A RESOLUTION ADOPTING THE LINN COUNTY MULTI-JURISDICTIONAL NATURAL HAZARD MITIGATION PLAN)))

RESOLUTION NO. 2019-1

WHEREAS, the City of Lebanon recognizes the threat that natural hazards pose to people, property and infrastructure; and,

WHEREAS, undertaking hazard mitigation actions will reduce the potential for harm from future hazard occurrences; and,

WHEREAS, an adopted Natural Hazards Mitigation Plan is required as a condition of future funding for mitigation projects under multiple Federal Emergency Management Agency (FEMA) pre- and post-disaster mitigation grant programs; and,

WHEREAS, the City, in conjunction with Linn County, participated in the FEMA-prescribed mitigation planning process to prepare the Linn County Multi-Jurisdictional Natural Hazard Mitigation Plan; and,

WHEREAS, the Oregon Office of Emergency Management and FEMA Region X officials have reviewed the Linn County Multi-Jurisdictional Natural Hazard Mitigation Plan and pre-approved the document contingent upon adoption by the participating governments and entities; and,

WHEREAS, the City Council finds that it is in the interests of the residents to adopt the Linn County Multi-Jurisdictional Natural Hazard Mitigation Plan which includes the City of Lebanon.

NOW, THEREFORE, THE CITY OF LEBANON, LINN COUNTY, OREGON, DOES RESOLVE AS FOLLOWS:

Section 1. Adoption. That the City Council adopt the Linn County Multi-Jurisdictional Natural Hazard Mitigation Plan as set forth in Exhibit 1.

Section 2. Effective Date. This resolution shall become effective upon passage by the Council and approval of the Mayor.

Adopted by the Lebanon City Council and executed on the 13th day of February 2019, with 6 yeas and 0 nays.

CITY COUNCIL OF LEBANON, OREGON

Paul Aziz, Mayor ☒
Jason Bolen, Council President ☐

Attested by:

Linda Kaser, City Clerk/Recorder

Linn County Multi-Jurisdictional Natural Hazards Mitigation Plan

Linn County and the Cities of: Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, & Waterloo

Photo Credits Gary Halvorson, Oregon State Archives

May 2017

Volume I: Basic Plan

Prepared for:

Linn County

Prepared by:

University of Oregon
Community Service Center
Oregon Partnership for Disaster Resilience

UNIVERSITY OF OREGON

CSC
Community Service Center

OREGON PARTNERSHIP FOR DISASTER RESILIENCE

This Natural Hazard Mitigation Plan was prepared by:

CSC
Community Service Center

OREGON PARTNERSHIP FOR DISASTER RESILIENCE

With support from:

UNIVERSITY OF OREGON

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

Planning grant funding provided by:

FEMA

Federal Emergency Management Agency (FEMA)
Pre-Disaster Mitigation Program
Grant: EMS-2014-PC-0005
Sub-grant Application Reference: PDMC-PL-10-OR-2013-001, and

Grant: EMS-2014-PC-0011
Sub-grant Application Reference: PDMC-PL-10-OR-2014-002

Additional Support Provided by:

OREGON MILITARY DEPARTMENT
OFFICE OF EMERGENCY MANAGEMENT
OEM

SPECIAL THANKS & ACKNOWLEDGEMENTS

Linn County developed this Multi-Jurisdictional Natural Hazards Mitigation Plan (NHMP) through a regional partnership funded by the Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation (PDM) Competitive Grant Program: EMS-2014-PC-0011, Sub-grant Application Reference: PDMC-PL-10-OR-2014-002. This updated Natural Hazard Mitigation Plan is a collaboration between Linn County and the Cities of Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, and Waterloo. The county utilized a four-phased planning process, plan templates and plan development support provided by the Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Community Service Center.

Special thanks to Olivia Glantz and Jennifer Cepello, Linn County Planners, for their leadership in convening the committee.

Linn County NHMP Update Steering Committee

Linn County

- Co-convener, Robert Wheeldon, Linn County Planning Director
- Co-convenor, Joe Larsen, Linn County Emergency Management Coordinator
- Jennifer Cepello, Linn County Planning and Building
- John Bradner, Albany Fire Department
- Dave Furtwangler, Cascade Timber & Linn County Planning Commission
- Chuck Knoll, Linn County Road Department (County Engineer)
- Sarah Bates, Linn County Public Health
- Steve Barnett, Linn County GIS
- Rayne Legras, Linn County Planning Commission
- Darrel Tedisch, City of Albany Emergency Management Specialist

City of Halsey

- Ronda Fischer, City Administrator
- Andy Ridinger, Public Works Director

City of Harrisburg

- Brian Latta, City Administrator
- Michele Eldridge, City Recorder/Assistant City Administrator
- Chuck Scholz, Public Works Director

City of Lebanon

- Rob Emmons, Engineering Services Supervisor
- Frank Stevenson, Lebanon Police Chief

City of Lyons

- Micki Valentine, City Recorder
- Richard Berkey, Public Works

City of Scio

- Ginger Allen, Interim City Manager
- Cathy Martin, Administrative Assistant
- Bob Waller, Public Works Supervisor

City of Sodaville

- Judy Smith, City Administrator
- Stan Smith, Public Works Director

City of Tangent

- Georgia Edwards, City Manager

City of Waterloo

- Cathy Nelson, City Recorder

Community Service Center Team

- Robert Parker, Director
- Josh Bruce, Director OPDR
- Michael Howard, Assistant Program Manager
- Julie Foster, Grant's Administrator
- Aniko Drlik-Muehleck, Project Assistant
- Kyle Collins, Project Assistant

Additional Thanks:

To the Department of Geology and Mineral Industries for assistance with hazard data; the Department of Land Conservation and Development staff in the hazards for flood data, mapping and process support; to the Oregon Military Department Office of Emergency Management for grant administration and process support.

About the Community Service Center

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

About the Oregon Partnership for Disaster Resilience

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

Plan Template Disclaimer

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

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PLAN SUMMARY

Linn County updated this Multi-Jurisdictional Natural Hazards Mitigation Plan (NHMP, MNHMP, or Plan) in an effort to prepare for the long-term effects resulting from natural hazards. It is impossible to predict exactly when these hazards will occur, or the extent to which they will affect the community. However, with careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, it is possible to create a resilient community that will benefit from long-term recovery planning efforts.

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

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

Why Develop this Mitigation Plan?

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

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

What is Mitigation?

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

- U.S. Federal Emergency Management Agency

Who Participated in Developing the Plan?

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

The County Steering Committee included representatives from the following jurisdictions, agencies and private entities:

- Linn County
- City of Albany
- Albany Fire Department
- Cascade Timber

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

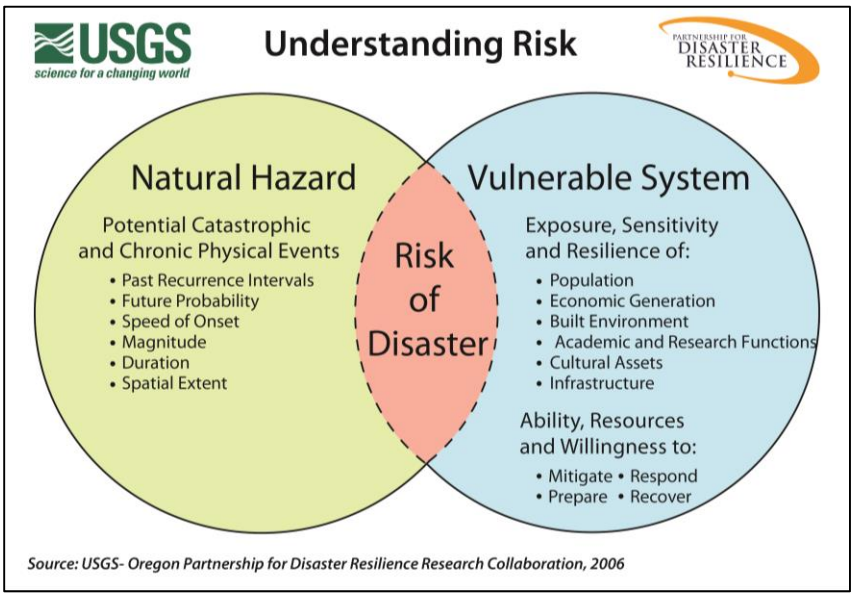
The Linn County Planning Director and Linn County Emergency Management Coordinator convened the planning process for Linn County and will take the lead in implementing, maintaining and updating the plan. Linn County is dedicated to directly involving the public in the continual review and update of the natural hazards mitigation plan. Although members of the Steering Committee represent the public to some extent, the public will also have the opportunity to continue to provide feedback about the plan throughout the implementation and maintenance period. Notably, the county invited additional participation in the planning process.

How Does this Mitigation Plan Reduce Risk?

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

The NHMP is intended to assist Linn County reduce the risk from natural hazards by identifying resources, information, and strategies for risk reduction. It is also intended to guide and coordinate mitigation activities throughout the county. A risk assessment consists of three phases: hazard identification, vulnerability assessment, and risk analysis, as illustrated in the following graphic.

Figure PS-1 Understanding Risk



Source: Oregon Partnership for Disaster Resilience.

By identifying and understanding the relationship between natural hazards, vulnerable systems, and existing capacity, Linn County is better equipped to identify and implement actions aimed at reducing the overall risk to natural hazards.

What is Linn County's Overall Risk to Hazards?

Linn County reviewed and updated their risk assessment to evaluate the probability of each hazard as well as the vulnerability of the community to that hazard. Scores are based on the Linn County Hazard Analysis submitted to the Oregon Office of Emergency Management (2011) and updated by the steering committee in 2016. Table PS-1 below summarizes hazard probability and vulnerability as determined by the county steering committee (for more information see Section 2, Risk Assessment).

Table PS-1 Risk Assessment Summary

Hazard	Probability	Vulnerability	Total Threat Score	Hazard Rank
Winter Storm	High	High	230	# 1
Earthquake - Cascadia	High	High	208	# 2
Flood	HIgh	Moderate	205	# 3
Wildfire	High	Moderate	200	# 4
Windstorm	High	Moderate	191	# 5
Landslide	High	Moderate	163	# 6
Earthquake - Crustal	Low	Moderate	141	# 7
Drought	Low	Low	106	# 8
Volcano*	Low	Moderate	98	# 9

**Not included in this Plan*

Source: Linn County NHMP Steering Committee

At the end of this executive summary, hazard briefs provide summary information for priority hazards in Linn County.

What is the Plan's Mission?

The mission of the Linn County NHMP is to:

Mission: *To reduce the impact of natural hazards on the community through planning, communication, coordination and partnership development.*

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

What are the Plan Goals?

The plan goals describe the overall direction that the participating jurisdiction's agencies, organizations, and citizens can take toward mitigating risk from natural hazards. Below is a list of the plan goals (Note: although numbered the goals are not prioritized):

Goal 1: *Enhance coordination and communication among Linn County stakeholders to implement the Plan.*

Goal 2: *Protect life, the built environment and natural systems through County policies, procedures and services.*

Goal 3: *Protect life, the built environment, the economy and natural resources through community-wide partnerships.*

How are the Action Items Organized?

The action items are organized within an action matrix included within Section 3, Mitigation Strategy (full descriptions are provided in Appendix A, *Action Item Forms*).

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

Data collection, research and the public participation process resulted in the development of the action items. The Action Item Matrix portrays the overall Plan framework and identifies linkages between the plan goals and actions. The matrix documents the title of each action along with the coordinating organization, timeline, and the plan goals addressed. Action items particular to each of the participating cities are included at the end of the action item matrix in Section 3, Mitigation Strategy and in the addenda.

Comprehensive Action Plan

The following table summarizes specific **priority** NHMP actions. Refer to the Mitigation Strategy section for a complete list of actions. Volume II, Appendix A contains detailed information for all action items, including potential partners, implementation ideas, proposed timeline and estimated budget.

Action ID Key: MH = Multi-Hazard, SW = Severe Weather, DR = Drought, LS = Landslide EQ = Earthquake, WF = Wildfire

Table PS-2 Linn County Priority NHMP Actions

Item ID	Action Item
High Priority	
MH-1	Develop mutual aid agreements with private parties. Agreements should document equipment, labor, and special expertise that could be mobilized rapidly in the event of a natural disaster. Agreements should also include maps of private parties' operating areas.
FL-1	Update Flood Insurance Rate Maps (FIRM).
WF-1	Update the Community Wildfire Protection Plan.
Medium Priority	
MH-2	Publicize opportunities for appropriate staff to attend FEMA G318 local mitigation planning workshops or related trainings.
MH-3	Maintain public awareness campaigns aimed at homeowners, children, the elderly, and non-English speaking residents to raise awareness about disaster preparedness and risk reduction.
MH-4	Encourage small businesses to develop continuity of business plans in the event of a disaster and to implement non-structural mitigation.
MH-Bridge 1	Develop a County wide list of all public bridge crossings leading to private structures on private and public lands.
MH-Bridge 2	Evaluate public bridges identified in MH-Bridge 1 for flood, scour, seismic and structural integrity and rank bridges by vulnerability.
MH-Bridge 4	Implement County's existing bridge scour protection plan, trageting 5-10 high priority bridges every year (as identified in MH-Bridge 2).
MH-Bridge 5	Implement a routine public bridge inspection program for bridges identified in MH-Bridge 1 and revisit bridge vulnerability ranking as necessary.
FL-2	Digitize LOMA/LOMAR and elevation certificates.
FL-3	Fund a new hydraulic study for Linn County.
FL-4a	Identify river and stream scour locations that impact County roads and prioritize areas for stabilization.
FL-4b	Stabilize priority road areas identified in FL-4a.
SW-1a	Inventory public and semi-public infrastructure and critical facilities and evalute for vulnerability to severe weather.
LS-1a	Identify landslide and rock fall areas adjacent to public roads and prioritize areas for stabilization/mitigation.
LS-1b	Stabilize priority areas identified in LS-1a.
LS-2a	Integrate new data on debris flow areas into County maps.
LS-2b	Update the development code to limit development in debris flow areas identified in LS-2a.
EQ-1a	Conduct a seismic vulnerability assessment of critical County-owned structures and prioritize vulnerable publicly owned structures.

Source: Linn County NHMP Steering Committee (2016)

Table PS-4 Halsey Priority NHMP Actions
[Insert Halsey Priority Actions – to be inserted at a later date.]

Source: Halsey NHMP Steering Committee (2016)

Table PS-5 Harrisburg Priority NHMP Actions
[Insert Harrisburg Priority Actions – to be inserted at a later date.]

Source: Harrisburg NHMP Steering Committee (2016)

Table PS-6 Lebanon Priority NHMP Actions
[Insert Lebanon Priority Actions – to be inserted at a later date.]

Source: Lebanon NHMP Steering Committee (2016)

Table PS-7 Lyons Priority NHMP Actions
[Insert Lyons Priority Actions – to be inserted at a later date.]

Source: Lyons NHMP Steering Committee (2016)

Table PS-8 Scio Priority NHMP Actions
[Insert Scio Priority Actions – to be inserted at a later date.]

Source: Scio NHMP Steering Committee (2016)

Table PS-9 Sodaville Priority NHMP Actions
[Insert Sodaville Priority Actions – to be inserted at a later date.]

Source: Sodaville NHMP Steering Committee (2016)

Table PS-10 Tangent Priority NHMP Actions
[Insert Tangent Priority Actions – to be inserted at a later date.]

Source: Tangent NHMP Steering Committee (2016)

Table PS-11 Waterloo Priority NHMP Actions
[Insert Waterloo Priority Actions – to be inserted at a later date.]

Source: Waterloo NHMP Steering Committee (2016)

How will the plan be implemented?

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

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

The plan maintenance section of this Plan details the formal process that will ensure that the Linn County NHMP remains an active and relevant document. The plan will be implemented, maintained, and updated by two designated co-conveners. The Linn County Planning Director and Linn County Emergency Management Coordinator are the designated co-conveners (Plan Co-Conveners) and are responsible for overseeing the review and implementation processes (see city addenda for city conveners). The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing a plan revision every five years. This section also describes how the communities will integrate public participation throughout the plan maintenance process.

Plan Adoption

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

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

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

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

The Steering Committees for Linn County and participating cities each met to review the plan update process and their governing bodies adopted the NHMP as shown below:

Linn County adopted the plan on **[DATE], 2017**

The City of Halsey adopted the plan on **[DATE], 2017**

The City of Harrisburg adopted the plan on **[DATE], 2017**

The City of Lebanon adopted the plan on **[DATE], 2017**

The City of Lyons adopted the plan on **[DATE], 2017**

The City of Scio adopted the plan on **[DATE], 2017**

The City of Sodaville adopted the plan on **[DATE], 2017**

The City of Tangent adopted the plan on **[DATE], 2017**

The City of Waterloo adopted the plan on **[DATE], 2017**

FEMA Region X approved the Linn County NHMP on **[DATE], 2017**. With approval of this Plan, the entities listed above are now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through **[DATE], 2017**.

Volume I:
Basic Plan

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SECTION I: INTRODUCTION

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

What is Natural Hazard Mitigation?

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

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

Why Develop a Mitigation Plan?

Linn County developed this Natural Hazards Mitigation Plan (NHMP or Plan) in an effort to reduce future loss of life and damage to property resulting from natural hazards. It is impossible to predict exactly when natural hazard events will occur, or the extent to which they will affect community assets. However, with careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, it is possible to minimize the losses that can result from natural hazards.

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

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

What Federal Requirements Does This Plan Address?

DMA2K is the latest federal legislation addressing mitigation planning. It reinforces the importance of mitigation planning and emphasizes planning for natural hazards before they occur. As such, this Act established the Pre-Disaster Mitigation (PDM) grant program and new requirements for the national post-disaster Hazard Mitigation Grant Program (HMGP). Section 322 of the Act specifically addresses mitigation planning at the state and local levels. State and local jurisdictions must have approved mitigation plans in place in order to qualify to receive post-disaster HMGP funds. Mitigation plans must demonstrate that State and local jurisdictions' proposed mitigation measures are based on a sound planning process that accounts for the risk to the individual and State and local jurisdictions' capabilities.

Chapter 44 Code of Federal Regulations (CFR), section 201.6, also requires a local government to have an approved mitigation plan in order to receive HMGP project grants.[2] Pursuant of Chapter 44 CFR, the Natural Hazard Mitigation Plan planning processes shall include opportunity for the public to comment on the plan during review, and the updated Natural Hazard Mitigation Plan shall include documentation of the public planning process used to develop the plan.[3] The Natural Hazard Mitigation Plan update must also contain a risk assessment, mitigation strategy and a plan maintenance process that has been formally adopted by the governing body of the jurisdiction.[4] Lastly, the Natural Hazard Mitigation Plan must be submitted to Oregon Military Department – Office of Emergency Management (OEM) for initial plan review, and then federal approval.[5] Additionally, a recent change in the way OEM administers the Emergency Management Performance Grant (EMPG), which helps fund local emergency management programs, also requires a FEMA-approved NHMP.

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

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

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

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

[3] ibid, subsection (b). 2015

[4] ibid, subsection (c). 2015

[5] ibid, subsection (d). 2015

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

How was the Plan Developed?

The plan was developed by the Linn County Natural Hazard Mitigation Plan Steering Committee and the Steering Committees for the cities of Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, and Waterloo. The Linn County Steering Committee (Convening Body) formally convened on two occasions to discuss and revise the plan. Each of the participating City Steering Committees met at least once formally. Steering Committee members contributed data and maps, and reviewed and updated the community profile, risk assessment, action items, and implementation and maintenance plan.

An open public involvement process is essential to the development of an effective plan. In order to develop a comprehensive approach to reducing the effects of natural disasters, the planning process shall include opportunity for the public, neighboring communities, local and regional agencies, as well as, private and non-profit entities to comment on the plan during review.[6] Linn County will post the draft NHMP on their website for the general public to provide feedback. In addition, Linn County discussed the NHMP update with opportunity for public input during the May 10, 2016 Planning Commission meeting. Prior to the meeting, Linn County provided a press release inviting the public to provide comment at the May Planning Commission meeting.

How is the Plan Organized?

Each volume of the plan provides specific information and resources to assist readers in understanding the hazard-specific issues facing county and city residents, businesses, and the environment. Combined, the sections work in synergy to create a mitigation plan that furthers the community's mission to reduce or eliminate long-term risk to people and their property from hazards and their effects. This plan structure enables stakeholders to use the section(s) of interest to them.

Volume I: Basic Plan

Plan Summary

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

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

Section 1: Introduction

The Introduction briefly describes the countywide mitigation planning efforts and the methodology used to develop the plan.

Section 2: Risk Assessment

Section 2 provides the factual basis for the mitigation strategies contained in Section 3. (Additional information is included within Appendix C, which contains an overall description of Linn County and incorporated cities.) This section includes a brief description of community sensitivities and vulnerabilities. The Risk Assessment allows readers to gain an understanding of the county's vulnerability and resilience to natural hazards.

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

- Drought
- Earthquake
- Flood
- Landslide
- Wildfire
- Severe Weather

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

Section 3: Mitigation Strategy

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

Section 4: Plan Implementation and Maintenance

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

Volume II: Jurisdictional Addenda

Volume II of the plan is reserved for any city or special district addenda developed through this multi-jurisdictional planning process. Several cities within the county participated in the NHMP process and created an addendum. As such, the five-year update cycle will be the same for all of these cities and the county. The City of Albany and the City of Sweet Home have their own stand-along NHMPs.

The plan includes city addenda for the following jurisdictions:

- City of Halsey (new)
- City of Harrisburg (new)
- City of Lebanon (new)
- City of Lyons (update)
- City of Scio (update)
- City of Sodaville (update)
- City of Tangent (update)
- City of Waterloo (new)

Volume III: Mitigation Resources

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

Appendix A: Planning and Public Process

This appendix includes commentary on major changes to the plan since 2010. It also documents changes to each of the 2010 action items. Finally, Appendix A includes documentation of all the countywide public processes utilized to develop the plan. It includes agendas and sign-in sheets for steering committee meetings as well as documentation of other public involvement methods.

Appendix B: Community Profile

The community profile describes the county and participating cities from a number of perspectives in order to help define and understand the region's sensitivity and resilience to natural hazards. The information in this section represents a snapshot in time of the current sensitivity and resilience factors in the region when the plan was updated.

Appendix C: Economic Analysis of Natural Hazard Mitigation Projects

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

Appendix D: Grant Programs and Resources

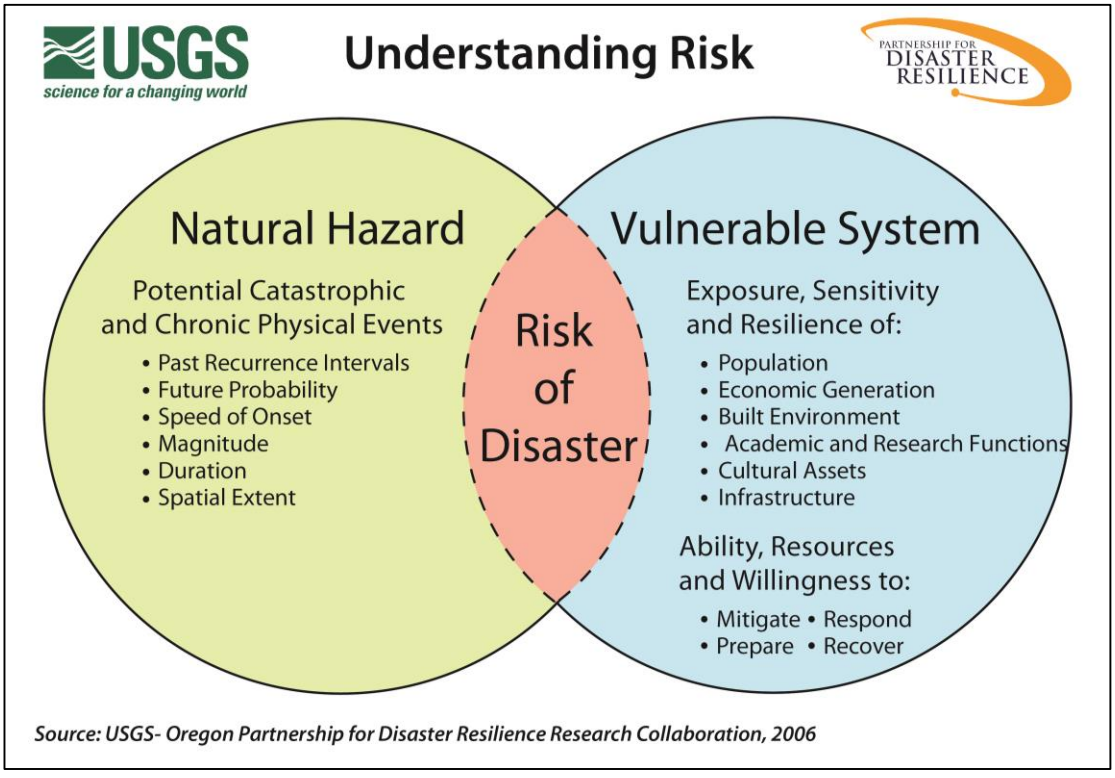
This appendix lists state and federal resources and programs by hazard.

SECTION 2: RISK ASSESSMENT

This section of the NHMP addresses 44 CFR 201.6(b)(2) - Risk Assessment. The Risk Assessment applies to Linn County and the Cities of Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, and Waterloo. City specific information is called out where relevant. In addition, this chapter can assist with addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards.

The information presented below, along with community characteristics presented in the Community Profile Appendix, is used to inform the risk reduction actions identified in Section 3 – Mitigation Strategy. The risk assessment process is graphically depicted in Figure 2-1 below. Ultimately, the goal of hazard mitigation is to reduce the area where hazards and vulnerable systems overlap.

Figure 2-1. Understanding Risk



Source: Oregon Partnership for Disaster Resilience.

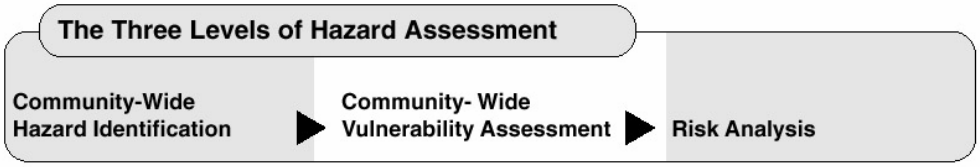
What is a Risk Assessment?

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

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

The following figure illustrates the three-phase risk assessment process:

Figure 2-2. Three Phases of a Risk Assessment



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

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

Hazard Identification

Linn County identifies six natural hazards that could have an impact on the county and each of the participating jurisdictions. Summary information for each hazard is presented below; additional information pertaining to the types and characteristics of each hazard is available in the State of Oregon Natural Hazard Mitigation Plan Region 3 Risk Assessment. Table 2-1 lists the hazards identified in the county in comparison to the hazards identified in the State of Oregon NHMP for the Mid/ Southern Willamette Valley (Region 3), which includes Linn County.

Table 2-1 Linn County Hazard Identification

Linn County	State of Oregon NHMP Region 3: Mid/ Southern Willamette Valley
Drought	Drought
Earthquake	Earthquake
Flood	Flood
Landslide	Landslide
None	Volcano
Wildfire	Wildfire
Severe Weather	Windstorm
	Winter Storm

Source: Linn County NHMP Steering Committee (2016) and
State of Oregon NHMP, Region 3: Mid/ Southern Willamette Valley (2015)

The following subsections briefly describe relevant information for each hazard. For additional background on the hazards, vulnerabilities and general risk assessment information for hazards in the Mid/ Southern Willamette Valley (Region 3) refer to the State of Oregon NHMP, Region 3: Mid/ Southern Willamette Valley Risk Assessment (2015).

Drought

Significant Changes Since Previous Plan:

The Drought Hazard section was reformatted since the 2010 Plan. There has not been any new data (with the minor exception of some previously omitted historic drought events), and as such the material has remained largely the same. However, the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2015) has been cited and incorporated where applicable. The probability and vulnerability assessments have also been updated.

Characteristics

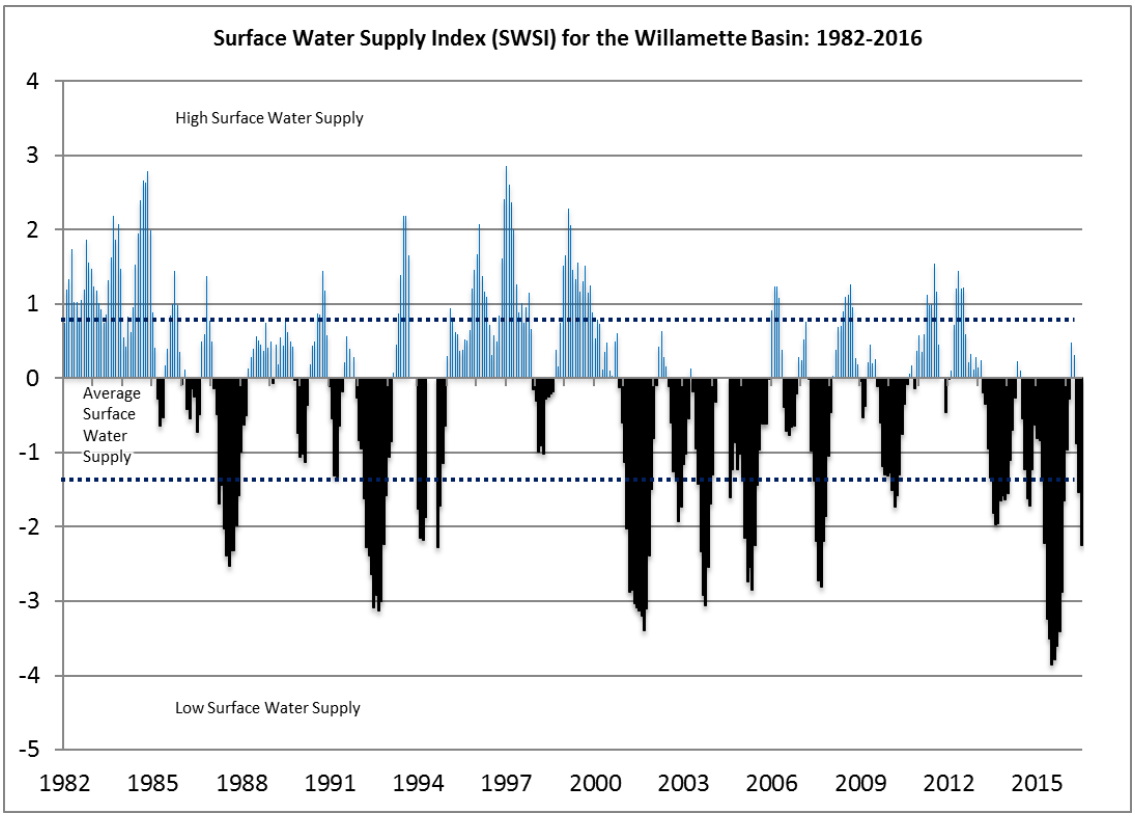
A drought is a period of drier than normal conditions. Drought occurs in virtually every climatic zone, but its characteristics vary significantly from one region to another. Drought is a temporary condition; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate. The extent of drought events depends upon the degree of moisture deficiency, and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city and county.

Location and Extent

Droughts occur in every climate zone, and can vary from region to region. Drought may occur throughout Linn County and may have profound effects on the economy, particularly the agricultural and hydro-power sectors. Drought is typically measured in terms of water availability in a defined geographical area. It is common to express drought with a numerical index that ranks severity. Most federal agencies use the Palmer Method which incorporates precipitation, runoff, evaporation and soil moisture. However, the Palmer Method does not incorporate snowpack as a variable. Therefore, it is not believed to provide a very accurate indication of drought conditions in Oregon and the Pacific Northwest.

The Surface Water Supply Index (SWSI) from the Natural Resources Conservation Service is an index of current water conditions throughout the state. The index uses parameters derived from snow, precipitation, reservoir and stream flow data. The data is gathered each month from key stations in each basin. The lowest SWSI value, -4.2, indicates extreme drought conditions (Low Surface Water Supply ranges from -1.6 to -4.2). The highest SWSI value, +4.2, indicates extreme wet conditions (High Surface Water Supply ranges from +1.6 to +4.2). The mid-point is 0.0, which indicates an average water supply (Average Water Supply ranges from +1.5 to -1.5). Figure 2-3 below shows the monthly history of SWSI values from February 1982 to October 2015 for the Willamette Basin which includes Linn County. Research shows that the periods of drought have fluctuated; recent drought periods occurred in 1987, 1992, 1994, 2001, 2003, 2005, and 2015.

Figure 2-3. SWSI Values for the Willamette Basin (1982-2016)



Source: Department of Agriculture-Natural Resources Conservation Service, "Surface Water Supply Index, Willamette Basin" www.or.nrcs.usda.gov. Accessed A 2016.

History

Drought conditions are not uncommon in Linn County, though there are no records of severe drought or damage from drought.

One recent drought event, and two previously omitted drought events, have been added to the hazard history since the previous plan (as shown in *italics* below):

- **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; 1976-1977 single driest year of century (eclipsed only by 2015 water-year)
- **1985-1997:** Generally a dry period, capped by statewide droughts in 1992 and 1994
- ***1992:*** *Formal Governor Declared Determination of State of Drought includes Linn County*
- **2000-2001:** Klamath drought intensifies; low snowpack in mountains worsens conditions. Due to lack of water Bonneville Power Administration asked some consumers (industrial and residential) to limit power use

- ***2005:*** *Due to water rationing some farmers cut back production of certain crops including wheat and hay*
- ***August 2015:*** *Federal Drought Declaration due low snow pack levels, and low water conditions*

El Niño

El Niño Southern Oscillation (ENSO) weather patterns can increase the frequency and severity of drought. During El Niño periods, alterations in atmospheric pressure in equatorial regions yield an increase in the surface temperature off the west coast of North America. This gradual warming sets off a chain reaction affecting major air and water currents throughout the Pacific Ocean. In the North Pacific, the Jet Stream is pushed north, carrying moisture laden air up and away from its normal landfall along the Pacific Northwest coast. In Oregon, this shift results in reduced precipitation and warmer temperatures, normally experienced several months after the initial onset of the El Niño. These periods tend to last nine to twelve months, after which surface temperatures begin to trend back towards the long-term average. El Niño periods tend to develop between March and June, and peak from December to April. ENSO generally follows a two to seven-year cycle, with El Niño or La Niña periods occurring every three to five years. However, the cycle is highly irregular, and no set pattern exists. The last major El Niño was during 1997-1998, current conditions indicate that 2015-2016 may be a large El Niño weather pattern.

Future Climate Variability[1]

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

Probability Assessment

Droughts are not uncommon in the State of Oregon, nor are they just an "east of the mountains" phenomenon. They occur in all parts of the state, in both summer and winter. Oregon's drought history reveals many short-term and a few long-term events. The average recurrence interval for severe droughts in Oregon is somewhere between 8 and 12 years. Based on the available data and research for Linn County the NHMP Steering Committee assessed the **probability of experiencing a locally severe drought as "moderate,"** meaning one incident is likely within the next 35 to 75-year period; *this rating has increased from the previous plan, which rated the probably of drought as "low*."

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

Vulnerability Assessment

The environmental and economic consequences of drought can be significant, especially for the agricultural sector. Drought also increases the probability of wildfires. Drought can affect all segments of Linn County's population, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). Also, domestic water-users may be subject to stringent conservation measures (e.g., rationing) as per the county's water management plan and could be faced with significant increases in electricity rates.

Factors included in assessing drought risk include agricultural practices, including crop types and varieties grown, soil types, topography, and water storage capacity. When sufficient data is collected for hazard identification and vulnerability assessment, a risk analysis can be completed.

A vulnerability assessment that describes the number of lives or amount of property exposed to elements of drought has not yet been conducted for Linn County due to resource limitations. 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, resources permitting. 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.

Based on feedback from the steering committee, however, **this plan rates Linn County's vulnerability to drought as "low,"** meaning that less than 1% of the population is likely to be affected. *This is an update for the previous plan, which did not provide a vulnerability rating for drought.*

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2015).

Earthquake

Significant Changes Since Previous Plan:

The Earthquake Hazard section was reformatted since the 2011 Linn Plan. There has not been any new data, or history, as such the material has remained largely the same. However, the Oregon Resilience Plan (2013) has been cited and incorporated where applicable. The probability and vulnerability ratings were updated to distinguish between a Cascadia Subduction Zone event and a crustal event. Large areas of Linn County fall within 2 of the zones identified in the Oregon Resilience Plan as having significantly different probabilities and vulnerabilities in a Cascadia Subduction Zone event. These differences have been incorporated throughout this section.

Characteristics

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

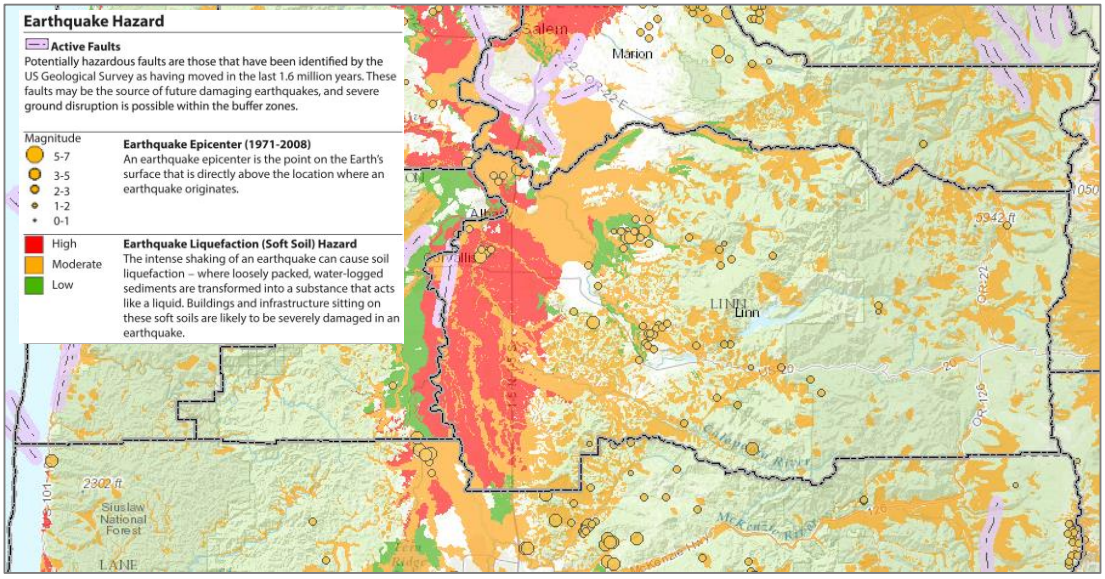
All types of earthquakes in the region have some tie to the subducting, or diving, of the dense, oceanic Juan de Fuca Plate under the lighter, continental North American Plate. There is also a link between the subducting plate and the formation of volcanoes some distance inland from the offshore subduction zone.

Location and Extent

There have been several significant recent earthquakes in the region; however, all significant events have been located in Klamath and Lake Counties in southern Oregon. The region has also been shaken historically by crustal and intraplate earthquakes and prehistorically by subduction zone earthquakes centered outside Central Oregon. All considered, there is good reason to believe that the most devastating future earthquakes would probably originate along shallow crustal faults in the region, or along the offshore Cascadia Subduction Zone.

Figure 2-4 shows a generalized geologic map of Linn County and includes the Owl Creek Fault (southwest of Albany) and the Mill Creek Fault (north of Albany, just south of Salem). The earthquakes shown in the figure below are relatively insignificant events below M 2.0. The larger events may have been slightly felt but little to no structural/property damage resulted. Thus, the seismic hazard for Linn County arises predominantly from major earthquakes on the Cascadia Subduction Zone. Smaller, crustal earthquakes in or near Linn County could be locally damaging, but would not be expected to produce widespread or major damage.

Figure 2-4. Earthquake Epicenters (1971-2008), Active Faults, and Soft Soils



Source: [Oregon HazVu: Statewide Geohazards Viewer (HazVu)]

The Oregon Department of Geology and Mineral Industries (DOGAMI), in partnership with other state and federal agencies, has undertaken a rigorous program in Oregon to identify seismic hazards, including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. DOGAMI has published a number of seismic hazard maps that are available for communities to use. The maps show liquefaction, ground motion amplification, landslide susceptibility, and relative earthquake hazards. OPDR used the DOGAMI Statewide Geohazards Viewer to present a visual map of recent earthquake activity, active faults, and liquefaction; ground shaking is generally expected to be higher in the areas marked by soft soils in the map above. The severity of an earthquake is dependent upon a number of factors including: 1) the distance from the earthquake's source (or epicenter); 2) the ability of the soil and rock to conduct the earthquake's seismic energy; 3) the degree (i.e., angle) of slope materials; 4) the composition of slope materials; 5) the magnitude of the earthquake; and 6) the type of earthquake.

For more information, see the following reports:

Open-File-Report: O-2003-02 – Map of Selected earthquakes for Oregon (1841-2002), 2003

Open-File-Report: O-2007-02 - Statewide seismic needs assessment: Implementation of Oregon 2005 Senate Bill 2 relating to public safety, earthquakes, and seismic rehabilitation of public buildings, 2007

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

Open-File-Report: O-2013-22 - Cascadia Subduction Zone earthquakes: A magnitude 9.0 earthquake scenario, 2013

Special Papers: SP-29, Earthquake damage in Oregon Preliminary estimates of future earthquake losses (1999)

Additional reports are available via DOGAMI's Publications Search website: http://www.oregongeology.org/pubs/search.php

Other agency/ consultant reports:

Regional All Hazard Mitigation Master Plan for Benton, Lane, and Linn Counties: Phase II (2001)

Oregon Seismic Safety Policy Advisory Commission Reports:

- Oregon Resilience Plan (2013)

History

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

According to the Oregon NHMP, the return period for the largest of the CSZ earthquakes (Magnitude 9.0+) is 530 years with the last CSZ event occurring 314 years ago in January of 1700. The probability of a 9.0+ CSZ event occurring in the next 50 years ranges from 7 - 15%. Notably, 10 - 20 "smaller" Magnitude 8.3 - 8.5 earthquakes occurred over the past 10,000 years that primarily affected the southern half of Oregon and northern California. The average return period for these events is roughly 240 years. The combined probability of any CSZ earthquake occurring in the next 50 years is 37 - 43%.

