



City of Salem

Natural Hazards Mitigation Plan

Report for:
City of Salem

Prepared by:
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Partners include:

- City of Salem
- Oregon Emergency Management
- FEMA Region X
- Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center

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Geographic Information Systems (GIS) Maps:

The contributions from the City of Salem's GIS Department were essential in illustrating the extent and potential losses associated with the natural hazards affecting the community.

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 Hazard 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 hazard mitigation plans. OPDR hereby authorizes the use of all content and language provided to the City of Salem in the plan template.

City of Salem Natural Hazards Mitigation Plan

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Executive Summary

The City of Salem developed this multi-jurisdictional Natural Hazards Mitigation 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 NHMP in order to receive federal funds for mitigation projects. Local and federal approval of this plan ensures that the City of Salem 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 . . .

Who Participated in Developing the Plan?

The City of Salem Natural Hazard Mitigation Plan 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. A project steering committee

guided the plan development process. The project steering committee included representatives from the following organizations.

- City of Salem Emergency Management
- City of Salem Public Works
- City of Salem Community Development
- City of Salem Fire Department
- Marion County Emergency Management
- Salem Hospital

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 City of Salem Emergency Manager convened the planning process and will take the lead in implementing, maintaining and updating the plan. The City of Salem is dedicated to directly involving the public in the continual reviewing and updating 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.

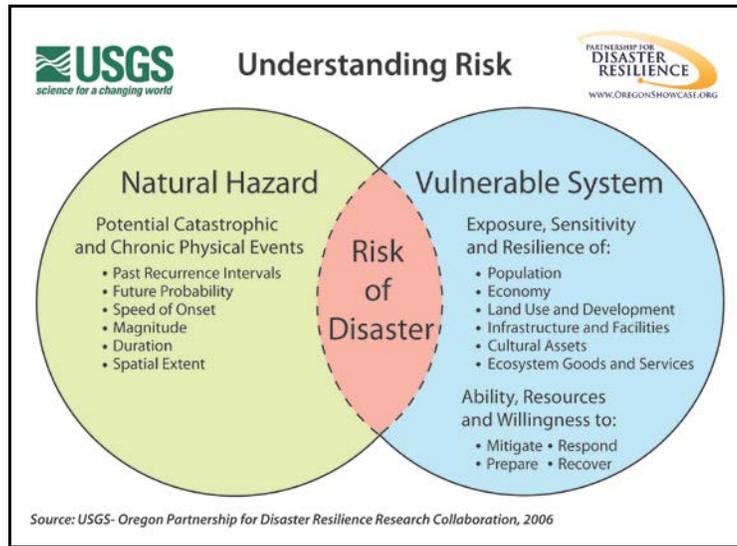
The City will ensure continues public involvement by posting the Salem Natural Hazard Mitigation Plan on the City’s website. The plan will also be archived and posted on the University of Oregon Libraries’ Scholar’s Bank Digital Archive.

How Does this Mitigation Plan Reduce Risk?

This natural hazard mitigation plan is intended to assist the City of Salem 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 Salem. A risk assessment consists of three phases: hazard identification, vulnerability assessment, and risk analysis, as illustrated in the following graphic.

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

Figure i.1 Understanding Risk



Source: Oregon Partnership for Disaster Resilience. 2012.

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

What is the City’s Overall Risk to Hazards?

The City of Salem reviewed and updated their risk assessment to evaluate the probability of each hazard as well as the vulnerability of the community to that hazard. In addition, the Salem Committee reviewed the recently updated Marion County NHMP to compare risk and vulnerability. Table i.1 below summarizes hazard vulnerability and probability as determined by the steering committee.

Table i.1: Risk Assessment Summary

Hazard	Vulnerability	Probability
Earthquake	High	High
Flood	High	High
Wind Storm	High	High
Winterstorm	High	High
Extreme Heat	High	Moderate
Landslide	Moderate	High
Hazardous Material	High	Moderate
Drought	Moderate	Moderate
Wildland-Urban Interface Fire	Low	Moderate
Volcanic Eruption	Moderate	Low

Source: City of Salem. NHMP Steering Committee. 2012.

What is the Plan’s Mission?

The mission of the City of Salem Natural Hazards Mitigation Plan is to:

Reduce or eliminate long-term risk to people and their property from hazards and their effects.

What are the Plan Goals?

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

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

Goal 1: Develop and implement mitigation activities to protect human life.

Goal 2: Protect existing buildings and infrastructure as well as future development from the impacts of natural hazards.

Goal 3: Strengthen communication and coordination of public and private partnerships and emergency services among local, county and regional governments and the private sector.

Goal 4: Enhance economic resilience to reduce the impact on the local economy.

Goal 5: Preserve and rehabilitate natural systems to serve natural hazard mitigation functions and protect natural resources.

How are the Action Items Organized?

The action items are organized within an action matrix (located at the end of this Summary), which lists all the multi-hazard and hazard-specific action items included in the mitigation plan. 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.

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

How will the plan be implemented?

The plan maintenance section of this plan details the formal process that will ensure that the City of Salem Natural Hazards Mitigation Plan remains an active and relevant document. The plan will be implemented, maintained and

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

updated by a designated convener. The Salem Emergency Manager is the designated convener is responsible for overseeing the annual review and implementation processes. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing a plan revision every five years. This section describes how the communities will integrate public participation throughout the plan maintenance process.

Plan Adoption

Once the plan is locally reviewed and deemed complete the Plan Convener submits it to the State Hazard Mitigation Officer at Oregon Emergency Management. Oregon Emergency Management 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 city formally adopts the plan via resolution. The City of Salem NHNP convener will be responsible for ensuring local adoption of the City of Salem Natural Hazards Mitigation Plan 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 city 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 Natural Hazards Mitigation Plan goals and actions depends upon regular Steering Committee participation and adequate support from 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 committee met on three occasions March 22nd, April 26th and May 17th, 2012 to review the plan update process.

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]

Section I: Introduction

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

What is Natural Hazard Mitigation?

The Federal Emergency Management Agency (FEMA) defines mitigation as “. . . the effort to reduce loss of life and property by lessening the impact of disasters . . . through risk analysis, which results in information that provides a foundation for mitigation activities that reduce risk.” 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.

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?

The City of Salem developed this Natural Hazards Mitigation 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 City of Salem will remain eligible for pre- and post-disaster mitigation project grants.

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 their proposed mitigation measures are based on a sound planning process that accounts for the risk to the individual and their capabilities.

Chapter 44 Code of Federal Regulations (CFR), section 201.6, also requires a local government to have an approved mitigation plan in order to receive HMGP project grants.¹ 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 NHMP shall include documentation of the public planning process used to develop the plan.² The NHMP update must also contain a risk assessment, mitigation strategy and a plan maintenance process that has been formally adopted by the governing body of the jurisdiction.³ Lastly, the Natural Hazard Mitigation Plan must be submitted to Oregon Emergency Management for initial plan review, and then federal approval.⁴

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

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

Statewide 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.

The primary responsibility for the development and implementation of risk reduction strategies and policies lies with local jurisdictions. However, resources exist at the state and federal levels. Some of the key agencies in this area include Oregon Emergency Management (OEM), Oregon Building Codes Division (BCD), Oregon Department of Forestry

¹ Code of Federal Regulations. Chapter 44. Section 201.6, subsection (a). 2010

² Code of Federal Regulations. Chapter 44. Section 201.6, subsection (b). 2010

³ Code of Federal Regulations. Chapter 44. Section 201.6, subsection (c). 2010

⁴ Code of Federal Regulations. Chapter 44. Section 201.6, subsection (d). 2010

(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 City of Salem Natural Hazard Mitigation Plan steering committee. The steering committee formally convened on three occasions to discuss and revise the plan. Steering committee members contributed data and maps and reviewed and updated the community profile, risk assessment, action items and implementation 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.⁵ Concurrent with the NHMP update process, the City of Salem has been engaged in an aggressive public outreach and education campaign associated with the January, 2012 flooding event. In addition, the City of Salem submitted a press release in the Statesman Journal, and on the City's website, to encourage the public to offer feedback on the plan update.

How is the Plan Organized?

Each volume of the mitigation plan provides specific information and resources to assist readers in understanding the hazard-specific issues facing City citizens, 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: Natural Hazard Mitigation Plan

SECTION 1: INTRODUCTION

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

SECTION 2: ALL-HAZARD RISK ASSESSMENT

Section 2 provides the factual basis for the mitigation strategies contained in Section 3. This section assesses natural hazard risk through the identification of hazards and an evaluation of potential hazard impacts—type, location, extent, etc. The risk assessment identifies important community assets and system vulnerabilities and evaluates the extent to which hazards impact the important assets identified by the community through a risk analysis.

SECTION 3: MISSION, GOALS AND ACTION ITEMS

This section documents the plan vision, mission, goals, and actions and also describes the components that guide implementation of the identified mitigation strategies. Actions are based on community sensitivity and resilience factors and the hazard assessments in Section 2 and the Hazard Annexes.

⁵ Code of Federal Regulations. Chapter 44. Section 201.6, subsection (b). 2010

SECTION 4: PLAN IMPLEMENTATION AND MAINTENANCE

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

Volume II: Hazard-Specific Annexes

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

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

- Drought;
- Earthquake;
- Extreme Heat;
- Flood;
- Hazardous Materials;
- Landslide;
- Volcanic Event;
- Wildfire;
- Windstorm; and
- Winter Storm.

Volume III: Resource Appendices

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

APPENDIX A: ACTION ITEM FORMS

This appendix contains the detailed action item forms for each of the mitigation strategies identified in this plan.

APPENDIX B: PLANNING AND PUBLIC PROCESS

This appendix includes documentation of all the city wide public processes utilized to develop the plan. It includes invitation lists, agendas, sign-in sheets, and summaries of steering committee meetings as well as any other public involvement methods.

APPENDIX C: ECONOMIC ANALYSIS OF NATURAL HAZARDS 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. This appendix was developed by *The Partnership*. 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.

APPENDIX D: COMMUNITY PROFILE

The community profile describes the City from a number of perspectives in order to help define and understand the City'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 City when the plan was updated. Sensitivity factors can be defined as those community assets and characteristics that may be impacted by natural hazards, (e.g., special populations, economic factors, and historic and cultural resources). Community resilience factors can be defined as the community's ability to manage risk and adapt to hazard event impacts (e.g., governmental structure, agency missions and directives, and plans, policies, and programs).

APPENDIX E: GRANT PROGRAMS

Appendix E lists state and federal resources and programs by hazard.

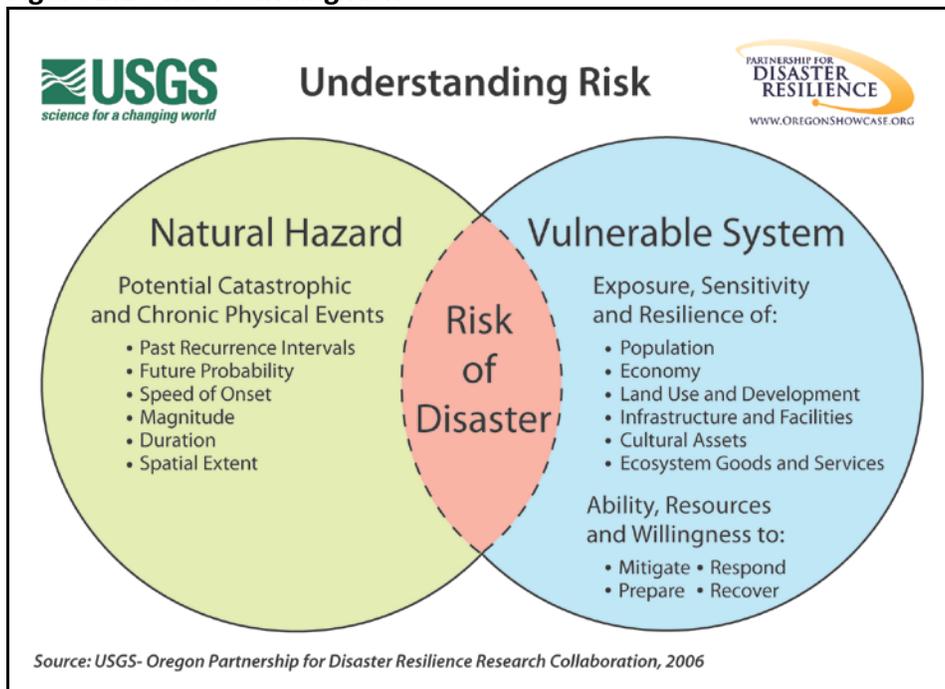
Section 2:

All-Hazard Risk Assessment

This section of the NHMP addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk begins with the identification of hazards that can impact the jurisdiction. Included in the hazard assessment is an evaluation of potential hazard impacts – type, location, extent, etc. The second step in the risk assessment process is the identification of important community assets and system vulnerabilities. Example vulnerabilities include people, businesses, homes, roads, historic places and drinking water sources. The last step is to evaluate the extent to which the identified hazards overlap with, or have an impact on, the important assets identified by the community.

The information presented below, along with hazard specific information presented in the Hazard Annexes and community characteristics presented in the Community Profile Appendix, will be used as the local level rationale for 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

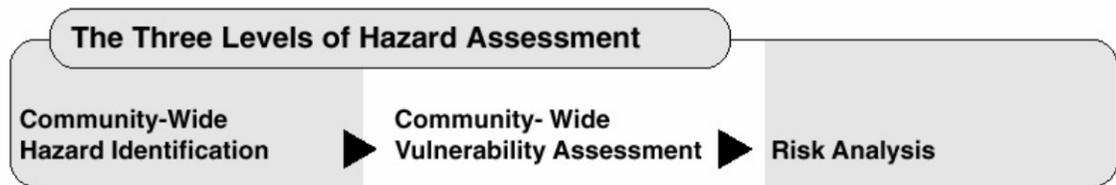


Source: Oregon Partnership for Disaster Resilience. 2012.

What is a Risk Assessment?

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

Figure 2.2 Three Phases of a Risk Assessment



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

The first phase, hazard identification, involves the identification of the geographic extent of a hazard, its intensity, and its probability of occurrence. This level of assessment typically involves producing a map. The outputs from this phase can also be used for land use planning, management, and regulation; public awareness; defining areas for further study; and identifying properties or structures appropriate for acquisition or relocation.⁶

The second phase, vulnerability assessment, combines the information from the hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard, and attempts to predict how different types of property and population groups will be affected by the hazard. This step can also assist in justifying changes to building codes or development regulations, property acquisition programs, policies concerning critical and public facilities, taxation strategies for mitigating risk, and informational programs for members of the public who are at risk.⁷

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

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

The City of Salem identifies 10 natural hazards that could have an impact on the city. These hazards include drought, earthquake, extreme heat, flood, hazardous materials, landslide, volcanic event, wildfire, windstorm and winter storm. For specific information pertaining to

⁶ Burby, R. 1998. Cooperating with Nature. Washington, DC: Joseph Henry Press.

⁷ Ibid.

individual hazards, reference the Hazard Chapter Annexes. Table 2.1 categorizes the hazards identified by the City of Salem and compares it to the regional hazards identified in Marion County and the State of Oregon Natural Hazard Mitigation Plan for the Mid-Southern Willamette Valley Region, which includes the City of Salem. Notably, severe wind and ice storms have been separated into two independent hazards, i.e. windstorm and winter storm; and extreme heat is a new hazards not identified in the previous Natural Hazard Mitigation Plan for the City of Salem.

Table 2.1 City Salem Hazard Identification

City of Salem*	Marion County>	State of Oregon HNMP Region 3: Mid-Southern Willamette Valley Hazards^
	Dam Failure	
Drought	Drought	Drought
Earthquake	Earthquake	Earthquake
Extreme Heat		
Flood	Flood	Flood
Landslide	Landslide	Landslide/Debris Flow
Hazardous Materials		
Volcanic Event	Volcanic Eruption	Volcanic
Wildfire (WUI)	Wildfire	Wildfire (WUI)
Windstorm	Windstorm	Windstorm
Winter Storm	Winter Storm	Winter Storm

*City of Salem NHMP Steering Committee. Updated April 26, 2012.

>Marion County Natural Hazard Mitigation Plan. 2011.

^State of Oregon Natural Hazard Mitigation Plan, Region 3: Mid-Southern Willamette Valley.

Federal Disaster Declarations

As of March 2012, FEMA has approved a total of 28 federal disaster declarations, two emergency declarations and 49 fire management assistance declarations in Oregon.⁸ 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 2.2 summarizes the major disasters declared for the City of Salem and the broader region of Marion County, after 1964. The table shows that all but one of the major disaster declarations throughout the region have been weather related.

⁸ FEMA. Declared Disasters by Year or State. http://www.fema.gov/news/disaster_totals_annual.fema#markS. Accessed March 8, 2012

Table 2.2 FEMA Major Disaster Declarations for the City of Salem and Beyond⁹

Declaration Number	Declaration Date	Incident(s) Period	Incident(s)	Individual Assistance	Public Assistance Categories
DR-4055	2-Mar-12	17-Jan-12 to 21-Jan-12	Severe Winter Storm, Flooding, Landslides, and Mudslides	None	A,B,C,D,E,F,G
DR-1956	17-Feb-11	13-Jan-11 to 21-Jan-11	Severe Winter Storm, Flooding, Mudslides, Landslides, and Debris Flow	None	A,B,C,D,E,F,G
DR-1824	2-Mar-09	13-Dec-08 to 26-Dec-08	Severe Winter Storm, Record and Near Record Snow, Landslides, and Mudslides	None	A,B,C,D,E,F,G
DR-1510	19-Feb-04	26-Dec-03 to 14-Jan-04	Severe Winter Storms	None	A,B,C,D,E,F,G
DR-1099	9-Feb-96	4-Feb-96 to 21-Feb-96	Severe Storms, Flooding	Yes	A,B,C,D,E,F,G
DR-985	26-Apr-93	25-Mar-93	Earthquake	None	A,B,C,D,E,F,G
DR-413	25-Jan-74	25-Jan-74	Severe Storms, Snow Melt, Flooding	Yes	A,B,C,D,E,F,G
DR-184	24-Dec-64	24-Dec-64	Heavy Rains and Flooding	Yes	A,B,C,D,E,F,G

Source: FEMA, Oregon Disaster History, Major Disaster Declarations

Since 2008, two hazard events have triggered a Presidential Disaster Declaration for the City of Salem and the immediate region. The first occurred in March 2009 in response to heavy snow, landslides and mudslides during the 2008-2009 winter season.¹⁰ The second and most recent disaster declaration in Oregon was issued in March 2012 for a winter flooding event.¹¹

Drought

CHARACTERISTICS

Droughts are not uncommon in Oregon. Drought occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another.¹² A drought is a period of drier than normal conditions that results in water-related problems and can occur in both summer and winter months¹³

Droughts appear to be recurring and they can have a profound effect on the economy, particularly the hydro-power and agricultural sectors. Although drought may not cause significant impacts to non-farming communities, the financial impact affects the economic

⁹ FEMA. Oregon Disaster History. Major Disaster Declarations

¹⁰ FEMA. "FEMA Expands Incident Period for December Snow Storm". April 2, 2009.

<http://www.fema.gov/news/newsrelease.fema?id=47876>

¹¹ FEMA. <https://www.fema.gov/library/viewRecord.do?fromSearch=fromsearch&id=5876>

¹² National Drought Mitigation Center. 2007. What is Drought? <http://www.drought.unl.edu/whatis/what.htm>, accessed May 28, 2010.

¹³ Moreland, A. 1993. Open File Report 93-642. USGS.

stability of the county. The environmental consequences also are far-reaching. They include insect infestations in forests and the lack of water to support endangered fish species.

LOCATION/EXTENT

The extent of the drought depends upon the degree of moisture deficiency, and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city and county.

Although Salem is spared from most droughts because of its location east of the ocean and west of the Cascades, it has been affected by droughts in the past. The broader region surrounding the City of Salem experiences dry conditions annually during the summer months from June to September.¹⁴

Earthquake

CHARACTERISTICS

Oregon and the Pacific Northwest in general are susceptible to earthquakes from three sources: 1) shallow crustal events within the North American Plate; 2) deep intra-plate events within the subducting Juan de Fuca Plate; and 3) the off-shore Cascadian Subduction Zone.¹⁵

City of Salem and the surrounding area has experienced multiple earthquakes of an estimated magnitude of four and greater, with major earthquakes in 1949 (magnitude 7.1), 1962 (magnitude 5.2), and 2001 (magnitude 6.8). Primary earthquake hazards include ground shaking amplification, liquefaction, and earthquake-induced landslides. There are no high concentrations of earthquakes in northern Oregon, and all recent major quakes in northwest Oregon have been shallow.¹⁶

LOCATION/EXTENT

Within the Salem Urban Growth Boundary (UGB), the area south of the Willamette River and west of River Road has the highest risk of earthquakes. Other small areas with high earthquake risk exist to the east of the city.¹⁷ The areas most susceptible to ground amplification and liquefaction have young, soft alluvial sediments, found in most of the Willamette Valley and are along stream channels.¹⁸ The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event.

¹⁴ National Weather Service Climate Prediction Center. Drought Severity Index by Division (Long-Term Palmer) Archive. http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring, accessed February 17, 2010.

¹⁵ Wong, Ivan G and Jacqueline D.J. Bott."A Look Back at Oregon's Earthquake History, 1841-1994".Oregon Geology 57 (6): 125. 1995.

¹⁶ Ibid.

¹⁷ City of Salem Geographic Information Systems (GIS). Natural Hazard Mitigation Plan. Map 2.1.2A Amplification Susceptibility and Map 2.1.2B Liquefaction Susceptibility. 2008.

¹⁸ Burns, William, John 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, 2008

Extreme Heat

CHARACTERISTICS

The definition of extreme heat varies by region; however, in general a heat wave is a prolonged period of extreme heat for several days to several weeks. High temperatures are also often combined with excessive humidity.¹⁹ Heat is the number one weather-related killer in the United States, resulting in hundreds of fatalities each year. In fact, on average, excessive heat claims more lives each year than floods, lightning, tornadoes and hurricanes combined.²⁰

North American summers are hot; most summers see heat waves in one or more parts of the United States. East of the Rockies, they tend to combine both high temperature and high humidity; although some of the worst heat waves have been catastrophically dry.²¹

LOCATION/EXTENT

The most severe impact of extreme heat affects peoples' health directly. Most heat disorders occur because the victim has been overexposed to heat or has over-exercised for his or her age and physical condition. Older adults, young children, and those who are sick or overweight are more likely to succumb to extreme heat.²²

According to the Federal Emergency Management Agency, "conditions that can induce heat-related illnesses include stagnant atmospheric conditions and poor air quality. Consequently, people living in urban areas may be at greater risk from the effects of a prolonged heat wave than those living in rural areas. Also, asphalt and concrete store heat longer and gradually release heat at night, which can produce higher nighttime temperatures known as the "urban heat island effect."²³

Flood

CHARACTERISTICS

The principal types of flood that occur in City of Salem include riverine, shallow areas and urban flood. Riverine flooding is the most common type of flooding in the City of Salem, it typically occurs on larger rivers, such as the Willamette River, and usually results from large storms or prolonged wet periods. Portions of the City of Salem that are located along water bodies have the potential to experience riverine flooding after spring rains, heavy thunderstorms or rapid runoff from snow melt. Riverine floods can be slow or fast-rising, but usually develop over a period of days. The danger of riverine flooding occurs mainly during the winter months, with the onset of persistent, heavy rainfall, and during the spring, with melting of snow in the Coast Range. Shallow area floods are a special type of riverine flooding. FEMA defines a shallow area flood hazard as an area that is inundated by a 100-

¹⁹ FEMA. Are You Ready? Extreme Heat.

²⁰ National Oceanic Atmospheric Administration. Heat Wave: A Major Summer Killer. http://www.nws.noaa.gov/om/brochures/heat_wave.shtml. Accessed June 1, 2012.

²¹ Ibid.

²² FEMA. Are You Ready?. Extreme Heat.

²³ Ibid.

year flood with a flood depth between one to three feet. Such areas are generally flooded by low velocity sheet flows of water.²⁴

Urban flooding occurs where land has been converted from open space to areas consisting of homes, parking lots, and commercial, industrial and public buildings and structures. In such areas the previous ability of water to filter into the ground is often prevented by the extensive impervious surfaces associated with urban development. During periods of urban flooding streets can rapidly become swift moving rivers and basements and backyards can quickly fill with water. Storm drains and smaller creeks can back up due to yard waste and debris. Clogged storm drainage systems often lead to further localized flooding.

LOCATION/EXTENT

The City of Salem has more than 4,000 acres of floodplain and approximately 3,000 individual parcels that are partially or entirely located within the floodplain.²⁵ The most significant of the FEMA-determined floodplains and floodways either surround the southern side of the Willamette River west of Salem, or are within the greater Mill Creek/Pringle Creek watershed.²⁶

Properties in and near the floodplains in the City of Salem are subject to frequent flooding events. Since flooding is such a pervasive problem throughout the city, many residents have purchased flood insurance to help recover from losses incurred from flooding events.

RECENT FLOOD EVENTS

Heavy rains from the January 2012 storm caused extensive flooding throughout the City of Salem, with an estimated \$10.3 million in overall damage of city facilities.²⁷ Twelve Counties, including Marion County, have been designated as adversely affected by the January disaster.²⁸ During a five-day period starting January 16, the hills in South Salem received as much as 9.01 inches of rain. Runoff from the heavy rainfall was intensified by the melting of three- to six-inches of snow that had fallen in higher elevations a week earlier.²⁹ As of March 2, 2012, the President issued a major disaster declaration under the authority of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.³⁰

Hazardous Materials

CHARACTERISTICS

For the purposes of mitigation planning, hazardous materials releases are considered a secondary hazard derived from the impact of a natural hazard event (i.e. flooding in a chemical storage area could result in toxic levels of chemicals in water or air). Hazardous materials may be defined simply as any materials that may have negative impacts on human health.

²⁴ FEMA. Definitions of FEMA Flood Zone Designations.

²⁵ City of Salem. Floodplain Information.

<http://www.cityofsalem.net/Departments/PublicWorks/Administration/DevelopmentServices/Pages/FloodplainInformation.aspx>

²⁶ City of Salem Geographic Information Systems. Natural Hazard Mitigation Plan. Map FL.1. 2008.

²⁷ Statesman Journal. "Pricey Flood Repairs Needed at Salem Parks". February 29, 2012.

²⁸ FEMA. Oregon Disaster History. Major Disaster Declaration

²⁹ Statesman Journal. "Salem Hosts Flood Meetings Starting Tonight". March 19, 2012.

³⁰ FEMA. Oregon Disaster History. Major Disaster Declaration.

The severity of any hazardous material release incident for an affected community depends on several factors, including the toxicity, quantity, and dispersal characteristics of the hazardous material; local conditions such as wind direction, topography, soil and ground water characteristics; proximity to drinking water resources and populations.

LOCATION/EXTENT

Hazardous materials incidents would likely be localized near the source of the incident, but major incidents could have extensive evacuation zones and affect a significant portion of the City of Salem. The potential for casualties, including death and injury, is dependent on the location of incident, time of day, effectiveness of evacuation and materials involved.

RECENT HAZARDOUS MATERIALS INCIDENTS

Between 2008 and May 2012, there have been 68 reported hazardous materials incidents, most of which have been negligible.³¹ Gas leaks are reported as the most common type of hazardous materials incident reported in the city. The majority of incidents are reported as unintentional accidents, but there are a few incidents of intentional hazardous materials release and/or exposure, all of which were effectively and safety managed.

Landslide

CHARACTERISTICS

In Oregon, a significant number of locations are at risk to dangerous landslides. While not all landslides result in private property damage, many landslides impact transportation corridors, fuel and energy conduits, and communication facilities.³² They can also pose a serious threat to human life.

Landslides are broken down into two categories: (1) rapidly moving; and (2) slow moving. Rapidly moving landslides are typically “off-site” (debris flows and earth flows) and present the greatest risk to human life. Rapidly moving landslides have caused most of the recent landslide-related injuries and deaths in Oregon. Slow moving landslides tend to be “on-site” (slumps, earthflows, and block slides) and can cause significant property damage, but are less likely to result in serious human injuries.

Landslides vary greatly in the volumes of rock and soil involved, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials.

LOCATION/EXTENT

In general, areas at risk to landslides have steep slopes (25 percent or greater,) or a history of nearby landslides. In otherwise gently sloped areas, landslides can occur along steep river and creek banks, and along ocean bluff faces. At natural slopes under 30 percent, most landslide hazards are related to excavation and drainage practices, or the reactivation of preexisting landslide hazards.³³ The severity or extent of landslides is typically a function of

³¹ Oregon.gov. Hazardous Materials Incidents Searchable Database. 2008-2009; and Hazardous Materials Incident Reports, 2010-2012.

³² USGS Landslide Program Brochure, National Landslide Information Center, United States Geologic Survey.

³³ State Hazard Mitigation Plan. The Interagency Hazards Mitigation Team, (2000) Oregon State Police - Office of Emergency Management.

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

Natural conditions and human activities can both play a role in causing landslides. The incidence of landslides and their impact on people and property can be accelerated by development.

RECENT LANDSLIDE EVENTS

The geologic setting of the Salem Hills illustrates a historic pattern of landslides. In January, 2011, a landslide occurred on South River Road between Owens Street and Croissan Creek, a location that has experienced other slides in the past. The slide brought down a boulder that blocked a thoroughfare.³⁴

Volcanic Event

CHARACTERISTICS

The City of Salem and the Pacific Northwest lie within the “ring of fire,” an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the ring of fire, in part because of the movement of the Earth’s tectonic plates. Volcanic eruptions have the potential to coincide with numerous other hazards including ash fall, earthquakes, lava flows, pyroclastic flows, lahars and debris flows, and landslides. Ash fall and earthquakes are the two associated hazards that have the potential to impact the City of Salem directly.

LOCATION/EXTENT

Active volcanoes that could impact the City of Salem include: Mount Jefferson, Three Sisters and Broken Top, Mount Hood, Mount St. Helens, and Mount Rainier.³⁵ If any of these volcanoes erupted, there would be a possibility of ash that could affect air quality and/or the water quality. Specifically, Salem’s North Santiam watershed could be severely impacted by mudflows and volcanic ash falls derived from regional volcanic activity. The extent of damage from these hazards depends on the distance from the volcano, vent location, and type of hazardous events that occur during an eruption. The indirect effects of volcanoes within other counties must be considered as well.

Wildfire (WUI)

CHARACTERISTICS

While more common to the arid areas of central and eastern Oregon, the potential for losses due to Wildland Urban Interface (WUI) fires in the urbanized region should not be ignored. Fire is an essential part of Oregon’s ecosystem, but it is also a serious threat to life and property. Wildfires that have the potential to affect the City of Salem can be divided into three categories: interface, wildland, and firestorms. Ignition of a wildfire may occur naturally from lightning or from human causes such as debris burns, arson, careless

³⁴ Landslide Closes South River Road in Salem. www.salem-news.com. January 20, 2011. Accessed May 21, 2012.

³⁵ USGS “Volcano Hazards in the Mount Jefferson Region, Oregon”

smoking, and recreational activities or from an industrial accident. Once started, fuel, topography, weather and development conditions affect fire behavior.

LOCATION/EXTENT

The Marion County CWPP identifies the City of Salem as an at risk community based upon residential density and Fire District serviceability. The extent of damage to The City of Salem from WUI fires is dependent on a number of factors, including temperature, wind speed and direction, humidity, proximity to fuels, and steepness of slopes.³⁶ WUI fires can be intensified by development patterns, vegetation and natural fuels, and can merge into unwieldy and unpredictable events.

RECENT WUI EVENTS

The City of Salem has had relatively few occurrences of WUI Fire hazards that have resulted in minimal dollar losses. Between 2008 and 2011, 206 WUI fire incidents have been reported totaling \$5,877 in damages.³⁷ ³⁸ These incidents include vegetation fires, forest/wood fires, brush and grass fires.

Windstorm

CHARACTERISTICS

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

Although rare, tornados can and do occur in Oregon. Tornados are the most concentrated and violent storms produced by the earth's atmosphere. They are created by a vortex of rotating winds and strong vertical motion, which possess remarkable strength and cause widespread damage.

LOCATION/EXTENT

The damaging effects of windstorms may extend for distances of 100 to 300 miles from the center of storm activity. Windstorms in the City of Salem usually occur from October to March, and their extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain.³⁹

³⁶ Marion County. Community Wildfire Protection Plan (CWPP). 2008.

³⁷ Oregon All Incident Reporting System OAIRS . 2008-2009.

³⁸ FireBridge. City of Salem Wildland Types Responses. 2010 – 2011

³⁹ State of Oregon Natural Hazards Mitigation Plan. Oregonshowcase.org, March 2006.

http://www.oregonshowcase.org/downloads/pdf/stateplan/OR-SNHMP_wind_chapter_2009.pdf

Oregon and other western states have experienced tornadoes on occasion, many of which have produced significant damage and occasionally injury or death. Most of the tornadoes that develop in Oregon are caused by intense local thunderstorms. These storms also produce lightning, hail, and heavy rain, and are more common during the warm season from April to October.⁴⁰

RECENT WINDSTORM EVENTS

Since 2008, there have been no reports of damage in Salem resulting from windstorm events. However, windstorm events have resulted in damage to the surrounding area. In 2008, heavy winds caused thousands in damage across the City of Woodburn; and in 2009, just outside of Salem on Highway 22, winds and a thunderstorm that brought down several trees.

The most significant storm occurred in December of 2010 culminating in an EF2 tornado touching down in the City of Aumsville with wind speeds between 110 and 120 mph. This was the largest tornado recorded in Marion County to date and the second largest in the state since 1950. According to a December 23, 2010 NOAA storm survey report, the tornado traveled in a northeasterly direction and had a path length of approximately five-miles. The initial damage assessment estimated total losses at over \$1.1 million.⁴¹

Winter Storm

CHARACTERISTICS

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City of Salem typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.⁴²

While snow is relatively rare in western Oregon, when cold air moves westward through the Gorge, and sinks southward into the Willamette Valley snow events can occur. If a wet Pacific storm happens to reach the area at the same time that the cold air is present, larger than average snow events may result.⁴³

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

⁴⁰ Taylor, George H., Holly Bohman, and Luke Foster. August 1996. A History of Tornadoes in Oregon. Oregon Climate Service. Corvallis, OR: Oregon State University. http://www.ocs.orst.edu/pub_ftp/reports/book/tornado.html

⁴¹ December 14, 2010 Aumsville Tornado Initial Damage Assessment Summary Form, Marion County Emergency Management.

⁴² Interagency Hazard Mitigation Team. 2000. State Hazard Mitigation Plan. Salem, OR: Oregon State Police – Office of Emergency Management

⁴³ National Weather Service, Portland Office. www.wrh.noaa.gov/Portland/snowstorm.html.

LOCATION/EXTENT

All of the City of Salem is vulnerable to winter storms and impacts typically extend region-wide. The magnitude or severity of severe winter storms is determined by a number of meteorological factors including the amount and extent of snow or ice, air temperature, wind speed, and event duration.

RECENT WINTER STORM EVENTS

Over several weeks in early 2008, the foothills of the Cascades received unusually high amounts of snow from a series of storms. Towns east of Salem, including Idanha and Detroit, were buried by 12-feet of snow over these two months.⁴⁴ Several local agencies from Marion and Linn Counties, and the City of Salem were sent to assist these communities. Three dozen National Guard soldiers, along with snow removal equipment, inmate crews, and engineers, were sent by the State into the towns to remove snow and help those in need.⁴⁵

Another prolonged snowstorm hit the region during the 2008-2009 winter season. Salem received over a foot of snow and the Portland airport received a record 18.9 inches.⁴⁶ This snowstorm resulted in landslides and mudslides and warranted a Presidential Disaster Declaration on March 2, 2009.⁴⁷ Ten Oregon Counties were included in this disaster declaration, including Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties.⁴⁸

In March of 2012, the City of Salem experienced a relatively unusually late snowfall across the Willamette Valley. The City of Salem received two to seven inches of snow, with the highest amounts on the hill in South Salem. This was the biggest snowstorm to strike Salem this late in the winter season. On average Salem receives .3 inches of snow in March. Other recorded late snowfalls occurred in March of 1951 totaling 9.6 inches and March of 1960, where Salem received 8.5 inches.⁴⁹

Hazard Probability

Probability is the likelihood of future occurrence within a specified period of time. The City of Salem evaluated the best available probability data to develop the probability scores presented below. For the purposes of this plan, the city utilized the Oregon Emergency Management Hazard Analysis methodology probability definitions to determine hazard probability. The definitions are:

LOW = one incident likely within 75 to 100 years scores between 1 and 3 points

MEDIUM = one incident likely within 35 to 75 years scores between 4 and 7 points

⁴⁴ "Region 3: Mid/Southern Willamette Valley Regional Profile. January 2009.

⁴⁵ "Oregon National Guard Aids Detroit an Idenha Communities." February 5, 2008.

http://saalem-news.com/articles/february052008/guard_detroit_2-5-08.php

⁴⁶ "Some of Area's Snowstorms." National Weather Service, Portland Office.

<http://www.wrh.noaa.gov/pqr/paststorms/snow.php>

⁴⁷ FEMA. Winter Storm Disaster Declaration. <http://www.fema.gov/disaster/1824>

⁴⁸ FEMA. "FEMA Expands Incident Period for December Snow Storm". April 2, 2009.

<http://www.fema.gov/news/newsrelease.fema?id=47876>

⁴⁹ National Weather Service. Salem Airport. March 22, 2012.

HIGH = one incident likely within 10 to 35 years scores between 8 and 10 points

Table 2.3 presents the probability scores for each of the natural hazards present in City of Salem. As shown in the table, several hazards are rated with high probabilities including earthquake, flood, landslide, wind storm and winterstorm.

Table 2.3 Natural Hazard Probability Assessment Summary⁵⁰

Hazard	Probability
Earthquake	High
Flood	High
Landslide	High
Windstorm	High
Winter Storm	High
Extreme Heat	High
Drought	Moderate
Hazardous Material	Moderate
Wildland-Urban Interface Fire	Moderate
Volcanic Eruption	Low

Community Vulnerability

Community vulnerabilities are an important supplement to the NHMP risk assessment. For more in-depth information regarding specific community vulnerabilities, reference Appendix D: Community Profile.

Populations

The socio-demographic qualities of the community population such as language, race and ethnicity, age, income, and educational attainment are significant factors that can influence the community's ability to cope, adapt to and recover from natural disasters. Historically, 80 percent of the disaster burden falls on the public.⁵¹ 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. For planning purposes, it is essential Salem consider both immediate and long-term socio-demographic implications of hazard resilience.

VULNERABILITIES

- Even though approximately 90% of the entire city population is reported as proficient in English, over half of the native Spanish and Russian speakers are not proficient in English.⁵² These populations would serve to benefit from mitigation

⁵⁰ City of Salem. NHMP Steering Committee. 2012

⁵¹ Hazards Workshop Session Summary #16, Disasters, Diversity, and Equity. (July 2000). University of Colorado, Boulder.

⁵² U.S. Census Bureau. 2005-2009 American Community Survey. B16001 Languages Spoken at Home.

outreach, with special attention to cultural, visual and technology sensitive materials.

- Salem is also experiencing demographic changes in terms of age of the population. From 2000 to 2010 the age group younger than 15 increased by 12%, the 15 – 64 age group increased by 14.1%, and the 65 and older age group increased by 8.5%.⁵³ An aging population requires additional support from the community at large.

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. It is imperative that Salem recognize that economic diversification is a long-term issue; more immediate strategies to reduce vulnerability should focus on risk management for the dominant industries.⁵⁴

VULNERABILITIES

- According to the Oregon Employment Department, Salem unemployment has reduced since 2009, to 9.9%. In the event of a large—scale disaster, unemployment has the potential to rise when businesses and companies are unable to overcome the ramifications of the hazard event.
- The largest sectors of employment in the Salem Metropolitan Service Area are Government (28%), Services (24%), and Trade (21%).⁵⁵ In the event of a natural disaster, the government sector may not be as vulnerable in the short term as other sectors; however, other large industries such as agriculture, wholesale trade of electronic equipment and manufacturing of food products are industries that may be significantly affected by a disaster as these basic industries tend to rely on sales outside of the community.

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.⁵⁶ For example, natural capital such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from flooding and landslides. When natural systems are impacted or depleted by human activities, those activities can adversely affect community resilience to natural hazard events.

⁵³ U.S. Census Bureau. 2000 and 2010 Census. DP-1 Profile of General Population and Housing Characteristics.

⁵⁴ Ibid.

⁵⁵ Salem Chamber of Commerce. Labor Force in Salem. <http://www.salemchamber.org/employment/index.html>. Accessed February 7, 2012.

⁵⁶ Mayunga, J. 2007. Understanding and Applying the Concept of Community Disaster Resilience: A capital-based approach. Summer Academy for Social Vulnerability and Resilience Building.

VULNERABILITIES

- The primary river that flows through Salem is the Willamette River; other important streams that pass through are Mill Creek, the Mill Race, Pringle Creek, and the Shelton Ditch. Smaller streams in the eastern part of the city include Clark Creek, Jory Creek, Battle Creek, Croisan Creek and Clagget Creek, while Glen Creek and Brush Creek flow through West Salem.⁵⁷ These streams frequently flood, and while this can provide natural benefits, flooding can inflict personal injury and property damage.
- Salem obtains its drinking water from the North Santiam River watershed, located in the Cascade Foothills.⁵⁸ As this is the primary source of drinking water for the City, it is imperative to consider the hazards that can affect water quality, including flooding, landslides and drought.
- The combination of a growing population and development intensification can lead to the increasing risk of hazards, threatening loss of life, property and long-term economic disruption if land management is inadequate; such as floodplain development that is common throughout the City of Salem.

Critical Facilities and Infrastructure

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

VULNERABILITIES

- Considering, Salem is the State Capital and the second largest city in Oregon, it is critical to maintain the quality of built capacity (transportation networks, critical facilities, utility transmission, etc.) throughout the area, as it is likely that surrounding jurisdictions will seek assistance from Salem.
- Based on U.S. Census data, 69.6% of the residential housing throughout the City was built prior to current seismic building standards of 1990 and 37.1% were constructed prior to flood elevation requirement of the 1970's.⁵⁹
- The City of Salem has 44.3% of the housing units occupied by renters, versus homeowners.⁶⁰ Studies have shown that renters are less likely than homeowners to prepare for hazardous events.
- Roads and bridges in the City of Salem are highly vulnerable to hazards specifically earthquakes. Because bridges vary in size, materials, siting, and design, any given hazard will affect them differently. Salem must also consider roads and bridges

⁵⁷ Salem Online History. The Creeks of Salem. http://www.salemhistory.net/natural_history/salems_creeks.htm. Accessed January 30, 2011

⁵⁸ City of Salem. Department of Public Works.

<http://www.cityofsalem.net/Departments/PublicWorks/Operations/Water%20Services/Documents/ccr.pdf>

⁵⁹ U.S. Census Bureau, 2006-2010 American Community Survey. B25034 Year Structure Built.

⁶⁰ U.S. Census Bureau, 2010 Census. QT-H1 General Housing Characteristics

obstructed beyond the City limits, as this will likely have significant impacts on access in and out of Salem.

National Flood Insurance Program (NFIP)

The City of Salem Flood Insurance Rate Maps are current as of January 2003. Table 2.4 shows that as of March 31, 2012, the City of Salem has 1,068 National Flood Insurance Program (NFIP) policies in force, 188 claims⁶¹ and eight repetitive loss properties within the jurisdiction.⁶² The City of Salem’s last Community Assistance Visit was May 4, 2005; the city is a member of the Community Rating System (CRS) and has a Level 6 community rating, waiting for final verification of new status.⁶³

Table 2.4: NFIP Summary Table⁶⁴

Status of FIRM	Number of NFIP Policies	Claims	Last CAV*	CRS^ Rating
2-Jan-03	1,068	188	4-May-05	7

*Community Assistance Visit

^Community Rating System: The City of Salem CRS Rating has improved to a 6, and awaiting final approval

Vulnerability Summary

Vulnerability is a measure of the exposure of the built environment to hazards. The exposure of community assets to hazards are critical in the assessment of the degree of risk a community has to each hazard. Identifying the facilities and infrastructure at risk from various hazards can assist Salem in prioritizing resources for mitigation, and can assist in directing damage assessment efforts after a hazard event has occurred. The exposure of 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. City of Salem evaluated the best available vulnerability data to develop the vulnerability scores presented below. For the purposes of this plan, the city utilized the Oregon Emergency Management Hazard Analysis methodology vulnerability definitions to determine hazard probability. The definitions are:

LOW = less than 1-percent affected scores between 1 and 3 points

MEDIUM = between 1 and 10-percent affected scores between 4 and 7 points

HIGH = more than 10-percent affected scores between 8 and 10 points

Table 2.5 presents the vulnerability scores for each of the natural hazards present in City of Salem. As shown in the table, the city is highly vulnerable to the following hazards: earthquake, flood, hazardous materials incidents, wind storm and winterstorm.

⁶¹ BureauNet. Accessed May 11, 2012.

⁶² Robin Bunse. City of Salem, Public Works. May 7, 2012.

⁶³ BureauNet. Accessed May 11, 2012

⁶⁴ State NFIP Coordinator. March 3, 2012.

Table 2.5 Community Vulnerability Assessment Summary⁶⁵

Hazard	Vulnerability
Earthquake	High
Flood	High
Hazardous Material	High
Windstorm	High
Winter Storm	High
Extreme Heat	High
Drought	Moderate
Landslide	Moderate
Volcanic Eruption	Moderate
Wildland-Urban Interface Fire	Low

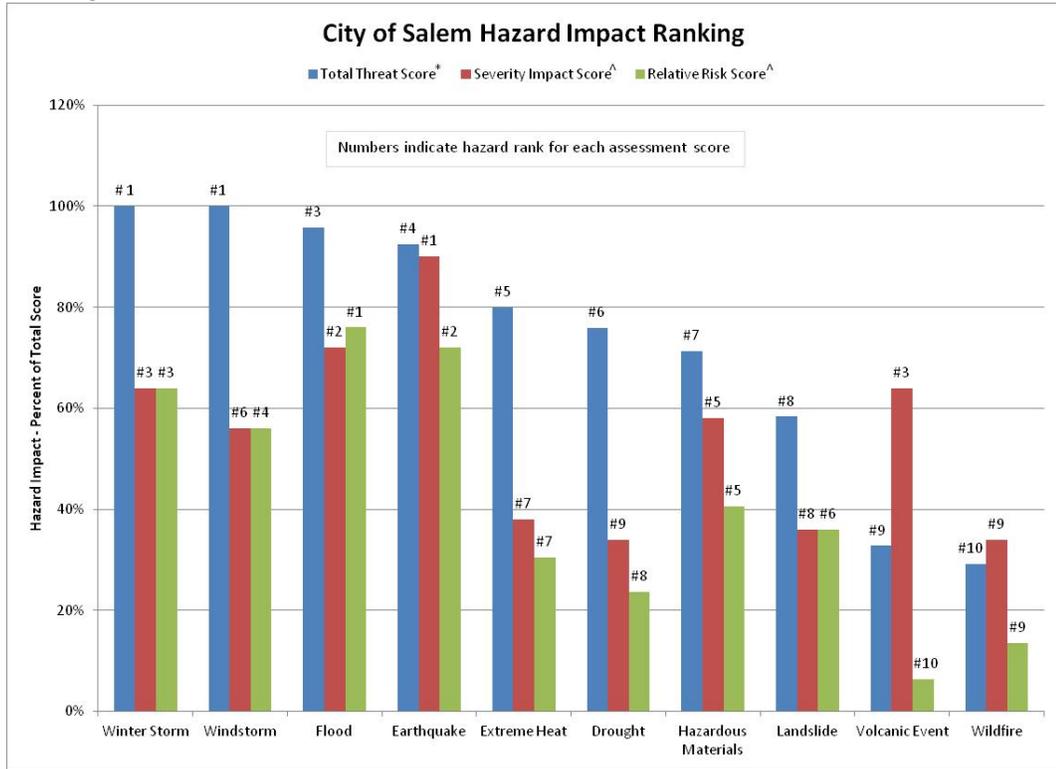
Risk Assessment

Table 2.6 presents the overall risk assessment for City of Salem including both the city’s hazard analysis and relative risk. The hazards are listed in rank order from high to low total threat score. With considerations for past historical events, vulnerability to populations, the maximum threat, and the probability, or likelihood of a particular hazard event occurring, winter storm, windstorm and flood are the three hazards with the highest priority concerning total threat score. Earthquake, flood and winter storm are designated with the highest severity impact scores and highest relative risk scores.

