Eugene-Springfield Multi-Jurisdictional
NATURAL HAZARDS MITIGATION PLAN

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Prepared for:

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1 Mitigation Plan

1.1 What is Natural Hazard Mitigation?

Natural hazard mitigation is defined as permanently reducing or alleviating the losses of life, property and injury resulting from natural hazards through long and short-term strategies. Strategies can include policy changes, such as updating ordinances; projects, such as seismic retrofits to critical facilities; or education and outreach to targeted audiences, such as residents with limited English skills and the elderly.

Hazard mitigation is the responsibility of 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 and property, improved delivery of essential services, economic stability, reduced cost and shortened recovery period following natural hazard events.

Finally, mitigating hazards makes simple financial sense. A report submitted to Congress by the National Institute of Building Science's Multi-hazard Mitigation Council (MMC) indicates that for every dollar spent on mitigation, society can expect an average savings of four dollars.

1.1.1 Why Develop a Mitigation Plan?

Eugene and Springfield jointly developed this Natural Hazards Mitigation Plan in an effort to identify risks and prioritize actions that will reduce future loss of life and property resulting from natural disasters. The planning process not only aids in prioritization, it increases cooperation and communication within the community. In addition, maintaining a current Natural Hazards Mitigation Plan increases potential for state and federal funding for mitigation and recovery projects.

When a community understands the relationship between the natural hazards it faces, its vulnerable systems, and its existing capabilities, it becomes better equipped to identify and implement actions aimed at reducing the community's overall risk of disasters.

1.1.2 What Natural Hazards are Addressed?

This plan focuses on the primary natural hazards that could affect Eugene and Springfield, including earthquakes, floods, landslides, winter storms, volcanoes, and wildland-urban interface fires. This plan also addresses

dam failure and hazardous materials spills, two anthropogenic hazards that are closely connected to natural hazards.

1.1.3 How Does the Plan Work?

The plan is strategic and non-regulatory in nature, meaning that it does not set forth any new policy. It does, however, provide: (1) a foundation for coordination and collaboration among agencies and the public; (2) identification and prioritization of future mitigation activities; and (3) aid in meeting federal planning requirements and qualifying for assistance programs.

This mitigation plan works in conjunction with other municipal plans and programs including local comprehensive land use plans, the Eugene-Springfield Multi-Jurisdictional Emergency Operations Plan, the Lane County Natural Hazards Mitigation Plan, local capital improvement plans and the State of Oregon Natural Hazards Mitigation Plan.

The actions described in the plan are intended to be implemented primarily through existing plans and programs within Eugene and Springfield; however, some of the mitigation actions described within the plan would require new programs or policies, or adjustments to existing programs and policies.

1.1.4 How Was the Plan Developed?

In 2013, staff from Eugene and Springfield, with support from the Oregon Partnership for Disaster Resilience, conducted a climate and hazards vulnerability assessment that has become the foundation of this update to this multi-jurisdictional Natural Hazards Mitigation Plan. The findings from this assessment have been summarized in the introduction under the vulnerability assessment heading. Complete findings from the assessment can be found in Section 4: Risk and Vulnerability.

After conducting the vulnerability assessment, Eugene and Springfield staff, members of the NHMP update steering group and partner agencies developed and refined appropriate mitigation actions to address some of the most significant risks revealed by the assessment. These new actions as well as several relevant actions carried over from the 2009 NHMP make up the mitigation strategies below.

The Natural Hazards Mitigation Plan update was supported by a project team made up of the following individuals:

- Matt McRae – Project Manager – City of Eugene
- Josh Bruce – Oregon Partnership for Disaster Resilience
- Forrest Chambers – City of Eugene
- Myrnie Daut – City of Eugene
- Ed Fredette – City of Eugene
- Lisa McLaughlin – Eugene Water and Electric Board
- Ken Vogeney – City of Springfield
- Patence Winningham – City of Eugene

In addition to the project team listed above, individuals from more than 20 businesses, non-profits and government agencies were consulted for their expertise and perspective during the vulnerability assessment process. A list of these participants can be found at the end of Section 4: Risk and Vulnerability. The plan update also relied on significant input from the NHMP subcommittee of the Lane Preparedness Coalition (described in the implementation section below). Greater documentation of the planning process can be found in Appendix B: Planning and Public Process.