While Linn County has not experienced any significant earthquakes in recent history, earthquakes in Oregon that have affected the county are listed below[2] (there have not been any significant earthquake events since the previous plan):

- **January 1700:** Offshore, Cascadia Subduction Zone (CSZ)- Approximate 9.0 magnitude earthquake generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast (additional CSZ events occurred approximately in 1400 BCE, 1050 BCE, 600 BCE, 400, 750, and 900)
- **November 1896:** McMinnville, 4.0 magnitude
- **July 1930:** Perrydale, 4.0 magnitude
- **April 1949:** Olympia, WA, 7.1 magnitude, significant damage in Washington, minor damage in NW Oregon
- **August 1961:** Albany, 4.5 magnitude, minor damage in Albany
- November 1962: Portland area, 5.5 magnitude, shaking lasted up to 30 seconds; chimneys cracked; windows broken; furniture moved
- **March 1963:** Salem, 4.6 magnitude, minor damage in Salem
- **November 1962:** Portland- A 5.2-5.5 magnitude earthquake caused damage to many homes (chimneys, windows, etc); the earthquake was a crustal event
- **March 1993:** Scotts Mills- A 5.6 magnitude earthquake caused $27-$30 million in damages to homes, schools, businesses, state buildings (Salem). Crustal Event (FEMA-985-DR-OR)
- **September 1993:** Klamath Falls- Two earthquakes (5.9-6.0) caused two deaths and extensive damage. $7.5 million in damage to homes, commercial, and government buildings. Crustal event (FEMA-1004-DR-OR)
- **February 2001:** Nisqually, WA, 6.8 magnitude, felt in region, no local damage reported

Probability Assessment

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

According to the Oregon NHMP, the return period for the largest of the CSZ earthquakes (Magnitude 9.0+) is 530 years with the last CSZ event occurring 314 years ago in January of

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

The Pacific Northwest Seismic Network: Notable Pacific Northwest Earthquakes since 1993

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

Establishing a probability for crustal earthquakes is difficult given the small number of historic events in the region. Earthquakes generated by volcanic activity in Oregon's Cascade Range are possible, but likewise unpredictable. For more information, see DOGAMI reports linked above.

Based on the available data for Linn County from the 2015 Oregon NHMP Region 3 Risk Assessment,[3] the NHMP Steering Committee determined that the **probability of experiencing a Cascadia Subduction Zone (CSZ) is "high",** meaning one incident is likely within the next 10 – 35-year period. *The previous NHMP rated the earthquake probability as "high" as well, although it did not distinguish between CSZ and crustal earthquakes.* The Steering Committee determined that **the probability of experiencing a crustal earthquake is "moderate,"** meaning that one incident is likely to occur within the next 35 – 75-year period. *The previous NHMP did not distinguish between CSZ and crustal earthquakes, so this rating is new.*

Cascadia Subduction Zone

Paleoseismic studies along the Oregon coast indicate that the state has experienced seven Cascadia Subduction Zone (CSZ) events possibly as large as M9 in the last 3,500 years. These events are estimated to have an average recurrence interval between 500 and 600 years, although the time interval between individual events ranges from 150 to 1,000 years. The last CSZ event occurred approximately 300 years ago. Scientists estimate the chance in the next 50 years of a great subduction zone earthquake is between 10 and 20 percent, assuming that the recurrence is on the order of 400 +/- 200 years.

New research from Oregon State University suggests that the CSZ has at least 4 segments that sometimes rupture independently of one another. Magnitude-9 ruptures affecting the entire subduction zone have occurred 19 times in the past 10,000 years. Over that time, shorter segments have ruptured farther south in Oregon and Northern California, producing magnitude-8 quakes. As such, the risks of a subduction zone quake may differ from north to south. Quakes originating in the northern portion of the CSZ tend to rupture the full length of the subduction zone. In southern Oregon and Northern California, quakes along the subduction zone appear to strike more frequently.

Benioff (Deep) Zone

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

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[3] 2015 Oregon NHMP DRAFT. Chapter 2: Risk Assessment | Regional Risk Assessments-Region 3: Mid/Southern Willamette Valley Hazards and Vulnerability, Earthquake. P. 518. http://www.oregon.gov/LCD/HAZ/docs/2015ORNHMP/150223_PublicReviewDRAFTReg3.pdf

Crustal Zone

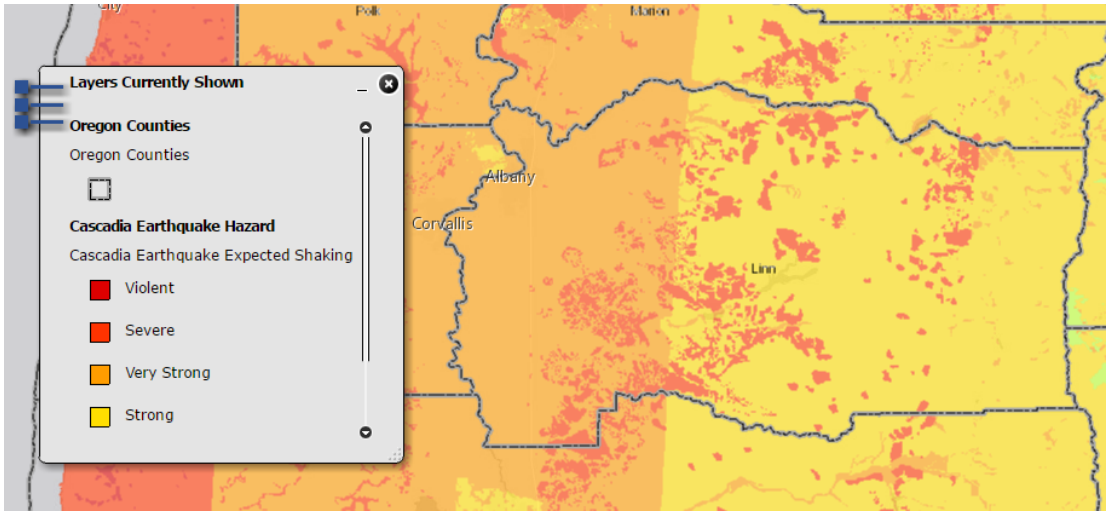
Based on the historical seismicity in Western Oregon and on analogies to other geologically similar areas, small to moderate earthquakes up to M5 or M5.5 are possible almost anywhere in Western Oregon, including Linn County. Although the possibility of larger crustal earthquakes in the M6+ range cannot be ruled out, the probability of such events is likely to be very low.

Vulnerability Assessment

The local faults, the county's proximity to the Cascadia Subduction Zone, potential slope instability, and the prevalence of certain soils subject to liquefaction and amplification combine to give the county a high-risk profile. Due to the expected pattern of damage resulting from a CSZ event, the Oregon Resilience Plan divides the State into four distinct zones and places Linn County predominately within the "Willamette Valley Zone" (Valley Zone, from the summit of the Coast Range to the summit of the Cascades)[4]. Within the Valley Zone damage and shaking is expected to be widespread but moderate, an event will be disruptive to daily life and commerce, and the main priority is expected to be restoring services to business and residents.[5]

Figure 2-5 below shows the expected shaking/ damage potential for Linn County as a result of a Cascadia Subduction Zone (CSZ) earthquake event. The figure shows that the county will experience "strong" to "severe shaking" that will last two to four minutes. The strong shaking will be extremely damaging to lifeline transportation routes including I-5, Hwy 20, and Hwy 99. For more information on expected losses due to a CSZ event see the Oregon Resilience Plan (note, several of the county and city mitigation actions utilize the analysis within the ORP as justification and to inform their rationale).

Figure 2-5. Cascadia Subduction Zone Damage Potential



[4] Oregon Seismic Safety Policy Advisory Commission, *Oregon Resilience Plan* (2013)

[5] Ibid.

Source: Oregon HazVu: Statewide Geohazards Viewer (HazVu)

The NHMP Steering Committee rated the county as having a **"high" vulnerability to the Cascadia Subduction Zone (CSZ) earthquake hazard**, meaning that more than 10% of the region's population or assets would be affected by a major CSZ emergency or disaster and a **"moderate" vulnerability to crustal earthquakes**, meaning that between 1% and 10% of the region's population or assets would be affected by a major crustal earthquake emergency or disaster. *The previous NHMP rated the earthquake vulnerability as "high" but did not distinguish between the crustal and CSZ events.*

1999 Assessment

Factors included in an assessment of earthquake risk include population and property distribution in the hazard area, the frequency of earthquake events, landslide susceptibility, buildings, infrastructure, and disaster preparedness of the region. This type of analysis can generate estimates of the damages to the county due to an earthquake event in a specific location.

Seismic activity can cause great loss to businesses, either a large-scale corporation or a small retail shop. Losses not only result in rebuilding cost, but fragile inventory and equipment can be destroyed. When a company is forced to stop production for just a day, business loss can be tremendous. Residents, businesses, and industry all suffer temporary loss of income when their source of finances is damaged or disrupted.

The potential losses from an earthquake in Linn County extend beyond those to human life, homes, property and the landscape. A recent earthquake damage model has not been conducted for Linn County, however, based upon data from a 1999 DOGAMI report rough loss estimates are available.[6] The economic base in Linn County is estimated at $4.724 billion (in 1999 dollars; $6.805 billion in 2016 dollars, ranking it 7 of 36 Oregon counties); it is expected that the county will incur total direct losses valuing $443 million (in 1999 dollars, $638 million in 2016 dollars) for the Cascadia model and $998 million (in 1999 dollars, $1.4 billion in 2016 dollars) for the 500-year model. The CSZ event direct losses amount to a loss ratio of 5%, while the 500-year model event direct losses amount to a loss ratio of 12%.[7] Table 2-2 on the next page adjusts the economic loss estimates from DOGAMI's 1999 report to account for inflation and reflect potential economic loss in 2016 dollars.

While the expected losses have increased due to increased development in the county, as well as inflation, the loss ratio and relative damage for the county is expected to be similar. See table on the following page for more information on expected losses. Local business economies are at substantial risk if an earthquake damages or otherwise necessitates the closure of any of the major transportation routes.

[6] Y. Wang & J.L. Clark, Special Paper 29, Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses. 1999. DOGAMI.

[7] *Ibid.* The loss ratio is determined as a percentage of the expected losses to the county's economic base.

For more information, see: Special Papers: SP-29, Earthquake damage in Oregon Preliminary estimates of future earthquake losses (1999)

Table 2-2. Linn County Earthquake Damage Summary

Linn County	8.5 Cascadia Subduction Zone Event	500-year model
Injuries	281	736
Death	5	15
Displaced households	615	1,372
Short-term shelter needs	445	1,005
Economic losses for buildings	$443 million/ $638 million*	$1 billion/ $1.4 billion*
Operational the day after the quake		
Fires Stations	62%	n/a
Police Stations	60%	n/a
Schools	53%	n/a
Bridges	79%	n/a
Economic losses to		
Highways	$11 million/ $15.8 million*	$34 million/ $49 million*
Airports	$9 million/ $13 million*	$24 million/ $34.5 million*
Communication Systems		
Economic losses	$1 million/ $1.4 million*	$4 million/ $5.7 million*
Operating the day of the quake	69%	n/a
Debris generated *(thousands of tons)*	400	818

These figures have a high degree of uncertainty and should be used only for general planning purposes. Beause of rounding, numbers may not add up to 100%.

Because the 500 year model includes several earthquakes, the number of facilities operational the "day after" cannot be calculated.

Source: Y. Wang & J.L. Clark, Special Paper 29, Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses. 1999. DOGAMI.
Note: * - 1999 dollars were adjusted for inflation to represent estimated economic loss in 2016 dollars (Source: State of Oregon Employment Department Inflation Calculator)

2007 Rapid Visual Survey

In 2007, DOGAMI completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon Legislature in Senate Bill 2 (2005). RVS is a technique used by the Federal Emergency Management Agency (FEMA), known as FEMA 154, to identify, inventory, and rank buildings that are potentially vulnerable to seismic events. DOGAMI ranked each building surveyed with a 'low,' 'moderate,' 'high,' or 'very high' potential for collapse in the event of an earthquake. It is important to note that these rankings represent a probability of collapse based on limited observed and analytical data and are therefore approximate rankings. To fully assess a building's potential for collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to survey.

DOGAMI surveyed 89 buildings in Linn County. Buildings with a 'high' or 'very high' potential for collapse are listed below. Additional information can be found within the RVS study on DOGAMI's website (www.oregongeology.org).

'Very High' Collapse Potential

- Linn-Benton Community College – College Center
- Linn-Benton Community College – Health Occupations
- Linn-Benton Community College – Industrial A
- Linn-Benton Community College – Science and Technology
- Linn-Benton Community College – Service Center
- Linn-Benton Community College – Student Union Building
- Linn-Benton Community College – Willamette Hall
- Central Linn High School (Central Linn 552)
- Harrisburg Elementary School (Harrisburg 7J)
- Harrisburg Middle School (Harrisburg 7J)
- Lebanon High School (Lebanon Community 9)
- Lebanon Fire District Station 31
- Mari-Linn Elementary School (North Santiam 29J)
- Mill City Fire Department (Mill City Rural Fire Protection District)
- Scio High School (Scio 95)
- Scio Middle School (Scio 95)
- Hawthorne Elementary School (Sweet Home 55)
- Sweet Home High School (Sweet Home 55)

'High' Collapse Potential

- Calapooia Middle School (Greater Albany 8J)
- Central Elementary School (Greater Albany 8J)
- Periwinkle Elementary School (Greater Albany 8J)
- Linn County Sheriff's Office (1115 Jackson St. SE, Albany)
- Linn-Benton Community College – Activity Center
- Linn-Benton Community College – Takena Hall
- Brownsville Rural Fire District #61
- Central Linn Elementary School (Central Linn 552)
- Halsey-Shedd Rural Fire Protection District
- Harrisburg High School (Harrisburg 7J)
- Harrisburg Fire & Rescue – Station 41
- Linn County Sheriff's Office (354 Smith St., Harrisburg)
- Green Acres School (Lebanon Community 9)
- Lacomb School (Lebanon Community 9)
- Lebanon Police Department
- Linn County Sheriff's Office (274 Cedar St., Mill City)
- Foster Elementary School (Sweet Home 55)
- Oak Heights Elementary School (Sweet Home 55)
- Sweet Home Junior High School (Sweet Home 55)
- Linn-Benton Community College Branch – Sweet Home Center

Mitigation Successes

Seismic retrofit grant awards per the Seismic Rehabilitation Grant Program[8] have been funded to retrofit Linn-Benton Community College's Takena Hall (2014 grant award, $1,470,540) and Linn-Benton Community College's Science Technology Building (2010 grant award, $565,016). The City of Albany Fire District (Station 12) and the Greater Albany School District's Central Elementary also received seismic rehabilitation grant funding in 2010 and 2011 respectively.

For more information, see: Open-File-Report: O-2007-02 - Statewide seismic needs assessment: Implementation of Oregon 2005 Senate Bill 2 relating to public safety, earthquakes, and seismic rehabilitation of public buildings, 2007, and

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

2008 Assessment

In 2008, the Oregon Department of Geology and Mineral Industries (DOGAMI) developed regional earthquake hazard information to assess potential damages and losses for various earthquake scenarios in the Mid-Willamette Valley[9]. More specifically, DOGAMI:

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

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

- A magnitude ~6.5 crustal fault earthquake
- A magnitude 9.0 Cascadia Subduction Zone earthquake

Information was consolidated into the Hazards U.S. Multi-Hazard methodology and computer application (HAZUS – MH), which is a federally developed program used to model various earthquake scenarios and estimate associated damage and loss. The following is a brief summary of damage and loss estimates for Linn County in a magnitude 9.0 Cascadia Subduction Zone earthquake scenario:

- Estimated fatalities during late afternoon business hours: 67
- Injuries from minor to life threatening: 1,049
- Injuries requiring hospitalization: 264

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[8] The Seismic Rehabilitation Grant Program (SRGP) is a state of Oregon competitive grant program that provides funding for the seismic rehabilitation of critical public buildings, particularly public schools and emergency services facilities.

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

- Households displaced: 2,563
- People needing shelter: 653

Note: Linn County has one hospital with 71 beds. The hospital is expected to withstand earthquake impacts in the HAZUS M9.0 CSZ scenario

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

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2015).

Flood

Significant Changes Since Previous Plan:

The Flood Hazard section includes updated National Flood Insurance Program (NFIP), FIRMs/ FIS (2010), maps, and history information since the 2010 Linn Plan. This section has also been reformatted.

Characteristics

Flooding results when rain and snowmelt creates water flow that exceed the carrying capacity of rivers, streams, channels, ditches, and other watercourses. In Oregon, flooding is most common from October through April when storms from the Pacific Ocean bring intense rainfall. Most of Oregon's destructive natural disasters have been floods.[10] The principal types of flood that occur in Linn County include: riverine floods, shallow area floods, and urban floods.

Floods frequently occur in Linn County during periods of heavy rainfall. The primary sources of riverine flooding include the Willamette River and its tributaries, especially:

- The Calapooia River
- The North Santiam River
- The South Santiam River
- Thomas Creek
- Crabtree Creek
- Ames Creek
- Oak Creek
- Peter's Ditch
- Truax Creek

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

Location and Extent

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

The magnitude of flood used as the standard for floodplain management in the United States is a flood having a probability of occurrence of 1 percent in any given year. This flood is also known as the 100-year flood or base flood. The most readily available source of information regarding the 100-year flood is the system of Flood Insurance Rate Maps (FIRMs) prepared by FEMA. These maps are used to support the NFIP. The FIRMs show 100-year floodplain boundaries for identified flood hazards. These areas are also referred to as Special Flood Hazard Areas (SFHAs) and are the basis for flood insurance and floodplain management requirements.

Most areas with significant development in Linn County do not fall within the mapped floodplains, however, Brownsville, Scio, and Tangent do have some areas that could be significantly impacted by flooding. In the past, commercial buildings in Albany, Lebanon, and Sweet Home have been impacted by flooding, however agricultural lands have suffered by far the most damage throughout the county. For more information, refer to the following Flood Insurance Study (FIS) and associated Flood Insurance Rate Maps (FIRM):

- Linn County Flood Insurance Study (Revised Dec. 8, 2016)

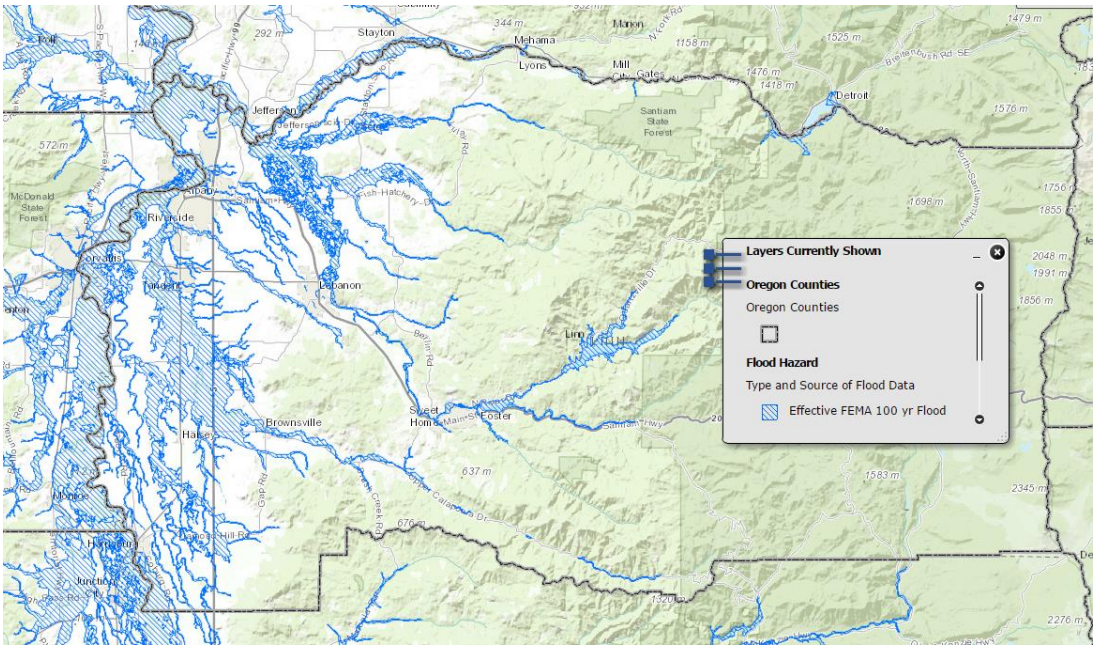
Additional reports are available via DOGAMI's Publications Search website: http://www.oregongeology.org/pubs/search.php

Other agency/ consultant reports:

Regional All Hazard Mitigation Master Plan for Benton, Lane, and Linn Counties: Phase I (1998)

The special flood hazard that identifies the location and extent of the flood hazard is included as Figure 2-6, for more detailed mapping see the 2016 FIS or the community profile for Linn County located on the Oregon Risk MAP website.

Figure 2-6. Special Flood Hazard Area



Source: [Oregon HazVu: Statewide Geohazards Viewer (HazVu)]

History

Linn County has a lengthy flood history. The most serious flooding in Linn County occurs in December and January. These events are often associated with La Nina conditions that result in prolonged rain and rapid snow melt on saturated or frozen ground. The resultant sudden impact of water swells rivers, causing tributary streams to overflow their banks and flood communities.

Annual intense rainfalls combined with snow pack in the Cascade Foothills, and the flat topography of the Willamette Basin, creates a setting for a history of floods in Linn County. Spring snowmelt sometimes causes problematic flooding. Water flows more quickly over logged forestland, transmitting more rainwater into streams and rivers more quickly. Sheet flooding that originates from agricultural land that is far from a source river or stream may not be predicted on federal Flood Insurance Rate Maps.

Listed below are historical flooding events that affected the mid-Willamette Valley region; little historical knowledge is available for the remaining streams within the study area.

Two significant flood events have been added since the previous plan (shown in *italics below*):

- **Dec. 1861:** Willamette Basin and Coastal Rivers - Preceded by two weeks of heavy rain. Every town on the Willamette was flooded or washed away. 635,000 cfs at Portland (greatest known flood on Willamette River, prior to the creation of a stream-gaging network for recording flood heights).
- **Feb. 1890:** Willamette Basin and Coastal Rivers - Second largest known flood in the Willamette Basin. Almost every large bridge washed downstream.

- **Dec. 1937:** Western Oregon - Flooding followed heavy rains. Considerable highway flooding; landslides.
- **Jan. 1953:** Western Oregon - Widespread flooding in western Oregon accompanied by wind storm.
- **Dec. 1964-Jan. 1965:** Willamette Basin - Highest recorded 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); peak discharge of 320,000 cubic feet per second (cfs) was regulated to a peak of 186,000 cfs. Throughout the Willamette Valley, it caused $157 million in damages and 20 people lost their lives.
- **Jan. 1974:** Western Oregon - Flooding followed heavy wet snow and freezing rain. Nine counties received Disaster Declaration. (FEMA-413-DR-OR)
- **Dec. 1978:** Western Oregon - Intense heavy rain, snowmelt, saturated ground.
- **Feb. 1986:** Entire State - Severe statewide flooding. Rain and melting snow. Numerous homes flooded and highways closed.
- **Feb. 1987:** Western Oregon - Willamette River and tributaries. Mudslides damaged highways and homes.
- **Feb. 1996:** Entire State - Deep snow pack, warm temperatures, record-breaking rains. Flooding, landslides, power-outages. (FEMA-1099-DR-OR)
- **Nov. – Dec. 1996:** Entire State - Record-breaking precipitation; local flooding / landslides. (FEMA-1149-DR-OR)
- **Dec. 2005-Jan. 2006:** A very wet series of Pacific systems moved through northwest Oregon and southwest Washington dropping copious amounts of rainfall over the area. During the period of time, between 2-3 inches of precipitation fell over the Willamette Valley, and between 4-5 inches fell over parts of the Coast and Cascade Ranges. This period of heavy rainfall pushed many rivers above bank, and most of those above flood stage. Many roads around the area were reported closed due to high water, and road workers were busy battling several landslides.
- ***Jan. 2012:*** *Heavy rain, landslides, and downed trees. (FEMA-4055-DR-OR)*
- ***Dec. 2015:*** *Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides. (FEMA-4258-DR-OR)*

Probability Assessment

The Federal Emergency Management Agency (FEMA) has mapped the 10, 50, 100, and 500-year floodplains in portions of Linn County (see Figure 2-6 and referenced FIS for more information). This corresponds to a 10%, 2%, 1% and 0.2% chance of a certain magnitude flood in any given year. The 100-year flood is the benchmark upon which the National Flood Insurance Program (NFIP) is based.

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

Vulnerability Assessment

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

Changes to development patterns since 2010 have the potential to incur increased risk of flooding. However, County development regulations restrict, but does not prohibit, new development in areas identified as floodplain. This reduces the impact of flooding on future buildings.

FEMA recommends that communities use HAZUS software (HAZUS = Hazards United States; a geographic information system-based natural hazard loss estimation software package) to produce loss estimates that accurately reflect local conditions. The HAZUS-MH Flood Model allows planners and other practitioners to carry out a wide range of flood hazard analyses, including:

- Studies of specific return intervals of floods (e.g., 100-year return interval)
- Studies of discharge frequencies, including analysis of discharges from specific streams and the exposure to buildings and population from the resultant flooding.
- Studies of annualized losses from flooding.
- 'Quick look' assessments, which allow the user to quickly evaluate potential flooding from specific flood depths at specific locations.
- 'What if' scenarios, which allow users to evaluate the consequences of specific actions, such as the introduction of flow regulation devices, acquisition of flood-prone properties, and other mitigation measures.

The flood loss estimation methodology consists of two modules that carry out basic analytical processes: flood hazard analysis and flood loss estimation analysis. The flood hazard analysis module uses characteristics, such as frequency, discharge, and ground elevation to estimate flood depth, flood elevation, and flow velocity. The flood loss estimation module calculates physical damage and economic loss from the results of the hazard analysis.

As such, the NHMP Steering Committee rated the county as having a **"moderate" vulnerability to flood hazards**, meaning that between 1% and 10% of the region's population or assets would be affected by a major flood event; *the previous plan did not provide a vulnerability rating*.

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2015).

Landslide

Significant Changes Since Previous Plan:

The occurrence history for this hazard has been updated and new landslide susceptibility information based on updated Lidar data provided by DOGAMI (O-16-02) has also been included since the 2010 Linn Plan. The vulnerability rating has been updated as well, and this section has also been reformatted.

Characteristics

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

Linn County is subject to landslides or debris flows (mudslides), especially in the foothills of the Cascades, which may affect buildings, roads, and utilities.

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

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

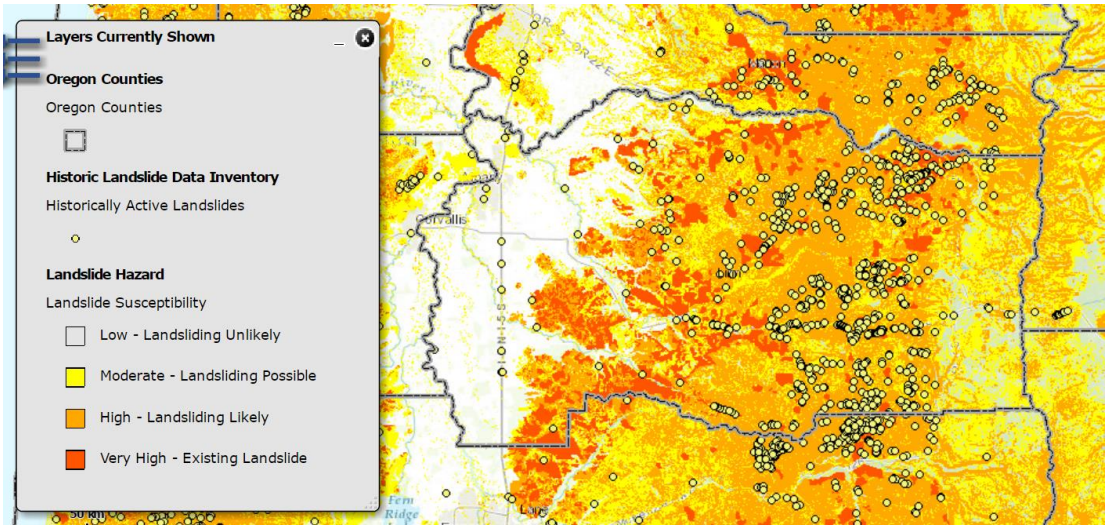
Location and Extent

The characteristics of the minerals and soils present in Linn County indicate the potential types of hazards that may occur. Rock hardness and soil characteristics can determine whether or not an area will be prone to geologic hazards such as landslides.

Landslides and debris flows are possible in any of the higher slope portions of Linn County, including much of the middle and eastern portions of the county (see Figure 2-7). In north central Linn County, massive slope failures are present on the sides of Hungry Hill, Rogers Mountain, McCully Mountain, and other high ridges leading eastward towards Detroit Dam. The slides typically develop in the Little Butte Formation and undercut the crests, forming pronounced head scarps. Depth of failure is great below the larger head scarps, and landslide features are well-developed in places. Landslides are also occurring in the Cascades Formation on the lower flanks of Snow Peak. On the south side of the mountain along Crabtree Creek, rapid down cutting is initiating a series of active slides. Finally, numerous scattered patches of mass movement topography are mapped in the region

bounded by Lebanon, Brownsville, and Sweet Home. Sliding is restricted to thick soils and tuffs of the Little Butte Formation. Most of these are underlain by basaltic intrusions and are generally stable. Figure 2-7 shows historic location of landslides as well as landslide susceptibility ratings for Linn County.

Figure 2-7. Historic Landslide Inventory and Landslide Susceptibility Rating



Source: DOGAMI Statewide Landslide Information Layer for Oregon (SLIDO)

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

For Linn County, many high landslide potential areas are in hilly-forested areas. Landslides in these areas may damage or destroy some timber and impact logging roads. Many of the major highways (with the exception of I-5) in Linn County are at risk for landslides at one or more locations with a high potential for road closures and damage to utility lines. Especially in the central and eastern portions of Linn County, with a limited redundancy of the road network, such road closures may isolate some communities.

In addition to direct landslide damages to roads and highways, affected communities are also subject to the economic impacts of road closures due to landslides, which may disrupt access to/egress from communities. Table 2-3 shows landslide susceptibility exposure for Linn County and the incorporated cities. Approximately 50% of the county land has High or Very High landslide susceptibility exposure, while the cities generally have less exposure (with the exception of Idanha). Note that even if a county or city has a high percentage of area in a high or very high landslide exposure susceptibility zone, this does not mean there is a high risk, because risk is the intersection of hazard and assets.

Table 2-3. Landslide Susceptibility Exposure

Jurisdiction	Area, ft^2	Low	Moderate	High	Very High
Linn County	64,272,873,796	28.8%	21.4%	37.3%	12.5%
Albany	493,730,826	77.6%	20.5%	1.9%	0.0%
Brownsville	35,575,433	65.7%	13.8%	19.4%	1.1%
Halsey	15,747,777	98.1%	1.9%	0.0%	0.0%
Harrisburg	40,248,157	93.3%	5.3%	1.5%	0.0%
Idanha	23,496,523	29.9%	26.2%	21.0%	23.0%
Lebanon	189,742,294	85.5%	6.2%	5.5%	2.8%
Lyons	24,374,762	86.1%	11.6%	2.3%	0.0%
Mill City	23,105,987	74.5%	16.9%	8.6%	0.0%
Millersburg	126,183,608	80.8%	16.4%	2.9%	0.0%
Scio	11,469,571	92.9%	5.5%	1.7%	0.0%
Sodaville	8,456,767	25.2%	56.0%	9.0%	9.8%
Sweet Home	161,643,770	72.3%	17.1%	8.0%	2.6%
Tangent	104,961,049	96.2%	3.5%	30.0%	0.0%
Waterloo	3,424,384	88.9%	10.2%	0.8%	0.0%

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

The severity or extent of landslides is typically a function of geology and the landslide triggering mechanism. Rainfall initiated landslides tend to be smaller, and earthquake induced landslides may be very large. Even small slides can cause property damage, result in injuries, or take lives.

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

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

Additional reports are available via DOGAMI's Publications Search website: http://www.oregongeology.org/pubs/search.php

Other agency/ consultant reports:

Regional All Hazard Mitigation Master Plan for Benton, Lane, and Linn Counties: Phase I (1998)

http://www.ci.lebanon.or.us/Modules/ShowDocument.aspx?documentid=382

History

Landslides may happen at any time of the year. In addition to landslides triggered by a combination of slope stability and water content, earthquakes may also trigger landslides. Areas prone to seismically triggered landslides are generally the same as those prone to

ordinary (i.e., non-seismic) landslides. As with ordinary landslides, seismically triggered landslides are more likely for earthquakes that occur when soils are saturated with water.

Debris flows and landslides are a very common occurrence in hilly areas of Oregon, including portions of Linn County. Many landslides occur in undeveloped areas and thus may go unnoticed or unreported. For example, DOGAMI conducted a statewide survey of landslides from four winter storms in 1996 and 1997 and found 9,582 documented landslides, with the actual number of landslides estimated to be many times the documented number. For the most part, landslides become a problem only when they impact developed areas and have the potential to damage buildings, roads, or utilities.

Below are listed the most severe landslide events, two (2) landslide events have been added since the previous plan (as shown in *italics* below):

- **Feb. 1996:** Entire State - Deep snow pack, warm temperatures, record-breaking rains. Flooding, landslides, power-outages. (FEMA-1099-DR-OR)
- **Nov. – Dec. 1996:** Entire State - Record-breaking precipitation; local flooding / landslides (FEMA-1107-DR-OR and FEMA-1149-DR-OR, *did not include Linn County*). The flood on the Willamette River in Salem was recorded as a 44-year flood event.
- ***January, 2012:*** *Severe winter storm, flooding, landslides, and mudslides (FEMA-4055-DR-OR).*
- ***December 2015:*** *Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides (FEMA-4258-DR-OR)*

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

Probability Assessment

The probability of rapidly moving landslides 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). Given the correlation between precipitation/snow melt and rapidly moving landslides, it would be feasible to construct a probability curve. Many slower moving slides present in developed areas have been identified and mapped; however, the probability and timing of their movement is difficult to quantify. The installation of slope indicators or the use of more advanced measuring techniques could provide information on these slower moving slides.

Based on the available data and research for Linn County the NHMP Steering Committee determined the **probability of experiencing a landslide is "high"** since 50% of the county's area has a high or very high susceptibility to landslide. DOGAMI defines "high" susceptibility to landslides as a combination of high landslide density and slope characteristics associated with being prone to landsliding. Figure 2-8 shows DOGAMI's methodology for rating landslide susceptibility. *This rating has not changed since the previous plan*.

Figure 2-8. DOGAMI Landslide Susceptibility Rating Methodology

Graphic display of how data sets are combined to create the final landslide susceptibility zones.		Landslide Density Combine: ❶ Generalized Geologic Map + ❷ Landslide Inventory			Landslides ❷ Landslide Inventory
	Class	Low (less than 7%)	Moderate (between 7% and 17%)	High (greater than 17%)	Existing Landslides
Slope Prone to Landsliding Combine: ❷ Landslide Inventory + ❸ Slope Map	Low (less than 1 STD)	Low	Moderate	High	Very High
	Moderate (between the mean and 1 STD)	Moderate	Moderate	High	Very High
	High (equal to or greater than mean)	High	High	High	Very High

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

Vulnerability Assessment

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

Roads and bridges are subject to closure during landslide events. Because many Linn County residents are dependent on roads and bridges for travel to work, delays and detours are likely to have an economic impact on county residents and businesses. To evaluate landslide mitigation for roads, the community can assess the number of vehicle trips per day, detour time around a road closure, and road use for commercial traffic or emergency access. Particular vulnerabilities include major routes including Highway 20, Highway 22, and Highway 126.

Lifelines and critical facilities should remain accessible if possible during a natural hazard event. The impact of closed transportation arteries may be increased if the closed road or bridge is a critical lifeline to hospitals or other emergency facilities. Therefore, inspection and repair of critical transportation facilities and routes is essential and should receive high priority. Losses of power and phone service are also potential consequences of landslide events. Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas. Flood events can also cause landslides, which can have serious impacts on gas lines.

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

1. Extent of landslide susceptible areas;
2. Inventory of buildings and infrastructure in landslide susceptible areas;

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

Currently, data does not allow for specific estimates of life and property losses during a given scenario.

As such, the NHMP Steering Committee rated the county as having a **"moderate" vulnerability to landslide hazards**, meaning that between 1% and 10% of the region's population or assets would be affected by a major disaster; *this rating has increased since the previous plan, which rated vulnerability to landslides as being "low*."

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2015).

Volcano

Significant Changes Since Previous Plan:

The Volcano Hazard section is new to this NHMP.

Characteristics

The Pacific Northwest, lie within the "ring of fire," an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the ring of fire, in part because of the movement of the Earth's tectonic plates. The Earth's outermost shell, the lithosphere, is broken into a series of slabs known as tectonic plates. These plates are rigid, but they float on a hotter, softer layer in the Earth's mantle. As the plates move about on the layer beneath them, they spread apart, collide, or slide past each other. Volcanoes occur most frequently at the boundaries of these plates and volcanic eruptions occur when molten material, or magma, rises to the surface.

The primary threat to lives and property from active volcanoes is from violent eruptions that unleash tremendous blast forces, generate mud and debris flows, or produce flying debris and ash clouds. The immediate danger area in a volcanic eruption generally lies within a 20-mile radius of the blast site.

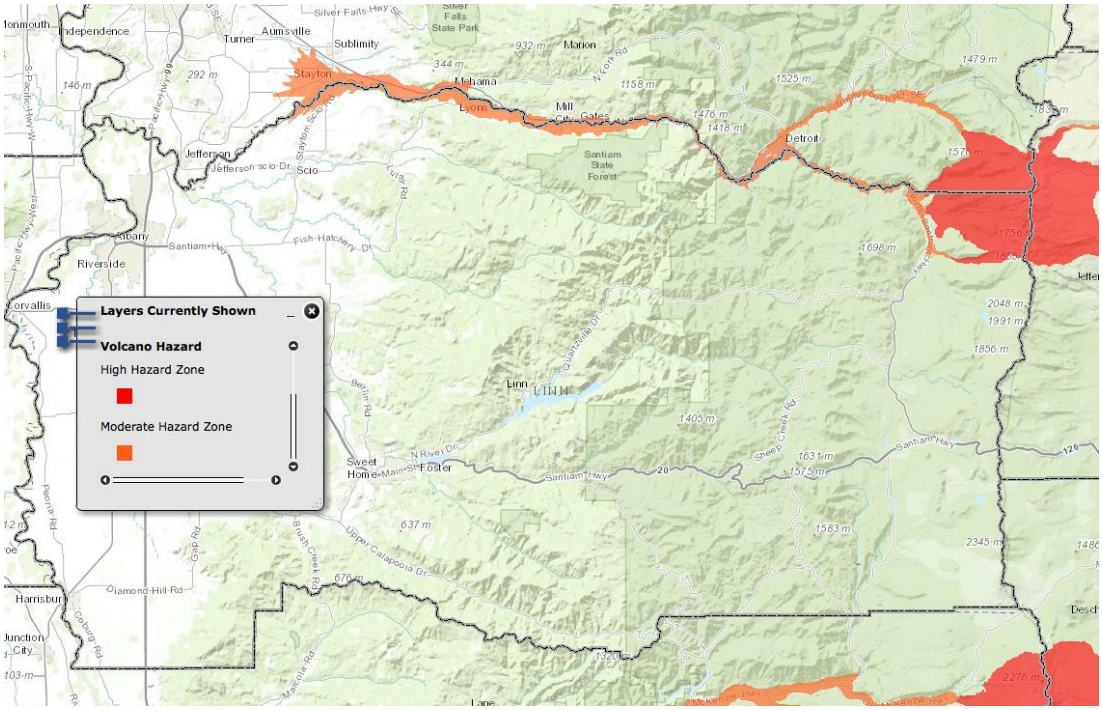
Location and Extent

Volcanic eruption is not an immediate threat to the residents of Linn County, there is one active volcano within the county; Mt. Jefferson. Nevertheless, the secondary threats caused by volcanoes in the Cascade region must be considered. Volcanoes are located near the Northeast (Mt. Jefferson) and Southeast (Three Sisters); see Figure 2-9. Volcanic ash can contaminate water supplies, cause electrical storms, create health problems, and collapse roofs.

Linn County is located on the Pacific Rim. Tectonic movement within the earth's crust can renew nearby dormant volcanoes resulting in ash fallout. Volcanic activity is possible from Mount Hood and Mount Saint Helens, Mt. Jefferson, Three Sisters, Mount Bachelor, and the

Newberry Crater areas. Because the distance to these potentially active volcanic areas is so great, the only adverse effect for the majority of the county would impact areas of the county is ash fallout, with perhaps some impact on water supplies. However, the north border of the county along the Santiam River is more at risk (including Mill City) due to the possibility of lahar activity following the course of the river. In general, the majority of the county's population and infrastructure will be minimally affected by volcanic activity. Additionally, the area potentially affected by ash fallout depends upon the height attained by the eruption column and the atmospheric conditions at the time of the eruption.