Table 2.6 Hazard Impact

⁶⁵ City of Salem. NHMP Steering Committee. 2012.

Ranking



Source: *Oregon Emergency Management. Risk Assessment Methodology. 2009.
 ^City of Salem. NHMP Steering Committee. 2012.

Section 3: Mission, Goals, and Action Items

Section III outlines City of Salem’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 Natural Hazard Mitigation Plan steering committee reviewed and updated the mission, goals and action items documented in this plan. Additional planning process documentation is in Appendix B.

Mitigation Plan Mission

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

The City of Salem developed the following mission statement for the City of Salem Natural hazards Mitigation Plan:

Reduce or eliminate long-term risk to people and their property resulting from natural hazards and their effects.

The 2008 City of Salem Natural Hazards Mitigation Plan did not have an established mission statement. The 2012 plan update steering committee reviewed the 2008 plan and agreed that the above statement best describes the over purpose and intent of this plan.

Mitigation Plan Goals

The plan goals help guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal 1

Develop and implement mitigation activities to protect human life.

Goal 2

Protect existing buildings and infrastructure as well as future development from the impacts of natural hazards.

Goal 3

Strengthen communication and coordination of public and private partnerships and emergency services among local, county and regional governments and the private sector.

Goal 4

Enhance economic resilience to reduce the impact on the local economy.

Goal 5

Preserve and rehabilitate natural systems to serve natural hazard mitigation functions and protect natural resources.

Existing Mitigation Activities

Existing mitigation activities include current mitigation programs and activities that are being implemented by the City in an effort to reduce the community's overall risk to natural hazards. Documenting these efforts can assist the jurisdiction to better understand risk and can assist in documenting successes. For a comprehensive list of existing mitigation activities for each specific hazard, reference Volume II: Hazard Annexes.

Government Structure

Beyond Emergency Management, most departments within the city governance structure have some degree of responsibility in building overall community resilience. Each plays a role in ensuring that city functions and normal operations resume after an incident, and the needs of the population are met. For further explanation regarding how these departments influence hazard resilience, reference Appendix D: Community Profile.

Existing Plan & Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Linking existing plans and policies to the Natural Hazards Mitigation Plan helps identify what resources already exist that can be used to implement the action items identified in the Plan. Plans and policies already in existence have support from local residents, businesses and policy makers.⁶⁶ Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs.⁶⁷ Implementing the Natural Hazard Mitigation Plan's action items through such plans and policies increases their likelihood of being supported and implemented.

Community Organizations and Programs

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. The City 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. Appendix D provides a comprehensive list of community organizations and programs, and offers a more thorough explanation of how existing community organizations and programs can be utilized for hazard mitigation.

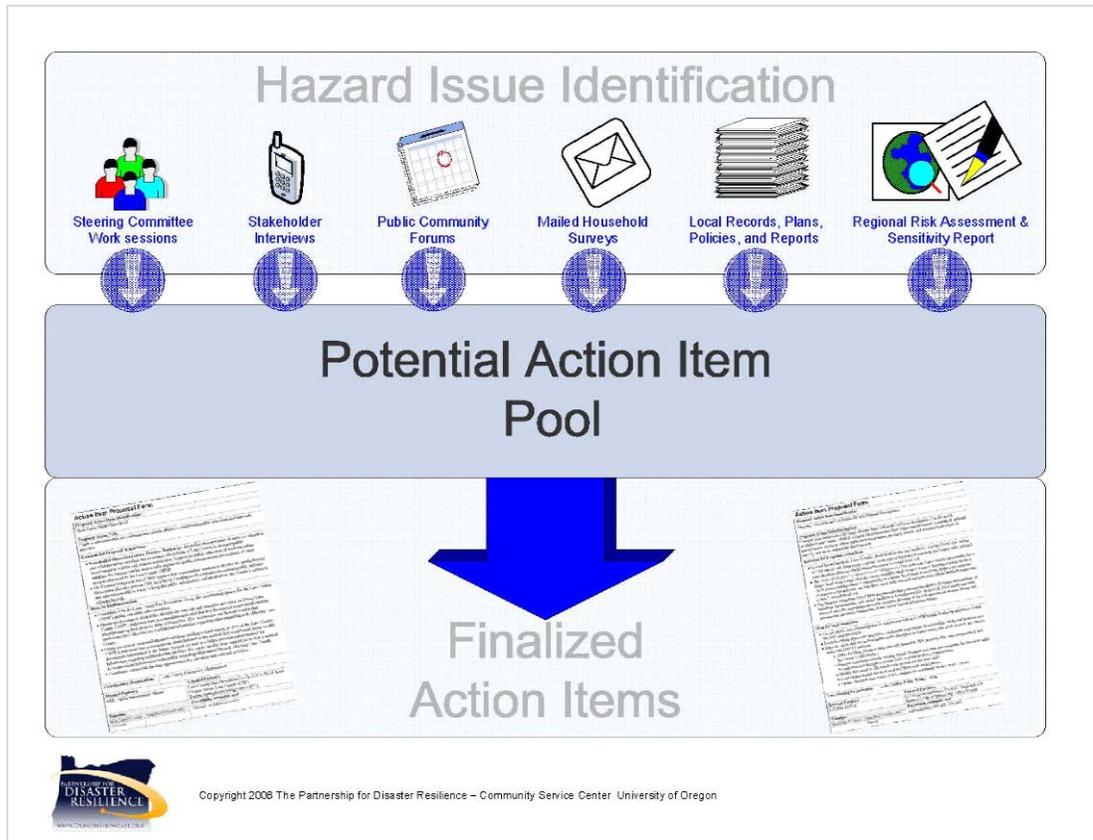
⁶⁶ Burby, Raymond J., ed. 1998. *Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities*.

² Ibid.

Current Mitigation Plan Action Items

Short- and long-term 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. They address both multi-hazard (MH) and hazard-specific issues. Action items can be developed through a number of sources. The figure below illustrates some of these sources. A description of how the plan’s mitigation actions were developed is provided below.

Figure 3.1 Action Item Sources



Source: Partnership for Disaster Resilience, 2006

Each action item has a corresponding action item worksheet describing the activity, identifying the rationale for the project, identifying potential ideas for implementation, and assigning coordinating and partner organizations. The action item worksheets can assist the community in pre-packaging potential projects for grant funding. The worksheet components are described below. These action item worksheets are located in Appendix A.

Rationale or Key Issues Addressed

Action items should be fact-based and tied directly to issues or needs identified throughout the planning process. Action items can be developed at any time during the planning

process and can come from a number of sources, including participants in the planning process, noted deficiencies in local capability, or issues identified through the risk assessment. The rationale for proposed action items is based on the information documented in Section 2 and the Hazard Annexes.

Ideas for Implementation:

The ideas for implementation offer a transition from theory to practice and serve as a starting point for this plan. This component of the action item is dynamic, since some ideas may prove to not be feasible, and new ideas may be added during the plan maintenance process. Ideas for implementation include such things as collaboration with relevant organizations, grant programs, tax incentives, human resources, education and outreach, research, and physical manipulation of buildings and infrastructure.

IMPLEMENTATION THROUGH EXISTING PROGRAMS

The City of Salem Natural Hazard Mitigation Plan includes a range of action items that, when implemented, will reduce loss from hazard events in the City. Within the plan, FEMA requires the identification of existing programs that might be used to implement these action items. The City of Salem currently addresses statewide planning goals and legislative requirements through its comprehensive land use plan, capital improvements plan, mandated standards and building codes. To the extent possible, the City of Salem will work to incorporate the recommended mitigation action items into existing programs and procedures.

Many of the City of Salem Natural Hazards Mitigation Plan's recommendations are consistent with the goals and objectives of the City's existing plans and policies. Plans and programs that can incorporate mitigation action items include the Comprehensive Plan, Transportation System Master Plan, Stormwater Master Plan, Capital Improvement Plan, Emergency Operations Plan, Unified Development Code (UDC), Floodplain Management Plan, Erosion Prevention and Sediment Control (EPSC) Program, and the Marion County Community Wildfire Protection Plan (CWPP). Because these plans are used on a regular basis, incorporating mitigation actions into these plans will likewise facilitate their implementation; reference Appendix A for a complete list of recommended actions and corresponding existing plans and policies.

Coordinating Organization:

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

Internal and External Partners:

The internal and external partner organizations listed in the Action Item Worksheets are potential partners recommended by the project Steering Committee but not necessarily contacted during the development of the plan. The coordinating organization should contact the identified partner organizations to see if they are capable of and interested in participation. This initial contact is also to gain a commitment of time and/or resources toward completion of the action items.

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

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

Plan Goals Addressed:

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

Timeline:

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

Action Item	Proposed Action Title	Lead Agency	Partner Organizations	Timeline	Alignment with Plan Goals				
					Protect lives.	Protect existing infrastructure and development.	Increase cooperation and coordination among stakeholders.	Reduce economic loss.	Protect the natural environment.
Plan Implementation #1	Request FEMA approval of the Natural Hazards Mitigation Plan Update.	Emergency Management	Salem Natural Hazards Mitigation Committee, Salem City Council, Oregon Office of Emergency Management, FEMA Region X	Short Term			X		
Plan Implementation #2	Salem Emergency Management will take on the role of convener to coordinate hazard mitigation meetings and implementation of mitigation action items.	Emergency Management	Salem Natural Hazards Mitigation Committee, Oregon Office of Emergency Management, FEMA Region X	Ongoing			X		
Plan Implementation #3	The Salem Natural Hazard Mitigation Committee will be the coordinating body responsible for implementing the Salem Natural Hazards Mitigation Plan.	Emergency Management	Salem Natural Hazards Mitigation Committee, Oregon Office of Emergency Management	Ongoing			X		
Plan Implementation #4	The Salem Natural Hazard Steering Committee will review the Hazard Mitigation Crosswalk to identify hazard mitigation policy changes for the City of Salem throughout existing plans. (Action Item under development)	Emergency Management	Salem Natural Hazards Mitigation Committee	Ongoing		X	X		X
Multi-Hazard #1	Coordinate with the Capital Projects Advisory Board to integrate natural hazard mitigation into State and City respective capital improvements.	Salem Community Development Department	Natural Hazard Mitigation Committee, FEMA, OEM, Capital Projects Advisory Board	Ongoing		X	X		
Multi-Hazard #2	Develop an inventory of the number and type of critical facilities within the community that are at reasonable risk for each hazard type.	Public Works	Salem Natural Hazards Mitigation Committee, GIS, IT, FEMA	Short Term		X			

Action Item	Proposed Action Title	Lead Agency	Partner Organizations	Timeline	Alignment with Plan Goals				
					Protect lives.	Protect existing infrastructure and development.	Increase cooperation and coordination among stakeholders.	Reduce economic loss.	Protect the natural environment.
Multi-Hazard #3	Develop public outreach materials for all natural hazard risks addressed in the Salem Natural Hazards Mitigation Plan. Materials should include mitigation actions residents and businesses can implement to reduce their risk to natural hazards, and where they can obtain more detailed natural hazard information.	Emergency Management	Salem Community Development Department, Public Works, FEMA, Oregon State Police, Oregon Office of Emergency Management	Ongoing		X	X	X	
Multi-Hazard #4	Include a post-disaster recovery and mitigation annex/appendix in the Salem Emergency Operations Plan that encourages property owners to incorporate retrofitting and mitigation measures in recovery efforts.	Emergency Management	Salem Natural Hazards Mitigation Committee, FEMA, Oregon State Police, Oregon Office of Emergency Management	Short Term		X	X		
Multi-Hazard #5	Ensure UDC updates consider specific hazards when updating the Salem code for mitigating the location of future development in identified/mapped high hazard areas.	Community Development Department	Salem Natural Hazards Mitigation Committee, DLCD, FEMA	Ongoing		X			X
Multi-Hazard #6	Strengthen or replace unsafe public structures (especially facilities critical to disaster and post-disaster planning/response).	Public Works	Salem Public Works, Fire Department, Police Department, Community Development, Urban Development, Administrative Services, FEMA, ODOT	Long Term	X	X			

Action Item	Proposed Action Title	Lead Agency	Partner Organizations	Timeline	Alignment with Plan Goals				
					Protect lives.	Protect existing infrastructure and development.	Increase cooperation and coordination among stakeholders.	Reduce economic loss.	Protect the natural environment.
Multi-Hazard #7	Continue developing alert and warning systems to notify residents of incidents involving natural hazards and hazardous materials.	Emergency Management	Public Works, Police Department, GIS and Mapping Departments, ODOT, FEMA, OSHA	Long Term	X		X		
Drought #1	Action Item in Development								
Earthquake #1	Develop an inventory of un-reinforced masonry structures and develop appropriate mitigation action items to reduce the impacts of seismic events.	Community Development Department	Salem Urban Development, Public Works, Fire, FEMA, DOGAMI	Long Term	X	X			
Earthquake #2	Identify and inventory critical facilities that require seismic retrofit.	Emergency Management	Salem Natural Hazards Mitigation Committee, Salem Community Development Department, Salem Public Works, FEMA, OEM, DOGAMI, Local School Districts	Ongoing		X	X		
Earthquake #3	Partner with the school districts to help identify and prioritize seismic retrofits to school district facilities.	Emergency Management	Salem Natural Hazards Mitigation Committee, Salem Community Development Department, FEMA, OEM, DOGAMI, Salem-Keizer School District, private schools, Chemeketa C.C., Willamette University, Corban University	Long Term	X	X			
Extream Heat #1	Action Item in Development								

Action Item	Proposed Action Title	Lead Agency	Partner Organizations	Timeline	Alignment with Plan Goals				
					Protect lives.	Protect existing infrastructure and development.	Increase cooperation and coordination among stakeholders.	Reduce economic loss.	Protect the natural environment.
Flood #1	Adopt a floodplain management plan in accordance with FEMA's Community Rating System guidelines.	Public Works	City of Salem Emergency Management, Salem Fire, Salem Operations and Engineering FEMA, National Flood Insurance Program, Floodplain Management Committee	Short Term		X	X	X	X
Flood #2	Improve the City of Salem's National Flood Insurance Program (NFIP) Community Rating System (CRS) to reduce NFIP premiums.	Public Works	Salem Community Development DLCD, National Flood Insurance Program, FEMA, Marion and Polk Counties	Ongoing			X	X	
Hazardous Materials #1	Map facilities that handle or contain hazardous materials, rank them based on their level of risk, and refine response strategies for each situation in the event of an accident.	Fire Department	Salem Emergency Management, Public Works OSHA, Salem Chamber of Commerce, Neighborhood Associations, ODOT, OEM, State Police, State Fire Marshal	Short Term	X		X		X
Landslide #1	Map areas of landslide risk adjacent to the North Santiam River (upstream of the Geren Island water intake structures) and areas impacted by a catastrophic failure of the Detroit or Big Cliff Dams.	Public Works	Salem Community Development, US Army Corps, DLCD, FEMA, BLM, USFS	Long Term	X	X			X

Action Item	Proposed Action Title	Lead Agency	Partner Organizations	Timeline	Alignment with Plan Goals				
					Protect lives.	Protect existing infrastructure and development.	Increase cooperation and coordination among stakeholders.	Reduce economic loss.	Protect the natural environment.
Landslide #2	Improve the existing Erosion Prevention and Sediment Control (EPSC) program and regulations established in SRC 65 and 69 to help control erosion.	Public Works	Salem Natural Hazards Mitigation Committee, Community Development, FEMA, DLCD, ODEQ, ODOT	Ongoing				X	X
Landslide #3	Update landslide overlay maps using Light Detection and Ranging (LIDAR) data.	Public Works	Salem Natural Hazards Mitigation Committee, City GIS technicians, FEMA, NOAA, DLCD, DOGAMI, Keizer, Turner, Marion County, Polk County	Long Term		X	X		
Volcanic Eruption #1	Action Item in Development								
Windstorm #1	Partner with public and private utilities to educate the public about hazardous trees and the damage they can cause in the event of a windstorm.	Public Works	Salem Community Services Parks Operations , Salem Fire Department, ODOT, Portland General Electric, Salem Electric	Long Term		X		X	
Winter Storm #1	Partner with public and private utilities to educate the public about hazardous trees and the damage they can cause in the event of a winter storm.	Public Works	Salem Community Services Parks Operations , Salem Fire Department, ODOT, Portland General Electric, Salem Electric	Long Term		X		X	
Wildfire #1	Conduct wildfire prevention outreach, as outlined in the Marion County Community Wildfire Protection Plan (CWPP), to residents near the wildland-urban interface.	Fire Department	Salem Public Works, Community Development Departments, Police Department, Community Services, Oregon Department of Forestry, Marion County Fire District #1, Salem Suburban Fire District, Neighborhood Associations	Short Term	X		X		

Section 4: Plan Implementation and Maintenance

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

Implementing the Plan

The City of Salem Natural Hazard Mitigation Plan was developed and will be implemented through a collaborative process. After the Plan is locally reviewed and deemed complete, City of Salem Emergency Management submits it to the State Hazard Mitigation Officer at Oregon Emergency Management. Oregon Emergency Management submits the plan to the Federal Emergency Management Agency (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 City of Salem will adopt the plan via resolution. At that point the City of Salem will gain eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and Flood Mitigation Assistance program funds.

Convener

The City of Salem Emergency Manager will serve as the convener for the City of Salem Natural Hazard Mitigation Plan. The convener's responsibilities include:

- Coordinate 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
- Utilize the Risk Assessment as a tool for prioritizing proposed natural hazard risk reduction projects.

Coordinating Body

The City of Salem steering committee serves as the coordinating body for the mitigation plan. 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 Natural Hazards Mitigation Plan 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 organizations were represented and served on the steering committee during the development of the City of Salem Natural Hazard Mitigation Plan:

- Aaron Panko, City of Salem Community Development
- Robin Bunse, City of Salem Public Works
- Jim Stewart, City of Salem Fire Department
- John Vanderzanden, Marion County Emergency Management
- Mike Gotterba, Public Works
- Wayne McFarlin, Salem Hospital

To make the coordination and review of the City of Salem Natural Hazard Mitigation Plan 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 internal or external partners on the individual action item forms found in Appendix A.

Plan Maintenance

Plan maintenance is a critical component of the natural hazard mitigation plan. Proper maintenance of the plan ensures that this plan will maximize the City's efforts to reduce the risks posed by natural hazards. This section was developed by the University of Oregon's Partnership for Disaster Resilience and includes a process to ensure that a regular review and update of the plan occurs. The steering committee 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.

Semi-Annual Meetings

The Committee will meet on a semi-annual basis to complete the following tasks. During the first meeting the Committee 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; and
- Prioritize potential mitigation projects using the methodology described below.

During the second meeting of the year the Committee will:

- Review existing and new risk assessment data;
- Discuss methods for continued public involvement; and
- Document successes and lessons learned during the year.

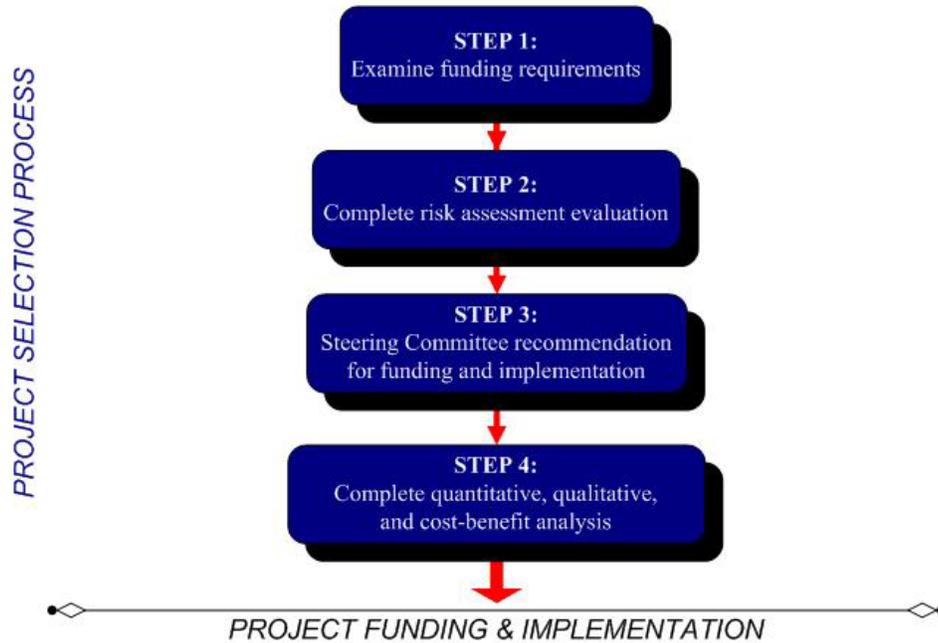
The convener will be responsible for documenting the outcome of the semi-annual meetings in Appendix B. The process the coordinating body will use to prioritize mitigation projects is detailed in the section below. The plan's format allows the City of Salem to review and update sections when new data becomes available. New data can be easily incorporated, resulting in a natural hazards mitigation plan 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. Projects may be identified by committee members, local government staff, other planning documents, or the risk assessment. Figure 4.1 illustrates the project development and prioritization process.

Figure 4.1: Project Prioritization Process

Action Item and Project Review Process



Source: Community Service Center’s Partnership for Disaster Resilience at the University of Oregon, 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 city’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 C Grant Programs 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 Emergency Management, 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.

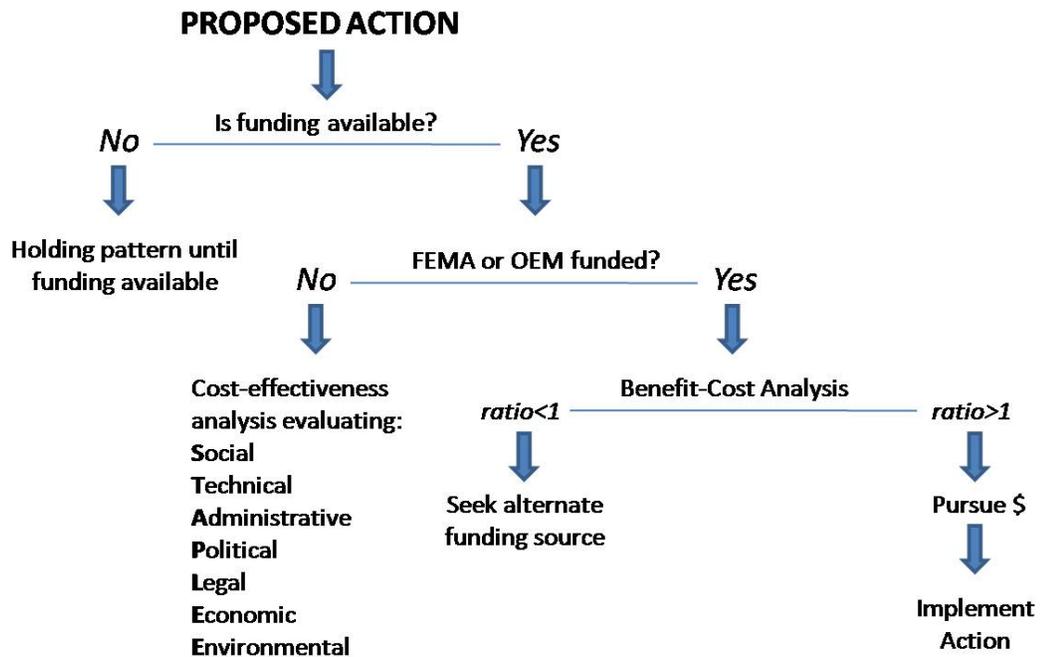
STEP 3: COMMITTEE RECOMMENDATION

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: Community Service Center’s Partnership for Disaster Resilience at the University of Oregon, 2010.

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

For non-federally funded or nonstructural projects, a qualitative assessment will be completed to determine the project’s cost effectiveness. The committee 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. The STAPLE/E technique has been tailored for use in natural hazard action item prioritization by the Partnership for Disaster Resilience at the University of Oregon’s Community Service Center.

Continued Public Involvement & Participation

The City of Salem is dedicated to directly involving the public in the continual reviewing and updating 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.

The City will ensure continued public involvement by posting the Salem Natural Hazard Mitigation Plan on the City’s website at www.salem.or.us and www.cityofsalem.net. The plan will also be archived and posted on the University of Oregon Libraries’ Scholar’s Bank Digital Archive at the following address:

<https://scholarsbank.uoregon.edu/xmlui/>

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 City of Salem Natural Hazards Mitigation Plan is due to be updated in 2017. The convener 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 convener 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.

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?			
Do future annexations include hazard prone areas?			
Are there new high risk populations?			
Are there completed mitigation actions that have decreased overall vulnerability?			

Mitigation Plan Update Toolkit			
Question	Yes	No	Plan Update Action
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.

Drought Hazard Annex

Causes and Characteristics of Drought

A drought is a period of drier than normal conditions that results in water-related problems.¹ Drought occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another.² Drought is a temporary condition; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate.³

The National Drought Mitigation Center and the National Center for Atmospheric Research define drought by categorizing it according to the “type of drought.” These types include the following:

Meteorological or Climatological Droughts

Meteorological droughts are defined in terms of the departure from a normal precipitation pattern and the duration of the event. These droughts are a slow-onset phenomenon that can take at least three months to develop and may last for several seasons or years.

Agricultural Droughts

Agricultural droughts link the various characteristics of meteorological drought to agricultural impacts. The focus is on precipitation shortages and soil-water deficits. Agricultural drought is largely the result of a deficit of soil moisture. A plant's demand for water is dependent on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

Hydrological Droughts

Hydrological droughts refer to deficiencies in surface water and sub-surface water supplies. It is measured as stream flow, and as lake, reservoir, and ground water levels. Hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, the shortage will be reflected in declining surface and sub-surface water levels.

Socioeconomic Droughts

Socioeconomic droughts occur when physical water shortage begins to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with supply, demand, and economic good. One could argue that a physical water shortage with no socio-economic impacts is a policy success.

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. The Oregon Drought Severity Index is the most commonly used drought measurement in the state

¹ Moreland, A. 1993. Open File Report 93-642. USGS.

² National Drought Mitigation Center. 2007. What is Drought? <http://www.drought.unl.edu/whatis/what.htm>, accessed May 28, 2010.

³ National Drought Mitigation Center. 2006. What is Drought?: Understanding and Defining Drought. <http://www.drought.unl.edu/whatis/concept.htm>, accessed May 28, 2010.

because it incorporates both local conditions and mountain snow pack. The Oregon Drought Severity Index categorizes droughts as mild, moderate, severe, and extreme.

History of Drought in City of Salem

Although Salem is spared from most droughts because of its location east of the ocean and west of the Cascades, it has been affected by droughts in the past. The broader region surrounding the City of Salem experiences dry conditions annually during the summer months from June to September. The Drought Severity Index shows episodes of drought within the past five years occurring during the summer through the fall.⁴ Periodically, this region experiences more significant drought conditions that affect the region or the state.

Between 1928 and 1941, there was a statewide drought. Low stream flows prevailed in western Oregon during the period from 1976-81, with 1976-77 being the driest year of the century. The 1985-94 drought was not as severe as the 1976-77 drought in any single year, but the cumulative effect of ten consecutive years with mostly dry conditions caused statewide problems. The peak year of the drought was 1992, when a drought emergency was declared for all of Oregon.⁵ Dates for significant drought events that affected the City of Salem are listed in Table DR-1. There have been no drought events since the 2008 City of Salem NHMP.

⁴ National Weather Service Climate Prediction Center. Drought Severity Index by Division (Long-Term Palmer) Archive. http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring, accessed February 17, 2010.

⁵ Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR. Oregon State University Press.

Table DR-1: History of Droughts

Date	Location	Comments
February, 2005	Statewide	February 2005 was the driest February on record since 1977. Above normal temperatures contributed to decreased water availability for the summer. Stream and river levels dropped significantly and watermasters regulated live flow use by irrigators. Drought conditions also led to the use of stored water, when it was available. However, water availability in the Willamette Valley was not as severely affected as with other parts of the state.
1985-1994	Statewide	A dry period lasting from 1985 to 1994 caused significant problems statewide. The peak year was 1992, when the state declared a drought emergency. In the seven-year period from 1986-1992, Medford received only five years' worth of precipitation and other areas of southern Oregon were also significantly affected. Forests throughout Oregon suffered from a lack of moisture with fires common and insect pests flourishing.
1976-1981	Willamette Valley	During this drought period in western Oregon, low stream flows prevailed. The period between 1976 and 1977 was the single driest year of the century. The Portland Airport received only 7.19 inches of rain between October 1976 and February 1977. Corvallis received only 22.2 inches of precipitation, 52 percent of the "normal" of 42.7 inches. During the winter of that year, airborne dry ice seeding was used in Polk County as a means of enhancing winter precipitation for agricultural use.
1928-1941	Statewide	A significant drought affected all of Oregon from 1928 to 1941. The prolonged statewide drought created significant problems for the agriculture industry. The first of the three Tillamook Forest burns occurred during this drought in 1933.

Risk Assessment

How are Hazards Identified?

The extent of the drought depends upon the degree of moisture deficiency, and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city and county. In severe droughts, environmental and economic consequences can be significant.

Probability of Future Occurrence

Droughts are not uncommon in 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 eight and 12 years.⁶

Given the average recurrence interval for severe droughts in Oregon, the steering committee determined that there is a **moderate** probability the City of Salem will experience severe extended drought conditions, meaning that one drought event is likely to occur within the next 35 to 75 years. This rating is consistent with the 2008 City of Salem Hazard Analysis.

Vulnerability Assessment

The severity of a drought occurrence poses a risk for agricultural and timber losses, property damage, and disruption of water supplies and availability in urban and rural areas. Factors used to assess drought risk include agricultural practices, such as crop types and varieties grown, soil types, topography, and water storage capacity.

Due to the nature of droughts and their extensive effects, the Marion County steering committee determined that Marion County has a **moderate** vulnerability to drought, meaning up to 10% percent of the city's population or regional assets would be affected. This rating is consistent with the 2008 City of Salem Hazard Analysis.

Risk Analysis

The City of Salem steering committee determined that the history of drought events is **high**, with at least four events occurring over the last 100 years. The maximum threat of a drought is also **high**, considering the percentage of population and property that could be impacted under a worst—case scenario.⁷

Droughts in the past have caused no personal injury or death. The potential for future injuries or deaths is anticipated to remain similar to historic events. Salem estimates that less than 10% of the City's population could be physically displaced by a drought, and there would be little or no impact on community social networks.⁸

Facilities throughout the City anticipate little or no damage due to a drought, estimated at less than \$1 million for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely less than 10% of businesses located in the City and surrounding area could experience commerce interruption for a period of days. The agricultural sector could suffer the greatest impact from a drought in comparison to other types of business. Lastly, drought would likely have moderate impacts on more than 75% of the City's ecological systems, including, clean water, wildlife habitat, and parks.⁹

The relative risk of a drought is estimated by considering the probability of a drought event and the severity of the outcome when a drought occurs. On a scale of 1 to 25, with 1 being

⁶ Marion County. Natural Hazard Mitigation Plan. 2011.

⁷ City of Salem. NHMP Steering Committee. 2012.

⁸ Ibid.

⁹ Ibid.

the lowest and 25 being the highest relative risk, drought hazards in the City of Salem are a score of 5.9.¹⁰

Community Hazard Issues

What is susceptible to damage during a hazard event?

Drought is frequently an "incremental" hazard, meaning both the onset and end are often difficult to determine. Also, its effects may accumulate slowly over a considerable period of time and may linger for years after the termination of the event.

Droughts are not just a summer-time phenomenon; winter droughts can have a profound impact on agriculture, particularly east of the Cascade Mountains. Also, below average snowfall in higher elevations has a far-reaching effect, especially in terms of hydro-electric power, irrigation, recreational opportunities and a variety of industrial uses. The area surrounding the City of Salem has a large agricultural economy which would suffer significantly during an extended drought.

Drought can affect all segments of a jurisdiction's population, particularly those employed in water-dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). Also, domestic water-users may be subject to stringent conservation measures (e.g., rationing) and could be faced with significant increases in electricity rates. In addition, water-borne transportation systems, such as the ferry in Buena Vista, could be impacted by periods of low water.

There also are environmental consequences to drought. A prolonged drought in forests promotes an increase of insect pests, which in turn, damage trees already weakened by a lack of water. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.¹¹

Some environmental effects of drought are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. Many species, however, will eventually recover from this temporary aberration. Oregon has several fish species listed as threatened or endangered pursuant to the Endangered Species Act (ESA) of 1973. Some of these species have habitat requirements that often conflict with the needs or desires of the human environment. For example, in times of scarcity, the amount of water necessary to maintain certain fish species may conflict with the needs of the local agricultural community. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape.¹²

¹⁰ Oregon Emergency Management. Hazard Analysis Methodology, Relative Risk. 2009

¹¹ National Drought Mitigation Center. 2006. Understanding Your Risk and Impacts: Impacts of Drought. <http://www.drought.unl.edu/risk/impacts.htm>, accessed May 28, 2010.

¹² National Drought Mitigation Center. 2006. Understanding Your Risk and Impacts: Impacts of Drought. <http://www.drought.unl.edu/risk/impacts.htm>, accessed May 28, 2010.

Existing Hazard Mitigation Activities

Water Management and Conservation Plan

The City of Salem Public Works Department has a Water Management and Conservation Plan that addresses drought and sets forth a plan of action to reduce the negative impacts from a drought. The WMCP satisfies the requirement that each municipal water right permit extension holders submit a WMCP to gain access to additional quantities of water. As a holder of permits, this WMCP describes the City of Salem’s water uses, water needs, water conservation program, and plans for development of existing water rights to meet short- and long-term customer demands. In addition to meeting the rules’ requirements, this WMCP demonstrates Salem’s stewardship of water resources.¹³

Salem has taken a multifaceted approach to water resource management by taking a holistic perspective of these resources over a 100-year planning period. Along with its WMCP, Salem coordinated a biological assessment of water withdrawals on Endangered Species Act (ESA) listed species, an update to the Water System Master Plan, and a Source Water Protection Plan. These coordinated efforts lead to a common water resource strategy that strikes a balance between the City’s need to divert water to meet its customers’ demand by 2105 and protect water resources for future generations reliant on the health and availability of these resources.¹⁴

Lawn Watering

In an effort to conserve water the city encourages residents to reduce water use in the summer, specifically by reducing water usage for lawns, through the “One Inch per Week” campaign. To help people join the campaign, the city gives out free watering gauges to the public. Salem businesses have already taken the lead to reduce water use. The city’s water staff are also working with public agencies that use Salem’s drinking water—the State of Oregon, the Salem—Keizer School District, and Salem Parks—to continue expanding their water saving efforts.¹⁵

Outreach

The City of Salem actively utilizes the city’s website to encourage water conservation. The website offers various strategies to reduce water usage in the home, i.e. WaterWise Drip Calculator and descriptions of water-wise plants.¹⁶

Drought Mitigation Action Items

Action items for drought are in development.

¹³ City of Salem. Public Works. Water Management and Conservation Plan. March 2009.

¹⁴ City of Salem. Public Works. Water Management and Conservation Plan. March 2009.

¹⁵ City of Salem. Public Works, Lawn Watering. Accessed April 17, 2012.

<http://www.cityofsalem.net/Departments/PublicWorks/Operations/Water%20Services/Pages/LawnWatering.aspx>

¹⁶ City of Salem. Public Works, Water Conservation. Accessed April 17, 2012.

<http://www.cityofsalem.net/Departments/PublicWorks/Operations/Water%20Services/Pages/WaterConservation.aspx>

Earthquake Hazard Annex

Causes and Characteristics of Earthquake

Seismic events were once thought to pose little or no threat to Oregon communities. However, recent earthquakes and scientific evidence indicate that the risk to people and property is much greater than previously thought. Oregon and the Pacific Northwest in general are susceptible to earthquakes from three sources: 1) shallow crustal events within the North American Plate; 2) deep intra-plate events within the subducting Juan de Fuca Plate; and 3) the off-shore Cascadian Subduction Zone.

Crustal Fault Earthquakes

Crustal fault earthquakes are the most common types of earthquakes and occur at relatively shallow depths of six to twelve miles below the surface. While most crustal fault earthquakes are smaller than magnitude 4.0 and generally create little or no damage, they can produce earthquakes of magnitudes 7.0 and higher and cause extensive damage. The Mount Angel Fault, a crustal fault located within the county, produced a 5.7 magnitude quake in 1993.¹

The western part of Oregon is underlain by a large and complex system of faults (e.g., Portland Hills) that can produce damaging earthquakes. There is a direct relationship between a fault's length and its ability to generate damaging ground motions: smaller nearby faults produce lower magnitude events, but their ground shaking can be strong and damage can be high because of the fault's proximity. Earthquakes can trigger other geologic and soils failures that contribute to damage.

Deep Intraplate Earthquakes

Occurring at depths from 25 to 40 miles below the earth's surface in the subducting oceanic crust, deep intraplate earthquakes can reach magnitude 7.5.² The February 28, 2001 earthquake in Washington State was a deep intraplate earthquake. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah.³

Subduction Zone Earthquakes

The Pacific Northwest is located at a convergent plate boundary, where the Juan de Fuca and North American tectonic plates meet. The two plates are converging at a rate of about one to two inches per year. This boundary is called the Cascadia Subduction Zone (see Figure 1.0). It extends from British Columbia to northern California. Subduction zone earthquakes are caused by the abrupt release of slowly accumulated stress.

While all three types of earthquakes have the potential to cause major damage, subduction zone earthquakes pose the greatest danger. A major CSZ event could generate an earthquake with a magnitude of 9.0 or greater resulting in devastating damage and loss of

¹ Wong, Ivan G and Jacqueline D.J. Bott. November 1995. "A Look Back at Oregon's Earthquake History, 1841- 1994." Oregon Geology 57 (6): 125.

² Ibid.

³ Hill, Richard. "Geo Watch Warning Quake Shook Portland 40 Years Ago." The Oregonian. October 30, 2002.

life. Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon including City of Salem. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes.⁴

Subduction zones similar to the Cascadia Subduction Zone have produced earthquakes with magnitudes of 8.0 or larger. Historic subduction zone earthquakes include the 1960 Chile earthquake (magnitude 9.5), the 1964 southern Alaska (magnitude 9.2) earthquakes and the 2004 Indian Ocean earthquake (magnitude 9.0). Geologic evidence shows that the Cascadia Subduction Zone has generated great earthquakes, most recently about 300 years ago. The specific hazards associated with an earthquake are explained below:

Ground Shaking

Ground shaking is defined as the motion or seismic waves felt on the Earth's surface caused by an earthquake. Ground shaking is the primary cause of earthquake damage.

Ground Shaking Amplification

Ground shaking amplification refers to the soils and soft sedimentary rocks near the surface that can modify ground shaking from an earthquake. Such factors can increase or decrease the amplification (i.e., strength) as well as the frequency of the shaking.

Surface Faulting

Surface faulting are planes or surfaces in Earth materials along which failure occurs. Such faults can be found deep within the earth or on the surface. Earthquakes occurring from deep lying faults usually create only ground shaking.

Earthquake-Induced Landslides

These landslides are secondary hazards that occur from ground shaking.

Liquefaction

Liquefaction takes place when ground shaking causes granular soils to turn from a solid into a liquid state. This in turn causes soils to lose their strength and their ability to support weight.

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.

History of Earthquakes in City of Salem

The City of Salem has been affected by earthquakes in the surrounding area of an estimated magnitude of four and greater. The Pacific Northwest has experienced major earthquakes in 1949 (magnitude 7.1), 1962 (magnitude 5.2), and 2001 (magnitude 6.8). Table EQ-2 shows the location of selected Pacific Northwest earthquakes that have occurred since 1949.

There are no high concentrations of earthquakes in northern Oregon, and all major quakes in northwest Oregon have been shallow.⁵ Within the Salem Urban Growth Boundary (UGB),

⁴ UO Community Planning Workshop. 2002.

the area south of the Willamette River and west of River Road has the highest risk of earthquakes. Other small areas with high earthquake risk exist to the east of the city.⁶ There have been no reported earthquakes since the last NHMP Update in 2008.

Table EQ-2: Earthquake History in Salem and Surrounding Area

Date	Location	Comments
February, 2001	Nisqually, WA	The most recent earthquake to be felt in Marion County was the Nisqually earthquake, on February 28, 2001. The earthquake was centered 35 miles southwest of Seattle and registered 6.8 on the Richter Scale. While the quake caused little damage in Marion County, it did temporarily close businesses and schools to assess potential damage.
March, 1993	Scotts Mills, OR	The Scotts Mills Earthquake originated about two miles south of Scotts Mills and twelve to thirteen miles underground. In Salem, the rotunda of the state Capitol cracked, and the Golden Pioneer statue nearly rocked off its base.
March, 1963	Salem, OR	On March 7, 1963, a quake measuring 4.6 on the Richter scale shook Marion County. Despite the low magnitude of the quake, damage still occurred – especially to older masonry buildings.
November, 1962	Vancouver, WA	Three and a half weeks after the devastating Columbus Day Storm, an earthquake that measured approximately 5.2 on the Richter scale shook the Portland area. It was the largest quake to be generated by a fault under Portland and Vancouver. The Oregon Statesman reported little damage, although much of Marion County was shaken up.
April, 1961	Albany, OR	A quake in April of 1961 caused little damage to the county, but startled many residents. The quake was centered just south of Salem, and registered 4.6 on the Richter scale. Described by most as a double shock, it shook houses and rattled dishes, but damage was very limited. Albany reported some cracked plaster.[1]
November, 1957	Salem, OR	The 1957 earthquake registered a 5.0 on the Richter Scale. Most reports indicated only one sharp jolt or a few seconds of shaking. The earthquake caused slight damage in Salem, and temporary power outtages.
April, 1949	Olympia, WA	April 13, 1949, Marion County residents felt an earthquake that was centered near Olympia, Washington. While Marion County was shaken by the quake, damage was minimal. In downtown Salem and West Salem areas buildings trembled, light-fixtures swayed, dishes rattle in cupboards.

⁵ Pacific Northwest Seismograph Network. "Selected Pacific Northwest Earthquakes Since 1872". <http://www.pnsn.org/>

⁶ City of Salem Geographic Information Systems (GIS). Natural Hazard Mitigation Plan. Map 2.1.2A Earthquake Hazard Amplification Susceptibility. 2008.

Risk Assessment

How are Hazards Identified?

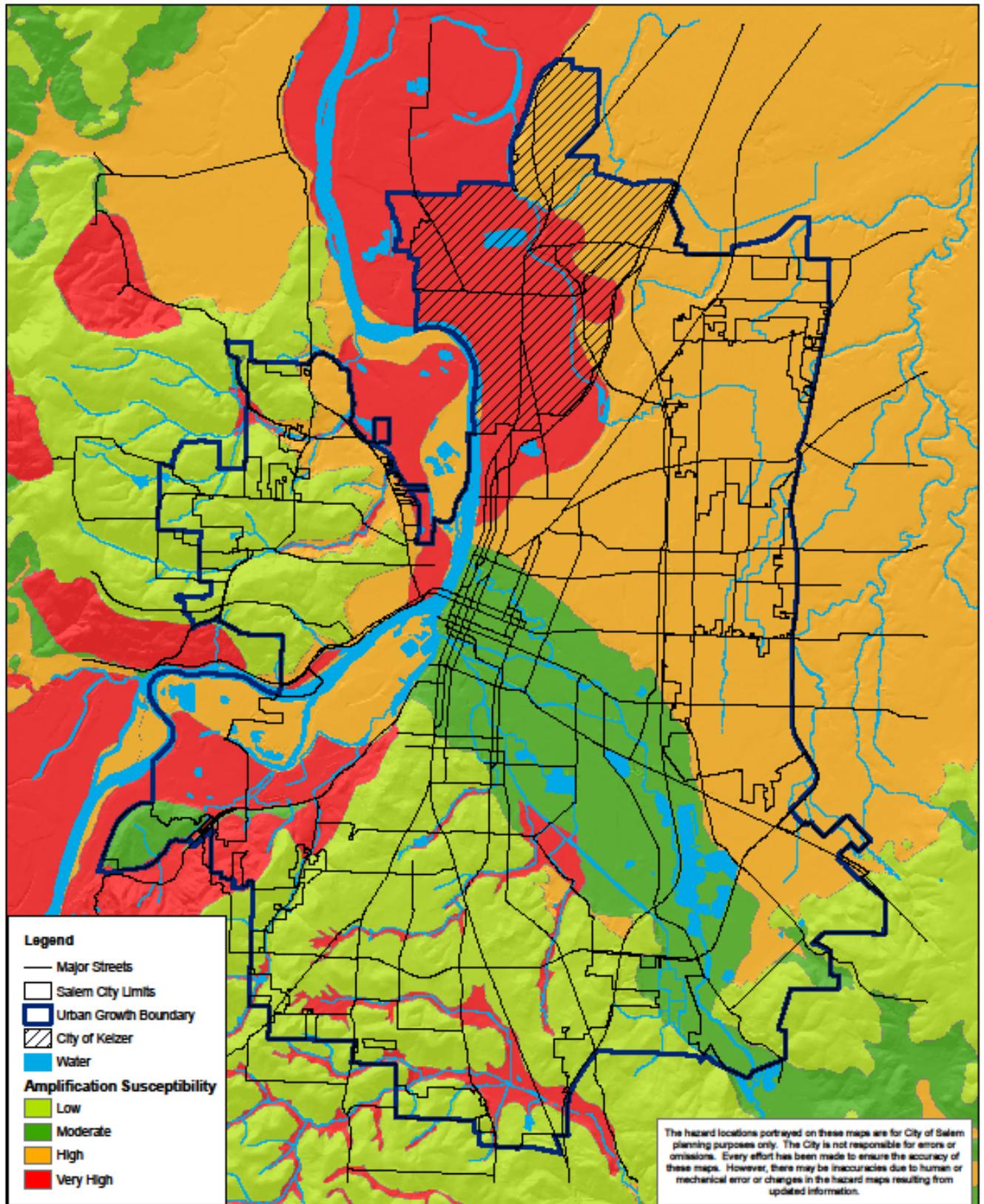
The Department of Geology and Mineral Industries (DOGAMI), in partnership with other state and federal agencies, has mapped earthquake hazards in much of the Salem area. Through this partnership, DOGAMI has identified areas in selected Oregon communities that will suffer more damage, relative to other areas, during an earthquake. Primary earthquake hazards include ground shaking amplification, liquefaction, and earthquake-induced landslides. Areas most susceptible to ground amplification and liquefaction have young, soft alluvial sediments, found in most of the Willamette Valley and are along stream channels.⁷

The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event.

