with our other Mitigation Planning coffee break series webinars at Natural Hazards Mitigation Planning Coffee Break Series - YouTube

Plan Integration: Linking Local Planning Efforts (2015)- This step-by-step guide helps communities review local plans for possible integration and improve alignment efforts, including interagency coordination. Plan Integration: Linking Local Planning Efforts (2015)

The **Mitigation Planning and Community Rating System Bulletin** provides an overview of how to bring together planning efforts between the Community Rating System (CRS) and hazard mitigation plans. Mitigation Planning and the Community Rating System: Key Topics Bulletin (fema.gov)

- ***Mitigation Ideas/Best Practice Resources***

The **Region 10 Seismic Mitigation Showcase Guides** highlight mitigation successes in earthquake and tsunami mitigation by documenting specific locations and communities, the decision-making process, path to funding , and how partnerships were developed. Seismic Mitigation Showcase Guides | FEMA.gov

The **Mitigation Ideas: A Resource for Reducing Risk from Natural Hazards** resource presents ideas for how to mitigate the impacts of different natural hazards, from drought and sea level rise, to severe winter weather and wildfire. The document also includes ideas for actions that communities can take to reduce risk to multiple hazards, such as incorporating a hazard risk assessment into the local development review process. You can find it in the FEMA Library at Mitigation Ideas (fema.gov)

The **Local Mitigation Planning Handbook** provides guidance to local governments on developing or updating hazard mitigation plans to meet and go above the requirements. You can find it in the FEMA Library at Local Mitigation Planning Handbook (fema.gov).

The FEMA Region 10 **Risk Mapping, Analysis, and Planning program (Risk MAP)** releases a monthly newsletter that includes information about upcoming events and training opportunities, as well as hazard and risk related news from around the Region. Past newsletters can be viewed at Newsletter (starr-team.com) If you would like to receive future newsletters, email rxnewsletter@starr-team.com and ask to be included.

This Post Disaster Redevelopment Guide has guidance on how to integrate risk reduction strategies into existing local plans, policies, codes, and programs for community development or redevelopment patterns. Planning for Post-Disaster Redevelopment (fema.gov)

The mitigation strategy may include eligible projects to be funded through FEMA's hazard mitigation grant programs (Building Resilient Infrastructure and Communities (BRIC), Hazard Mitigation Grant Program, and Flood Mitigation Assistance). Contact your State Hazard Mitigation Officer, Anna Feigum at anna.r.feigum@mil.state.or.us, for more information.