Figure 2-9. Volcano Hazard Area

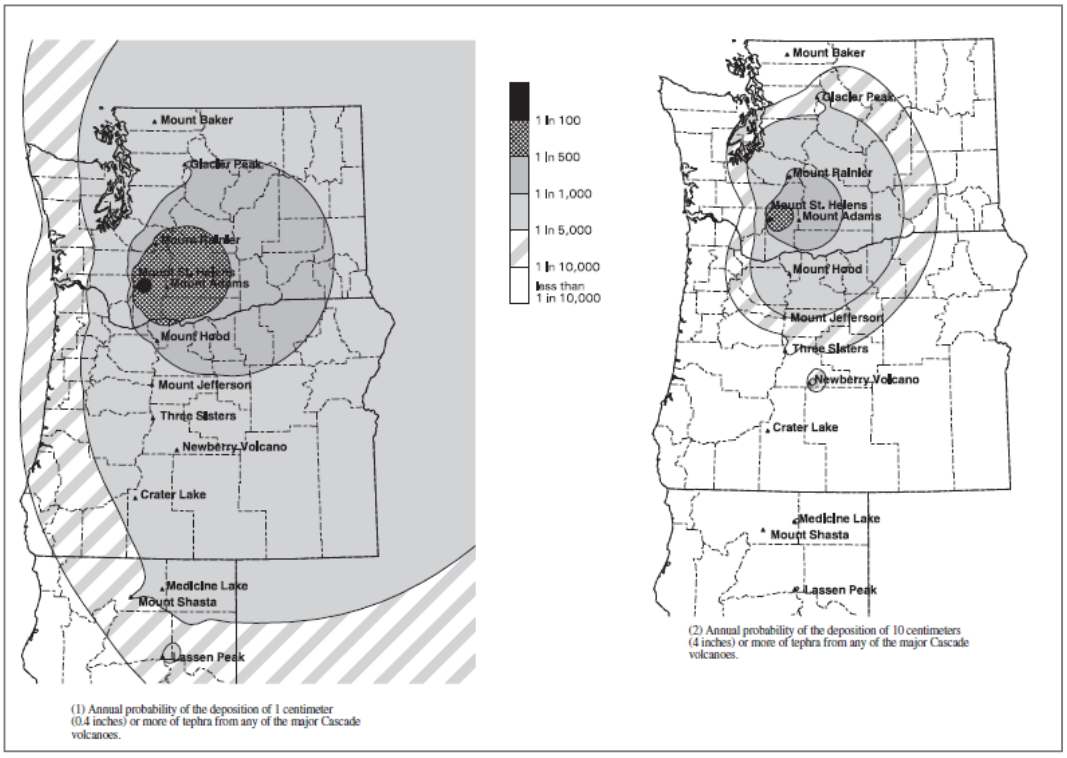


Source: Oregon HazVu: Statewide Geohazards Viewer (HazVu)

Geologic hazard maps have been created for most of the volcanoes in the Cascade Range by the USGS Volcano Program at the Cascade Volcano Observatory in Vancouver, WA and are available at http://vulcan.wr.usgs.gov/Publications/hazards_reports.html.

Scientists use wind direction to predict areas that might be affected by volcanic ash; during an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. The predominant wind pattern over the Cascades originates from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes. Regional tephra fall shows the annual probability of ten centimeters or more of ash accumulation from Pacific Northwest volcanoes. Figure 2-10 depicts the potential and geographical extent of volcanic ash fall in excess of ten centimeters from a large eruption of Mt. St. Helens.

Figure 2-10. Regional Tephra-fall Maps



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

History

Mount Hood and Mount St. Helens are two active volcanoes in the vicinity of Linn County. Mount Hood is northeast of the county and is more than 500,000 years old. It has had two significant eruptive periods, one about 1,500 years ago and another about 200 years ago. Mount St. Helens is located in southern Washington State and has been active throughout its 50,000-year lifetime. In the past 200 years, seven of the Cascade volcanoes have erupted, including (from north to south): Mt. Baker, Glacier Peak, Mt. Rainier, Mount St. Helens (Washington); Mt. Hood (Oregon); Mt. Shasta, and Mt. Lassen (California). Mount Jefferson may have erupted about 1,100 years ago.

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

Probability Assessment

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

The CVO Volcanic tephra fall map is based on the combined likelihood of tephra-producing eruptions occurring at Cascade volcanoes. Probability zones extend farther east of the range because winds blow from westerly directions most of the time. The map shows annual probabilities for a fall of one centimeter (about 0.4 inch). The patterns on the map show the dominating influence of Mount St. Helens as a tephra producer. Because small eruptions are more numerous than large eruptions, the probability of a thick tephra fall at a given locality is lower than that of a thin tephra fall. The annual probability of a fall of one centimeter or more of tephra is about 1 in 10,000 for Linn County. This is small when compared to other risks faced by the county. The USGS map on the previous page illustrates potential tephra fall in the region.

Based on the available data and research for Linn County, the NHMP Steering Committee determined the **probability of experiencing volcanic activity is "low,"** meaning one incident is likely within the next 75 – 100-year period.

Vulnerabilities

Risks for Linn County associated with regional volcanic activity would be ash fall, air quality, possible lahar flows within the Santiam River basin, and possible economic or social disruption due to air traffic issues due to the ash cloud.

At the time of this update, sufficient data was not available to determine volcanic eruption vulnerability in terms of explicit types and numbers of existing and future buildings, infrastructure, or critical infrastructure.

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

As such, the NHMP Steering Committee rated the county as having a **"moderate" vulnerability to volcanic activity**, meaning that between 1% and 10% of the region's population or assets would be affected by a major disaster (volcanic ash).

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2015).

Wildfire

Significant Changes Since Previous Plan:

The occurrence history for this hazard has been updated since the 2010 Linn Plan. In addition, this section has also been reformatted.

Characteristics

Wildfires occur in areas with large amounts of flammable vegetation that require a suppression response due to uncontrolled burning. Fire is an essential part of Oregon's ecosystem, but can also pose a serious threat to life and property particularly in the state's growing rural communities. Wildfire can be divided into three categories: interface, wildland, and firestorms. The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element and can sweep through vegetation that is adjacent to a combustible home. New residents in remote locations are often surprised to learn that in moving away from built-up urban areas, they have also left behind readily available fire services providing structural protection.

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

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

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

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

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

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

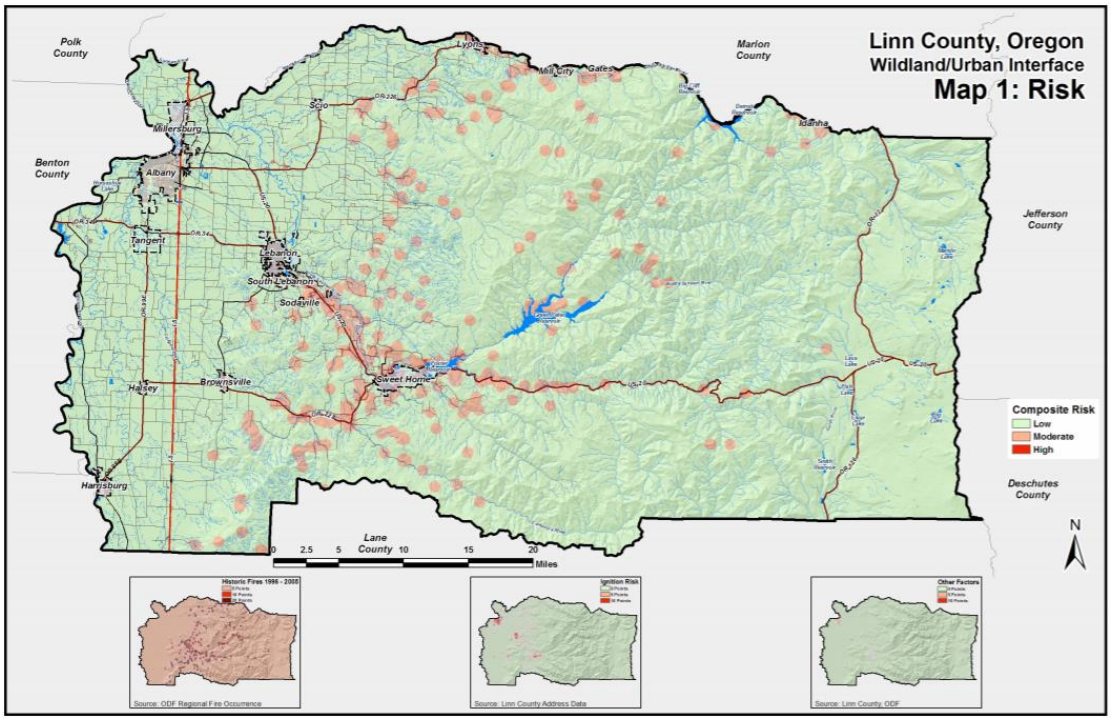
Location and Extent

Wildfire hazard areas are commonly identified in regions of the Wildland Urban Interface. The interface is the urban-rural fringe where homes and other structures are built into a densely forested or natural landscape. If left unchecked, it is likely that fires in these areas will threaten lives and property. One challenge Linn County faces is from the increasing number of houses being built in the urban/rural fringe as compared to twenty years ago. The "interface" between urban or suburban areas and the resource lands has significantly increased the threat to life and property from fires. Responding to fires in the expanding Wildland Urban Interface area may tax existing fire protection systems beyond original design or current capability.

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

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

Figure 2-11. Wildfire-Urban Interface



Source: Linn County CWPP (2007)

History

Linn County regularly experience wildfires, though not often of significant scale. Between 2010 and 2016, the Oregon Department of Forestry (ODF) reports that the North Cascade District (Santiam Unit) experienced a total of 34 fires burning a total of 131.5 acres. For the South Cascade District (Sweet Home Unit), ODF reports a total of 99 fires burning a total of 46.4 acres.

There has been three significant wildfire events since the previous plan, and additional historical wildfire information specific to Linn County has been added (as shown in *italics* below):

- ***1960 – 1970:*** *ODF reports a total of 327 fires in South Cascade District 77 (Sweet Home Unit), burning a total of 2,213.9 acres. While most of these fires were tiny, the largest burned 598 acres in 1966.*
- ***1971 – 1980:*** *ODF reports a total of 241 fires in South Cascade District 77 (Sweet Home Unit), burning a total of 2,856.45 acres. While most of these fires were tiny, the largest burned 837 acres in 1980.*
- ***1981 – 1990:*** *ODF reports a total of 191 fires in South Cascade District 77 (Sweet Home Unit), burning a total of 2,934.9 acres. While most of these fires were tiny, the largest burned 2,023 acres in 1987.*
- ***1991 – 2000:*** *ODF reports a total of 2 fires in North Cascade District 58 (Santiam Unit), burning a total of 0.13 acres. ODF reports a total of 251 fires in South Cascade District 77 (Sweet Home Unit), burning a total of 260.2 acres. While most of these fires were tiny, the largest, the Thomas Creek Fire, burned 70.1 acres in 1998.*
- ***2001 – 2010:*** *ODF reports a total of 41 fires in North Cascade District 58 (Santiam Unit), burning a total of 65.2 acres. ODF reports a total of 257 fires in South Cascade District 77 (Sweet Home Unit), burning a total of 1,426.68 acres. While most of these fires were tiny, the largest, the Middle Fork Fire, burned 1,070 acres in 2006.*
- ***2012:*** *Hilltop Fire, burned 16.5 acres in South Cascade District 77 (Sweet Home Unit).*
- ***2014:*** *Gates Complex (GM) Fire, burned 35 acres in North Cascade District 58 (Santiam Unit).*
- ***2014:*** *7 Mile Fire, burned 45 acres in North Cascade District 58 (Santiam Unit).*

See the Oregon Department of Forestry's Fires List for more information: http://www.odf.state.or.us/DIVISIONS/protection/fire_protection/fires/FIRESlist.asp

Probability Assessment

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

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

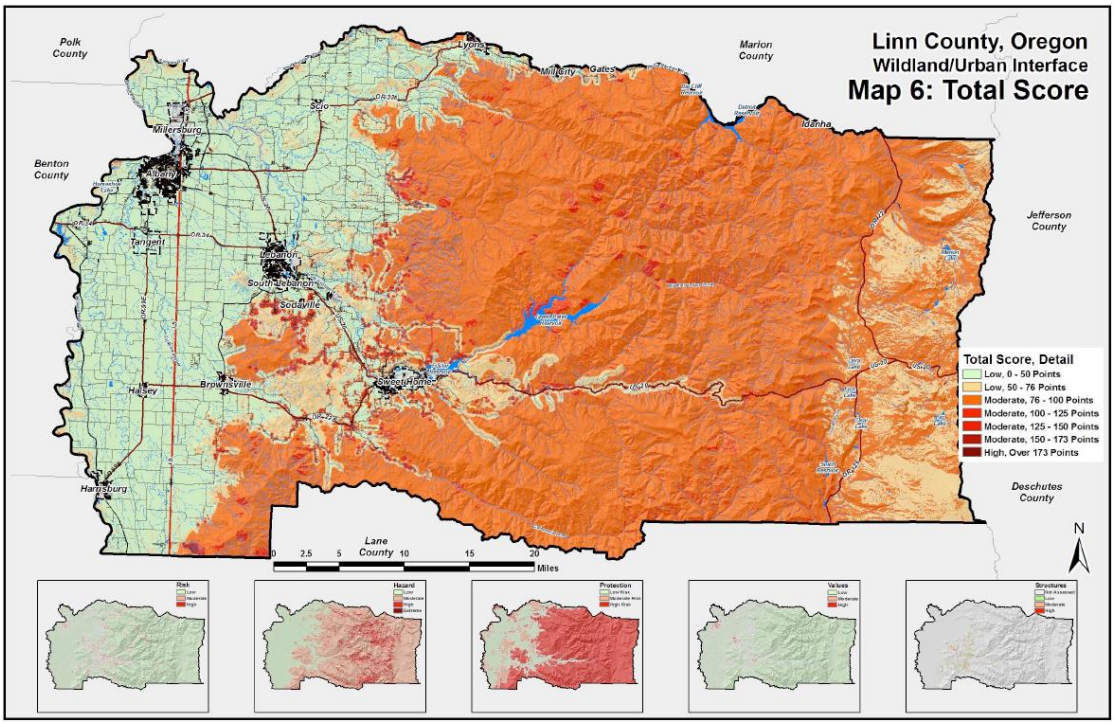
Vulnerability Assessment

The 2007 Linn County Community Wildfire Protection Plan uses five measures to assess the County's vulnerability to wildfires:

- **Risk:** the potential and frequency with which wildfire ignitions might occur, based on historic fires, foreseeable conditions, the density of homes within the Wildland Urban Interface boundary, and other factors
- **Hazard:** the natural conditions—vegetative fuels, weather, topographic features—that may contribute to and affect the behavior of wildfire
- **Protection capability:** the community's ability to plan and prepare for, as well as respond to and suppress, structural and wildland fires
- **Values protected:** a measure of the people, property, and essential infrastructure that may suffer losses in a wildfire event
- **Structural vulnerability:** a measure of the capacity of structures in the County's Wildland Urban Interface areas to resist wildfires if they occur, based on an assessment recently completed by the Oregon Department of Forestry

As demonstrated in the composite vulnerability map for Linn County in Figure 2-12, the 2007 Linn County CWPP rates about two-thirds of the county's area as moderately vulnerable to wildfires. Areas of high vulnerability do exist, however, in the interface areas around Sweet Home, Sodaville, Green Peter Reservoir, and to the northeast of Brownsville. The foothills of the Cascades also have some areas of high vulnerability.

Figure 2-12. Total Vulnerability for Linn County



Source: Linn County CWPP (2007)

Based on this information from the CWPP, the NHMP Steering Committee rated the county as having a **"moderate" vulnerability to wildfire hazards**; *this rating has not changed since the previous plan*.

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2015).

Severe Weather

Significant Changes Since Previous Plan:

The Severe Weather Hazard has been edited to reference new history since the 2010 Linn Plan. This section has also been reformatted.

Characteristics – Windstorm

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

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

Characteristics – Winter Storms

Winter storms affecting Linn County are generally characterized by a combination of heavy rains and high winds throughout the county, including ice and snowfall, especially at higher elevations in the Cascades. Heavy rains can result in localized or widespread flooding, as well as debris slides and landslides.

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

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

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

Location and Extent – Windstorm

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

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

Location and Extent – Winter Storms

Ice storms occasionally occur in northern areas of Oregon, resulting from cold air flowing westward through the Columbia Gorge. Freezing rain can be the most damaging of ice formations. While sleet and hail can create hazards for motorists when it accumulates, freezing rain can cause the most dangerous conditions within a community. Ice buildup can bring down trees, communication towers, and wires creating hazards for property owners, motorists, and pedestrians alike. The most common freezing rain problems occur near the Columbia Gorge. The Gorge is the most significant east-west air passage through the Cascades. Rain arriving from the west can fall on frozen streets, cars, and other sub-freezing surfaces, creating dangerous conditions.

The National Climatic Data Center has established climate zones in the United States for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the Pacific Ocean give the state diversified climates. Linn County is located within Zone 2: Willamette Valley and Zone 4: Northern Cascades. The climate in Zone 2 generally consists of cool, wet winters and warm, dry summers.[11] These wet winters result in potentially destructive winter storms that produce heavy snow, ice, rain and freezing rain, and high winds. The climate in Zone 4 generally consists of cold winters with a large amount of snowfall (November – March), cool springs and falls with rain, and warm summers, often punctuated with thunderstorms.[12]

[11] Oregon Climate Service. "The Climate of Oregon: Climate Zone 2: Willamette Valley." Special Report 914. (1993).

[12] Oregon Climate Service. "The Climate of Oregon: Climate Zone 4: Northern Cascades." Special Report 916. (1993).

Figure 2-13. Oregon Climate Divisions

Source: Oregon Climate Service

The principal types of winter storms affecting Linn County include:

- **Snowstorms:** require three ingredients: cold air, moisture, and air disturbance. The result is snow, small ice particles that fall from the sky. In Oregon, the further inland and north one moves, the more snowfall can be expected. Blizzards are included in this category.
- **Ice storms:** are a type of winter storm that forms when a layer of warm air is sandwiched by two layers of cold air. Frozen precipitation melts when it hits the warm layer, and refreezes when hitting the cold layer below the inversion. Ice storms can include sleet (when the rain refreezes before hitting the ground) or freezing rain (when the rain freezes once hitting the ground).
- **Extreme Cold:** Dangerously low temperatures accompany many winter storms. This is particularly dangerous because snow and ice storms can cause power outages, leaving many people without adequate heating.

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

History – Windstorms

Windstorms occur yearly; more destructive storms occur once or twice per decade, most recently in December 2015. The following windstorms have occurred within, and/or near

Linn County, four (4) windstorm events were added to this hazard history section since the previous plan (shown in *italics* below)[13]:

- **Jan. 1880:** Coast and Willamette Valley, In Portland, sustained south wind speeds of 60 mph were observed. Elsewhere, south winds were reported as high as 65 mph with gusts to 80 mph. Thousands of trees, many five to eight feet in diameter, were easily toppled in the high winds. Buildings throughout the Willamette Valley were destroyed. Hundreds more, including numerous large public buildings, were severely damaged.
- **Jan. 1921:** Coast and Willamette Valley, Hurricane-force winds were reported along the entire Oregon and Washington coasts. 113 mph was officially recorded at the north head of the mouth of the Columbia River on the Washington side. Very strong winds were also reported in the Willamette Valley. Widespread damage to buildings and standing timber.
- **Apr. 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
- **Dec. 1951:** Statewide, wind speed 60 mph in Willamette Valley. 75 mph gusts. Damage to buildings and utility lines.
- **Dec. 1955:** Statewide, Wind speeds 55-65 mph with 69 mph gusts. Considerable damage to buildings and utility lines
- **Nov. 1958:** Statewide, Wind speeds at 51 mph with 71 mph gusts. Every major highway blocked by fallen trees
- **Oct. 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
- **Oct. 1967:** Statewide, Significant widespread damage occurred to agriculture, timber, power and telephone utilities, and homes. Portland airport recorded a fastest mile of 70 mph. Wind speeds of 100 to 115 mph were unofficially recorded along the Oregon coast. There was one fatality and about 15 persons were seriously injured.
- **Mar. 1971:** Most of Oregon, Greatest damage in Willamette Valley. Homes and power lines destroyed by falling trees.
- **Nov. 1981:** Most of Oregon, highest winds since 1962. Wind speed 71 mph in Salem. Marinas, airports and bridges severely damaged.
- **Jan. 1990:** Statewide, Heavy rain with winds exceeding 75 mph. Significant damage, and one fatality.
- **Dec. 1996:** 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)

[13] Taylor, George H., and Ray Hatton, 1999, The Oregon Weather Book; The Spatial Hazard Events and Losses Database for the United States, [Online Database]. Columbia, SC: University of South Carolina. Available at http://www.sheldus.org; U.S. Department of Commerce. National Climatic Data Center. Available at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms; National Weather Service Forecast Office. Available at http://www.wrh.noaa.gov/pqr/paststorms/wind.php

- **Nov. 1997:** Western Oregon, Wind speed 52 mph in Willamette Valley. Trees uprooted. Considerable damage to small airports.
- **Feb. 2002:** Western Oregon, Strongest storm to strike western Oregon in several years. Many downed power lines (trees); damage to buildings; water supply problems (lack of power). Estimated damage costs: $6.14 million. (FEMA-1405-DR-OR)
- **Jan. 2005:** Windstorms caused $6,000 of damage in Linn and Marion Counties. A storm total of $15,000 in damages spread out among Linn, Marion, Clackamas, Multnomah, and Washington Counties.
- **Dec. 15, 2005:** Willamette Valley, a decent windstorm moved up the Willamette Valley bringing strong winds to the central and southern valley. $3,000 in property damage in Linn and Marion Counties.
- **Feb. 2006:** Linn, Marion, Lane, Benton, Polk, Yamhill, windstorms with gusts up to 77 mph causes $227,000 in damages in Linn, Lane, Marion, Benton, Polk, and Yamhill Counties.
- **Dec. 1-3, 2007:** Oregon and Washington, a relentless storm pummeled the Oregon and Washington Coasts for 3 days bringing the strongest winds the area has seen since the Columbus Day storm.
- ***Jun. 2009:*** *Willamette Valley, series of storms brought high winds, thunderstorms, rain, and hail.*
- ***Jan. 2012:*** *Severe winter storm, landslides, mudslides, flooding, including high winds (FEMA-4055-DR-OR)*
- ***Feb. 2014:*** *Coast and Willamette Valley, severe winter storm including high winds (FEMA-4169-DR-OR)*
- ***Dec. 2015:*** *Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides. (FEMA-4258-DR-OR)*

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

History – Winter Storms

Winter storms occur yearly; more destructive storms occur once or twice per decade, most recently in December 2015. The following winter storms have occurred within, and/or near Linn County, five (5) winter storm events were added to this hazard history section since the previous plan (shown in *italics* below)[14]:

- **Dec. 1861:** Statewide, Snowfall varied between 1 and 3 feet. Did not leave Willamette Valley floor until late February
- **Dec. 1864:** Willamette Valley and Columbia Basin, Heavy snowfall. Albany (Linn County) received 16 inches in 1 day.

[14] Taylor, George H., and Ray Hatton, 1999, The Oregon Weather Book; The Spatial Hazard Events and Losses Database for the United States, [Online Database]. Columbia, SC: University of South Carolina. Available at http://www.sheldus.org; U.S. Department of Commerce. National Climatic Data Center. Available at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms; National Weather Service Forecast Office. Available at http://www.wrh.noaa.gov/pqr/paststorms/wind.php

- **Dec. 1884:** Columbia River Basin and Willamette Valley, Most of the heavy snow fell over the Columbia River Basin from Portland to The Dalles and along the Cascades foothills in the Willamette valley. Albany received 19 inches.
- **Dec. 1892:** Northwest Oregon, Substantial snow fell across most of northern Oregon, with the greatest snowfall reported over northwestern Oregon.
- **Jan. 1916**: Statewide, two snow storms, each totaling 5 inches or more
- **Jan.- Feb. 1937:** Statewide, Heavy snow throughout the Willamette Valley. Corvallis received 18 inches of snow.
- **Jan. 1950:** Statewide, Heaviest snowfall since 1890. Many highway closures. Considerable property damage. Corvallis received 52 inches in snowfall for the month of January.
- **Jan. 1956:** Western Oregon, Packed snow became ice. Many automobile accidents throughout the region.
- **Mar. 1960:** Statewide, Snowfall: 3-12 inches, depending on location. More than 100 snow related accidents in Marion County.
- **Jan. 1969:** Statewide, for many areas, this was the most extreme storm on record. Snowfall over the state was much above normal, mostly in part due to a very cold January. Eugene had a total snow depth of 47 inches. Losses in livestock were heavy. Many communities were completely isolated for close to a week. At times, traffic on nearly every major highway west of the Cascades was halted. Three to $4 million in property damage statewide.
- **Jan. 1980:** Statewide, a series of storms bringing snow, ice, wind, and freezing rain. Six fatalities.
- **Feb. 1985:** Statewide, Western valleys received between 2-4 inches of snow; Massive power failures (tree limbs broke power lines)
- **Dec. 1985:** Willamette Valley, Heavy snowfall throughout valley
- **Mar. 1988:** Statewide, Strong winds and heavy snow
- **Feb. 1989:** Statewide, Heavy snowfall and record low temperatures. Salem received 9 inches. Extensive power failures as well as considerable home and business damage resulting from frozen plumbing throughout the state.
- **Feb. 1990:** Statewide, The Willamette Valley was coated with 2 to 4 inches except the higher hills around Portland received up to 1 foot.
- **Dec. 1992:** Western Oregon, Heavy snow. Interstate Highway closed.
- Feb. 1993: Western Oregon, Record snowfall at Salem airport.
- **Winter 1998-9:** Statewide, Series of storms. One of the snowiest winters in Oregon history.
- **Dec. 2003 – Jan. 2004:** Statewide, Wet snow blanketed highways in the Willamette Valley, causing power lines and trees to topple. Oregon 34 east of Philomath was closed for 30 hours January 5 and 6 while crews removed trees. Critical services were disrupted, 10,000 customers without power for 3 to 4 days; one person died as a result of power outage. Presidential disaster declaration for 30 of Oregon's 36 counties *(FEMA-1510-DR-OR)*.
- **Dec. 2008:** Willamette Valley, a series of storms dropped feet of snow over portions of the Willamette Valley. The onset of cold air moved in around December 14 and lingered through Christmas morning *(FEMA-1824-DR-OR)*
- **Jan. – Feb. 2008:** A series of vigorous winter storms brought record setting snow accumulation to Detroit, Oregon. Three dozen Oregon National Guard personnel

were called in to help with snow removal in Detroit and Idanha. The towns received over 12 feet of snow in several weeks.

- ***Jan. 2012:*** *Severe winter storm, landslides, mudslides, flooding, including high winds (FEMA-4055-DR-OR)*
- ***Mar. 2012:*** *mixture of snow, rain, wind throughout much of the coast and Willamette Valley, snow accumulations up to 7-inches, trees down, roads closed.*
- ***Dec. 2013:*** *Willamette Valley, snow accumulations up to 9-inches*
- ***Feb. 2014:*** *coast and Willamette Valley, severe winter storm including high winds.*
- ***Dec. 2015:*** *Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides. (FEMA-4258-DR-OR)*

Probability Assessment – Windstorms

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

Table 2-4 shows the wind speed probability intervals that structures 30 feet above the ground would expect to be exposed to within a 25, 50 and 100-year period. The table shows that structures in Region 3, which includes the Linn County, can expect to be exposed to 60 mph winds in a 25-year recurrence interval (4% annual probability).

Table 2-4. Probability of Severe Wind Events (Region 3)

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

Source: Oregon State Natural Hazard Mitigation Plan, 2015

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

Probability Assessment – Winter Storms

The recurrence interval for a severe winter storm is about every 13 years; however, there can be many localized storms between these periods. Severe winter storms occur in western Oregon regularly from November through February. Linn County experiences winter storms a couple times every year, particularly at higher elevations in the Cascades.

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

Vulnerabilities – Windstorm

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

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

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

Vulnerabilities – Winter Storm

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

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

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

Property is at risk due to flooding and landslides that may result if there is a heavy snowmelt. Additionally, ice, wind, and snow can affect the stability of trees, power and telephone lines, and TV and radio antennas. Down trees and limbs can become major

hazards for houses, cars, utilities and other property. Such damage in turn can become major obstacles to providing critical emergency response, police, fire, and other disaster recovery services.

Severe winter weather also can cause the temporary closure of key roads and highways, air and train operations, businesses, schools, government offices and other important community services. Below freezing temperatures can also lead to breaks in un-insulated water lines serving schools, businesses, industries, and individual homes. All of these effects, if lasting more than several days, can create significant economic impacts for the affected communities, surrounding region, and region. In the rural areas of Oregon severe winter storms can isolate small communities, farms, and ranches.

At the time of this update, sufficient data was not available to determine winter storm vulnerability in terms of explicit types and numbers of existing and future buildings, infrastructure, or critical infrastructure.

Since much of the County's population resides in or close to the Cascades where severe winter storms often impact daily life, the NHMP Steering Committee rated the county as having a **"high" vulnerability to winter storm hazards**, meaning that more than 10% of the region's population or assets would be affected by a major disaster; *this rating has not changed since the previous plan*.

More information on this hazard can be found in the Risk Assessment for Region 3, Mid-Willamette Valley, of the Oregon NHMP (2015).

Other reports:

Regional All Hazard Mitigation Master Plan for Benton, Lane, and Linn Counties: Phase I (1998)

Federal Disaster and Emergency Declarations

Reviewing past events can provide a general sense of the hazards that have caused significant damage in the county. Where trends emerge, disaster declarations can help inform hazard mitigation project priorities.

President Dwight D. Eisenhower approved the first federal disaster declaration in May 1953 following a tornado in Georgia. Since then, federally declared disasters have been approved within every state as a result of natural hazard related events. As of May 2017, FEMA has approved a total of 32 major disaster declarations, 65 fire management assistance declarations, and two (2) emergency declarations in Oregon.[15] When governors ask for presidential declarations of major disaster or emergency, they stipulate which counties in their state they want included in the declaration. Table 2-5 summarizes the major disasters declared in Oregon that affected Linn County, since 1955. The table shows that there have been ten (10) major disaster declarations for the county (three since the previous plan). All of which were related to weather events resulting primarily in flooding, landslides, and wind related damage.

An Emergency Declaration is more limited in scope and without the long-term federal recovery programs of a Major Disaster Declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring. Linn County has one Emergency Declaration related to the 2005 Hurricane Katrina evacuation.

Fire Management Assistance may be provided after a State submits a request for assistance to the FEMA Regional Director at the time a "threat of major disaster" exists. There is one fire management assistance declaration on record for the county.

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

Table 2-5. FEMA Major Disaster (DR), and Emergency (EM), and Fire Management Assistance (FMA) Declarations for Linn County

Declaration Number	Declaration Date	Incident Period From	Incident Period To	Incident	Individual Assistance	Public Assistance Categories
DR-184	12/24/1964	12/24/1964	12/24/1964	Heavy rains and flooding	Yes	A, B, C, D, E, F, G
DR-319	1/21/1972	1/21/1972	1/21/1972	Severe Storms, Flooding	Yes	A, B, C, D, E, F, G
DR-1099	2/9/1996	2/4/1996	2/21/1996	Severe Storms/Flooding	Yes	A, B, C, D, E, F, G
DR-1107	3/19/1997	12/10/1996	12/12/1996	Severe Storms/High Winds	None	A, B, C, D, E, F, G
DR-1405	3/12/2002	2/7/2002	2/8/2002	Severe Winter Windstorm with High Winds	None	A, B, C, D, E, F, G
DR-1510	2/19/2004	12/26/2003	1/14/2004	Severe Winter Storm	None	A, B, C, D, E, F, G
DR-1632	3/20/2006	12/18/2005	1/21/2006	Severe Storms, Flooding, Landslides, and Mudslides	None	A, B, C, D, E, F, G
DR-4055	3/2/2012	1/17/2012	1/21/2012	Severe Winter Storm, Flooding, Landslides, and Mudslides	None	A, B, C, D, E, F, G
DR-4169	4/4/2014	2/6/2014	2/10/2014	Severe Winter Storm	None	A, B, C, D, E, F, G
DR-4258	2/17/2016	12/6/2015	12/23/2015	Oregon Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides	None	A, B, C, D, E, F, G
EM-3228	9/7/2005	8/29/2005	10/1/2005	Hurricane Katrina Evacuation	None	B
FMA-2493	8/20/2003	8/20/2003	10/22/2003	Booth Fire	None	B, H

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

Vulnerability Summary

Community vulnerabilities are an important component of the NHMP risk assessment. For more in-depth information regarding specific community vulnerabilities, reference Volume II, Hazard Annexes and Appendix B: Community Profile. Data sources for the following community vulnerability information can be found in Appendix B – *Community Profile*, unless otherwise noted below.

Population

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

percent of the disaster burden falls on the public.[16] Of this number, a disproportionate burden is placed upon special needs groups, particularly children, the elderly, the disabled, minorities, and low-income persons. Population vulnerabilities can be reduced or eliminated with proper outreach and community mitigation planning.

Population Vulnerabilities

- As of 2014, approximately 17% of Linn County's population is over the age of 64; that number is projected to rise to about 22% (or roughly 33,000 individuals) by 2035.
- The Linn County age dependency ratio[17] is 56.6, which is higher than that of the State of Oregon (48.6); the age dependency figure for the county is expected to increase to 64.0 by the year 2035.
- Approximately 11% of Linn County population over age 64 lives alone; this percentage is greatest in Lebanon (16%).
- Approximately 18% of Scio households are single-parent.
- Approximately 18% of Harrisburg's population is Hispanic/Latino.
- Linn County's real median income is decreasing, with the largest decreases in Tangent (-19%), Harrisburg (-15%), and Sweet Home (-13%). Waterloo's median income is increasing at a rapid rate (132%).
- Approximately 19% of the Linn County population lived at or below the poverty line in 2015 (28% of children).
- While over 90% of the population over 25 has graduated high school or higher, only 17% have a bachelor's degree or higher. Mill City has a lower percentage of high school graduates.
- Approximately 17% of the Linn County population is estimated to have a disability. Of that, approximately 7,900 individuals over 64 (40%) are disabled.
- About 51% of Linn County renters (48% of owners with a mortgage) spend more than 30% of their income on housing.

Economy

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

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

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

Economic Vulnerabilities

- According to the Oregon Employment Department, Linn County unemployment has decreased from 14% in 2009 to less than 6% in 2016.
- The largest sectors of employment in Linn County are State Government, mainly Trade, Transportation, and Utilities (20%), Manufacturing (17%), Education and Health Services (13%), or Local Government (12%).
- The largest revenue sectors in Linn County are Retail Trade ($1.2 billion), Healthcare and Social Assistance ($422 million), and Transportation and Warehousing ($201 million).
- The Education and Health Services is expected to have the most growth from 2012 to 2022 at 17%. Construction (15%), Natural Resources and Mining (13%), and Other Services (13%) are the next closest growth sectors.

Environment

The capacity of the natural environment is essential in sustaining all forms of life including human life, yet it often plays an underrepresented role in community resiliency to natural hazards. The natural environment includes land, air, water and other natural resources that support and provide space to live, work and recreate.[18] Natural capital such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from weather-related hazards, such as flooding and landslides. When natural systems are impacted or depleted by human activities, those activities can adversely affect community resilience to natural hazard events.

Environmental Vulnerabilities

- Forest ecosystems are vulnerable to drought, wildfire, and severe storm impacts.

Built Environment, Critical Facilities, and Infrastructure

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

Housing Vulnerabilities

- Mobile home and other non-permanent residential structures account for 12% of housing in Linn County. In Tangent mobile homes account for 42%. These structures are particularly vulnerable to certain natural hazards, such as earthquake, windstorms, and heavy flooding events.

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

- Based on U.S. Census data, approximately two-thirds of the residential housing in Linn County was built before the current seismic building standards of the early 1990s.[19]
- Approximately 40% of residential structures were constructed prior to the local implementation of the flood elevation requirements of the 1970's (county Flood Insurance Rate Maps –FIRMs- were not completed until the late 1970s and early 1980s).
- The housing vacancy rate in Linn County was estimated at about 7% in 2015.

Critical Facilities and Infrastructure Vulnerabilities

- Virtually all state and county roads and bridges in Linn County are vulnerable to multiple hazards including flood, landslide, and earthquake. Impacts to the transportation system can result in the isolation of vulnerable populations, limit access to critical facilities such as hospitals and adversely impact local commerce, employment and economic activity.
- Most of Linn County's power is generated outside the region; there is no redundancy in power transmission and only limited redundancy in the power distribution network.
- There are seven (7) "high threat potential" dams and one (1) "significant threat potential" dam (Carmen Diversion); the county has 11 dams categorized as "low threat potential.

National Flood Insurance Program (NFIP) Vulnerability

FEMA modernized the Linn County Flood Insurance Rate Maps (FIRMs) in September 2010. Table 2-6 shows that as of April 2016, Linn County (including NFIP participating incorporated cities) has 1,054 National Flood Insurance Program (NFIP) policies in force. Of those, 684 are for properties that were developed before development of the initial FIRM. The last Community Assistance Visit (CAV) for unincorporated Linn County was on August 25, 2005. Unincorporated Linn County does not participate in the Community Rating System (CRS); the cities of Albany and Scio are members and have ratings of 6 and 10 respectively. The table shows that the majority of flood insurance policies are for residential structures, primarily single-family homes.

There have been 97 paid claims in the county totaling just over $1.5 million. In addition, there have been 82 Pre-FIRM claims and two (2) substantial damage claims paid to date. Linn County has nine (9) Repetitive Loss (RL) Properties[20], and one (1) Severe Repetitive Loss Property (see Table 2-6)[21].

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[19] Ibid.

[20] A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

[21] A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding

Table 2-6. Flood Insurance Detail

Jurisdiction	Effective FIRM and FIS	Initial FIRM Date	Total Policies	Pre-FIRM Policies	Policies by Building Type				Minus Rated A Zone
					Single Family	2 to 4 Family	Other Residential	Non-Residential	
Linn County	-	-	1,054	684	895	18	6	135	72
Unincorporated	9/29/2010	9/29/1986	587	371	473	6	3	105	50
Albany	9/29/2010	4/3/1985	247	190	232	4	2	9	9
Brownsville	9/29/2010	8/17/1981	43	22	39	1	0	3	5
Halsey	9/29/2010	9/29/2010	0	0	0	0	0	0	0
Harrisburg	9/29/2010	2/3/1982	13	8	12	0	0	1	1
Idanha	1/19/2000	3/1/1979	2	1	2	0	0	0	0
Lebanon	9/29/2010	7/2/1981	37	24	30	4	1	2	1
Lyons	9/29/2010	12/15/1981	7	3	7	0	0	0	0
Mill City	9/29/2010	3/1/1979	1	1	1	0	0	0	0
Millersburg	9/29/2010	6/15/1982	7	0	5	0	0	2	0
Scio	9/29/2010	8/1/1984	73	40	64	3	0	6	5
Sodaville	9/29/2010	9/29/2010	0	0	0	0	0	0	0
Sweet Home	9/29/2010	3/1/1982	22	15	17	0	0	5	1
Tangent	9/29/2010	5/17/1982	15	9	13	0	0	2	0
Waterloo	9/29/2010	9/29/2010	0	0	0	0	0	0	0

Jurisdiction	Insurance in Force	Total Paid Claims	Pre-FIRM Claims Paid	Substantial Damage Claims	Total Paid Amount	Repetitive Loss Properties	Severe Repetitive Loss Properties	CRS Class Rating	Last CAV
Linn County	$ 230,901,600	97	82	3	$ 1,526,254	9	1	-	-
Unincorporated	$ 121,544,900	47	37	2	$ 779,892	6	1	NP	8/25/2005
Albany	$ 58,534,100	11	10	0	$ 113,663	2	0	6	9/8/2011
Brownsville	$ 8,696,000	5	5	0	$ 41,985	0	0	NP	7/27/2005
Halsey	$ -	0	0	0	$ -	0	0	NP	none
Harrisburg	$ 3,492,100	0	0	0	$ -	0	0	NP	4/2/1999
Idanha	$ 496,900	1	1	0	$ 5,711	0	0	NP	12/31/1994
Lebanon	$ 9,618,500	0	0	0	$ -	0	0	NP	8/10/2006
Lyons	$ 1,832,000	0	0	0	$ -	0	0	NP	3/31/1995
Mill City	$ 350,000	0	0	0	$ -	0	0	NP	12/31/1994
Millersburg	$ 2,550,000	0	0	0	$ -	0	0	NP	1/1/1992
Scio	$ 16,296,800	30	26	1	$ 574,490	1	0	10	5/1/2014
Sodaville	$ -	0	0	0	$ -	0	0	NP	none
Sweet Home	$ 3,791,400	2	2	0	$ 7,878	0	0	NP	4/18/2005
Tangent	$ 3,698,900	1	1	0	$ 2,635	0	0	NP	7/1/1991
Waterloo	$ -	0	0	0	$ -	0	0	NP	none

Source: Information compiled by Department of Land Conservation and Development, April 2016.
Note 1: NP = Not Participating
Source: Department of Land Conservation and Development, April 2016.

$20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Risk Assessment

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

The Linn County steering committee worked with OPDR to develop a county-wide risk assessment. Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, and Waterloo held separate steering committee meetings and worked with OPDR to complete a jurisdiction specific hazard analysis; for more information on the process see Appendix B. City specific information is presented in Volume II, *City Addenda*.

Probability Summary

The table below presents the probability scores for each of the natural hazards present in Linn County for which descriptions are provided herein, and in Volume III with detail for the participating cities. As shown in the table with **bold text**, several hazards are rated with high probabilities.

Table 2-7. Natural Hazard Probability Assessment Summary

		Earthquake						Severe Weather	
	Drought	Cascadia	Crustal	Flood	Landslide	Volcano	Wildfire	Windstorm	Winter Storm
Linn County	Moderate	**High**	Moderate	**High**	**High**	Low	**High**	**High**	**High**
Halsey									
Harrisburg									
Lebanon									
Lyons									
Scio									
Sodaville									
Tangent									
Waterloo									

Source: Linn County and City NHMP Steering Committees 2016.
Note – City ratings will be added later.

Vulnerability Summary

Vulnerability assesses the extent to which people are susceptible to injury or other impacts resulting from a hazard as well as the exposure of the built environment or other community assets (social, environmental, economic, etc.) to hazards. The exposure of community assets to hazards is critical in the assessment of the degree of risk a community has to each hazard. Identifying the populations, facilities and infrastructure at risk from various hazards can assist the county in prioritizing resources for mitigation, and can assist in directing damage assessment efforts after a hazard event has occurred. The exposure of county and city assets to each hazard and potential implications are explained in each hazard section.