⁷ Burns, William, John 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, 2008

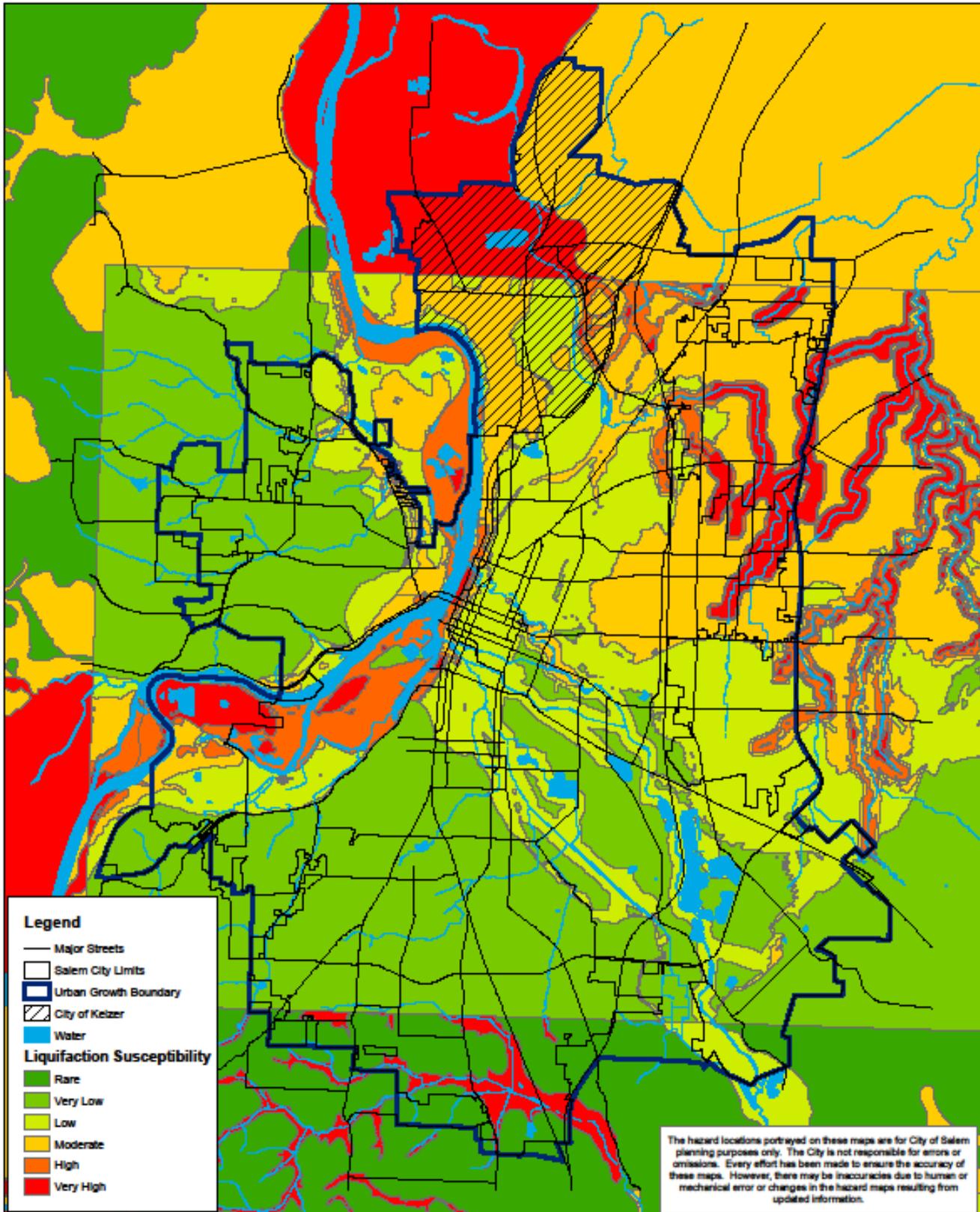
CITY OF SALEM NATURAL HAZARD MITIGATION PLAN

MAP EQ.1: EARTHQUAKE HAZARD - AMPLIFICATION SUSCEPTIBILITY



CITY OF SALEM NATURAL HAZARD MITIGATION PLAN

MAP EQ.2: EARTHQUAKE HAZARD - LIQUIFACTION SUSCEPTIBILITY



Probability of Future Occurrence

Scientists estimate the chance in the next 50 years of a large subduction zone earthquake is between 10 and 20 percent, assuming that the recurrence is on the order of 400 +/- 200 years.⁸ Establishing a probability for crustal earthquakes is more difficult. There have been five earthquakes above magnitude 4 centered in the mid-Willamette Valley, of which the 1993 Scotts Mills earthquake was the largest. Oregon's seismic record is short and the number of earthquakes above a magnitude 4 centered in the mid-Willamette Valley is small. Therefore, any kind of prediction would be questionable. Earthquakes generated by volcanic activity in Oregon's Cascade Range are possible, but likewise unpredictable.

Over the last 63 years seven damaging earthquakes affected the Willamette Valley, ranging from 4.5 to 7.1 in magnitude. This averages out to one damaging earthquake every nine years. Given this recurrence interval, the City of Salem steering committee rated the probability of an earthquake occurring as **high**, meaning that it is likely the City of Salem will be affected by a damaging earthquake within a 10-35 year period. The high ranking is consistent with the 2008 City of Salem Hazard Analysis.

Vulnerability Assessment

The effects of earthquakes span a large area. The degree to which earthquakes are felt, however, and the damages associated with them may vary. At risk from earthquake damage are unreinforced masonry buildings, bridges built before earthquake standards were incorporated into building codes, many "high tech" and hazardous material facilities, extensive sewer, water, and natural gas pipelines, petroleum pipelines, and other critical facilities and private property located within the city. The areas that are particularly vulnerable to potential earthquakes in the city have been identified as those with soft, alluvial sediments and lands along stream channels, which appear in a significant portion of the Willamette Valley.⁹

The City of Salem Steering Committee determined that the city's vulnerability to earthquakes **high**, meaning that more than 10% of the population and the regional assets would be impacted by an earthquake. The high ranking is consistent with the 2008 City of Salem Hazard Analysis.

Risk Analysis

The City of Salem steering committee determined that the history of earthquake events is **high**, with at least four events occurring over the last 100 years. The maximum threat of an earthquake is also **high**, considering the percentage of population and property that could be impacted under a worst—case scenario.¹⁰

Earthquakes in the past caused no injuries regarding the health and safety of residents. However, the potential for injuries or deaths from past events or from similar events in other communities could escalate resulting in multiple deaths and major injuries. It is estimated that 50-75% of the City's population would be physically displaced by an

⁸ *Oregon Geology*, Volume 64, No. 1, Spring 2002.

⁹ City of Salem Geographic Information Systems (GIS). Natural Hazard Mitigation Plan. Map 2.1.2A Amplification Susceptibility and Map 2.1.2B Liquefaction Susceptibility. 2008.

¹⁰ City of Salem. NHMP Steering Committee. 2012.

earthquake, accounting for the number of homes that would be damaged from seismic activity, and there would be extensive impact on community social networks.¹¹

Most facilities throughout the City anticipate extensive damage due to an earthquake, estimated at more than \$1 billion for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely more than 75% of businesses located in the City and surrounding area would experience commerce interruption for a period of a year or longer. Earthquakes have the potential to inflict widespread damage to not only buildings but also the transportation network that may inhibit access to businesses. Lastly, earthquakes would likely have extensive impacts on more than 75% of the City's ecological systems, including, clean water, wildlife habitat, and parks.¹²

Building Collapse Potential

The City of Salem's human and physical assets are highly at risk from earthquake hazards in the next 35 years. The hazard profile above indicates several moderate earthquakes that have occurred within the Salem city limits or in surrounding areas; three of the earthquakes since 1949 have caused damage in the City.

In 2007, DOGAMI completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon Legislature in Senate Bill 2 (2005). RVS is a technique used by the Federal Emergency Management Agency (FEMA), known as FEMA 154, to identify, inventory, and rank buildings that are potentially vulnerable to seismic events. DOGAMI surveyed buildings in Salem and gave them a 'low,' 'moderate,' 'high,' or 'very high' potential of collapse in the event of an earthquake. It is important to note that these rankings represent a probability of collapse based on limited observed and analytical data and are therefore approximate rankings.¹³ To fully assess a building's potential of collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to survey.

Table EQ-3 City of Salem Building Collapse Potential¹⁴

Level of Collapse Potential in the City of Salem			
Low (<1%)	Moderate (>1%)	High (>10%)	Very High (100%)
29	9	33	7

Of the facilities evaluated by DOGAMI using RVS: seven schools, seven government buildings and emergency services facilities (including the State Capital, Salem City Hall and Oregon State Police), and eleven Chemeketa Community College buildings have a high collapse potential. Concerning the seven buildings with very high collapse potential, they are all 24-J school district buildings.¹⁵

¹¹ Ibid.

¹² Ibid.

¹³ State of Oregon Department of Geologic and Mineral Industries, *Implementation of 2005 Senate Bill*

2 Relating to Public Safety, Seismic Safety and Seismic Rehabilitation of Public Building, May 22, 2007, iv.

¹⁴ DOGAMI 2007. Open File Report 07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment

¹⁵ Ibid.

Community Hazard Issues

What is susceptible to damage during a hazard event?

The degree of damage and injury from earthquake hazards will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event. The City of Salem steering committee identified relative risks associated with earthquake hazards; they estimate that there will be disruption of social networks, extensive damage to facilities, an extended interruption of commercial services and access, damage to ecological systems and widespread population displacement.

Existing Hazard Mitigation Activities

Building Codes

City of Salem has adopted the International Building Code which includes regulations that address seismic hazards.

The Oregon State Building Codes Division adopts statewide standards for building construction that are administered by the state, cities and counties throughout Oregon. The codes apply to new construction and to the alteration of, or addition to, existing structures. Within these standards are six levels of design and engineering specifications that are applied to areas according to the expected degree of ground motion and site conditions that a given area could experience during an earthquake. The Structural Code requires a site-specific seismic hazard report for projects including critical facilities such as hospitals, fire and police stations, emergency response facilities, and special occupancy structures, such as large schools and prisons.

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

Requirements for existing buildings vary depending on the type and size of the alteration and whether there is a change in the use of the building that is considered more hazardous. Oregon State Building Codes recognize the difficulty of meeting new construction standards in existing buildings and allow some exception to the general seismic standards. Upgrading existing buildings to resist earthquake forces is more expensive than meeting code requirements for new construction. The state code only requires seismic upgrades when there is significant structural alteration to the building or where there is a change in use that puts building occupants and the community at greater risk.

Local building officials are responsible for enforcing these codes. Although there is no statewide building code for substandard structures, local communities have the option of adopting a local building code to mitigate hazards in existing buildings. Oregon Revised Statutes allow municipalities to create local programs to require seismic retrofitting of

existing buildings within their communities. The building codes do not regulate public utilities or facilities constructed in public right-of-way, such as bridges.¹⁶

Outreach

City of Salem provides information to the public about earthquake hazards and preparedness measures on the city website. In 2011, the city, along with Community Emergency Response Teams (CERT), Willamette University and Oregon Department of Geology and Mineral Industries hosted a public speaking engagement that provided an opportunity for the Salem community to learn the latest science and more about the chances of a large magnitude earthquake in Oregon.¹⁷

Seismic Retrofit

A Pre-Disaster Mitigation Grant (PDM) of \$1,037,250 in federal funding was awarded to the City of Salem to seismically reinforce Fire Stations 2, 4, and 6. The remaining PDM grant funds were used towards seismic reinforcement of Fire Station 1.¹⁸

The major seismic upgrade and remodel of Fire Station 1, the Headquarters for the Salem Fire Department, will provide the duty staff and administrative personnel a modern functional location from which the city will be able to better meet the needs of the citizens of Salem.

Earthquake Mitigation Action Items

The following actions have been identified by the City of Salem steering committee, and are recommended for mitigating the potential effects of earthquakes in the City of Salem. Please see full action item worksheets in Appendix A.

EQ#1: Develop an inventory of un-reinforced masonry structures and develop appropriate mitigation action items to reduce the impacts of seismic events.

EQ#2: Identify and inventory critical facilities that require seismic retrofit.

EQ#3: Partner with the school districts to help identify and prioritize seismic retrofits to school district facilities.

¹⁶ City of Salem. Building and Safety Division. International Building Code.

¹⁷ City of Salem. Emergency Management, Disaster Preparedness.

<http://www.cityofsalem.net/Departments/Fire/EmergencyManagement/Pages/DisasterPreparednessMonth.aspx>

¹⁸ City of Salem. Pre-Disaster Mitigation Program Contract Addendum No. 1. August 10, 2009.
<http://www.cityofsalem.net/CouncilMeetingAgenda/Documents/162/4.3c.pdf>

Extreme Heat Hazard Annex

Causes and Characteristics of Extreme Heat

The definition of extreme heat varies by region; however, in general a heat wave is a prolonged period of extreme heat for several days to several weeks. High temperatures are also often combined with excessive humidity.¹

Heat is the number one weather-related killer in the United States, resulting in hundreds of fatalities each year. In fact, on average, excessive heat claims more lives each year than floods, lightning, tornadoes and hurricanes combined. In the disastrous heat wave of 1980, more than 1,250 people died. In the heat wave of 1995 more than 700 deaths in the Chicago area were attributed to heat. In August 2003, a record heat wave in Europe claimed an estimated 50,000 lives.²

North American summers are hot; most summers see heat waves in one or more parts of the United States. East of the Rockies, they tend to combine both high temperature and high humidity; although some of the worst heat waves have been catastrophically dry.³

Each National Weather Service Forecast Office issues the following heat-related products as conditions warrant:⁴

Excessive Heat Outlooks

Excessive heat outlooks are issued when the potential exists for an excessive heat event in the next 3-7 days. An Outlook provides information to those who need considerable lead time to prepare for the event, such as public utility staff, emergency managers and public health officials. See the mean heat index and probability forecasts maps.

Excessive Heat Watches

Excessive heat watches are issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A Watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain. A Watch provides enough lead time so that those who need to prepare can do so, such as cities officials who have excessive heat event mitigation plans.

Excessive Heat Warning/Advisories

Excessive heat warnings and advisories are issued when an excessive heat event is expected in the next 36 hours. These products are issued when an excessive heat event is occurring, is imminent, or has a very high probability of occurring. The warning is used for conditions posing a threat to life or property. An advisory is for less serious conditions that cause significant discomfort or inconvenience and, if caution is not taken, could lead to a threat to life and/or property.

¹ FEMA. Are You Ready?. Extreme Heat

² National Oceanic Atmospheric Administration. Heat Wave: A Major Summer Killer. http://www.nws.noaa.gov/om/brochures/heat_wave.shtml. Accessed June 1, 2012.

³ Ibid.

⁴ Ibid.

History of Extreme Heat in City of Salem

July, 2009

In July 2009 heat advisories were issued across the Pacific Northwest, with record highs of 107 degrees Fahrenheit in Salem, 106 in Portland and over 100 in Seattle.⁵ The heat wave lasted several days, which is unusual. Many homes and buildings throughout Northern Oregon and Washington do not have air-conditioning, because temperatures are generally moderate in this region. Cooling centers for the elderly were open late in Portland as well as in other communities throughout the Pacific Northwest.⁶

Risk Assessment

How are Hazards Identified?

NOAA's heat alert procedures are based mainly on Heat Index Values. The Heat Index, sometimes referred to as the apparent temperature is given in degrees Fahrenheit. The Heat Index is a measure of how hot it really feels when relative humidity is factored with the actual air temperature.

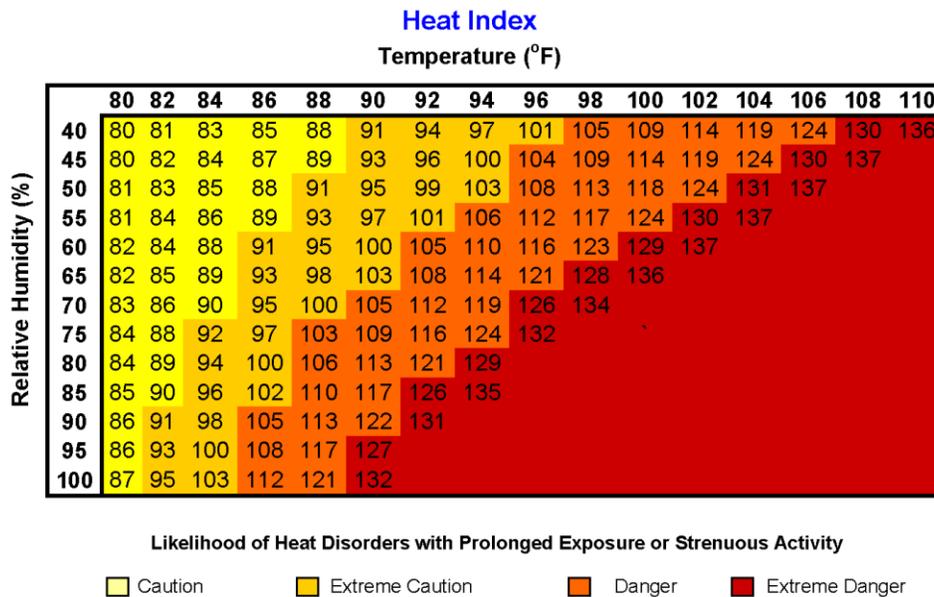
To find the Heat Index temperature, look at the Heat Index chart below. As an example, if the air temperature is 96°F and the relative humidity is 65%, the heat index--how hot it feels--is 121°F. The Weather Service will initiate alert procedures when the Heat Index is expected to exceed 105°-110°F (depending on local climate) for at least two consecutive days.⁷

⁵ CBS. Northwest Heat Wave Sets Records. July 29, 2009. www.CBSnews.com.

⁶ Ibid.

⁷ National Oceanic Atmospheric Administration. Heat Wave: A Major Summer Killer. http://www.nws.noaa.gov/om/brochures/heat_wave.shtml. Accessed June 1, 2012.

Figure EH.1 National Weather Service Heat Index (HI)
 NOAA's National Weather Service



Source: National Oceanic Atmospheric Administration. Heat Wave: A Major Summer Killer. http://www.nws.noaa.gov/om/brochures/heat_wave.shtml. Accessed June 1, 2012.

The Heat Index Chart shaded zone above 105°F shows a level that may cause increasingly severe heat disorders with continued exposure or physical activity.

Probability of Future Occurrence

The City of Salem steering committee determined that the probability of extreme heat is **high**, meaning that one event is likely in a 35-75 year period.⁸ Extreme heat is a recently added hazard and not included in the 2008 City of Salem Hazard Analysis.

Vulnerability Assessment

Considering the widespread impacts of an extreme heat event, and the maximum severity of high temperatures, the City of Salem steering committee rated the city’s vulnerability to flood as **high**, meaning that more than 10% of the city’s population or assets would be impacted by extreme heat.⁹

Risk Analysis

The City of Salem steering committee determined that the history of extreme heat events is **high**, with at least four events occurring over the last 100 years. The maximum threat of extreme heat is also **high**, considering the percentage of population and property that could be impacted under a worst—case scenario.¹⁰

⁸ Oregon Emergency Management. Hazard Analysis Methodology. 2009.

⁹ Oregon Emergency Management. Hazard Analysis Methodology. 2009.

¹⁰ City of Salem. NHMP Steering Committee. 2012.

Extreme heat events in the past caused few minor injuries to the health and safety of residents. However, the potential for injuries or deaths from past events or from similar events in other communities could escalate resulting in multiple major injuries or possible death. It is estimated that less than 10% of the City's population would be physically displaced by an extreme heat, likely accounting for those individuals who seek refuge in a cooling center, and there would be mild impact on community social networks.¹¹

Facilities throughout the City are anticipated to reflect little to no damage due to extreme heat, estimated at less than \$1 million for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely 10-30% of businesses located in the City and surrounding area would experience commerce interruption for a period of at least a few days. Extreme heat has the potential to overload the electric grid and result in widespread power outages. Lastly, extreme heat would likely have mild impacts on 10-25% of the City's ecological systems, including, clean water, wildlife habitat, and parks.¹²

The relative risk of extreme heat is estimated by considering the probability of an extreme heat event and the severity of the outcome when an event occurs. On a scale of 1 to 25, with 1 being the lowest and 25 being the highest relative risk, extreme heat hazards in the City of Salem are a score of 7.6.¹³

Community Hazard Issues

What is susceptible to damage during a hazard event?

According to FEMA, heat kills by pushing the human body beyond its limits. In extreme heat and high humidity, evaporation is slowed and the body must work extra hard to maintain normal temperature.¹⁴ Most heat disorders occur because the victim has been overexposed to heat or has over-exercised for his or her age and physical condition. Older adults, young children, and those who are sick or overweight are more likely to succumb to extreme heat.¹⁵

Conditions that can induce heat-related illness include stagnant atmospheric conditions and poor air quality. Consequently, people living in urban areas may be at greater risk from the effects of a prolonged heat wave than those living in rural areas. Also, asphalt and concrete store heat longer and gradually release heat at night, which can produce higher nighttime temperatures known as the "urban heat island effect".¹⁶

¹¹ Ibid.

¹² Ibid.

¹³ Oregon Emergency Management. Hazard Analysis Methodology, Relative Risk. 2009

¹⁴ FEMA. Are You Ready?. Extreme Heat.

¹⁵ Ibid.

¹⁶ Ibid.

Table EH.1 Heat Disorders

Heat Cramps	Muscular pains and spasms due to heavy exertion. Although heat cramps are the least severe of heat related medical problems, they are often the first signal that the body is having trouble with the heat.
Heat Exhaustion	Typically occurs when people exercise heavily or work in hot, humid places where body fluids are lost through heavy sweating. Blood flow to the skin increases, causing blood flow to decrease to the vital organs. This results in a form of mild shock. In not treated, the victim's condition will worsen. Body temperature will keep rising and the victim may suffer heat stroke.
Heat Stroke	Heat stroke is life-threatening. The victim's temperature control system, which produces sweating to cool the body, stops working. The body temperature can rise so high that brain damage and death may result if the body is not cooled quickly.
Sun Stroke	Another terms for heat stroke.

Source: FEMA. Are You Ready? Extreme Heat.

Existing Hazard Mitigation Activities

Outreach

The City of Salem maintains the City's website to include public outreach information that provides strategies for staying cool and minimizing the effects of warm temperatures. The City also describes the various symptoms of heat disorders that can be associated with extreme heat exposure.¹⁷

Extreme Heat Mitigation Action Items

Action items for extreme heat are under development.

¹⁷ City of Salem. Willamette Valley Communications Center, Extreme Heat.
<http://www.cityofsalem.net/Departments/Police/WVCC/Pages/ExtremeHeat.aspx>.

Flood Hazard Annex

Causes and Characteristics of Flood

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. Flooding can be aggravated when rain is accompanied by snowmelt and frozen ground. The principal types of flood that occur in City of Salem include:

Riverine Floods

Riverine flooding typically occurs on larger rivers and streams when water levels overflow their banks, and this type of flooding usually results from large storms or prolonged wet periods. Portions of the City of Salem that are located along water bodies have the potential to experience riverine flooding after spring rains, heavy thunderstorms or rapid runoff from snow melt. Riverine floods can be slow or fast-rising, but usually develop over a period of days. The danger of riverine flooding occurs mainly during the winter months, with the onset of persistent, heavy rainfall, and during the spring, with melting of snow in the Coast Range. Riverine flooding is the most common type of flooding in Salem. The areas subject to riverine flooding have been mapped by the Federal Emergency Management Agency (FEMA) for the National Flood Insurance Program (NFIP). The national and state flood mapping standard is the 100-year or base floodplain.

Shallow Area Floods

Shallow area floods are a special type of riverine flooding. FEMA defines a shallow area flood hazard as an area that is inundated by a 100-year flood with a flood depth between one to three feet. Such areas are generally flooded by low velocity sheet flows of water.

Urban floods

Urban flooding occurs where land has been converted from fields or woodlands to developed areas consisting of homes, parking lots, and commercial, industrial and public buildings and structures. In such areas the previous ability of water to filter into the ground is often prevented by the extensive impervious surfaces associated with urban development. This in turn results in more water quickly running off into watercourses which causes water levels to rise above pre-development levels. During periods of urban flooding streets can rapidly become swift moving rivers and basements and backyards can quickly fill with water. Storm drains and smaller creeks can back up due to yard waste and debris. Clogged storm drainage systems often lead to further localized flooding. Localized flooding is especially a concern in Keizer, a city located adjacent to Salem within the Clagget Creek watershed.¹ Another source of urban flooding is grading associated with development. In some cases, such grading can alter changes in drainage direction of water from one property to another.

¹ City of Salem Natural Hazard Mitigation Plan. 2008.

History of Floods in City of Salem

The City of Salem has more than 4,000 acres of floodplain and approximately 3,000 individual parcels that are partially or entirely located within the floodplain. In Salem, flooding generally occurs when: (1) unusually warm weather mixed with heavy rain melts snow in the higher elevations and flood local streams, and/or (2) ongoing development within the City continues to displace natural areas that have historically functioned as flood storage.²

The Willamette River basin has a long history of flooding. The largest flood on record on the Willamette River occurred in 1861. In 1861, town of Champoeg disappeared in the flood.³ Since then, however, the construction of flood control dams in the 1940s and 1950s has changed the pattern of flooding significantly. The City of Salem has experienced four major floods and five lesser floods during the last 48 years. One of the most memorable floods during this time period, the "Christmas" flood of 1964, was rated "approximately a 100-year flood", and according to FEMA was probably the most damaging in Oregon's history.⁴ Table FL-1 provides an overview of flooding history in the City of Salem. Floods occurring since the 2008 NHMP are discussed in more detail below.

² City of Salem. Floodplain Information. <http://www.cityofsalem.net/Departments/PublicWorks/Administration/DevelopmentServices/Pages/FloodplainInformation.aspx>

³ Dennis Wylie, Park Manager, Champoeg State Heritage Area. Telephone interview November 5, 2004.

⁴ Marion County Emergency Management. Available at <http://publicworks.co.marion.or.us/emergencymanagement/>.

Table FL-1: Flooding History in Salem and Marion County

Date	Location	Comments
January, 2012	Salem area	Severe winter storm, flooding, landslides, and mudslides warranted a Presidential disaster declaration. Twelve counties have been adversely affected by the storm.
January, 2006	Willamette Watershed	Heavy rains caused many rivers to crest above flood stage in the Willamette Valley, causing road closures and damage to agricultural lands.
December, 2005	Willamette Watershed	Heavy rains caused rivers to crest above flood stage in Polk, Marion, Linn, Lane, and Benton Counties, as well as other counties in the Willamette Valley.
January, 1997	Mid-Willamette Valley	Heavy rains from the January 1997 storm caused flooding throughout the county. The Willamette River crested at 29 feet, one foot above flood level.
November, 1996	Salem-Keizer	Flooding occurred in November 1996 adding to that occurred as a result of the February 1996 flood. Salem received about six inches of rain over a 48-hour period. The heavy rains swamped the Salem-Keizer sewer system.
February , 1996	Willamette Watershed- Rivers and Creeks	Snow-pack, warm temperatures, and record-breaking rains caused streams to rise to all-time flood record levels. Total damages within Marion County were approximately \$24 million.
February , 1986	Salem area	Heavy rain and snowmelt caused high water levels in the Willamette and Pudding rivers. The Willamette River crested at just over 29 feet and within ten inches of flooding. The Pudding River crested at 24½, two-and-one-half feet above flood levels. In Salem, Minto Brown Island was closed because of high water on roads.
January, 1974	Willamette Watershed	Heavy snow and a series of storms caused flooding conditions. Nine counties were declared disaster areas. In Marion County, the Willamette River crested at 32 feet, four feet above flood level and two bridges were washed away on Mill Creek. In Salem and other communities, wastewater treatment plants exceeded capacity resulting in millions of gallons of raw sewage being discharged into the Willamette River. Total damages to Marion County were approximately \$1.75 million.
December-January, 1964	The State of Oregon was declared an emergency disaster area	The “Christmas” flood of 1964 was the largest flood to occur since major dam construction occurred on the upper Willamette. In Salem, the Willamette River crested nearly 10 feet above flood stage. There were hundreds of landslides, bridges and roads washed out, houses were damaged or destroyed, and thousands of people were forced to evacuate their homes.

January 2012

Heavy rains from the January 2012 storm caused extensive flooding throughout the City of Salem, with an estimated \$10.3 million in overall damage of city facilities and just under \$1

million in damage to parks.⁵ 12 Counties, including Marion County, have been designated as adversely affected by the January disaster.⁶ During a five-day period starting Jan. 16, the hills in South Salem received as much as 9.01 inches of rain. Runoff from the heavy rainfall was intensified by the melting of three to six inches of snow that had fallen in higher elevations a week earlier.⁷

As of March 2, 2012, the President issued a major disaster declaration under the authority of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5121 *et seq.*⁸ Following the declaration, affected and qualified infrastructure and emergency costs are eligible for a 75% reimbursement from FEMA to help the community recover from damage caused by the storm. The President's declaration, while the process is still ongoing, will bring needed money into the state to help repair Oregon roads, bridges, culverts and other governmental facilities. The money will also help prevent future danger to lives and property.⁹ Although requests for federal aid to help pay for damage to government infrastructure were approved March 2, the Federal Emergency Management Agency has denied other requests to help rebuild homes in Salem damaged by January floods.¹⁰

Risk Assessment

How are Hazards Identified?

The City of Salem features the Willamette River and many smaller tributaries, or streams, that are susceptible to annual flooding events that pose threats to life and safety and cause significant property damage. These streams include Battle Creek, Cinnamon Creek, Clagget Creek, Croisan Creek, Davidson Creek, Glenn Creek, Jory Creek, Laurel Creek, Little Pudding Creek, Mill Creek, Mill Race, Pettyjohn Creek, Powell Creek, Pringle Creek, Scotch Creel, Shelton Ditch, Waln Creek, and Winslow Creek.¹¹ Map FL.1 identified floodplains and floodways throughout the City.

⁵ Statesman Journal. "Pricey Flood Repairs Needed at Salem Parks". February 29, 2012.

⁶ FEMA. Oregon Disaster History. Major Disaster Declaration

⁷ Statesman Journal. "Salem Hosts Flood Meetings Starting Tonight". March 19, 2012.

⁸ FEMA. Oregon Disaster History. Major Disaster Declaration.

⁹ Oregon.gov. Oregon Presidential Disaster Declaration. Press Release March 2, 1012.

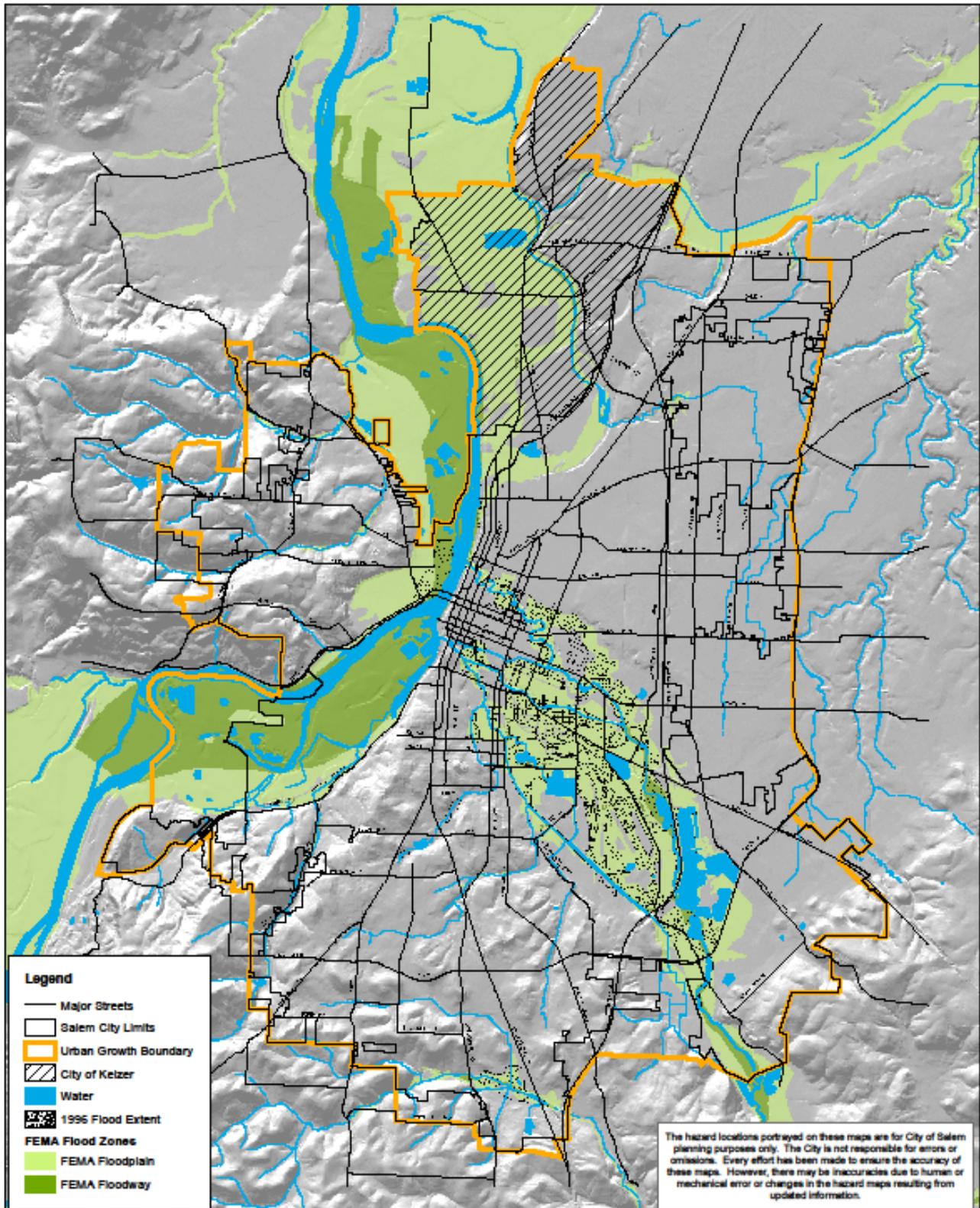
¹⁰ Statesman Journal. "Salem Hosts Flood Meetings Starting Tonight". March 19, 2012.

¹¹ City of Salem. Floodplain Information.

<http://www.cityofsalem.net/Departments/PublicWorks/Administration/DevelopmentServices/Pages/FloodplainInformation.aspx>

CITY OF SALEM NATURAL HAZARD MITIGATION PLAN

MAP FL.1: FLOOD INFORMATION



Repetitive Flood Loss in City of Salem

Properties in and near the floodplains in the City of Salem are subject to frequent flooding events. Since flooding is such a pervasive problem throughout the city, many residents have purchased flood insurance to help recover from losses incurred from flooding events. Flood insurance covers only the improved land, or the actual building structure. Repetitive loss structures are defined as a National Flood Insurance Program (NFIP)-insured structure that has had at least two paid flood losses of more than \$1,000 each in any 10-year period since 1978¹². Repetitive loss structures are troublesome because they continue to expose lives and valuable property to the flooding hazard. Local governments as well as federal agencies such as FEMA recognize this pitfall in floodplain insurance, and attempts to remove the risk from repetitive loss of properties through projects such as acquiring land and relocating homes, or by elevating structures. Continued repetitive loss claims from flood events lead to an increased amount of damage caused by floods, higher insurance rates, and contribute to the rising cost of taxpayer funded disaster relief for flood victims.¹³

The City of Salem Flood Insurance Rate Maps are current as of January 2003. As of March 31, 2012, the City of Salem has 1,068 flood insurance policies¹⁴, 188 claims and eight repetitive loss properties within the jurisdiction.¹⁵ All of the repetitive loss properties reported throughout the City of Salem are identified as commercial properties. The City of Salem's last Community Assistance Visit was May 4, 2005; the city is a member of the Community Rating System (CRS) and has a level 7 community rating.¹⁶

Probability of Future Occurrence

The historical incidence of flooding events resulting in substantial losses indicates significant flooding events likely within a 10-15 year range, well within the 35 year range used for high likelihood incidents. The City of Salem steering committee determined that the probability of flooding is **high**, meaning that one event is likely in a 10-35 year period. This rating is consistent with the 2008 City of Salem Hazard Analysis.¹⁷

Vulnerability Assessment

Given the large number of residents in flood hazard areas and facilities in or near the 100-year floodplain, the City of Salem steering committee rated the city's vulnerability to flood as **high**, meaning that more than 10% of the city's population or assets would be impacted by a flood. This rating is consistent with the 2008 City of Salem Hazard Analysis.¹⁸

Risk Analysis

The City of Salem steering committee determined that the history of flood events is **high**, with at least four events occurring over the last 100 years. The maximum threat of a flood is

¹² Federal Emergency Management Agency. Definitions, available online at <http://www.fema.gov/business/nfip/19def2.shtm#R>

¹³ National Flood Insurance Program. Available on the World Wide Web <http://www.fema.gov/nfip>. Accessed April 2002.

¹⁴ BureauNet. Accessed May 11, 2012.

¹⁵ Robin Bunse. City of Salem, Public Works. May 7, 2012.

¹⁶ BureauNet. Accessed May 11, 2012.

¹⁷ Oregon Emergency Management. Hazard Analysis Methodology. 2009.

¹⁸ Ibid.

also **high**, considering the percentage of population and property that could be impacted under a worst—case scenario.¹⁹

Floods in the past caused multiple major injuries or death. The potential for future injuries or deaths is anticipated to remain similar to historic events. It is estimated that 10-25% of the City’s population would be physically displaced by a flood, accounting for the number of homes located in or near floodplains, and there would be moderate impact on community social networks.²⁰

Multiple facilities throughout the City anticipate severe damage due to a flood, estimated between \$10 million and \$100 million for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely 10-30% of businesses located in the City and surrounding area would experience commerce interruption for a period of a months. Floods have the potential to inflict widespread damage to not only buildings but also the transportation network that may inhibit access to businesses. Lastly, floods would likely have extensive impacts on more than 75% of the City’s ecological systems, including, clean water, wildlife habitat, and parks.²¹

Community Hazard Issues

What is susceptible to damage during a hazard event?

The extent of the damage and risk to people caused by flood events is primarily dependent on the depth and velocity of floodwaters. Fast moving floodwaters can wash buildings off their foundations and sweep vehicles downstream. Roads, bridges, other infrastructure and lifelines (pipelines, utility, water, sewer, communications systems, etc.) can be seriously damaged when high water combines with flood debris, mud and ice. Extensive flood damage to residences and other structures also results from basement flooding and landslide damage related to soil saturation. Surface water entering into crawlspaces, basements, and daylight basements is common during flood events not only in or near flooded areas but also on hillsides and other areas far removed from floodplains. Most damage is caused by water saturating materials susceptible to loss (e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings and appliances). If not properly protected from the entry of flood waters, mechanical, electrical and similar equipment can also be damaged or destroyed by flooding.

The most significant of the FEMA-determined floodplains and floodways either surround the southern side of the Willamette River west of Salem, or are within the greater Mill Creek/Pringle Creek watershed. The Mill Creek area includes residential and commercial/industrial developments to the southeast of downtown.²²

The City of Salem steering committee identified the following additional impacts specific to Salem. These include impacts to the population, critical facilities, critical routes and infrastructure including ingress and egress.

¹⁹ City of Salem. NHMP Steering Committee. 2012.

²⁰ Ibid.

²¹ Ibid.

²² City of Salem Geographic Information Systems (GIS). Natural Hazard Mitigation Plan. Map FL-1. 2008.

Existing Hazard Mitigation Activities

Participation in NFIP and CRS

City of Salem participates in the National Flood Insurance Program (NFIP) and Community Rating System (CRS). Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent.²³ In City of Salem, all homes and other buildings legally constructed in the floodplain after January 1974 must be mitigated to NFIP standards with the first floor being elevated at least one foot above base flood level, or in the case of non-residential buildings, flood proofed to at least one foot above the base flood level.

The Community Rating System places the city's flood outreach efforts and management practices at a Class 7 rating. The CRS rating for the city has improved from a Class 8, since the most recent NHMP Update. As a result of the City of Salem improving to a Class 7, flood insurance premium rates for Salem policy holders are discounted 15% to reflect the reduced flood risk resulting from the City's flood hazard mitigation actions.²⁴ For CRS participating communities, flood insurance premium rates are discounted in increments of 5%; i.e., a Class 1 community would receive a 45% premium discount, while a Class 9 community would receive a 5% discount.²⁵

Floodplain Management Plan

The City of Salem is initiating the planning process for a new Floodplain Management Plan. Creation of the Plan will identify flood hazards, establish a program of activities to mitigate the hazards, and coordinate mitigation activities to prevent conflicts with other community needs.²⁶ Completion of the Plan is anticipated by December of 2012.

Public Works, Stormwater Services

The City of Salem High Water Watch (HWW) has been developed to serve as an early warning system for use by regional emergency management staff and for public awareness. A HWW level has been established for each of the ten continuous stream monitoring stations in Salem, located on five different streams: Mill Creek, Pringle Creek, Clark Creek, Glenn Creek, and Battle Creek.²⁷

Floodplain Development

To minimize damage to structures during flood events, the City requires all new construction in the floodplain to get a floodplain development permit. The permit requires development to be anchored against movement by floodwaters, resistant to flood forces,

²³ FEMA, Region 10. Floodplain Management: a Local Administrator's Guide to the National Flood Insurance Program.

²⁴ Federal Emergency Management Agency Community Status Report Book - Oregon: Communities Participating in the National Flood Program. 2010

²⁵ Ibid.

²⁶ City of Salem. Floodplain Committee Information. Accessed August 28, 2012.

<http://www.cityofsalem.net/DEPARTMENTS/PUBLICWORKS/ADMINISTRATION/DEVELOPMENTSERVICES/Pages/FloodplainInformation.aspx>

²⁷ City of Salem. Public Works. Stormwater Services.

<http://www.cityofsalem.net/DEPARTMENTS/PUBLICWORKS/OPERATIONS/STORMWATERSERVICES/Pages/High-Water-Watch.aspx>

constructed with flood resistant materials, and flood-proofed or elevated so that the first floor of living space, as well as all mechanical and services, is at least one foot above the elevation of the 100-year flood. These standards apply to new structures and to substantial improvements of existing structures. The City defines a substantial improvement as any reconstruction, rehabilitation, or addition to an existing structure, the cost of which exceeds 50 percent of the structure at appraised or market value. Other types of development within the floodplain, such as, grading, cut and fill, installation of riprap, and other bank stabilization techniques also require a floodplain development permit.²⁸

Elevation Certificate Maintenance

Elevation certificates are administered by Development Services and are required for buildings constructed in the floodplain in order to demonstrate that the building is elevated adequately to protect it from flooding.²⁹ The Elevation Certificate is an important administrative tool of the National Flood Insurance Program (NFIP). It is used to determine the proper flood insurance premium rate; it can be used to document elevation information necessary to ensure compliance with community floodplain management regulations; and it may be used to support a request for a Letter of Map Amendment (LOMA) or Letter of Map Revision based on fill (LOMR-F). The City of Salem has Elevation Certificates on file for many of the properties that have developed. The City will keep all Elevation Certificates it receives on file for future availability to the public.³⁰

Floodplain Overlay Zone

The Floodplain Overlay Revised Code (SRC), Chapter 140, adopted by the City of Salem, requires a floodplain development permit be obtained before construction, development or change of use begins within any floodplain or area of special flood hazard. SRC 140 identifies the types of uses allowed in the floodplain, floodway and flood fringe; and outlines the compliance procedures and restrictions imposed on each use. In addition, SRC 140 describes construction performance standards and specifications for flood hazard protection.³¹

Minto Brown Park Restoration

Minto Brown Park is an 898-acre park located in South Salem along the west side of River Road South. Most of the park is within the Willamette River floodway. It currently includes approximately 286 acres of cropland, 486 acres of recreational and natural areas, and 97 acres for other uses. The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) and the City of Salem have entered into a floodplain easement agreement to remove approximately 165.7 acres of cropland from agricultural use.

²⁸ City of Salem. Public Works, Development Services.
http://www.cityofsalem.net/Departments/PublicWorks/Administration/DevelopmentServices/Documents/ds_fp_outreach_flood.pdf

²⁹ City of Salem. Public Works, Development Department. "Development Bulletin". Volume 1, Issue 2.
http://www.cityofsalem.net/Departments/PublicWorks/Administration/DevelopmentServices/Development%20Bulletins/v01_iss02.pdf

³⁰ City of Salem. Public Works, Development Services.
http://www.cityofsalem.net/Departments/PublicWorks/Administration/DevelopmentServices/Documents/ds_fp_outreach_realtor.pdf

³¹ City of Salem. Revised Code, Chapter 140.
<http://www.cityofsalem.net/Departments/Legal/Salem%20Revised%20Codes/Floodplain%20Overlay%20Zones.pdf>

The Minto Brown Island Park restoration project will enhance Minto Brown Island Park, restore the easement area to natural, native condition, and provide for additional wildlife and natural habitat. This project is part of a \$145 million federal stimulus program announced in early March 2009. Nationwide, more than 4,000 applications for projects valued at \$1.4 billion were received. On June 3, 2009, the USDA informed the City that the Minto Brown restoration was one of three proposals selected in Oregon.³²

Outreach

The City is working on ways to improve and increase circulation of and accessibility of information that pertains to floodplain hazards, in an effort to better educate and assist its citizens about developing and living in the floodplain. The city utilizes its website and distributes community brochures and newsletters to property owners within or adjacent to the floodplain. These resources describe flood history, flood insurance requirements, floodplain development permitting, home retrofit resources, and flood warning and safety programs.³³ Salem also most recently held community meetings to capture January 2012 flood information and compile feedback from residents and business owners.³⁴

Stormwater Management

The City of Salem seeks to reduce the impacts of flooding through the implementation of the Stormwater Management Plan (SWMP). The SWMP promotes environmental stewardship, preserves and enhances stream corridors, balances water quantity and quality and identifies community outreach strategies. The SWMP reduces flooding throughout the City by integrating flow control facilities into the drainage system network. These stormwater management practices influence stormwater infiltration and can delay peak stream flow.³⁵

Wetlands

The City of Salem adopted the Wetlands Revised Code Chapter (SRC) 126, because of the significance wetlands have on reducing the impacts of flooding. SRC 126 identifies wetlands located within the City of Salem which are significant and non-significant, and establishes the foundation for a wetlands protection program that will provide for the long-term protection of wetlands within the City of Salem³⁶. Each property owner whose property contains a wetland and each person owning property within one hundred feet of such affected property shall receive written notice of such designation. Property owners can appeal for amendments to the official wetland maps if the owner can demonstrate that the designation fails to satisfy the criteria for a locally significant wetland.³⁷

³² City of Salem. Minto Brown Island Park Restoration Information.

<http://www.cityofsalem.net/Residents/Parks/Pages/Minto-BrownIslandParkEasementProposal.aspx>

³³ City of Salem. Floodplain Insurance.

http://www.cityofsalem.net/Departments/PublicWorks/Administration/DevelopmentServices/Documents/ds_fp_insurance.pdf

³⁴ Statesman Journal. "Salem Hosts Flood Meetings Starting Tonight". March 19, 2012.

³⁵ City of Salem. Stormwater Management Plan. 2010.

<http://www.cityofsalem.net/Departments/PublicWorks/Operations/StormwaterServices/Pages/SWMPReview.aspx>

³⁶ City of Salem. Revised Code 126, Wetlands.

<http://www.cityofsalem.net/Departments/Legal/Salem%20Revised%20Codes/Wetlands.pdf>

³⁷ Ibid.

Flood Mitigation Action Items

The following actions have been identified by the City of Salem steering committee, and are recommended for mitigating the potential effects of floods in the City of Salem. Please see full action item worksheets in Appendix A.

FL#1: Adopt a floodplain management plan in accordance with FEMA's Community Rating System guidelines.

FL#2: Improve the City of Salem's National Flood Insurance Program (NFIP) Community Rating System (CRS) to reduce NFIP premiums.

Hazardous Materials Hazard Annex

Causes and Characteristics of Hazardous Materials

For the purposes of mitigation planning, hazardous materials releases are considered a secondary hazard derived from the impact of a natural hazard event (i.e. flooding in a chemical storage area could result in toxic levels of chemicals in water or air). Hazardous materials may be defined simply as any materials that may have negative impacts on human health. That is, exposure to hazardous materials may result in injury, sickness, or death. They may also include materials that may cause negative impacts on the environment or on animal or plant species.

Hazardous chemicals are widely used in heavy industry, manufacturing, agriculture, mining, the oil and gas industry, forestry, and transportation as well as in medical facilities and commercial, public, and residential buildings. There are literally hundreds of thousands of chemicals that may be hazardous to human health, at least to some extent. A typical single family home may contain dozens of potentially hazardous materials including fuels, paints, solvents, cleaning chemicals, pesticides, herbicides, medicines and others. However, for mitigation planning purposes, small quantities of slightly or moderately hazardous materials being used by end users are rarely the focus of interest. Rather, interest is focused primarily on larger quantities of hazardous materials in industrial use and on hazardous materials being transported, where the potential for accidental spills is high. Situations involving extremely hazardous materials or large quantities of hazardous materials in locations where accidents or malevolent actions (terrorism or sabotage) may result in significant public health risk are of special concern for planning purposes.

The severity of any hazardous material release incident for an affected community depends on several factors, including the toxicity, quantity, and dispersal characteristics of the hazardous material; local conditions such as wind direction, topography, soil and ground water characteristics; proximity to drinking water resources and populations.

There are three principal modes of human exposure to hazardous materials, **inhalation** of gaseous or particulate materials via the respiratory (breathing) process; **ingestion** of hazardous materials via contaminated food or water; and **direct contact** with skin or eyes. Exposure to hazardous materials can result in a wide range of negative health effects on humans. Hazardous materials are generally classified by their health effects. The most common classes of hazardous materials are summarized below.

Flammable Materials

Flammable materials are substances where fire is the primary threat, although explosions and chemical effects listed below may also occur. Common examples include gasoline, diesel fuel, and propane.

Explosives

Explosives are materials where explosion is the primary threat, although fires and chemical effects listed below may also occur. Common examples include dynamite and other explosives used in construction or demolition.

Irritants

Irritants are substances that cause inflammation or chemical burns of the eyes, nose, throat, lungs, skin or other tissues of the body in which they come in contact. Examples of irritants are strong acids such as sulfuric or nitric acid.

Asphyxiates

Asphyxiates are substances which interfere with breathing. Simple asphyxiates cause injury or death by displacing the oxygen necessary for life. Nitrogen is a good example. Nitrogen is a normally harmless gas that constitutes about 78% of the atmosphere. However, nitrogen releases in a confined space may result in asphyxiation by displacing oxygen. Chemical asphyxiates are substances that prevent the body from using oxygen or otherwise interfere with the breathing process. Common examples are carbon monoxide and cyanides.