1.2 Plan Goals

The following goals were developed by the Project Team and the NHMP Subcommittee of the Lane Preparedness Coalition. These two entities compared a) the goals in the Oregon NHMP, b) the goals in the Lane County NHMP, and c) the goals from the existing (2009) Eugene-Springfield Multi-Jurisdictional NHMP. Based on that review and discussion, the team added and adjusted the goals to better align with companion plans and to better reflect current community hazard mitigation needs.

Goal 1: Save lives and reduce injuries

Goal 2: Minimize damage to buildings and infrastructure, especially to critical facilities

Goal 3: Minimize economic losses and strengthen the economic well-being of the Eugene-Springfield Metro Area

Goal 4: Decrease disruption of public services, businesses, schools, and families

Goal 5: Protect environmental resources and utilize natural systems to reduce natural hazard impacts

Goal 6: Foster public/private partnerships that achieve mitigation outcomes

Goal 7: Utilize the land development code to mitigate risks posed by natural hazards

Goal 8: Protect historic and cultural resources

Goal 9: Maintain and enhance current spirit of communication, collaboration and coordination among public, non-governmental organizations (NGO) and private sector hazard mitigation partners

Goal 10: Integrate local Natural Hazard Mitigation strategies into significant community-wide plans.

Goal 11: Document and evaluate the Eugene-Springfield metro region's progress in implementing hazard mitigation strategies.

1.3. Summary of Risk and Vulnerability Assessments

Risk Matrix

Table 1 is the summary risk assessment matrix providing an overview of each hazard and the associated risk in the Eugene-Springfield area. Below the matrix you will find a summary of the in depth vulnerability assessment conducted in Eugene-Springfield that provides extensive detail about some of the risks of greater concern.

Table 1-1. Risk Matrix

Hazard	Vulnerability	Probability
Winter Storm (snow, ice, wind)	H	H
Flood: Riverine	M	M
Flood: Stormwater	L	H
Wildfire: Eugene	M	H
Wildfire: Springfield	L	H
Landslide: Eugene	L	H
Landslide: Springfield	L	M
Hazardous Material Incident	M	H
Earthquake: Subduction Zone	H	M
Earthquake: Crustal	H	L
Earthquake: Intraplate	H	L
Volcano	H	M
Dam Failure	H	L

Vulnerability	
High	More than 10% of population or assets to be affected
Med	1% - 10% of population or assets to be affected
Low	Less than 1% of population or assets to be affected

Probability	
High	One incident likely within 10-35 yrs
Med	One incident likely within 35-75 yrs
Low	One incident likely within 75-100 yrs

1.3.1 Vulnerability Assessment

Vulnerability Assessment Process

In 2013 and 2014 the Cities of Eugene and Springfield conducted a climate and hazards vulnerability assessment to inform the update of the Multi-Jurisdictional Natural Hazards Mitigation Plan. City of Eugene and City of Springfield staff, with support from the Oregon Partnership for Disaster Resilience, conducted group interviews totaling six hours for each community sector. The team met with local and regional experts in each of the following sectors: drinking water, healthcare and public health, electricity, transportation, food, housing, communication, stormwater, wastewater, natural systems, and public safety.

Working from a standard list of questions, the team collected information about the adaptive capacity and sensitivity of each system to specific hazards. The summary of findings below provides a description of key themes from across all sectors.

Detailed findings from this vulnerability assessment process can be found in Section 4. These sector summaries include high-level information including sector descriptions, an assessment of adaptive capacity, critical vulnerabilities, hazard specific sensitivities and key sector interdependencies.

1.3.2 Hazards

The vulnerability assessment reflects sensitivities to earthquake, flood, wildfire, winter storm, climate change, and rising fuel prices. Because of limited meeting time with system experts, the assessment does not reflect all hazards for all sectors.

1.4 Summary of Findings

Below is a list of high-level findings from the Eugene-Springfield Climate and Hazards Vulnerability Assessment. This does not represent all of the lessons learned or all of the important information collected during the assessment. It is a short collection of some of the common themes that emerged from across multiple sectors.