Vulnerability includes the percentage of population and property likely to be affected under an "average" occurrence of the hazard. Linn County evaluated the best available vulnerability data to develop the vulnerability scores presented below. For the purposes of this NHMP, the county and cities utilized the Oregon Military Department – Office of Emergency Management (OEM) Hazard Analysis methodology vulnerability definitions to determine hazard probability.

Table 2-8 presents the vulnerability scores for each of the natural hazards present in Linn County and for participating cities. As shown in the table with **bold text**, the Cascadia Subduction Earthquake event is the only hazard that is rated with a high vulnerability.

Table 2-8. Community Vulnerability Assessment Summary

		Earthquake						Severe Weather	
	Drought	Cascadia	Crustal	Flood	Landslide	Volcano	Wildfire	Windstorm	Winter Storm
Linn County	Low	**High**	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	**High**
Halsey									
Harrisburg									
Lebanon									
Lyons									
Scio									
Sodaville									
Tangent									
Waterloo									

Source: Linn County and City NHMP Steering Committees 2015.
Note – City ratings will be added later.

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

Hazard Analysis Matrix

The hazard analysis matrix involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous sections), and (2) the likelihood or probability of the harm occurring. The table below presents the entire updated hazard analysis matrix for Linn County. The hazards are listed in rank order from high to low. The table shows that hazard scores are influenced by each of the four categories combined. With considerations for past historical events, the probability or likelihood of a particular hazard event occurring, the vulnerability to the community, and the maximum threat or worst-case scenario, winter storms, earthquake (Cascadia), flood, and wildfire events rank as the top hazard threats to the county (top tier). Windstorm, landslide, and earthquake (crustal) events rank in the middle (middle tier). Drought and volcano (volcanic ash) comprise the lowest ranked hazards in the county (bottom tier).

Table 2-9. Hazard Analysis Matrix – Linn County

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	Hazard Tiers
Winter Storm	20	50	90	70	230	# 1	*Top Tier*
Earthquake - Cascadia	2	50	100	56	208	# 2	
Flood - Riverine	20	35	80	70	205	# 3	
Wildfire (WUI)	20	30	80	70	200	# 4	
Windstorm	16	35	70	70	191	# 5	*Middle Tier*
Landslide	20	20	60	63	163	# 6	
Earthquake - Crustal	6	30	70	35	141	# 7	
Drought	16	5	50	35	106	# 8	*Bottom Tier*
Volcano*	2	25	50	21	98	# 9	

**Not included in this Plan*

Source: Linn County Steering Committee (2015); Analysis and Ranking by OPDR

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

City Specific Risk Assessment

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

The eight participating cities in Linn County (Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, and Waterloo) held local steering committee meetings and completed a jurisdiction specific hazard analysis. The multi-jurisdictional risk assessment information is located herein and within the Risk Assessment section of each city's addendum, which is located in Volume II of this NHMP.

Hazard Analysis Methodology

The hazard analysis methodology in Oregon (primarily to inform Emergency Operations Planning) was first developed by FEMA circa 1983, and gradually refined by the Oregon Military Department's Office of Emergency Management over the years.

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

The Oregon method provides the jurisdiction with a sense of hazard priorities, or relative risk. It doesn't predict the occurrence of a particular hazard, but it does "quantify" the risk of one hazard compared with another. By doing this analysis, planning can first be focused where the risk is greatest.

In this analysis, severity ratings, and weight factors, are applied to the four categories of history, vulnerability, maximum threat (worst-case scenario), and probability as demonstrated below.

History (Weight Factor = 2)

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 Planning (EOP) 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 = 0 to 1 event in the past 100 years, scores between 1 and 3 points
MODERATE = 2 to 3 event in the past 100 years, scores between 4 and 7 points
HIGH = 4+ events in the past 100 years, scores between 8 and 10 points

Probability (Weight Factor = 7)

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

LOW = one incident likely within 75 to 100 years, scores between 1 and 3 points
MODERATE = one incident likely within 35 to 75 years, scores between 4 and 7 points
HIGH = one incident likely within 10 to 35 years, scores between 8 and 10 points

Vulnerability (Weight Factor = 5)

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

LOW = < 1% affected, scores between 1 and 3 points
MODERATE = 1 - 10% affected, scores between 4 and 7 points
HIGH = > 10% affected, scores between 8 and 10 points

Maximum Threat (Weight Factor =10)

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

LOW = < 5% affected, scores between 1 and 3 points
MODERATE = 5 - 25% affected, scores between 4 and 7 points
HIGH = > 25% affected, scores between 8 and 10 points

SECTION 3: MITIGATION STRATEGY

Section 3 outlines Linn County's strategy to reduce or avoid long-term vulnerabilities to the identified hazards. Specifically, this section presents a mission and specific goals and actions thereby addressing the mitigation strategy requirements contained in 44 CFR 201.6(c). The NHMP Steering Committee reviewed and updated the mission, goals and action items documented in this plan. Additional planning process documentation is in Appendix A.

Mitigation Plan Mission

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

The mission of the Linn County NHMP is:

> ***To reduce the impact of natural hazards on the community through planning, communication, coordination and partnership development.***

The 2016 NHMP Steering Committee reviewed the previous plans mission statement and agreed that the mission as stated in the 2010 NHMP still accurately captured the mission of Linn County's NHMP.

Mitigation Plan Goals

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

Stakeholder participation was a key aspect in developing the plan goals. Meetings with the project Steering Committee and the Linn County Planning Commission served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss for natural hazards in Linn County.

The 2016 Linn County NHMP Steering Committee reviewed the 2010 plan goals in comparison to the State Natural Hazard Mitigation Plan (2015) goals and determined that the 2010 NHMP goals still accurately encompassed the range of activities the County would like to pursue to mitigate the potential damage caused by natural hazards. The goals presented here, therefore, are the same as those recorded in the 2010 plan.

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

Below is a list of the plan goals:

> **Goal 1:** *Enhance coordination and communication among Linn County stakeholders to implement the Plan.*
>
> **Goal 2:** *Protect life, the built environment and natural systems through County policies, procedures and services.*
>
> **Goal 3:** *Protect life, the built environment, the economy and natural resources through community-wide partnerships.*

During the meetings on May 26, 2016, the Linn County NHMP steering committee reviewed the Linn County mission and goal statements. The cities of participating in this plan all agreed to adopt the Linn County mission and goal statements (see Volume III, Appendix A for more information).

Action Item Development Process

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

Figure 3-1. Development of Action Items

The majority of the action items were first created during the previous NHMP planning processes. During these processes, steering committees developed maps of local vulnerable populations, facilities, and infrastructure in respect to each identified hazard. Review of these maps generated discussion around potential actions to mitigate impacts to the vulnerable areas. The Oregon Partnership for Disaster Resilience (OPDR) provided guidance in the development of action items by presenting and discussing actions that were used in

other communities. OPDR also took note of ideas that came up in Steering Committee meetings and drafted specific actions that met the intent of the Steering Committee. All actions were then reviewed by the Steering Committee, discussed at length, and revised as necessary before becoming a part of this document.

During this update of the Linn County NHMP, the Steering Committee made significant revisions to the action items to (1) better address identified concerns and (2) be more manageable to implement. The Steering Committee decided to list the actions by the hazard they address rather than by the objectives identified in 2010. The Steering Committee agreed that the objectives did not greatly add value to the plan and determined that it would be easier to connect actions with the issues they seek to mitigate by listing each action under a corresponding hazard.

The Steering Committee also agreed that the action item forms included in the 2010 plan did not assist them in implementing actions, so action item forms are omitted from this 2016 update.

Priority Actions

Action items identified through the planning process are an important part of the mitigation plan. Action items are detailed recommendations for activities that local departments, citizens, and others could engage in to reduce risk. Due to resource constraints, Linn County and participating cities are listing a set of high priority actions (Table 3-1) in an effort to focus attention on an achievable set of high leverage activities over the next five-years. This plan identifies priority actions based on an evaluation of high impact hazards, resource availability and FEMA identified best practices. Steering Committee members were asked to select the three actions they viewed as most critical and attainable based on the above noted criteria. Those actions that received three to four votes are listed here as high priority.

Note 1: See Volume II, *City Addenda*, for the Priority Actions for each participating city.

Action Item Matrix

The action item matrix (Table 3-2) presents a pool of mitigation actions. The majority of these actions carry forward from prior versions of this plan. This expanded list of actions is available for local consideration as resources, capacity, technical expertise and/or political will become available. Appendix A provides additional details about how the action items have been modified since 2010.

Note 2: See Volume II, *City Addenda*, for the Action Item Matrix for each participating city.

Table 3-1. Linn Priority Action Items

Action Item	Priority	Time Line	Lead Organization	Partner/Supporting Organizations	How Changed
MH-1. Develop mutual aid agreements with private parties. Agreements should document equipment, labor, and special expertise that could be mobilized rapidly in the event of a natural disaster. Agreements should also include maps of private parties' operating areas.	High (3)	Ongoing	Emergency Management	Health Dept. - Emergency Preparedness Coord.; Road Dept; ODOT;ODF; Private timber owners; private land owners	New wording
FL-1. Update Flood Insurance Rate Maps (FIRM).	High (4)	2-5 years	Planning & Building Department	Building Official; Emergency Management; Insurance Companies; Cities; FEMA; OEM;GIS	Keep
WF-1. Update the Community Wildfire Protection Plan.	High (4)	1-3 years	Oregon Department of Forestry	Emergency Management; Fire Districts; Cities; Fire Marshall; OEM	New

Source Linn County NHMP Steering Committee, updated 2016

Table 3-2. Linn Action Item Pool

Action Item	Priority	Time Line	Lead Organization	Partner/Supporting Organizations	How Changed
MH-1. Develop mutual aid agreements with private parties. Agreements should document equipment, labor, and special expertise that could be mobilized rapidly in the event of a natural disaster. Agreements should also include maps of private parties' operating areas.	High (3)	Ongoing	Emergency Management	Health Dept. - Emergency Preparedness Coord.; Road Dept; ODOT;ODF; Private timber owners; private land owners	Reworded
MH-2. Publicize opportunities for appropriate staff to attend FEMA G318 local mitigation planning workshops or related trainings.	Medium (2)	Ongoing	Emergency Management	Oregon Emergency Management; DOGAMI; FEMA; Fire Marshall; Insurance Companies; Linn County Roads; Linn County Facilities Manager	Reworded
MH-3. Maintain public awareness campaigns aimed at homeowners, children, the elderly, and non-English speaking residents to raise awareness about disaster preparedness and risk reduction.	Medium (2)	Ongoing	Department of Health Services - Emergency Preparedness Coordinator	Emergency Management; Linn-Benton Vulnerable Population Planning Working Group; Red Cross; COG; Cities; Linn Benton ESD; United Way; State Agencies; Hospitals; Insurance Companies; Children and Families Commission	Reworded & New lead
MH-4. Encourage small businesses to develop continuity of business plans in the event of a disaster and to implement non-structural mitigation.	Medium (1)	3-5 years	Cascades West Council of Governments	Business Development Coordinator; LBCC Business Development; Red Cross	New lead
MH-5. Evaluate the Goal 7 section of the Linn County Comprehensive Plan and update policies to incorporate mitigation principles.	Low (0)	1-3 years	Planning & Building Department	Emergency Management; Planning Commission; Board of Commissioners	Reworded
MH-6. Update replacement costs on existing County Asset Inventory(s) at least every 5 years.	Low (0)	Ongoing	General Services	Linn County Property Management; Treasurer; Assessor; GIS; Road Department; Health Department	Reworded

Source Linn County NHMP Steering Committee, updated 2016

Table 3-2. Linn Action Item Pool (continued)

	Action Item	Priority	Time Line	Lead Organization	Partner/Supporting Organizations	How Changed
MULTI-HAZARD: BRIDGES	**MH-Bridge 1.** Develop a County wide list of all public bridge crossings leading to private structures on private and public lands.	Medium (2)	1-3 years	Road Department	Emergency Management, Private land owners, Public agencies	Reworded, New Lead
	MH-Bridge 2. Evaluate public bridges identified in MH-Bridge 1 for flood, scour, seismic and structural integrity and rank bridges by vulnerability.	Medium (2)	2-5 years	Road Department	General Services; Road Department; Board of Commissioners; FEMA; DOGAMI; OEM; ODOT; U.S. DOT	New
	MH-Bridge 3. Implement County's existing bridge scour protection plan, trageting 5-10 high priority bridges every year (as identified in MH-Bridge 2).	Medium (2)	Ongoing	Road Department	GIS Department	New
	MH-Bridge 4. Implement structural mitigation projects for prioritized, vulnerable publicly owned bridges identified in MH-Bridge 2. Target 1 - 2 mitigation projects per CIP budget cycle.	Medium (2)	Ongoing	Road Department	General Services; Road Department; Board of Commissioners; FEMA; DOGAMI; OEM; ODOT; U.S. DOT	Reworded
	MH-Bridge 5. Implement a routine public bridge inspection program for bridges identified in MH-Bridge 1 and revisit bridge vulnerability ranking as necessary.	Medium (2)	Ongoing	Road Department	Planning and Building; Linn County Fire Defense Board; Private Land owners Public agencies	Reworded
	MH-Bridge 6. Work with private bridge owners to mitigate particularly vulnerable private bridges.	Low (0)	Ongoing	Road Department	Planning and Building; Linn County Fire Defense Board; Private Land owners Public agencies	New

Source Linn County NHMP Steering Committee, updated 2016

Table 3-2. Linn Action Item Pool (continued)

	Action Item	Priority	Time Line	Lead Organization	Partner/Supporting Organizations	How Changed
FLOOD	**FL-1.** Update Flood Insurance Rate Maps (FIRM).	High (4)	2-5 years	Planning & Building Department	Building Official; Emergency Management; Insurance Companies; Cities; FEMA; OEM;GIS	No Change
	FL-2. Digitize LOMA/LOMR and elevation certificates.	Medium (2)	1-3 years	GIS Department		New
	FL-3. Fund a new hydrolic study for Linn County.	Medium (1)	2-5 years	Road Department	Surveyor; GIS; Floodplain Manager; FEMA	Reworded
	FL-4a. Identify river and stream scour locations that impact County roads and prioritize areas for stabilization.	Medium (1)	1-2 years	Road Department	GIS Department	New
	FL-4b. Stabilize priority road areas identified in FL-4a.	Medium (1)	3-5 years	Road Department	GIS Department	New
	FL-5. Buy out properties in areas vulnerable to flooding as they become available.	Low (0)	Ongoing	Planning & Building Department/Floodplain Administrator	Parks Department; Road Department; Board of Commissioners	New
	FL-6. Encourage multi-objective stream and river enhancement projects that maximize flood mitigation.	Low (0)	Ongoing	Road Department	Cities; Emergency Management; Watershed Councils; Water Control Districts; DSL; ODFW; DOF; DEQ; FEMA; USCE; Planning and Building Department	No Change
	Action Item	**Priority**	**Time Line**	**Lead Organization**	**Partner/Supporting Organizations**	**How Changed**
SEVERE WEATHER	**SW-1a.** Inventory public and semi-public infrastructure and critical facilities and evalute for vulnerability to severe weather.	Medium (1)	1-3 years	Emergency Management	Road Dept; Planning & Building; Assessor; GIS; Health Dept.; General Services; Emergency Services Providers; ODOT; OEM; FEMA; Insurance Companies; Utility Companies	Reworded
	SW-1b. Mitigate the vulnerable structures identified in SW-1a. Target 5 mitigation projects per year.	Low (0)	3-5 years	General Services	Emergency Management; Health Dept.; ODOT; OEM; FEMA; Insurance Companies; Utility Companies	New

Source Linn County NHMP Steering Committee, updated 2016

Table 3-2. Linn Action Item Pool (continued)

	Action Item	Priority	Time Line	Lead Organization	Partner/Supporting Organizations	How Changed
DROUGHT	**DR-1.** Develop and adopt a Drought Contingency Plan for Linn County. e.g. http://northsantiam.org/projects/north-santiam-drought-contingency-planning-2016-2017/	Low (0)	Ongoing	Watermaster	Planning and Building; Emergency Management; Parks and Recreation Department; NRCS; Department of Agriculture; WRD; Local Water Districts	Reworded & New Lead
	DR-2. Support local agency programs for farmers and ranchers, that provide education and training on water conservation measures, including drought management practices for crops and livestock.	Low (0)	Ongoing	Planning and Building Department	OSU Extension Services; NRCS; Farm Bureau: WRD; ODFW; Watershed Councils; Water Districts	No Change
	Action Item	**Priority**	**Time Line**	**Lead Organization**	**Partner/Supporting Organizations**	**How Changed**
LANDSLIDE	**LS-1a.** Identify landslide and rock fall areas adjacent to public roads and prioritize areas for stabilization/ mitigation.	Medium (1)	1-3 years	Road Department	GIS Department	New
	LS-1b. Stabilize priority areas identified in LS-1a.	Medium (1)	3-5 years	Road Department	GIS Department	New
	LS-2a. Integrate new data on debris flow areas into County maps.	Medium (1)	1-3 years	GIS Department	DOGAMI	Reworded
	LS-2b. Update the development code to limit development in debris flow areas identified in LS-2a.	Medium (1)	3-5 years	Planning Department	GIS	New
	LS-3. Increase public education related to landslide hazards by distributing DOGAMI landslide informational brochure.	Low (0)	Ongoing	Department of Health Services - Emergency Preparedness Coordinator	CERT; Planning Dept.; Dept of Forestry; DOGAMI; OEM; ODOT; Road Department; Radio Stations	New lead

Source Linn County NHMP Steering Committee, updated 2016

Table 3-2. Linn Action Item Pool (continued)

	Action Item	Priority	Time Line	Lead Organization	Partner/Supporting Organizations	How Changed
EARTHQUAKE	**EQ-1a.** Conduct a seismic vulnerability assessment of critical County-owned structures and prioritize vulnerable publicly owned structures.	Medium (2)	1-3 years	General Services	General Services; Road Dept.; Building Official; OEM; Assessor; DOGAMI; Safety Committee	No Change
	EQ-1b. Implement x structural mitigation project for prioritized, vulnerable publicly owned structures identified in EQ-1a per year. (Consider funding from State Seismic Rehabilitation Grant Program.)	Low (0)	Ongoing	General Services	General Services; Road Dept.; Building Official; OEM; Assessor; DOGAMI; Safety Committee	No Change
	EQ-2. Develop a program to implement non-structural retrofit of County staff offices and workspaces.	Low (0)	1-5 years	Safety Committee	General Services; County Insurance Carrier; OEM; OR- OSHA; BC	New lead
	EQ-3. Train 10 - 20 county staff through the ATC 20/145 Damage Assessment Classes over the next 5 years.	Low (0)	1-5 years	Emergency Management	OEM	New
	EQ-4. Assist K-12 schools, child care facilities and private schools to develop vulnerability assessment and mitigation projects to improve safety.	Low (0)	Ongoing	Cities	Emergency Management; Health Dept.; School Districts; Private Schools; American Red Cross; DOGAMI; OEM; Oregon Department of Education	New Lead
	Action Item	**Priority**	**Time Line**	**Lead Organization**	**Partner/Supporting Organizations**	**How Changed**
WILDFIRE	**WF-1.** Update the Community Wildfire Protection Plan.	High (4)	1-3 years	Oregon Department of Forestry	Emergency Management; Fire Districts; Cities; Fire Marshall; OEM	New
	WF-2. Partner with the Oregon Department of Forestry and Rural Fire Districts to promote home site assessment programs for the wildfire hazard.	Low (0)	Ongoing	Oregon Department of Forestry	Fire Districts; Cities; Fire Marshall; OEM; Emergency Management	New lead

Source Linn County NHMP Steering Committee, updated 2016

SECTION 4:
PLAN IMPLEMENTATION AND MAINTENANCE

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

Implementing the Plan

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

Plan Adoption

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

Co-Conveners

The Linn County Emergency Management Coordinator and the Linn County Planning and Building Director serve as co-conveners for the Linn County NHMP. They will take responsibility for plan implementation, facilitate the Hazard Mitigation Coordinating Body meetings, and assign tasks such as updating and presenting the plan to the rest of the members of the Coordinating Body (see City Addenda for city conveners). Plan implementation and evaluation will be a shared responsibility among all of the assigned Hazard Coordinating Body Members. The Co-Conveners' specific responsibilities include:

- Coordinating Steering Committee meeting dates, times, locations, agendas, and member notification;
- Documenting the discussions and outcomes of committee meetings;

- Serving as a communication conduit between the Steering Committee and the public/stakeholders;
- Identifying emergency management-related funding sources for natural hazard mitigation projects; and
- Utilizing the Risk Assessment as a tool for prioritizing proposed natural hazard risk reduction projects.

Coordinating Body

The Linn County Co-Conveners will form a Natural Hazard Coordinating Body for updating and implementing the NHMP. The Coordinating Body responsibilities include:

- Attending future plan maintenance and plan update meetings (or designating a representative to serve in your place);
- Serving as the local evaluation committee for funding programs such as the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and Flood Mitigation Assistance program funds;
- Prioritizing and recommending funding for natural hazard risk reduction projects;
- Evaluating and updating the NHMP in accordance with the prescribed maintenance schedule;
- Developing and coordinating ad hoc and/or standing subcommittees as needed; and
- Coordinating public involvement activities.

Members

The following jurisdictions, agencies, and/ or organizations were represented and served on the Steering Committee during the development of the Linn County NHMP (for a list of individuals see Section 1, *Special Thanks & Acknowledgements*):

- Linn County Emergency Management
- Linn County GIS
- Linn County Planning and Building Department
- Linn County Planning Commission
- Linn County Public Health
- Linn County Road Department (County Engineering)
- Albany Fire Department
- Cascade Timber
- City of Albany Emergency Management

To make the coordination and review of the Linn County NHMP as broad and useful as possible, the Coordinating Body will engage additional stakeholders and other relevant hazard mitigation organizations and agencies to implement the identified action items. Specific organizations have been identified as either lead or supporting partners on the individual action items found in Volume I, Section 3 and Volume III, Appendix A.

Implementation through Existing Programs

The NHMP includes a range of action items that, when implemented, will reduce loss from hazard events in the county. Within the plan, FEMA requires the identification of existing programs that might be used to implement these action items. Linn County, and the

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

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

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

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

For additional examples of plans, programs or agencies that may be used to implement mitigation activities refer to list of plans in Appendix B, *Community Profile*.

Plan Maintenance

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

Annual Meetings

The Coordinating Body will meet on an **annual basis** to complete the following tasks. During the first meeting, prior to the wildfire/ irrigation season, the Coordinating Body will:

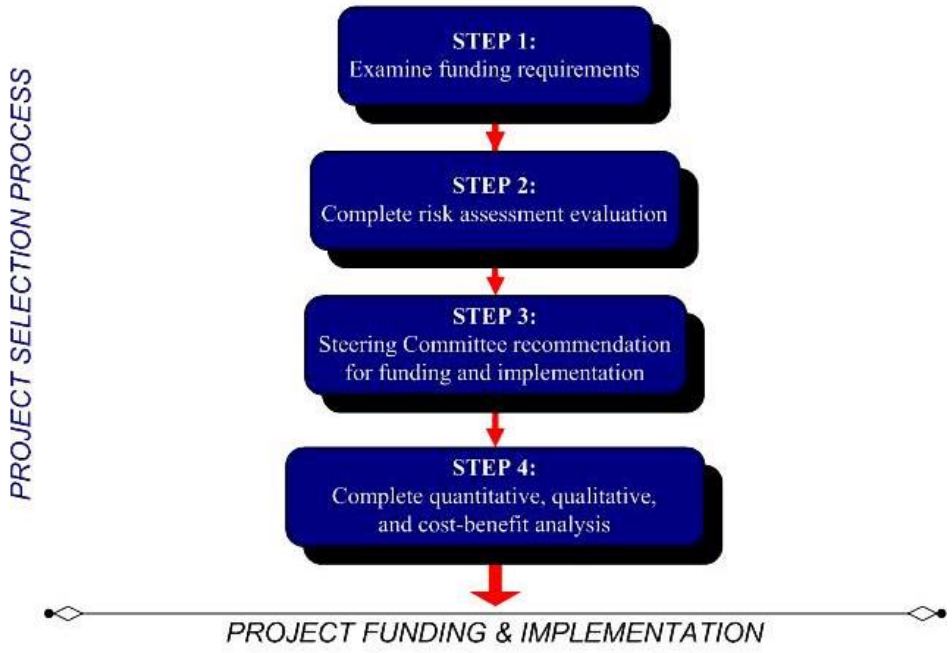
- Review existing action items to determine appropriateness for funding;
- Educate and train new members on the plan and mitigation in general;
- Identify issues that may not have been identified when the plan was developed;
- Prioritize potential mitigation projects using the methodology described below;
- Review existing and new risk assessment data;
- Discuss methods for continued public involvement; and
- Document successes and lessons learned during the year.

The Co-Conveners will be responsible for documenting the outcome of the annual meetings in Appendix A. The process the Coordinating Body will use to prioritize mitigation projects is detailed in the section below. The plan's format allows the County and participating jurisdictions to review and update sections when new data becomes available. New data can be easily incorporated, resulting in an NHMP that remains current and relevant to the participating jurisdictions.

Project Prioritization Process

The Disaster Mitigation Act of 2000 requires that jurisdictions identify a process for prioritizing potential actions. Potential mitigation activities often come from a variety of sources; therefore, the project prioritization process needs to be flexible. Committee members, local government staff, other planning documents, or the risk assessment may be the source to identify projects. Figure 4-1 illustrates the project development and prioritization process.

Figure 4-1 Action Item and Project Review Process



Source: Oregon Partnership for Disaster Resilience, 2008.

Step 1: Examine funding requirements

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

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

Step 2: Complete risk assessment evaluation

The second step in prioritizing the plan's action items is to examine which hazards the selected actions are associated with and where these hazards rank in terms of community risk. The Coordinating Body will determine whether or not the plan's risk assessment supports the implementation of eligible mitigation activities. This determination will be

based on the location of the potential activities, their proximity to known hazard areas, and whether community assets are at risk. The Coordinating Body will additionally consider whether the selected actions mitigate hazards that are likely to occur in the future, or are likely to result in severe / catastrophic damages.

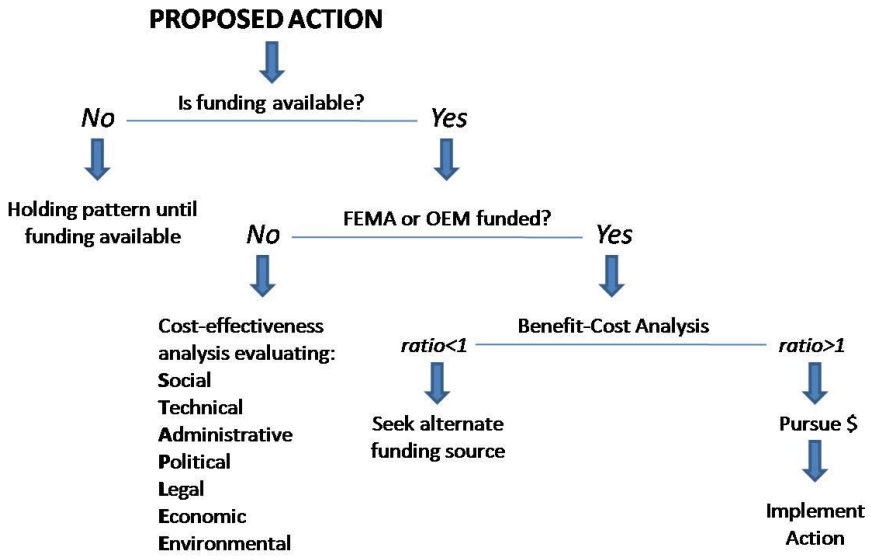
Step 3: Coordinating Body Recommendation

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

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

The fourth step is to identify the costs and benefits associated with the selected natural hazard mitigation strategies, measures or projects. Two categories of analysis that are used in this step are: (1) benefit/cost analysis, and (2) cost-effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity assists 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. Figure 4.2 shows decision criteria for selecting the appropriate method of analysis.

Figure 4-2 Benefit Cost Decision Criteria



Source: Oregon Partnership for Disaster Resilience, 2010.

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

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

Continued Public Involvement and Participation

The participating jurisdictions are dedicated to involving the public directly in the continual reshaping and updating of the Linn County NHMP. Although members of the Coordinating Body represent the public to some extent, the public will also have the opportunity to continue to provide feedback about the plan.

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

- Post copies of their plans on corresponding websites;
- Place articles in the local newspaper directing the public where to view and provide feedback;
- Publicize Coordinating Body Meetings; and
- Create press releases for Steering Committee Meetings.

In addition to the involvement activities listed above, Linn County will ensure continued public involvement by posting the Linn County NHMP on the county's website (www.co.linn.or.us/). The plan will also be archived and posted on the University of Oregon Libraries' Scholar's Bank Digital Archive (https://scholarsbank.uoregon.edu).

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. **The Linn County NHMP is due to be updated by [MONTH] [DATE], 2022.** The Co-Conveners will be responsible for organizing the coordinating body to address plan update needs. The Coordinating Body will be responsible for updating any deficiencies found in the plan, and for ultimately meeting the Disaster Mitigation Act of 2000's plan update requirements.

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

Table 4-1 Natural Hazards Mitigation Plan Update Toolkit

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

Source: Oregon Partnership for Disaster Resilience, 2010.

Volume II:
City Addenda

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Volume II – City Addenda, will be provided in a separate submittal.

Volume III: Appendices

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APPENDIX A:
PLANNING AND PUBLIC PROCESS

Plan Update Changes

This memo describes the changes made to the 2010 Linn County Natural Hazards Mitigation Plan (NHMP) during the 2016 plan update process. Major changes are documented by plan section.

Project Background

Linn County and incorporated cities partnered with the Oregon Partnership for Disaster Resilience (OPDR) to update the 2010 Linn County Natural Hazards Mitigation Plan (NHMP). The Disaster Mitigation Act of 2000 requires communities to update their mitigation plans every five years to remain eligible for Pre-Disaster Mitigation (PDM) program funding, Flood Mitigation Assistance (FMA) program funding, and Hazard Grant Mitigation Program (HMGP) funding. OPDR met with members of the Linn County steering committee and steering committees for each of the included jurisdictions to update or add to the NHMP. During this update cycle the cities of Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, and Waterloo opted to participate; as such the 2016 plan is multi-jurisdictional. OPDR and the committees made several changes to the previous NHMP. Major changes are documented and summarized in this memo.

2016 Plan Update Changes

The sections below only discuss *major* changes made to the NHMPs during the 2016 plan update process. Major changes include the replacement or deletion of large portions of text, changes to the plan's organization, new mitigation action items, and the addition of city addenda to the plan. If a section is not addressed in this memo, then it can be assumed that no significant changes occurred.

The plan's format and organization have been altered to fit within OPDR's plan templates. Table A-1 below lists the 2010 Linn County NHMP plan section names and the corresponding 2016 section names, as updated (major Volumes are highlighted). This memo will use the 2016 plan update section names to reference any changes, additions, or deletions within the plan.

Table A-1. Changes to Plan Organization

2010 Linn County NHMP	2016 Linn County NHMP
Special Thanks & Acknowledgements	Acknowledgements
Table of Contents	Table of Contents
Approval Letter	Approval Letters and Resolutions
-	FEMA Review Tool
Volume I: Basic Plan	Volume I: Basic Plan
Executive Summary	Plan Summary
Section 1: Introduction	Section 1: Introduction
Section 2: Community Profile	Section 2: Risk Assessment and Appendix B: Community Profile
Section 3: Risk Assessment	Section 2: Risk Assessment
Section 4: Action Plan	Section 3: Mitigation Strategy
Section 5: Plan Implementation and Maintenance	Section 4: Plan Implementation and Maintenance
Volume II: Hazard Chapters	Volume I: Basic Plan
Drought	Section 2: Risk Assessment and Appendix B: Community Profile
Earthquake	
Flood	
Landslide	
Volcano	
Wildfire	
Windstorm	
Winter Storm	
Volume III: City/ Special District Addendums	Volume II: City Addenda
Lyons	Lyons
Scio	Scio
Sodaville	Sodaville
Tangent	Tangent
-	Halsey
-	Harrisburg
-	Lebanon
-	Waterloo
Volume IV: Resource Appendices	Volume IV: Appendices
Appendix A: Public Participation	Appendix A: Planning and Public Process
Appendix B: Action Item Proposal Forms	*Removed - Steering committee did not want action item forms.*
Appendix C: Economic Analysis of Natural Hazard Mitigation Projects	Appendix C: Economic Analysis of Natural Hazard Mitigation Projects
Appendix D: DOGAMI Earthquake HAZUS Models	Section 2: Risk Assessment
Appendix E: Grant Programs	Appendix D: Grant Programs

Several new sections were added and formatting was changed throughout the 2016 Linn County Multi-jurisdictional NHMP.

Front Pages

1. The plan's cover has been updated.
2. Acknowledgements have been updated to include the 2016 project partners and planning participants.
3. The FEMA approval letter, review tool, and county and city resolutions of adoption are included.

Volume I: Basic Plan

Volume I provides the overall plan framework for the 2016 Multi-jurisdictional NHMP update. Volume I includes the following sections:

Plan Summary

The 2016 NHMP includes an updated plan summary that provides information about the purpose of natural hazards mitigation planning and describes how the plan will be implemented.

Section 1: Introduction

Section 1 introduces the concept of natural hazards mitigation planning and answers the question, "Why develop a mitigation plan?" Additionally, Section 1 summarizes the 2016 plan update process, and provides an overview of how the plan is organized. Major changes to Section 1 include the following:

- Most of Section 1 includes new information that replaces out of date text found in the 2010 NHMP. The new text describes the federal requirements that the plan addresses and gives examples of the policy framework for natural hazards planning in Oregon.
- Section 1 of the 2016 update outlines the entire layout of the plan update, which has been altered as described above.

Section 2: Risk Assessment

Section 2 consists of three phases: hazard identification, vulnerability assessment, and risk analysis. Hazard identification involves the identification of hazard geographic extent, its intensity, and probability of occurrence. The second phase, attempts to predict how different types of property and population groups will be affected by the hazard. The third phase involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Changes to Section 2 include:

- The hazard chapters of the previous NHMP have been integrated into this section and within Appendix B, *Community Profile*.
- Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities were updated. Information previously provided in the Hazard Chapters is placed in this section. Extraneous information was removed and links to technical reports were added as a replacement.
- Links to specific hazard studies and data are embedded directly into the plan where relevant and available.
- National Flood Insurance Program (NFIP) information was updated.

- The hazard assessment (history, maximum threat, probability, and vulnerability scores) has been updated for the county (city information is included in this section and with more detail within the City Addenda of Volume II).

Section 3: Mitigation Strategy

This section provides the basis and justification for the mission, goals, and mitigation actions identified in the NHMP. Major changes to Section 3 include the following:

- The section name changed from "Action Plan" to "Mitigation Strategy."
- The steering committee met to review previous action items and made changes to the language, lead agencies, and partners where applicable (as shown in Tables 3-1 and 3-2, tables within the city addenda, and on the following pages of this appendix).
- New action items are based upon continuous community needs, the identification of new hazards, deferred action items, and current needs based upon the community risk assessment. New actions are identified in the following pages.
- Actions were reorganized by hazard rather than goal.
- A list of prioritized actions for each jurisdiction, including the County, are included in this update.
- Participating cities met following the County meeting to review the updates and to create or update their own action items.

The following pages document changes to the 2010 action items.

Table A-2. Action Item Status and Changes

MULTI-HAZARD							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Change**	**Notes**
MH-ST	~~**Action 1.2.2.** Develop County protocols and strategies for the dissemination of media messages that focus on individual responsibility for disaster safety and risk reduction.~~	-	Ongoing	Public Information Officer	Planning and Building; Emergency Management; State Agencies; FEMA	Delete - Combined & new lead	This was previously deferred due to lack of resources. Combine with 3.1.1
MH-ST	~~**Action 2.1.1.** Provide mitigation awareness training to Planning and Building, Public works and GIS Staff.~~ **Action 2.1.1.** Publicize opportunities for appropriate staff to attend FEMA G318 local mitigation planning workshops or related trainings.	MH-2	1-3 years	Emergency Management	Oregon Emergency Management; DOGAMI; FEMA; Fire Marshall; Insurance Companies; Linn County Roads; Linn County Facilities Manager	Reworded	Suggest changing to send appropriate Co staff to FEMA G318 local mitigation planning workshop or related EM training. Joe is lead, will forward on opportunities.
MH-ST	~~**Action 3.1.1.** Maintain public awareness campaigns aimed at homeowners, children, the elderly, and non-English speaking residents to make them aware of what they can do to prepare for natural hazard events.~~ **Action 3.1.1.** Maintain public awareness campaigns aimed at homeowners, children, the elderly, and non-English speaking residents to raise awareness about disaster preparedness and risk reduction.	MH-3	Ongoing	Department of Health Services - Emergency Preparedness Coordinator	Emergency Management; Linn-Benton Vulnerable Population Planning Working Group; Red Cross; COG; Cities; Linn Benton ESD; United Way; State Agencies; Hospitals; Insurance Companies; Children and Families Commission	Reworded, combined, & new lead	Combined with Action 1.2.2 CERT program is active - they advertise for basic training, and do community preparedness presentations; the County Health Dpt is also very active on preparedness.
MH-LT	**Action 3.2.1.** Encourage small businesses to develop continuity of business plans in the event of a disaster and to implement non-structural mitigation.	MH-4	3-5 years	Cascades West Council of Governments	Business Development Coordinator; LBCC Business Development; Red Cross	New lead	This was previously deferred because no one at the County had the capacity to pursue this. It will now live with the COG.
MH-LT	~~**Action 2.1.3.** Evaluate current development codes to incorporate mitigation principles.~~ **Action 2.1.3.** Evaluate the Goal 7 section of the Linn County Comprehensive Plan and update policies to incorporate mitigation principles.	MH-5	3-5 years	Planning & Building Department	Emergency Management; Planning Commission; Board of Commissioners;	Reworded	Linn County is currently in the very beginning stages of development code review. Rather than focusing on code first, however, update Comp Plan policies and then base code changes off of these updates.
MH-ST	~~**Action 2.2.1.** Develop an inventory of county assets including replacement costs.~~ **Action 2.2.1.** Update replacement costs on existing County Asset Inventory(s) at least every 5 years.	MH-6	1-3 years	General Services	Linn County Property Management; Treasurer; Assessor; GIS; Road Department	Reworded	Departments already keep inventories, the action should be to keep the inventories up-to-date.
MH-LT	~~**Action 3.3.7.** Create database of local private resources including equipment, labor, special expertise and operating area as well as contact information that could be mobilized rapidly in the event of fire, earthquake, flood or severe weather impacts.~~ **Action 3.3.7.** Develop mutual aid agreements with private parties. Agreements should document equipment, labor, and special expertise that could be mobilized rapidly in the event of a natural disaster. Agreements should also include maps of private parties' operating areas.	MH-1	Ongoing	Emergency Management	Health Dept. - Emergency Preparedness Coord.; Road Dept; ODOT;ODF; Private timber owners; private land owners	Reworded	This is a big task, but it needs to be done; it will be an ongoing action. Joe will add to his list as things come up. Add in language about mutual aid agreements.

Table A-2. Action Item Status and Changes (continued)

MULTI-HAZARD - BRIDGES							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Change**	**Notes**
MH-ST	~~**Action 2.3.3.** Evaluate hazards that might impact every transportation route previously identified as critical to the transportation network.~~	-	1-3 years	Road Department	Emergency Management; 911 Coordinator; Sheriff; State Police; OEM; Fire Marshall	Delete - covered by a new action	Critical routes have been identified. Hazard evaluation is happening as part of other actions related to roads/transporation routes so action is not necessary. A new series of landslide actions have been created around this.
MH-LT	~~**Action 2.2.10.** Develop a County wide list of all bridge crossings leading to private structures on private and public lands and evaluate for flood, scour, seismic and structural integrity.~~ **Action 2.2.10. (Bridge Action 1)** Develop a County wide list of all public bridge crossings leading to private structures on private and public lands.	MH-Bridge 1	Ongoing	Road Department	Emergency Management, Private land owners, Public agencies	Reworded, new lead	
MH-LT	**(Bridge Action 2)** Evaluate public bridges identified in Action 2.2.10 for flood, scour, seismic and structural integrity and rank bridges by vulnerability.	MH-Bridge 2	Ongoing	Road Department	General Services; Road Department; Board of Commissioners; FEMA; DOGAMI; OEM; ODOT; U.S. DOT	New	Part of the new bridge series.
MH-LT	~~**Action 2.1.6.** Develop a scour protection plan for Linn County Bridges.~~ **(Bridge Action 3)** Implement County's existing bridge scour protection plan, trageting 5-19 high priority bridges every year.	MH-Bridge 3	Ongoing	Road Department	GIS Department	Complete. Follow-up created	The County completed a scour protection plan and it now needs to be implemented.
MH-LT	~~**Action 2.4.5.** Implement structural mitigation projects for prioritized, vulnerable publicly owned bridges identified in Action 2.4.4.~~ **Action 2.4.5. (Bridge Action 4)** Implement structural mitigation projects for prioritized, vulnerable publicly owned bridges identified in Bridge Action 1. Target 1 - 2 mitigation projects per CIP budget cycle.	MH-Bridge 4	3-5 years	Road Department	General Services; Road Department; Board of Commissioners; FEMA; DOGAMI; OEM; ODOT; U.S. DOT	Reworded	Action needs to be more specific and tied to the CIP budget cycle.
MH-LT	~~**Action 3.3.6.** Implement a routine bridge inspection program for bridges identified in Action 2.2.10 to ensure the bridges continues to be structurally sound.~~ **Action 3.3.6. (Bridge Action 5).** Implement a routine public bridge inspection program for bridges identified in Action 2.2.10 and revisit bridge vulnerability ranking as necessary.	MH-Bridge 5	Ongoing	Road Department	Planning and Building; Linn County Fire Defense Board; Private Land owners Public agencies	Reworded	
MH-LT	**(Bridge Action 6)** Work with private bridge owners to mitigate particularly vulnerable private bridges.	MH-Bridge 6	Ongoing	Road Department	Planning and Building; Linn County Fire Defense Board; Private Land owners Public agencies	New	Road departement wants action around private bridges.