Anesthetics and Narcotics

Anesthetics and narcotics are substances which act on the body by depressing the central nervous system. Signs and symptoms include drowsiness, weakness, fatigue, and lack of coordination, unconsciousness, paralysis of the respiratory system and death. Examples include numerous hydrocarbon and organic compounds.

Hazardous materials may also have a wide variety of more specialized impacts on human health. Other types of toxic effects are briefly summarized in Table HM-1.

Table HM-1: Other Types of Hazardous Materials

Type of Hazardous Material	Effects on Humans
Hepatotoxin	Liver damage
Nephrotoxin	Kidney damage
Neurotoxin	Neurological (nerve) damage
Carcinogen	May result in cancer
Mutagen	May produce changes in the genetic material of cells
Teratogen	May have adverse affects on sperm, ova, or fetal tissue
Radioactive materials	May result directly in radiation sickness at high exposure levels or act as carcinogen, mutagen, or teratogen
Infectious substances	Biological materials such as bacteria or viruses that may cause illness or death

History of Hazardous Materials in City of Salem

Large-scale hazardous materials incidents are rare in the City of Salem. Between 2008 and May 2012, there have been 68 reported hazardous materials incidents, most of which have been negligible.¹ Gas leaks are reported as the most common type of hazardous materials incident reported in the city. The majority of incidents are reported as unintentional accidents, but there are a few incidents of intentional hazardous materials release and/or exposure, all of which were effectively and safety managed. Table HM-2 identifies the number and type of hazard incidents per year since 2010. The hazardous materials incident data for 2008 and 2009 did not account for incident type and therefore is not documented

¹ Oregon.gov. Hazardous Materials Incidents Searchable Database. 2008-2009; and Hazardous Materials Incident Reports, 2010-2012.

in the table, and data for 2012 only captures incidents prior to May 2012. Brief descriptions of the most significant hazardous materials incidents are provided below.

Table HM-2: Number of Hazardous Materials Incidents by Type and Year²

Type of Incident	2010	2011	2012
Chemical Spill or Leak	6	3	4
Chemical Hazard	1	0	0
Biological Hazard	1	1	0
Gas Leak	10	10	0
Gasoline or Other Flammable Liquid Spill	2	0	0
Oil of Other Combustible Liquid Spill	5	3	0
Toxic Condition, Other	1	0	0
Combustible/Flammable Gas/Liquid Condition, Other	1	1	2
Refrigeration Leak	0	1	1

March 23, 2012

Three people were evacuated due to an unintentional release of 55 gallons of methanol, 55 pounds of potassium hydroxide, and 10 pounds of Magnesol (synthetic magnesium silicate) that resulted in a fire. During the fire, command was made aware there was approx 1000 gallons of vegetable oil in the structure. The fire was controlled in a timely fashion. However, they now had product running into the storm drains. City of Salem Environmental Services was called, and surface and storm drain cleanup ensued.

June 30, 2011

A 500 lb. propane tank dropped near North Salem High School, resulting in the evacuation of the entire school, including an on campus day care. The tank continued to leak well into the incident until responders were able to plug the tank.

Risk Assessment

How are Hazards Identified?

The Office of State Fire Marshal maintains a hazardous materials database provided to city Fire Departments. The database includes information on chemicals stored by address with name, and phone number. The City of Salem Environmental Services Section also maintains a vast database (e.g., underground fuel tanks, waste generators, contaminated properties, etc.). These and other databases are linked to addresses of sites that use/generate hazardous materials/waste. The City of Salem Fire Department and Public Works have utilized the information in these databases and have a full-capacity hazmat response team to respond to hazardous materials incidents.³

In the City of Salem, specific places have higher than average risks for hazardous material releases. In particular, trucking routes along I-5 and Highway 22 that run through Salem are

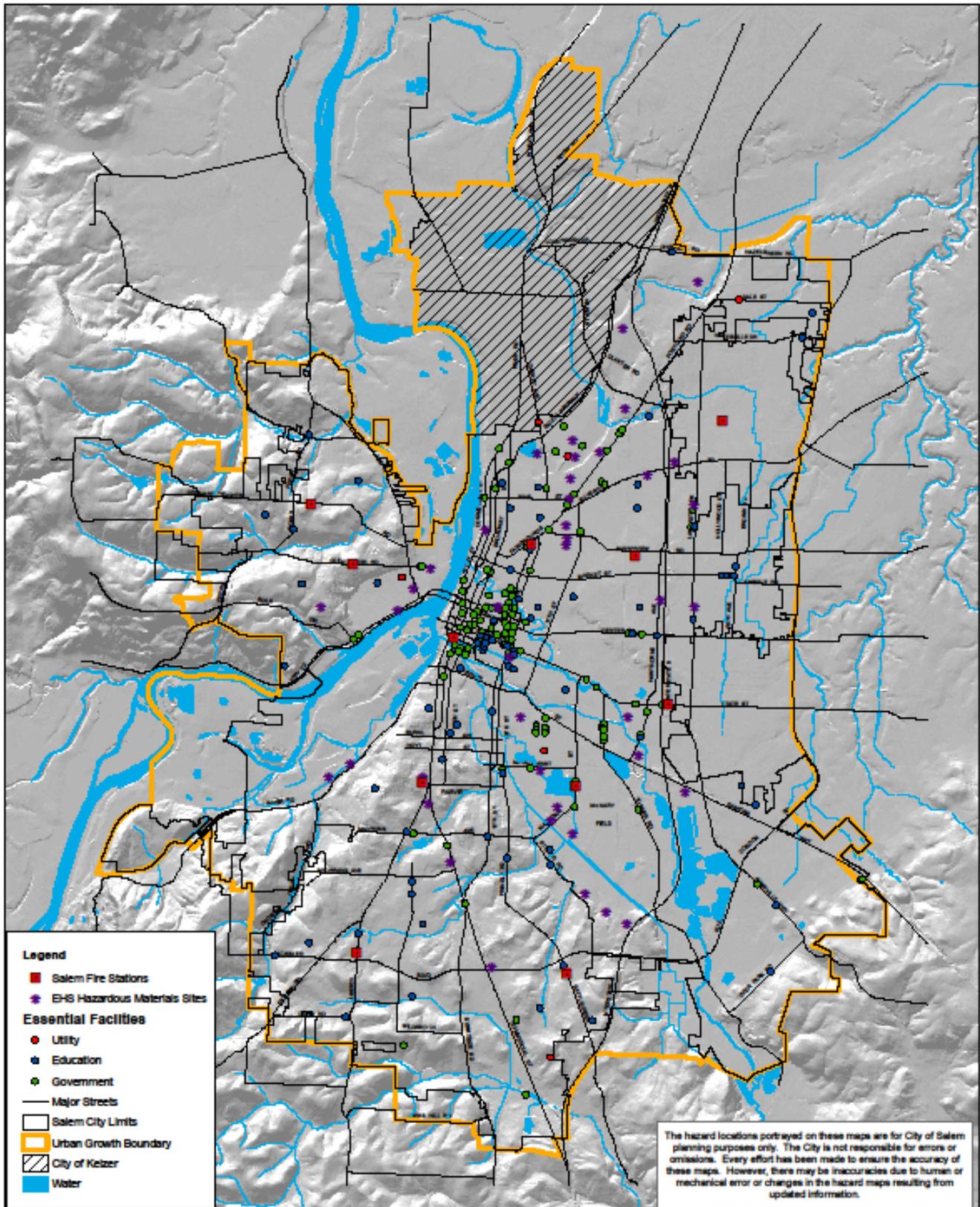
² Oregon.gov. Hazardous Materials Incidents Reports. 2010-2012.
http://www.oregon.gov/OSP/SFM/CR2K_InfoAvailable.shtml#Hazardous_Materials_Incident_Reports

³ City of Salem. Natural Hazard Mitigation Plan. 2008.

vulnerable because of the quantity of materials transported along these routes. Also, the railroad lines that run through downtown Salem near the Capital area are a concern because they carry significant quantities of hazardous materials transported through Salem each year. Map HM.1 identifies important facilities and hazardous materials locations.

CITY OF SALEM NATURAL HAZARD MITIGATION PLAN

MAP HM.1: IMPORTANT FACILITIES AND HAZARDOUS MATERIALS LOCATIONS CLASSIFIED EHS



Probability of Future Occurrence

Considering that 68 hazardous materials incidents of varying magnitude have occurred in the City of Salem area over the last five years, the City of Salem Steering Committee determined that the probability of future hazardous materials incidents is **moderate**, meaning that one event is likely in a 35-75 year period. This rating is consistent with the 2008 City of Salem Hazard Analysis.⁴

Vulnerability Assessment

Many facilities throughout the city hold and store hazardous materials, the areas surrounding these facilities and the adjacent transport network that carry the substances are especially vulnerable. The City of Salem Steering Committee rated the city's vulnerability to hazardous materials incidents as **high**, meaning that more than 10% of the city's population or assets would be impacted by a hazardous materials incident. This rating is consistent with the 2008 City of Salem Hazard Analysis.⁵

Risk Analysis

The City of Salem steering committee determined that the history of hazardous materials events is **low**, with less than a couple events occurring over the last 100 years. The maximum threat of extreme heat is **high**, considering the percentage of population and property that could be impacted under a worst—case scenario.⁶

Hazardous materials events in the past caused multiple minor injuries or a major injury impacting the health and safety of residents. However, the potential for injuries or deaths from past events or from similar events in other communities could escalate resulting in multiple deaths and major injuries. It is estimated that less than 10% of the City's population would be physically displaced by a hazardous materials incident, likely the result of a minor spill or leak, and there would be mild impact on community social networks.⁷

Facilities throughout the City are anticipated to reflect minor damage to several facilities due to hazardous materials, estimated between \$1 million to \$10 million for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely 10-30% of businesses located in the City and surrounding area would experience commerce interruption for a period of at least a few days. Hazardous materials can be extremely dangerous and businesses will be forced to closed if they are within the incident impact radius. Lastly, extreme heat would likely have extensive impacts on more than 75% of the City's ecological systems, including, clean water, wildlife habitat, and parks.⁸

Community Hazard Issues

What is susceptible to damage during a hazard event?

Most hazardous materials incidents would be localized near the source of the incident, but major incidents could have extensive evacuation zones and affect a significant portion of the

⁴ Oregon Emergency Management. Hazard Analysis Methodology. 2009.

⁵ Ibid.

⁶ City of Salem. NHMP Steering Committee. 2012.

⁷ Ibid.

⁸ Ibid.

City of Salem. The potential for casualties, including death and injury, is dependent on the location of incident, time of day, effectiveness of evacuation and materials involved.

In terms of infrastructure vulnerability, different infrastructure will be impacted to different degrees by a hazardous materials incident. Most incidents would have a negligible impact on buildings except for those structures adjacent to an explosive incident. Most utilities may also face minimal vulnerability, with the exception of water utilities and the potential impacts of a spill in upstream waters. Other incidents may result in temporary street or bridge closures. Considering the City of Salem, it is the State Capital, there is increasingly sensitive infrastructure and may increase the risk of an intentional hazardous materials incident.

Existing Hazard Mitigation Activities

Perhaps the single most critical factor in enhancing both mitigation planning and emergency response planning is **specific inventory awareness** for major hazardous materials sites within each jurisdiction. Specific inventory awareness means detailed knowledge of the types of hazardous materials, quantities of hazardous materials and locations of every location in a jurisdiction with significant quantities of hazardous materials. In this context, what constitutes a significant quantity varies depending on the toxicity of the material, the dispersal characteristics and the nature and population of nearby areas likely to be affected by hazardous materials incidents.

The Office of State Fire Marshal's Hazardous Substance Information System (HSIS) database contains a vast amount of information on the inventories of hazardous materials at fixed locations in Salem. The City of Salem also houses data pertaining to the transportation of hazardous materials within or through the area—these inventories are integrated into the Salem Fire Department.

Hazardous Materials Mitigation Action Items

The following action has been identified by the City of Salem steering committee, and is recommended for mitigating the potential effects of hazardous materials in the City of Salem. Please see full action item worksheets in Appendix A.

HM#1: Map facilities that handle or contain hazardous materials, rank them based on their level of risk, and refine response strategies for each situation in the event of an accident.

Hazard Annex Landslide

Causes and Characteristics of Landslides

Landslides are a geologic hazard in almost every state in America. Nationally, landslides cause 25 to 50 deaths each year.¹ In Oregon, economic losses due to landslides for a typical year are estimated to be over \$10 million.² In years with heavy storms, such as in 1996, losses can be an order of magnitude higher and exceed \$100 million.³ In Oregon, a significant number of locations are at risk to dangerous landslides. While not all landslides result in private property damage, many landslides impact transportation corridors, fuel and energy conduits, and communication facilities.⁴ They can also pose a serious threat to human life.

A 1998 study completed by Oregon's Department of Geology and Mineral Industry (DOGAMI) states that although few landslides develop in the Willamette Valley as compared to more mountainous parts of the state, the marine sedimentary rock units near Salem and the edges of the valley are susceptible to large slides.⁵

Landslides can be broken down into two categories: (1) rapidly moving; and (2) slow moving, in addition to "on-site" or "off-site" hazards. Rapidly moving landslides are typically "off-site" (debris flows and earth flows) and present the greatest risk to human life, and persons living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury. Rapidly moving landslides have also caused most of the recent landslide-related injuries and deaths in Oregon. Slow moving landslides tend to be "on-site" (slumps, earthflows, and block slides) and can cause significant property damage, but are less likely to result in serious human injuries.

Types of Landslides

Landslides are downhill or lateral movements of rock, debris, or soil mass. The size of a landslide usually depends on the geology and the landslide triggering mechanism. Landslides initiated by rainfall tend to be smaller, while those initiated by earthquakes may be very large. Slides associated with volcanic eruptions can include as much as one cubic mile of material.

Landslides vary greatly in the volumes of rock and soil involved, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Landslides are given different names depending on the type of failure and their composition and characteristics. Types of

¹ Mileti, Dennis. 1999. *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington D.C.: Joseph Henry Press.

² Wang, Yumei, Renee D. Summers, R. Jon Hofmeister, and Oregon Department of Geology and Mineral Industries. 2002. "Open-File Report O-02-05: Landslide Loss Estimation Pilot Project in Oregon." http://www.oregon.gov/LCD/docs/rulemaking/012308/item_1_Keohoe_att_b.pdf, accessed February 14, 2010

³ Ibid.

⁴ USGS Landslide Program Brochure, National Landslide Information Center, United States Geologic Survey.

⁵ Harvey, Andrew F. and Gary L. Peterson. 1998. *Water-Induced Landslide Hazards, Western Portion of the Salem Hills, Marion County, Oregon*.

landslides include slides, rock falls, and flows. For more explanation on landslide types and characteristics, reference resources provided by the United States Geological Survey (USGS).

Slides

Slides move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface and translational slides where movement occurs along a flat surface. These slides are generally slow moving and can be deep. Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage, but are far less likely to result in serious injuries than rapidly moving landslides.⁶

Erosion

Erosion occurs when ditches or culverts beneath hillside roads become blocked with debris. If the ditches are blocked, run-off from the slopes is inhibited during periods of precipitation. This causes the run-off water to collect in soil, and in some cases, cause a slide. Usually the slides are small (100 – 1,000 cubic yards), but they can be quite large.

Rock Falls

Rock falls occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. They are fast moving with the materials free falling or bouncing down the slope. In falls, material is detached from a steep slope or cliff. The volume of material involved is generally small, but large boulders or blocks of rock can cause significant damage. Rock falls have the potential to break off power poles located on hillsides.⁷

Flows

Plastic or liquid movements in which land mass (e.g. soil and rock) breaks up and flows during movement. Earthquakes often trigger flows.⁸ Debris flows normally occur when a landslide moves downslope as a semi-fluid mass scouring, or partially scouring soils from the slope along its path. Flows are typically rapidly moving and also tend to increase in volume as they scour out the channel.⁹ Flows often occur during heavy rainfall, can occur on gentle slopes, and can move rapidly for large distances.

Conditions Affecting Landslides

Natural conditions and human activities can both play a role in causing landslides. Certain geologic formations are more susceptible to landslides than others. Locations with steep slopes are at the greatest risk of slides. However, the incidence of landslides and their impact on people and property can be accelerated by development. Developers who are uninformed about geologic conditions and processes may create conditions that can increase the risk of or even trigger landslides.

There are four principal factors that affect or increase the likelihood of landslides:

⁶ Interagency Hazard Mitigation Team. 2000. State Hazard Mitigation Plan. Oregon State Police – Office of Emergency Management.

⁷ Eichorn, Ernie. Field Representative, Chemawa District, Bonneville Power Authority. Personal Interview. 10 November 2004.

⁸ Robert Olson Associates. June 1999. Metro Regional Hazard Mitigation Policy and Planning Guide. Portland, OR: Metro.

⁹ Ibid.

- Natural conditions and processes including the geology of the site, rainfall, wave and water action, seismic tremors and earthquakes and volcanic activity.
- Excavation and grading on sloping ground for homes, roads and other structures.
- Drainage and groundwater alterations that are natural or human-caused can trigger landslides. Human activities that may cause slides include broken or leaking water or sewer lines, water retention facilities, irrigation and stream alterations, ineffective storm water management and excess runoff due to increased impervious surfaces.
- Change or removal of vegetation on very steep slopes due to timber harvesting, land clearing and wildfire.

History of Landslides in City of Salem

In February 1996, November 1996, and December 1996/January 1997 the Willamette Valley experienced heavy rainfall and snowmelt which led to widespread landslide events throughout the state. Disaster declarations were issued for Marion County for the February 1996 and December 1996/January 1997 storms.¹⁰ During these storms, many landslides occurred in the eastern portion of the state, and are too numerous to list here. In 2000, DOGAMI mapped the historical instances of landslide events throughout the Willamette Valley for the 1996-1997 storms, including the City of Salem.¹¹

The geologic setting of the Salem Hills illustrates a historic pattern of landslides. Many prominent features that help identify the ancient landslide terrain are hummocky topography, disrupted drainage patterns, sag ponds, springs, back-tilted bedrock blocks, and subdued head scarps.¹² In 2005 a landslide blocked traffic to the City of Salem along South River Road, near South Owen Street. The 2005 Slide did not damage any homes.¹³ Another landslide occurred in January of 2011 on South River Road between Owens Street and Croissan Creek. The slide brought down a boulder that blocked thoroughfare.¹⁴

Risk Assessment

How are Hazards Identified?

Geologic and geographic factors are important in identifying landslide-prone areas. Stream channels, for example, have major influences on landslides, due to undercutting of slopes by stream erosion and long-term hillside processes.

¹⁰ Oregon State Archives, Governor's Executive Orders, *EO-96-12, EO-97-9*, http://arcweb.sos.state.or.us/governors/Kitzhaber/web_pages/governor/legal/execords.htm, accessed September 28, 2010.

¹¹ Harvey, Andrew F. and Gary L. Peterson. 1998. *Water-Induced Landslide Hazards, Western Portion of the Salem Hills, Marion County, Oregon*.

¹² *Ibid.*

¹³ City of Salem. *Natural Hazard Mitigation Plan*. 2008.

¹⁴ *Landslide Closes South River Road in Salem*. www.salem-news.com. January 20, 2011. Accessed May 21, 2012.

The Oregon Department of Forestry (ODF) Storm Impacts Study conducted after the 1996-97 landslide events found that the highest probability for the initiation of shallow, rapidly moving landslides was on slopes of 70 to 80 percent steepness. A moderate hazard of shallow rapid landslide initiation can exist on slopes between 50 and 70 percent.¹⁵

In general, areas at risk to landslides have steep slopes (25 percent or greater,) or a history of nearby landslides. In otherwise gently sloped areas, landslides can occur along steep river and creek banks, and along ocean bluff faces. At natural slopes under 30 percent, most landslide hazards are related to excavation and drainage practices, or the reactivation of preexisting landslide hazards.¹⁶

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.

Probability of Future Occurrence

The probability of rapidly moving landslide occurring depends on a number of factors, including steepness of slope, slope materials, local geology, vegetative cover, human activity, and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides (debris flows). Consequently, the Oregon Department of Forestry tracks storms during the rainy season, monitors rain gauges and snow melt, and issues warnings as conditions warrant. Geo-engineers with the Oregon Department of Forestry (ODF) estimate widespread landslides about every 20 years; landslides at a local level can be expected every two or three years.¹⁷

Based on the landslide history, the City of Salem steering committee determined that the probability of a landslide occurring is **high**, meaning that one event is likely in a 10-35 year period. This rating is consistent with the 2008 City of Salem Hazard Analysis.

Vulnerability Assessment

To a large degree, landslides are very difficult to predict. Vulnerability assessments assist in predicting how different types of property and population groups will be affected by a hazard.¹⁸ The optimum method for doing this analysis at the city or county level is to use parcel-specific assessment data on land use and structures.¹⁹ Data that includes specific landslide-prone and debris flow locations in the county can be used to assess the population and total value of property at risk from future landslide occurrences.

Landslides can impact major transportation arteries, blocking residents from essential services and businesses. Many aspects of the city are vulnerable to landslides. This includes land use and development patterns, the economy, population segments, ecosystem services, and cultural assets. The impacts to these community sectors are described in more detail in the hazard impacts section below.

¹⁵ Storm Impacts and Landslides of 1996 Final Report. (1999) Oregon Department of Forestry.

¹⁶ State Hazard Mitigation Plan. The Interagency Hazards Mitigation Team, (2000) Oregon State Police - Office of Emergency Management.

¹⁷ Mills, K. 2002. Oregon's Debris Flow Warning System. *Cordilleran Section-98th Annual Meeting*. Corvallis.

¹⁸ Burby, R., ed. 1998. *Cooperating with Nature*. Washington D.C.: Joseph Henry Press.

¹⁹ Ibid.

The City of Salem steering committee determined Salem has a **moderate** vulnerability to landslides. A moderate rating means that 1-10% of the population or regional assets would be impacted by a landslide. This rating is consistent with the 2008 City of Salem Hazard Analysis.

Risk Analysis

The City of Salem steering committee determined that the history of landslide events is **high**, with at least four events occurring over the last 100 years. The maximum threat of landslides is **low**, considering the percentage of population and property that could be impacted under a worst—case scenario.²⁰

Landslides in the past caused few minor injuries. However, the potential for injuries or deaths from past events or from similar events in other communities could escalate resulting in multiple minor injuries and a possible major injury. Salem estimates that less than 10% of the City’s population could be physically displaced by a landslide, considering landslide events tend to have localized impacts; and there would be little to no impact on community social networks.²¹

Multiple facilities throughout the City anticipate moderate damage due to a landslide, estimated at less than \$1 million for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely that less than 10% of businesses located in the City and surrounding area could experience commerce interruption for a period of days. Landslide hazards have the potential to affect transportation and may inhibit access to businesses until roadways can be cleared. Lastly, landslides would likely have mild impacts on 10-25% of the City’s ecological systems, including, clean water, wildlife habitat, and parks.²²

The relative risk of a landslide is estimated by considering the probability of a landslide event and the severity of the outcome when an event occurs. On a scale of 1 to 25, with 1 being the lowest and 25 being the highest relative risk, flood hazards in the City of Salem are a score of a nine.²³

Community Hazard Issues

What is susceptible to damage during a hazard event?

Depending upon the type, location, severity and area affected, severe property damage, injuries and loss of life can be caused by landslide hazards. Landslides can damage or temporarily disrupt utility services, roads and other transportation systems and critical lifeline services such as police, fire, medical, utility and communication systems, and emergency response. In addition to the immediate damage and loss of services, serious disruption of roads, infrastructure and critical facilities and services may also have longer term impacts on the economy of the community and surrounding area.

²⁰ City of Salem. NHMP Steering Committee. 2012.

²¹ Ibid.

²² Ibid.

²³ Oregon Emergency Management. Hazard Analysis Methodology, Relative Risk. 2009

Increasing the risk to people and property from the effects of landslides are the following five factors:

- Improper excavation practices, sometimes aggravated by drainage issues, can reduce the stability of otherwise stable slopes.
- Allowing development on or adjacent to existing landslides or known landslide-prone areas raises the risk of future slides regardless of excavation and drainage practices. Homeowners and developers should understand that in many potential landslide settings there are no development practices that can completely assure slope stability from future slide events.
- Building on fairly gentle slopes can still be subject to landslides that begin a long distance away from the development. Sites at greatest risk are those situated against the base of very steep slopes, in confined stream channels (small canyons), and on fans (rises) at the mouth of these confined channels. Home siting practices do not cause these landslides, but rather put residents and property at risk of landslide impacts. In these cases, the simplest way to avoid such potential effects is to locate development out of the impact area, or construct debris flow diversions for the structures that are at risk.
- Certain forest practices can contribute to increased risk of landslides. Forest practices may alter the physical landscape and its vegetation, which can affect the stability of steep slopes. Physical alterations can include slope steepening, slope-water effects, and changes in soil strength. Of all forest management activities, roads have the greatest effects on slope stability, although changing road construction and maintenance practices are reducing the effects of forest roads on landslides.
- High rainfall accumulation in a short period of time increases the probability of landslide. An extreme winter storm can produce up to 6 inches of rainfall in a 24 hour period; if the storm occurs well into the winter season, when the ground is already saturated, the hydraulic overload effect is heightened.

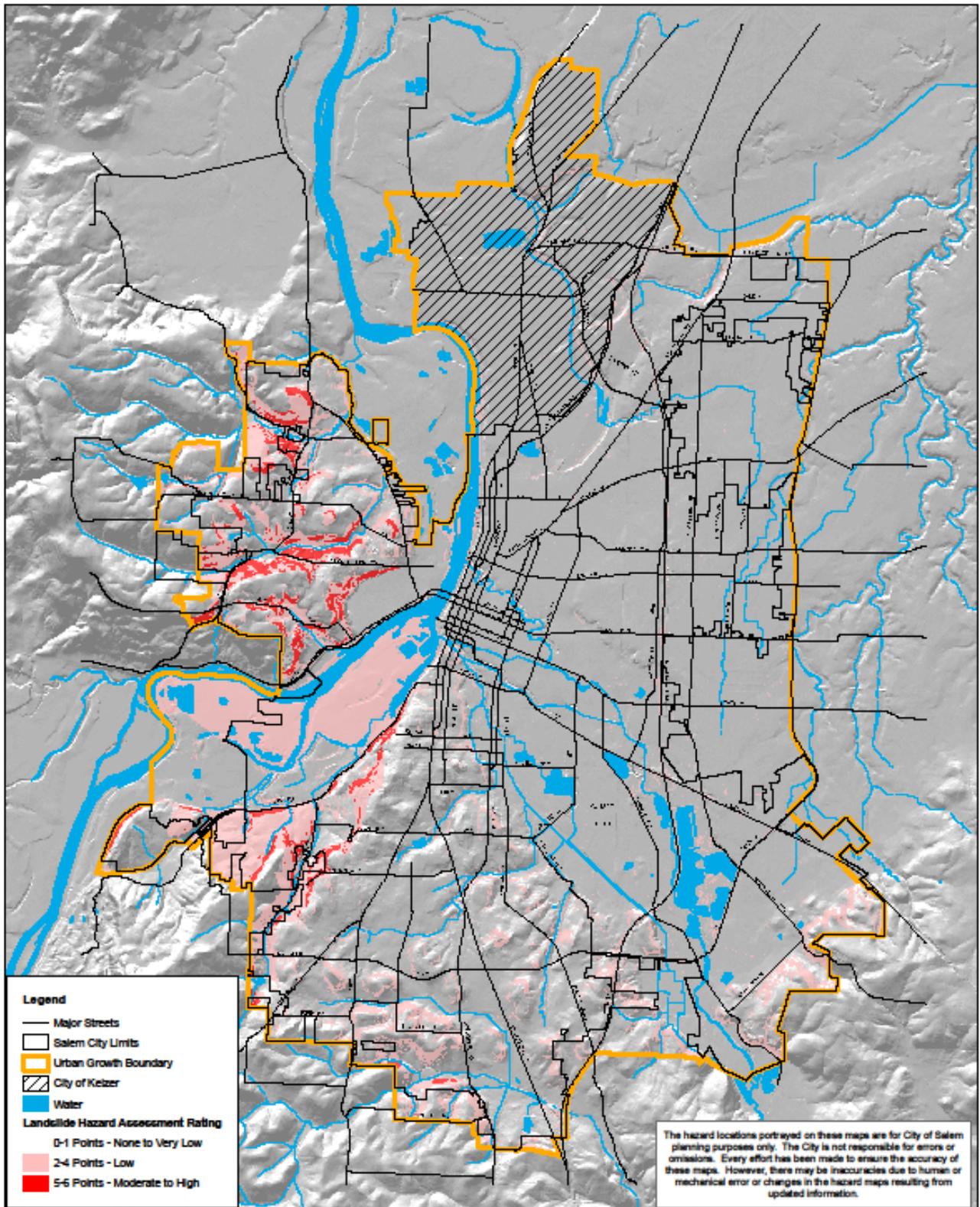
Portions of the City of Salem that are at risk to landslide hazards are located to the west of downtown Salem in two main locations. The first area is in West Salem and is bounded to the south by the Willamette River and east by Wallace Rd. The majority of the landslide risks occur around Gibson Creek and Turnage Brook. To the south of the river, the highest landslide risk is around Croisan Creek and westward toward the South Hills.²⁴ This area near South River Road and Liberty Street, reflect further risk where there has been clearing of vegetation on steep slopes for new developments.²⁵ Various areas of low risk are located south of Salem along the southern boundary of the UGB.

²⁴ City of Salem. Natural Hazard Mitigation Plan. 2008.

²⁵ Marion County. Natural Hazard Mitigation Plan. 2011.

CITY OF SALEM NATURAL HAZARD MITIGATION PLAN

MAP LS.1: LANDSLIDE SUSCEPTIBILITY STUDY INFORMATION



Existing Hazard Mitigation Activities

South River Road

The City of Salem has undertaken several projects along South River Road to divert water away from the top of the slope, screen and contain falling debris, reduce vegetation, and remove hazardous trees to decrease the vulnerability of landslide hazards in the area.²⁶

Pre-Treatment Facility

Landslides and mudslides in the City of Salem's drinking water supply watershed have negatively impacted the surface water quality of the North Santiam River, which prevented the use of the City's slow sand filters for drinking water treatment. The City installed a new pre-treatment facility in 1998 to reduce the potential impact of surface water quality, and coordination efforts for activities within the North Santiam watershed have been greatly improved among affected stakeholders (USFS, BLM, Oregon Department of Forestry, North Santiam communities, and private parties).²⁷

Landslide Mitigation Action Items

The following actions have been identified by the City of Salem steering committee, and are recommended for mitigating the potential effects of landslides in the City of Salem. Please see full action item worksheets in Appendix A.

LS#1: Map areas of landslide risk adjacent to the North Santiam River (upstream of the Geren Island water intake structures) and areas impacted by a catastrophic failure of the Detroit or Big Cliff Dams.

LS#2: Improve the existing Erosion Prevention and Sediment Control (EPSC) program and regulations established in SRC 65 and 69 to help control erosion.

LS#3: Update landslide overlay maps using Light Detection and Ranging (LIDAR) data.

²⁶ City of Salem. Natural Hazard Mitigation Plan. 2008

²⁷ Greenwalt, Travis and Deborah McGrath. "Protecting the City's Water: Designing a Payment for Ecosystems Services Program". Natural Resources & Environment. Volume 24, Number 1. 2009

Volcanic Eruption Hazard Annex

Causes and Characteristics of Volcanic Eruption

The City of Salem and the Pacific Northwest lie within the “ring of fire,” an area of very active volcanic activity surrounding the Pacific Basin (see figure 5 for volcano location on the west coast). Volcanic eruptions occur regularly along the ring of fire, in part because of the movement of the Earth’s tectonic plates. The Earth’s outermost shell, the lithosphere, is broken into a series of slabs known as tectonic plates. These plates are rigid, but they float on a hotter, softer layer in the Earth’s mantle. As the plates move about on the layer beneath them, they spread apart, collide, or slide past each other. Volcanoes occur most frequently at the boundaries of these plates and volcanic eruptions occur when the hotter, molten materials, or magma, rise to the surface. In Oregon, volcanic activity can be found along the Cascade Range which was formed by the Juan de Fuca plate sinking beneath the North American plate.¹

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

Ash fall

One of the most serious hazards from an eruption is the rock (*bombs*) and dust-sized ash particles - called *tephra* - blown into the air. The dust-sized ash particles can travel enormous distances and are a serious by-product of volcanic eruptions. Within a few miles of the vent, the main tephra hazards to man-made structures and humans include high temperatures, being buried, and being hit by falling fragments. Within ten to twelve miles, hot tephra may set fire to forests and flammable structures.

During an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction.² The predominant wind pattern over the Cascades is from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes.³ The potential and geographical extent of volcanic ash fall in the Pacific Northwest from an eruption on Mt. St. Helens is depicted in Figure 3 below.⁴

Earthquakes

Earthquakes can trigger volcanic eruptions or they can cause them. An earthquake produced by stress changes in solid rock from injection or withdrawal of magma (molten rock) is called a volcano-tectonic earthquake. The other categories of volcanic earthquakes, called long period earthquakes, are produced by the injection of magma into surrounding rock. Volcanic

¹ Oregon State Natural Hazard Mitigation Plan. 2009. “Volcanic Hazards Chapter,” http://aaaweb1.uoregon.edu/opdr/sites/aaaweb1.uoregon.edu/opdr/files/OR-SNHMP_volcanic_chapter_2009_0.pdf, accessed February 12, 2010

² Ibid.

³ Ibid.

⁴ Ibid.

earthquakes tend to be mostly small and not a problem for areas tens of miles from the volcano.

Lava flows

Lava flows are streams of molten rock that erupt relatively non-explosively from a volcano and move downslope, causing extensive damage or total destruction by burning, crushing, or burying everything in their paths. Secondary effects can include forest fires, flooding, and permanent reconfiguration of stream channels.⁵ The most likely instance of a lava flow in Marion County would occur near Mount Jefferson.

Pyroclastic flows and surges

Pyroclastic flows are avalanches of rock and gas at temperatures of 600 to 1500 degrees Fahrenheit. They typically sweep down the flanks of volcanoes at speeds of up to 150 miles per hour. Pyroclastic surges are a more dilute mixture of gas and rock. They can move even more rapidly than a pyroclastic flow and are more mobile. Both generally follow valleys, but surges sometimes have enough momentum to overtop hills or ridges in their paths. Because of their high speed, pyroclastic flows and surges are difficult or impossible to escape. If, it is expected that they will occur, evacuation orders should be issued as soon as possible for the hazardous areas. Objects and structures in the path of a pyroclastic flow are generally destroyed or swept away by the impact of debris or by accompanying hurricane-force winds. Wood and other combustible materials are commonly burned. People and animals may also be burned or killed by inhaling hot ash and gases. The deposit that results from pyroclastic flows is a combination of rock bombs and ash and is termed *ignimbrite*. These deposits may accumulate to hundreds of feet thick and can harden to resistant rock.⁶ Residents in the southeastern corner of Marion County have a potential risk if these events occur at Mount Jefferson.

Lahars and debris flows

A lahar consists of a mixture of water and rock fragments that flow down the slope of a volcano, usually along a stream channel. A lahar can be generated by volcanic activity (for example, melting snow or glacier), prolonged rain, or other weather conditions resulting in rapid snow melt. When moving, a lahar resembles a mass of wet concrete carrying rocks and boulders. Lahars vary in size and speed. Large lahars may be hundreds of meters wide, tens of meters deep, and move faster than a person can run. The Cascade Mountains and nearby floodplains contain abundant evidence of lahar activity and destruction. Past lahars at Mount Hood completely buried valley floors in the Sandy, Hood, and White River drainages. Figure 4 illustrates the aftermath of a lahar.

Debris flows are sudden and very rapid movements of rock and soil downhill; they are often called mudslides. They can be triggered by a variety of phenomena, including weather conditions, very steep slopes, and earthquakes. Debris flows can travel miles and attain speeds as high as 100 miles per hour. Structures and objects in their path (e.g., dams, bridges) will sometimes be incorporated into the flow. They often contain enough water to

⁵ Oregon State Natural Hazard Mitigation Plan. 2009. "Volcanic Hazards Chapter," http://aaaweb1.uoregon.edu/opdr/sites/aaaweb1.uoregon.edu/opdr/files/OR-SNHMP_volcanic_chapter_2009_0.pdf, accessed February 12, 2010

⁶ Ibid.

transform into lahars. Debris flows are common throughout the steep volcanoes of the Cascade Range.

The major hazard to human life from lahars and debris flows is from burial and impact by boulders and other debris. Buildings, dams, bridges, and other property in the path of a lahar can be buried, smashed, or carried away. Flooding can occur behind temporary dams created by logjams or other debris in streams.

Lahars and debris flows can result in the disruption of utility and transportation systems. Municipalities, industries, and individuals who take their water from streams affected by lahars may have water quality and quantity issues. Endangered species could be adversely affected by changes in streams, including the deposition of debris in streambeds and floodplains. For example, salmonids trying to spawn could find it impossible to swim upstream.

Both debris flows and lahars can occur for many years after an eruptive episode at a volcano.

Landslides (debris avalanches)

Because the volcanoes that form the Cascade Mountains are composed of layers of weak fragmented rock and lava they are prone to gravity driven failure such as landslides. Landslides range in size from small to massive summit or flank failures. They may be triggered by erosion that over steepens slopes or during times of excessive rainfall or snowmelt. Speeds of movement range from slow creep to more catastrophic failure. If enough water is incorporated into the material the failure will become a lahar. Primary hazards are to roads, bridges, dams, and buildings that might be constructed on the landslide or be damaged by the movement.

History of Volcanic Eruption in City of Salem

There are five active volcanoes that could potentially impact the City of Salem and the broader region. These include: Mount Jefferson, Three Sisters and Broken Top, Mount Hood, Mount St. Helens, and Mount Rainier (see Figure 5 below). However, only one of these volcanoes, Mount St. Helens, has impacted the area near the City of Salem within the past 30 years.

Table VE-1: Regional Volcanic History

Volcano	Comments
Mount St. Helens	Mount St. Helens, located in southwestern Washington about 120 miles northeast of the City of Salem, it is fifty thousand years old. Over the past 521 years, it has produced four major explosive eruptions and dozens of smaller eruptions. On May 18th, 1980, Mount St. Helens exploded violently after two months of intense earthquake activity and intermittent, relatively weak eruptions, causing the worst volcanic disaster in the recorded history of the United States. Mount St. Helens continued to be active, on March 8, 2005, a plume of ash and steam spewed nearly seven miles high into the air. Ten small earthquakes were measured in the area leading up to the eruption. The largest appeared to be a magnitude 2.5, according to the USGS.
Mount Jefferson	Mount Jefferson has erupted repeatedly for hundreds of thousands of years, with its last eruptive episode during the last major glaciations, which culminated about 15,000 years ago. Geologic evidence shows that Mount Jefferson is capable of large explosive eruptions.
Three Sisters & Broken Top	The Three Sisters are located about 110 miles from Salem and 40 miles southeast of the edge of Marion County. Recently, volcanic activity has been found on the South Sister. The surface moved toward the satellite (mostly upward) by as much as ten centimeters (about four inches) sometime between August 1996 and October 2000. There is no immediate danger of a volcanic eruption or other hazardous activity. The potential exists, however, that further activity could increase danger.
Mount Hood	Mount Hood is located about 120 miles northeast of the City of Salem. It has been recurrently active over the past 50,000 years. It has had two significant eruptive periods in geologically recent times, one about 1,500 years ago and another about 200 years ago. Mount Hood has shown no recent signs of volcanic activity.
Mount Rainier	Mount Rainier is located approximately 174 miles north of the City of Salem. Mount Rainier is an active volcano that first erupted about half a million years ago. Mount Rainier is known to have erupted as recently as in the 1840s, and large eruptions took place as recently as about 1,000 and 2,300 years ago. The primary hazard posed to the City of Salem and surrounding region is ash fallout from Mount Rainier.

Risk Assessment

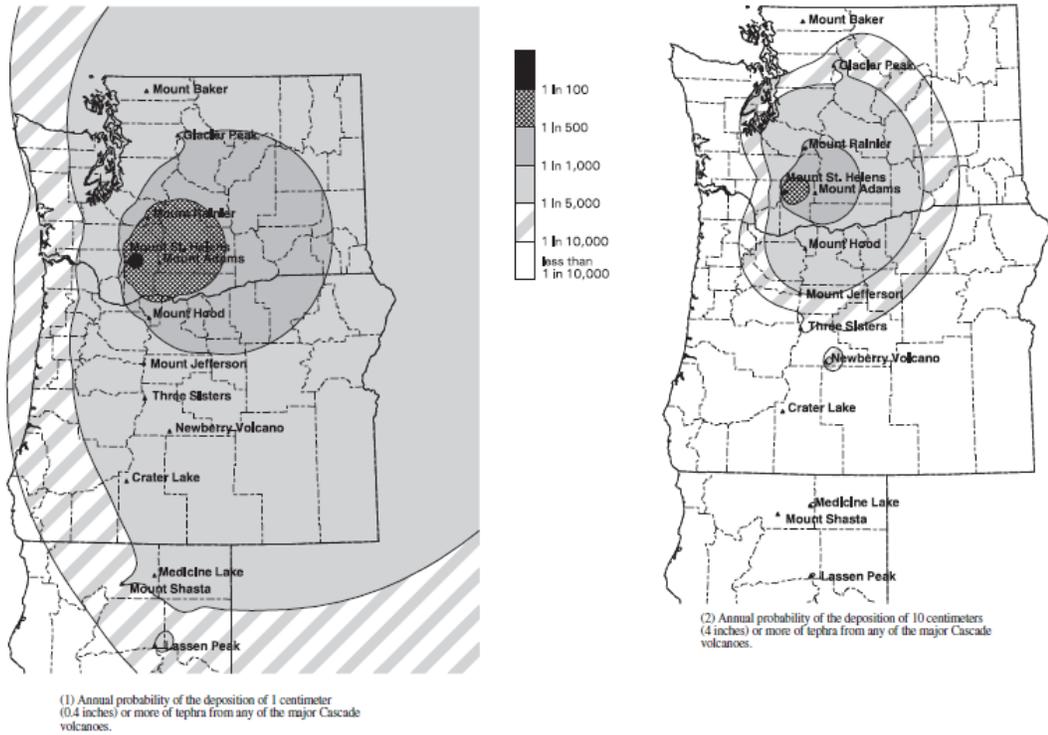
How are Hazards Identified?

The location of the volcanic hazard for the City of Salem is depicted in the United States Geologic Survey (USGS) Cascades Volcano Observatory (CVO) volcanic hazard zonation reports for Mount Jefferson, produced in 2000. The reports include a description of potential hazards that may occur to immediate communities. The extent of damage from these hazards depends on the distance from the volcano, vent location, and type of hazardous events that occur during an eruption.

Scientists also use wind direction to predict areas that might be affected by volcanic ash; during an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. The predominant wind pattern over the 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 VE-2 depicts the potential and geographical extent of volcanic ash fall in excess of ten centimeters from a large eruption of Mt. St. Helens.

Figure VE-1 Regional Tephra-fall Maps



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

Probability of Future Occurrence

Because geologic history is fragmentary for these volcanoes, the probability of future explosive eruptions is difficult to estimate. Only two explosive episodes have occurred at the South Sister since the ending of the ice age (about 12,000 years ago). Given the fragmentary record, the annual probability of the South and Middle Sister entering a new period of eruptive activity has been estimated from 1 in several thousand to 1 in 10,000.⁷

Similar difficulties complicate predictions of future eruptions at Mt. Jefferson. There have been four eruptive episodes since the end of the Ice Age (within the last 20,000 years). Such a frequency suggests an annual probability of about 1 in 4,000 to 1 in 3,000.⁸

Given the low annual probability of a volcanic eruption, the City of Salem steering committee rated the probability of volcanic eruption as **low**, meaning that one incident is

⁷ United States Geologic Survey Open File Report 99-437, p.8.
⁸ United States Geologic Survey Open File Report 99-24, p.11.

likely in a 75 to 100 year period. This rating is not consistent with the 2008 City of Salem Hazard Analysis

Vulnerability Assessment

While a quantitative vulnerability assessment (an assessment that describes number of lives or amount of property exposed to the hazard) has not yet been conducted for Marion County volcanic eruption events, there are many qualitative factors (issues relating to what is in danger within a community) that point to potential vulnerability. The portion of Marion County, east of Salem, faces the greatest threat of volcanic eruption from Mount Jefferson. In addition, its proximity to a number of Cascade Range volcanoes places the county at risk from ash fallout originating from such an event.

The City of Salem steering committee rated the county's vulnerability to volcanic eruption as **moderate**, meaning 1-10% of the population or regional assets would be affected by a volcano. This rating is not consistent with the 2008 City of Salem Hazard Analysis. Vulnerabilities are described in detail in the following section community hazard issues.

Risk Analysis

The City of Salem steering committee determined that the history of volcanic events is **low**, with less than a couple events occurring over the last 100 years. The maximum threat of a volcanic eruption is **moderate**, considering the percentage of population and property that could be impacted under a worst—case scenario.⁹

Volcanic eruptions in the past caused multiple minor injuries or a major injury to the health and safety of residents. The potential for future injuries or deaths is anticipated to remain similar to historic events. It is estimated that less than 1% of the City's population would be physically displaced by a volcanic eruption, considering the primary volcanic hazard that could impact the City is ash fallout, and there would be moderate impact on community social networks.¹⁰

Several facilities throughout the City anticipate mild damage due to a volcanic eruption, estimated between \$1 million and \$10 million for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely more than 75% of businesses located in the City and surrounding area would experience commerce interruption for a period of several weeks. Ash fall from volcanic eruptions has the potential to impact a wide region, inflicting damage to building circulation systems and road surface conditions. Lastly, volcanic eruptions would likely have extensive impacts on more than 75% of the City's ecological systems, including, clean water, wildlife habitat, and parks.¹¹

Community Hazard Issues

What is susceptible to damage during a hazard event?

Salem could be affected by volcanic activity from Mt. St. Helens, Mt. Hood, or Mt. Jefferson. If any of these volcanoes erupted, there would be a possibility of ash that could affect air quality and/or the water quality. Specifically, Salem's North Santiam watershed could be

⁹ City of Salem. NHMP Steering Committee. 2012.

¹⁰ Ibid.

¹¹ Ibid.

severely impacted by mudflows and volcanic ash falls derived from regional volcanic activity. The indirect effects of volcanoes within other counties must be considered as well.

Areas of vulnerability in the event of volcanic eruption, for which the greatest threat in the City of Salem is natural resources, buildings and infrastructure, segments of the population, and the economy.

Existing Hazard Mitigation Activities

The City of Salem does not have any specific mitigation activities relevant to volcanic hazards.

Volcanic Eruption Mitigation Action Items

Action items for volcanic eruption hazards are in development.

Wildland Urban Interface Fire Hazard Annex

Causes and Characteristics of Wildland Urban Interface (WUI) Fire

While more common to the arid areas of central and eastern Oregon, the potential for losses due to WUI fires in the urbanized region should not be ignored. Fire is an essential part of Oregon's ecosystem, but it is also a serious threat to life and property particularly in the state's growing rural communities. Wildfires are fires occurring in areas having large areas of flammable vegetation that require a suppression response. Areas of wildfire risk exist throughout the state with areas in central, southwest and northeast Oregon having the highest risk. The Oregon Department of Forestry has estimated that there are about 200,000 homes in areas of serious wildfire risk.

The impact on communities from wildfire can be huge. In 1990, Bend's Awbrey Hall Fire destroyed 21 homes, causing \$9 million in damage and costing over \$2 million to suppress. The 1996 Skeleton fire in Bend burned over 17,000 acres and damaged or destroyed 30 homes and structures. Statewide that same year, 218,000 acres were burned, 600 homes threatened and 44 homes were lost. The 2002 Biscuit fire in southern Oregon affected over 500,000 acres and cost \$150 million to suppress. Wildfires that have the potential to affect the City of Salem can be divided into three categories: interface, wildland, and firestorms.

Interface Fires

Essentially an interface fire occurs where wildland and developed areas come together with both vegetation and structural development combining to provide fuel. The wildland/urban interface (sometimes called rural interface in small communities or outlying areas) can be divided into three categories.

- The classic wildland/urban interface exists where well-defined urban and suburban development presses up against open expanses of wildland areas.
- The mixed wildland/urban interface is more typical of the problems in areas of exurban or rural development: isolated homes, subdivisions, resorts and small communities situated in predominantly in wildland settings.
- The occluded wildland/urban interface where islands of wildland vegetation exist within a largely urbanized area.