Table A-2. Action Item Status and Changes (continued)

FLOOD/SCOUR							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Change**	**Notes**
FL-LT	**Action 2.2.3.** Update Flood Insurance Rate Maps (FIRM).	FL-1	2-5 years	Planning & Building Department	Building Official; Emergency Management; Insurance Companies; Cities; FEMA; OEM;GIS	No Change	Risk MAP isn't going to happen for a while, so something needs to happen in place of this. This is a "wish" that the County will need to find a way to fund.
FL-LT	**New Action 1.** Digitize LOMA/LOMR and elevation certificates.	FL-2	2-5 years	GIS Department		New	GIS is going to take this project on.
FL-LT	~~**Action 2.2.11.** Discuss funding opportunities to conduct a new hydraulic study for Linn County.~~ **Action 2.2.11.** Fund a new hydrolic study for Linn County.	FL-3	Ongoing	Road Department	Surveyor; GIS; Floodplain Manager; FEMA	Reworded	Risk MAP isn't happening for a while so need to rethink how we present the action - put Risk MAP in as a potential funding stream
FL-LT	**Action 3.3.2.** Encourage multi-objective stream and river enhancement projects that maximize flood mitigation.	FL-6	Ongoing	Road Department	Cities; Emergency Management; Watershed Councils; Water Control Districts; DSL; ODFW; DOF; DEQ; FEMA; USCE; Planning and Building Department	No Change	
FL-LT	**New Action 2.** Buy out properties in areas vulnerable to flooding as they become available.	FL-5		Planning & Building Department/ Floodplain Administrator	Parks Department; Road Department; Board of Commissioners	New	Steering committee would like to add this.
FL-LT	**New Action 3.** Identify river and stream scour locations that impact County roads and prioritize areas for stabilization.	FL-4a		Road Department	GIS Department	New	Specific to stabilizing roads. Bridges have their own stabilization/mitigation action
FL-LT	**New Action 4.** Stabilize priority road areas identified in New Action 3.	FL-4b		Road Department	GIS Department	New	Follow-up to previous action
SEVERE WEATHER							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Change**	**Notes**
WS-LT	~~**Action 2.2.5.** Inventory buildings, infrastructure and critical facilities that are vulnerable to severe weather.~~ **Action 2.2.5.** Inventory public and semi-public infrastructure and critical facilities and evalute for vulnerability to severe weather.	SW-1a	2-5 years	Emergency Management	Road Dept; Planning & Building; Assessor; GIS; Emergency Services Providers; ODOT; OEM; FEMA; Insurance Companies; Utility Companies	Reworded	
WS-LT	**New Action 5.** Mitigate the vulnerable structures identified in Action 2.2.5. Target 5 mitigation projects per year.	SW-1b	2-5 years	General Services	Emergency Management; Health Dept.; ODOT; OEM; FEMA; Insurance Companies; Utility Companies	New	Follow-up to previous action

Table A-2. Action Item Status and Changes (continued)

DROUGHT							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Change**	**Notes**
DR-ST	~~**Action 2.2.6** Support local agency programs that promote measures to reduce water use during drought emergencies.~~ **Action 2.2.6.** Develop and adopt a Drought Contingency Plan for Linn County. e.g. http://northsantiam.org/projects/north-santiam-drought-contingency-planning-2016-2017/	DR-1	Ongoing	Watermaster	Planning and Building; Emergency Management; Parks and Recreation Department; NRCS; Department of Agriculture; WRD; Local Water Districts	Reworded & new lead	This action is more exploratory - it will require the County to find funding.
DR-LT	**Action 3.1.2.** Support local agency programs for farmers and ranchers, that provide education and training on water conservation measures, including drought management practices for crops and livestock.	DR-2	Ongoing	Planning and Building Department	OSU Extension Services; NRCS; Farm Bureau: WRD; ODFW; Watershed Councils; Water Districts	No Change	This is another exploratory action that will require a funding source.
LANDSLIDE							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Change**	**Notes**
LS-LT	**New Action 6.** Identify landslide and rock fall areas adjacent to public roads and prioritize areas for stabilization/mitigation.	LS-1a		Road Department	GIS Department	New	Based on Action 2.3.3.
LS-LT	**New Action 7.** Stabilize priority areas identified in New Action 6.	LS-1b		Road Department	GIS Department	New	Follow-up to New Action 1.
LS-LT	~~**Action 2.2.8.** Continue to improve identification of debris flow area in Linn County by using mapping with current data technology.~~ **Action 2.2.8.** Integrate new data on debris flow areas into County maps.	LS-2a	3-5 years	GIS Department	DOGAMI	Reworded	
LS-LT	**New Action 8.** Update the development code to limit development in debris flow areas identified in Action 2.2.8.	LS-2b	3-5 years	Planning Department	GIS.; DOGAMI	New	Follow-up to previous action
LS-ST	**Action 3.1.4.** Increase public education related to landslide hazards by distributing DOGAMI landslide informational brochure.	LS-3	Ongoing	Department of Health Services - Emergency Preparedness Coordinator	CERT; Planning Dept.; Dept of Forestry; DOGAMI; OEM; ODOT; Road Department; Radio Stations	New lead	

Table A-2. Action Item Status and Changes (continued)

EARTHQUAKE							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Change**	**Notes**
EQ-LT	**Action 2.4.2.** Conduct a seismic vulnerability assessment of critical County-owned structures and prioritize vulnerable publicly owned structures.	EQ-1a	1-3 years	General Services	General Services; Road Dept.; Building Official; OEM; Assessor; DOGAMI; Safety Committee	No Change	Some progress has been made, more work required.
EQ-LT	**Action 2.4.3.** Implement 1 structural mitigation project for prioritized, vulnerable publicly owned structures identified in Action 2.4.2 per year. (Consider funding from State Seismic Rehabilitation Grant Program.)	EQ-1b	3-5 years	General Services	General Services; Road Dept.; Building Official; OEM; Assessor; DOGAMI; Safety Committee	No Change	Add reference to the seismic rehab grant program.
EQ-ST	**Action 2.4.1.** Develop a program to implement non-structural retrofit of County staff offices and workspaces.	EQ-2	1-3 years	Safety Committee	General Services; County Insurance Carrier; OEM; OR- OSHA; BC	New lead	This lives better with the safety committee
EQ-ST	**New Action 9.** Train 10 - 20 county staff through the ATC 20/145 Damage Assessment Classes over the next 5 years.	EQ-3	1-5 years	Emergency Management	OEM	New	This will help people be more prepared to deal with earthquake issues in the workplace.
EQ-ST	**Action 3.3.1.** Assist K-12 schools, child care facilities and private schools to develop vulnerability assessment and mitigation projects to improve safety.	EQ-4	1-3 years	Cities	Emergency Management; Health Dept.; School Districts; Private Schools; American Red Cross; DOGAMI; OEM; Oregon Department of Education	New lead	Cities will need to spearhead this effort.
EQ-LT	~~**Action 2.4.4.** Conduct a seismic vulnerability assessment of all County-owned bridges on lifeline routes and prioritize vulnerable bridges.~~	-	3-5 years	Road Department	County Engineer; Board of Commissioners; DOGAMI; Fire Marshall; 911 Coordinator; OEM; ODOT; Sheriff	Delete - Combined w/ other bridge actions	This is connected to the bridge action series listed in multi-hazard.
EQ-LT	~~**Action 2.4.5.** Implement structural mitigation projects for prioritized, vulnerable publicly owned bridges identified in Action 2.4.4.~~	-	3-5 years	Road Department	General Services; Road Department; Board of Commissioners; FEMA; DOGAMI; OEM; ODOT; U.S. DOT	Reworded & combined w/ bridge actions	This is connected to the bridge action series listed in multi-hazard.
WILDFIRE							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Change**	**Notes**
WF-ST	~~**Action 3.3.4.** Develop a countywide Community Wildfire Protection Plan~~ **Action 3.3.4.** Update the Community Wildfire Protection Plan.	WF-1	1-3 years	Oregon Department of Forestry	Emergency Management; Fire Districts; Cities; Fire Marshall; OEM	Complete. Follow-up created	CWPP is currently from 2007.
WF-ST	**Action 3.3.5.** Partner with the Oregon Department of Forestry and Rural Fire Districts to promote home site assessment programs for the wildfire hazard.	WF-2	Ongoing	Oregon Department of Forestry	Fire Districts; Cities; Fire Marshall; OEM; Emergency Management	New lead	ODF should be the lead here.

Table A-3. Completed Action Items

Completed Actions (Not Included in 2016 Action Plan)							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Status**	**Notes**
MH-ST	**Action 1.2.1.** Encourage and support the development of local community plan supplements to the County Natural Hazard Mitigation Plan.	-	Ongoing	Steering Committee	Cities; Emergency Mngt; Planning and Building Dept; OEM; OPDR; Fire Defense Board	Complete	All sizable jurisdictions are participating in the 2016 plan update.
MH-ST	**Action 1.2.4.** Develop and maintain a database of current action items.	-	1-3 years	Steering Committee	Planning and Building; Emergency Management	Complete	This is part of the Maintenance & Implementation section.
MH-ST	**Action 2.1.2.** Develop a continuity of government plan that details how core governmental operations will be maintained in the event of an emergency.	-	1-3 years	Linn County Administrative Officer	Emergency Management; Elected Officials; Board of Commissioners; County Departments	Complete	This is included in the Emergency Operations Plan.
WS-ST	**Action 2.2.4.** Develop pre-storm strategies for coordinated debris removal following wind and winter storms.	-	Ongoing	Road Department	Emergency Management; Sheriff; 911 Coordinator; Utility Companies, Cities	Complete	Polk County has been doing this for the entire region and it's now complete.
MH-LT	**Action 2.2.7.** Geo-code the location, type, footprint and elevation data for buildings, infrastructure, and critical facilities in natural hazard areas.	-	Ongoing	GIS Department	Assessor; Planning & Building Dept.; Emergency Management; Road Dept.; FEMA; OEM; DOGAMI; Cities; Insurance Companies	Complete	
FL-LT	**Action 2.2.12.** Develop a risk analysis for each section identified in the Linn County Natural Hazard Mitigation Plan.	-	Ongoing	Steering Committee	County Departments	Complete	This is part of the NHMP update process.
MH-ST	**Action 2.3.1.** Update the Emergency Operations Plan.	-	1-3 years	Emergency Management	County Administrator; Sheriff; Road Dept; COG; Cities; 911 Coordinator; State Police; Utility Companies	Complete	An update was completed in Jan. 2016.

Table A-4. Deleted Action Items

Deleted Actions (Not Included in 2016 Action Plan)							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Status**	**Notes**
MH-ST	**Action 1.1.1.** Develop formal agreements with internal and external partners to work together on risk reduction efforts in the County.	-	Ongoing	Board of County Commissioners	Emergency Management; COG; Cities; State Agencies; Non-profit Organizations; OSU Extension Service; ODOT; Private Industry; Roads	Delete	This is part of the Maintenance & Implementation section.
MH-ST	**Action 1.1.2.** Explore funding opportunities with internal and external partners to implement the actions identified in the plan.	-	Ongoing	Emergency Management	Oregon Emergency Management; DOGAMI; FEMA; OPDR; State & Federal Agencies;	Delete	This is part of the Maintenance & Implementation section.
MH-LT	**Action 1.1.3.** Establish benchmarks to assist in evaluating and updating the plan.	-	3-5 years	Steering Committee	Planning and Building Dept.; Linn County Emergency Management; State & Federal Agencies; Private Industry	Delete	This is part of the Maintenance & Implementation section.
MH-ST	**Action 1.2.3.** Distribute information regarding the Natural Hazard Mitigation Plan to public officials and community leaders, and provide updates on hazard vulnerability and County hazard mitigation activities.	-	1-3 years	Steering Committee	Planning and Building; County Departments; State Agencies	Delete	This is part of the Maintenance & Implementation section.
FL-ST	**Action 2.1.4.** Participate in the National Flood Insurance Program's Community Rating System.	-	Ongoing	Planning & Building Department	Building Official; Emergency Management; Board of Commissioners; FEMA; Insurance Companies; Cities	Delete	The Community Rating System is too cumbersome. This probably won't happen unless everyone is really committed to doing it. This might make more sense at the city scale.
FL-LT	**Action 2.1.5.** Develop management strategies to preserve the function of the floodplain.	-	Ongoing	Planning & Building Department	Building Official; Cities; FEMA; DSL; ODFW; OWRD; Watershed Councils	Delete	This is already being covered by other entities and doesn't need to be included in this plan.
EQ-LT	**Action 2.2.2.** Re-run DOGAMI HAZUS with local refined data.	-	Ongoing	GIS Department	Emergency Management; Planning and Building; Assessor; DOGAMI; FEMA	Delete	Updates included in this plan.
LS-LT	**Action 2.2.6.** Use final DOF Debris Flow Hazard maps and improved development data to update the landslide vulnerability and risk analysis.	-	3-5 years	Emergency Management	GIS; Assessor; Road Department; Planning and Building; DOF; DOGAMI; OEM; FEMA	Delete	Updates included in this plan.
LS-LT	**Action 2.2.9.** Implement Linn County existing development standards for structures located within a "mass movement area".	-	Ongoing	Planning & Building Department	GIS Department; Emergency Management;DOGAMI	Delete	Covered elsewhere.
MH-LT	**Action 2.3.2.** Consolidate the Mitigation Plan, Emergency Operations Plan, recovery plans, and continuity of operations plans into a Unified Disaster Plan.	-	3-5 years	Emergency Management	County Administrator; Sheriff; Road Dept; COG; Cities; 911 Coordinator; State Police; Utility Companies	Delete	Steering committee doesn't like this action.
LS-ST	**Action 3.1.2.** Use and publicize the Oregon Department of Forestry's debris flow warning system.	-	Ongoing	Emergency Management	Dept of Forestry; DOGAMI; OEM; ODOT; Road Department; Radio Stations	Delete	This is not a mitigation action; it is reactionary.

Table A-4. Deleted Action Items (continued)

Deleted Actions (Not Included in 2016 Action Plan)							
2010 Label	**Action**	**2016 Label**	**Time Line**	**Lead Organization**	**Partner Organizations**	**Status**	**Notes**
WF-LT	**Action 3.3.3.** Conduct community-based fuel reduction demonstration projects in the interface.	-	Ongoing	Oregon Department of Forestry	Emergency Management; Department of Forestry; Fire Districts; Cities; OEM	Delete	The 2007 CWPP includes a goal to prioritize fuel reduction projects; an update CWPP will cover this action.
WS-LT	**Action 3.3.6.** Develop a partnership to identify areas where required visual buffers along designated scenic highways have potential blow down issues endangering life and infrastructure.	-	Ongoing	Emergency Management	Road Dept; ODOT;ODF; Private timber owners; private land owners	Delete	The County does not control scenic highways and therefore can't do anything about this; steering committee is also unclear about the meaning of this action.
WS-LT	**Action 3.3.6.** Develop partnerships to implement progra ms to keep trees from threatening lives, property, and public infrastr ucture during wind and winter storms.	-	2-5 years	Emergency Management	Road Dept; Parks Dept; Utilities; Insurance Cos; OSU Extension Service; Timber Cos; DOF; Arbor Care Companies	Delete	Deleted - deemed unfeasible

Section 4: Plan Implementation and Maintenance

The steering committee met each year since the previous version of this NHMP. Progress towards action items is documented in the action item section below. The steering committee agreed to continue meeting annually, scheduled and managed by the plan's co-conveners (the Emergency Management Coordinator and the Planning and Building Director). Information about the city conveners is located in the jurisdictional addenda in Volume II. The steering committees will discuss options to integrate the NHMP into other planning documents (including the comprehensive plan) during their annual meetings.

Volume II: Jurisdictional Addenda

The cities of Halsey, Harrisburg, Lebanon, and Waterloo participated in the 2016 version of the NHMP for the first time. Lyons, Scio, Sodaville, and Tangent participated in the previous plan, and have been updated their addenda for the 2016 NHMP.

Volume III: Appendices

Below is a summary of the appendices included in the 2016 NHMP:

Appendix A: Planning and Public Process

This planning and public process appendix reflects changes made to the Linn County NHMP and documents the 2016 planning and public process.

Appendix B: Community Profile

The community profile has been updated to conform with the OPDR template and includes information for Linn County, and the cities of Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, and Waterloo.

Appendix C: Economic Analysis of Natural Hazard Mitigation Projects

Updates are provided for the economic analysis of natural hazard mitigation projects.

Appendix D: Grant Programs and Resources

Grant programs and resources were previously listed in the NHMP's hazard profiles. Some of the previously provided resources were deemed unnecessary since this material is covered within the Oregon NHMP and appropriate resources are provided within the Hazard Annexes of Volume II. Updates were made to the remaining grant programs and resources.

2016 NHMP
PUBLIC PARTICIPATION PROCESS

2016 NHMP Update

Linn County understands the importance of directly involving the public in the review and update of the natural hazard mitigation plan. Although members of the steering committee represent the public to some extent, the residents of Linn County, Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, and Waterloo are also given the opportunity to provide feedback about the Plan. The Plan will also undergo review on an annual basis.

Linn County made the Plan available via the Oregon Partnership for Disaster Resilience's website for public comment from March XX, 2017 through the FEMA review period. The cities of Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Tangent, and Waterloo were included within the press release provided in local newspapers notifying the public of the Plan's availability for comment. Each of the cities also addressed the City Addenda during City Council meetings, giving the public an additional opportunity to provide comment on the city-specific plans.

Public Involvement Summary

Linn County provided a press release that ran on May 2, 2016 to inform the public that an update to the NHMP was occurring and to invite public comment during the upcoming Planning Commission meeting (see next page).

On May 10, 2016, the Planning Director provided the Planning Commission with information about the NHMP update process and the public had an opportunity to offer comments (see Agenda and Minutes from the Planning Commission meeting on the following pages).

Finally, Linn County provided a press release to allow the public to view and comment on the updated plan (see below). There were X comments received during the public review period via the OPDR project page for the Linn County NHMP update. Members of the steering committee provided edits and updates to the NHMP during this period as reflected in the final document.

Planning Commission Meeting Press Release

ALBANY DEMOCRAT-HERALD | WWW.DEMOCRATHERALD.COM

Hazard mitigation comments sought

Linn County is updating its 2010 Natural Hazards Mitigation Plan, according to Robert Wheeldon, Linn County Planning and Building director and the public has an opportunity to comment May 10.

A meeting will be held at 7:30 p.m. at the George Miller Room B of the Old Armory Building on the corner of 4th Ave. and Lyon St.

The planning team consists of representatives from Linn County's Planning and Building Department, GIS Department, Emergency Management Department, Road Department, Parks Department, Fire Defense Board and Planning Commission.

Also, the cities of Brownsville, Halsey, Harrisburg, Lebanon, Lyons, Scio, Sodaville, Sweet Home, Tangent and Waterloo are participating in the plan update.

The county is working in coordination with the Oregon Partnership for Disaster Resilience and the Oregon Office of Emergency Management to complete the update work.

Upon completion and FEMA (Federal Emergency Management Agency) approval, Linn County's updated Natural Hazard Mitigation Plan will make Linn County eligible to apply for federal funding towards natural hazard mitigation projects.

Wheeldon said natural hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. Example mitigation strategies include policy changes, such as updated ordinances; projects, such as seismic retrofits to critical facilities; and education and outreach to targeted audiences, such as non-English speaking residents or senior populations.

Wheeldon said Linn County's Natural Hazard Mitigation Plan focuses on the primary natural hazards that could affect the Willamette Valley and the Cascades, including: floods, droughts, landslides, earthquakes, wildfires and severe weather such as high winds or heavy snow.

Contact Linn County reporter Alex Paul at 541-812-6114.

Linn County Planning Commission Agenda

LINN COUNTY PLANNING AND BUILDING DEPARTMENT
Robert Wheeldon, Director

Room 114, Linn County Courthouse
PO 100 Box, Albany, Oregon 97321
Phone 541-967-3816, Fax 541-926-2060, www.co.linn.or.us

AGENDA

May 10, 2016; 7:00 pm

Linn County Planning Commission
Old Armory Building, George Miller Room B
(Corner of 4th Avenue and Lyon Street, Albany, Oregon)

Call to Order

Approval of Minutes of April 12, 2016

No Cases Scheduled for Hearing

Other Business

1. Natural Hazards Mitigation Plan Update

   The Planning Commission will conduct a public forum and accept public comment regarding the five-year update of the Linn County Natural Hazards Mitigation Plan

2. Update of Planning Commission Bylaws

   The Planning Commission will review and consider proposed amendments to the Commission Bylaws and Operating Procedures. The Commission will make a recommendation to the Board of Commissioners to adopt the amendments as proposed or adopt the amendments with modifications.

General Discussion

Adjournment

Linn County Planning Commission Meeting Minutes

LINN COUNTY PLANNING AND BUILDING DEPARTMENT
Robert Wheeldon, Director

Room 114, Linn County Courthouse
PO Box 100, Albany, Oregon 97321
Phone 541-967-3816 Fax 541-926-2060
www.co.linn.or.us

LINN COUNTY PLANNING COMMISSION
MEETING SUMMARY
May 10, 2016

CALL TO ORDER: Chair Bronson called the meeting to order at 7:05 p.m.
MEMBERS PRESENT: Alderman, Boshart, Bronson, Cromwell, Furtwangler, Legras, McKinney
MEMBERS ABSENT: Egan, Roark
STAFF PRESENT: Alyssa Boles, Robert Wheeldon

APPROVAL OF MINUTES: Commissioner Boshart introduced and Commissioner Legras seconded a motion to approve the minutes of April 12, 2016, without correction. The motion passed unanimously (6-0).

LAND USE APPLICATIONS SCHEDULED FOR HEARING: None

OTHER BUSINESS:

1. Natural Hazards Mitigation Plan Update

   The Commission held a public forum to accept public comment regarding the five-year update of the Linn County Natural Hazard Mitigation Plan (NHMP). Planning and Building Department Director Robert Wheeldon presented background, process and summary information regarding the plan update, distributed handouts, and answered questions from the Commission. No public comments were submitted. Following the presentation Director Wheeldon met individually with Edie Wilcox of Sweet Home, discussed the plan update and City addenda process, and invited Ms. Wilcox to the scheduled May 26, 2016 NHMP Steering Committee meeting. [Begin recording: 00:01:15; End recording: 00:24:53]

2. Update of Planning Commission Bylaws

   Associate Planner Alyssa Boles presented proposed changes to the Planning Commission Bylaws and Operating Procedures. The current Policy and Procedure Manual was adopted in 1974 and last revised in 1976. After the staff presentation and a brief discussion of the draft Bylaws, Commissioner Cromwell introduced and Commissioner Furtwangler seconded a motion to recommend the Board of Commissioners adopt the proposed Bylaws as presented. The motion passed unanimously (6-0). [Begin recording: 00:24:53; End recording: 00:38:50]

General Discussion

Director Wheeldon informed the Commission that the scheduled June 14, 2016 Commission meeting will include proposed Comprehensive Plan and Development Code amendments, at the Board's request, to adopt a Public Services Plan designation and Zoning district. [Begin recording: 00:38:50; End recording: 00:48:25]

ADJOURNMENT: The meeting was adjourned at 7:50 p.m. [End Recording: 00:49:50]

Respectfully submitted,

Robert Wheeldon
Director

Final Plan Comment Press Release

[Paste in when available]

Linn County Steering Committee

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

- **Meeting #1:** Background, Community Profile Update, Hazard History Update, Goal, Objective, and Action Item Review
  March 29, 2016
- **Meeting #2:** Public Outreach Strategy Update, Action Item Update, Plan Implementation and Maintenance
  May 26, 2016

The following pages provide copies of meeting agendas and sign-in sheets from county and city steering committee meetings.

In addition to the County steering committee meetings, each of the cities met once with OPDR staff over the phone to review and update or create city hazard histories, risk assessments, and action items. These meetings occurred on the following dates:

- **Waterloo:** August 15, 2016
- **Halsey:** August 17, 2016
- **Sodaville:** August 23, 2016
- **Scio:** August 24, 2016
- **Lyons:** August 25, 2016
- **Tangent:** August 26, 2016
- **Lebanon:** August 30, 2016
- **Harrisburg:** October 6, 2016

Volume II: City Addenda include more information about City steering committees and meetings. The generic agenda for each meeting is included here after the County agendas and sign-in sheets.

Linn County Meeting #1

UNIVERSITY OF OREGON

Agenda

Meeting: Linn County Natural Hazard Mitigation Plan Update: Kick off Meeting
Date: March 29, 2015
Time: 1:00 – 4:00 PM
Location: 300 SW 4th ST, Albany or 97321, Basement Conference Room

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I.	**Introduction and Background** a. Community Service Center b. Project Context c. Committee Introductions	**10 minutes**
II.	**Natural Hazard Mitigation Planning** a. Emergency Management Overview b. Natural Hazard Mitigation Plans (NHMP) Overview c. Project Timeline	**10 minutes**
III.	**Community Profile Update** a. Community Profile b. Critical facilities	**30 minutes**
IV.	**Hazard History Review**	**30 minutes**
	BREAK	**10 minutes**
V.	**State and County Goals**	**20 minutes**
VI.	**Mitigation Actions Review**	**60 minutes**
VII.	**Wrap Up and Next Steps** a. Next Steps b. Future Meetings	**10 minutes**

OREGON PARTNERSHIP FOR DISASTER RESILIENCE | COMMUNITY SERVICE CENTER
1209 University of Oregon | Eugene, Oregon 97403 | T: 541.346.3889 | F: 541.346.2040 http://csc.uoregon.edu/opdr

PARTNERSHIP FOR DISASTER RESILIENCE
CSC OREGON HMGP/DPDR

Meeting Sign-In

Linn County NHMP Update: Kickoff March 29, 2016
Albany, Oregon

Please complete your contact information and initial next to your name

FIRST	LAST	AGENCY	TITLE	EMAIL
Josef	Larsen	LINN COUNTY	EM	JLARSEN@LINNSHERIFF.ORG
Olivia	Gluntz	Linn Co. Planning	Planner	Ogluntz@co.linn.or.us
Dave	Fruetwangler	Linn Co. Planning Comm. Cascade Timber	Commissioner	dfruetwangler@cascadetimber.com
Steve	Barnett	Linn County GIS	GIS Manager	sbarnette co.linn.or.us
Rayne	Legras	Linn Co Planning Comm.	planning Commission	raynelegras@gmail.com
Robert	Wheeldon	Linn County P&B	DIRECTOR	rwheeldon@co.linn.or.us
Darrel	Tedisch	City of Albany	Emergency Management Specialist	darrel.tedisch@c.albany.or.us
Aniko	Drlik-Muehleck	UO - OPDR	Project Coord.	aniko@uoregon.edu

Linn County Meeting #2

UNIVERSITY OF OREGON

Agenda

Meeting: Linn County Natural Hazard Mitigation Plan Update: Action Updates & Plan Implementation and Maintenance
Date: May 26, 2016
Time: 2:00 – 4:00 PM
Location: 300 SW 4th ST, Albany or 97321, Basement Conference Room

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I.	**Welcome and Meeting Goals** a. Project Updates b. Committee Introductions	**10 minutes**
II.	**Public Outreach Strategy Updates** a. Planning Commission Meeting Overview b. Next steps	**15 minutes**
III.	**Action Item Update and Review** a. Present changes b. Discuss new actions c. Prioritize actions	**45minutes**
IV.	**Plan Implementation and Maintenance** a. Recommended updates b. Discuss committee membership c. Discuss meeting schedule	**30 minutes**
V.	**Questions and Discussion**	**10 minutes**
VI.	**Wrap Up and Next Steps** a. Next Steps	**10 minutes**

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Meeting Sign-In

Linn County NHMP Update: Actions, Implementation, and Maintenance May 25, 2016
Albany, Oregon

Please complete your contact information and initial next to your name

FIRST	LAST	AGENCY	TITLE	EMAIL
Jennifer	Cepello	Linn County Planning & Building		jcepello@co.linn.or.us
John	Bradner	Albany Fire Dept.	Fire Chief	john.bradner@cityofalbany.net
Tom	Bruce	UO - OPDR	DIRECTOR	TOBRUCE@UOREGON.EDU
Aniko	Drlik-Muehleck	UO - OPDR	Project Coord.	aniko@uoregon.edu
Dave	Fruitwangler	Cascade Timber	President	dfruitwangler@cascadetimber.com
Chuck	Knoll	Linn County Dept	County Engineer	cknoll@co.linn.or.us
Sarah	Bates	L.C. Public Health	Emergency Preparedness Coord.	Sbates@co.linn.or.us
Robert	Wheeldon	L.C. Planning	Director	rwheeldon@co.linn.or.us
Steve	Barnett	Linn GIS	Manager	sbarnette@co.linn.or.us
Joe	Larsen	LINN CO. E.M.	LINN CO. EM	JLARSEN@LINNSHERIFF.OR
Rayne	Legras	LinnCo Planning Comm.	Volunteer	rayneltegras@gmail.com
Darrel	Tedisch	City of Albany	Emergency Management Specialist	Darrel.tedisch@cityofalbany.net

City Addenda Meeting Agenda

UNIVERSITY OF OREGON

Agenda

Meeting: Linn County Natural Hazard Mitigation Plan Update: City Addenda
Date: August XX, 2016
Time: X:XX – X:XX XM (1.5 hours)
Location: Phone Call

I.	**Welcome and Background**	**5 minutes**
	a. Introductions	
	b. What is a Natural Hazard Mitigation Plan?	
II.	**Hazard History**	**10 minutes**
	a. Tell us about your community – what should we know?	
	b. Review and revise hazard history	
	c. What are the critical hazard concerns for your community?	
III.	**Critical Infrastructure**	**15 minutes**
	a. What critical infrastructure should we call out in the plan?	
	b. What are your vulnerabilities to different hazards?	
IV.	**City Actions**	**45 minutes**
	a. Proposed actions based on policy analysis/previous plan review	
	b. Feedback, revisions, and new actions	
	c. Prioritization	
V.	**Public Outreach Strategy**	**10 minutes**
	a. Examples of outreach	
	b. Document your outreach!	
VI.	**Wrap Up and Next Steps**	**5 minutes**
	a. Next Steps/Questions?	

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APPENDIX B: COMMUNITY PROFILE

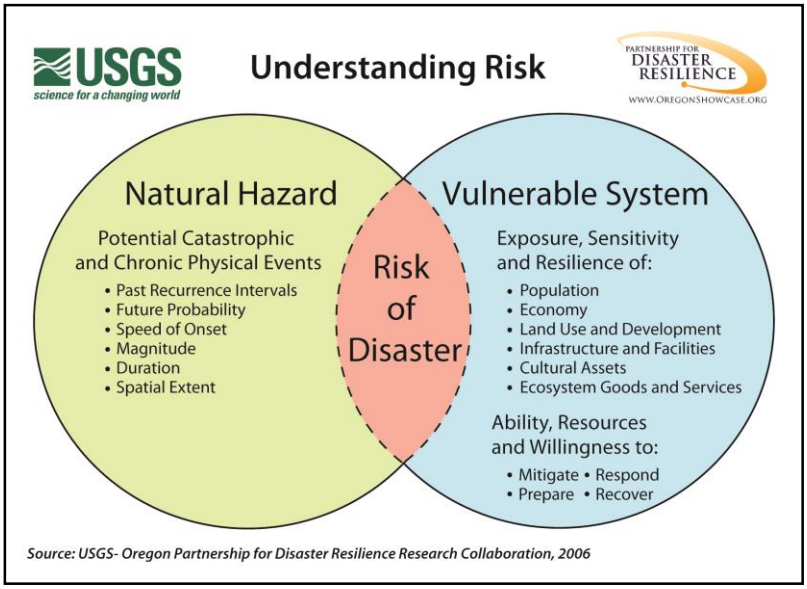
Introduction

The following section describes Linn County from a number of perspectives in order to help define and understand the county's sensitivity and resilience to natural hazards. Sensitivity factors can be defined as those community assets and characteristics that may be impacted by natural hazards, such as special populations, economic factors, and historic and cultural resources. Community resilience can be defined as the community's ability to manage risk and adapt to natural hazard impacts. In order to help define and understand the County's sensitivity and resilience to natural hazards, the following capacities must be examined:

- **Natural Environment**
- **Social/ Demographic**
- **Economic**
- **Built Environment**
- **Community Connectivity**
- **Political**

The Community Profile describes the sensitivity and resilience to natural hazards of Linn County as they relate to each capacity. It provides a snapshot in time when the plan was developed and will assist in preparation for a more resilient community. The information in this section, along with the hazard assessments located in the Risk Assessment, should be used as the local level rationale for the risk reduction actions identified in Section 3 – Mitigation Strategy. The identification of actions that reduce the county's sensitivity and increase its resilience can assist in reducing overall risk. This can be shown as the area of overlap in Figure 2.1 below.

Figure B-1 Understanding Risk



Significant Changes Since Previous Plan:

Information in this section was updated to account for changes in development and includes updated demographic information where available. In addition, significant content was added to this section.

Natural Environment Capacity

Natural environment capacity is recognized as the geography, climate, and land cover of the area such as, urban, water and forested lands that maintain clean water, air and a stable climate.[1] Natural resources such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from weather-related hazards, such as flooding and landslides. However, natural systems are often impacted or depleted by human activities adversely affecting community resilience.

History, Location, and Geography

Linn County is located in the mid-Willamette Valley, in western Oregon, and covers an area of 2,297 square miles. It is bounded to the north by Marion County, to the west by Benton County, to the south by Lane County, to the east by Deschutes and Jefferson Counties, and to the northwest by Polk County. The elevation ranges from 125 feet along the Willamette River in western Linn County to 10,497 feet at the peak of Mt. Jefferson in eastern Linn County.

Linn County is subject to impacts from natural hazard events including floods, severe winter storms, windstorms, landslides (mass movement), and wildfires. The impacts of past hazard events in Linn County have resulted in loss of life and property, economic losses, and damaged infrastructure.

Western Linn County is subject to stream flooding and ponding, such as occurred during the floods of 1964, 1974 and 1996. Linn County experienced severe damage during the Columbus Day wind storm in 1962, and parts of southern and western Linn County were severely impacted by a wind storm in February of 2002. Eastern Linn County is susceptible to landslides, winter storms and wildfire. Most recently, in January 2004 the county was impacted by a severe winter storm that resulted in damage and hazards related to snow and ice.

These types of chronic hazards can be expected to continue to impact the county in the future. The county may also be subject to impacts from future catastrophic hazards such as earthquakes and volcanoes. The risks from future natural disasters and the impacts of future disasters on the population, economy and infrastructure will increase as areas of risk become more heavily developed.

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

Climate

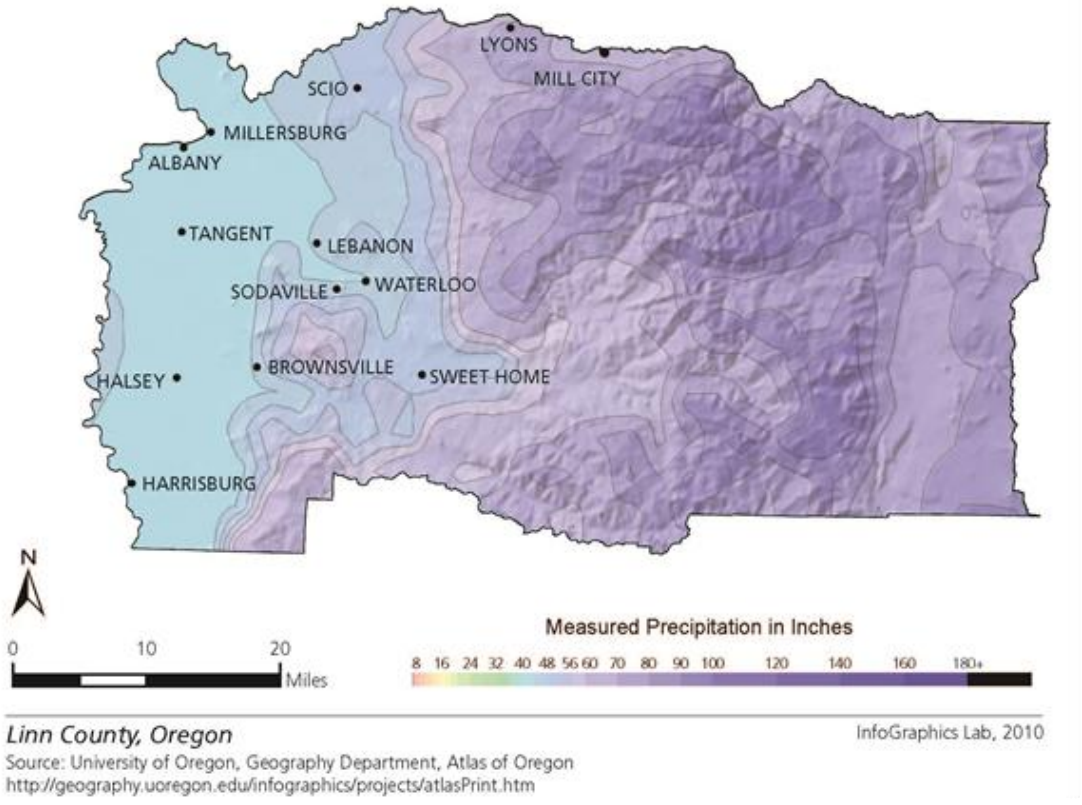
Climate refers to the temperatures, weather patterns, and precipitation in the region. This section covers historic climate information. Estimated future climate conditions and possible impacts are also provided (for a more detailed analysis refer to the State Risk Assessment.

Linn County has a diverse climate and geography. It includes broad, fertile bottomlands and terraces throughout the valley floor in the west, varied relief of the Cascade foothills, and the abundant forests and volcanic peaks of the Cascade Range in the east. Western Linn County is characterized by a temperate climate. Summers are warm and dry, but extremely hot days are rare. Winters are cool and rainy, but snow and freezing temperatures are uncommon, except at higher foothill elevations.

Eastern Linn County consists of the higher elevations of the Cascade Range. Winters are colder with much more precipitation, much of it in the form of snow. Summers in the mountains are mostly dry with warm days, cool nights, and occasional lightning storms. Average annual precipitation on the valley floor is around 40 to 45 inches, occurring mostly between the months of October through March. Precipitation increases as the elevation rises east into the Cascade foothills. Annual precipitation at Foster is 54 inches, increasing to 62 inches at Cascadia, and 85 inches at the Santiam Pass.

In most winters, one or two storms bring strong and sometimes damaging winds. Heavy rains often result in localized flooding and ponding on the valley floor. In some years, heavy rain storms can combine with rapid snow melt in the mountains to cause serious flooding.

Figure B-2 Linn County Average Annual Precipitation



Mountain Ranges

Nearly all of Linn County's population lives in the Willamette Valley between the Willamette River and the Cascade foothills. The eastern half of the county is undeveloped forest land of the Cascade Range. The Cascades were formed by volcanic activity resulting from the convergence of two tectonic plates. Visible landmarks created by past volcanic activity include Snow Peak, Mount Washington, Mount Jefferson, and Three Fingered Jack. The tallest peak in Linn County is Mount Jefferson, at 10,497 feet.

Although mostly uninhabited, the Cascades draw large numbers of recreational visitors throughout the year. The rugged, steep mountains are subject to a variety of natural events, including lightning storms and wildfire during the hot summer months, severe storms during winter, and landslides in winter and spring.

Rivers

Linn County contains four major rivers and many smaller rivers, creeks and drainages. The largest river in the county is the Willamette River. The Willamette River establishes Linn County's western boundary and flows past the communities of Harrisburg, Peoria, and Albany. The North Santiam River establishes most of the county's northern boundary and flows past the communities of Idanha, Gates, Mill City and Lyons.

The South Santiam River and the Calapooia River watersheds are entirely within Linn County. The South Santiam River begins high in the Cascade Mountains and runs across the valley floor merging with the North Santiam River north of Albany. The South Santiam river flows through the communities of Cascadia, Sweet Home, Waterloo, and Lebanon. The Calapooia River runs from the Cascade foothills in southeast Linn County through the communities of Holley, Crawfordsville, and Brownsville before entering the Willamette River in Albany.

Other smaller drainages in Linn County include the Middle Fork of the Santiam River, Roaring River, Crabtree Creek, Thomas Creek, Hamilton Creek, McDowell Creek, Wiley Creek, Muddy Creek, Courtney Creek and others. Combined with the many sloughs and low-lying areas on the valley floor, the county is highly susceptible to flood hazards. Linn County's rivers and general physiography are depicted in Figure B-3 below.

Figure B-3 Linn County Physiography.

Soils and Other Geologic Features

On the broad flood plains along the Willamette River and the lower reaches of the Santiam River system the soils are generally well drained. The soils on terraces and within remnant channels adjacent to the flood plains are sometimes characterized by internal drainage problems which can increase as they broaden and become nearly level to depressional.

Between the broad Willamette Valley terraces to the west and the mountainous uplands of the Cascade Range to the east are low foothills that range in elevation from 300 to 1400 feet. The topography ranges from gently sloping areas on low plateaus to steep side slopes. The soils in these areas formed in material derived from igneous or sedimentary rock and are often poorly drained. The South Santiam and Calapooia Rivers, and minor streams such as Thomas and Crabtree Creeks, dissect these low foothills forming major and minor valleys that have both narrow flood plains and narrow stream terraces.

The mountainous uplands of the western Cascade Range have elevations up to 5000 feet. The Cascades formed from volcanic material such as hard basalt and soft pyroclastic and sedimentary material. Volcanic ash covers much of the higher areas. The differences in the hardness of these materials accounts for the differing rates of dissection. The mountains are characterized by gently sloping soils on high plateaus and steep to very steep soils on canyon walls and side slopes. Steep headwalls and rolling slump blocks indicate slumping and landslide problems in some areas.

The Cascades are drained by tributaries of the Willamette River system. The upper valleys of the tributaries are narrow and have stream terraces of recent origin. The streams are characterized by waterfalls and numerous rapids until they reach the nearly level areas of the Willamette Valley.

The U.S. Army Corps of Engineers has built flood control dams on the North, South and Middle Forks of the Santiam River. These structures have controlled much of the historical flooding in the lower reaches of the valleys, especially those of the Willamette Valley. Many areas that were active flood plains in the past are no longer subject to periodic flooding.

Hazard Severity

Dynamic weather and diverse geography across Linn County are indicators of hazard vulnerability when combined with the changing climate and severe weather related events. Both wet and dry cycles are likely to last longer and be more extreme, leading to periods of deeper drought and more frequent flash flooding. Less precipitation in the summers and subsequently lower soil moisture with hotter temperatures will likely increase the amount of vegetation, such as rangeland and grasslands, consumed by wildfire.

Synthesis

The physical geography, weather, climate and land cover of an area represent various interrelated systems that affect overall risk and exposure to natural hazards. The projected climate change models representing Central Oregon indicate the potential for increased effects of hazards, particularly drought and wildfire due to changing climate of the region. Central Oregon is projected to have warmer and drier summers with less precipitation. In addition, winter temperatures will be warmer, which means a decrease in mountain snowpack. These factors combined with periods of population growth and development intensification can lead to increasing risk of hazards, threatening loss of life, property and long-term economic disruption if land management is inadequate.

Social/Demographic Capacity

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

Population

Table B-1 displays the population characteristics of Linn County and it's cities, jurisdictions shown in **bold** are participating in this NHMP. Albany has the largest population (44,403) in Linn County, followed by Lebanon (15,740), Sweet Home (9,090), and Harrisburg (3,645). Although the cities of Albany and Sweet Home are not participating in this NHMP, they both have Stand-Alone Natural Hazards Mitigation Plans. Approximately one-third of the county's population resides in the unincorporated areas.

Between 2010 and 2015, Linn County experienced a 3.4% increase in population. The smaller cities of Millersburg and Idanha had the highest population growth between 2010 and 2015.

Table B-1 Population Estimate

Jurisdiction	Population 2010	Population 2015	Population Change (2010-2015) Number	Population Change (2010-2015) Percent	Percent County Population
Linn County	**116,840**	**120,860**	**4,020**	**3.4%**	**100%**
Albany*^	43,738	44,403	665	1.5%	37%
Brownsville	1,670	1,690	20	1.2%	1%
Gates**	42	43	1	1.7%	< 1%
Halsey	**910**	**915**	**5**	**0.5%**	**< 1%**
Harrisburg	**3,565**	**3,645**	**80**	**2.2%**	**3%**
Idanha**	57	62	5	8.7%	< 1%
Lebanon	**15,525**	**15,740**	**215**	**1.4%**	**13%**
Lyons	**1,160**	**1,160**	**0**	**0.0%**	**1%**
Mill City**	1,531	1,556	25	1.7%	1%
Millersburg	1,345	1,620	275	20.4%	1%
Scio	**840**	**850**	**10**	**1.2%**	**1%**
Sodaville	**310**	**325**	**15**	**4.8%**	**< 1%**
Sweet Home^	8,945	9,090	145	1.6%	8%
Tangent	**1,165**	**1,200**	**35**	**3.0%**	**1%**
Waterloo	**230**	**230**	**0**	**0.0%**	**< 1%**
Unincorporated	**35,807**	**38,330**	**2,524**	**7.0%**	**32%**

Source: Portland State University, Population Research Center. "Annual Population Report Tables, 2015"
*A part of the Albany population (7,267, 14%) is within Benton County.
** Parts of the total populations of Gates (442, 91%), Idanha (78, 56%), and Mill City (299, 16%) are in Marion County. Each of these cities has an addendum within the Marion County MNHMP.
^ Albany and Sweet Home have Stand Alone Natural Hazards Mitigation Plans

Population size itself is not an indicator of vulnerability. More important is the location, composition, and capacity of the population within the community. Research by social scientists demonstrates that human capital indices such as language, race, age, income, education and health can affect the integrity of a community. Therefore, these human capitals can impact community resilience to natural hazards.

Tourists

Tourists are not counted in population statistics; and are therefore considered separately in this analysis. The table below shows the estimated number of person nights in private homes, hotels and motels, and other types of accommodations. The table shows that, between 2013-2015, about two-thirds of visitors in Linn County lodge in private homes, just under one-fifth stay in hotels/ motels, and the remaining visitors stay at other accommodations (vacation homes/ campgrounds). Tourists' lodging in private homes suggests these visitors are staying with family and friends. For hazard preparedness and mitigation purposes, outreach to residents in Linn County will likely be transferred to these visitors in some capacity. Visitors staying at hotel/motels are less likely to benefit from local preparedness outreach efforts aimed at residents.

B-2 Annual Visitor Estimates in Person Nights

Jurisdiction	2013 Person-Nights (1,000's)	Percent	2014 Person-Nights (1,000's)	Percent	2015 Person-Nights (1,000's)	Percent
Linn County	1,871	100%	1,887	100%	1,934	100%
Hotel/Motel	341	18%	354	18%	373	19%
Private Home	1,208	64%	1,209	63%	1,231	64%
Other	322	17%	324	17%	330	17%

Source: Oregon Tourism Commission, Oregon Travel Impacts: 1991-2015p, Dean Runyan Associates

Tourists are specifically vulnerable due to the difficulty of locating or accounting for travelers within the region. Tourists are often at greater risk during a natural disaster because of unfamiliarity with evacuation routes, communication outlets, or even the type of hazard that may occur. Knowing whether the region's visitors are staying in friends/relatives homes in hotels/motels, or elsewhere can be instructive when developing outreach efforts.[2]

Language

Special consideration should be given to populations who do not speak English as their primary language. Language barriers can be a challenge when disseminating hazard planning and mitigation resources to the general public, and it is less likely they will be prepared if special attention is not given to language and culturally appropriate outreach techniques.

There are various languages spoken across Linn County; the primary language is English. Overall, 2% of the total population in Linn County is not proficient in English. Albany (1,309, 3%) has the largest population of residents who have limited or no English speaking ability. Outreach materials used to communicate with, plan for, and respond to non-English speaking populations should take into consideration the language needs of these populations.

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

Table B-3 Linn County Language Barriers

Jurisdiction	Population 5 years and over Estimate	English Only		Multiple Languages		Limited or No English	
		Number	Percent	Number	Percent	Number	Percent
Linn County	111,565	103,344	93%	8,221	7%	2,199	2%
Albany	48,368	43,849	91%	4,519	9%	1,309	3%
Brownsville	1,412	1,345	95%	67	5%	0	0%
Halsey	1,070	1,001	94%	69	6%	23	2%
Harrisburg	3,357	2,931	87%	426	13%	131	4%
Lebanon	14,716	13,783	94%	933	6%	90	1%
Lyons	1,052	1,050	100%	2	0%	0	0%
Mill City	1,650	1,453	88%	197	12%	46	3%
Millersburg	1,594	1,410	88%	184	12%	26	2%
Scio	764	749	98%	15	2%	1	0%
Sodaville	352	349	99%	3	1%	0	0%
Sweet Home	8,396	8,119	97%	277	3%	79	1%
Tangent	965	925	96%	40	4%	6	1%
Waterloo	251	210	84%	41	16%	5	2%

Source: U.S. Census Bureau, 2011-2015 American Community Survey Estimates, Table DP02

Race

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

The majority of the population in Linn County is racially White (93%). Approximately, 8% of the population is ethnically Hispanic or Latino.

Table B-4 Race and Hispanic or Latino Origin

	Total Population	White	Black	AIAN	Asian	NHPI	Some Other Race	Two or More Races	Hispanic or Latino	Percent
Linn County	**118,971**	**93%**	**0%**	**2%**	**1%**	**0%**	**1%**	**3%**	**9,856**	**8%**
Albany	51,511	90%	1%	2%	2%	0%	2%	3%	6,008	12%
Brownsville	1,561	92%	1%	2%	0%	0%	4%	1%	101	6%
Halsey	**1,128**	**89%**	**0%**	**1%**	**0%**	**1%**	**2%**	**7%**	**136**	**12%**
Harrisburg	**3,660**	**89%**	**0%**	**2%**	**0%**	**0%**	**6%**	**3%**	**646**	**18%**
Lebanon	**15,962**	**95%**	**0%**	**3%**	**1%**	**0%**	**0%**	**1%**	**448**	**3%**
Lyons	**1,174**	**98%**	**1%**	**0%**	**0%**	**0%**	**0%**	**2%**	**32**	**3%**
Mill City	1,781	93%	0%	0%	0%	0%	4%	3%	191	11%
Millersburg	1,661	93%	0%	1%	1%	0%	1%	4%	321	19%
Scio	**832**	**96%**	**1%**	**0%**	**0%**	**0%**	**0%**	**2%**	**18**	**2%**
Sodaville	**367**	**86%**	**1%**	**1%**	**1%**	**0%**	**0%**	**11%**	**6**	**2%**
Sweet Home	9,140	96%	0%	0%	1%	1%	1%	3%	267	3%
Tangent	**1,022**	**98%**	**0%**	**1%**	**0%**	**0%**	**1%**	**1%**	**110**	**11%**
Waterloo	**264**	**98%**	**0%**	**2%**	**0%**	**0%**	**0%**	**0%**	**42**	**16%**

Source: Social Explorer, Table T12, U.S. Census Bureau, 2011-2015 American Community Survey Estimates
AIAN = American Indian and Alaskan Native, NHPI = Native Hawaiian and Other Pacific Islanders

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

Gender

Linn County has slightly more females than males (Female 51.9%, Male: 48.1%).[3] It is important to recognize that women tend to have more institutionalized obstacles than men during recovery due to sector-specific employment, lower wages, and family care responsibilities.[4]

Age

Of the factors influencing socio demographic capacity, the most significant indicator in Linn County may be age of the population. As depicted in the table below, as of 2015, 19% of the population is less than 15 and 17% is over the age of 64. The Linn County age dependency ratio[5] is 56.6. The age dependency ratio indicates a higher percentage of dependent aged people to that of working age. The Oregon Office of Economic Analysis projects that, in 2035, there will be a higher percentage of the county population over the age of 64 (22%). As the population ages, Linn County may need to consider different mitigation and

[3] Social Explorer, Table 4, U.S. Census Bureau, 2011-2015 American Community Survey Estimates

[4] Ibid.

[5] The age dependency ratio is derived by dividing the combined under 15 and 65-and-over populations by the 15-to-64 population and multiplying by 100. A number close to 50 indicates about twice as many people are of working age than non-working age. A number that is closer to 100 implies an equal number of working age population as non-working age population. A higher number indicates greater sensitivity.

preparedness actions to address the specific needs of this group. The age dependency ratio for Linn County is expected to rise to 64.0 in 2035, largely because of increases in the >64 age cohort.

Table B-5 Population by Vulnerable Age Groups

Jurisdiction	Total	< 15 Years		> 64 Years		15 to 64	Age Dependency Ratio
		Number	Percent	Number	Percent		
Linn County	**118,971**	**23,107**	**19%**	**19,902**	**17%**	**75,962**	**56.6**
Albany	51,511	10,783	21%	7,003	14%	33,725	52.7
Brownsville	1,561	283	18%	252	16%	1,026	52.1
Halsey	**1,128**	**287**	**25%**	**124**	**11%**	**717**	**57.3**
Harrisburg	**3,660**	**953**	**26%**	**280**	**8%**	**2,427**	**50.8**
Lebanon	**15,962**	**3,209**	**20%**	**2,813**	**18%**	**9,940**	**60.6**
Lyons	**1,174**	**291**	**25%**	**183**	**16%**	**700**	**67.7**
Mill City	1,781	373	21%	328	18%	1,080	64.9
Millersburg	1,661	363	22%	215	13%	1,083	53.4
Scio	**832**	**205**	**25%**	**63**	**8%**	**564**	**47.5**
Sodaville	**367**	**52**	**14%**	**22**	**6%**	**293**	**25.3**
Sweet Home	9,140	2,081	23%	1,649	18%	5,410	68.9
Tangent	**1,022**	**209**	**20%**	**155**	**15%**	**658**	**55.3**
Waterloo	**264**	**32**	**12%**	**48**	**18%**	**184**	**43.5**
2035							
Oregon	4,995,200	865,889	17%	1,082,781	22%	3,046,530	64.0
Linn County	150,395	27,849	19%	32,855	22%	89,691	67.7

Source: Social Explorer, Table 17, U.S. Census Bureau, 2011-2015 American Community Survey Estimates, Office of Economic Analysis, Long-Term County Population Forecast, 2010-2050 (2013 release).

The age profile of an area has a direct impact both on what actions are prioritized for mitigation and how response to hazard incidents is carried out. School age children rarely make decisions about emergency management. Therefore, a larger youth population in an area will increase the importance of outreach to schools and parents on effective ways to teach children about fire safety, earthquake response, and evacuation plans. Furthermore, children are more vulnerable to the heat and cold, have few transportation options and require assistance to access medical facilities. Older populations may also have special needs prior to, during and after a natural disaster. Older populations may require assistance in evacuation due to limited mobility or health issues. Additionally, older populations may require special medical equipment or medications, and can lack the social and economic resources needed for post-disaster recovery.[6]

Families and Living Arrangements

Two ways the census defines households are by type of living arrangement and family structure. A householder may live in a “family household” (a group related to one another by birth, marriage or adoption living together); in a “nonfamily household” (a group of

[6] Wood, Nathan. Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon. U.S. Geological Survey, Reston, VA, 2007.

unrelated people living together); or alone. Linn County is predominately comprised of family households (68%). Of all households, 25% are one-person non-family households (householder living alone). Countywide about 11% of householders live alone and are over the age of 65 (about 16% of all households in Lebanon).

Table B-6 Household Type

Jurisdiction	Total Households Estimate	Family Households Estimate	Family Households Percent	Household Living Alone Estimate	Household Living Alone Percent	Householder Living Alone (age 65+) Estimate	Householder Living Alone (age 65+) Percent
Linn County	**45,100**	**30,709**	**68%**	**11,144**	**25%**	**4,952**	**11%**
Albany	19,729	13,092	66%	5,205	26%	1,963	10%
Brownsville	598	383	64%	166	28%	59	10%
Halsey	**389**	**274**	**70%**	**75**	**19%**	**19**	**5%**
Harrisburg	**1,174**	**892**	**76%**	**186**	**16%**	**35**	**3%**
Lebanon	**6,509**	**3,863**	**59%**	**2,001**	**31%**	**1,017**	**16%**
Lyons	**417**	**325**	**78%**	**78**	**19%**	**47**	**11%**
Mill City	669	499	75%	158	24%	70	10%
Millersburg	592	475	80%	103	17%	42	7%
Scio	**288**	**215**	**75%**	**56**	**19%**	**12**	**4%**
Sodaville	**129**	**99**	**77%**	**21**	**16%**	**9**	**7%**
Sweet Home	3,335	2,150	64%	946	28%	482	14%
Tangent	**380**	**243**	**64%**	**115**	**30%**	**51**	**13%**
Waterloo	**86**	**72**	**84%**	**8**	**9%**	**3**	**3%**

Source: U.S. Census Bureau, 2011-2015 American Community Survey Estimates, Table DP02

The table below shows household structures for families with children. About 18% of all households within the county are married family households that have children; Harrisburg has the highest percentage. Scio (18%) and Lebanon (11%) have the highest percentage of single parent households. These populations will likely require additional support during a disaster and will inflict strain on the system if improperly managed.

Table B-7 Family Households with Children by Head of Household

Jurisdiction	Total Households Estimate	Married-Couple with Children Estimate	Married-Couple with Children Percent	Single Parent with Children Estimate	Single Parent with Children Percent
Linn County	**45,100**	**8,200**	**18%**	**4,579**	**10%**
Albany	19,729	3,528	18%	2,820	14%
Brownsville	598	71	12%	40	7%
Halsey	**389**	**87**	**22%**	**14**	**4%**
Harrisburg	**1,174**	**405**	**34%**	**40**	**3%**
Lebanon	**6,509**	**1,041**	**16%**	**686**	**11%**
Lyons	**417**	**114**	**27%**	**20**	**5%**
Mill City	669	153	23%	71	11%
Millersburg	592	169	29%	15	3%
Scio	**288**	**65**	**23%**	**51**	**18%**
Sodaville	**129**	**31**	**24%**	**5**	**4%**
Sweet Home	3,335	485	15%	506	15%
Tangent	**380**	**86**	**23%**	**10**	**3%**
Waterloo	**86**	**19**	**22%**	**6**	**7%**

Source: U.S. Census Bureau, 2011-2015 American Community Survey Estimates, Table DP02

Income

Household income and poverty status are indicators of socio demographic capacity and the stability of the local economy. Household income can be used to compare economic areas as a whole, but does not reflect how the income is divided among the area residents. Between 2010 and 2015 the share of households making less than $30,000 increased more than other income cohorts.

Table B-8 Household Income

Household Income	2010^ Households	2010^ Percent	2015 Households	2015 Percent	Change in Share Households	Change in Share Percent
Less than $15,000	5,411	12%	6,411	14%	1,000	2%
$15,000-$29,999	7,010	16%	8,662	19%	1,652	3%
$30,000-$44,999	7,470	17%	7,211	16%	-259	-1%
$45,000-$59,999	6,229	14%	6,489	14%	260	0%
$60,000-$74,999	4,734	11%	5,142	11%	408	1%
$75,000-$99,999	5,850	13%	5,843	13%	-7	0%
$100,000-$199,999	6,924	16%	4,790	11%	-2,134	-5%
$200,000 or more	747	2%	552	1%	-195	0%

Source: Social Explorer, Table 56, U.S. Census Bureau, 2011-2015 American Community Survey and 2006-2010 American Community Survey

^ 2010 dollars are adjusted for 2015 using the Social Explorers Inflation Calculator.

Table B-9 below shows decreases in real incomes across Linn County and cities. The 2015 median household income across Linn County is $45,644; this is lower than the inflation adjusted 2010 figure, representing a 8.4% decline in real incomes. Millersburg, Waterloo, and Lyons have the highest median household incomes, while Sweet Home and Mill City have the lowest median household incomes. Waterloo had a 132% increase in median household income between 2010 and 2015.

Table B-9 Median Household Income

	Median Household Income		Percent
	2010^	2015	Change
Linn County	**$49,840**	**$45,644**	**-8%**
Albany	$48,361	$47,150	-3%
Brownsville	$48,669	$48,158	-1%
Halsey	**$57,975**	**$51,958**	**-10%**
Harrisburg	**$56,778**	**$48,125**	**-15%**
Lebanon	**$43,875**	**$40,530**	**-8%**
Lyons	**$55,807**	**$60,417**	**8%**
Mill City	$38,792	$38,689	0%
Millersburg	$66,446	$72,778	10%
Scio	**$42,365**	**$49,531**	**17%**
Sodaville	**$55,392**	**$50,938**	**-8%**
Sweet Home	$40,433	$35,076	-13%
Tangent	**$55,176**	**$44,643**	**-19%**
Waterloo	**$27,866**	**$64,722**	**132%**

Source: Social Explorer, Table 57, U.S. Census Bureau, 2011-2015 American Community Survey Estimates and 2006-2010 American Community Survey Estimates
Note: ^ - 2010 dollars adjusted for 2015 via Social Explorer's Inflation Calculator

The table below identifies the percentage of individuals and cohort groups that are below the poverty level in 2015. It is estimated that about 19% of individuals, 28% of children under 18, and 8% of seniors live below the poverty level across the county. Sweet Home, Harrisburg, Albany, and Lebanon have the highest poverty rates. Harrisburg and Millersburg have the highest poverty rates for children under 18. Overall, 7% of Linn County residents

live in "deep poverty" (having incomes below half the federal poverty level), the percent is greatest in Sweet Home at 16%.[7]

Table B-10 Poverty Rates

	Total Population in Poverty		Children Under 18 in Poverty		18 to 64 in Poverty		65 or over in Poverty	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Linn County	**22,201**	**19%**	**7,619**	**28%**	**13,027**	**18%**	**1,555**	**8%**
Albany	10,050	20%	3,778	30%	5,912	19%	360	5%
Brownsville	221	14%	68	21%	128	13%	25	10%
Halsey	**105**	**9%**	**17**	**6%**	**84**	**12%**	**4**	**3%**
Harrisburg	**780**	**21%**	**406**	**36%**	**350**	**16%**	**24**	**9%**
Lebanon	**3,154**	**20%**	**983**	**27%**	**1,797**	**19%**	**374**	**13%**
Lyons	**133**	**11%**	**49**	**15%**	**77**	**12%**	**7**	**4%**
Mill City	357	20%	106	23%	199	20%	52	16%
Millersburg	291	18%	148	34%	135	13%	8	4%
Scio	**133**	**16%**	**41**	**16%**	**92**	**18%**	**0**	**0%**
Sodaville	**36**	**10%**	**3**	**4%**	**31**	**12%**	**2**	**9%**
Sweet Home	2,151	24%	813	33%	1,197	24%	141	9%
Tangent	**155**	**15%**	**43**	**17%**	**104**	**17%**	**8**	**5%**
Waterloo	**34**	**13%**	**9**	**18%**	**22**	**13%**	**3**	**6%**

Source: Social Explorer Tables 114, 115, 116, U.S. Census Bureau, 2011-2015 American Community Survey Estimates

Cutter's research suggests that lack of wealth contributes to social vulnerability because individual and community resources are not as readily available. Affluent communities are more likely to have both the collective and individual capacity to more quickly rebound from a hazard event, while impoverished communities and individuals may not have this capacity –leading to increased vulnerability. Wealth can help those affected by hazard incidents to absorb the impacts of a disaster more easily. Conversely, poverty, at both an individual and community level, can drastically alter recovery time and quality.[8]

Federal assistance programs such as food stamps are another indicator of poverty or lack of resource access. Statewide social assistance programs like the Supplemental Nutritional Assistance Program (SNAP) and Temporary Assistance for Needy Families (TANF) provide assistance to individuals and families. In District 4 (Albany and Lebanon field offices), TANF reaches approximately 2,000 individuals per month and SNAP helps to feed about 17,000 people (11,000 households) per month.[9] Those reliant on federal assistance are more

[7] Social Explorer Tables 117, U.S. Census Bureau, 2011-2015 American Community Survey Estimates

[8] Cutter, S. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*.

[9] Sabatino, J. (2017). *Oregon TANF Caseload FLASH, "One and Two Parent Families Combined",* District 4, Albany and Lebanon; February 2017 data, and Sabatino, J. (2017). *Oregon SNAP Program Activity, "SSP, APD and AAA Combined",* District 4, Albany and Lebanon; February 2017 data. Retrieved from State of Oregon Office of Business Intelligence website: http://www.oregon.gov/DHS/ASSISTANCE/Pages/Data.aspx, March 2017.

vulnerable in the wake of disaster because of a lack of personal financial resources and reliance on government support.

Education

Educational attainment of community residents is also identified as an influencing factor in socio demographic capacity. Educational attainment often reflects higher income and therefore higher self-reliance. Widespread educational attainment is also beneficial for the regional economy and employment sectors as there are potential employees for professional, service and manual labor workforces. An oversaturation of either highly educated residents or low educational attainment can have negative effects on the resiliency of the community.

According to the U.S. Census, about 90% of the Linn County population over 25 years of age has graduated from high school or received a high school equivalency, with approximately 17% going on to earn a Bachelor's and/ or a Graduate or professional degree.

Table B-11 Educational Attainment

	Linn County	Albany	Brownsville	**Halsey**	**Harrisburg**	**Lebanon**	**Lyons**
Population 25 years and over	**80,945**	34,059	1,112	**724**	**2,225**	**10,932**	**768**
Less than high school	**8,461**	3,455	91	**47**	**158**	**919**	**94**
High school graduate or GED	**25,103**	8,655	420	**222**	**931**	**3,344**	**350**
Some college, no degree	**33,367**	13,617	425	**330**	**756**	**4,838**	**243**
Bachelor's degree	**9,734**	5,451	124	**77**	**286**	**1,326**	**71**
Graduate or professional degree	**4,280**	2,881	52	**48**	**94**	**505**	**10**
Percent without Highschool Degree	***10%***	*10%*	*8%*	***6%***	***7%***	***8%***	***12%***
Percent High School Graduate or Higher	***90%***	*90%*	*92%*	***94%***	***93%***	***92%***	***88%***
Percent Bachelor's Degree or Higher	***17%***	*24%*	*16%*	***17%***	***17%***	***17%***	***11%***

	Mill City	Millersburg	**Scio**	**Sodaville**	Sweet Home	**Tangent**	**Waterloo**
Population 25 years and over	1,196	1,113	**500**	**256**	5,662	**673**	**178**
Less than high school	241	137	**52**	**27**	629	**86**	**15**
High school graduate or GED	393	343	**172**	**87**	2,211	**176**	**93**
Some college, no degree	419	373	**194**	**109**	2,288	**303**	**51**
Bachelor's degree	100	202	**73**	**18**	377	**78**	**16**
Graduate or professional degree	43	58	**9**	**15**	157	**30**	**3**
Percent without Highschool Degree	*20%*	*12%*	***10%***	***11%***	*11%*	***13%***	***8%***
Percent High School Graduate or Higher	*80%*	*88%*	***90%***	***89%***	*89%*	***87%***	***92%***
Percent Bachelor's Degree or Higher	*12%*	*23%*	***16%***	***13%***	*9%*	***16%***	***11%***

Source: Social Explorer, Table 25, U.S. Census Bureau, 2011-2015 American Community Survey Estimates

Health

Individual and community health play an integral role in community resiliency, as indicators such as health insurance, people with disabilities, dependencies, homelessness and crime rate paint an overall picture of a community's well-being. These factors translate to a community's ability to prepare, respond to, and cope with the impacts of a disaster.

The Resilience Capacity Index recognizes those who lack health insurance or are impaired with sensory, mental or physical disabilities, have higher vulnerability to hazards and will

likely require additional community support and resources. The percentage of population in Linn County without health insurance is about 12%. The percentage of uninsured changes with age, the highest rates of uninsured are within the 18 to 64 age cahort, with nearly 18% of the age cohort without health insurance. The ability to provide services to the uninsured populations may burden local providers following a natural disaster.

Table B-12 Health Insurance Coverage

Jurisdiction	Population	Without Health Insurance							
		Total Population		Under 18 years		18 to 64 years		65+	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
Linn County	**118,233**	**14,202**	**12%**	**1,467**	**5%**	**12,688**	18%	**47**	**0%**
Albany	50,844	5,651	11%	443	4%	5,166	7%	42	1%
Brownsville	1,561	248	16%	21	6%	227	10%	0	0%
Halsey	**1,128**	**237**	**21%**	**73**	**23%**	**164**	**-2%**	**0**	**0%**
Harrisburg	**3,660**	**575**	**16%**	**0**	**0%**	**575**	**16%**	**0**	**0%**
Lebanon	**15,928**	**1,807**	**11%**	**275**	**7%**	**1,532**	**4%**	**0**	**0%**
Lyons	**1,174**	**38**	**3%**	**0**	**0%**	**35**	**2%**	**3**	**2%**
Mill City	1,781	112	6%	5	1%	107	5%	0	0%
Millersburg	1,661	138	8%	0	0%	138	8%	0	0%
Scio	**832**	**107**	**13%**	**9**	**3%**	**98**	**10%**	**0**	**0%**
Sodaville	**367**	**21**	**6%**	**0**	**0%**	**21**	**8%**	**0**	**0%**
Sweet Home	9,113	1,053	12%	50	2%	1,003	20%	0	0%
Tangent	**1,022**	**92**	**9%**	**4**	**2%**	**88**	**14%**	**0**	**0%**
Waterloo	**264**	**43**	**16%**	**6**	**12%**	**37**	**22%**	**0**	**0%**

Source: Social Explorer, Table 146, U.S. Census Bureau, 2011-2015 American Community Survey Estimates.

The table below describes disability status of the population. As of 2015, 17% of the Linn County non-institutionalized population identifies with one or more disabilities. Sweet Home has the highest percentage of its total population with a disability (23%), and Sodaville has the highest percentage of individuals 65 years and over with a disability (43%). The highest percentage (excluding Albany) of individuals under 18 years with a disability are in Mill City (8%), while the largest number (excluding Albany) are in Lebanon. Excluding Albany, the greatest number of people 18 to 65 with a disability are in Lebanon and Sweet Home.

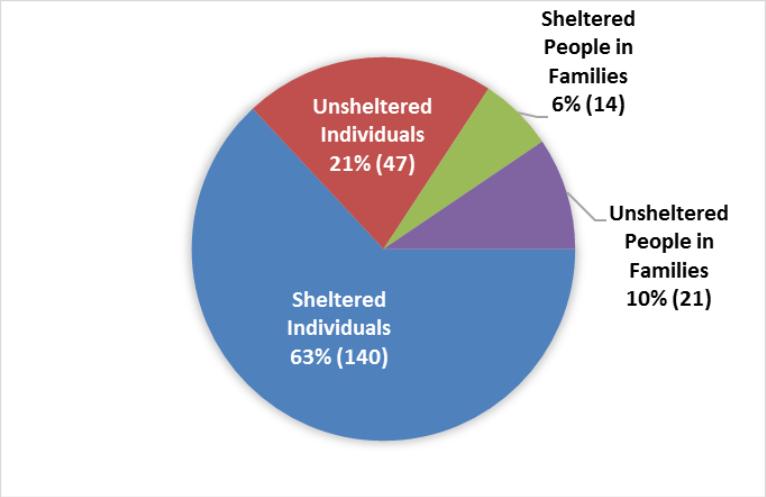
Table B-13 Disability Status

Jurisdiction	Total Population Estimate	With a disability		Under 18 years with a disability		18 to 65 years with a disability		65 years and over with a disability	
		Estimate	Percent	Estimate	Percent^	Estimate	Percent^	Estimate	Percent^
Linn County	**118,233**	**20,253**	**17%**	**1,815**	**6%**	**10,486**	**15%**	**7,953**	**40%**
Albany	50,844	8,282	16%	1,156	8%	4,411	12%	2,716	29%
Brownsville	1,561	270	17%	13	4%	159	14%	99	28%
Halsey	**1,128**	**157**	**14%**	**18**	**5%**	**79**	**10%**	**61**	**33%**
Harrisburg	**3,660**	**390**	**11%**	**71**	**6%**	**261**	**10%**	**58**	**17%**
Lebanon	**15,928**	**2,910**	**18%**	**173**	**4%**	**1,441**	**13%**	**1,297**	**32%**
Lyons	**1,174**	**196**	**17%**	**9**	**3%**	**99**	**13%**	**89**	**33%**
Mill City	1,781	430	24%	38	8%	223	18%	170	34%
Millersburg	1,661	191	11%	2	0%	103	9%	87	29%
Scio	**832**	**69**	**8%**	**4**	**1%**	**27**	**5%**	**40**	**39%**
Sodaville	**367**	**58**	**16%**	**4**	**5%**	**40**	**13%**	**15**	**43%**
Sweet Home	9,113	2,113	23%	141	5%	1,301	21%	672	29%
Tangent	**1,022**	**148**	**14%**	**14**	**5%**	**60**	**9%**	**75**	**33%**
Waterloo	**264**	**42**	**16%**	**3**	**6%**	**17**	**9%**	**23**	**33%**

Source: U.S. Census Bureau, 2011-2015 American Community Survey, Table S1810.
^Percent of age group

In 2015, Oregon Housing and Community Services (OHCS) conducted a point-in-time homeless count to identify the number of homeless, their age and their family type. The OHCS study found that 187 individuals in Linn County identify as homeless; 140 were sheltered (14 in families), 47 were unsheltered (21 in families).

Figure B-4 Linn County PIT Homeless Count (2015)



Source: Oregon Housing and Community Services, 2015 Point-in-Time Homeless Count

Synthesis

For planning purposes, it is essential to consider both immediate and long-term socio-demographic implications of hazard resilience. Immediate concerns include the growing elderly population and the high percentage of age dependent population (those who do not work because of being too young or too old). The current status of other Social/-demographic capacity indicators such as graduation rate, poverty level, householders living alone, and single-parent households can have long-term impacts on the economy and stability of the community ultimately affecting future resilience.

Economic Capacity

Economic capacity refers to the financial resources present and revenue generated in the community to achieve a higher quality of life. Income equality, housing affordability, economic diversification, employment and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources and infrastructure are interconnected in the existing economic picture. Once any inherent strengths or systematic vulnerabilities become apparent, both the public and private sectors can take action to increase the resilience of the local economy.

Regional Affordability

The evaluation of regional affordability supplements the identification of Social/demographic capacity indicators, i.e. median income, and is a critical analysis tool to understanding the economic status of a community. This information can capture the likelihood of individuals' ability to prepare for hazards, through retrofitting homes or purchasing insurance. If the community reflects high-income inequality or housing cost burden, the potential for home-owners and renters to implement mitigation can be drastically reduced. Therefore, regional affordability is a mechanism for generalizing the abilities of community residents to get back on their feet without Federal, State or local assistance.

Income Equality

Income equality is a measure of the distribution of economic resources, as measured by income, across a population. It is a statistic defining the degree to which all persons have a similar income. The table below illustrates the county and cities level of income inequality. The Gini index is a measure of income inequality. The index varies from zero to one. A value of one indicates perfect inequality (only one household has any income). A value of zero indicates perfect equality (all households have the same income).[10]

The cities within the county vary with the greatest income equality within the City of Waterloo, while Tangent, Sweet Home, and Albany are all over 0.4. Based on social science research, the region's cohesive response to a hazard event may be affected by the distribution of wealth in communities that have less income equality[11].

[10]University of California Berkeley. Building Resilient Regions, Resilience Capacity Index. http://brr.berkeley.edu/rci/.

[11] Susan Cutter, Christopher G. Burton, and Christopher T. Emrich. 2010. "Disaster Resilience Indicators for Benchmarking Baseline Conditions," Journal of Homeland Security and Emergency Management 7, no.1: 1-22

Table B-14 Regional Income Equality

Jurisdiction	Income Inequality Coefficient
Linn County	**0.42**
Albany	0.41
Brownsville	0.39
Halsey	**0.29**
Harrisburg	**0.36**
Lebanon	**0.40**
Lyons	**0.36**
Mill City	0.37
Millersburg	0.41
Scio	**0.32**
Sodaville	**0.37**
Sweet Home	0.44
Tangent	**0.41**
Waterloo	**0.24**

Source: Social Explorer, Table 157, U.S. Census Bureau, 2011-2015 American Community Survey Estimates

Housing Affordability

Housing affordability is a measure of economic security gauged by the percentage of an area's households paying less than 30% of their income on housing.[12] Households spending 30% or more are considered housing cost burdened. The table below displays the percentage of homeowners `and renters reflecting housing cost burden across the region.

Linn County has a large percent of homeowners with a mortgage spending more than 30% of their income on housing (48%). Among renters, nearly 8,200 renters (51%) in Linn County pay more than 30% of their income on rent. In general, the population that spends more of their income on housing has proportionally fewer resources and less flexibility for alternative investments in times of crisis.[13] This disparity imposes challenges for a community recovering from a disaster as housing costs may exceed the ability of local residents to repair or move to a new location. These populations may live paycheck to paycheck and are extremely dependent on their employer, in the event their employer is also impacted it will further the detriment experienced by these individuals and families.

[12] University of California Berkeley. Building Resilient Regions, Resilience Capacity Index. http://brr.berkeley.edu/rci/.

[13] Ibid.

Table B-15 Households Spending > 30% of Income on Housing

Jurisdiction	Owners				Renters	
	With Mortgage		Without Mortgage			
	Number	Percent	Number	Percent	Number	Percent
Linn County	**8,855**	**48%**	**2,175**	**21%**	**8,199**	**51%**
Albany	3,076	37%	690	20%	4,451	55%
Brownsville	145	49%	47	28%	61	45%
Halsey	**80**	**41%**	**0**	**0%**	**70**	**53%**
Harrisburg	**310**	**55%**	**94**	**32%**	**149**	**47%**
Lebanon	**1,290**	**53%**	**247**	**21%**	**1,566**	**54%**
Lyons	**97**	**45%**	**19**	**23%**	**41**	**35%**
Mill City	**210**	61%	**23**	21%	**117**	54%
Millersburg	**146**	43%	**20**	14%	**64**	55%
Scio	**88**	**51%**	**2**	**5%**	**39**	**50%**
Sodaville	**44**	**57%**	**2**	**10%**	**14**	**45%**
Sweet Home	**446**	45%	**138**	15%	**816**	58%
Tangent	**47**	**33%**	**48**	**40%**	**45**	**39%**
Waterloo	**19**	**40%**	**0**	**0%**	**3**	**23%**

Source: Social Explorer, Tables 103 and 109, U.S. Census Bureau, 2011-2015 American Community Survey Estimates

Economic Diversity

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. Business activity in the Willamette Valley region is fairly homogeneous and consists mostly of small businesses. The Mid/Southern Willamette Valley Region Profile within the State Natural Hazards Mitigation Plan summarizes the current state of the area's economic environment:

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. One method for measuring economic diversity is through use of the Herfindahl Index, a formula that compares the composition of county and regional economies with those of states or the nation as a whole. Using the Herfindahl Index, a diversity ranking of 1 indicates the Oregon County with the most diverse economic activity compared to the state as a whole, while a ranking of 36 corresponds with the least diverse county economy. The table below describes the Herfindahl Index Scores for counties in the region.

Table B-16 shows that, as of 2013, Linn County has an economic diversity rank of 4, this is on a scale between all 36 counties in the state where 1 is the most diverse economic county in Oregon and 36 is the least diverse.

Table B-16 Regional Herfindahl Index Scores

County	2008 Employment	2008 Number of Industries	2008 State Rank	2013 Employment	2013 Number of Industries	2013 State Rank
Benton	26,433	199	23	25,247	201	21
Lane	123,008	260	4	114,670	260	5
Lincoln	14,286	183	29	13,491	179	30
Linn	**36,360**	**225**	**5**	**33,934**	**222**	**4**
Marion	105,758	252	3	101,571	245	3
Polk	12,837	178	18	12,179	167	9
Yamhill	27,797	209	9	27,860	209	6

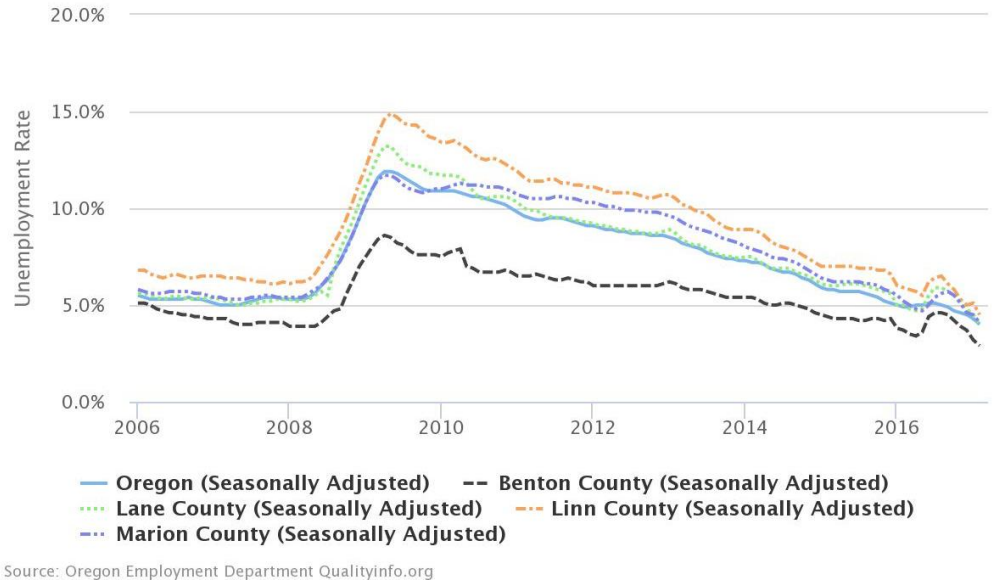
Source: Oregon Employment Department

While illustrative, economic diversity is not a guarantor of economic vitality or resilience. Linn County, as of 2017, is listed as an economically distressed community as prescribed by Oregon Law. The economic distress measure is based on indicators of decreasing new jobs, average wages and income, and is associated with an increase of unemployment.[14]

Employment and Wages

According to the Oregon Employment Department, unemployment has declined since 2009 (14.0%) yet remains at a rate slightly higher than the State of Oregon and other counties in the region (5.8%).

Figure B-5 Local Area Unemployment Statistics

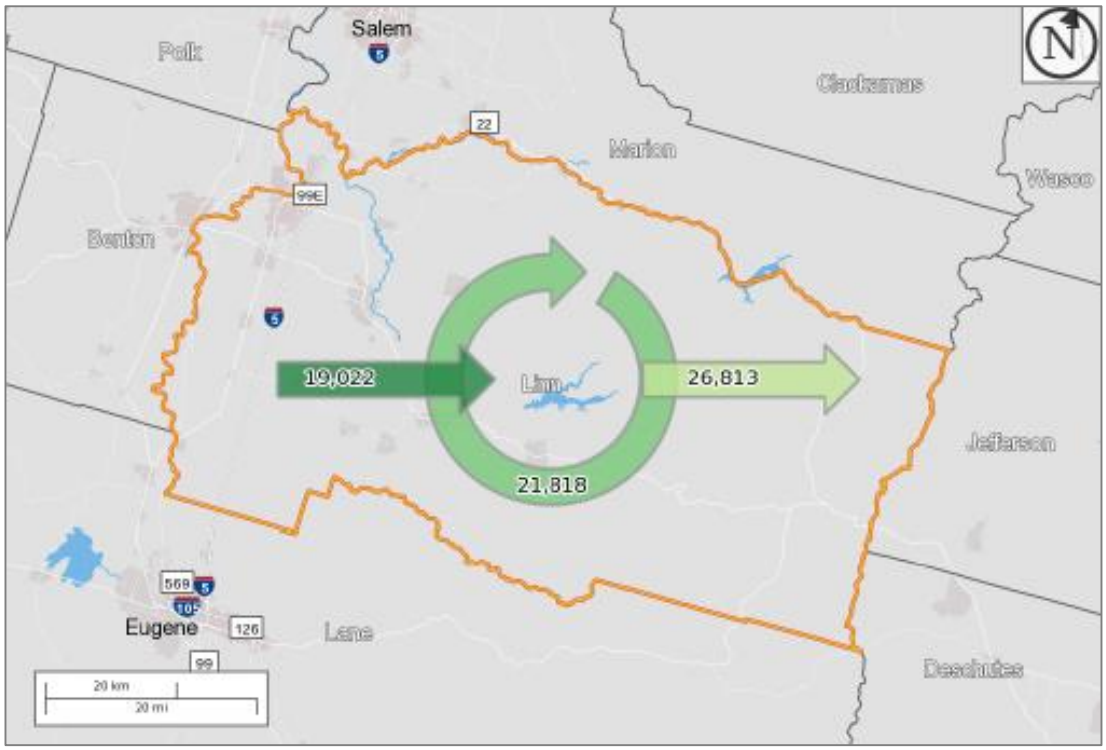


Source: Oregon Employment Department, "Local Area Employment Statistics" 2005-2016, Qualityinfo.org .