Wildland Fires

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

Firestorms

Firestorms are events of such extreme intensity that effective suppression is virtually impossible. Firestorms often occur during dry, windy weather and generally burn until conditions change or the available fuel is consumed. The disastrous 1991 East Bay Fire in Oakland, California is an example of an interface fire that developed into a firestorm.

Conditions Contributing to Wildfires

Ignition of a wildfire may occur naturally from lightning or from human causes such as debris burns, arson, careless smoking, and recreational activities or from an industrial accident. Once started, four main conditions affect the fire's behavior: fuel, topography, weather and development.

Fuel

Fuel is the material that feeds a fire. Fuel is classified by volume and type. As a western state, Oregon is prone to wildfires due to its prevalent conifer, brush and rangeland fuel types.

Topography

Topography influences the movement of air and directs a fire's course. Slope and hillsides are key factors in fire behavior. Unfortunately, hillsides with steep topographic characteristics are also desirable areas for residential development.

Weather

Weather is the most variable factor affecting wildfire behavior. High risk areas in Oregon share a hot, dry season in late summer and early fall with high temperatures and low humidity.

Development

The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element and can sweep through vegetation that is adjacent to a combustible home. New residents in remote locations are often surprised to learn that in moving away from built-up urban areas, they have also left behind readily available fire services providing structural protection.

History of WUI Fire in City of Salem

The City of Salem has had relatively few occurrences of WUI Fire hazards that have resulted in minimal dollar losses. The various types of WUI Fires that the City of Salem has reported since 2008 are depicted in Table WUI-1 below.

Table WUI-1: History of WUI Fire in Salem^{1 2}

Year	Number of Incidents	Total Loss (Dollars)
Vegetation Fire		
2008	26	\$235
2009	28	\$250
2010	0	\$0
2011	3	\$0
Forest or Wood Fire		
2008	2	\$0
2009	4	\$0
2010	0	\$0
2011	0	\$0
Brush-Grass Fire Mixture		
2008	35	\$2,340
2009	24	\$2,055
2010	20	\$600
2011	15	\$310
Grass Fire Only		
2008	18	\$21
2009	20	\$46
2010	0	\$0
2011	11	\$20

Risk Assessment

While the City of Salem does not have a specific wildfire management plan, The City of Salem is incorporated into the 2008 Marion County Community Wildfire Protection Plan (CWPP). One of the core elements of a CWPP is developing an understanding of the risk of potential losses to life, property and natural resources during a wildfire. This risk assessment adopts the approach produced by Oregon Department of Forestry (ODF) under the National Association of State Foresters (NASF) guidance which includes the following three risk objectives:

- Identify Communities-at-Risk and the Wildland-Urban Interface
- Develop and conduct a wildfire risk assessment of all land in Marion County, surrounding the City of Salem.
- Identify and prioritize hazardous fuels treatment projects for all land in Marion County.

The Marion County wildfire risk assessment is the analysis of the potential losses to life, property and natural resources. The analysis takes into consideration a combination of factors defined below:

Risk: the potential and frequency for wildfire ignitions (based on past occurrences) **Hazard:** the conditions that may contribute to wildfire (fuels, slope, aspect, elevation and weather)

¹ Oregon All Incident Reporting System OAIRS 2008-2009.

² FireBridge. City of Salem Wildland Types Responses. 2010 – 2011

Values: the people, property, natural resources and other resources that could suffer losses in a wildfire event.

Protection Capability: the ability to mitigate losses, prepare for, respond to and suppress wildland and structural fires.

Structural Vulnerability: the elements that influence the level of exposure of the hazard to the structure (roof type and building materials, access to the structure, and whether or not there is defensible space or fuels reduction around the structure.)³

How are Hazards Identified?

The Marion County CWPP identifies the City of Salem as an at risk community based upon residential density and Fire District serviceability. The extent of damage to The City of Salem from WUI fires is dependent on a number of factors, including temperature, wind speed and direction, humidity, proximity to fuels, and steepness of slopes.⁴

Probability of Future Occurrence

The natural ignition of forest fires is largely a function of weather and fuel; human-caused fires add another dimension to the probability. Dry and diseased forests can be mapped accurately and some statement can be made about the probability of lightning strikes. Each forest is different and consequently has different probability and recurrence estimates. Wildfire always has been a part of these ecosystems and sometimes with devastating effects. The intensity and behavior of wildfire depends on a number of factors including fuel, topography, weather, and density of development. There are a number of often-discussed strategies to reduce the negative impacts of these phenomena. They include land-use regulations, management techniques, site standards, building codes, and a recently passed Oregon Forestland-Urban Interface Fire Protection Act (1997). All of these have a bearing on a community's ability to prevent, withstand, and recover from a wildfire event.

Based on the City of Salem's historical incidence of wildfire events, the City of Salem steering committee determined that the probability of wildfire is **moderate**, meaning one wildfire is likely to occur in a 35 to 75 year period. This probability rating is also consistent with the 2008 City of Salem Hazard Analysis.

Vulnerability Assessment

Wildfires are a natural part of forest and grassland ecosystems. Past forest practices included the suppression of all forest and grassland fires. This practice, coupled with hundreds of acres of dry brush or trees weakened or killed through insect infestation, has fostered a dangerous situation. Present state and national forest practices include the reduction of understory vegetation through thinning and prescribed (controlled) burning.

Each year a significant number of people build homes within or on the edge of the forest (urban/wildland interface), thereby increasing wildfire hazards. Many Oregon communities (incorporated and unincorporated) are within or abut areas subject to serious wildfire hazards, complicating firefighting efforts and significantly increasing the cost of fire

³ Marion County. Community Wildfire Protection Plan (CWPP). Chapter 3. 2008.

⁴ Marion County. Community Wildfire Protection Plan (CWPP). 2008.

suppression. Considering few areas within the City of Salem are considered at risk to wildfires, the City of Salem steering committee determined that the city has a **low** vulnerability to wildfire, meaning that <10% of the community's population or assets would be impacted by a wildfire. This vulnerability rating is not consistent with the 2008 City of Salem Hazard Analysis.⁵

Risk Analysis

The City of Salem steering committee determined that the history of wildfire is **low**, with less than a couple events occurring over the last 100 years. The maximum threat of wildfire is also **low**, considering the percentage of population and property that could be impacted under a worst—case scenario.⁶

Wildfires in the past have caused no personal injury or death. However, the potential for injuries or deaths from past events or from similar events in other communities could escalate resulting in multiple minor injuries or possible major injury. Salem estimates that less than 10% of the City's population could be physically displaced by a wildfire, considering the proximity of residential housing to WUI vulnerable areas; and there would be mild impact on community social networks.⁷

Multiple facilities throughout the City anticipate moderate damage due to wildfires, estimated at less than \$1 million for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely that less than 10% of businesses located in the City and surrounding area could experience commerce interruption for a period of hours. The businesses most impacted are those in close proximity to WUI areas. Lastly, wildfires could likely have mild impacts on 10-25% of the City's ecological systems, including, clean water, wildlife habitat, and parks.⁸

The relative risk of a wildfire is estimated by considering the probability of a wildfire and the severity of the outcome when an event occurs. On a scale of 1 to 25, with 1 being the lowest and 25 being the highest relative risk, wildfire hazards in the City of Salem are a score of 3.4.⁹

Community Wildfire Protection Plan

The Marion County CWPP identifies the City of Salem as a community with moderate/low WUI fire risk priority based on three risk factors: fire behavior, values, and infrastructure.¹⁰ Each factor was given a situation rating ranging from 1-3; 1 indicates a higher vulnerability and a 3 correlates with a lower vulnerability.

Fire Behavior

The City of Salem *fire behavior-risk factor* is a Situation 2. A Situation 2 community has moderate slopes, broken moderate fuels, and some ladder fuels. The composition of surrounding fuels is conducive to torching and spotting. These conditions may lead to

⁵ Region 3: Mid/Southern Willamette Valley Regional Profile. January 2009

⁶ City of Salem. NHMP Steering Committee. 2012.

⁷ Ibid.

⁸ Ibid.

⁹ Oregon Emergency Management. Hazard Analysis Methodology, Relative Risk. 2009

¹⁰ Marion County. Community Wildfire Protection Plan. 2008

moderate fire fighting effectiveness. There is a history of some large fires and/or moderate fire occurrence.

Values at Risk

The City of Salem *values at risk-risk factor* is a Situation 1. A Situation 1 community is most characteristic of an urban interface setting. The setting contains a high density of homes, businesses, and other facilities that continue across the interface. There is a lack of defensible space where personnel can safely work to provide protection. The community watershed for municipal water is at high risk of being burned compared to other watersheds within that geographic region. There is a high potential for economic loss to the community and likely loss of housing units and/or businesses. There are unique cultural, historical or natural heritage values at risk.

Infrastructure

The City of Salem *infrastructure-risk factor* is a Situation 3. A Situation 3 community has multiple entrances and exits that are well equipped for fire trucks, wide loop roads, fire hydrants, open water sources (pools, creeks, and lakes), an active emergency operations group, and an evacuation plan in place in an area surrounded by a fireproof landscape. The federal land management agencies will work collaboratively with States, Tribes, local communities, and other interested parties to develop a ranking process to focus fuel reduction activities by identifying communities most at risk. Public input is welcome on the form a ranking system should take, as is input on measures that may be useful to assess the impacts of fuels treatment projects.

Community Hazard Issues

What is susceptible to damage during a hazard event?

The City of Salem's WUI is characterized by a diverse mixture of varying housing structures, development patterns, ornamental and natural vegetation, and natural fuels. In the event of a wildfire, vegetation, structures, and other flammables can merge into unwieldy and unpredictable events. Factors germane to the fighting of such fires include access, firebreaks, and proximity of water sources, distance from a fire station, and available firefighting personnel and equipment. Reviewing past wildland/urban interface fires from around the area shows that many structures are destroyed or damaged for one or more of the following reasons:¹¹

- Combustible roofing material;
- Wood construction;
- Structures with no defensible space;
- Fire department with poor access to structures;
- Subdivisions located in heavy natural fuel types;
- Structures located on steep slopes covered with flammable vegetation;
- Limited water supply; and
- Winds over 30 miles per hour.

¹¹ Marion County Community Wildfire Protection Plan (CWPP). 2008.

Of particular concern to firefighters are developments with narrow roadways and few routes of egress, or routes with very limited accessibility. Many new subdivisions are constructed with cul-de-sacs, which contribute to the problem of road access. Most cul-de-sacs do not allow rear access to homes, which can be a significant problem for firefighters and emergency services in defending the structure and ensuring the safety of its inhabitants. As well water supply is a critical factor in their ability to fight WUI fires. Developments lacking an adequate water supply and hydrant taps create extra challenges for firefighting personnel. Another water supply issue is that of small diameter pipe water systems, which are inadequate to provide sustained fire-fighting flows.

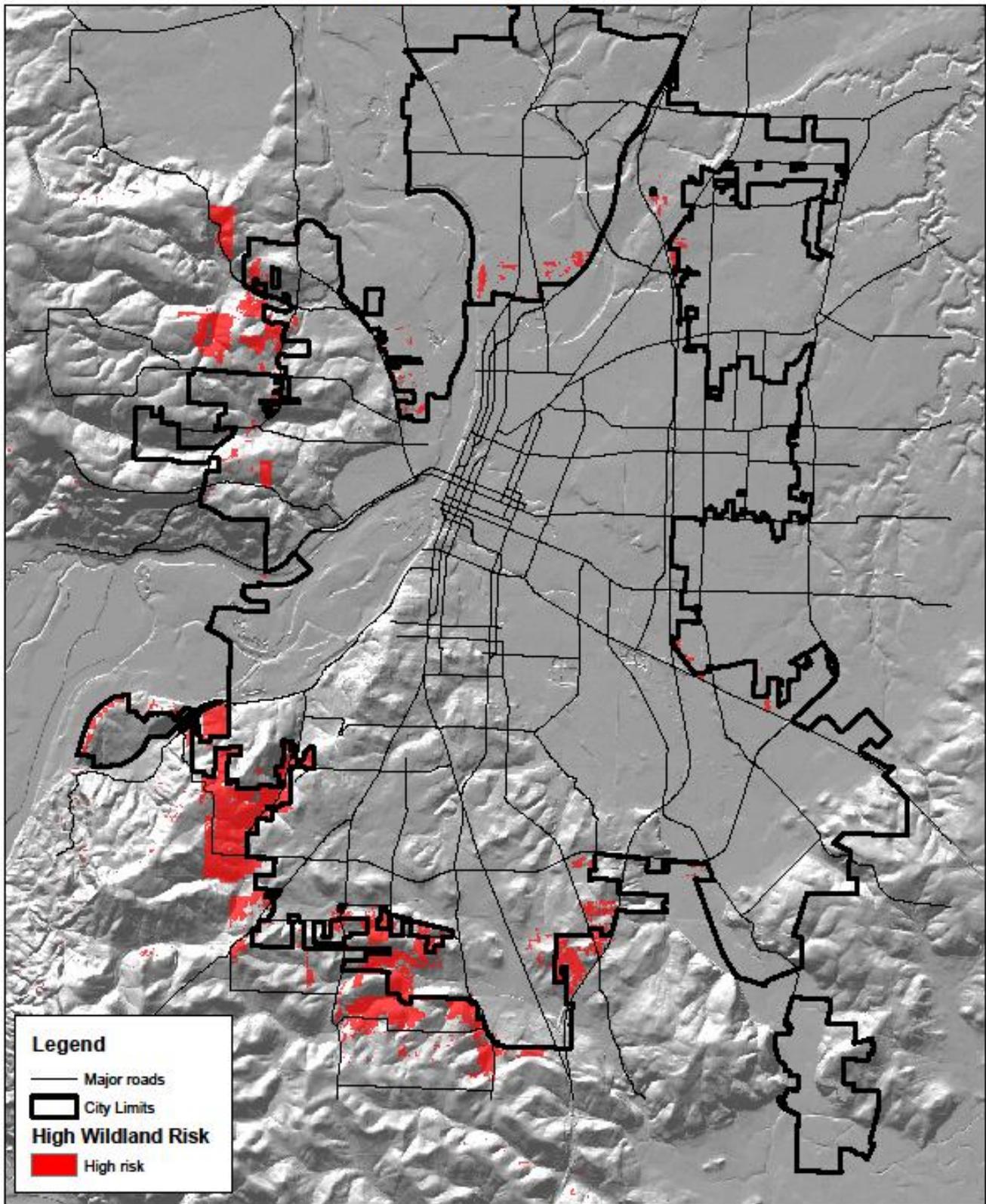
Numerous residences are located in the heavily wooded hillsides around Salem and the trend of people locating in or near forested lands continues. Frequently occurring fires in such heavily wooded areas are not a natural occurrence, but the threat increases when subject to more human activity. The State of Oregon has noted that such interfaces really are an intermingling of homes and other structures at various densities and complexity within areas of heavy natural cover or forestlands. When buildings burn in or close to areas of heavy vegetation, especially during the dry months, the risk increases. Areas where structures are built in proximity to dense vegetation may be vulnerable to urban-wildland interface fire. Of particular concern are areas with narrow roadways and few routes of egress and ingress.

The City of Salem steering committee identified a few areas vulnerable to WUI fire hazards. The areas with the highest risk are characterized by steep slopes, combustible fuels, and values at risk (meaning valuable property adjacent to wildland areas). The majority of the high risk area is along the southern boundary of the UGB, with additional interface risks at the northwestern UGB boundary in West Salem and in Keizer. The South Salem Hills was identified as an area of particular concern because of its potential for future development along steep forested slopes; reference Map WF.1 for areas with wildfire risk.¹² Most wildland urban interface areas are adjacent to the Salem Suburban Fire Department's jurisdiction.

¹² Marion County Community Wildfire Protection Plan (CWPP). 2008.

CITY OF SALEM NATURAL HAZARD MITIGATION PLAN

MAP WF.1: WILDFIRE RISK AREAS



Existing Hazard Mitigation Activities

Reducing WUI Fire Fuels

The Fire and Life Safety Division of the Salem Fire Department works to reduce WUI fire fuel loads in a few limited areas within the City of Salem that have been identified as potential areas at risk to WUI fire spread. The Fire and Life Safety Division also works with the City of Salem Compliance Services on an as-needed basis in responding to concerns related to hazardous weeds issues.

WUI Fire Mitigation Action Items

The following action has been identified by the City of Salem steering committee, and is recommended for mitigating the potential effects of wildfire in the City of Salem. Please see full action item worksheets in Appendix A.

WF#1: Conduct wildfire prevention outreach, as outlined in the Marion County Community Wildfire Protection Plan (CWPP), to residents near the wildland-urban interface.

Windstorm Hazard Annex

Causes and Characteristics of Windstorms

Extreme winds occur throughout Oregon. The most persistent high winds take place along the Oregon Coast and in the Columbia River Gorge. West winds generated from the Pacific Ocean are strongest along the coast and slow down inland due to the obstruction of the Coastal mountain range.¹ Prevailing winds in Oregon vary with the seasons. In summer, the most common wind directions are from the west or northwest; in winter, they are from the south and east. Local topography, however, plays a major role in affecting wind direction. For example, the north-south orientation of the Willamette Valley channels the wind most of the time, causing predominately north and south winds.²

Although rare, tornados can and do occur in Oregon. Tornadoes are the most concentrated and violent storms produced by the earth's atmosphere. They are created by a vortex of rotating winds and strong vertical motion, which possess remarkable strength and cause widespread damage. Wind speeds in excess of 300 mph have been observed within tornadoes, and it is suspected that some tornado winds exceed 400 mph. The low pressure at the center of a tornado can destroy buildings and other structures it passes over. Tornadoes are most common in the Midwest, and are more infrequent and generally small west of the Rockies. Nonetheless, Oregon and other western states have experienced tornadoes on occasion, many of which have produced significant damage and occasionally injury or death. Oregon's tornadoes can be formed in association with large Pacific storms arriving from the west. Most of them, however, are caused by intense local thunderstorms. These storms also produce lightning, hail, and heavy rain, and are more common during the warm season from April to October.³

History of Windstorms in the City of Salem

Windstorms have historically been a threat to the City of Salem. Windstorm events over the last century are listed in the table below, though not exclusive to the city have caused particularly severe damage to Marion County and the surrounding area.

1 US Department of Agriculture. <http://www.fsa.usda.gov/or/Notice/Flp104.pdf>

2 Statesman Journal. February 8, 2002.

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

Table WS-1: History of Windstorms in the City of Salem and Surrounding Area

Date	Comments
June, 2009	A strong wind storm with 80 mph winds, and followed by a thunderstorm, brought down numerous trees along Highway 22 and caused approximately \$2,000 in damage.
March, 2008	Heavy winds measured at 40 mph causes \$15,000 in damage near Woodburn.
May, 2007	A hail storm causes \$5,000 in damages in Marion County.
February, 2006	A windstorm with gusts up to 77 mph caused \$227,000 in damages in Linn, Lane, Marion, Benton, Polk, and Yamhill Counties.
January, 2005	Windstorms cause \$6,000 worth of property damage in Linn and Marion Counties. A storm total of \$15,000 in damages was spread out among Linn, Marion, Clackamas, Multnomah, and Washington Counties.
December, 2004	A windstorm causes \$6,250 in property damage in Marion, Lane, and Polk Counties.
July, 2003	A major windstorm in Marion County caused approximately \$15,000 in property damage.
February, 2002	This Willamette Valley windstorm arrived with wind gusts up to 70 mph causing 27,000 power outages statewide. The severity of this storm prompted President Bush to issue major disaster declarations for five Oregon counties. Nine other Oregon counties, including Marion County, were named contiguous counties, allowing family farmers to receive loans to address storm related damage. Eastern Marion County was one of the areas hardest hit by this storm.
December, 1995	This windstorm caused widespread damage, power and communication outages; prompting Governor Kitzhaber to declare a state of emergency for all of western Oregon. 150 National Guard Troops were sent to assist residents and public utility crews. The storm caused three deaths, one in Marion County. The windstorm resulted in \$800,000 of damage in Marion County, In Woodburn "millions of gallons of raw sewage" flowed into Salem area creeks and the Willamette River. Salem reported average winds of 40 mph with gusts up to 59 mph.
November, 1981	In November 1981 sustained winds in Salem reached 52 mph and gusts were recorded at 71 mph. Eleven people were killed and \$50 million in damage was reported as a result of the two storms. Numerous injuries resulted from wind-blown debris in western Washington and Oregon. Across the Pacific Northwest, hundreds of downed trees and power lines caused massive power outages and roof damage. The storm caused 500,000 Oregon residents to lose power, 20,000 in the Salem area alone.
March, 1971	This March windstorm produced winds up to 50 mph and hit the Hubbard and Scotts Mills area particularly hard while also causing power outages for approximately 60 homes in the Salem area.

Date	Comments
October, 1962	The Columbus Day storm in 1962 produced sustained winds in Salem of 58 mph and gusts as high as 90 mph. It was the most destructive windstorm ever recorded in Oregon, both in terms of loss of life and property damage. Damage was most severe in the Willamette Valley where the storm killed 38 people and was responsible for two deaths in Salem and four injuries in Silverton. The storm caused upwards of \$200 million in damage (over \$800 million in today's dollars) statewide. Approximately \$4 million (in 1962 dollars) in damage occurred just in Salem. Hundreds of thousands of homes were without power for short periods of time, while others were without power for two to three weeks. More than 50,000 homes were seriously damaged, and nearly 100 were completely destroyed.
December, 1951	This mid-century storm with winds recorded at 57 mph and gusts up to 76 mph resulted in four Oregon deaths, power outages and highway closures due to downed trees.
April, 1931	This storm, recorded winds up to 40 mph and gales up to 75 mph. The storm blew dust from Eastern Oregon down the Columbia Gorge where it then settled over much of the Willamette Valley. The dust reduced visibility to distances less than one mile. The sediment-filled winds also felled hundreds of trees causing road closures between Mill City and Detroit. The winds also caused several devastating fires. There were 22 home fires in the Salem area and throughout the Willamette Valley forest fires, as large as 3,000 acres in Linn County, were whipped up by the winds.

The following table specifically describes known tornadoes occurring throughout the area. Tornadoes impacting the Willamette Valley have resulted collectively in over One million of dollars in property damage since 1960.

Table WS-2: History of Tornadoes in the City of Salem and Surrounding Area

Date	Location	Comments
December 4, 2010	Aumsville	An EF2 tornado with wind speeds between 110 and 120 mph touched down in the City of Aumsville. This was the largest tornado recorded in Marion County. The tornado damaged numerous residential and commercial structures, downed power and light poles, and felled trees. Total losses from the storm are estimated at over \$1.1 million.
December 16, 2006	NE Salem	Immediately following a thunderstorm with frequent lightning and small hail, an F0 tornado touched down approximately eight miles northeast of Salem. The 50-yard wide funnel traveled approximately two-miles over rural agricultural land.
October 3, 1998	Silverton	A Silverton Police officer reported seeing a small tornado touch down near Silverton. There were no reports of damage or injury.
November 12, 1997	Silverton	This tornado caused minor damage to timber units.
September 17, 1997	N Aumsville	A small tornado estimated at 10-yards wide and a half-mile long touched down near Aumsville. There were no reports of injuries or property damage.
September 17, 1997	SW Turner	An F0 tornado touched down two miles southwest of Turner resulting in \$10,000 in minor damage to a rural subdivision. The tornado impacted an area 50-yards wide and one mile long.

Date	Location	Comments
May 31, 1997	E Keizer	An F0 tornado touched down approximately one-mile east of Keizer. The 50-yard wide funnel traveled approximately 1.5 miles. The storm uprooted 30-40 foot tall trees and damaged a barn resulting in \$15,000 in repair costs.
October 26, 1984	Aurora	A small F0 tornado reportedly struck six-miles west of Aurora. It had a path length of one-half mile and width of 67 yards and caused minimal property damage. Estimated damage from the storm was \$4,000.
March 8, 2960	Aumsville	A small F1 tornado with of width of seven yards traveled approximately one mile. There were no reports of injuries. The event resulted in \$2,500 in property damage to several farms and uprooted a number of trees.
October 26, 1984	NW Donald	Estimated beginning lat/lon 45°14' 122°53'
November 1, 1925	Salem	Tornado with estimated beginning lat/lon 44°52'/123°11'

December 14, 2010 – Aumsville Tornado

An EF2 tornado with wind speeds between 110 and 120 mph touched down on Main Street near the southerly boundary of the City of Aumsville. This was the largest tornado recorded in Marion County to date and the second largest in the state since 1950. According to a December, 23, 2010 NOAA storm survey report, the tornado traveled in a northeasterly direction and had a path length of approximately five-miles. An on-sight ground assessment concluded that the tornado did not appear to be on the ground for the entire five-mile path length.

The tornado damaged numerous residential and commercial structures, downed power and light poles, uprooted or snapped of over 30 large (average 18-24 inch diameter breast height) trees and resulted in two minor injuries from flying debris. The initial damage assessment conducted by Marion County Emergency Management in collaboration with local and state partners estimate total losses from the storm at over \$1.1 million.⁴ Damage included the total destruction of two homes and one business and major damage to an additional six homes and one business. In all, 63 dwellings, seven business, eight outbuildings and a number of public facilities were impacted by this storm. At the time of this report, response and recovery activities in Aumsville are still underway; final damage reports and the extent of resources made available from local, state and federal sources are pending.

June 2009

A strong wind storm with 80 mph winds, and followed by a thunderstorm, brought down numerous trees along Highway 22 and caused approximately \$2,000 in damage.⁵

March 2008

Heavy winds measured at 40 mph causes \$15,000 in damage near Woodburn.⁶

⁴ December 14, 2010 Aumsville Tornado Initial Damage Assessment Summary Form, Marion County Emergency Management.

⁵ Ibid.

⁶ Ibid.

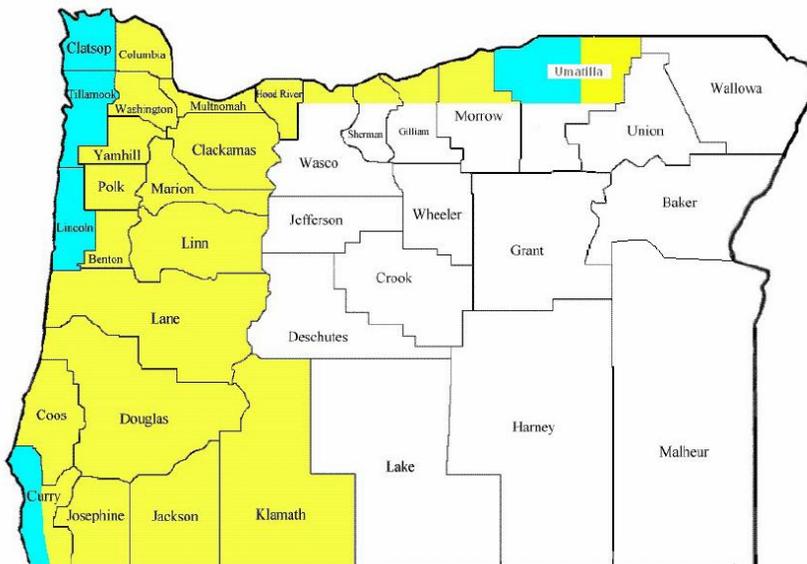
Risk Assessment

How are Hazards Identified?

Windstorms in the City of Salem usually occur from October to March, and their extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain.⁷ They are primarily identified by the National Weather Service. The National Weather Service uses weather forecast models to predict oncoming windstorms, while monitoring storms with weather stations in protected valley locations throughout Oregon.⁸

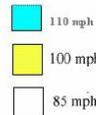
Tree damage associated with windstorms is very place sensitive. For identifying the hazards posed to structures, Figure WS-1 below shows the maximum wind speed that structures 33 ft above the ground would expect to be exposed to.

Figure WS-1 Oregon Building Codes Wind Speed Map



a. All areas with full exposure to the ocean winds shall be designated 110 mph areas.
b. Values are nominal design 3-second gust wind speeds in miles per hour at 33 feet above ground for Exposure C category.

c. Areas in Multnomah and Hood River Counties with full exposure to Columbia River Gorge winds shall be designated 110 mph areas.



Source: State of Oregon Natural Hazards Mitigation Plan. 2012.

Probability of Future Occurrence

The hazard history section details 25 severe windstorms and/or tornadoes affecting the City of Salem and the surrounding area in the last 87 years. While other storms could have been

⁷ State of Oregon Natural Hazards Mitigation Plan. Oregonshowcase.org, March 2006.
http://www.oregonshowcase.org/downloads/pdf/stateplan/OR-SNHMP_wind_chapter_2009.pdf

⁸ "Some of the Area's Windstorms." National Weather Service, Portland.
<http://www.wrh.noaa.gov/pqr/paststorms/wind.php>

included with more background information available, those included average out to one windstorm or tornado every 3.4 years.

The City of Salem steering committee determined that based on this information, the probability of a windstorm occurring is **high**, meaning that the City of Salem will be affected by a windstorm or tornado within a 10-35 year period. This high rating is consistent with the 2008 City of Salem Hazard Analysis.

Vulnerability Assessment

Windstorms can cause power outages, transportation, and economic disruptions. Structures most vulnerable to high winds in the City of Salem include insufficiently-anchored manufactured homes and older buildings with roof structures not designed for anticipated wind loads. Fallen trees and debris are common and can block roads for long periods, in addition to bringing down power and/or utility lines. As noted in the hazard history section above, almost all major wind storms in the City of Salem and surrounding region have caused some damage to property.

The City of Salem steering committee determined that the city's vulnerability to windstorms is **high**, meaning that more than 10% of the population or regional assets would be affected by a windstorm. This rating is consistent with the 2008 City of Salem Hazard Analysis.

Risk Analysis

The City of Salem steering committee determined that the history of windstorm events is **high**, with at least four events occurring over the last 100 years. The maximum threat of a windstorm is also **high**, considering the percentage of population and property that could be impacted under a worst—case scenario.⁹

Windstorms in the past caused multiple minor injuries or a major injury. However, the potential for injuries or deaths from past events or from similar events in other communities could escalate resulting in multiple major injuries or possible death. Salem estimates that less than 10% of the City's population could be physically displaced by a windstorm, accounting for the number of homes that loose power or properties with downed trees; and there would be mild impact on community social networks.¹⁰

Several facilities throughout the City anticipate mild damage due to a windstorm, estimated between \$1 million and \$10 million for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely 10-30% of businesses located in the City and surrounding area could experience commerce interruption for a period of a days. Windstorms have the potential to inflict widespread power outages and until power can be restored, business may experience interruption. Lastly, windstorms would likely have extensive impacts on more than 75% of the City's ecological systems, including, clean water, wildlife habitat, and parks.¹¹

The relative risk of a windstorm is estimated by considering the probability of a event and the severity of the outcome when a windstorm occurs. On a scale of 1 to 25, with 1 being

⁹ City of Salem. NHMP Steering Committee. 2012.

¹⁰ Ibid.

¹¹ Ibid.

the lowest and 25 being the highest relative risk, windstorm hazards in the City of Salem are a score of 14.¹²

Community Hazard Issues

What is susceptible to damage during a hazard event?

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

Negative pressure also affects the sides and roof: passing currents create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact and remove the building protective envelope (doors, windows, and walls), internal pressures rise and result in roof or leeward building component failures and considerable structural damage. The effects of winds are magnified in the upper levels of multi-story structures.¹³ Manufactured homes, multi-story retirement homes, and buildings in need of roof repair are structures that may be most vulnerable to wind storms in the City of Salem. Buildings adjacent to open fields or adjacent to trees are also more vulnerable to wind storms than more protected structures. The effects of wind speed are shown in Table WS-3.

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

¹² Oregon Emergency Management. Hazard Analysis Methodology, Relative Risk. 2009

¹³ Marion County. Natural Hazard Mitigation Plan. 2011.

Table WS-3: Effects of Wind Speed¹⁴

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

Existing Hazard Mitigation Activities

The City of Salem does not have existing hazard mitigation activities pertaining to windstorm hazards.

Windstorm Mitigation Action Items

The following action has been identified by the City of Salem steering committee, and is recommended for mitigating the potential effects of windstorms in the City of Salem. Please see full action item worksheets in Appendix A.

WI #1: Partner with public and private utilities to educate the public about hazardous trees and the damage they can cause in the event of a wind or winter storm.

¹⁴ Washington County, Office of Consolidated Emergency Management. Wind Effects.

Winter Storm Hazard Annex

Causes and Characteristics of Winter Storm

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City of Salem typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.¹

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. The City of Salem is in Zone 2 as seen in Figure WT-1. The climate in Zone 2 generally consists of wet winters and dry summers.²

Figure WT-1: Oregon Climate Zones



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

While snow is relatively rare in western Oregon, the break in the natural Cascades barrier at the Columbia Gorge provides a low-level passage through the mountains. Cold air, which lies east of the Cascades, often moves westward through the Gorge, and funnels cold air into the Portland area, and can sink southward into the Willamette Valley. If a wet Pacific storm happens to reach the area at the same time that the cold air is present, larger than average snow events may result.³

Ice storms occasionally occur in northern areas of Oregon, resulting from cold air flowing westward through the Columbia Gorge. Like snow, ice storms are comprised of cold temperatures and moisture, but subtle changes can result in varying types of ice formation, including freezing rain, sleet, and hail. Freezing rain can be the most damaging of ice

¹ Interagency Hazard Mitigation Team. 2000. State Hazard Mitigation Plan. Salem, OR: Oregon State Police – Office of Emergency Management

² National Weather Service, Portland Bureau. March 2001. <http://www.wrh.noaa.gov/Portland/snowstorm.html>.

³ National Weather Service, Portland Office. www.wrh.noaa.gov/Portland/snowstorm.html.

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, but also pose a hazard to the City of Salem.⁴

History of Winter Storms in the City of Salem

Destructive storms, producing heavy snow and ice, have occurred throughout northwestern Oregon's history. The most significant storms which have affected the City of Salem are listed below.

Table WT-1: History of Winter Storms in the City of Salem and Surrounding Area

Date	Comments
December, 2008	A prolonged snowstorm hit the region during the 2008-2009 winter season.. During this time, Salem received over a foot of snow and the Portland airport received a record 18.9 inches. A disaster declaration was made on March 2, 2009 for this winter storm, and its associated landslides and mudslides.
January-February, 2008	Idanha and Detroit, two towns east of Salem, were buried by 12 feet of snow throughout the winter storms of January-February 2008 .
December, 2003- January, 2004	The storm resulted from the collision of a mass of moisture from the Pacific with an arctic cold front. Climatologists considered this the worst storm to pelt the west side of Oregon's Cascade Range since 1992. Salem received three inches of snow and freezing rain. The hardest hit included areas in east Multnomah County, Oregon City, Estacada, Molalla and Mulino, and the Salem area. This was a typical storm for the Cascade region, but relatively rare on the valley floor where impacts were severe.
February, 1996	Similar to the 1978 event, this storm began with a mass of cold air trapped in western Oregon followed by a warmer front that blew over the top of the cold air mass. Once the two fronts collided, they created a severe ice storm. Traffic accidents and power outages plagued the Willamette Valley. Freezing rain fell for two days, causing a 100-car pileup between Clackamas County and Salem, and a 22-car pile-up on Highway 22 near Eola.
February, 1993	This storm event dropped nearly twelve inches of snow in Salem between February 18th and 19th; the greatest amount of snowfall ever recorded in a 24-hour period in Salem. As a result of the storm 2,100 Silverton area residents and 1,500 residents on Highway 99E north of Salem lost power. There were also several minor, storm-related injuries reported by Salem hospitals.

⁴ Taylor, George H. and Chris Hannan. The Oregon Weather Book. Corvallis, OR: Oregon State University Press. 1999

Date	Comments
February, 1989	The February 1989 storm dropped seven inches of snow on Marion County region and saw temperatures as low as zero degrees Fahrenheit with a wind-chill factor dipping to 75 degrees below zero. The storm led to accidents on Interstate 5 that closed the highway between Salem and Albany. There was also a storm related, four-vehicle accident on Highway 22 near Silverton. Hospitals in Salem reported 25 snow related injuries. In Salem, the adverse weather cost \$40,000 to keep streets open, \$10,000 more than the city budgeted for the storm. In addition, the extreme cold damaged 20 to 40 percent of the county's cranberry crop.
January, 1978	During the early days of January 1978, a layer of cold air was driven into the Willamette Valley from Eastern Oregon via the Columbia Gorge. Rain from a higher warm air mass fell through the cold air below causing it to freeze. The cold temperatures and freezing rain iced roads throughout Marion County and the Willamette Valley causing eight traffic fatalities and dozens of traffic accidents.
January, 1963	Four inches of snow were recorded at McNary Field in Salem, Detroit recorded thirteen inches and Stayton reported that slush had frozen on area roadways.
March, 1960	Salem received 8.5 inches of snow and higher elevations received as much as 11 inches. This storm was responsible for two fatalities in Oregon, and 100 storm-related accidents across Marion County. In addition, most schools throughout the county were closed for several days.
January, 1957	The cold weather in January 1957 was the result of an arctic air mass that moved into Eastern Oregon and spread west toward the coast. The cold temperatures brought multiple inches of snow to the Willamette Valley, and temperatures were in the mid-teens. Electricity was interrupted to many Salem residents and numerous house fires broke out. The cold temperatures also caused the Bonneville Power Authority to cut interruptible power to the regions' industrial customers because ice behind the dam slowed water flow and limited the ability to generate power.
January, 1950	The entire month of January 1950 was cold and frequent snowstorms occurred statewide, including snowfall , precipitation and freezing rain. During this time, Marion County experienced wind gusts up to 80 mph and sustained winds up to 25 mph. Thirty-nine inches of snow fell on Salem over the course of the month, 54 inches fell in Detroit and 122 inches blanketed Detroit Dam. In Salem, Mill Creek flooded onto airport roads.
January, 1937	The winter storms of January 1937 broke an eighteen year record for snowfall in Salem with 27 inches and caused \$50,000 in property damage. In addition to property damage, many major roads were closed and residents of Detroit and Mill City were stranded for five days as heavy snow and a landslide blocked a connecting highway
December, 1924	Temperatures stayed near or below the freezing mark for eleven days. Most streams and rivers were frozen and blocked with ice, including the Willamette River. In addition to the cold weather, four inches of snow fell over much of the Willamette Valley.
December, 1919	The December 1919 snowstorm was recorded as the third heaviest snowfall-producing storm in Oregon. The Columbia River froze over, closing the river to navigation from the confluence with the Willamette River upstream. The snowstorm affected nearly every part of the state, with heavy snow falling over a widespread area
January, 1916	This winter storm affected the entire state, with heavy snow accumulation in the Cascades. Every reporting station in western Oregon, except for the southwestern interior and the coastal areas, recorded storm totals of at least five inches and most locations had eight inches or more.

December 2008

A prolonged snowstorm hit the region during the 2008-2009 winter season, with its worst effects felt from December 20-26, 2008. During this time, Salem received over a foot of snow. Lafayette, near the border of Marion County received almost two feet of snow, while Portland airport received a record 18.9 inches.⁵ A disaster for this snowstorm, and its

⁵ "Some of Area's Snowstorms." National Weather Service, Portland Office.
<http://www.wrh.noaa.gov/pqr/paststorms/snow.php>

associated landslides and mudslides, was declared on March 2, 2009.⁶ A total number of ten Oregon counties were included in this disaster declaration, including Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties.⁷

January-February 2008

Over several weeks in early 2008, the foothills of the Cascades received unusually high amounts of snow from a series of storms. While towns east of Salem including, Idanha and Detroit commonly receive heavy snowfall each winter, they were both buried by 12 feet of snow over these two months.⁸ Several local agencies from Marion and Linn Counties and the City of Salem were sent to assist these communities. Three dozen National Guard soldiers, along with snow removal equipment, inmate crews, and engineers, were sent by the State into the towns to remove snow and help those in need.⁹

Risk Assessment

How are Hazards Identified?

All of the City of Salem is vulnerable to winter storms and impacts typically extend region-wide. The magnitude or severity of severe winter storms is determined by a number of meteorological factors including the amount and extent of snow or ice, air temperature, wind speed, and event duration.

Precipitation, an additional element of severe winter storms, is measured by gauging stations. The National Weather Service, Portland Bureau, monitors the stations and provides public warnings on storm, snow, and ice events as appropriate.

Probability of Future Occurrence

The City of Salem and the broader region has experienced 15 severe winter storms in the last 100 years, in the form of snow, ice or severe cold. This averages out to one severe winter storm every 7 years. The City of Salem steering committee determined that the city's probability of a severe winter storm is **high**, meaning that the City of Salem will likely experience one winter storm within a 10-35 year period. This high probability ranking is consistent with the 2008 City of Salem Hazard Analysis.

Vulnerability Assessment

Severe winter storms can cause power outages and transportation and economic disruptions, and pose a high risk for injuries and loss of life. The events can also be typified by a need to shelter and care for adversely impacted individuals. The City of Salem has suffered severe winter storms in the past that brought economic hardship and affected the life and safety of residents. Future severe winter storms may cause similar impacts countywide.

⁶ FEMA. Winter Storm Disaster Declaration. <http://www.fema.gov/disaster/1824>

⁷ FEMA. "FEMA Expands Incident Period for December Snow Storm". April 2, 2009. <http://www.fema.gov/news/newsrelease.fema?id=47876>

⁸ "Region 3: Mid/Southern Willamette Valley Regional Profile. January 2009.

⁹ "Oregon National Guard Aids Detroit an Idanha Communities." February 5, 2008. http://salem-news.com/articles/february052008/guard_detroit_2-5-08.php

The City of Salem steering committee determined that the city's vulnerability to a severe winter storm is **high**, meaning more than 10% of the population or regional assets would be impacted by a severe winter storm. This high rating is consistent with the 2008 City of Salem Hazard Analysis.

Risk Analysis

The City of Salem steering committee determined that the history of winter storm events is **high**, with at least four events occurring over the last 100 years. The maximum threat of a winter storm is also **high**, considering the percentage of population and property that could be impacted under a worst—case scenario.¹⁰

Winter storms in the past caused multiple major injuries or death. The potential for future injuries or deaths is anticipated to remain similar to historic events. Salem estimates that less than 10% of the City's population could be physically displaced by a winter storm, accounting for families that may not have access to warm shelter; and there would be moderate impact on community social networks due to poor driving conditions.¹¹

Several facilities throughout the City anticipate mild damage due to winter storms, estimated at less than \$1 million for hazard response, structural repairs and equipment replacement. In terms of commercial business, it is likely that more than 75% of businesses located in the City and surrounding area could experience commerce interruption for a period of days until driving conditions improve. Winter storms will likely have the greatest impacts on the transportation system, as snow and ice can cause dangerous driving conditions. Lastly, winter storms could likely have extensive impacts on more than 75% of the City's ecological systems, including, clean water, wildlife habitat, and parks.¹²

The relative risk of a winter storm is estimated by considering the probability of a winter storm and the severity of the outcome when an event occurs. On a scale of 1 to 25, with 1 being the lowest and 25 being the highest relative risk, winter storm hazards in the City of Salem are a score of 16.¹³

Community Hazard Issues

What is susceptible to damage during a hazard event?

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

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

¹⁰ City of Salem. NHMP Steering Committee. 2012.

¹¹ Ibid.

¹² Ibid.

¹³ Oregon Emergency Management. Hazard Analysis Methodology, Relative Risk. 2009

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, and industry and individual homes. All of these effects if lasting more than several days can create significant economic impacts for the communities affected as well for the surrounding region, and even outside of Oregon. In the rural areas of Oregon severe winter storms can isolate small communities, farms and ranches and create serious problems for open range cattle operations such as those in southeastern Oregon.

Winter storms can have significant impacts to the local economy. Early and late season extreme cold can damage agricultural crops, while snow and ice can block access for the distribution of crops and provision of agricultural services. Also, a lack of access to employment centers, like correctional facilities, the state mental hospital, Willamette University, and the Central Businesses District in downtown Salem, can have detrimental economic impacts.

Existing Hazard Mitigation Activities

Street Maintenance

The City of Salem Parks and Transportation Services division is responsible for performing precautionary measures to maintain the safety and operability of roads during winter storm conditions. The Street Maintenance program is recognized as one of the most effective in the region, it is designed to provide the best use of limited resources to maximize the movement of traffic within the community during winter weather. During storm events, they focus on clearing major arterial and collector streets first, and then responds to residential connector streets, school zones, transit routes, and steep residential streets as resources become available. The City of Salem also has Exchange-of-Service agreements with Marion County, Polk County, and the Salem Maintenance Section of ODOT that allow the city to swap portions of routes adjoining areas already served by other agencies.¹⁴

Winter Storm Mitigation Action Items

The following action has been identified by the City of Salem steering committee, and is recommended for mitigating the potential effects of winter storms in the City of Salem. Please see full action item worksheets in Appendix A.

WS #1: Partner with public and private utilities to educate the public about hazardous trees and the damage they can cause in the event of a wind or winter storm.

¹⁴ City of Salem. Parks and Transportation Services Division, Street Maintenance Section. Accessed May 3, 2012.

Appendix A: Action Item Forms

Plan Implementation Action #1

Proposed Action Item:		Alignment with Plan Goals:	
Request FEMA approval of the Salem Natural Hazards Mitigation Plan Update.		<i>Increase cooperation and coordination among stakeholders.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> FEMA approval of the Salem Natural Hazards Mitigation Plan update is required to maintain eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and Flood Mitigation Assistance program funds The Disaster Mitigation Act of 2000 requires plans to include an action item that ensures the coordination of all relevant jurisdictions to request FEMA approval of the plan update [§201.6(c)(3)(iv)]. The Mitigation Plan should be coordinated with, and ideally developed in cooperation with, all of the local jurisdictions within the geographical area. [FMA FEMA 299 Guidance] 			
Ideas for Implementation:			
Plan Approval Process:			
<ol style="list-style-type: none"> 1. After updates have been completed and incorporated into the plan, the plan will be approved by the Salem Natural Hazards Mitigation Committee. 2. The plan will be submitted to the State Hazard Mitigation Officer at Oregon Emergency Management for their approval. 3. Oregon Emergency Management will submit the plan to the Federal Emergency Management Agency (FEMA--Region X) for review and approval. 4. Upon acceptance by FEMA, the City of Salem's City Council will adopt the plan via resolution. 			
Lead Agency:	City of Salem Emergency Management		
Internal Partners:		External Partners:	
Salem Natural Hazards Mitigation Committee		Salem City Council, Oregon Office of Emergency Management, FEMA Region X	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
Short Term			
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Plan Implementation Action #2

Proposed Action Item:		Alignment with Plan Goals:	
Salem Emergency Management will take on the role of convener to coordinate hazard mitigation meetings and implementation of mitigation action items.		<i>Increase cooperation and coordination among stakeholders.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The convener identified in the 2003 Hazard Mitigation Plan is the Community Development Department, which focused on the creation of the Hazard Mitigation Plan. Review of past meetings regarding the Salem Natural Hazards Mitigation Plan and discussions with staff indicate that Salem Emergency Management would be a more appropriate convener. The convener's role would be to implement and maintain the plan together with the coordinating body identified in the mitigation plan. 			
Ideas for Implementation:			
The roles and responsibilities of the convener include the following:			
<ol style="list-style-type: none"> 1. Coordinate Salem Natural Hazards Mitigation Committee meeting dates, times, locations, agendas, and member notification; 2. Document outcomes of Committee meetings; 3. Serve as a communication conduit between the Committee and key plan stakeholders; 4. Identify emergency management-related funding sources for natural hazard mitigation projects; 5. Incorporate, maintain, and update the City's natural hazard risk GIS data elements; and 6. Utilize the Risk Assessment as a tool for prioritizing proposed natural hazard risk reduction projects. 			
Contact: Roger Stevenson, Emergency Manager City of Salem Emergency Management 595 Cottage St NE Salem, OR 97301			
Lead Agency:	City of Salem Emergency Management		
Internal Partners:		External Partners:	
Salem Natural Hazards Mitigation Committee		FEMA Region X, Oregon Office of Emergency Management (OEM)	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Ongoing		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Plan Implementation Action #3

Proposed Action Item:		Alignment with Plan Goals:	
The Salem Natural Hazards Mitigation Committee will be the coordinating body responsible for implementing the Salem Natural Hazards Mitigation Plan.		<i>Increase cooperation and coordination among stakeholders.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The Salem Natural Hazards Mitigation Committee identified itself, with the inclusion of other members, to be the main body to implement the Salem Natural Hazards Mitigation Plan. The Disaster Mitigation Act of 2000 requires Mitigation Plans to include a maintenance section describing the method and schedule of monitoring, evaluating, and updating the Mitigation Plan within a five-year cycle [201.6(c)(4)(i)]. A key component to effective maintenance is to have a coordinating body responsible for both the maintenance and implementation of the plan to ensure that it remains relevant to Salem’s needs. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Convene the Salem Natural Hazards Mitigation Committee on a semi-annual basis to discuss Plan action items and methods for their implementation. After natural hazard events occur, convene the coordinating body to discuss action items for implementation or strategies for amending the plan to incorporate new action items. 			
Lead Agency:		City of Salem Emergency Management	
Internal Partners:		External Partners:	
Salem Natural Hazards Mitigation Committee		Oregon Office of Emergency Management	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Ongoing		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Plan Implementation Action #4

Proposed Action Item:		Alignment with Plan Goals:	
The Salem Natural Hazards Steering Committee will review the Hazard Mitigation Crosswalk to identify hazard mitigation policy changes for the City of Salem throughout existing plans.		<i>Increase cooperation and coordination among stakeholders.</i> <i>Protect existing and future development.</i> <i>Protect the natural environment.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The Hazard Mitigation Crosswalk identifies inconsistencies and variations of hazard mitigation policies across existing plans. The crosswalk is a tool that will enable to City of Salem to begin advocating for policy change in terms of aligning other community planning mechanisms with hazard mitigation. Each existing plan shall address applicable hazards, i.e. The Transportation Systems Plan may make reference to landslide hazards that impact transportation connectivity. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Draft hazard policy examples for planning committees. Target policy change for plans when they are scheduled for review or update. Propose changes to board. 			
Lead Agency:		City of Salem Emergency Management	
Internal Partners:		External Partners:	
Salem Natural Hazards Mitigation Committee			
Timeline:		If available, estimated cost:	
Short Term (0-2 years)	Long Term (2-4 or more years)		
	Ongoing		
Form Submitted by:		Salem Natural Hazards Mitigation Committee	
Action Item Status: Action item review and development is in progress			

Multi-Hazard Action # 1

Proposed Action Item:		Alignment with Plan Goals:	
Coordinate with the Capital Projects Advisory Board to integrate natural hazard mitigation into State and City respective capital improvements.		<i>Increase cooperation and coordination among stakeholders. Protect existing and future development.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The Capital Projects Advisory Board is identified as the main body to implement the State of Oregon capital improvement projects within the greater Salem area. A similar responsibility rests with the Salem Public Works Department in the development and implementation of the City's Capital Improvements Program (CIP). It is important that natural hazard mitigation be integrated into both the State's and Salem's Capital Improvement Program so that critical public facilities, including government buildings, are constructed to function during and after natural disasters. Local units of government want to ensure continuous service by strengthening essential facilities. Ensuring continuous service will assist residents in recovering from a natural disaster as well as make the process easier. The Disaster Mitigation Act of 2000 requires communities to maintain the Hazard Mitigation Plan by having local governments incorporate the requirements of the mitigation plan into other planning mechanisms [201.6(c)(4)(ii)]. Coordinating mitigation activities with other planning activities will help local governments incorporate mitigation into other plans and policies currently being developed. Coordination will also reduce duplication of planning efforts, strengthening the overall mitigation planning process. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Determine what roles the Capital Projects Board plays in mitigating natural hazards, especially for State of Oregon properties or others in Salem for which it has jurisdiction. Review action items and discuss which ones can be integrated into Capital Improvement Program for the City of Salem. Inventory critical facilities that may be potentially vulnerable to a natural disaster and present these to the Capital Projects Advisory Board for their review. Include members of the Capital Projects Advisory Board in the Natural Hazard Mitigation Committee meetings as needed. Realign or replace roads and utilities when feasible in the course of regularly scheduled replacement to reduce the impact of natural hazard events on new development. Explore the possibility of under grounding utilities that are vulnerable to windstorms and winter storms. 			
Lead Agency:	Salem Community Development Department		
Internal Partners:		External Partners:	
Natural Hazard Mitigation Committee		FEMA, OEM, Capital Projects Advisory Board	
Timeline:		If available, estimated cost:	
Short Term (0-2 years)	Long Term (2-4 or more years)		
	Ongoing		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Multi-Hazard Action # 2

Proposed Action Item:		Alignment with Plan Goals:	
Develop an inventory of the number and type of critical facilities within the community that are at reasonable risk for each hazard type.		<i>Protect existing and future development.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> Many older commercial buildings in the City of Salem are vulnerable to damage in the event of a natural disaster. This could have significant impacts on the City of Salem's economy. Identifying and retrofitting buildings that are susceptible to a natural disaster will reduce the vulnerability of the buildings in the event of a natural disaster and improve the resiliency of Salem's local economy. OEM's checklist for local mitigation plans includes the need to estimate the type and number of structures within the community at risk for each hazard type, including residences, businesses, critical facilities (hospitals, fire stations, and storage sites for hazardous materials), and infrastructure (e.g., roads and utilities). There also needs to be a map of repetitive flood loss properties (extent of flooding, no evaluation of cost of property damage) and discussion of potential mitigation activities for these properties. The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)]. Inventorying important historic and cultural resources and identifying their vulnerability to natural hazards will help to develop mitigation actions that reduce the City of Salem's overall vulnerability to natural hazards. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Determine vulnerabilities of community structures to natural hazards Identify appropriate mitigation measures to help preserve structures within the community that are at risk for each hazard type. Create an electronic data base which illustrates an inventory of the number and type of structures within the community that are at risk for each hazard type. Identify significant cultural and historic resources, whether on the national register or not, that are worthy of additional protection. 			
Lead Agency:	Public Works		
Internal Partners:		External Partners:	
Salem Natural Hazards Mitigation Committee, GIS, IT		FEMA	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
Short Term			
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Multi-Hazard Action # 3

Proposed Action Item:		Alignment with Plan Goals:	
Develop public outreach materials for all natural hazard risks addressed in the Salem Natural Hazards Mitigation Plan. Materials should include mitigation actions residents and businesses can implement to reduce their risk to natural hazards, and where they can obtain more detailed natural hazard information.		<p><i>Increase cooperation and coordination among stakeholders.</i></p> <p><i>Reduce economic loss.</i></p> <p><i>Protect existing and future development.</i></p>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> • Conducting public outreach campaigns raises awareness about natural hazards and helps illustrate what residents and businesses can do to reduce the impact of a natural disaster on their properties, thereby significantly reducing the impact of a natural disaster on the City of Salem. • Several natural hazards, such as severe weather, earthquakes, and floods, have the potential for disrupting transportation services and isolating rural residents from basic services and needs. The City of Salem has a large number of residents, and they need to be educated about the dangers that natural hazards pose and what actions they can take to mitigate the impact hazards on the community. • The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions and projects that reduce the effects of a hazard on the community [201.6(c)(3)(ii)]. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> • Conduct public outreach campaigns, such as articles in the newspaper or through brochures instructing residents and businesses about the risks natural hazards pose and mitigation actions they can implement. • Coordinate with other groups conducting other emergency management activities to assist in conducting public outreach campaigns, developing emergency kits, and educating residents and businesses about other mitigation activities • Develop handouts that inform residents and businesses about natural hazard risk, appropriate mitigation actions that can be implemented, and where citizens can obtain further information. • Create an online informational website where residents and businesses can be educated about appropriate mitigation actions residents and businesses can implement to reduce the impact of natural hazards • Work with local real estate trade associations to prepare informational handouts advising property owners of natural hazard risks in their area and measures they can implement to reduce their risk of exposure. 			
Lead Agency:	Salem Emergency Management		
Internal Partners:		External Partners:	
Salem Community Development Department, Public Works		FEMA, Oregon State Police, Oregon Office of Emergency Management	
Timeline:		If available, estimated cost:	
Short Term (0-2 years)	Long Term (2-4 or more years)		
	Ongoing		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Multi-Hazard Action # 4

Proposed Action Item:		Alignment with Plan Goals:	
Include a post-disaster recovery and mitigation annex/appendix in the Salem Emergency Operations Plan that encourages property owners to incorporate retrofitting and mitigation measures in recovery efforts.		<p><i>Protect existing and future development.</i></p> <p><i>Increase cooperation and coordination among stakeholders.</i></p>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> Disaster response is an important component to natural hazards planning that can save lives and property during a natural disaster. Coordinating disaster response efforts with the mitigation plan will ensure that the plan remains relevant to the larger community. Resources that may not be available on a routine basis for certain improvements may become available through various disaster relief sources, particularly where careful planning has allowed the community to identify certain needs in advance, saving critical time in the aftermath of a disaster. The Disaster Mitigation Act of 2000 requires communities to develop actions that reduce the impact of a natural hazard [201.6(c)(3)(ii)]. Incorporating information about mitigation and retrofitting will increase the City of Salem’s ability to recover from a natural disaster. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Seek guidance from FEMA and the Oregon Office of Emergency Management on how to incorporate recovery and mitigation measures into the Salem Emergency Operations Plan. Periodically update the recovery and mitigation measures that have been incorporated into the Salem Emergency Operations Plan 			
Lead Agency:	Salem Emergency Management		
Internal Partners:		External Partners:	
Salem Natural Hazards Mitigation Committee		FEMA, Oregon State Police, Oregon Office of Emergency Management	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)	Minimal.	
Short term			
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Multi-Hazard Action # 5

Proposed Action Item:		Alignment with Plan Goals:	
Ensure UDC updates consider specific hazards when updating the Salem code for mitigating the location of future development in identified/mapped high hazard areas.		<p><i>Protect existing and future development.</i></p> <p><i>Protect the natural environment.</i></p>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> • Goal 7 of Oregon's Land Use Planning Goals requires that local governments "adopt or amend, as necessary, based on the evaluation of risk, plan policies and implementing measures...[that prohibit] the siting of essential facilities, major structures, hazardous facilities and special occupancy structures, as defined in the state building code (ORS 455.447(1) (a)(b)(c) and (e)), in identified hazard areas..." • The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community [201.6(c)(3)(ii)]. Adjusting the Salem code to move future development from identified/mapped hazards areas will reduce the vulnerability of new development to natural hazards. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> • Consider transferring development rights from high hazard areas to safer areas, especially in those areas where the risk to people and property cannot be mitigated. • Address high hazard areas and consider measures for mitigating the location of future development in these areas during the update of the Salem code. 			
Lead Agency:	Salem Community Development Department		
Internal Partners:		External Partners:	
Salem Natural Hazards Mitigation Committee		DLCD, FEMA	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Ongoing		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Multi-Hazard Action # 6

Proposed Action Item:		Alignment with Plan Goals:	
Strengthen or replace unsafe public structures (especially facilities critical to disaster and post-disaster planning/response).		<i>Protect lives. Protect existing and future development.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The Disaster Mitigation Act of 2000 requires communities to assess their vulnerability to natural hazards, particularly by identifying the types and number of buildings, infrastructure, and critical facilities that could be affected. It is important that critical facilities function during and after disasters. Strengthening all essential facilities will improve recovery capacity and reduce risk and loss of life. Retrofitting of vital infrastructure, such as schools and community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Develop formal agreements with internal and external partners who could assist the partners in collaborating and sharing the responsibility of natural hazard mitigation. Such actions to form collaborative partnerships and commitments to mitigation can assist the City in reducing its risk to the natural hazards addressed by the Natural Hazards Mitigation Plan. Conduct structural and non-structural retrofits of critical facilities to reduce the impacts of a natural hazard. Conduct a cost-benefit analysis to assess whether the cost of mitigation improvements to critical facilities balance with the benefits to be gained. Create proposals to reinforce buildings so they can withstand an earthquake and thereby reduce vulnerability risks; ORS 455.447 regulates vulnerable building retrofits. 			
Lead Agency:	Salem Public Works Department		
Internal Partners:		External Partners:	
Salem Public Works, Fire Department, Police Department, Community Development, Urban Development, Administrative Services		FEMA, ODOT	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Long Term		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status: The seismic retrofit of fire stations is complete			

Multi-Hazard Action # 7

Proposed Action Item:		Alignment with Plan Goals:	
Continue developing alert and warning systems to notify residents of incidents involving natural hazards and hazardous materials.		<i>Protect Lives.</i> <i>Increase cooperation and coordination among stakeholders.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> Alert and warning systems can provide a life-saving service to residents in the event of a natural or manmade disaster. Natural and manmade disasters can occur at any time, often unannounced, putting people at risk. Developing alert and warning systems can reduce the risk of exposure to natural hazard incidents and hazardous materials spills and help to save lives and property. Alert and warning system have significant relevance to hazardous materials accidents. Hazardous materials are located near businesses and residences in Salem as well as along major transportation routes. Trucking routes along the I-5 corridor and Highway 22 may also contain hazardous materials because there are no restrictions on the type of cargo that travels over these routes which run through residential and commercial areas in the city. In addition, the heavily-traveled railroad line near the Capital area has approximately 12,000 cars of hazardous materials running through the area each year. Accidents in businesses or on any of the above routes can have an adverse impact on the quality of life and economy of the city and the state; significant events have already occurred in Salem in 1976 and along the I-5 corridor. Alert and warning systems can help to prevent larger accidents from occurring and help to save lives and property. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Continue to enforce the Salem Fire Prevention Code to regulate hazardous materials. Develop strategies in local building codes and zoning ordinances to reduce the impact of natural hazard and manmade hazard events on buildings and infrastructure. Continue to develop a reverse 9-11 system to alert nearby residents and businesses of natural hazard events or hazardous materials accident. Develop improved maps to locate areas vulnerable to natural hazard events and hazardous materials. 			
Lead Agency:	Emergency Management		
Internal Partners:		External Partners:	
Public Works, Police Department, GIS and Mapping Departments		ODOT, FEMA, OSHA	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Long Term		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Drought Action #1

Proposed Action Item:		Alignment with Plan Goals:
Rationale for Proposed Action Item:		
Ideas for Implementation:		
Lead Agency:		
Internal Partners:		External Partners:
Timeline:		If available, estimated cost:
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)	
Form Submitted by:		
Action Item Status: Action item review and development is in progress.		

Earthquake Action #1

Proposed Action Item:		Alignment with Plan Goals:	
Develop an inventory of un-reinforced masonry structures and develop appropriate mitigation action items to reduce the impacts of seismic events.		<p><i>Protect lives.</i></p> <p><i>Protect existing and future development.</i></p>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The City of Salem has numerous un-reinforced masonry structures in their downtown. Un-reinforced masonry structures are particularly susceptible to earthquakes, and if damaged, can disrupt businesses located in historic downtown buildings. Inventorying un-reinforced masonry structures and developing action items to address these buildings will help reduce the vulnerability to seismic events. The Salem Natural Hazards Mitigation Committee identified seismic events as having a high probability of recurrence and a high vulnerability in the City of Salem. Addressing the most vulnerable buildings first, those made of un-reinforced masonry, will reduce the city's vulnerability to seismic events. The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)]. Inventorying un-reinforced masonry structures will identify the major issues surrounding these buildings and what appropriate mitigation measures should be used to address these issues. In addition, protecting existing buildings and infrastructure will help reduce the negative impact of a seismic event on the community. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Identify critical facilities constructed of un-reinforced masonry and develop appropriate mitigation action items or consider relocating the facility to a new building. Seek funding to develop programs to retrofit un-reinforced masonry buildings and provide outreach on seismic hazards. 			
Lead Agency:	Salem Community Development Department		
Internal Partners:		External Partners:	
Salem Urban Development, Public Works, Fire		FEMA, DOGAMI	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Long Term		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Earthquake Action #2

Proposed Action Item:		Alignment with Plan Goals:
Identify and inventory critical facilities that require seismic retrofit.		<i>Protect existing and future development.</i> <i>Increase cooperation and coordination among stakeholders.</i>
Rationale for Proposed Action Item:		
<ul style="list-style-type: none"> The Salem Natural Hazards Mitigation Committee noted that certain critical facilities have a high vulnerability for seismic events. Seismically retrofitting these facilities will significantly reduce their vulnerability in the event of an earthquake. Oregon Senate Bill 3 (2005) enables the Oregon Office of Emergency Management to develop a grant program to seismically rehabilitate critical public facilities. While the grant program is still being developed, conducting an inventory of critical facilities early will assist communities in obtaining funding once the grant program is in place. The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions that protect new and existing buildings [201.6(c)(3)(ii)]. Seismically retrofitting existing critical facilities, including reservoirs and pump stations, will help Salem reduce their vulnerability to seismic events. The Department of Geology and Mineral Industries (DOGAMI) Statewide Seismic Needs Assessment completed in 2007 of educational and emergency service facilities in the state of Oregon identified 48 school structures with a high or very high likelihood of collapse in the event of a major earthquake. In addition, five police structures had a high likelihood of collapse in the event of an earthquake. These facilities should be retrofitted accordingly to reduce the likelihood of collapse should an earthquake occur. 		
Ideas for Implementation:		
<ul style="list-style-type: none"> Use DOGAMI's Seismic Needs Assessment of buildings in Salem to identify and prioritize buildings vulnerable to seismic events. Seek additional information from DOGAMI, if vulnerable reservoirs and pump stations are not included in the Seismic Needs Assessment. Coordinate with OEM and FEMA to determine funding for conducting seismic retrofit of buildings. 		
Lead Agency:	City of Salem Emergency Management	
Internal Partners:		External Partners:
Salem Natural Hazards Mitigation Committee, Salem Community Development Department, Salem Public Works		FEMA, OEM, DOGAMI, Local School Districts
Timeline:		If available, estimated cost:
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)	Potentially very expensive, but costs can be offset by grant programs.
	Ongoing	
Form Submitted by:	Salem Natural Hazards Mitigation Committee	
Action Item Status: The retrofit of three fire structures has been completed.		

Earthquake Action #3

Proposed Action Item:		Alignment with Plan Goals:
Partner with the school districts to help identify and prioritize seismic retrofits to school district facilities.		<i>Protect lives. Protect existing and future development.</i>
Rationale for Proposed Action Item:		
<ul style="list-style-type: none"> • Due to the high concentration of students and the relative vulnerability of that population, schools have large negative impacts from seismic events. Seismically retrofitting these facilities will significantly reduce their vulnerability in the event of an earthquake. • Oregon Senate Bill 3 (2005) enables the Oregon Office of Emergency Management to develop a grant program to seismically rehabilitate critical public facilities. While the grant program is still being developed, conducting an inventory of critical facilities early will assist communities in obtaining funding once the grant program is in place. • The Department of Geology and Mineral Industries (DOGAMI) Statewide Seismic Needs Assessment completed in 2007 of educational facilities in the state of Oregon identified 48 school structures with a high or very high likelihood of collapse in the event of a major earthquake. These facilities should be retrofitted accordingly to reduce the likelihood of collapse in the event of an earthquake. • The Disaster Mitigation Act of 2000 requires communities to identify comprehensive actions that protect new and existing buildings [201.6(c)(3)(ii)]. Seismically retrofitting existing critical facilities, including reservoirs and pump stations and especially schools, will help Salem reduce their vulnerability to seismic events. 		
Ideas for Implementation:		
<ul style="list-style-type: none"> • Use DOGAMI's Seismic Needs Assessment of Salem school facilities to identify and prioritize school district facilities that are vulnerable to seismic events. • Educate school district officials about the effectiveness of natural hazard mitigation actions. • Coordinate with OEM and FEMA to seek funding for conducting seismic retrofit of buildings. • Engage the members of the school district with the Salem Natural Hazards Mitigation Committee. 		
Lead Agency:	City of Salem Emergency Management	
Internal Partners:		External Partners:
Salem Natural Hazards Mitigation Committee, Salem Community Development Department,		FEMA, OEM, DOGAMI, Salem-Keizer School District, private schools, Chemeketa C.C., Willamette University, Corban University
Timeline:		If available, estimated cost:
Short Term (0-2 years)	Long Term (2-4 or more years)	Potentially very expensive, but costs can be offset by grant programs.
	Long Term	
Form Submitted by:	Salem Natural Hazards Mitigation Committee	
Action Item Status: Salem has identified the schools that need retrofit, but no prioritization has taken place.		

Extreme Heat Action #1

Proposed Action Item:		Alignment with Plan Goals:	
Rationale for Proposed Action Item:			
Ideas for Implementation:			
Lead Agency:			
Internal Partners:		External Partners:	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
Form Submitted by:			
Action Item Status: Action item review and development is in progress.			

Flood Action #1

Proposed Action Item:		Alignment with Plan Goals:	
Adopt a floodplain management plan in accordance with FEMA's Community Rating System guidelines.		<i>Increase cooperation and coordination among stakeholders. Protect the natural environment.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> Floodplain management for Salem is unique and warrants a separate public process to identify specific action items. Factors include involvement in the Community Rating System, Endangered Species Act and compliance with existing adopted plans. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Continue 10-step process identified by FEMA. The City's Public Works department has started the process and anticipates a final Floodplain Management Plan to be presented to City Council by the end of 2012. 			
Lead Agency:	Salem Public Works Department		
Internal Partners:		External Partners:	
City of Salem Emergency Management, Salem Fire, Salem Operations and Engineering		FEMA, National Flood Insurance Program, Floodplain Management Committee	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
Short Term			
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Flood Action #2

Proposed Action Item:		Alignment with Plan Goals:	
Improve the City of Salem’s National Flood Insurance Program (NFIP) Community Rating System (CRS) to reduce NFIP premiums.		<i>Increase cooperation and coordination among stakeholders. Reduce economic loss.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. As a result, insurance premiums under the NFIP are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance. The City of Salem has entered the CRS program with a rating of eight. Implementing action items to improve the CRS rating will significantly reduce NFIP premiums on structures located within the floodplain. The Disaster Mitigation Act of 2000 requires communities to identify mitigation actions that address existing buildings and infrastructure [201.6(c)(3)(ii)]. Maintaining the status of the Community Rating System program can help the community to enhance mitigation efforts and decrease the vulnerability to floods. In addition, the Flood Mitigation Assistance Program requires that communities maintain their compliance with the NFIP. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Coordinate with the Department of Land Conservation and Development (DLCD) and FEMA to maintain the Community Rating System. Educate businesses and homeowners currently under the NFIP program about the CRS program and any mitigation actions they can implement to reduce their insurance premiums. Identify homes not in the NFIP that should have flood insurance. Develop mitigation activities to address repetitive and single loss flood properties in Salem, particularly in the area of McGilchrist Avenue and Pringle Road SE, adjacent to West Pringle Creek. 			
Lead Agency:	Salem Public Works Department		
Internal Partners:		External Partners:	
Salem Community Development		DLCD, National Flood Insurance Program, FEMA, Marion and Polk Counties	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Ongoing		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status: The City of Salem CRS Rating is now at a 6.			

Flood Action #3

Proposed Action Item:		Alignment with Plan Goals:	
Implement the early warning monitoring system in the Mill Creek Watershed through upgrades of existing equipment and the installation of new rain and stream gauges within the drainage area.		<i>Protect lives.</i> <i>Protect existing and future development.</i> <i>Reduce economic loss</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The City of Salem suffered significant damage to both public and private property as a result of intense rainfall and subsequent flooding in January 2012. Some of the damage could have been prevented with timely recognition and notification of the likelihood of a flood event. The data collected from the early warning system will be used for real time model interpretation to allow predictions of potential flooding locations and severity within the Mill Creek Watershed. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Implement upgrades to existing rain gauges, installation of new rain gauges and the installation of new stream gauges all at strategic locations within the Mill Creek Watershed. Improve telemetry capability. 			
Lead Agency:	Public Works		
Internal Partners:		External Partners:	
		Salem Emergency Management	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
Short Term			
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status: This action item is currently in development.			

Hazardous Materials Action #1

Proposed Action Item: (from Action # 5)		Alignment with Plan Goals:	
Map facilities that handle or contain hazardous materials, rank them based on their level of risk, and refine response strategies for each situation in the event of an accident.		<i>Increase cooperation and coordination among stakeholders.</i> <i>Protect lives.</i> <i>Protect the natural environment.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The City of Salem has identified and mapped hazardous materials located in the city. These maps need to be updated to determine the number and types of natural hazards present, and their level of risk. The Salem Natural Hazards Mitigation Committee indicated how the railroad running near the Capital Mall area in Salem is an area for potential concern because of the significant amount of hazardous materials that run through the area each year. Accidents with people and automobiles could derail cars and have the potential to spill hazardous materials in the Capital Mall area, affecting City and State operations. Refining response strategies for accidents on the railroad line would reduce the vulnerability of the City of Salem to hazardous materials incidents. The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)]. Identifying facilities that handle or contain hazardous materials, ranking them based on their level of risk, and developing appropriate response strategies will help reduce the negative impact of hazardous materials on the population in Salem and improve disaster response efforts. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Contact businesses and property owners with hazardous materials about strategies they can implement to reduce the impacts of hazardous materials in their immediate area. Coordinate response strategies with alert warning systems to minimize potential exposure to hazardous materials. Provide information on shelter-in-place strategies to property owners and neighbors to reduce exposure to hazardous materials and simplify response efforts. Identify vulnerable areas along the Union Pacific and Burlington Northern Santa Fe railroad lines and coordinate with railroad companies to develop strategies for reducing accidents along the railroad lines. 			
Lead Agency:	Salem Fire Department		
Internal Partners:		External Partners:	
Salem Emergency Management, Public Works		OSHA, Salem Chamber of Commerce, Neighborhood Associations, ODOT, OEM, State Police, State Fire Marshal	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
Short Term			
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status: Action item review and development is in progress.			

Landslide Action #1

Proposed Action Item:		Alignment with Plan Goals:	
Map areas of landslide risk adjacent to the North Santiam River (upstream of the Geren Island water intake structures) and areas impacted by a catastrophic failure of the Detroit or Big Cliff Dams.		<p><i>Protect existing and future development.</i></p> <p><i>Protect lives.</i></p> <p><i>Protect natural environment</i></p>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The current landslide hazard maps are a compilation of existing maps. These maps are a “work in progress” and have been compiled at widely varying scales and sometimes only depict risk for certain types of landslides. These various scales and levels of detail may lead to people to believe that some areas have no slope hazard, when the case is that those areas just have not yet been evaluated. Systematic upgrading of these maps will lead to greater understanding of hazard locales. Focusing on areas that will be developed and will affect people and critical infrastructure will improve land use planning and provide for more efficient and cost effective development. Better data provides for better decisions to minimize loss. Incorporating indirect economic loss better depicts the cost from natural hazard events. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Improve knowledge of debris flow (rapid moving) landslide hazard areas. Improve landslide hazard area maps for a variety of types of landslides that focus on areas that will affect people and critical infrastructure and facilities. Educate identified vulnerable residential and commercial building owners, occupants, and developers of their vulnerability to risk. 			
Lead Agency:	Salem Public Works Department		
Internal Partners:		External Partners:	
Salem Community Development		US Army Corps, DLCD, FEMA, BLM, USFS	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Long Term		
Form Submitted by:	Salem Natural Hazards Mitigation Committee		
Action Item Status:			

Landslide Action #2

Proposed Action Item:		Alignment with Plan Goals:	
Improve the existing Erosion Prevention and Sediment Control (EPSC) program and regulations established in SRC 65 and 69 to help control erosion.		<i>Reduce Economic Loss.</i> <i>Protect the natural environment.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> Each year tons of sediment nationally are washed and blown from construction sites into municipal storm drainage systems and local streams, rivers, wetlands, and lakes. It is a major source of pollution to these water bodies. Eroded materials also clog streets, storm drains, culverts, and stream channels and cause private property damage. The degradation of fish and wildlife habitat and water quality, plus the burden placed on ratepayers for cleanup, could be largely avoided through implementation of adequate erosion prevention and sediment control practices. (EPSC Handbook) The Salem Natural Hazards Mitigation Committee identified SRC 75 and 69 as ordinances that need further improvement to help control sediment erosion on construction sites, especially those with excavation activity. The Disaster Mitigation Act of 2000 requires communities to identify mitigation actions that address new and existing buildings and infrastructure [201.6(c)(3)(ii)]. Developing mitigation actions for erosion control can significantly reduce the impact of future landslide events and help maintain environmental quality in streams around the City of Salem. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Maintain plan submittal requirements and recommended measures to prevent erosion and control sediments on construction sites and other properties as set forth in the EPSC Handbook. Support City of Salem staff in the dissemination of information and updating of the EPSC handbook. Restrict construction activity during rainy times of the year to control erosion on construction sites. Identify areas in SRC 75 and 69 that could use further improvement to control sediment erosion. 			
Lead Agency:		Salem Public Works Department	
Internal Partners:		External Partners:	
Salem Natural Hazards Mitigation Committee, Community Development		FEMA, DLCD, ODEQ, ODOT	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Ongoing		
Form Submitted by:		Salem Natural Hazards Mitigation Committee	
Action Item Status:			

Landslide Action #3

Proposed Action Item:		Alignment with Plan Goals:
Update landslide overlay maps using Light Detection and Ranging (LIDAR) data.		<i>Increase cooperation and coordination among stakeholders. Protect existing and future development.</i>
Rationale for Proposed Action Item:		
<ul style="list-style-type: none"> LIDAR (Light Detection and Ranging) is a new tool that can provide very precise, accurate, and high-resolution images of the surface of the earth, vegetation, and the built environment. The data are collected with aircraft-mounted lasers capable of recording elevation measurements at a rate of 2,000 to 5,000 pulses per second and have a vertical precision of 15 centimeters (6 inches). LIDAR mapping increases the ability to identify areas that are prone to landslides. In 2007 the Oregon Legislature Assembly directed DOGAMI to extend LIDAR collection efforts throughout the state. The ultimate goal is to provide high-quality LIDAR coverage for the entire state. 		
Ideas for Implementation:		
<ul style="list-style-type: none"> Contact DOGAMI and provide a map of Salem along with an estimate of available funding. Seek funding opportunities with DOGAMI to conduct LIDAR mapping for the City of Salem. Once mapping is complete assess the need to update landslide ordinances. Explore potential cost-sharing agreements with Keizer, Turner, Marion and Polk Counties for LIDAR mapping of the entire Salem-Keizer urbanized area. 		
Lead Agency:	Salem Public Works Department	
Internal Partners:		External Partners:
Salem Natural Hazards Mitigation Committee, City GIS technicians		FEMA, NOAA, DLCD, DOGAMI, Keizer, Turner, Marion County, Polk County
Timeline:		If available, estimated cost:
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)	Potentially very expensive
	Long term	
Form Submitted by:	Salem Natural Hazards Mitigation Committee	
Action Item Status:		

Volcanic Eruption Action #1

Proposed Action Item:		Alignment with Plan Goals:	
Rationale for Proposed Action Item:			
Ideas for Implementation:			
Lead Agency:			
Internal Partners:		External Partners:	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
Form Submitted by:			
Action Item Status: This action item is currently in development by the Salem Public Works Department			

Windstorm Action #1

Proposed Action Item:		Alignment with Plan Goals:
Partner with public and private utilities to educate the public about hazardous trees and the damage they can cause in the event of a wind or winter storm.		<i>Reduce economic loss. Protect existing and future development.</i>
Rationale for Proposed Action Item:		
<ul style="list-style-type: none"> Overhead electrical lines and other above ground utilities are subject to damage from nearby trees in high winds and winter storm damage. Post-disaster, it is difficult to remove debris from the downed utility lines and this difficulty delays the time for restoration of power to the community. Partnering with utility companies to maintain and remove hazardous trees, in addition to educating the public about the damage hazardous trees can cause, will help reduce risk of damage from severe wind and winter storms. The Disaster Mitigation Act of 2000 requires communities to develop comprehensive actions to reduce the impacts of natural hazards, with an emphasis on new and existing buildings and infrastructure [201.6(c)(3)(ii)]. Maintenance and removal of hazardous trees will reduce the impact of severe weather, and will continue power service to rural customers as well as ODOT, State Police, county sheriff, emergency services, telephone utilities, and cell phone companies. 		
Ideas for Implementation:		
<ul style="list-style-type: none"> Coordinate with the City of Salem Public Works Department to gather information about the maintenance and removal of hazardous trees. Work with the community and City of Salem Public Works Department to identify areas that are prone to damage from nearby trees and perform the necessary maintenance or removal of those trees. Create a hazardous tree inventory. 		
Lead Agency:	Salem Public Works Department	
Internal Partners:		External Partners:
Salem Community Services Parks Operations , Salem Fire Department		ODOT Portland General Electric, Salem Electric
Timeline:		If available, estimated cost:
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)	
	Long Term	
Form Submitted by:	Salem Natural Hazards Mitigation Committee	
Action Item Status: Action item review and development is in progress.		

Winter Storm Action #1

Proposed Action Item:		Alignment with Plan Goals:	
Partner with public and private utilities to educate the public about hazardous trees and the damage they can cause in the event of a wind or winter storm.		<i>Reduce economic loss. Protect existing and future development.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> Overhead electrical lines and other above ground utilities are subject to damage from nearby trees in high winds and winter storm damage. Post-disaster, it is difficult to remove debris from the downed utility lines and this difficulty delays the time for restoration of power to the community. Partnering with utility companies to maintain and remove hazardous trees, in addition to educating the public about the damage hazardous trees can cause, will help reduce risk of damage from severe wind and winter storms. The Disaster Mitigation Act of 2000 requires communities to develop comprehensive actions to reduce the impacts of natural hazards, with an emphasis on new and existing buildings and infrastructure [201.6(c)(3)(ii)]. Maintenance and removal of hazardous trees will reduce the impact of severe weather, and will continue power service to rural customers as well as ODOT, State Police, county sheriff, emergency services, telephone utilities, and cell phone companies. 			
Ideas for Implementation:			
<ul style="list-style-type: none"> Coordinate with the City of Salem Public Works Department to gather information about the maintenance and removal of hazardous trees. Work with the community and City of Salem Public Works Department to identify areas that are prone to damage from nearby trees and perform the necessary maintenance or removal of those trees. Create a hazardous tree inventory. 			
Lead Agency:		Salem Public Works Department	
Internal Partners:		External Partners:	
Salem Community Services Parks Operations , Salem Fire Department		ODOT Portland General Electric, Salem Electric	
Timeline:		If available, estimated cost:	
<u>Short Term</u> (0-2 years)	<u>Long Term</u> (2-4 or more years)		
	Long Term		
Form Submitted by:		Salem Natural Hazards Mitigation Committee	
Action Item Status: Action item review and development is in progress.			

Wildland Urban Interface Fire Action # 1

Proposed Action Item:		Alignment with Plan Goals:	
Conduct wildfire prevention outreach, as outlined in the Marion County Community Wildfire Protection Plan (CWPP), to residents near the wildland-urban interface.		<i>Increase cooperation and coordination among stakeholders. Protect lives.</i>	
Rationale for Proposed Action Item:			
<ul style="list-style-type: none"> The Oregon Department of Forestry (ODF) recently completed a Communities at Risk Assessment for the City of Salem that shows areas in northwest and south Salem that are at high risk to wildfire events (See Map 2.1.5: Fire Hazard Areas). Although these areas are just outside of the Salem city limits, they are vulnerable to wildfire events that could impact residents within the city limits. Conducting wildfire prevention outreach to residents near these areas can significantly reduce the vulnerability of the neighborhoods to wildfire events. Interviews with Salem Fire Department staff indicate that the areas with the highest risk have the steepest slopes, the right fuels, and high valued property. The areas outlined by the ODF Communities at Risk Assessment show that many of the areas at risk are near steep slopes and have combustible fuels. Conducting wildfire prevention outreach can help to reduce vulnerability of residents to wildfire events. The Marion County Community Wildfire Protection Plan (2008) outlines strategies for conducting wildfire prevention outreach to residents living in the wildland-urban interface. Conducting wildfire prevention outreach using the CWPP will help to integrate mitigation into existing plans and policies as required by the Disaster Mitigation Act of 2000 [201.6(c)(4)(ii)]. The Disaster Mitigation Act of 2000 requires communities to identify mitigation actions that address new and existing buildings and infrastructure [201.6(c)(3)(ii)]. Conducting wildfire prevention outreach measures as outlined in the Marion County CWPP will help to protect new and existing buildings from wildfire events. 			
as for Implementation:			
<ul style="list-style-type: none"> The Marion County Community Wildfire Protection Plan contains several action items for reducing the impacts of wildfire on communities throughout the county, including actions to conduct public outreach about fuels reduction and defensible space (see Chapter 6: Action Plan, Marion County CWPP). Using these action items can assist in reducing the impact of wildfire on the City of Salem. Coordinate with responsible agencies listed in the Marion County CWPP to implement action items. 			
Lead Agency:		Salem Fire Department	
Internal Partners:		External Partners:	
Salem Public Works and Community Development Departments, Police Department, Community Services		Oregon Department of Forestry, Marion County Fire District #1, Salem Suburban Fire District, Neighborhood Associations	
Timeline:		If available, estimated cost:	
Short Term (0-2 years)	Long Term (2-4 or more years)		
Short Term			
Form Submitted by:		Salem Natural Hazards Mitigation Committee	
Action Item Status: Action item review and development is in progress.			

Appendix B: Planning and Public Process



Memo

To: Federal Emergency Management Agency
From: Oregon Partnership for Disaster Resilience
Date: June 8, 2012
Re: List of changes to the 2008 City of Salem NHMP for the 2012 Plan Update

Purpose

This memo describes the changes made to the 2008 City of Salem Natural Hazards Mitigation Plan (NHMP) during the 2012 plan update process. Major changes are documented by plan section.

Project Background

In the Winter of 2012, the City of Salem partnered with the Oregon Partnership for Disaster Resilience (OPDR) to update the 2008 City of Salem 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 City of Salem steering committee in March, April, and May of 2012 to update all content within the city's NHMP. OPDR and the committee made several changes to the 2008 NHMP. Major changes are documented and summarized in this memo.

2012 Plan Update Changes

The sections below only discuss *major* changes made to the 2008 City of Salem NHMP during the 2012 plan update process. Major changes include replacement or deletion of large portions of text, changes to the plan's organization, and new additions 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 B1 below lists the 2008 plan section names and the corresponding 2012 section names, as updated. This memo will use the 2012 plan update section names to reference any changes, additions, or deletions within the plan.

Table B.1 Changes to Plan Sections

2008 City of Salem NHMP	2012 City of Salem NHMP
Table of Contents	Table of Contents
1.0 Introduction	Section 1: Introduction
2.0 Natural Hazards	Volume II: Hazard Annexes
3.0 Goals and Objectives	Section 3: Mission, Goals and Action Items
4.0 All Hazards Risk Assessment	Section 2: Risk Assessment
5.0 Mitigation Action Items	Section 3: Mission, Goals and Action Items
6.0 References	Deleted
Appendix A	Appendix A: Action Item Forms
Appendix B	Appendix B: Planning and Public Process
Appendix C	Appendix C: Economic Analysis of Natural Hazard Mitigation Projects
Appendix D	Appendix D: Community Profile
Appendix E	Appendix E: Grant Programs
Appendix F	Deleted

Several new sections were added and formatting was changed throughout the 2012 City of Salem NHMP. As well, the City of Salem steering committee added extreme heat to the list of hazards that impact the city, to address potential climate change issues.

All of the appendices from the 2008 Plan were replaced and/or updated with new appendices for the 2012 update. Appendices A, B, and D from the 2008 Plan were deleted and changed to the appendices listed in the table above. Appendix C remained the same, and appendices E and F were combined into Appendix B in the 2012 update.

Front Pages

1. The plan’s cover has been updated.
2. Acknowledgements have been updated to include the 2008 project partners and planning participants.

Volume I: Natural Hazard Mitigation Plan

Volume I provides the overall plan framework for the 2012 NHMP update. Volume I contains the following sections: an Executive Summary; Section 1: Introduction; Section 2: Risk Assessment; Section 3: Mission, Goals, and Action Items; and Section 4: Plan Implementation and Maintenance.

Executive Summary

The 2012 NHMP now includes an executive summary that provides information about the purpose of natural hazards mitigation planning and describes how the plan will be implemented.

Section 1: Introduction

Section 1 introduces the concept of natural hazards mitigation planning and answers the question, “Why develop a mitigation plan?” Additionally, Section 1 summarizes the 2012 plan update process, and provides an overview of how the plan is organized. Major changes to Section 1 include the following:

1. Most of Section 1 includes new information that replaces out of date text found in the 2008 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.
2. Section 1 of the 2012 update, outlines the entire layout of the plan update, which has been significantly altered since 2008.

Section 2: Risk Assessment

Section 2, Risk Assessment, 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. Lastly, 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:

1. Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities were updated.
2. Extreme heat was identified as a new hazard for the 2012 risk assessment.
3. The 2012 City of Salem Hazard Analysis vulnerability of wildfires was updated from moderate to low.
4. The 2012 City of Salem Hazard Analysis probability of volcanic hazards was updated from moderate to low; and vulnerability of volcanic hazards was updated from low to moderate.
5. The specific hazard chapters and descriptions are located within the risk analysis, rather than in an independent section.

Section 3: Mission, Goals, and Action Items

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:

1. The deletion of many completed action items.
2. The addition of new action items for hazards not accounted for in the 2008 NHMP.
3. The revision of existing actions, lead agency and partner designations.

On May 17th, 2012, the City of Salem steering committee met to review the 2008 NHMP action items. The City of Salem steering committee reviewed and identified which of the 2008 NHMP's 32 action items had been completed or not, or whether they should be deleted. Action items were deleted for a number of reasons, including not meeting basic action item criteria such as being measurable, assignable, or achievable.

After deciding which actions to delete, OPDR worked with the steering committee to formulate new action items for the 2012 Natural Hazard Mitigation Plan. These 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. They are designed to be feasibly accomplished within the next five years, and can be found in Appendix A.

The 32 action items from the 2008 NHMP and their status are discussed in table B.2.

Table B.2 2008 City of Salem NHMP Action Items

2008 Action Item	Proposed Action Title	Status	2012 Action Item (Deferred Actions Only)	Explanation
Plan Implementation Action Items				
PI #1	Request FEMA approval of the Salem Natural Hazards Mitigation Plan Update.	Deferred	PI #1	This action was suggested to remain part of the update, as a reference tool for Salem Emergency Management
PI #1	Salem Emergency Management will take on the role of convener to coordinate hazard mitigation meetings and implementation of mitigation action items.	Deferred	PI #2	This action was suggested to remain part of the update, as a reference tool for Salem Emergency Management
PI #3	The Salem Natural Hazards Mitigation Committee will be the coordinating body responsible for implementing the Salem Natural Hazards Mitigation Plan.	Deferred	PI #3	This action was suggested to remain part of the update, as a reference tool for Salem Emergency Management
Multi-Hazard Action Items				
MH #1	Coordinate with the Capital Projects Advisory Board to integrate natural hazard mitigation into State and City respective capital improvements.	Deferred	MH #1	This is an ongoing action.
MH #2	Develop an inventory of the number and type of structures within the community that are at risk for each hazard type.	Deferred	MH #2	This action was revised to make it specific and realistic. The revised action only addresses critical facilities that are subject to reasonable risk. Public works is now the lead agency
MH #3	Develop and annually update contacts and telephone numbers of personnel that would be involved in emergency preparedness/response to coordinate emergency response actions.	Deleted		This action is addressed in the City of Salem Emergency Operations Plan.

2008 Action Item	Proposed Action Title	Status	2012 Action Item (Deferred Actions Only)	Explanation
MH #4	Develop and annually update an electronic map/database containing critical facilities at risk so that the data is readily accessible to all City personnel responding to a disaster.	Completed		
MH #5	Develop public outreach materials for all natural hazard risks addressed in the Salem Natural Hazards Mitigation Plan. Materials should include mitigation actions residents and businesses can implement to reduce their risk to natural hazards, and where they can obtain more detailed natural hazard information.	Deferred	MH #3	This action has been completed for flood hazards, but is ongoing for all other hazards.
MH #6	Develop a database of names, phone numbers, etc. of all stakeholders (cities, counties, citizens, businesses, and others) involved in planning for and responding to natural disasters.	Completed		
MH #7	Include a post-disaster recovery and mitigation annex/appendix in the Salem Emergency Operations Plan that encourages property owners to incorporate retrofitting and mitigation measures in recovery efforts.	Deferred	MH #4	
MH #8	Maintain a liaison with the Office of Emergency Management to remain informed of state laws and regulations, and potential grant opportunities, governing all aspects of post-disaster recovery and mitigation.	Deleted		

2008 Action Item	Proposed Action Title	Status	2012 Action Item (Deferred Actions Only)	Explanation
MH #9	Consider measures when updating the Salem code for mitigating the location of future development in identified/mapped high hazard areas.	Deferred	MH #5	This action was revised to make it specific and realistic. The revised action ensures that UDC updates will address specific hazards. Estimated time frame is 2 years.
MH #10	Develop and improve natural hazard map overlays, including a composite hazard map, to guide the planning and permit review process.	Completed		
MH #11	Strengthen or replace unsafe public structures (especially facilities critical to disaster and post-disaster planning/response).	Deferred	MH #6	This action was completed for the seismic retrofit of fire stations, but is ongoing for schools throughout the City.
MH #12	Prescribe standards for the design and construction of new public facilities in high hazard areas.	Deleted		
MH #13	Continue developing alert and warning systems to notify residents of incidents involving natural hazards and hazardous materials.	Deferred	MH #7	This action is ongoing. Salem Emergency Management replaces the Salem Fire Department as the lead agency.
Landslide Action Items				
LS #1	Map areas of landslide risk adjacent to the North Santiam River (upstream of the Geren Island water intake structures) and areas impacted by a catastrophic failure of the Detroit or Big Cliff Dams.	Deferred	LS #1	
LS #2	Develop a general landslide awareness program based on monitoring soil saturation and rain forecasts (e.g. press release associated with extended period of rain).	Deleted		

2008 Action Item	Proposed Action Title	Status	2012 Action Item (Deferred Actions Only)	Explanation
LS #3	Educate and inform residents in designated landslide areas about mitigation activities that residents can take to reduce the impact of landslides on their properties.	Deleted		
LS #4	Improve the existing Erosion Prevention and Sediment Control (EPSC) program and regulations established in SRC 65 and 69 to help control erosion.	Deferred	LS #2	This action is currently underway.
LS #5	Update landslide overlay maps using Light Detection and Ranging (LIDAR) data.	Deferred	LS #3	
Earthquake Action Items				
EQ #1	Develop an inventory of un-reinforced masonry structures and develop appropriate mitigation action items to reduce the impacts of seismic events.	Deferred	EQ #1	
EQ #2	Identify and inventory critical facilities that require seismic retrofit.	Deferred	EQ #2	This action is ongoing.
EQ #3	Partner with the school districts to help identify and prioritize seismic retrofits to school district facilities.	Deferred	EQ #3	The City has identified the school district facilities that need seismic retrofits, but have yet to prioritize.
Flood Action Items				
FL #1	Develop a flood warning system on local creeks that is consistent with the 2000 Stormwater Master Plan and the Corps of Engineers (COE) Section 205 Flood Damage Reduction Study for Mill Creek.	Completed		This action item was completed and replaced by action FL #1 during the 2012 update.

2008 Action Item	Proposed Action Title	Status	2012 Action Item (Deferred Actions Only)	Explanation
FL #2	Encourage landowners in the UGB to provide set-asides for open space for less intensive development in floodplains.	Deleted		This action item was replaced by action FL #1 during the 2012 update.
FL #3	Implement recommendations presented in the 2000 Stormwater Master Plan (SWMP) to reduce flood hazards in the city.	Deferred	FL #1	This action was revised by the City of Salem Public Works to adopt a floodplain management plan in accordance with the Community Rating System.
FL #4	Revise SRC 140 Floodplain Overlay Zones to increase flood freeboard at 2 feet above the 100-year elevation in areas where past floods (including the 1996 floods) have been higher than the FIRM-predicted 100-year elevation.	Deleted		This action item was replaced by action FL #1 during the 2012 update.
FL #5	Improve the City of Salem's National Flood Insurance Program (NFIP) Community Rating System (CRS) to reduce NFIP premiums.	Deferred	FL #2	This action is ongoing. The City of Salem's CRS rating is a Class 6 Rating, a reduction of two rating classes since the 2008 NHMP update.
Hazardous Materials Action Items				
HM #1	Map facilities that handle or contain hazardous materials, rank them based on their level of risk, and refine response strategies for each situation in the event of an accident.	Deferred	HM #1	This action will remain in the plan update, but needs revision. The steering committee will work with Salem Fire to revise the existing action for hazardous materials.
Winter Storm Action Items				
WS #1	Partner with public and private utilities to educate the public about hazardous trees and the damage they can cause in the event of a wind or winter storm.	Deferred	WS #1	This action will remain in the plan update, but needs revision. The steering committee will work with the Parks Superintendant and the Urban Forester to develop an action for winter storm hazards.