[14] Business Oregon – Oregon Economic Data "Distressed Communities List", http://www.oregon4biz.com/Publications/Distressed-List/

Linn County employers draw just under half of their workforce from outside the county. The Linn County economy is a cornerstone of regional economic vitality. Figure B-6 shows the county's laborshed; the map shows that about 53% of workers live and work in the county (21,818), 47% of workers come from outside the county (19,022), and about 55% of residents work outside of the county (26,813).

Figure B-6 Linn County Laborshed



Source: U.S. Bureau of the Census, On The Map.

Mitigation activities are needed at the business level to ensure the health and safety of workers and limit damage to industrial infrastructure. Employees are highly mobile, commuting from all over the surrounding area to industrial and business centers. As daily transit rises, there is an increased risk that a natural hazard event will disrupt the travel plans of residents across the region and seriously hinder the ability of the economy to meet the needs of Polk County residents and businesses.

Industry

Major Regional Industry

Key industries are those that represent major employers and are significant revenue generators. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry specific discussions below. Identifying key industries in the region enables communities to target mitigation activities towards those industries' specific sensitivities. It

is important to recognize that the impact that a natural hazard event has on one industry can reverberate throughout the regional economy.

This is of specific concern when the businesses belong to the basic sector industry. Basic sector industries are those that are dependent on sales outside of the local community; they bring money into a local community via employment. The farm and ranch, information, and wholesale trade industries are all examples of basic industries. Non-basic sector industries are those that are dependent on local sales for their business, such as retail trade, construction, and health services.

Employment by Industry

Economic resilience to natural disasters is particularly important for the major employment industries in the region. If these industries are negatively impacted by a natural hazard, such that employment is affected, the impact will be felt throughout the regional economy. Thus, understanding and addressing the sensitivities of these industries is a strategic way to increase the resiliency of the entire regional economy.

Table B-17 displays the occupation for the employed population 16-years and older. As of 2015, there were approximately 43,500 individuals employed throughout the county with and average wage of $39,414. The majority of the employed work either in *Trade, Transportation & Utilities* (20%), *Manufacturing* (17%), *Education and Health Services* (13%), or *Local Government* (12%) occupations. Between 2010 and 2015 the *Natural Resources and Mining (54%), Construction (46%), Other Services (22%), and Education and Health Services* (15%) occupations saw the greatest percent increase in employment.

Table B-17 Occupation for Employed Population (16+)

Industry	2015				Percent Change in Employment (2010-2015)	Employment Forecast (2014-2024)
	Firms	Employment	Percent Employment	Average Wage		
Total Payroll Employment	3,272	43,518	100%	$39,414	10%	8%
Total Private	3,103	36,425	84%	$39,487	14%	9%
Natural Resources and Mining	207	2,466	6%	$36,067	54%	13%
Construction	316	2,459	6%	$47,472	46%	15%
Manufacturing	194	7,293	17%	$58,057	11%	1%
Trade, Transportation & Utilities	625	8,827	20%	$35,604	6%	7%
Wholesale Trade	146	1,554	4%	$50,644	8%	10%
Retail Trade	353	4,881	11%	$25,749	11%	7%
Information	32	349	1%	$43,255	-9%	-5%
Financial Activities	244	1,261	3%	$38,748	8%	11%
Professional and Business Services	312	3,172	7%	$34,560	4%	4%
Education and Health Services	280	5,462	13%	$42,766	15%	16%
Leisure and Hospitality	264	3,328	8%	$15,290	9%	10%
Other Services	621	1,798	4%	$20,495	22%	13%
Private Non-Classified	3	(c)	-	(c)	-	-
Government	168	7,093	16%	$39,041	-5%	4%
Federal	26	311	1%	$67,026	-10%	-4%
State	30	1,356	3%	$31,997	12%	6%
Local	112	5,424	12%	$39,211	-9%	2%

Source: Oregon Employment Department, "2010 and 2015 Employment and Wages by Industry (QCEW) Summary Industry Report Data" and "Industry Employment Forecast 2014-2024, Benton and Linn Counties". http://www.qualityinfo.org. Accessed March 2017.

High Revenue Sectors

In 2012, the three sectors with the highest revenue were Retail Trade, Healthcare and social assistance, and transportation and warehousing. Table B-18 shows the revenue generated by each economic sector (Note: not all sectors are reported). All of the sectors combined generated more than $2.2 billion in revenue for the County.

Linn County relies on both basic and non-basic sector industries and it is important to consider the effects each may have on the economy following a disaster. Basic sector businesses have a multiplier effect on a local economy that can spur the creation of new jobs, some of which may be non-basic. The presence of basic sector jobs can help speed the local recovery; however, if basic sector production is hampered by a natural hazard event, the multiplier effect could be experienced in reverse. In this case, a decrease in basic sector purchasing power results in lower profits and potential job losses for the non-basic businesses that are dependent on them.

Table B-18 Revenue of Top Sectors in Linn County (Employer)

Sector Meaning (NAICS code)	Sector Revenue ($1,000)	
Retail trade	$	1,181,597
Health care and social assistance	$	422,251
Transportation and warehousing	$	201,141
Administrative and support and waste management and remediation services	$	130,892
Accommodation and food services	$	130,424
Professional, scientific, and technical services	$	84,807
Real estate and rental and leasing	$	48,532
Arts, entertainment, and recreation	$	16,564
Educational services	$	3,773
Utilities	Q	
Information	N	
Finance and insurance	N	
Other services (except public administration)	D	
Manufacturing	-	

Source: U.S. Census Bureau, 2012 Economic Census, Table EC1200A1.
D = Withheld to avoid disclosing data for individual companies; data are included in higher level totals
N = Not available or not comparable
Q= Revenue not collected at this level of detail for multi-establishment firms

Future Employment in Industry

Sectors that are anticipated to be major employers in the future also warrant special attention in the hazard mitigation planning process. As shown in Table B-17, between 2014 and 2024, the largest employment growth for the combined Benton-Linn County region is

anticipated within Education and Health Services (16%), Construction (15%), Natural Resources and Mining (13%), and Other Services (13%).[15]

Synthesis

The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families and the community to absorb disaster impacts for a quick recovery. A higher than average unemployment rate and housing affordability are concerns for economic stability following a natural disaster. Because the major employers are key to post-disaster recovery efforts, the region is bolstered by its major employment sectors. It is important to consider what might happen to the economy if the largest revenue generators and employers are impacted by a disaster.

[15] Oregon Employment Department, "Employment Projections by Industry and Occupations: 2014-2024 Oregon and Regional Summary".

Built Environment Capacity

Built Environment capacity refers to the built environment and infrastructure that supports the community. The various forms, quantity, and quality of built capital mentioned above contribute significantly to community resilience. Physical infrastructures, including utility and transportation lifelines, are critical during a disaster and are essential for proper functioning and response. The lack or poor condition of infrastructure can negatively affect a community's ability to cope, respond and recover from a natural disaster. Following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediately available resources.

Land Use and Development Patterns

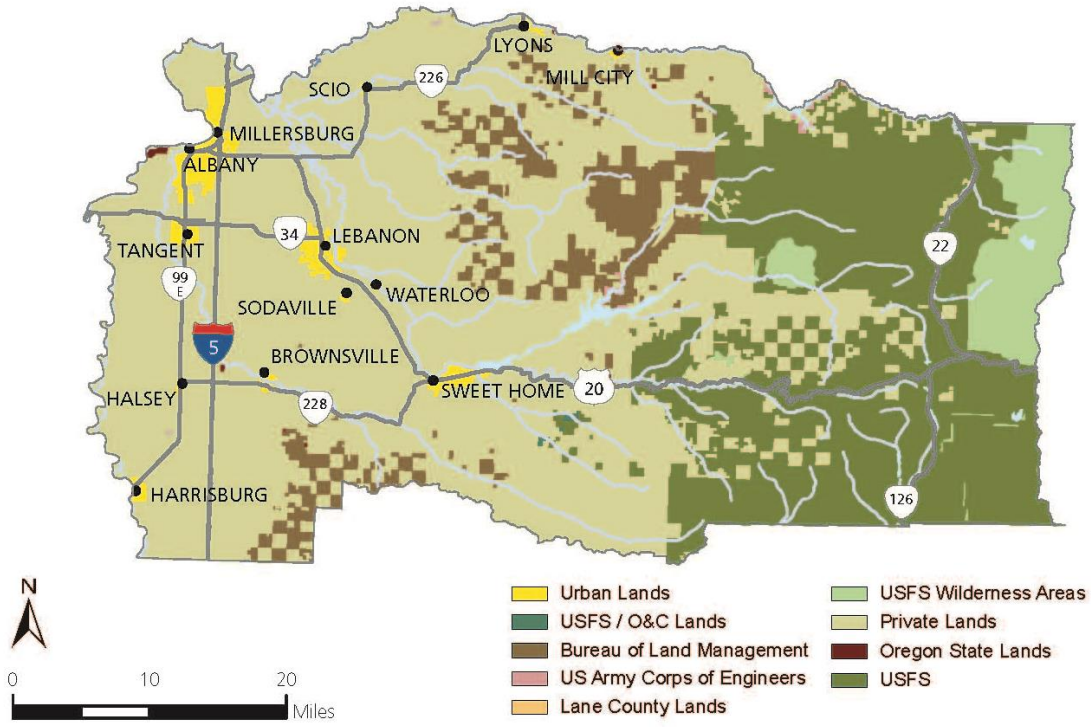
Linn County encompasses both the rich agricultural lands of the Willamette Valley and the productive forested mountainsides of the Cascade Range. Much of the area in the eastern portion of Linn County is classified as Forest Resource in the *Comprehensive Plan* with the majority of this in the Cascade mountain range. The topography, sparse population and high precipitation of this region make it a prime location for forestry. Over 900,000 acres, nearly 65 percent of Linn County, is forested.[16] Much of the forested land is held in large-acre ownership with the Willamette National Forest managed by the U.S. Forest Service as one of the largest holdings. The Bureau of Land Management (BLM) in the U.S. Department of the Interior administers lands under its jurisdiction[17]. Agricultural activity occurs throughout the valley region and in the foothills of the county. Between the farmlands in the west and the mountainous forests in the east is an area that blends the character of the two major geographic regions of Linn County.

In the foothills of the Cascade Range, spanning from the northern to the southern border of the county are hilly lands with many streams. Rural residential development has occurred within these areas. These lands are designated Farm/Forest, a hybrid of the agricultural lands and the forestlands and comprise approximately seven percent of Linn County. Land ownership is depicted in Figure B-7 below.

16 Linn County. "Land Use Element Code." 2005.

17 ibid

Figure B-7 Linn County Land Ownership



Linn County, Oregon InfoGraphics Lab, 2010

Source: Oregon Geospatial Enterprise Office (GEO), http://www.oregon.gov/DAS/EISPD/GEO/alphalist.shtml
Lane Council of Governments (LCOG) http://www.lcog.org/

Linn County is a large, predominately rural county characterized by a dispersed settlement pattern and three main population centers — Albany, Lebanon, and Sweet Home. Linn County consists of 15 incorporated cities (the cities of Albany, Gates, Idanha, and Mill City have portions in Benton or Marion County) and six unincorporated communities. Unincorporated communities are settlements located outside urban growth boundaries and include a mixture of land uses, specifically at least three commercial, industrial or public land uses.[18]

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

Regulatory Context

Oregon land use laws require land outside Urban Growth Boundaries (UGBs) to be protected for farm, forest, and aggregate resource values. For the most part, this law limits the

[18] Land Concervation and Development Department. "Oregon Administrative Rules Compilation." 2003.

amount of development in the rural areas. However, the land use designation can change from resource protection in one of two ways:

- The requested change could qualify as an exception to Statewide Planning Goals, in which case the city must demonstrate to the State that the change meets requirements for an exception. These lands, known as exception lands, are predominantly designated for residential use.
- Resource land can also be converted to non-resource use when it can be demonstrated that the land is no longer suitable for farm or forest production.

Local and state policies currently direct growth away from rural lands into UGBs, and, to a lesser extent, into rural communities. If development follows historical development trends, urban areas will expand their UGBs, rural unincorporated communities will continue to grow, and overall rural residential density will increase slightly with the bulk of rural lands kept in farm and forest use. The existing pattern of development in the rural areas, that of radiating out from the urban areas along rivers and streams is likely to continue. Most of the "easy to develop" land is already developed, in general leaving more constrained land such as land in the floodplains or on steep slopes to be developed in the future, perhaps increasing the rate at which development occurs in natural hazard areas.

Since 1973, Oregon has maintained a strong statewide program for land use planning. The foundation of that program is a set of 19 statewide planning goals that express the state's policies on land use and on related topics, such as citizen involvement, land use planning, and natural resources.

Most of the goals are accompanied by "guidelines," which are suggestions about how a goal may be applied. Oregon's statewide goals are achieved through local comprehensive planning. State law requires each city and city to adopt a comprehensive plan and the zoning and land-division ordinances needed to put the plan into effect. The local comprehensive plans must be consistent with the statewide planning goals. Plans are reviewed for such consistency by the state's Land Conservation and Development Commission (LCDC). When LCDC officially approves a local government's plan, the plan is said to be "acknowledged." It then becomes the controlling document for land use in the area covered by that plan.

Goal 7

Goal 7: Areas Subject to Natural Disasters and Hazards has the overriding purpose to "protect people and property from natural hazards". Goal 7 requires local governments to adopt comprehensive plans (inventories, policies and implementing measures) to reduce risk to people and property from natural hazards. Natural hazards include floods, landslides, earthquakes, tsunamis, coastal erosion, and wildfires.

To comply with Goal 7, local governments are required to respond to new hazard inventory information from federal or state agencies. The local government must evaluate the hazard risk and assess the:

a) frequency, severity, and location of the hazard;
b) effects of the hazard on existing and future development;
c) potential for development in the hazard area to increase the frequency and severity of the hazard; and

d) types and intensities of land uses to be allowed in the hazard area.

Local governments must adopt or amend comprehensive plan policies and implementing measures to avoid development in hazard areas where the risk cannot be mitigated. In addition, the siting of essential facilities, major structures, hazardous facilities and special occupancy structures should be prohibited in hazard areas where the risk to public safety cannot be mitigated. The state recognizes compliance with Goal 7 for coastal and riverine flood hazards by adopting and implementing local floodplain regulations that meet the minimum National Flood Insurance Program (NFIP) requirements.

In adopting plan policies and implementing measures for protection from natural hazards local governments should consider:

a) the benefits of maintaining natural hazard areas as open space, recreation, and other low density uses;
b) the beneficial effects that natural hazards can have on natural resources and the environment; and
c) the effects of development and mitigation measures in identified hazard areas on the management of natural resources.

Local governments should coordinate their land use plans and decisions with emergency preparedness, response, recovery and mitigation programs. Given the numerous waterways, agricultural, and forest lands, special attention should be given to problems associated with river bank erosion and potential for wild land/urban interface fires.

Goal 7 guides local governments to give special attention to emergency access when considering development in identified hazard areas, including:

a) Consider programs to manage stormwater runoff as a means to address flood and landslide hazards,
b) Consider non-regulatory approaches to help implement the goal,
c) When reviewing development requests in high hazard areas, require site specific reports, appropriate for the level and type of hazards. Site specific reports should evaluate the risk to the site, as well as the risk the proposed development may pose to other properties.
d) Consider measures exceeding the National Flood Insurance Program.

Housing

In addition to location, the characteristics of the housing stock affect the level of risk posed by natural hazards. The table below identifies the types of housing most common throughout Linn County. Of particular interest are mobile homes, which account for about 12% of the housing. The highest percentage of mobile homes are in the cities of Tangent, Sodaville, and Waterloo. Mobile homes are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing the structures, because they are more prone to wind damage than wood-frame construction.[19] In other natural hazard events, such as earthquakes and floods, moveable structures like

[19] Ibid.

mobile homes are more likely to shift on their foundations and create hazardous conditions for occupants.

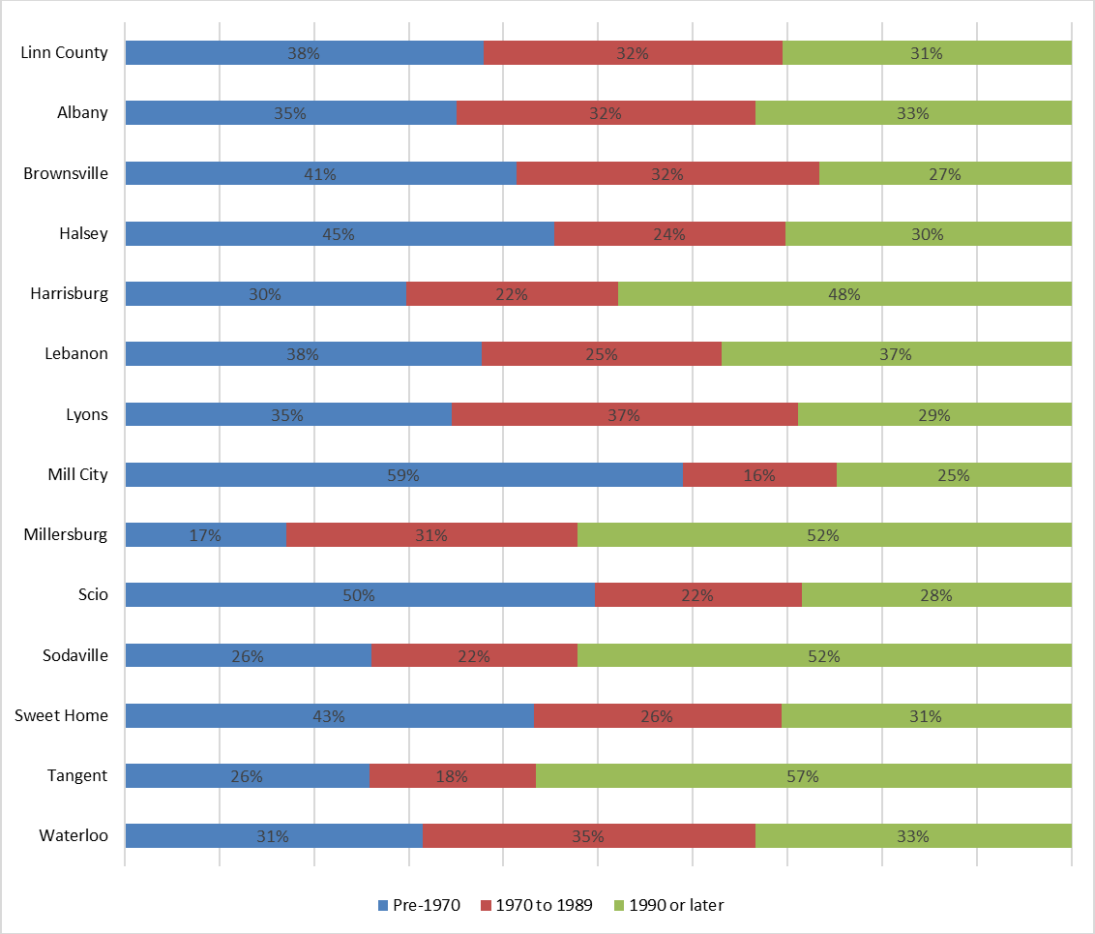
Table B-19 Housing Profile

Jurisdiction	Total Housing Units	Single Family		Multi-Family		Mobile Homes*	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Linn County	**49,005**	**34,733**	**71%**	**8,367**	**17%**	**5,905**	**12%**
Albany	21,095	14,720	70%	5,142	24%	1,233	6%
Brownsville	703	555	79%	35	5%	113	16%
Halsey	**410**	**349**	**85%**	**40**	**10%**	**21**	**5%**
Harrisburg	**1,292**	**970**	**75%**	**167**	**13%**	**155**	**12%**
Lebanon	**7,117**	**4,633**	**65%**	**2,038**	**29%**	**446**	**6%**
Lyons	**481**	**376**	**78%**	**16**	**3%**	**89**	**19%**
Mill City	734	598	81%	69	9%	67	9%
Millersburg	632	477	75%	67	11%	88	14%
Scio	**302**	**241**	**80%**	**37**	**12%**	**24**	**8%**
Sodaville	**138**	**100**	**72%**	**0**	**0%**	**38**	**28%**
Sweet Home	3,608	2,479	69%	545	15%	584	16%
Tangent	**403**	**229**	**57%**	**3**	**1%**	**171**	**42%**
Waterloo	**105**	**81**	**77%**	**0**	**0%**	**24**	**23%**

Source: Social Explorer, Table 97, U.S. Census Bureau, 2011-2015 American Community Survey
* Also includes boats, RVs, vans, etc. that are used as a residence.

Aside from location and type of housing, the year structures were built has implications. Seismic building standards were codified via the Uniform Building Code starting in 1974; more rigorous building code standards were passed in 1990s that accounted for the Cascadia earthquake fault. Therefore, homes built before the 1990s are more vulnerable to seismic events. Also in the 1970's, FEMA began assisting communities with floodplain mapping as a response to administer the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Upon receipt of floodplain maps, communities started to develop floodplain management ordinances to protect people and property from flood loss and damage. The table below illustrates the number and percent of homes built between 1970 and 2015. Countywide, about 38% of the housing stock was built prior to 1970, before the implementation of floodplain management ordinances. About 70% of the housing stock was built before 1990 and the codification of seismic building standards. Approximately one-third of Linn County's housing stock was built after 1990.

Figure B-8 Year Structure Built



Source: U.S. Census Bureau, 2011-2015 American Community Survey Estimates, Table DP04

Critical Facilities

Critical facilities are those facilities that are essential to government response and recovery activities (e.g., hospitals, police, fire and rescue stations, school districts and higher education institutions). The interruption or destruction of any of these facilities would have a debilitating effect on incident management.

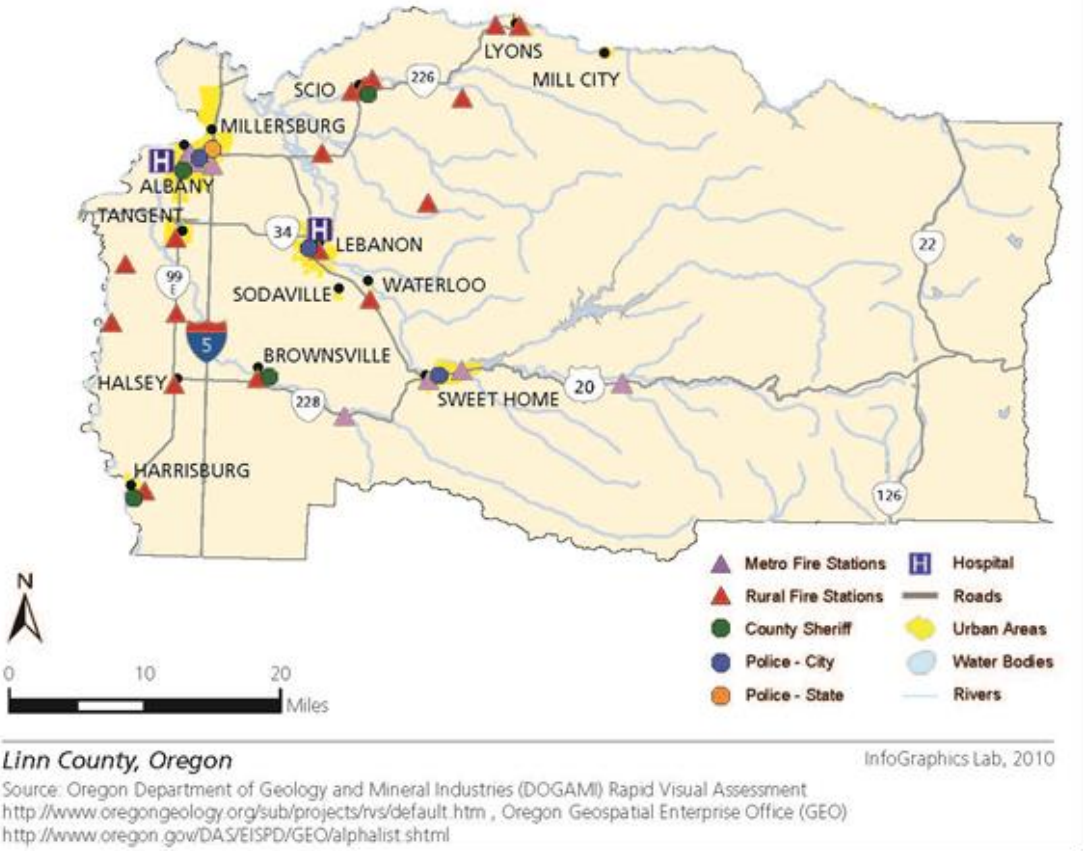
A critical facility is defined as a facility in either the public or private sector that provides essential products and services to the general public, such as preserving the quality of life in the County and fulfilling important public safety, emergency response, and disaster recovery functions. Critical facilities are shown on Figure B-9.

Critical facilities are those facilities that are essential to government response and recovery activities. These facilities include local police and fire stations, public works facilities, sewer and water facilities, hospitals, and shelters. Specifically, Linn County includes two hospitals with 131 beds, four police stations, and seven fire and rescue facilities[20].

[20] State Hospital Licensing Department, Local Sheriff Offices, Oregon State Fire Marshal.

Other critical and necessary facilities vital to the efficient delivery of key governmental services, or that may significantly impact the public's ability to recover from emergencies, include correctional institutions, public services buildings, law enforcement centers, courthouses, and juvenile service buildings.

Figure B-9 Linn County Critical Facilities



Emergency Facilities

Emergency facilities include law enforcement, fire and ambulance facilities, and emergency operations center (EOC) sites. The following tables list emergency facilities in Linn County.

Table B-20 Law Enforcement Facilities

Facility Description	Facility Address
Linn County Sheriff's Office:	
Main office, Jail, 911/Dispatch Center, EOC	1115 Jackson St. SE, Albany
Civil Division Substation	300 4th Ave. SW, Albany
Sheriff's Brownsville Substation	255 N. Main St., Brownsville
Sheriff's Harrisburg Substation	354 Smith St., Harrisburg
Sheriff's Lyons Substation	242 Fifth St., Lyons
Sheriff's Mill City Substation	274 SW Cedar St., Lyons
Sheriff's Millersburg Substation	4310 NE Woods Rd., Albany
Sheriff's Scio Substation	38957 N. Main St., Scio
Sheriff's Sweet Home Substation	1951 Main St., Sweet Home
Sheriff's Sweet Home Substation	3225 Hwy. 20, Sweet Home
Albany Police Department: Also secondary PSAP & dispatch for police	1117 Jackson St. SE, Albany
Lebanon Police Department: Also secondary PSAP & dispatch for police	40 E. Maple St., Lebanon
Sweet Home Police Department: Also PSAP/Dispatch for police & fire	1950 Main St., Sweet Home
Oregon State Police: Albany state police barracks	3400 Spicer Dr., Albany

Source: Linn County Emergency Management

Table B-21 Fire and Ambulance Facilities

Facility Description	Facility Address
Albany Fire Department	
Headquarters	333 Broadalbin, Albany
Station 11 – fire & ambulance	110 Sixth Ave SE
Station 12 – fire & ambulance	120 34th Ave. SE
Station 13 – fire & ambulance	1980 Three Lakes Rd. SE
Station 14 – fire & ambulance	1850 Gibson Hill NW
Brownsville Fire District	
Station 61	255 N. Main St. Brownsville
Halsey/Shedd/Peoria Fire District	
Halsey Fire Station 51	740 W. Second St., Halsey
Shedd Fire Station 52	31922 B St., Shedd
Peoria Fire Station 53	29399 Abraham Dr., Peoria
Oakville Fire Station 54	31919 Oakville Dr., Oakville

Source: Linn County Emergency Management

Table B-21 Fire and Ambulance Facilities (continued)

Facility Description	Facility Address
Harrisburg Fire District	
Station 41	500 Smith, Harrisburg
Jefferson Fire District	
Station 630	4310 NE Woods Rd., Albany
Lebanon Fire District	
Station 31 – fire & ambulance, joint w/City EOC	1050 W. Oak St., Lebanon
Station 32 – fire	34128 E. Lacomb Dr., Lacomb
Station 33 – fire	30570 Fairview Rd., Lebanon
Lyons Fire & Ambulance District	
Station 550 – fire & ambulance	1114 Main St., Lyons
Station 570 - fire	39079 Jordan Rd., Lyons
Mill City Fire District	
Station 790	400 S. First, Mill City
Scio Fire District	
Station 90, Admin., joint city/fire district EOC	38975 SW Sixth Ave.
Station 91	39023 Second Ave.
Station 92	37587 Crabtree Dr., Crabtree
Station 93	43042 Burmester Dr., Scio
Sweet Home Fire & Ambulance District	
Station 21 – fire & ambulance	1099 Long St., Sweet Home
Station 22	1390 47th Ave., Foster
Station 23	25995 First Ave., Crawfordsville
Station 24	Hwy. 20, Cascadia
Tangent Fire District	
Station 71	32053 Birdfoot Dr., Tangent

Source: Linn County Emergency Management

Table B-22 Emergency Operations Center Sites

Facility Description	Facility Address
Linn County Courthouse: alternate EOC, principal seat of county government, critical site for county information technology & GIS, sheriff's substation for the civil division	300 4th Ave. SW, Albany
Albany City Hall: principal seat of city government/ city EOC	333 Broadalbin, Albany
Brownsville City Hall: principal seat of city government/ EOC	255 N. Main St., Brownsville
Halsey City Hall: principal seat of city government, city EOC	773 W. First St., Halsey
Harrisburg City Hall: principal seat of city government/ EOC	354 Smith St., Harrisburg
Lyons City Hall: principal seat of city government	449 Fifth St., Lyons
Lebanon City Hall: principal seat of city government	925 Main St., Lebanon
Mill City Hall: principal seat of city government	252 SW Cedar St., Mill City
Millersburg City Hall: principal seat of city government/ EOC	4222 Old Salem Rd, Albany
Scio City Hall: principal seat of city government, city EOC	38957 NW 1st Ave., Scio
Sodaville City Hall: principal seat of city government/ EOC	30723 Sodaville Rd., Sodaville
Sweet Home City Hall: principal seat of city government/ EOC	140 12th Ave., Sweet Home
Tangent City Hall: principal seat of city government, city EOC	32166 Old Oak Dr., Tangent

Source: Linn County Emergency Management

Infrastructure Profile

Physical infrastructure such as dams, levees, roads, bridges, railways and airports support Linn County communities and economies. Due to the fundamental role that physical infrastructure plays both in pre- and post-disaster, they deserve special attention in the context of creating resilient communities.

Transportation networks, systems for power transmission, and critical facilities such as hospitals and police stations are all vital to the functioning of the region. Due to the fundamental role that infrastructure plays both pre-and post-disaster it deserves special attention in the context of creating more resilient communities. The information

documented in this section of the profile can provide the basis for informed decisions about how to reduce the vulnerability of Linn County's infrastructure to natural hazards. During an emergency, local transit systems can be shut down, affecting evacuations. In addition, roads may become unusable from localized flooding and severe winter storms can potentially disrupt the daily driving routine of county residents.

Bridges and Highways

Because of earthquake risk, the seismic vulnerability of the county's bridges is an important issue. Non-functional bridges can disrupt emergency operations, sever lifelines, and disrupt local and freight traffic. These disruptions may exacerbate local economic losses if industries are unable to transport goods. The county's bridges are part of the state and interstate highway system that is maintained by the Oregon Department of Transportation (ODOT) or that are part of regional and local systems that are maintained by the region's counties and cities.

The bridges in Linn County require ongoing management and maintenance due to the age and types of bridges. Modern bridges, which require minimum maintenance and are designed to withstand earthquakes, consist of pre-stressed reinforced concrete structures set on deep steel piling foundations.

Bridge inspection is provided by the Oregon State Highway Division. Bridges less than 20 feet in length are inspected by Linn County. All Linn County bridges are inspected at two year intervals. Bridges that are found to be in critical condition during an inspection are prioritized for immediate replacement. Continued repair, maintenance and widening of bridges will be necessary over the next 20 years. Linn County is working closely with the Oregon Department of Transportation to inventory and rank all the County's bridges with respect to earthquake response.

Three bridges in the county are considered too narrow. These are the Brownsville Bridge, the Scio Bridge and the Mill City Bridge. Linn and Benton counties are separated by the Willamette River so there are no land connections between the two counties. There are only two bridge crossing points linking the two counties, comprising five total bridges. Two are on Highway 20 in Albany and three are on Highway 34 at Corvallis.

The Van Buren Street Bridge linking Linn County and the City of Corvallis on Highway 34 is in need of improvement or replacement. Damage to any of these crossings could impact the economies of the two counties. These inter-county routes may become strained with increased development and commuting traffic.

The table below shows the structural condition of bridges in the region. A distressed bridge is a condition rating used by the Oregon Department of Transportation (ODOT) indicating that a bridge has been identified as having a structural or other deficiency, while a deficient bridge is a federal performance measure used for non-ODOT bridges; the ratings do not imply that a bridge is unsafe.[21] The table shows that the county has a higher percentage of bridges that are distressed and/ or deficient (23%), than does the state (21%). About 29% of

[21] Oregon. Bridge Engineering Section (2012). 2012 Bridge Condition Report. Salem, Oregon: Bridge Section, Oregon Department. of Transportation.

the county and 18% of the city owned bridges within Linn County are distressed, compared to 10% of State Owned (ODOT) bridges.

Table B-23 Bridge Inventory

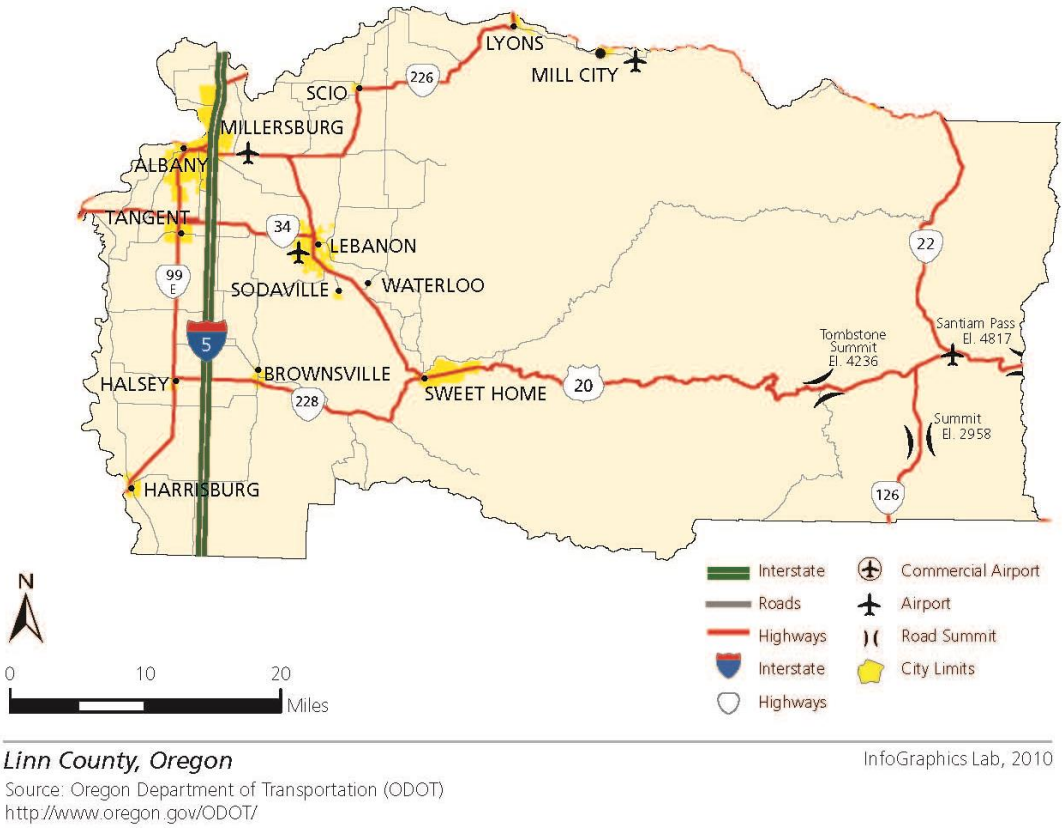
	Bridge Condition	Oregon	Region 3	Linn
State Owned	Distressed	610	118	13
	Sub-total	2,718	610	142
	Percent Distressed	22%	19%	10%
County Owned	Deficient	633	194	88
	Sub-total	3,420	942	299
	Percent Distressed	19%	21%	29%
City Owned	Deficient	160	44	7
	Sub-total	614	208	39
	Percent Deficient	26%	21%	18%
Other Owned	Deficient	40	6	2
	Sub-total	115	24	4
	Percent Deficient	35%	25%	50%
Area Total (All Owners)	Deficient	1,443	362	110
	Sub-total	6,769	1,741	474
	Percent Deficient	21%	21%	23%
Historic Covered		334	71	11

Source: Oregon Department of Transportation, 2014; Oregon Department of Transportation (2013), Oregon's Historic Bridge Field Guide
Note: ODOT bridge classifications overlap and sub-total is not used to calculate percent distressed, calculation for ODOT distressed bridges accounts for this overlap.

A well-developed network of local rural highways and county roads connects the Linn County communities to each other and to the region. Interstate 5 (I-5) is the major north-south freeway through Linn County and is the main route for vehicles traveling between Eugene and Portland and between Washington and California. Highway 99E runs parallel to I-5 and serves the communities of Harrisburg, Halsey, Shedd, Tangent, and Albany, as well as providing a backup route to the freeway. Other state highways the serve Linn County include:

- US Route 20 -- Runs from Newport at the Oregon Coast east through Corvallis, Albany, Lebanon, Sweet Home and then continues beyond eastern Oregon;
- State Highway 34 – Runs from Waldport at the Oregon Coast east through Corvallis, Albany and Lebanon;
- State Highway 226 – Runs from US Route 20 near Crabtree northeasterly through Scio and Lyons to Marion County; and
- State Highway 228 – Runs from Halsey east across I-5 to Brownsville and Sweet Home.

Figure B-10 Linn County Transportation Routes



Lifeline Routes

Lifeline routes are critical transportation routes that are vital to continued public safety, mobility and commerce in the event of a natural disaster. The ODOT has identified state highways and important secondary lifeline routes in Linn County. The County designates the ODOT lifeline routes in Linn County as Priority 1 routes. Priority 1 routes receive the highest priority for emergency road maintenance in the event of road closures.

The Linn County Road Department is divided into five maintenance districts. The lifeline route priority maps are attached to the end of this section. The lifeline route maps are organized by maintenance district and show the emergency maintenance classification for Priority 1, Priority 2, and Priority 3 routes.

Dams

Dam failures can occur rapidly and with little warning. Fortunately, most failures result in minor damage and pose little or no risk to life safety. However, the potential for severe damage still exists. The Oregon Water and Resources Department has inventoried all dams located in Oregon and Linn County. There are seven dams that are categorized as high hazard, and one dam categorized as significant hazard; the Carmen Diversion.

Table B-24 Linn County Dam Inventory

Threat Potential	Number	Name
High	7	Big Cliff Dam, Detroit Reservoir, Green Peter Reservoir, Foster Reservoir, Foster Log Pond, Trail Bridge Reg. Reservoir, Smith River
Significant	1	Carmen Diversion
Low	11	Helms Reservoir, American Can Dams, Freres Log Pond, Mt. Jefferson Lumber Log Pond, Bentz Bros. Pond 3, Freres Lumber Company Log Pond, Johnson Creek Reservoir (Linn), Gann Reservoir #1 (Linn), Macedo Dairy Lagoon, Tadmore Lake Dam, Meritt Dairy (Lagoon)
Total	19	-

Source: Oregon Water Resources Department, "Dam Inventory Query"

Transportation

It is important to understand the transportation network and commuting characteristics of your community in order to maintain an effective response system to natural hazards. The communities of Linn County are linked together and to other regions of the state by Interstate 5, U.S. Highway 20, State Highway 34, State Highway 99E, and a network of regional and local rural highways and county roads. Highway 99E runs north to south, providing connections to Tangent and Albany. Highway 20 and Highway 22, run east to west, providing the main access for the rural areas of Linn County. Highway 20 has an average daily traffic count of 22,700 vehicles per day.[22]

The major providers of public transportation include Linn-Benton Loop Bus, and Albany and Corvallis Transit Systems. Railroads and airports provide other modes of transportation in the county. Linn County is served by the Burlington Northern & Santa Fe (BNSF), Union Pacific (UP), Portland & Western (P&W), and Albany & Eastern (A&E) railroads.[23] Facilities that support air travel include four (4) public airports, 20 private airstrips, and one helipad.[24]

Utility Lifelines

Utility lifelines are the resources that the public relies on daily, (i.e., electricity, fuel and communication lines). If these lines fail or are disrupted, the essential functions of the community can become severely impaired. Utility lifelines are closely related to physical

[22] Ibid
[23] Albany Transportation System Plan, 2009.
[24] Federal Aviation Administration, "Airport Facilities Data," Airport Data (5010) and Contact Information, http://www.faa.gov/airports_airtraffic/airports/, accessed February 2, 2010.

infrastructure, (i.e., dams and power plants) as they transmit the power generated from these facilities.