2008 Action Item	Proposed Action Title	Status	2012 Action Item (Deferred Actions Only)	Explanation
Windstorm Action Items				
WI #1	Partner with public and private utilities to educate the public about hazardous trees and the damage they can cause in the event of a wind or winter storm.	Deferred	WI #1	This action will remain in the plan update, but needs revision. The steering committee will work with Portland general Electric (PGE) and Salem Electric to develop an action for winstorm hazards.
Wildfire Action Items				
WF#1	Conduct wildfire prevention outreach, as outlined in the Marion County Community Wildfire Protection Plan (CWPP), to residents near the wildland-urban interface.	Deferred	WF #1	This action will remain in the plan update, but needs revision. The steering committee will work with Salem Fire to revise the existing action.

Section 4: Plan Implementation and Maintenance

This section details the formal process that will ensure that the City of Salem Natural Hazard Mitigation Plan remains an active and relevant document. Major changes to Section 4 include the following:

1. The convener and coordinating body members have been updated to reflect new committee membership and the plan maintenance schedule has been updated.
2. New strategies for continued public involvement have been added.
3. OPDR added a 'Mitigation Plan Update Toolkit' to the 2010 NHMP. The toolkit is designed to assist the plan's convener in determining 5-year plan update activities and timelines.

Volume II: Hazard Annexes

Volume II contains individual hazard annexes. The hazard annexes provide detailed risk assessments for drought, earthquake, extreme heat, flood, hazardous materials, landslide, volcano, wildfire, wind storms, and winter storms. For the 2012 update, OPDR reorganized the content within each hazard chapter. Content now follows OPDR's templates, which are organized to follow the three phases of a risk assessment (i.e., community-wide hazard identification; community-wide vulnerability assessment; and risk analysis). The structure of OPDR's hazard annexes better facilitates FEMA plan review processes as well.

In terms of content, OPDR updated each hazard's history of events, and improved upon the hazards' causes and characteristics descriptions, using information from new studies or reports. For each hazard annex, OPDR also included more detailed descriptions of the City of Salem's vulnerability to each hazard. The hazard annexes continue to describe "existing mitigation" efforts for all hazards, and list the action items that relate to each hazard.

Specific changes made to each hazard annex include the following:

Hazard Annex: Drought

1. Added new information about the hazard's causes and characteristics, location, and extent.
2. Updated the history of previous occurrences.
3. Updated the probability and vulnerability of the risk analysis, with input from the steering committee relative risk assessment.
4. Updated existing hazard mitigation activities.
5. There were no drought action items in the 2008 NHMP. The City of Salem steering committee is in the process of developing drought action items for the 2012 NHMP update.

Hazard Annex: Earthquake

1. Added new information about the hazard's causes and characteristics, location, and extent.
2. Updated the history of previous occurrences.
3. Updated the probability and vulnerability of the risk analysis, with input from the steering committee relative risk assessment.

4. Added information from the Oregon Department of Geology and Mineral Industries' 2007 Rapid Visual Survey.
5. Updated existing hazard mitigation activities.

Hazard Annex: Extreme Heat

1. This is a new hazard annex that was developed for the 2012 NHMP update. The steering committee wanted to add the hazard to address potential issues of climate change and induced heat waves. All content within the extreme Heat Hazard Annex is new.
2. The City of Salem steering committee is in the process of developing extreme heat action items for the 2012 NHMP update.

Hazard Annex: Flood

1. Added new information about the hazard's causes and characteristics, location, and extent.
2. Updated the history of previous occurrences, including documentation of the 2012 presidential disaster declaration for the 2012 flood.
3. Information about the City of Salem's participation in the NFIP was added/updated within the 2012 NHMP. Additional information regarding repetitive loss properties is new as well.
4. Updated the probability and vulnerability of the risk analysis, with input from the steering committee relative risk assessment.
5. Updated existing hazard mitigation activities.

Hazard Annex: Hazardous Materials

1. Added new information about the hazard's causes and characteristics, location, and extent.
2. Updated the history of previous occurrences.
3. Updated the probability and vulnerability of the risk analysis, with input from the steering committee relative risk assessment.
4. Updated existing hazard mitigation activities.
5. The City of Salem steering committee is in the process of revising hazardous materials action items for the 2012 NHMP update.

Hazard Annex: Landslide

1. Added new information about the hazard's causes and characteristics, location, and extent.
2. Updated the history of previous occurrences.
3. Updated the probability and vulnerability of the risk analysis, with input from the steering committee relative risk assessment.
4. Updated existing hazard mitigation activities.

Hazard Annex: Volcanic Eruption

1. Added new information about the hazard's causes and characteristics, location, and extent.
2. Updated the history of previous occurrences.
3. Updated the probability and vulnerability of the risk analysis, with input from the steering committee relative risk assessment.

4. There were no volcanic hazard action items in the 2008 NHMP. The City of Salem steering committee is in the process of developing volcanic hazards action items for the 2012 NHMP update.

Hazard Annex: Wildfire

1. Added new information about the hazard's causes and characteristics, location, and extent.
2. Updated the history of previous occurrences.
3. Updated the probability and vulnerability of the risk analysis, with input from the steering committee relative risk assessment.
4. In 2008, Marion County developed a Community Wildfire Protection Plan (CWPP). To be consistent with the CWPP, risk assessment information from the CWPP was incorporated into the wildfire hazard annex.
5. Included information identifying factors that increase vulnerability of the WUI to wildfire.
6. Updated existing hazard mitigation activities.
7. The City of Salem steering committee is in the process of revising wildfire action items for the 2012 NHMP update.

Hazard Annex: Winter Storm

1. In the 2008 NHMP, winter storm was combined with windstorms as severe weather hazards. In the 2012 update, winter storms were established as an independent hazard annex.
2. Added new information about the hazard's causes and characteristics, location, and extent.
3. Updated the history of previous occurrences, including documentation of two presidential disaster declarations for winter storms.
4. Updated the probability and vulnerability of the risk analysis, with input from the steering committee relative risk assessment.
5. Updated existing hazard mitigation activities.
6. The City of Salem steering committee is in the process of revising winter storm action items for the 2012 NHMP update.

Hazard Annex: Windstorm

1. In the 2008 NHMP, windstorm was combined with winter storms as severe weather hazards. In the 2012 update, windstorms were established as an independent hazard annex.
2. Added new information about the hazard's causes and characteristics, location, and extent.
3. Updated the history of previous occurrences, including documentation of the 2012 Aumsville tornado and other recent events.
4. Updated the probability and vulnerability of the risk analysis, with input from the steering committee relative risk assessment.
5. The City of Salem steering committee is in the process of revising windstorm action items for the 2012 NHMP update.

Volume III: Mitigation Resources

Appendix A: Action Item Forms

Appendix A in the 2012 update replaces the former Appendix A from the 2008 Plan; the new Appendix A lists the plan's action items. Action items are detailed recommendations for activities that local departments, citizens and others could engage in to reduce risk. This appendix contains detailed action item forms for each of the mitigation strategies identified in this plan.

Many of the 2012 action items were deferred from the 2008 NHMP, some are revised versions of the 2008 action items, and a couple of the updated action items are completely new and were identified by the City of Salem steering committee on May 17th, 2012.

As of June 12, 2012, drought, extreme heat, volcanic eruption, winter storm, windstorm and wildfire action items are currently under review and development by the City of Salem steering committee.

Appendix B: Planning and Public Process

Appendix E and F from the 2008 NHMP have been revised and combined as Appendix B in the 2012 update; and the 2008 NHMP Appendix B has been removed. Appendix B includes documentation of the public processes utilized to develop the plan. It includes invitation lists, agendas, sign-in sheets, and summaries of steering committee meetings, and public involvement meetings or outreach strategies. The 2008 NHMP's public process is also fully documented in Appendix B.

Appendix C: Economic Analysis of Natural Hazard Mitigation Projects

Appendix C describes the Federal Emergency Management Agency's (FEMA) requirements for benefit cost analyses in natural hazards mitigation, as well as various approaches for conducting economic analyses of proposed mitigation activities. This appendix replaces the 2008 NHMP's information about benefit cost analyses from Appendix C.

Appendix D

Appendix D is new to the 2012 update. The community profile describes the City of Salem's natural environment, demographics, cultural capital, built infrastructure and government systems, etc.

Appendix E

This appendix lists state and federal resources and programs by hazard. Appendix E replaces the 2008 NHMP's Appendix A. Resources, programs, and contacts have been updated.



Meeting: Natural Hazards Mitigation Plan Update: Kickoff Meeting
Date: March 22, 2012
Time: 1:30-3:30pm

AGENDA

I. Introductions and Background

(15 minutes)

- Welcome & Introductions
- Review of Meeting Goals and Objectives
- Process Overview
 - Why Are We Here?
 - Who is Involved?

II. Natural Hazards Mitigation Planning Overview

(90 minutes)

- What is Natural Hazards Mitigation Planning?
- Grant Opportunities
- Plan Update Process
- New FEMA Plan Review Guidance
- Steering Committees
- Public Involvement Strategies
- Next Steps
 - Community Profile Update
 - Hazard Mitigation Crosswalk Introduction
 - Set Date for Next Meeting

Questions?

(15 minutes)

City of Salem 2012 NHMP Update – Work Plan

Issue Summary

A Natural Hazard Mitigation Plan (NHMP) forms the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. It creates a framework for risk-based decision making to reduce damages to lives, property, and the economy from future disasters. Jurisdictions with Federal Emergency Management Agency (FEMA) approved mitigation plans are eligible for federal grant funding to implement those mitigation items identified in the plan. However, jurisdictions are required to review, update, and re-seek FEMA approval of their plans every five years in order to maintain grant eligibility.

The City of Salem Natural Hazard mitigation Plan Update

The City of Salem's Natural Hazard Mitigation plan was adopted in 2008 and is due for a 5-year update by 2013. Updating the mitigation plan is a requirement for maintaining eligibility for the Federal Emergency Management Agency's Pre-Disaster Mitigation and Hazard Mitigation Grant Programs. This project is being funded in part with Pre Disaster Mitigation Grant funding from the Federal Emergency Management Agency. The NHMP Update process is described briefly below:

Task 1: Identify Project Lead and Steering Committee Members

Salem will designate a project lead. OPDR will work with that project lead to identify potential steering committee members or work with existing disaster planning committees. The steering committee will be responsible for overseeing the plan update process, providing information to update the plan, and providing feedback on plan drafts.

In addition, OPDR will work with the project lead to develop dates for mitigation meetings. The dates and locations of subsequent meetings will be established with project lead at a later date

Deliverable: Project lead and steering committee members identified, date and location of first steering committee meeting established.

Timeline: February 2012

Task 2: Develop a Work Plan

After the project lead is identified OPDR will work with the project lead to:

- Establish a viable work plan that enables submission of the Salem NHMP Update for FEMA approval in June 2012
- Obtain a detailed line item budget from Salem including local match sources
- Finalize Intergovernmental Agreement between the City of Salem and the University of Oregon

Deliverable: Formalized work plan with established timelines

Timeline: February 2012

Task 3: Develop a Public Involvement Strategy

In preparation of the first steering committee, it is important to review the public involvement strategy identified in the 2008 City of Salem NHMP and update the strategy. The strategy will be discussed at the initial meeting.

- Outreach strategies may include public information workshops, press releases and stakeholder online comments.

Deliverable: Identified public involvement strategy

Timeline: February 2012

Task 4: Distribute Planning Resources

Once the project leads and steering committees are set, OPDR will distribute planning resources. These will include OPDR's Pre-Disaster Mitigation Training Manual and the Pre-Disaster Mitigation Plan Update Manual. These documents walk a community through the process of creating or updating a NHMP to meet and in most cases, exceed the minimum FEMA planning requirements.

Deliverable: Plan Update Resources

Timeline: February 2012

Task 5: Thorough Review of Existing Plan

OPDR will complete a thorough review of the 2008 City of Salem NHMP for deficiencies by developing a crosswalk that will detail policies and action items documented in locally adopted plans. The crosswalk will identify consistencies and variations between the adopted plans with regards to the integration of hazard mitigation initiatives. These deficiencies will be addressed in the plan update process, and will be specifically addressed in Task 10 and Task 11.

Deliverable: Hazard Mitigation Policy Crosswalk

Timeline: February – March 2012

Task 6: Develop or Update Salem Community Profile

OPDR will develop or update the community profile of Salem and make any necessary changes to relate information in the profile to natural hazards mitigation. The profile will include information about the area's geography and climate; population and demographics; employment and economics, housing, land use and development, transportation and commuting patterns, critical facilities and infrastructure, and historic and cultural resources. Additionally, the community profile will describe the government structure, existing plans and policies, and community organizations and programs. Existing plans and policies should highlight specific opportunities for the integration of mitigation goals and actions. Potential data sources for completing community profiles include: comprehensive plan, census, state natural hazard mitigation plan regional profiles, national register of historic places, and the Portland State University Population Research Center.

Deliverable: Draft community profile

Timeline: February - March 2012

Task 7: Conduct Plan Update Initiation Meeting between OPDR and Salem

OPDR will hold the first meeting in Salem. Attendees will include the lead for the City of Salem as well as the city's steering committee. Topics to discuss at this meeting include:

- Overview of Natural Hazards Mitigation. Committee members will be refreshed on natural hazard mitigation, its purpose, and the benefits that a mitigation plan can provide a community.
- Review the scope of work and timeline. OPDR will discuss firm meeting dates with the project lead at a later date.
- Review roles and responsibilities of the committee.
- Discuss public involvement strategy to be used during the update process
- Consider additional stakeholders that need representation, i.e. county representatives, or external partners such as the Red Cross and Hospitals.
- Discuss draft community profile. OPDR will send Salem the community profile prior to this meeting. Salem will have a chance to review their draft community profile and provide any further input.
- Collect meeting documentation: agendas, minutes, attendance sheet

Deliverable: Work Session #1

Timeline: March 2012

Task 8: Update Risk Assessments

The risk assessments for Salem should contain updated information regarding the following natural hazard profiles: wildfire, earthquake, flood, landslides, severe winter storm, severe winter storms, and earthquake. The risk assessment will also identify and profile any new hazards that are not addressed in the current plan, to include new EMPG requirements for a THIRA including a terrorism component

The following FEMA requirements must be reviewed and updated for each hazard: causes, characteristics, location, extent, previous occurrences, probability, vulnerability, and

community-related impacts (or potential impacts). The causes, characteristics, location, extent, previous occurrences and probability can be reviewed and updated prior to the second steering committee meeting by reviewing local, state, and federal studies or plans. Information on hazard history events, probability, and vulnerability will be compiled and discussed with the local steering committee at the second meeting.

- Collect documentation related to any hazard occurrences or emergency declaration in Salem since 2008
- Update repetitive loss property data
- Collect and local, state, or federal studies or reports completed since 2008
 - Local development ordinances, flood maps, HAZUS studies, DOGAMI studies, USGS reports, etc.
- Salem will provide GIS staff support for the development of any new hazard maps

Deliverable: Draft risk assessments

Timeline: March – April 2012

Task 9: Second Steering Committee Meeting

The second steering committee meeting will discuss risk assessments: methodologies, common barriers and ways to deal with them. The jurisdictions will have a chance to review their risk assessments and provide any further input.

- Identify and invite new committee members
- Identify new hazards to be included in the risk analysis
- Discuss changes made to the hazard profile and gather new information (Causes, characteristics, location, extent, previous occurrences, probability assessments, hazard maps)
- Review and update the vulnerability assessment (vulnerability assessment, repetitive flood loss information)
- Review and Update risk analysis is available
- Collect meeting documentation: agendas, minutes, attendance sheet

Deliverable: Work Session #2

Timeline: April 2012

Task 10: Develop or Update Action Items

One important part of the plan update process is documenting which mitigation actions have been implemented and which are still pending. The updated plan's mitigation actions can consist of deferred actions from the previously approved plans, and new actions that address new vulnerabilities. To accomplish this task OPDR will interview each lead agency responsible for existing action items to determine the extent of progress on each, factors affecting accomplishment, and estimated timelines for their completion

After the first work session and prior to the third, OPDR will draft potential actions for the county and participating cities. New actions should be based on vulnerabilities identified within the risk assessment. All vulnerabilities should have a corresponding action. It is not necessary that each hazard have an action, but if a hazard has a “high” probability of occurrence and a “high” vulnerability-then there must be a mitigation action for that hazard.

Each action will have a corresponding action item worksheet that lists the action’s alignment with goals and existing plans and policies, rationale, ideas for implementation, coordinating organization, partner organization, and potential funding sources.

OPDR will bring expertise in natural hazard mitigation planning to the project by providing detailed recommendations for goals, objectives, and action items to include in the updated plan. OPDR will present these recommendations to the stakeholders group for consideration.

Deliverable: Documented status of action items and draft action items

Timeline: April – May 2012

Task 11: Develop or Update Maintenance and Implementation Sections

The NHMP for Salem needs to contain a section detailing how the plan will be maintained and implemented. OPDR will be responsible for drafting a Maintenance and Implementation section of the plan to be reviewed prior to the final meeting.

Deliverable: Draft Maintenance and implementation sections

Timeline: May 2012

Task 12: Third Steering Committee Meeting

The third work session will address the goals and actions within the individual mitigation plans. Included in this work session will be a discussion of the state NHMP goals as well as how to craft successful action items.

- Review Plan Goals
- Review Mitigation Action Items
- Document Continued NFIP Compliance
- Review Proposed Mitigation Actions to ensure compliance with FEMA requirements

The third work session will also address how to craft maintenance and implementation strategies to ensure the plan will be implemented. The project lead and steering committee will learn about common pitfalls in both the implementation and maintenance of a natural hazard mitigation plan as well as how to get around them. OPDR will propose a meeting schedule and framework to ensure that the NHMP doesn’t lapse and is updated in a timely manner. OPDR will also detail funding sources available for mitigation projects.

Deliverable: Hazard mitigation framework – goals, action items, implementation strategy

Timeline: May 2012

Task 13: Final Edits and FEMA Approval Guidance

Based on comments from the steering committee and the final work session, OPDR will complete final edits to the City of Salem NHMP Update and submit them to FEMA. When the plan has been sent to FEMA, OPDR will guide Salem through the FEMA approval process.

Also, a requirement for all updated NHMPs is to craft a memo detailing the changes made to the newly-submitted NHMP. OPDR will complete a changes memo describing major changes made to the Salem NHMP.

- Deliver a final FEMA pre-approved NHMP and sample resolution to Salem by September 1, 2012 for local adoption.

Deliverable: Completed NHMP and memo describing changes to the NHMP

Timeline: June 1, 2012

3/22/2012	NHMP Review 2012					
Present	Name	E-Mail Address	Phone Number	Fax Number	Title	Department
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	Gene Bloom	BLOOM_GENE@salkeiz.k12.or.us				
	Glenn Davis	GDAVIS@cityofsalem.net				
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	JOHN VANDERZANDEN	JVanderzanden@co.marion.or.us				
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	Skip Miller	SMILLER@cityofsalem.net	588-6123			Police
d	Wayne McFarlin	wayne.mcfarlin@SalemHealth.org	503-531-1249			
	UBAH ROBIN					



Meeting: Natural Hazards Mitigation Plan Update: Risk Assessment Meeting
Date: April 26, 2012
Time: 1:30-3:30 pm
Location: City of Salem EOC

- I. Welcome and Introductions (5 minutes)**
 - a. Overview of Risk Assessment process

- II. Review Hazard Identification (30 minutes)**
 - a. Update Hazard Inventories

- III. Review Existing Vulnerability Information (45 minutes)**
 - a. Discuss Resource Exposure
 - b. Community Profile discussion
 - c. Review Community Asset Worksheets

- IV. Relative Risk Overview – Exercise (30 minutes)**
 - a. Outline potential severity/impact of potential hazards

- V. Next Steps (10 minutes)**
 - a. THIRA
 - b. Prepare for final Action Item and Implementation Strategy meeting

Drought Hazard Updates

Causes and Characteristics

The National Drought Mitigation Center indicates that drought occurs in virtually all climatic zones, 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 National Drought Mitigation Center categorizes drought into four classifications.

- *Meteorological or climatological droughts*: are defined in terms of the departure from a normal precipitation pattern and the duration of the event. These droughts are a slow-onset phenomenon that can take at least three months to develop and may last for several seasons or years.
- *Agricultural droughts*: link the various characteristics of meteorological drought to agricultural impacts. The focus is on precipitation shortages and soil-water deficits. Agricultural drought is largely the result of a deficit of soil moisture. A plant's demand for water is dependent on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.
- *Hydrological droughts*: refer to deficiencies in surface water and sub-surface water supplies. It is measured as stream flow, and as lake, reservoir, and ground water levels. Hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, the shortage will be reflected in declining surface and sub-surface water levels.
- *Socioeconomic droughts*: occur when physical water shortage begins to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with supply, demand, and economic good. One could argue that a physical water shortage with no socio-economic impacts is a policy success.

History of Drought in the City of Salem

- Added a chart of the significant drought events that have impacted the City of Salem and the broader region throughout recent history.

Risk Assessment

- The extent of the drought depends upon the degree of moisture deficiency, and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city and county. In severe droughts, environmental and economic consequences can be significant.

Probability of Future Occurrence

- The probability of a drought occurring in the City of Salem is **moderate**. This is consistent with the 2008 Hazard Analysis. A moderate probability of occurrence means that one event is likely within a 35-75 year time period.

Vulnerability Assessment

- The City of Salem is **moderately** vulnerable to future drought events. This is consistent with the 2008 Hazard Analysis. This means that 10% of the population is likely to be affected by future drought.

Risk Analysis

- Added new content derived from the City of Salem Steering Committee relative risk assessment, including estimation of risk in terms of health and safety, facilities impact, and community impact.

Earthquake Hazard Updates

Causes and Characteristics

Most large earthquakes in the Pacific Northwest are shallow crustal, deep intraplate, or subduction zone earthquakes. These earthquakes can have great impact on Oregon communities. With its location in the Pacific Northwest, the City of Salem is susceptible to both intraplate and subduction zone earthquakes. Earthquake characteristics include ground shaking, earthquake-related landslides, ground liquefaction, and ground amplification.

Extensive information was added regarding the different types of earthquakes.

- *Crustal fault* earthquakes are the most common types of earthquakes and occur at relatively shallow depths of six to twelve miles below the surface. While most crustal fault earthquakes are smaller than magnitude 4.0 and generally create little or no damage, they can produce earthquakes of magnitudes 7.0 and higher and cause extensive damage.
- Deep intraplate earthquakes occur at depths from 25 to 40 miles below the earth's surface in the subducting oceanic crust, deep intraplate earthquakes can reach magnitude 7.5.
- *Subduction zone* earthquakes are located at a convergent plate boundary, where one plate is submerging beneath the other, i.e. Juan de Fuca and North American plate. If this particular subduction zone were to slip, it could generate a high magnitude event.

This update also includes information about the secondary hazards that can be triggered following seismic activity.

- *Ground shaking* is defined as the motion or seismic waves felt on the Earth's surface caused by an earthquake. Ground shaking is the primary cause of earthquake damage.
- *Ground shaking amplification* refers to the soils and soft sedimentary rocks near the surface that can modify ground shaking from an earthquake. Such factors can increase or decrease the amplification (i.e., strength) as well as the frequency of the shaking.
- *Surface faulting* are planes or surfaces in Earth materials along which failure occurs. Such faults can be found deep within the earth or on the surface. Earthquakes occurring from deep lying faults usually create only ground shaking.
- *Landslides* are also a secondary hazard that can occur from ground shaking.

- *Liquefaction* takes place when ground shaking causes granular soils to turn from a solid into a liquid state. This in turn causes soils to lose their strength and their ability to support weight.

History of Earthquakes in the City of Salem

- Added a chart of the significant earthquakes that have impacted the City of Salem and the broader region in recent history.

Risk Assessment

- No changes

Probability of Future Occurrence

- The probability of an earthquake occurring in the City of Salem is **high**. This is consistent with the 2008 Hazard Analysis. A high probability of occurrence means that one event is likely within a 10-35 year time period.

Vulnerability Assessment

- The City of Salem is **highly** vulnerable to future seismic events. This is consistent with the 2008 Hazard Analysis. This means that more than 10% of the population is likely to be affected by future earthquakes.

Risk Analysis

- Added new content derived from the City of Salem Steering Committee relative risk assessment, including estimation of risk in terms of health and safety, facilities impact, and community impact.
- In 2007 DOGAMI completed a rapid visual screening (RVS) assessment of educational and emergency facilities in the City of Salem, to determine collapse potential during a seismic event. The 2012 update includes information on the number of educational and emergency facilities with low, moderate, high and very high collapse potential.

Extreme Heat Hazard Updates

Extreme heat is a new hazard identified by the 2012 City of Salem Steering Committee and therefore all information is new.

Flood Hazard Updates

Causes and Characteristics

Flooding occurs when climate (or weather patterns), geology, and hydrology combine to create conditions where water flows outside of its usual course. In the City of Salem, geography and climate combine to create chronic seasonal flooding conditions.

Extensive information was added regarding flood types, including information about riverine, shallow and urban flooding.

- *Riverine* flooding typically occurs on larger rivers and streams when water levels overflow their banks, and this type of flooding usually results from large storms or prolonged wet periods.

- *Shallow area* floods are a special type of riverine flooding. FEMA defines a shallow area flood hazard as an area that is inundated by a 100-year flood with a flood depth between one to three feet. Such areas are generally flooded by low velocity sheet flows of water.
- *Urban flooding* occurs where land has been converted from fields or woodlands to developed areas consisting of homes, parking lots, and commercial, industrial and public buildings and structures. In such areas the previous ability of water to filter into the ground is often prevented by the extensive impervious surfaces associated with urban development.

History of Floods in the City of Salem

- Added a chart of the significant floods that have impacted the City of Salem and the broader region throughout recent history; including, the January 2012 flood events.

Risk Assessment

- This update includes a description of rivers throughout the city that experience frequent flooding
- Updated the repetitive flood loss properties information to include eight properties.
- Updated the number of NFIP policies in force (1,068) and the improved CRS standing to a Class Rating of a 6.

Probability of Future Occurrence

- The probability of a flood occurring in the City of Salem is **high**. This is consistent with the 2008 Hazard Analysis. A high probability of occurrence means that one event is likely within a 10-35 year time period.

Vulnerability Assessment

- The City of Salem is **highly** vulnerable to future flood events. This is consistent with the 2008 Hazard Analysis. This means that more than 10% of the population is likely to be affected by future flooding.

Risk Analysis

- Added new content derived from the City of Salem Steering Committee relative risk assessment, including estimation of risk in terms of health and safety, facilities impact, and community impact.

Hazardous Materials Updates

Causes and Characteristics

The 2011 Marion County Natural Hazard Mitigation Plan addresses the severity of any hazardous material release in a community depends on several factors, including the toxicity, quantity, and dispersal characteristics of the hazardous material; local conditions such as wind direction, topography, soil and ground water characteristics; proximity to drinking water resources and populations.

There are three principal modes of human exposure to hazardous materials, **inhalation** of gaseous or particulate materials via the respiratory (breathing) process; **ingestion** of hazardous materials via contaminated food or water; and **direct contact** with skin or eyes. Exposure to hazardous materials can result in a wide range of negative health effects on humans. Hazardous materials are generally classified by their health effects.

- *Flammable materials*: are substances where fire is the primary threat. Common examples include gasoline, diesel fuel, and propane.
- *Explosives*: are materials where explosion is the primary threat. Common examples include dynamite and other explosives used in construction or demolition.
- *Irritants*: are substances that cause inflammation or chemical burns of the eyes, nose, throat, lungs, skin or other tissues of the body in which they come in contact. Examples of irritants are strong acids such as sulfuric or nitric acid.
- *Asphyxiates*: are substances which interfere with breathing. Chemical asphyxiates are substances that prevent the body from using oxygen or otherwise interfere with the breathing process. Common examples are carbon monoxide and cyanides.
- *Anesthetics and narcotics*: are substances which act on the body by depressing the central nervous system. Examples include numerous hydrocarbon and organic compounds.

History of Hazardous Materials Incidents in the City of Salem

- Added a chart of hazardous materials incidents that have impacted the City of Salem between 2010 and 2012. The most common hazardous materials incidents are gas leaks of manageable size.

Risk Assessment

- No changes

Probability of Future Occurrence

- The probability of a hazardous materials incident occurring in the City of Salem is **moderate**. This is consistent with the 2008 Hazard Analysis. A moderate probability of occurrence means that one event is likely within a 35-75 year time period.

Vulnerability Assessment

- The City of Salem is **highly** vulnerable to future hazardous materials incidents. This is consistent with the 2008 Hazard Analysis. This means that more than 10% of the population is likely to be affected by future hazardous materials incidents.

Risk Analysis

- Added new content derived from the City of Salem Steering Committee relative risk assessment, including estimation of risk in terms of health and safety, facilities impact, and community impact.

Landslide Hazard Updates

Causes and Characteristics

According to DOGAMI, economic losses due to landslides for a typical year are estimated to be over \$10 million throughout Oregon. In years with heavy storms, such as in 1996, losses can be an order of magnitude higher and exceed \$100 million. Landslides can be broken down into two categories: (1) rapidly moving; and (2) slow moving, in addition to “on-site” or “off-site” hazards. Rapidly moving landslides are typically “off-site” (debris flows and earth flows) and present the greatest risk to human life, and persons living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury.

Landslides are downhill or lateral movements of rock, debris, or soil mass. The size of a landslide usually depends on the geology and the landslide triggering mechanism. Landslides initiated by rainfall tend to be smaller, while those initiated by earthquakes may be very large. Slides associated with volcanic eruptions can include as much as one cubic mile of material.

Extensive information was added regarding landslide type.

- *Slides* move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface and translational slides where movement occurs along a flat surface. These slides are generally slow moving and can be deep.
- *Rock falls* occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. They are fast moving with the materials free falling or bouncing down the slope.
- *Flows* are plastic or liquid movements in which land mass (e.g. soil and rock) breaks up and flows during movement. Flows are typically rapidly moving and also tend to increase in volume as they scour out the channel. Flows are most commonly caused by heavy rainfall and also earthquakes.

This update also includes information about the conditions that affect the severity of landslides. There are four principal factors that affect or increase the likelihood of landslides:

- Natural conditions and processes including the geology of the site, rainfall, wave and water action, seismic tremors and earthquakes and volcanic activity.
- Excavation and grading on sloping ground for homes, roads and other structures.
- Drainage and groundwater alterations that are natural or human-caused can trigger landslides. Human activities that may cause slides include broken or leaking water or sewer lines, water retention facilities, irrigation and stream alterations, ineffective storm water management and excess runoff due to increased impervious surfaces.
- Change or removal of vegetation on very steep slopes due to timber harvesting, land clearing and wildfire.

History of Landslides in the City of Salem

- Significant landslides in recent history were documented, including events from 1996, 1997, 2005 and 2011.

Risk Assessment

- The 2000 State of Oregon Hazard Mitigation Plan identifies areas most at risk to landslides have steep slopes (25 percent or greater,) or a history of nearby landslides. In otherwise gently sloped areas, landslides can occur along steep river and creek banks, and along ocean bluff faces. At natural slopes under 30 percent, most landslide hazards are related to excavation and drainage practices, or the reactivation of preexisting landslide hazards.
- The 2011 Marion County Natural Hazard Mitigation Plan documents that the severity and 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.

Probability of Future Occurrence

- The probability of a landslide occurring in the City of Salem is **high**. This is consistent with the 2008 Hazard Analysis. A high probability of occurrence means that one event is likely within a 10-35 year time period.

Vulnerability Assessment

- The City of Salem is **moderately** vulnerable to future landslide events. This is consistent with the 2008 Hazard Analysis. This means that 1-10% of the population is likely to be affected by future landslides.

Risk Analysis

- Added new content derived from the City of Salem Steering Committee relative risk assessment, including estimation of risk in terms of health and safety, facilities impact, and community impact.

Volcanic Eruption Hazard Updates

Causes and Characteristics

According to the State of Oregon Natural Hazard Mitigation Plan, the City of Salem and the Pacific Northwest lie within the “ring of fire,” an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the ring of fire, in part because of the movement of the Earth’s tectonic plates.

The primary threat to lives and property from active volcanoes is from violent eruptions that unleash tremendous blast forces, generate mud and debris flows, and produce flying debris and ash clouds. The immediate danger area in a volcanic eruption generally lies within a 20-mile radius of the blast site. This update includes information about the secondary hazards that can be triggered with a volcanic eruption.

- *Ash fall*: One of the most serious hazards from an eruption is the rock (*bombs*) and dust-sized ash particles - called *tephra* - blown into the air. The dust-sized ash particles can travel enormous distances and are a serious by-product of volcanic eruptions. According to the State of Oregon Natural Hazard Mitigation Plan, ash fall deposition is controlled by the prevailing wind direction.
- *Earthquake*: Earthquakes can trigger volcanic eruptions or they can cause them. An earthquake produced by stress changes in solid rock from injection or withdrawal of magma (molten rock) is called a volcano-tectonic earthquake.
- *Lava flow*: Lava flows are streams of molten rock that erupt relatively non-explosively from a volcano and move downslope, causing extensive damage or total destruction by burning, crushing, or burying everything in their paths. Secondary effects can include forest fires, flooding, and permanent reconfiguration of stream channels.
- *Pyroclastic Flows*: Pyroclastic flows are avalanches of rock and gas at temperatures of 600 to 1500 degrees Fahrenheit. They typically sweep down the flanks of volcanoes at speeds of up to 150 miles per hour.
- *Lahars*: A lahar consists of a mixture of water and rock fragments that flow down the slope of a volcano, usually along a stream channel. A lahar can be generated by volcanic activity (for example, melting snow or glacier), prolonged rain, or other weather conditions resulting in rapid snow melt.
- *Debris flows*: Debris flows are sudden and very rapid movements of rock and soil downhill; they are often called mudslides. They can be triggered by a variety of phenomena, including weather conditions, very steep slopes, and earthquakes.
- *Landslides*: Because the volcanoes that form the Cascade Mountains are composed of layers of weak fragmented rock and lava they are prone to gravity driven failure such as landslides. If enough water is incorporated into the material the failure will become a lahar. Primary hazards are to roads, bridges, dams, and buildings that might be constructed on the landslide or be damaged by the movement.

History of Volcanic Eruption in the City of Salem

- Added a chart of volcanoes that have impacted the City of Salem and the broader region throughout history. There have been no recent volcanic events in the region.

Risk Assessment

- According to the Marion County Natural Hazard Mitigation Plan, 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.

Probability of Future Occurrence

- The probability of a volcanic eruption occurring in the City of Salem is **low**. This is not consistent with the 2008 Hazard Analysis and has been updated since 2008. A low probability of occurrence means that one event is likely within a 75-100 year time period.

Vulnerability Assessment

- The City of Salem is **moderately** vulnerable to future volcanic hazards. This is not consistent with the 2008 Hazard Analysis and has been updated since 2008. This means that 1-10% of the population is likely to be affected by future volcanic events.

Risk Analysis

- Added new content derived from the City of Salem Steering Committee relative risk assessment, including estimation of risk in terms of health and safety, facilities impact, and community impact.

Wildfire Hazard Updates

Causes and Characteristics

Extensive information was added regarding the description of various WUI fire characteristics. The WUI can be divided into three categories.

- *Interface fires:* Interface fires are characteristic of classic, mixed and occluded wildland/urban interfaces where homes and development abut wildland boundaries.
- *Wildland fires:* A wildland fire's main fuel source is natural vegetation. Often referred to as forest or rangeland fires, these fires occur in national forests and parks, private timberland, and on public and private rangeland.
- *Firestorms:* Firestorms are events of such extreme intensity that effective suppression is virtually impossible. Firestorms often occur during dry, windy weather and generally burn until conditions change or the available fuel is consumed.

This update also includes information about the conditions that affect the severity of wildfires. Ignition of a wildfire may occur naturally from lightning or from human causes such as debris burns, arson, careless smoking, and recreational activities or from an industrial accident. Once started, four main conditions affect the fire's behavior: fuel, topography, weather and development.

History of Wildfires in the City of Salem

- Added a chart of wildfires that have impacted the City of Salem and the broader region throughout recent history.

Risk Assessment

- While the City of Salem does not have a specific wildfire management plan, The City of Salem is incorporated into the 2008 Marion County Community Wildfire Protection Plan (CWPP). The CWPP takes into consideration risk, values, protection capability, and structural vulnerability
- The Marion County CWPP identifies the City of Salem as an at risk community based upon residential density and Fire District serviceability. The extent of damage to The City of Salem from WUI fires is dependent on a number of factors, including temperature, wind speed and direction, humidity, proximity to fuels, and steepness of slopes.

Probability of Future Occurrence

- The probability of a wildfire occurring in the City of Salem is **moderate**. This is consistent with the 2008 Hazard Analysis. A moderate probability of occurrence means that one event is likely within a 35-75 year time period.

Vulnerability Assessment

- The City of Salem has **low** vulnerability to future wildfire events. This is not consistent with the 2008 Hazard Analysis and has been updated since 2008. This means that less than 10% of the population is likely to be affected by future wildfires.

Risk Analysis

- Added new content derived from the City of Salem Steering Committee relative risk assessment, including estimation of risk in terms of health and safety, facilities impact, and community impact.

Windstorm Hazard Updates

The 2008 NHMP documented windstorms and winter storms together within severe weather hazards. The 2012 update created documentation for windstorm separately from winter storm hazards.

Causes and Characteristics

Extreme winds occur throughout Oregon. The most persistent high winds take place along the Oregon Coast and in the Columbia River Gorge. According to the United States Department of Agriculture, west winds generated from the Pacific Ocean are strongest along the coast and slow down inland due to the obstruction of the Coastal mountain range.

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

History of Windstorms in the City of Salem

- Added a chart of the significant windstorms that have impacted the City of Salem and the broader region throughout recent history; including, the December 2010 Aumsville tornado, and June 2009 and March 2008 windstorm events.

Risk Assessment

- According to The State of Oregon Natural Hazard Mitigation Plan, windstorms that impact the City of Salem typically occur from October to March, and their extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain. Storms are primarily identified by the National Weather Service and provide warning for the City of Salem.

Probability of Future Occurrence

- The probability of a windstorm occurring in the City of Salem is **high**. Even though windstorm is a new independent hazard, this rating is consistent with the 2008 Hazard Analysis for severe weather hazards. A high probability of occurrence means that one event is likely within a 10-35 year time period.

Vulnerability Assessment

- The City of Salem is **highly** vulnerable to future windstorm events. This is consistent with the 2008 Hazard Analysis. This means that more than 10% of the population is likely to be affected by future windstorms.

Risk Analysis

- Added new content derived from the City of Salem Steering Committee relative risk assessment, including estimation of risk in terms of health and safety, facilities impact, and community impact.

Winter Storm Hazard Updates

The 2008 NHMP documented winter storms and windstorm together within severe weather hazards. The 2012 update created documentation for winter storm separately from windstorm hazards.

Causes and Characteristics

According to the State of Oregon Hazard Mitigation Plan, severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting the City of Salem typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.

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.

History of Winter Storms in the City of Salem

- Added a chart of the significant winter storms that have impacted the City of Salem and the broader region throughout recent history; including, the winter storms of December 2008 that warranted a Presidential Disaster Declaration.

Risk Assessment

- All of the City of Salem is vulnerable to winter storms and impacts typically extend region-wide. The magnitude or severity of severe winter storms is determined by a number of meteorological factors including the amount and extent of snow or ice, air temperature, wind speed, and event duration.

Probability of Future Occurrence

- The probability of a winter storm occurring in the City of Salem is **high**. Even though winter storm is a new independent hazard, this rating is consistent with the 2008 Hazard Analysis for severe weather hazards. A high probability of occurrence means that one event is likely within a 10-35 year time period.

Vulnerability Assessment

- The City of Salem is **highly** vulnerable to future winter storm events. This is consistent with the 2008 Hazard Analysis. This means that more than 10% of the population is likely to be affected by future winter storms.

Risk Analysis

- Added new content derived from the City of Salem Steering Committee relative risk assessment, including estimation of risk in terms of health and safety, facilities impact, and community impact.

4/26/2012	NHMP Review 2012					
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Meeting: Mitigation Strategy & Plan Implementation Review and Update

Date: May 17, 2012

Time: 1:30 pm – 4:30 pm

Location: City of Salem EOC

AGENDA

- 1) Introductions & Mitigation Strategy Workshop Overview **(10 minutes)**
- 2) Reviewing and Updating Mission & Goals **(15 minutes)**
- 3) Mitigation Strategy Overview **(1.5 hours)**
 - Action Item Review and Development
- 4) Documenting Changes **(5 minutes)**
- Break **(15 minutes)**
- 5) Plan Implementation and Maintenance Overview **(10 minutes)**
 - Prioritization Process
- 6) Monitoring, Evaluating, and Updating the Plan **(5 minutes)**
- 7) Implementation Through Existing Programs **(15 minutes)**
 - Hazard Mitigation Crosswalk
- 8) Continued Public Involvement **(5 minutes)**
- 9) Next Steps **(10 minutes)**

5/17/2012	NHMP Review 2012					
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2008 NHMP Public Participation Process

2008 NHMP Update

In February 2008, the City of Salem contracted with the Oregon Partnership for Disaster Resilience (the Partnership) at the University of Oregon's Community Service Center to document and facilitate the five-year update of the Salem Natural Hazards Mitigation Plan. Salem Emergency Management re-convened the Mitigation Coordinating Committee (MCC) to guide the development of the 2008 plan update. During the plan update, the MCC's title changed to the Salem Natural Hazards Mitigation Committee (the Committee). The Partnership facilitated three Plan update meetings with the Committee on March 19th, April 30th, and May 22nd, 2008. The 2008 NHMP is available for public viewing on the City's website and the University of Oregon searchable online library.

Steering Committee

The steering committee formed under the guidance of Roger Stevenson, City of Salem Emergency Manager. Steering committee members possessed familiarity with the City of Salem and how it is affected by natural hazard events. The steering committee guided the plan through several steps including goal formation, action item development, stakeholder identification, and information sharing to make the plan as comprehensive as possible. The following organizations were represented and served on the Committee during the 2008 update of the Natural Hazards Mitigation Plan:

- Salem Emergency Management
- Salem Fire Department
- Salem Hospital
- City of Salem Police
- City of Salem Public Works- Development Services Division
- City of Salem Public Works – Emergency Preparedness Division
- City of Salem Public Works – Operations Division
- City of Salem Public Works – Utilities Planning Section
- City of Salem Community Development – Planning Division
- Marion County Emergency Management

Plan Implementation and Maintenance

On June 20, 2008, the Committee submitted the plan to the Oregon Office of Emergency Management to in turn submit to FEMA for pre-approval. The City of Salem City Council subsequently adopted the 2008 plan update on August 25, 2008. Following the adoption of the 2008 NHMP, the Plan underwent review on a bi—annual basis. The following is a list of

dates where the NHMP goals, actions and implementation strategy were discussed and reviewed.

- May 13, 2009
- December 17, 2009
- January, 21, 2010
- February 25, 2010
- March 31, 2011
- October 20, 2011
- November 10, 2011
- January 19, 2012

2012 NHMP Public Participation Process

2012 NHMP Update

The City of Salem is dedicated to directly involving the public in the review and update of the natural hazard mitigation plan. Although members of the steering committee represent the public to some extent, the City of Salem residents are also given the opportunity to provide feedback about the Plan. The Plan will undergo review on a bi—annual basis.

The City of Salem made the Plan available at www.cityofsalem.net for public comment through June 25th – July 11th, 2012. During this same period the public was also invited to participate in a brief survey regarding hazard mitigation planning across the City. The survey was formulated and managed by Oregon Partnership for Disaster Resilience.

Public Involvement Summary

During the public review period a few suggestions were made to improve the 2012 City of Salem NHMP and general hazard mitigation planning throughout the City. The comments are listed below:

2012 NHMP Draft Comments

- A public comment period of less than two weeks is an inadequate timeframe and should be lengthened.
- The 2012 NHMP should address the varying deficiencies within the Salem Revised Code that likely elicit hazards to occur:
 - SRC 65 does not require standard excavation practices for residential property, such as those provided for by the Oregon Structural Specialty Code and the Uniform Building Code.
 - SRC 69 does not consider slope gradient in excavation applications.
 - SRC 75 does not require standard erosion control practices, in particular regarding residential construction.
 - SRC 230.400g (Hillside Development Ordinance) language is suggestive rather than regulatory.

Hazard Mitigation Comments

- The City of Salem should reprioritize capital improvement projects and the allocation of funding, by focusing on the maintenance and retrofit of existing infrastructure and buildings that are vulnerable to hazards.
- The City of Salem should focus risk reduction activities primarily on flood, earthquake, hazardous materials and winter storm hazards.
- Community residents consider elder-care facilities, schools (K-12), hospitals, major bridges, fire and police stations, and higher education institutions as very important community assets.

- Hazard planning should focus on protecting critical facilities, preventing development in hazardous areas, strengthening emergency services and promoting collaboration between diverse community partners.
- Strengthen resilience—focused collaboration between local not-for-profit organizations and the City government through meetings, trainings, drills.

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 State Police – 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 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, police, 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.

What are some Economic Analysis Approaches for Evaluating Mitigation Strategies?

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into three general categories: benefit/cost analysis, cost-effectiveness analysis and the STAPLE/E approach. The distinction between the three methods is outlined below:

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by the state 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.

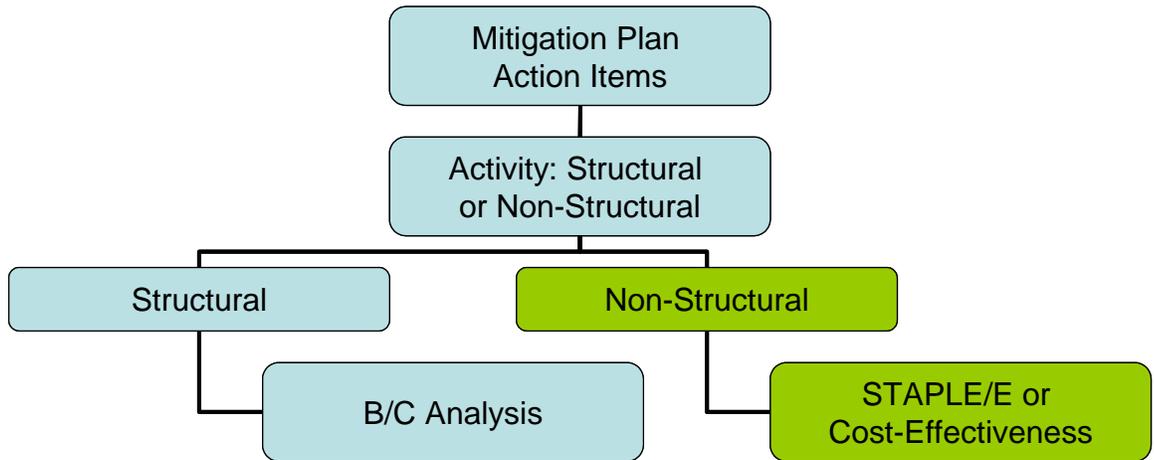
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

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 C.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

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Goettel & Horner Inc., *Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in the City of Portland*, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

Goettel & Horner Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects Volume V, Earthquakes*, Prepared for FEMA's Hazard Mitigation Branch, October 25, 1995.

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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.

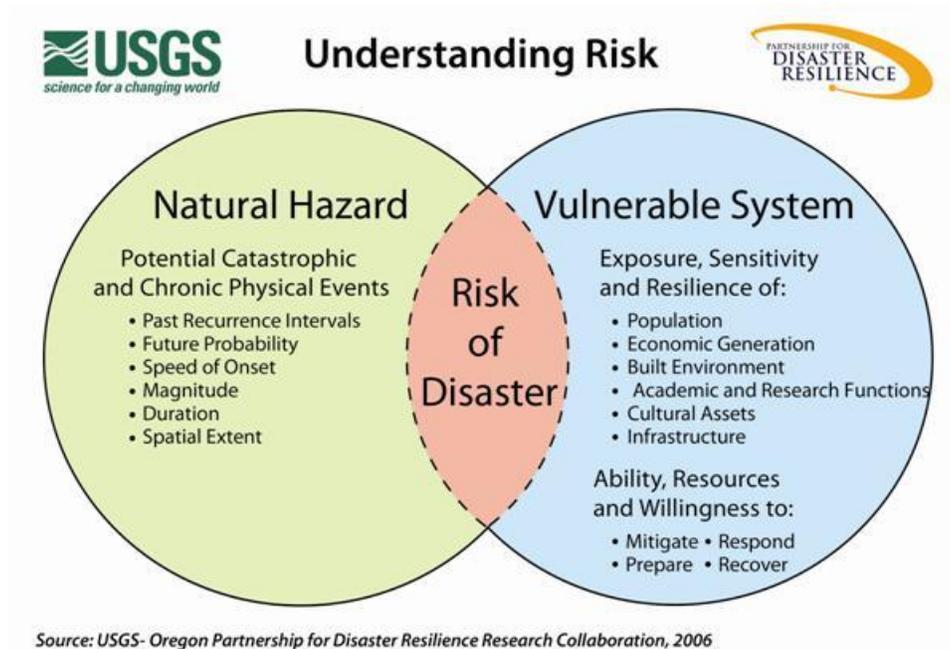
VSP Associates, Inc., *Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects*, 1993.