The electric, oil, and gas lines that run through the Mid/Southern Willamette region are both municipally and privately owned. A network of electricity transmission lines running through the Mid/Southern Willamette region allows Oregon utility companies to exchange electricity with other states and Canada. Most of the natural gas Oregon uses originates in Alberta, Canada. Northwest Natural Gas owns one main natural gas transmission pipeline. An oil pipeline originating in the Puget Sound runs through the region and terminates in Eugene. These lines may be vulnerable to severe, but infrequent natural hazards, such as earthquakes.[25]

Synthesis

Given the unique dependent, rural nature of Linn County, maintaining the quality of built capacity throughout the area is critical. The planning considerations seemingly most significant are contingency planning for medical resources and lifeline systems due to the imminent need for these resources. Functionality of hospitals and dependent care facilities are a significant priority in providing for Linn County residents. One factor that is critical to consider in planning is the availability of medical beds in local hospitals and dependent care facilities. In the event of a disaster, medical beds may be at a premium providing not just for the growing elderly population, but the entire County. Other facilities to consider are utility lifelines and transportation lifelines such as, airports, railways, roads and bridges with surrounding counties to acquire utility service and infrastructure repair.

While these elements are traditionally recognized as part of response and recovery from a natural disaster, it is essential to start building relationships and establishing contractual agreements with entities that may be critical in supporting community resilience.

[25] 2012 Oregon NHMP

Community Connectivity Capacity

Community connectivity capacity places strong emphasis on social structure, trust, norms, and cultural resources within a community. In terms of community resilience, these emerging elements of social and cultural capital will be drawn upon to stabilize the recovery of the community. Social and cultural capitals are present in all communities; however, it may be dramatically different from one city to the next as these capitals reflect the specific needs and composition of the community residents.

Social Systems and Service Providers

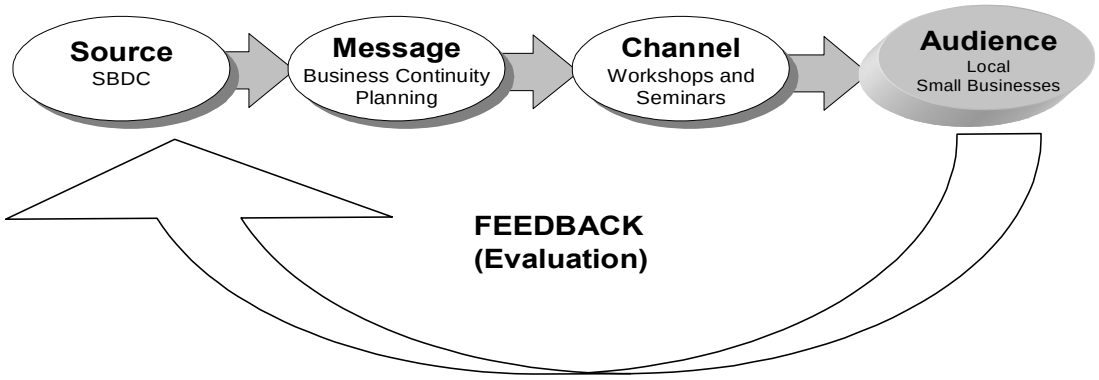
Social systems include community organizations and programs that provide social and community-based services, such as employment, health, senior and disabled services, professional associations and veterans' affairs for the public. In planning for natural hazard mitigation, it is important to know what social systems exist within the community because of their existing connections to the public. Often, actions identified by the plan involve communicating with the public or specific subgroups within the population (e.g. elderly, children, low income, etc.). Linn County can use existing social systems as resources for implementing such communication-related activities because these service providers already work directly with the public on a number of issues, one of which could be natural hazard preparedness and mitigation. The presence of these services are more predominantly located in urbanized areas of the County (towns of Linn County), this is synonymous with the general urbanizing trend of local residents.

The following is a brief explanation of how the communication process works and how the community's existing social service providers could be used to provide natural hazard related messages to their clients.

There are five essential elements for communicating effectively to a target audience:

1. The source of the message must be credible,
2. The message must be appropriately designed,
3. The channel for communicating the message must be carefully selected,
4. The audience must be clearly defined, and
5. The recommended action must be clearly stated and a feedback channel established for questions, comments and suggestions.

Figure B-11 Communication Process



Source: Adapted from the U.S. Environmental Protection Agency Radon Division's outreach program

The following table provides a list of existing social systems within Linn County. The table provides information on each organization or program's service area, types of services offered, populations served, and how the organization or program could be involved in natural hazard mitigation. The three involvement methods identified in the table are defined below:

- Education and outreach – organization could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.
- Information dissemination – organization could partner with the community to provide hazard related information to target audiences.
- Plan/project implementation – organization may have plans and/or policies that may be used to implement mitigation activities or the organization could serve as the coordinating or partner organization to implement mitigation actions.

The information provided in the table can also be used to complete action item worksheets by identifying potential coordinating agencies and internal and external partners.

Civic Engagement

Civic engagement and involvement in local, state and national politics are important indicators of community connectivity. Those who are more invested in their community may have a higher tendency to vote in political elections. The 2012 Presidential General Election resulted in 82.23% voter turnout in the County as of November 6th, 2012.[26] These results are relatively equal to voter participation reported across the State (82.8%).[27] Other indicators such as volunteerism, participation in formal community networks and community

[26] Linn County archives, http://www.co.linn.or.us/elections/ElectionArchive/20121106_Results.htm

[27] Oregon Blue Book, Voter Participation. http://bluebook.state.or.us/state/elections/elections04.htm

charitable contributions are examples of other civic engagement that may increase community connectivity.

Cultural Resources

Historic Places

Historic and cultural resources such as historic structures and landmarks can help to define a community and may also be sources for tourism revenue. Protecting these resources from the impact of disasters is important because they have an important role in defining and supporting the community. According to the National Register Bulletin, "a contributing resource is a building, site, structure, or object adds to the historic associations, historic architectural qualities, or archeological values for which a property is significant because it was present during the period of significance, related to the documented significance of the property, and possesses historical integrity or is capable of yielding important information about the period; or it independently meets the National Register criteria."[28] If a structure does not meet these criteria, it is considered to be non-contributing.

The table below identifies the number of eligible/significant (ES) and eligible/contributing (EC) historical sites in Linn County. The table also shows how many ES and EC sites are listed on the National Register and are located and in incorporated cities, and how many contributing and non-contributing resources are located at ES and EC sites. Overall, there are a total of 1,858 historically registered places in Linn County.

Table B-25 Linn County Historic Places

Eligible Sites	Total Sites	Listed on the National Register	Within a National Register Historic District
ES-Significant	108	62	3
EC-Contributing	1,750	1	636
Total	**1,858**	**63**	**639**

Source: Oregon Historic Sites Database

Historic and cultural resources such as historic structures and landmarks can help to define a community and may also be sources of tourism dollars. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important. As an important historical and cultural resource, the Willamette River offers natural beauty, abundant wildlife, and diverse recreational opportunities.[29] In addition to natural resources, Linn County also has nearly 70 structures on the National Register of Historic Places[30]:

- Aegerter, David and Maggie, Barn, Scio, Oregon
- Albany Custom Mill (Water Street Station), Albany, Oregon

[28] U.S. Department of the Interior, National Park Service, Cultural Resources, National Register Bulletin 16A: "How to Complete the National Register Registration Form".

[29] Oregon State Marine Board & Oregon State Parks, "1998 Willamette River Recreation Guide," http://www.oregon.gov/OSMB/library/docs/WillametteGuide.pdf, accessed January 23, 2010

[30] Oregon Historic Sites Database, http://heritagedata.prd.state.or.us/historic/, accessed April 26, 2017

- Albany Downtown Commercial Historic District, Albany, Oregon
- Albany Hebrew Cemetery, Albany, Oregon
- Albany Municipal Airport Historic District, Albany, Oregon
- Angell-- Brewster House, Lebanon, Oregon
- Archibald, Steven and Elizabeth, Farmstead (Archibald-Ropp Farmstead), Tangent, Oregon
- Barber, Granville H., House, Albany, Oregon
- Baker, Hiram, House, Lebanon, Oregon
- Booth, Dr. J.C., House, Lebanon, Oregon
- Boston Flour Mill (Thompson Flouring Mill), Shedd, Oregon
- Brown, Hugh Leeper, Barn, Brownsville, Oregon
- Brown, John and Amelia, Farmhouse (Atavista Farm), Brownsville, Oregon
- Cascadia Cave (35 LIN 11), Cascadia, Oregon
- Chamberlain, George Earle, House, Albany, Oregon
- Chambers, Matthew C., Barn, Albany, Oregon
- Cochran, William, Barn (Eggleston, Mattie and Wingo, Barn), Brownsville, Oregon
- Cooley, George C., House, Brownsville, Oregon
- Crabtree Creek—Hoffman Covered Bridge, north of Crabtree, Oregon
- Crandall, Louis A., House, Lebanon, Oregon
- Crawfordsville Bridge, Crawfordsville, Oregon
- Dawson, Alfred, House, Albany, Oregon
- Elkins Flour Mill, Lebanon, Oregon
- Fields, Hugh, House, Brownsville, Oregon
- First Baptist Church of Brownsville, Brownsville, Oregon
- First Evangelical Church of Albany, Albany, Oregon
- Flinn Block, Building, Albany, Oregon
- Hackleman Historic District, Albany, Oregon
- Hamilton, Joseph, Farm Group, Albany, Oregon
- Hannah Bridge, Scio, Oregon
- Harrisburg Odd Fellows Hall, Harrisburg, Oregon
- Hochstedler, George, House, Albany, Oregon
- Howe, C.J., Building, Brownsville, Oregon
- Independence Prairie Ranger Station, Willamette National Forest, Marion Forks, Oregon
- Larwood Bridge, east of Crabtree, Oregon
- Lebanon Pioneer Cemetery, Lebanon, Oregon
- Lebanon Southern Pacific Railroad Depot, Lebanon, Oregon
- Macpherson, Hector and Margaret, Barn, Albany, Oregon
- Maurer, Joseph and Barbar, House, Lebanon, Oregon
- Methodist Episcopal Church South (Bethesda Heritage Church), Albany, Oregon
- Milde, Gottlieb and Della, Barn, Brownsville, Oregon
- Monteith Historic District, Albany, Oregon
- Monteith, Thomas and Walter, House, Albany, Oregon
- Moore, John and Mary, House, Brownsville, Oregon
- Moyer, John M., House, Brownsville, Oregon
- Mt. Pleasant Presbyterian Church, Stayton, Oregon

- Parker, Moses, House, Albany, Oregon
- Perry, E.C., Building, Scio, Oregon
- Porter-Brasfield House, Shedd, Oregon
- Ralston, John and Lottie, Cottage, Lebanon, Oregon
- Ralston, John, House, Albany, Oregon
- Rock Hill School, Lebanon, Oregon
- Ross- - Averill House, Brownsville, Oregon
- Ryan, Michael and Mary, Barn, Scio, Oregon
- Short Bridge, Cascadia, Oregon
- Smith, James Alexander and Elmarion, Barn and Lame – Smith House, Halsey, Oregon
- St. Mary's Roman Catholic Church, Albany, Oregon
- Starr and Blakely Drug Store, Brownsville, Oregon
- Stellmacher, Gus and Emma, Farmstead, Tangent, Oregon
- Thomas Creek – Gilkey Covered Bridge, north of Crabtree, Oregon
- Thomas Creek – Shimanek Covered Bridge, east of Scio, Oregon
- United Presbyterian Church and Rectory, Albany, Oregon
- United Presbyterian Church of Shedd (Valley Rose Chapel), Shedd, Oregon
- Weddle Bridge, northwest of Crabtree, Oregon
- Wesely, Joseph, House and Barn, Scio, Oregon
- Wigle Cemetery, Harrisburg, Oregon
- Wigle, Abraham and Mary, House, Harrisburg, Oregon
- Wigle, Jacob and Maranda K., Farmstead, Brownsville, Oregon
- Z.C.B.J. Tolstoj Lodge No. 224, Scio, Oregon

Libraries and Museums

Libraries and museums develop cultural capacity and community connectivity as they are places of knowledge and recognition, they are common spaces for the community to gather, and can serve critical functions in maintaining the sense of community during a disaster. They are recognized as safe places and reflect normalcy in times of distress. There are currently nine community libraries in Linn County located in Albany, Brownsville, Lebanon, Lyons, Scio, and Sweet Home. There are approximately eleven museums in Linn County, which have an emphasis on the history and culture of the region.

Cultural Events

Other such institutions that can strengthen community connectivity are the presence of festivals and organizations that engage diverse cultural interests. Examples of events and institutions include the Northwest Art and Air Festival in Albany along with the Bi-Mart Country Music Festival. Not only do these events bring revenue into the community, they have potential to improve cultural competence and enhance the sense of place. Cultural connectivity is important to community resilience, as people may be more inclined to remain in the community because they feel part of the community and culture.

Community Stability

Community stability is a measure of rootedness in place. It is hypothesized that resilience to a disaster stems in part from familiarity with place, not only for navigating the community during a crisis, but also accessing services and other supports for economic or social challenges.[31] The table below estimates residential stability across Linn County. It is calculated by the number of people who have lived in the same house and those who have moved within the same region (county) a year ago, compared to the percentage of people who have migrated into the region. Linn County overall has geographic stability rating of about 93% (i.e., 93% of the population lived in the same house or moved within the county).

Table B-26 Regional Residential Stability

Jurisdiction	Population	Geographic Stability	Same House	Moved Within Same County
Linn County	**117,875**	**93%**	**83%**	**10%**
Albany	51,073	93%	79%	13%
Brownsville	1,548	93%	83%	10%
Halsey	**1,117**	**95%**	**81%**	**14%**
Harrisburg	**3,650**	**96%**	**93%**	**3%**
Lebanon	**15,733**	**92%**	**77%**	**15%**
Lyons	**1,150**	**95%**	**95%**	**0%**
Mill City	1,736	91%	85%	5%
Millersburg	1,658	95%	88%	7%
Scio	**817**	**93%**	**87%**	**5%**
Sodaville	**365**	**92%**	**90%**	**1%**
Sweet Home	9,086	90%	79%	11%
Tangent	**999**	**90%**	**86%**	**4%**
Waterloo	**264**	**99%**	**90%**	**9%**

Source: Social Explorer, Table 130, U.S. Census Bureau, 2011-2015 American Community Survey Estimates

Homeownership

Housing tenure describes whether residents rent or own the housing units they occupy. Homeowners are typically more financially stable but are at risk of greater property loss in a post-disaster situation. People may rent because they choose not to own, they do not have the financial resources for home ownership, or they are transient.

Collectively, about two-thirds of the occupied housing units in Linn County are owner-occupied. Conversely, about one-third are renter occupied; Lebanon, Sweet Home, and Albany have the highest percentages of renter-occupied housing. Brownsville, Lyons, and Waterloo have the highest percentage of vacant housing units.

[31] Cutter, Susan, Christopher Burton, Christopher Emrich. "Disaster Resilience Indicators for Benchmarking Baseline Conditions". Journal of Homeland Security and Emergency Management.

Table B-27 Housing Tenure and Vacancy

Jurisdiction	Total Occupied Units	Owner-occupied		Renter-occupied		Vacant^	
		Estimate	Percent	Estimate	Percent	Estimate	Percent
Linn County	45,100	28,988	64%	16,112	36%	3,329	7%
Albany	19,729	11,636	59%	8,093	41%	1,319	6%
Brownsville	598	463	77%	135	23%	100	14%
Halsey	389	257	66%	132	34%	21	5%
Harrisburg	1,174	857	73%	317	27%	76	6%
Lebanon	6,509	3,590	55%	2,919	45%	565	8%
Lyons	417	300	72%	117	28%	56	12%
Mill City	669	453	68%	216	32%	56	8%
Millersburg	592	476	80%	116	20%	40	6%
Scio	288	210	73%	78	27%	14	5%
Sodaville	129	98	76%	31	24%	9	7%
Sweet Home	3,335	1,928	58%	1,407	42%	190	5%
Tangent	380	264	69%	116	31%	23	6%
Waterloo	86	73	85%	13	15%	12	11%

Source: Social Explorer, Table 94, U.S. Census Bureau, 2011-2015 American Community Survey Estimates
* = Functional vacant units, computed after removing seasonal, recreational, or occasional housing units from vacant housing units.

According to Cutter, wealth increases resiliency and recovery from disasters. Renters often do not have personal financial resources or insurance to assist them post-disaster. On the other hand, renters tend to be more mobile and have fewer assets at risk of natural hazards.[32] In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or unaffordable post-disaster.

Synthesis

Linn County has distinct social and cultural resources that work in favor to increase community connectivity and resilience. Sustaining social and cultural resources, such as social services and cultural events, may be essential to preserving community cohesion and a sense of place. The presence of larger communities makes additional resources and services available for the public. However, it is important to consider that these amenities may not be equally distributed to the rural portions of the County and may produce implications for recovery in the event of a disaster.

In the long-term, it may be of specific interest to the Linn County to evaluate community stability. A community experiencing instability and low homeownership may hinder the effectiveness of social and cultural resources, distressing community coping and response mechanisms.

[32] Cutter, S. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*.

Political Capacity

Political capacity is recognized as the government and planning structures established within the community. In terms of hazard resilience, it is essential for political capital to encompass diverse government and non-government entities in collaboration; as disaster losses stem from a predictable result of interactions between the physical environment, social and demographic characteristics and the built environment.[33] Resilient political capital seeks to involve various stakeholders in hazard planning and works towards integrating the Natural Hazard Mitigation Plan with other community plans, so that all planning approaches are consistent.

Government Structure

Local governments and their departments can encourage natural hazard mitigation at the county level by integrating mitigation strategies into existing plans, policies, and programs. If mitigation strategies are successfully integrated, mitigation becomes part of a government's daily activities. This section describes Linn County's county government departments that can be useful for hazards mitigation.

Linn County's governing jurisdiction includes all areas not governed by the Bureau of Land Management, Willamette National Forest, or State owned land. Linn County has three (3) County Commissioners, elects an assessor, county clerk, district attorney, sheriff, treasurer, and consists of the following departments.

Business Development: provides business planning and counseling, financial counseling, loan packaging, and financial assistance to local business. This department can provide information to local businesses about incorporating hazard mitigation into their business practices

Circuit Court: provide fair and accessible justice services that protect the rights of individuals, preserve community welfare and inspire public confidence.

County Attorney: responsible for responding to legal issues of Linn County. Serves as a legal resource center for county departments and personnel.

Extension Services: The Linn County Office of the Oregon State University Extension Service provides research-based educational information and programs in agriculture, forestry, 4-H/youth and Family and Community Development for the citizens of Linn County. Extension services can assist in disseminating information about natural hazards mitigation to the public.

Fair & Expo Services: responsible for assuring the long-term viability of the Linn County Fairgrounds, presenting an exceptional Annual Fair which celebrates the heritage and diversity of Linn County, and providing year-round opportunities for facility usage. The fair and expo services department can incorporate mitigation activities into their buildings and operations to reduce the impact of hazards to the Linn County Fairgrounds.

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

GIS: Geographic Information System (GIS) is designed for developing, maintaining, analyzing and displaying digital spatial data. The GIS department can play a role in identifying areas vulnerable to natural hazards.

Health Services: responsible for providing health related programs and services to citizens of Linn County. Programs and services include; Alcohol, drug, and problem gambling prevention and treatment; Commission on Children and Families; Development Disabilities programs; Environmental Health programs; and Mental Health Services. Health services can play a role in mitigation by informing the public about natural hazards that Linn County faces.

Justice Courts: responsible for carrying out legal processes regarding certain civil and criminal actions that arise outside city limits of any municipality. Linn County Justice Courts are located in Harrisburg, Lebanon, and Sweet Home.

Juvenile: increase public safety by coaching youth and families to make positive choices through education, skill building and community partnerships.

Law Library: legal research library serving citizens and legal professionals.

Museums: holds historical information representing all of Linn County.

Parks: responsible for maintaining or developing public recreational areas. This includes but is not limited to hiking trails, camping and swimming areas, boat access points, and other points of interest included in the 22 county parks. Parks can be a partner in implementing mitigation action items to reduce the impact of hazards on local parks.

Planning and Building: responsible for planning and building tasks such as permitting, code enforcement, examination of plans and buildings, code violations, and implementation of the county comprehensive plan. Planning and building departments play an important role by creating and/or implementing policies related to hazards mitigation.

Roads: responsible for the maintenance of approximately 1,139 miles of roadway and 325 bridges, as well as hundreds of culverts and other minor structures. The road department can integrate action items related to mitigating hazards to road infrastructure.

Surveyor: responsible for providing the citizens of Linn County with professional surveying expertise and advice, and carry out the surveying duties required by the Oregon Revised Statutes.

Tax Collector: responsible for collecting property taxes from each property owner in Linn County.

Existing Plans and Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports or studies. Plans and policies already in existence have support from local residents, businesses and policy makers. Many

land-use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs.[34]

The Linn County multi-jurisdictional Natural Hazards Mitigation Plan includes a range of recommended action items that, when implemented, will reduce the county's vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the county's existing plans and policies. Linking existing plans and policies to the Natural Hazards Mitigation Plan helps identify what resources already exist that can be used to implement the action items identified in the Plan. Implementing the natural hazards mitigation plan's action items through existing plans and policies increases their likelihood of being supported and getting updated, and maximizes the county's resources.

The following is a list of active plans and policies in Linn County that are relevant to natural hazards mitigation:

Linn County Comprehensive Plan

Date of Last Revision: 2001

Author/Owner: Linn County

Description: Provides a general path for the course of growth and development of Linn County. The Comprehensive Plan is charted by the map, goals, and policies of this Comprehensive Plan in conjunction with the comprehensive plans of the cities in Linn County.

Relationship to Natural Hazard Mitigation Planning: The Linn County Comprehensive Plan guides land use within the county. Goals of preserving resources and protecting life from hazards can be linked to action items that guide development to reduce the county's risk to natural hazards. Hazard mitigation can be linked to action items for how the County will implement Oregon Statewide Planning Goal 7 requirements.

Linn County Community Wildfire Protection Plan

Date of Last Revision: 2007

Author/Owner: EcoNorthwest/Linn County

Description: This plan describes Linn County's risk from wildfires as well as the specific steps that it will take to reduce that risk now and in the future. It is a Community Wildfire Protection Plan (CWPP), a collaborative effort to reduce the potential for future loss of life and property resulting from wildfire. This CWPP is intended to assist Linn County in reducing its risk from WUI wildfire hazards by identifying resources, information, and strategies for risk reduction. It will also help to guide and coordinate mitigation activities throughout the County.

Relationship to Natural Hazard Mitigation Planning: Action items contained within this wildfire protection plan are efforts intended to mitigate losses from future wildfires.

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

Linn County Floodplain Management Code

Date of Last Revision: 2016

Author/Owner: Linn County

Description: Regulations which apply to all areas of special flood hazard within the jurisdiction of Linn County, except areas within incorporated cities.

Relationship to Natural Hazard Mitigation Planning: Provisions of the Floodplain Management Code are to promote public safety and welfare and minimize flood related losses.

Linn County Transportation Plan Code

Date of Last Revision: 2005

Author/Owner: Linn County

Description: The Transportation Plan contains brief background descriptions of facilities and issues followed by the complete list of adopted County transportation policies. In addition, sections of the Plan list and prioritize proposed transportation projects.

Relation to Natural Hazard Mitigation Planning: Transportation systems assist in evacuation and response in the event of a natural hazard. Action items in the County's Natural Hazard Plan that are aimed at making the County's transit system more disaster resistant to reduce potential damage and risk can be linked to this Plan.

Appendix C: Economic Analysis of Natural Hazard Mitigation Projects

This appendix was developed by the Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center. It has been reviewed and accepted by the Federal Emergency Management Agency as a means of documenting how the prioritization of actions shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

The appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects. It describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies. Information in this section is derived in part from: The Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon Military Department – Office of Emergency Management, 2000), and Federal Emergency Management Agency Publication 331, *Report on Costs and Benefits of Natural Hazard Mitigation*. This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how an economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred. Evaluating possible natural hazard mitigation activities provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables. First, natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, law enforcement, utilities, and schools. Second, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars. Third, many of the impacts of such events produce "ripple-effects" throughout the community, greatly increasing the disaster's social and economic consequences.

While not easily accomplished, there is value from a public policy perspective, in assessing the positive and negative impacts from mitigation activities, and obtaining an instructive benefit/cost comparison. Otherwise, the decision to pursue or not pursue various mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

Mitigation Strategy Economic Analyses Approaches

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into three general categories: benefit/cost analysis, cost-effectiveness analysis and the STAPLE/E approach. The distinction between the three methods is outlined below:

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by the state Oregon Military Department – Office of Emergency Management (OEM), the Federal Emergency Management Agency, and other state and federal agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

Benefit/cost analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation activity. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoiding future damages, and risk. In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented. A project must have a benefit/cost ratio greater than 1 (i.e., the net benefits will exceed the net costs) to be eligible for FEMA funding.

Cost-Effectiveness Analysis

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

Investing in Public Sector Mitigation Activities

Evaluating mitigation strategies in the public sector is complicated because it involves estimating all of the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. Some benefits cannot be evaluated monetarily, but still affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions which involve a diverse set of beneficiaries and non-market benefits.

Investing in Private Sector Mitigation Activities

Private sector mitigation projects may occur on the basis of one or two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether a private entity or a public agency, required to conform to a mandated standard may consider the following options:

1. Request cost sharing from public agencies;
2. Dispose of the building or land either by sale or demolition;
3. Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
4. Evaluate the most feasible alternatives and initiate the most cost effective hazard mitigation alternative.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to prospective purchases. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of a sale regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

STAPLE/E Approach

Considering detailed benefit/cost or cost-effectiveness analysis for every possible mitigation activity could be very time consuming and may not be practical. There are some alternate approaches for conducting a quick evaluation of the proposed mitigation activities which could be used to identify those mitigation activities that merit more detailed assessment. One of those methods is the STAPLE/E approach.

Using STAPLE/E criteria, mitigation activities can be evaluated quickly by steering committees in a synthetic fashion. This set of criteria requires the committee to assess the mitigation activities based on the Social, Technical, Administrative, Political, Legal, Economic and Environmental (STAPLE/E) constraints and opportunities of implementing the particular mitigation item in your community. The second chapter in FEMA's How-To Guide "Developing the Mitigation Plan – Identifying Mitigation Actions and Implementation Strategies" as well as the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process" outline some specific considerations in analyzing each aspect. The following are suggestions for how to examine each aspect of the STAPLE/E approach from the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process."

Social: Community development staff, local non-profit organizations, or a local planning board can help answer these questions.

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- Will the action cause social disruption?

Technical: The city or county public works staff, and building department staff can help answer these questions.

- Will the proposed action work?
- Will it create more problems than it solves?

- Does it solve a problem or only a symptom?
- Is it the most useful action in light of other community goals?

Administrative: Elected officials or the city or county administrator, can help answer these questions.

- Can the community implement the action?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political: Consult the mayor, city council or city board of commissioners, city or county administrator, and local planning commissions to help answer these questions.

- Is the action politically acceptable?
- Is there public support both to implement and to maintain the project?

Legal: Include legal counsel, land use planners, risk managers, and city council or county planning commission members, among others, in this discussion.

- Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
- Are there legal side effects? Could the activity be construed as a taking?
- Is the proposed action allowed by the comprehensive plan, or must the comprehensive plan be amended to allow the proposed action?
- Will the community be liable for action or lack of action?
- Will the activity be challenged?

Economic: Community economic development staff, civil engineers, building department staff, and the assessor's office can help answer these questions.

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs taken into account?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private?)
- How will this action affect the fiscal capability of the community?
- What burden will this action place on the tax base or local economy?
- What are the budget and revenue effects of this activity?

- Does the action contribute to other community goals, such as capital improvements or economic development?
- What benefits will the action provide? (This can include dollar amount of damages prevented, number of homes protected, credit under the CRS, potential for funding under the HMGP or the FMA program, etc.)

Environmental: Watershed councils, environmental groups, land use planners and natural resource managers can help answer these questions.

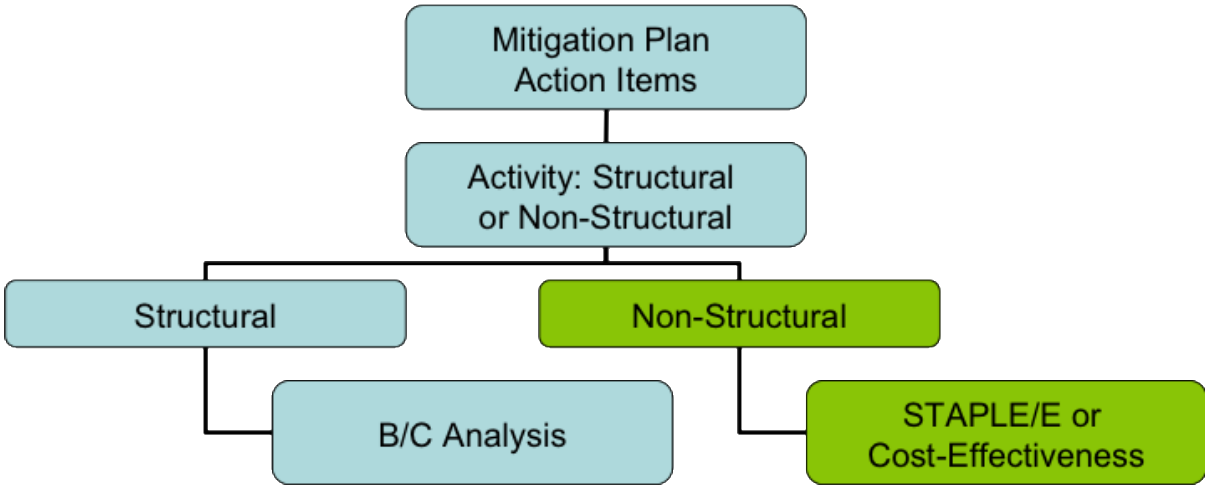
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

The STAPLE/E approach is helpful for doing a quick analysis of mitigation projects. Most projects that seek federal funding and others often require more detailed benefit/cost analyses.

When to use the Various Approaches

It is important to realize that various funding sources require different types of economic analyses. The following figure is to serve as a guideline for when to use the various approaches.

Figure D-1 Economic Analysis Flowchart



Source: Oregon Partnership for Disaster Resilience. 2005.

Implementing the Approaches

Benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E are important tools in evaluating whether or not to implement a mitigation activity. A framework for evaluating mitigation activities is outlined below. This framework should be used in further analyzing the feasibility of prioritized mitigation activities.

1. Identify the Activities

Activities for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation projects can assist in minimizing risk to natural hazards, but do so at varying economic costs.

2. Calculate the Costs and Benefits

Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate activities. Potential economic criteria to evaluate alternatives include:

- ***Determine the project cost***. This may include initial project development costs, and repair and operating costs of maintaining projects over time.
- ***Estimate the benefits***. Projecting the benefits, or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment. This is difficult to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.
- ***Consider costs and benefits to society and the environment***. These are not easily measured, but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.
- ***Determine the correct discount rate***. Determination of the discount rate can just be the risk-free cost of capital, but it may include the decision maker's time preference and also a risk premium. Including inflation should also be considered.

3. Analyze and Rank the Activities

Once costs and benefits have been quantified, economic analysis tools can rank the possible mitigation activities. Two methods for determining the best activities given varying costs and benefits include net present value and internal rate of return.

- ***Net present value***. Net present value is the value of the expected future returns of an investment minus the value of the expected future cost expressed in today's dollars. If the net present value is greater than the projected costs, the project may be determined feasible for implementation. Selecting the discount rate, and identifying the present and future costs and benefits of the project calculates the net present value of projects.
- ***Internal rate of return***. Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the internal rate of return is greater than the total costs of the project. Once the mitigation projects are ranked on the basis of economic criteria, decision-makers can consider other factors, such as risk, project effectiveness, and economic, environmental, and social returns in choosing the appropriate project for implementation.

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owners as a result of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of mitigation should consider reductions in physical damages and financial losses. A partial list follows:

- Building damages avoided
- Content damages avoided
- Inventory damages avoided
- Rental income losses avoided
- Relocation and disruption expenses avoided
- Proprietor's income losses avoided

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period of time.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These are usually termed "indirect" effects, but they can have a very direct effect on the economic value of the owner's building or land. They can be positive or negative, and include changes in the following:

- Commodity and resource prices
- Availability of resource supplies
- Commodity and resource demand changes

- Building and land values
- Capital availability and interest rates
- Availability of labor
- Economic structure
- Infrastructure
- Regional exports and imports
- Local, state, and national regulations and policies
- Insurance availability and rates

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. With this in mind, opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

Resources

CUREe Kajima Project, *Methodologies for Evaluating the Socio-Economic Consequences of Large Earthquakes*, Task 7.2 Economic Impact Analysis, Prepared by University of California, Berkeley Team, Robert A. Olson, VSP Associates, Team Leader; John M. Eidinger, G&E Engineering Systems; Kenneth A. Goettel, Goettel and Associates, Inc.; and Gerald L. Horner, Hazard Mitigation Economics Inc., 1997

Federal Emergency Management Agency, *Benefit/Cost Analysis of Hazard Mitigation* Projects, Riverine Flood, Version 1.05, Hazard Mitigation Economics, Inc., 1996

Federal Emergency Management Agency, *Report on the Costs and Benefits of Natural Hazard Mitigation*. Publication 331, 1996.

Goettel & Horner Inc., *Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in the City of Portland*, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

Goettel & Horner Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects* Volume V, Earthquakes, Prepared for FEMA's Hazard Mitigation Branch, Ocbober 25, 1995.

Horner, Gerald, *Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures*, Robert Olsen Associates, Prepared for Oregon Military Department – Office of Emergency Management, July 1999.

Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon State Police – Office of Emergency Management, 2000.)

Risk Management Solutions, Inc., *Development of a Standardized Earthquake Loss Estimation Methodology*, National Institute of Building Sciences, Volume I and II, 1994.

VSP Associates, Inc., *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings*, Volumes 1 & 2, Federal Emergency management Agency, FEMA Publication Numbers 227 and 228, 1991.

VSP Associates, Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects*, 1993.

VSP Associates, Inc., *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model*, Volume 1, Federal Emergency Management Agency, FEMA Publication Number 255, 1994.

APPENDIX D:
GRANT PROGRAMS AND RESOURCES

Introduction

There are numerous local, state and federal funding sources available to support natural hazard mitigation projects and planning. The Oregon Natural Hazard Mitigation Plan includes a comprehensive list of funding sources (refer to Oregon NHMP Chapter 2 Section F(1)). The following section includes an abbreviated list of the most common funding sources utilized by local jurisdictions in Oregon. Because grant programs often change, it is important to periodically review available funding sources for current guidelines and program descriptions.

Post-Disaster Federal Programs

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. http://www.fema.gov/hazard-mitigation-grant-program

Physical Disaster Loan Program

When physical disaster loans are made to homeowners and businesses following disaster declarations by the U.S. Small Business Administration (SBA), up to 20% of the loan amount can go towards specific measures taken to protect against recurring damage in similar future disasters. http://www.sba.gov/category/navigation-structure/loans-grants/small-business-loans/disaster-loans

Pre-Disaster Federal Programs

Pre-Disaster Mitigation Grant Program

The Pre-Disaster Mitigation (PDM) program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds. http://www.fema.gov/pre-disaster-mitigation-grant-program

Flood Mitigation Assistance Program

The overall goal of the Flood Mitigation Assistance (FMA) Program is to fund cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other National Flood Insurance Program (NFIP) insurable structures. This specifically includes:

- Reducing the number of repetitively or substantially damaged structures and the associated flood insurance claims;
- Encouraging long-term, comprehensive hazard mitigation planning;
- Responding to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development activities; and
- Complementing other federal and state mitigation programs with similar, long-term mitigation goals.

http://www.fema.gov/flood-mitigation-assistance-program

Detailed program and application information for federal post-disaster and pre-disaster programs can be found in the FY13 Hazard Mitigation Assistance Unified Guidance, available at: https://www.fema.gov/media-library/assets/documents/33634. Note that guidance regularly changes. Verify that you have the most recent edition.

For Oregon Military Department, Office of Emergency Management (OEM) grant guidance on Federal Hazard Mitigation Assistance, visit:
http://www.oregon.gov/OMD/OEM/pages/all_grants.aspx - Hazard_Mitigation_Grants

Contact: Angie Lane**,** angie.lane@state.or.us

State Programs

Seismic Rehabilitation Grant Program

The Seismic Rehabilitation Grant Program (SRGP) provides state funds to strengthen public schools and emergency services buildings so they will be less damaged during an earthquake. Reducing property damage, injuries, and casualties caused by earthquakes is the goal of the SRGP. http://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/

Community Development Block Grant Program

The Community Development Block Grant Program promotes viable communities by providing: 1) decent housing; 2) quality living environments; and 3) economic opportunities, especially for low and moderate income persons. Eligible activities most relevant to natural hazards mitigation include: acquisition of property for public purposes; construction/reconstruction of public infrastructure; community planning activities. Under special circumstances, CDBG funds also can be used to meet urgent community development needs arising in the last 18 months which pose immediate threats to health and welfare.

http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

Oregon Watershed Enhancement Board

While OWEB's primary responsibilities are implementing projects addressing coastal salmon restoration and improving water quality statewide, these projects can sometimes also benefit efforts to reduce flood and landslide hazards. In addition, OWEB conducts watershed workshops for landowners, watershed councils, educators, and others, and conducts a biennial conference highlighting watershed efforts statewide. Funding for OWEB programs comes from the general fund, state lottery, timber tax revenues, license plate revenues, angling license fees, and other sources. OWEB awards approximately $20 million in funding annually. More information at: http://www.oregon.gov/OWEB/Pages/index.aspx

Federal Mitigation Programs, Activities & Initiatives

Basic & Applied Research/Development

National Earthquake Hazard Reduction Program (NEHRP), National Science Foundation.

Through broad based participation, the NEHRP attempts to mitigate the effects of earthquakes. Member agencies in NEHRP are the US Geological Survey (USGS), the National Science Foundation (NSF), the Federal Emergency Management Agency (FEMA), and the National Institute for Standards and Technology (NIST). The agencies focus on research and development in areas such as the science of earthquakes, earthquake performance of buildings and other structures, societal impacts, and emergency response and recovery. http://www.nehrp.gov/

Decision, Risk, and Management Science Program, National Science Foundation.

Supports scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society. Disciplinary and interdisciplinary research, doctoral dissertation research, and workshops are funded in the areas of judgment and decision making; decision analysis and decision aids; risk analysis, perception, and communication; societal and public policy decision making; management science and organizational design. The program also supports small grants for exploratory research of a time-critical or high-risk, potentially transformative nature. http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423

Hazard ID and Mapping

National Flood Insurance Program: Flood Mapping; FEMA

Flood insurance rate maps and flood plain management maps for all NFIP communities. http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping

National Digital Orthophoto Program, DOI – USGS

Develops topographic quadrangles for use in mapping of flood and other hazards. http://www.ndop.gov/

Mapping Standards Support, DOI-USGS

Expertise in mapping and digital data standards to support the National Flood Insurance Program. http://ncgmp.usgs.gov/standards.html

Soil Survey, USDA-NRCS

Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation or related purposes. http://soils.usda.gov/survey/printed_surveys/

Project Support

Coastal Zone Management Program, NOAA.

Provides grants for planning and implementation of non-structural coastal flood and hurricane hazard mitigation projects and coastal wetlands restoration. http://coastalmanagement.noaa.gov/

Community Development Block Grant Entitlement Communities Program, US Department of Housing and Urban Development

Provides grants to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate- income persons. http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/entitlement

National Fire Plan (DOI – USDA)

The NFP provides technical, financial, and resource guidance and support for wildland fire management across the United States. This plan addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability. http://www.forestsandrangelands.gov/

Assistance to Firefighters Grant Program, FEMA

FEMA AFGM grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. Three types of grants are available: Assistance to Firefighters Grant (AFG), Fire Prevention and Safety (FP&S), and Staffing for Adequate Fire and Emergency Response (SAFER). http://www.fema.gov/welcome-assistance-firefighters-grant-program

Emergency Watershed Protection Program, USDA-NRCS

Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas

damaged by severe natural hazard events.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp

Rural Development Assistance – Utilities, USDA

Direct and guaranteed rural economic loans and business enterprise grants to address utility issues and development needs.
http://www.rurdev.usda.gov/Utilities_Programs_Grants.html

Rural Development Assistance – Housing, USDA.

The RDA program provides grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary. http://www.rurdev.usda.gov/HAD-HCFPGrants.html

Public Assistance Grant Program, FEMA.

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide assistance to State, Tribal and local governments, and certain types of Private Nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.
http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

National Flood Insurance Program, FEMA

The NFIP makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements. http://www.fema.gov/national-flood-insurance-program

HOME Investments Partnerships Program, HUD

The HOME IPP provides grants to states, local government and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons. http://www.hud.gov/offices/cpd/affordablehousing/programs/home/

Disaster Recovery Initiative, HUD

The DRI provides grants to fund gaps in available recovery assistance after disasters (including mitigation).
http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/dri

Emergency Management Performance Grants, FEMA

EMPG grants help state and local governments to sustain and enhance their all-hazards emergency management programs. http://www.fema.gov/fy-2012-emergency-management-performance-grants-program

Partners for Fish and Wildlife, DOI – FWS

The PFW program provides financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats. http://www.fws.gov/partners/

North American Wetland Conservation Fund, DOI-FWS

NAWC fund provides cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats. http://www.fws.gov/birdhabitat/Grants/index.shtm

Federal Land Transfer / Federal Land to Parks Program, DOI-NPS

Identifies, assesses, and transfers available federal real property for acquisition for State and local parks and recreation, such as open space. http://www.nps.gov/ncrc/programs/flp/index.htm

Wetlands Reserve program, USDA-NCRS

The WR program provides financial and technical assistance to protect and restore wetlands through easements and restoration agreements. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands

Secure Rural Schools and Community Self-Determination Act of 2000, US Forest Service.

Reauthorized for FY2012, it was originally enacted in 2000 to provide five years of transitional assistance to rural counties affected by the decline in revenue from timber harvests on federal lands. Funds have been used for improvements to public schools, roads, and stewardship projects. Money is also available for maintaining infrastructure, improving the health of watersheds and ecosystems, protecting communities, and strengthening local economies. http://www.fs.usda.gov/pts/