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: Community Profile

The following section describes the City from a number of perspectives in order to help define and understand the City’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 City when the plan was updated. Sensitivity factors can be defined as those community assets and characteristics that may be impacted by natural hazards, (e.g., special populations, economic factors, and historic and cultural resources). Community resilience factors can be defined as the community’s ability to manage risk and adapt to hazard event impacts (e.g., governmental structure, agency missions and directives, and plans, policies, and programs). The information documented below supplements information contained in the plan’s risk assessment. This section, along with the hazard assessments located in the Hazard Annex, are used to inform the mitigation strategy and 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, or the area of overlap shown in Figure D.1.

Figure D.1 Understanding Risk



Natural Environment Capacity

The capacity of the natural environment is composed of elements known as natural capital. Natural capital is essential in sustaining all forms of life including human life, yet it often plays an underrepresented role in community resiliency to natural hazards. Natural capital

includes land, air, water and other natural resources that support and provide space to live, work and recreate.¹ 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.

Geography and Climate

The City of Salem is located in the Willamette Valley, between the Coast and the Cascade Mountain Ranges and encompasses 47.9 square miles². The average elevation within the city limits is 154 ft. above sea level, ranging from 120 ft. around the Willamette River to 800 ft in the surrounding hills.³ Salem contains the volcanic Salem Hills in the south and is positioned between the 1,000 ft. Eola Hills directly to the west and the 600 ft. Waldo Hills to the east.

Like most of the Willamette Valley, Salem experiences a modified marine climate where winters are cool and wet, while summers are moderately warm and dry.⁴ The average annual precipitation is approximately 39.28 inches with the heaviest rainfall in late fall and winter. While major snow falls are rare, Salem does report an average annual snowfall of 7.1 inches.⁵

The primary river that flows through Salem is the Willamette River; other important streams that pass through are Mill Creek, the Mill Race, Pringle Creek, and the Shelton Ditch. Smaller streams in the eastern part of the city include Clark Creek, Jory Creek, Battle Creek, Croisan Creek and Clagget Creek, while Glen Creek and Brush Creek flow through West Salem.⁶

Salem obtains its drinking water from the North Santiam River watershed, located in the Cascade Foothills. Salem's average summer water use is over 35 million gallons with an average winter use of roughly 23 million gallons⁷.

Land Cover

Salem has a mix of residential, commercial, industrial and agricultural land uses. The central business district is in the core of downtown Salem, to the east of the Willamette River. Residential zoned lands emanate in all directions from the downtown. In many areas, including West Salem, agricultural use lands buffer in between the urban growth boundary and residential zoned areas. Due to the expansive network of rivers and streams throughout Salem, many residential, commercial and industrial zoned lands can be impacted by potential flooding, in the event the Willamette River and other local creeks and streams overflow their banks.

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.

² U.S. Census Bureau. State and County Quick Facts. <http://quickfacts.census.gov/qfd/states/41/4164900.html>. Accessed January 30, 2011

³ Oregon Blue Book. <http://bluebook.state.or.us/local/cities/sy/salem.htm>. Accessed January 30, 2011

⁴ Northwest River Forecast Center. <http://www.nwrfc.noaa.gov/river/river.cgi>

⁵ Oregon Climate Service. <http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?or7500>. Accessed January 30, 2011

⁶ Salem Online History. The Creeks of Salem. http://www.salemhistory.net/natural_history/salems_creeks.htm. Accessed January 30, 2011

⁷ City of Salem. Department of Public Works.

<http://www.cityofsalem.net/Departments/PublicWorks/Operations/Water%20Services/Documents/ccr.pdf>

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. Climate change variability also has the potential to increase the effects of hazards in the area. These factors combined with a growing population and development intensification can lead to increasing risk of hazards, threatening loss of life, property and long-term economic disruption if land management is inadequate.

Socio Demographic Capacity

Socio 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, and educational attainment 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

Between 2000 and 2010, Salem experienced a population percent change of approximately 13% with an average annual growth rate of 1.2%.⁸ These figures are consistent with statewide growth over the same period. The Portland State University Population Research Center projects Salem's population to increase by 28-33% from 2007 – 2030, an increase of approximately 36,000 additional persons in the City by 2030.⁹

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, and education can affect the integrity of a community. Therefore, these human capitals can impact community resilience to natural hazards.

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.¹⁰

While English is the dominant language spoken in Salem, 10.7% of the total population is not proficient in English and speak another primary language at home.¹¹ Table D.1 identifies the percentage of people not proficient in English by primary language, as well as, compared to the total population of Salem.

⁸ U.S. Census Bureau. 2000 and 2010 Census. DP-1.

⁹ Population Research Center College of Urban and Public Affairs Portland State University. Population Forecasts for Marion County, its Cities and Unincorporated Area 2010 – 2030. 2008.

¹⁰ State of Oregon Natural Hazards Mitigation Plan, Region 4 Southwest Oregon Regional Profile.

¹¹ U.S. Census Bureau, 2005-2009 American Community Survey. B16001 Languages Spoken at Home.

Table D.1 Salem Language Barriers

Language	Total Number of Speakers	Number of People not Proficient in English	Percentage of People not Proficient in English	
			By Language	By Total Population
English	111,035	0	0.0%	0.0%
Spanish or Spanish Creole	21,417	11,921	55.7%	8.5%
Russian	1,186	829	69.9%	0.6%
Chinese	982	599	61.0%	0.4%
German	544	47	8.6%	0.0%
Other	4506	1573	34.9%	1.1%
Total Population not Proficient in English				10.7%

Source: U.S. Census Bureau. 2005-2009 American Community Survey. B16001 Languages Spoken at Home.

Race

The impact in terms of loss and the ability to recover may also vary among minority population groups following a disaster. Studies have shown that racial and ethnic minorities can be more vulnerable to natural disaster events. This is not reflective of individual characteristics; instead, historic patterns of inequality along racial or ethnic divides have often resulted in minority communities that are more likely to have inferior building stock, degraded infrastructure, or less access to public services. Table D.2 describes Salem’s population by race and ethnicity.

Table D.2 Salem Race and Hispanic or Latino Origin

Race	Number	Percent
Total Population	154,637	
One Race	148,000	95.7%
White	122,213	79.0%
Black or African American	2,283	1.5%
American Indian and Alaska Native	2,284	1.5%
Asian	4,215	2.7%
Native Hawaiian and Other Pacific Islander	1,460	0.9%
Some Other Race	15,545	10.1%
Two or More Races	6,637	4.3%

Hispanic or Latino Origin	Number	Percent
Total Population	154,637	
Hispanic or Latino (of any race)	31,359	20.3%
Not Hispanic or Latino	123,278	79.7%

Source: U.S. Census Bureau. 2010 Census. QT-P3 Race and Hispanic or Latino Origin.

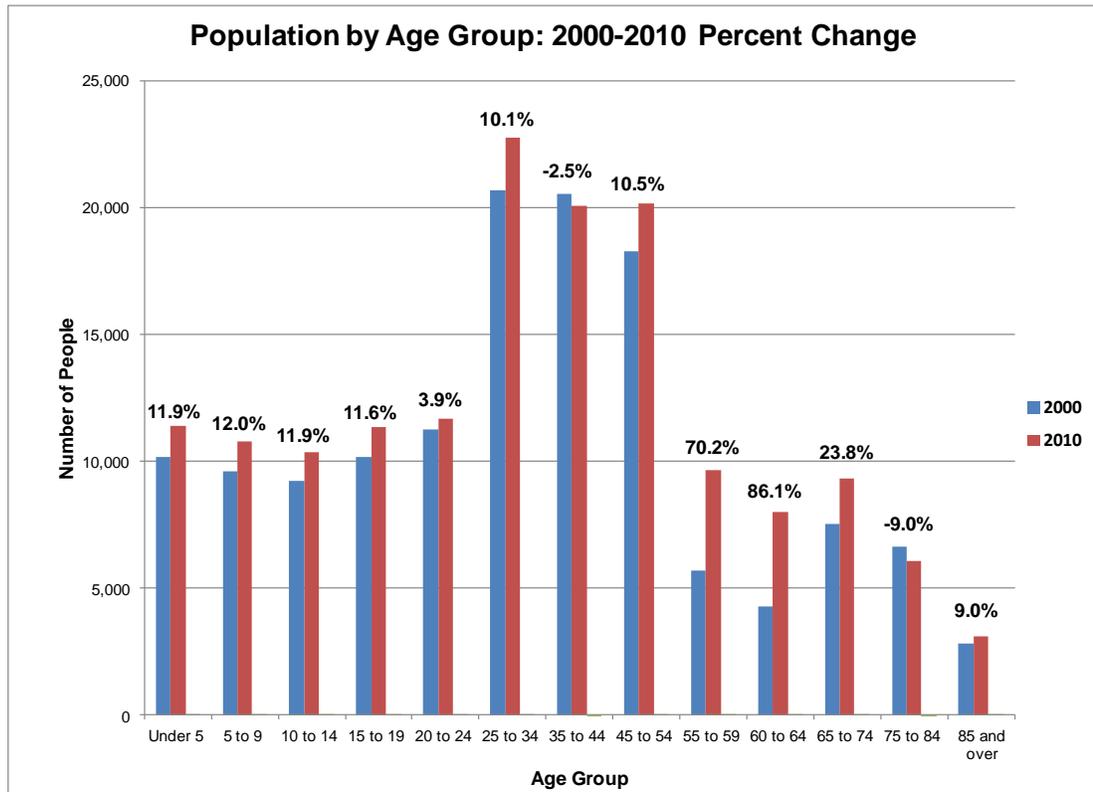
While the majority of people (79%) identify themselves as white, a significant number (21%) identify with a race other than white. Similarly, individuals with Hispanic or Latino origins comprise approximately 20% of the total Salem population. It will be important for the City to identify specific ways to support all portions of the community through hazard preparedness and response. Culturally appropriate, and effective, outreach can include both

methods and messaging targeted to this diverse audience. For example, connecting to historically disenfranchised populations through already trusted sources or providing preparedness handouts and presentations in the languages spoken by the population can go a long way to increasing overall community resilience.

Age

Salem is also experiencing demographic changes in terms of age of the population. From 2000 to 2010 the age group younger than 15 increased by 12%, the 15 – 64 age group increased by 14.1%, and the 65 and older age group increased by 8.5%.¹² Figure D.2 below shows Salem’s population by age and percent change between 2000 and 2010.

Figure D.2 Population by Age Group



Source: U.S. Census Bureau. 2000 and 2010 Census. DP-1 Profile of General Population and Housing Characteristics.

Disaster impacts, in terms of loss and the ability to recover, vary among population groups following a disaster. Historically, 80 percent of the disaster burden falls on the public.¹³ Of this number, a disproportionate burden is placed upon special needs groups, particularly children, the elderly, the disabled, minorities, and low-income persons.

¹² U.S. Census Bureau. 2000 and 2010 Census. DP-1 Profile of General Population and Housing Characteristics.

¹³ Hazards Workshop Session Summary #16, Disasters, Diversity, and Equity. (July 2000). University of Colorado, Boulder.

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. As of 2010, 21% of Salem’s total population is under 15 years of age. In general, children are more vulnerable to the heat and cold, have few transportation options and require assistance to access medical facilities.¹⁴ 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, 12% of the population is elderly, 65 years and older. Older populations may also have special needs prior to, during and after a disaster. Elderly populations may require assistance in evacuation due to limited mobility or health issues. Additionally, they may require special medical equipment or medications, and can lack the social and economic resources needed for post-disaster recovery.¹⁵

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.¹⁶

The median household income in Salem is approximately \$44 thousand; this is five-percent lower than the State of Oregon median income of \$49 thousand.¹⁷ Between 2000 and 2010, Salem experienced a 12.6% growth in income.¹⁸ Table 3 displays the percentage of households with median incomes. Just over a quarter (26.4%) of total households earn less than \$25 thousand annually. To further explain economic vulnerability present throughout Salem, the U.S. Census indicates that 16.7% of the total Salem population and 23.5% of individuals fewer than 18 years of age are in poverty.¹⁹

Table D.3 2010 Salem Median Household Income

	Total Households	Percent of Households
Less than \$24,999	14,953	26.4%
\$25,000 to \$49,999	16,506	29.2%
\$50,000 to \$99,000	16,944	29.9%
\$100,000 or more	8,177	14.5%

Source: U.S. Census Bureau. 2006 - 2010 American Community Survey, DP03 Selected Economic Characteristics

Income is a resilience indicator, as higher incomes are often associated with increased self reliance, and ability to prepare oneself if an emergency does occur. The higher the poverty rate, the more assistance the community will likely need in the event of a disaster, in the form of sheltering, medical assistance and transportation. Notably, higher income populations often have less mobility following significant hazard events because their assets

¹⁴ State of Oregon Natural Hazards Mitigation Plan, Region 4 Southwest Oregon Regional Profile.
¹⁵ Wood, Nathan. *Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon*. U.S. Geological Survey, Reston, VA, 2007.
¹⁶ State of Oregon Natural Hazards Mitigation Plan, Region 4 Southwest Oregon Regional Profile.
¹⁷ U.S. Census Bureau. 2006-2010 American Community Survey. DP03 Selected Economic Characteristics.
¹⁸ Ibid.
¹⁹ Ibid.

may be rooted in the local community. Conversely, lower income members of the population may find it easier to relocate.

Education

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

Table D.4 indicates educational attainment for individuals 25 years or older. The U.S. Census reports 84.5% of the population have graduated high school or received high school equivalency, and 58.9% of the population has received at least some form of higher education.

Table D.4 Educational Attainment

	<u>People</u>	<u>Percent of Population</u>
Less than 9th grade	6,779	7.0%
9th to 12th grade, no diploma	8,264	8.5%
High school graduate or Equivilent	24,915	25.6%
Some college, no degree	23,835	24.5%
Associate's degree	8,989	9.2%
Bachelor's degree	15,370	15.8%
Graduate or professional degree	9,106	9.4%

Source: U.S. Census Bureau. 2006-2010 American Community Survey. DP02 Selected Social Characteristics.

Synthesis

For planning purposes, it is essential Salem consider both immediate and long-term socio-demographic implications of hazard resilience. Immediate concerns regard the language barriers associated with a culturally diverse community. Even though approximately 90% of the entire city population is reported as proficient in English, over half of the native Spanish and Russian speakers are not proficient in English.²⁰ These populations would serve to benefit from mitigation outreach, with special attention to cultural, visual and technology sensitive materials.

The current status of other socio-demographic capacity indicators such as median household income and educational attainment can have long term impacts on the economy and stability of the community. The quality of schools can have significant influence on graduation rate and higher educational attainment. If schools are failing to meet state standards, it can often translate into poor quality of education; and poor education can lead

²⁰ U.S. Census Bureau. 2005-2009 American Community Survey. B16001 Languages Spoken at Home.

to lower paying jobs. Thus educational attainment throughout the community can have long term impacts on future regional employment, income and ultimately community stability and resilience.

Regional Economic Capacity

Regional economic capacity refers to the financial resources present in the community to achieve a higher quality of life. 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.

Economic Diversity

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. Salem's economic capacity is greatly influenced by regional economic diversity across Marion County, as the economy is not physically confined to jurisdictional boundaries. Marion County's economy is highly diversified. According to the Oregon Employment Department, Marion County's 2006 economic diversity rating was ten (with one being the most diverse, and 36 being the least).²¹

An economy that is heavily dependent upon a few key industries may have a more difficult time recovering after a natural disaster than one with a more diverse economic base. Economic resilience to natural disasters is particularly important for the major employment sectors in the region. If, these sectors are negatively impacted by a natural hazard, such that employment is affected, the impact will be felt throughout the regional economy.

Industry & Employment

Key industries are those that represent major employers and are significant to stimulating the local economy. 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.²² 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. Farm and ranch, information, and wholesale trade industries are all examples of basic industries. Non-basic sector industries are those that are dependent on local sales for their business, such as retail trade, construction, and health and social assistance.²³

²¹ Moore, Eric, "Measuring Economic Diversification," Oregon Employment Department, (2001), <http://www.qualityinfo.org/olmisj/ArticleReader?itemid=00002037&print=1>. Accessed January 20, 2010.

²² State of Oregon Natural Hazards Mitigation Plan, Region 4 Southwest Oregon Regional Profile.

²³ Ibid.

Employment by Industry

According to the Oregon Employment Department, Salem unemployment has reduced since 2009 (Table D.5). The largest sectors of employment in the Salem Metropolitan Service Area are Government (28%), Services (24%), and Trade (21%).²⁴

Table D.5 Area Unemployment

	2011 Unemployment Rate	Percent Change from 2009
Salem MSA	9.9	-0.8
Oregon	9.5	-1.6

Source: Oregon Employment Department. Local Area Employment Statistics. QualityInfo.org. Accessed March 2012.

Historically, the Salem area economy has been largely based on government employment, agriculture, food processing, wood and paper products and light manufacturing. However, since the 1980's, manufacturing has shown steady growth away from the traditional lumber and wood products, toward a more diverse group of industries; including manufactured homes, silicon wafers, metal products, electronic equipment, and tourism. The food products industry is the largest single manufacturing sector, employing 3,500 or more people year round, and as many as 10,000 during the peak of the processing season. High technology firms also employ a large number of workers, more than 1,750 on an ongoing basis. The labor force has a diversified skill base and includes: metal workers, assemblers, electrical/electronic technicians, machine operators, computer operators and programmers.²⁵

In the event of a natural disaster, the government sector may not be as vulnerable in the short term as other sectors, because funding streams are established annually and government entities are eligible to receive outside funding sources. However, other large industries such as agriculture, wholesale trade of electronic equipment and manufacturing of food products are industries that may be significantly affected by a disaster as these basic industries tend to rely on sales outside of the community.

Synthesis

The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families and the community to absorb disaster impacts for a quick recovery.

It is important to consider the ramifications if the largest employment 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. It is imperative that Salem recognize that economic diversification is a

²⁴ Salem Chamber of Commerce. Labor Force in Salem. <http://www.salemchamber.org/employment/index.html>. Accessed February 7, 2012.

²⁵ Ibid.

long-term issue; more immediate strategies to reduce vulnerability should focus on risk management for the dominant industries.

Built Capacity

Built capacity refers to the built environment and infrastructure that supports the community. Housing stock, critical facilities and physical infrastructure are critical during a disaster and are essential for proper functioning and response. The lack or poor condition of infrastructure can negatively affect a community’s ability to cope, respond and recover from a natural disaster. Following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediately available resources.

Housing Building Stock

The characteristics of the housing stock effects the level of risk posed by natural hazards. Table 6 identifies the types of housing most common throughout the city. Of particular interest are mobile homes and other non-permanent housing structures which account for 5.8% of the housing in Salem. Mobile structures are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing the structures as they are more prone to wind damage than wood-frame construction.

Table D.6 Salem Housing Profile

	Number of Housing Types	Percentage of Housing Types
Single-Family	38,658	64.2%
Multi-Family	18,025	30.0%
Mobile Homes	3,450	5.7%
Van, RV, Boat, etc.	47	0.1%
Total Housing Units	60,180	

Source: U.S. Census Bureau, 2006-2010 American Community Survey. B25024 Units in Structure.

Age of housing is another characteristic that influences a structure’s vulnerability to hazards. Generally, the older the home is, the greater the risk of damage. Structures built after the late 1960’s in the Northwest utilized earthquake resistant designs and construction.²⁶ Communities began implementing flood elevation ordinances in the 1970’s, and in 1990 Oregon again upgraded seismic standards to include earthquake loading in the building design.²⁷ Table D.7 shows the age of housing stock across the City.

²⁶ Wang Yumei and Bill Burns. “Case History on he Oregon Go Bond Task Force: Promoting Earthquake Safety in Public Schools and Emergency Facilities.” National Earthquake Conference. January 2006.

²⁷ Ibid.

Table D.7 Housing Year Built

	Structures	Percentage
Total Housing Units	60,180	
Pre 1970	22,298	37.10%
1970 - 1989	12,476	32.40%
1990 and Later	18,406	30.60%

Source: U.S. Census Bureau, 2006-2010 American Community Survey. B25034 Year Structure Built.

Knowing the age of the structure is helpful in targeting outreach regarding retrofitting and insurance for owners of older structures.²⁸ Based on U.S. Census data, 37.1% of the housing in Salem was built prior to 1970 and the implementation of flood elevation requirements. There is a need to identify if these homes are located in a floodplain, and target outreach to the property owners to encourage appropriate flood mitigation. Roughly 30.6% of the housing units in the city were built after 1990 when more stringent building codes were put in place; an additional 32.4% of housing stock was built prior to current seismic standards.²⁹ In addition to single-family households, it is also important to consider the structural integrity of multi-unit residences, as these structures will have an amplified impact on the population.

In 2010, Salem had 61,276 housing units. Of those 93.5% were occupied (57,290) and 6.5% (3,986) were vacant.³⁰ Of the occupied housing units, 55.7% were owner occupied, and 44.3% were renter occupied.³¹ Studies have shown that renters are less likely than homeowners to prepare for catastrophic events.³² Renters tend to have higher turnover rates that may limit their exposure to hazard information. Likewise, preparedness campaigns tend to pay less attention to renters. Renters typically have lower incomes and fewer resources to prepare for natural disasters, and renters may lack the motivation to invest in mitigation measures for a rented property.³³

Critical Facilities

Critical Facilities include buildings, their internal components and trained personnel, and may also include certain mobile units, such as those of first responders. For example, many vehicles of the police department, fire department (including ambulances), and public works department are key and essential components of the functions provided by these critical facilities.³⁴ The interruption or destruction of any of these facilities would have a debilitating effect on incident management and long-term recovery. Not all Critical Facilities are of equal importance, and are therefore subject to prioritization of criticality. The critical facilities identified by the City of Salem are reported in Table D.8

²⁸ State of Oregon Natural Hazards Mitigation Plan, Region 4 Southwest Oregon Regional Profile.

²⁹ U.S. Census Bureau, 2005-2009 American Community Survey. B25034 Year Structure Built 5 Year Estimate.

³⁰ U.S. Census Bureau, 2010 Census. QT-H1 General Housing Characteristics

³¹ Ibid.

³² Morrow, 1999; Burby and others, 2003.

³³ Burby and others, 2003.

³⁴ City of Salem. Salem Local Energy Assurance Plan. 2011.

Critical facilities in Salem are identified in Table D.8. While lifelines and other physical infrastructure, such as, dams, power generation facilities and transmission lines, are also critical, they have been documented under physical infrastructure and utility lifelines for the purposes of this profile. This information provides the basis for informed decisions about the infrastructure and facilities already in place that can be used to reduce the vulnerability of Salem to natural hazards.

Table D.8 Salem Critical Facilities

Facility Name	Type
Priority 1	
Anderson Readiness Center	Emergency Coordination/Communication
City Hall	Governance
Fire Station 1/ Fire Dept DOC	Emergency Response
Fire Station 10	Emergency Response
Fire Station 11	Emergency Response
Fire Station 2	Emergency Response
Fire Station 3	Emergency Response
Fire Station 4	Emergency Response
Fire Station 5	Emergency Response
Fire Station 6	Emergency Response
Fire Station 7	Emergency Response
Fire Station 8	Emergency Response
Fire Station 9	Emergency Response
Fire Training/ Secondary EOC	Emergency Response
IT Department	Governance
Marion County Public Works	Emergency Response
Oregon State Hospital Breitenbush Hall	Medical
Oregon State Hospital Building 48	Medical
Oregon State Hospital Eola Building	Medical
Oregon State Hospital McKenzie Hall	Medical
Oregon State Hospital Santiam Hall	Medical
Salem Health Laboratories	Medical
Salem Hospital Center For Outpatient Medicine	Medical
Salem Hospital Critical Care Tower	Medical
Salem Hospital Family Birth Center	Medical
Salem Hospital Regional Rehabilitation Center	Medical
Salem Hospital Winter Street Building	Medical
Salem Police Department/ Police Dept DOC	Emergency Response
Shop #19 Fleet Services Fuel Island	Transportation
Shop #2 Public Works Field Office/ DOC	Emergency Response
Shop #24 Radio Communication	Emergency Coordination/Communication
Shop #3 Fleet Services Office	Emergency Coordination/Communication
Willamette Valley Communication Center/ EOC	Emergency Coordination/Communication

Priority 2	
Cherriots	Transportation
Comcast - Electrical Blg	Energy
GTE	Energy
Info Tech Computer Support For Salem IT	Emergency Response
Portland General Electric Company	Energy
Qwest	Energy
Salem Area Transit Dispatch	Transportation
Salem Area Transit Fuel Station	Transportation
Salem Area Transit Maintenance Shop	Transportation
Salem Area Transit Wash Rack	Transportation
Salem Electric	Energy
Salem Keizer School District Central Services, 24J	Mass Care and Shelter
Salem/Keizer School District Admin Office	Mass Care and Shelter
Priority 3	
Airport	Transportation
Airport Tower	Transportation
Amtrak	Transportation
Army Aviation Support	Emergency Response
Main Library	Miscellaneous
Salem Housing Authority	Miscellaneous
School District 24J Reprographics	Miscellaneous
Transfer/Recycle Station	Miscellaneous
Weather Service	Governance
Priority 4	
Adult Mental Health	Special Needs
Harmony House	Special Needs
Mid-Willamette Valley Senior Center	Mass Care and Shelter
Northwest Senior And Disability Services	Mass Care and Shelter
Northwest Senior And Disability Services	Mass Care and Shelter
Seniors And Disabled Services	Special Needs
South Salem Sr. Center	Mass Care and Shelter

Source: City of Salem. Salem Local Energy Assurance Plan. 2011.

Salem is also unique in that there are a number of state owned government buildings throughout the City. These buildings are essential to government continuity throughout the entire state and should be included as critical infrastructure. It is essential that Salem recognize their importance; however the City does not necessarily have control over them.

Physical Infrastructure

Physical infrastructure includes transportation networks, dams and utilities. These infrastructures support the Salem community and economic activity. 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.³⁵

TRANSPORTATION

Roads & Bridges

Roads and bridges in the City of Salem are highly vulnerable to hazards specifically earthquakes. Because bridges vary in size, materials, siting, and design, any given hazard will affect them differently. When considering the expanse and integrity of transportation infrastructure within Salem and how it will impact the resilience of the City, it is imperative that infrastructure across Marion County is also considered. If a principal arterial is obstructed beyond the City limits it will likely have significant impacts on access in and out of Salem.

Interstate-5 (I-5) is the principle arterial that connects Salem to northern and southern Oregon, and traverses through the interior of the City. There are also two non-interstate principal arterials: Highway 22 and 99E. Highway 22 runs east and west, connecting the Oregon Coast to Central Oregon through Salem. Highway 99E runs north and south, and provides connections to Interstate-205 (I-205) at Oregon City, as well as, Corvallis and Eugene to the South. Both of these non-interstate principle arterials serve as the main access for rural areas outside of Salem, including, Dallas, Independence and Monmouth.

Bridge condition surrounding the City is also a factor that affects risk from natural hazards. Bridges damaged by hazards such as earthquakes can disrupt traffic and exacerbate economic losses because of the inability of industries to transport services and products to clients. The Marion County Public Works Department has assigned bridges with an operating rate, which determines whether overweight trucks can receive a permit to cross the bridge and if any requirements will be placed on their usage of the bridge. Six bridges just beyond the Salem City limits are presently restricted to certain maximum vehicle weights or dimensions. Table D.9 lists the weight and height restrictions of these bridges and shows the functional class of the roadway crossing that bridge.

Table D.9 Marion County Bridges: Height and Weight Restrictions

Facility	Over	Restriction	Functional Class
Gallon House Rd.	Abiqua Creek	Weight 20 Tons, Height 14' 2, "One Lane Bridge"	Local
Mt. Angel-Gervais Rd.	Pudding River	Weight 20 to 39 Tons (Depending on Configuration)	Minor Collector
Jefferson-Marion Rd.	SP Railroad	Weight 40 Tons	Arterial
Labish Center Rd.	Little Pudding River	Weight 40 Tons	Minor Collector
Rambler Dr.	Little Pudding River	Weight 40 Tons	Local
River Rd. S	Willamette River	Weight 40 Tons	Arterial

Marion County Rural Transportation Plan, 2005.

³⁵ State of Oregon Natural Hazards Mitigation Plan, Region 4 Southwest Oregon Regional Profile.

Limiting maximum vehicular weight on bridges can reduce bridge maintenance, extend bridge lifespan, and preserve transportation system continuity. Bridges provide functional links for Salem transportation corridors, and if they are not maintained the bridge may become unusable in the event of a natural disaster, effectively isolating the City if no other alternative transportation network exists.

Alternate Modes of Transport

Other important modes of transportation include railway, airports and public transportation. Union Pacific and Oregon Short Lines operate freight lines that traverse through Salem, connecting the transport of products to Washington and California.³⁶ The Oregon Department of Transportation also identifies four Amtrak passenger routes through the City: Routes 14, 9, 8 and 7. These routes transport people within the State and also Washington and California.³⁷ Facilities that support air travel include McNary Field, the only commercial service public use airport, three private use airports, and one heliport at the Salem Hospital.³⁸ Salem's mass transit services include Salem-Keizer Transit (Cherriots), serving the Salem-Keizer urban area, and the Chemeketa Area Regional Transportation System (CARTS). CARTS is a partnership between Marion, Polk and Yamhill Counties that provides weekday public transit for elderly and disabled persons as well as the general public.³⁹

DAMS

Dams play a crucial role in power generation and water control mechanisms for the region. Dam failures can occur rapidly and with little warning.⁴⁰ Fortunately most failures result in minor damage and pose little or no risk to life safety.⁴¹ However, the potential for severe damage still exists. The Oregon Water and Resources Department has inventoried all dams located across Marion County and Salem. The "hazard level" estimates the amount of damage that could occur in the event of dam failure.

Marion County has over 56 dams, and two are ranked at a high hazard level: Detroit Dam and Big Cliff Dam. Detroit and Big Cliff are hydroelectric dams that control the flow of water on the Santiam River, providing a major boating and recreational area. However, both dams are considered a major hazard for the large population downstream that would be at risk in the event of a dam failure, including populations in Salem. Besides the Detroit and Big Cliff dams, other major dams surrounding the Salem area include Waconda and Silverton.⁴²

UTILITY LIFELINES

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

³⁶ Oregon Department of Transportation. Oregon.gov.
http://www.oregon.gov/ODOT/RAIL/docs/Maps_Drawings/OR_Railroad.pdf

³⁷ Oregon Department of Transportation. Oregon.gov.
http://www.oregon.gov/ODOT/RAIL/docs/Maps_Drawings/Passrailmap.pdf

³⁸ Oregon Department of Transportation. Department of Aviation.
http://www.oregon.gov/Aviation/municipal_airports.shtml

³⁹ Ibid.

⁴⁰ Federal Emergency Management Agency. Dam Failure. www.fema.gov/hazard/damfailure/index.shtml. Accessed November 18, 2011.

⁴¹ Ibid.

⁴² Marion County. Oregon Emergency Operations: Basic Plan. 2005.

severely impaired. Utility lifelines are closely related to physical infrastructure, (i.e., dams and power plants) as they transmit the power generated from these facilities.

More than half of Oregon's electricity comes from hydropower, and about one percent comes from renewable sources, primarily biomass and wind.⁴³ The network of electricity transmission through Salem and the greater Marion County area is operated and distributed by the Bonneville Power Administration and Pacific Power.⁴⁴

Oregon does not have any crude oil resources or refineries, and so must import all of its petroleum products. Most is extracted and refined regionally – 90% of Oregon's petroleum products are refined in the Puget Sound area of Washington and 80% of the crude oil used to make these products comes from Alaska's North Slope oil fields.⁴⁵ The remainder of Oregon's petroleum comes primarily from refineries in Utah and British Columbia. Most of Oregon's oil enters on tanker ships at the Port of Portland, and is then distributed via tanker truck or via the Kinder-Morgan pipeline, which runs from Portland south to Eugene.⁴⁶ Although the Kinder-Morgan pipeline passes through Salem, it does not have an outlet there; Salem receives its petroleum via tanker truck. Oregon's petroleum supply system has a number of vulnerabilities that pose a risk to Salem. First, there is the possibility for disruption of the transmission system: the pipelines are 30 years old, and tanker trucks rely on the road network.⁴⁷

Synthesis

Given that Salem is the State Capital and the second largest city in the state, it is that much more critical to maintain the quality of built capacity throughout the area, as it is likely that surrounding jurisdictions will seek assistance from Salem. The planning considerations seemingly most significant for the city are contingency planning for emergency services, medical resources and lifeline systems. As mentioned above, functionality of the critical facilities should be a significant priority in providing for Salem residents. To maintain functionality, memorandums of understanding can be established with surrounding cities and counties for medical transport, treatment, utility and transportation lifeline 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.

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 capital is present in all communities; however, it may

⁴³ Loy, W. G., ed. 2001. Atlas of Oregon, 2nd Edition. Eugene, OR: University of Oregon Press

⁴⁴ Ibid.

⁴⁵ Oregon Department of Energy, "Nuclear and Energy-Related Emergency Preparedness" www.oregon.gov/ENERGY/.../emergency_preparedness_fact_sheet.p.

⁴⁶ City of Salem. Salem Local Energy Assurance Plan. 2011

⁴⁷ Ibid.

be dramatically different from one town to the next as these capitals reflect the specific needs and composition of the community residents.

Social Organizations

Social and cultural capital include community organizations and programs that provide community-based services, such as employment, health, senior and disabled services, professional associations and veterans' affairs for the public. In planning for natural hazard mitigation, it is important to know what social systems exist within the community because of their existing connections to the public. Often, actions identified by the plan involve communicating with the public or specific subgroups within the population (e.g. elderly, children, low income, etc.). The city 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 social organizations identified in Salem can be involved in hazard mitigation; a few methods are defined below.

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

Table D.10 Community Organizations and Programs

Name and Contact Information	Description	Service Area	Populations Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low Income	
American Legion 4774 Lilac Lane, Salem Phone: (503) 393-5560	Condensed Mission Statement: to inculcate a sense of individual obligation to the community, state and nation; to combat the autocracy of both the classes and the masses; to make right the master of might; to promote peace and goodwill on earth; to safeguard and transmit to posterity the principles of justice, freedom and democracy; to consecrate and sanctify our comradeship by our devotion to mutual helpfulness.	Marion County		X	X	X	X	X	<ul style="list-style-type: none"> • Information dissemination
American Red Cross (Willamette Valley Chapter) 675 Orchard Heights Road NW, Suite 200 Salem, OR 97304 Phone: (503) 585-5414	The American Red cross, a humanitarian organization led by volunteers and guided by its Congressional Charter and the Fundamental Principles of the International Red Cross Movement, will provide relief to victims of disaster and help people prevent, prepare for, and respond to emergencies.	Willamette Valley		X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination • Plan/project implementation
Boy Scouts of America 4395 Liberty Road South, Salem Phone: (503) 581-6601	To provide numerous volunteer services to community members in addition to preparing boys and young men for active participation in community life.	Marion County		X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Boys and Girls Club of Salem, Marion and Polk Counties 1395 Summer Street NE, Salem Phone: (503) 581-7383	To inspire and enable all young people, especially those from disadvantaged circumstances, to realize their full potential as productive, responsible, and caring citizens.	Marion County		X				X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
City of Salem Center 50+ 2615 Portland Road NE, Salem Phone: (503) 588-6303	Organization poised to meet the needs of the 50+ population of Salem	Salem			X	X			<ul style="list-style-type: none"> • Education and outreach • Information dissemination

Name and Contact Information	Description	Service Area	Populations Served						Involvement with Natural Hazard Mitigation	
			Businesses	Children	Disabled	Elders	Families	Low Income		
Early Learning Center 765 14th St. NE, Salem Phone: (503) 391-4964	Provide early learning opportunities to toddlers and preschoolers.	Salem/Keizer		X				X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Girl Scouts 1922 McGilchrist St. SE, Salem Phone: (503) 581-2451	To provide numerous volunteer services to community members in addition to preparing girls and young women for active participation in community life.	Marion County	X	X	X	X	X	X		<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Marion County Amateur Radio Marion County ARES C/O Marion County Emergency Management 5155 Silverton Rd NE Salem, OR 97305	Providing voluntary communications in time of need.	Marion County	X					X		<ul style="list-style-type: none"> • Education and outreach • Information dissemination • Plan/project implementation
Marion County Assisted Living Facilities	Complete listing of all facilities is available at: http://www.caring.com/local/assisted-living-facilities-in-marion-county-oregon	Marion County		X	X	X	X			<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Marion County Floodplain Program	Promote public health, safety and general welfare and to minimize public and private losses due to flood conditions.	Marion County	X	X	X	X	X			<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Marion County Search and Rescue PO Box 527, Salem Phone: (503) 373-4160	Helping search for individuals who appear to be lost or away from civilization for any number of reasons, and helping rescue such individuals if they are discovered to be in need of assistance.	Marion County	X	X	X	X	X	X		<ul style="list-style-type: none"> • Education and outreach • Information dissemination • Plan/project implementation
Marion-Polk Food Share 1660 Industrial Dr. NE, Salem Phone: (503) 581-3855	Food bank	Marion and Polk Counties	X	X	X	X	X	X		<ul style="list-style-type: none"> • Education and outreach • Information dissemination

Name and Contact Information	Description	Service Area	Populations Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low Income	
Marion Soil and Water Conservation District 650 Hawthorne Ave. SE Ste # 130, Salem Phone: (503) 391-9927	The mission of the Marion Soil and Water Conservation District is to protect, conserve and improve the quality of soil and water in Marion County through planning, technical assistance and education.	Marion County	X	X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Mid Willamette Valley Community Action Agency 2475 Center St. NE, Salem Phone: (503) 585-6232	Mission Statement: strengthen our communities through partnerships and programs which encourage, assist, and inspire individuals toward optimum self-management and well-being.	Marion and Polk Counties		X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
N.W. Natural Gas Company 3123 Broadway Street Northeast, Salem Phone: (503) 585-6611	Provides natural gas to homes and businesses in the region.		X				X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
OSU Extension Service 3180 Center St. NE Room 1361, Salem Phone: (503) 588 5301	Engages the people of Oregon with research-based knowledge and education that focus on strengthening communities and economies, sustaining natural resources, and promoting healthy families and individuals.	Marion County	X	X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Rotary Club of Salem 200 Commercial St. SE, Salem Phone: (503) 931-4120	Rotary is a worldwide organization of business and professional leaders that provides humanitarian service, encourages high ethical standards in all vocations, and helps build goodwill and peace in the world.	Salem	X	X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Salem Job and Career Center 605 Cottage Street NE, Salem Phone: (503) 378-4846	Employment Service	Salem						X	<ul style="list-style-type: none"> • Information dissemination

Name and Contact Information	Description	Service Area	Populations Served					Involvement with Natural Hazard Mitigation	
			Businesses	Children	Disabled	Elders	Families		Low Income
Salem Keizer Transit 220 High Street Northeast, Salem Phone: (503) 588-2424	Provides public transportation services within the urban growth boundary of Salem and Keizer. Mission is to enhance community livability by providing safe, efficient, and reliable public transportation services.	Salem and Keizer	X	X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Salem ELKS Lodge #336 2336 Turner Rd SE, Salem Phone: (503) 364-6839	Mission Statement: the benevolent and protective order of Elks of the United States of America will serve the people and communities through benevolent programs, demonstrating that Elks Care and Elks Share.	Salem		X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Salem Area Chamber of Commerce 1110 Commercial Street NE, Salem Phone: (503) 581-1466	Provide economic development assistance to local businesses.	Salem	X	X		X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination • Plan/project implementation
Salvation Army - Salem Community Center 1230 Winter St. E, Salem Phone: (503) 399-1230	Provides emergency assistance to people in need	Marion County		X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Strategic Economic Development Corporation(SED COR) 626 High Street NE Suite 200, Salem Phone: (503) 588-6225	SEDCOR is a private, non-profit membership organization comprised of over 500 businesses and community leaders dedicated to enhancing and diversifying the mid-Willamette economy.	Marion and Polk Counties	X	X	X	X	X	X	<ul style="list-style-type: none"> • Education and outreach • Information dissemination
Wheels Community Transportation	Provides transportation for elderly and disabled clientele.	Salem and Keizer			X	X			

Cultural Resources

Historic and cultural resources such as historic structures and landmarks can help to define a community and may also be sources for tourism revenue. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

The National Register of Historic Places reports 62 historically significant structures in Salem; this is 58% of the historic structures across Marion County.⁴⁸ A complete list of these structures can be found on the Oregon State Historic Preservation Office website at:

http://www.oregonheritage.org/OPRD/HCD/NATREG/docs/oregon_nr_list.pdf

The historic and cultural resources across Salem are maintained by the Marion Cultural Development Corporation. The non-profit preserves, enhances and supports the arts, history, architecture, libraries, museums, festivals and other cultural assets for the public.

Synthesis

Salem comprises various social and cultural resources that work in favor to increase community connectivity and resilience. Sustaining and preserving social and cultural resources such as, social services and historic places may be essential to preserving community cohesion and a sense of place. It is important to consider that these social services may not be equally accessible to residents of rural areas beyond Salem jurisdictional boundaries, and Salem may need to expand these provisions beyond traditional service areas.

Political Capacity

Political capacity includes the government and planning structures established within the community. Public access to the political process is also an important element of Political Capital. 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.⁴⁹ 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

Salem operates under the council-manager form of city government. The Mayor and the eight City Councilors are elected by the citizens and they develop the policies that direct city operation. The Mayor and Council hire the City Manager to implement policy direction and

⁴⁸ National Register of Historic Places, "2006 State Listings: Oregon-Marion County".
<http://www.nationalregisterofhistoricplaces.com/or/Marion/state2.html>. Accessed January 19, 2010.

⁴⁹ Mileti, D. 1999. Disaster by Design: a Reassessment of Natural Hazards in the United States. Washington D.C.: Joseph Henry Press.

actually manage city operations. The City Charter provides the authority under which the city operates and outlines roles of the Mayor, Council, and City Manager.⁵⁰

Beyond Emergency Management, most departments within the city governance structure have some degree of responsibility in building overall community resilience. Each plays a role in ensuring that city functions and normal operations resume after an incident, and the needs of the population are met.

Some divisions and departments of Salem government that have a role in hazard mitigation are:⁵¹

- **Community Development Department:** assists citizens in developing a dynamic and livable city through responsible land use planning and zoning, consistent application of building codes, solid support for compliance with all city codes, neighborhood association issues, and youth development.
 - **Planning Division:** is composed of two separate but intertwined programs. The Current Planning Program provides efficient, timely and fair development review, ensures compliance with land use rules, and protects and preserves historic heritage. The Long Range Planning Program ensures compliance with state land use planning goals, policies, and rules to maintain quality of living opportunities and to ensure well planned community growth.
 - **Building and Safety Division:** encompasses construction plans review, inspection services, and permitting; professional and police protective licensing; maintenance of multifamily-housing licensing; and other development information.
- **Public Works:** constructs and maintains the infrastructure necessary for the basic urban needs of the Salem metropolitan area. This includes a safe and reliable road system, healthy and plentiful water supply, a well-functioning storm drainage system, and proper treatment of wastewater.
 - **Parks & Transportation Services Division:** is responsible for parks maintenance, recreation, planning, traffic engineering, and maintenance of the City's transportation systems.
- **Information Technology & Facilities:** is responsible for the City of Salem's technical environment, building maintenance, operations and support. Working together with other City Departments, IT and Facilities provides solutions and support for building assets, computer networks, copy services, and telecommunication.

⁵⁰ City of Salem, City Government. <http://www.cityofsalem.net/CITYCOUNCIL/Pages/default.aspx>. Accessed February 21, 2012.

⁵¹ City of Salem, Departments. <http://www.cityofsalem.net/DEPARTMENTS/Pages/default.aspx>. Accessed February 12, 2012.

- **Building Operations:** maintains the City’s building operating systems through preventive and corrective maintenance at more than 90 city-owned structures, including the daily upkeep of the downtown parking structures and cemented areas.
- **Network & Technical Services:** cooperatively works with the City of Salem Departments and regional entities so as to maintain; personal computers, network servers, network connectivity, data security, and telephone services.
- **Geographic Information Systems (GIS):** is used by the City in a number of ways serving City staff, local and global businesses, and our citizens through mapping and spatial data.
- **Police:** The Salem Police Department brings police and citizens together to better fight crime in the community. Their mission is to reduce the fear of crime, protect individual rights, and enhance the quality of life.

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.⁵²

The City of Salem Natural Hazard Mitigation Plan includes a range of recommended action items that, when implemented, will reduce the city’s vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the city’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 city’s resources. The following are a list of plans and policies already in place in Salem and Marion County.

- City of Salem Emergency Management Plan
- Salem Area Comprehensive Plan
- Salem Transportation Plan
- Preliminary Capital Improvement Plan
- City of Salem Comprehensive Park and Recreation System Master Plan
- City of Salem Stormwater Management Plan
- Salem Local Energy Assurance Plan

⁵² Burby, Raymond J., ed. 1998. Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities.

Synthesis

As addressed above, many governmental entities are responsible for work relevant to hazards planning; however, from this perspective it is challenging to decipher whether these structures work collaboratively in practice towards improving hazard mitigation. On a similar note, in short of reviewing each of the relevant policy documents it is questionable whether the documents effectively integrate hazard initiatives into implementation policy. Further analysis is needed to evaluate the effectiveness of political capital in terms of community resilience.

Appendix E: Grant Programs

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/government/grant/hmgrp/>

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/services/disasterassistance/index.html>

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/government/grant/pdm/index.shtm>

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/government/grant/fma/index.shtm>

Detailed program and application information for federal post-disaster and pre-disaster programs can be found in the FY10 Hazard Mitigation Assistance Unified Guidance, available at <http://www.fema.gov/library/viewRecord.do?id=3649>

For Oregon Emergency Management grant guidance on Federal Hazard Mitigation Assistance, visit: http://www.oregon.gov/OMD/OEM/plans_train/grant_info/hma.pdf

OEM contact: Dennis Sigrist, dsigrist@oem.state.or.us

State Programs

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 Hazard 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://www.hud.gov/offices/cpd/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.
- <http://www.oweb.state.or.us/>

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&org=SES

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/plan/prevent/fhm/index.shtm>
- 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/ncgmpstandards/>
- 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/>

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, HUD. 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://www.hud.gov/offices/cpd/communitydevelopment/programs/entitlement/>
- National Fire Plan (DOI – USDA) Provides technical, financial, and resource guidance and support for wildland fire management across the United States. Addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability. <http://www.forestsandrangelands.gov/NFP/index.shtml>
- Assistance to Firefighters Grant Program, FEMA. 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.firegrantsupport.com/>
- 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/programs/EWP/>

- Rural Development Assistance – Utilities, USDA. Direct and guaranteed rural economic loans and business enterprise grants to address utility issues and development needs.
<http://www.usda.gov/rus/>
- Rural Development Assistance – Housing, USDA. 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/rhs/>
- 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/government/grant/pa/index.shtm>
- National Flood Insurance Program, FEMA. Makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements.
<http://www.fema.gov/business/nfip/>
- HOME Investments Partnerships Program, HUD. 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. Grants to fund gaps in available recovery assistance after disasters (including mitigation).
<http://www.hud.gov/offices/cpd/communitydevelopment/programs/dri/driquickfacts.cfm>
- Emergency Management Performance Grants, FEMA. Helps state and local governments to sustain and enhance their all-hazards emergency management programs.
<http://www.fema.gov/government/grant/empg/index.shtm#0>
- Partners for Fish and Wildlife, DOI – FWS. 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. Cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats. <http://www.doi.gov/partnerships/wetlands.html>
- 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/flp_questions.html
- Wetlands Reserve program, USDA-NCRS. Financial and technical assistance to protect and restore wetlands through easements and restoration agreements.
<http://www.nrcs.usda.gov/Programs/WRP/>
- Secure Rural Schools and Community Self-Determination Act of 2000, US Forest Service. Reauthorized for FY2008-2011, 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.fed.us/srs/>