1.4.1 Crucial Sectors and Crucial Hazards

There are three sectors that are fundamental to the operation, maintenance and restoration of all other sectors: electricity, transportation and fossil fuels. These sectors are disproportionately important; the resiliency of these systems is paramount to building, maintaining and restoring all other systems assessed.

1.4.2 Sector Findings

There is a unique culture of collaboration and information sharing within our community. Overall, this enhances regional adaptive capacity in a number of sectors. Information-sharing and active collaboration is particularly visible within the health, public safety, electricity, and transportation sectors. There is also a noticeable willingness to share information within other sectors, including the food and communications sectors.

Many sectors are heavily dependent on resources and decisions made outside of the Eugene-Springfield area, most notably the food, electricity and fossil fuel sectors.

For several sector managers, finding and keeping qualified staff is an important concern over the next decade with few obvious solutions.

There is a high level of interdependence among all sectors. Nearly every sector relies on several other sectors in order to function, with stormwater and natural systems being the least dependent on other sectors.

1.4.3 Hazard-Specific Findings

Specific Hazards of Lower Concern: Flood and Wildfire Events

While flood and wildfire events have the potential to cause severe loss and damage in localized areas as well as inconvenience for many and a drain on emergency response resources, these hazards are not likely to result in systemic failures across multiple sectors.

Specific Hazards of Greater Concern: Severe Earthquake and Severe Winter Storm Events

Both severe earthquake and severe winter storm events have the potential to cause region-wide cascading system failures.

Much of our regional adaptive capacity stems from our ability to draw resources, personnel, and expertise from nearby communities, particularly during an emergency. This capacity is severely restricted during region-wide events such as a Cascadia subduction zone earthquake, severe winter storm events, and to a lesser degree, severe flooding.

1.4.4 Earthquake-Specific Findings

Except for natural systems, all sectors are extremely vulnerable to a Cascadia subduction zone earthquake.

Very little has been done to prepare any systems, infrastructure or personnel to handle the initial impact and ongoing response and recovery that will follow this event.

Exceedingly limited staff availability in the aftermath of a severe earthquake will create problems and challenges that are difficult to predict or solve in advance of the earthquake.

Every sector will experience substantial failures and interruptions that are unfamiliar and therefore difficult (though not impossible) to plan for in advance.

Very few local residents have first-hand experience with a major earthquake, making it difficult to describe the potential experience and results.

1.4.5 Winter Storms

Severe winter storms disrupt two of the three sectors that all the others depend upon: Electricity and transportation. This disruption is more pronounced if the storm lasts more than a couple of days and if snow and ice accumulations are significant.

1.4.6 Climate Change

The sectors most likely to experience negative impacts associated with climate change are natural systems, drinking water and to a lesser extent, food, electricity and public health.

Several sector managers in the drinking water, public health and natural systems sectors are actively planning for the impacts of climate change. For the most part, other sectors are not.

Most built community sectors don’t appear to be at severe risk from projected climate-related impacts such as increasing temperatures, reduced snowpack, or changes in precipitation. However, the region’s natural systems are highly sensitive to climate change and the resulting secondary impacts on community sectors and the regional economy could be

substantial. Climate change appears to have the greatest overall negative impact on regional forest and water resources[1].

1.4.7 Fossil Fuel Dependency

All but one group indicated their sectors rely heavily on fossil fuels and fossil fuel-derived products to operate. Health care, food, water, transportation, public safety, electricity and housing appear most dependent.

The natural systems sector was the only sector with a low dependency on fossil fuels to function.

There is not yet widespread planning for how sectors will manage the rising fuel prices that are anticipated in the coming decades. Most participants indicated that the added cost will just be passed on to the customer. A notable exception is public safety, where sector managers indicated service levels would be reduced as there is no customer base or political will to absorb cost increases.

Nearly every group pointed out that the rate of fuel price increase makes all the difference when considering how disruptive price increases might be. A slow increase in prices is manageable, but a sharp increase in prices would strain sectors – some of them dramatically.

Almost all backup power systems in Eugene-Springfield rely on diesel or natural gas – both transported by pipeline from Portland and beyond.

There is an information gap regarding the fossil fuel sector. Because the vulnerability assessment project team was unsuccessful at convening representatives from this sector, there is a need for more information about how this sector operates locally. In the absence of local sources of information, there are regional information sources that shed light on some of the potential challenges facing the fossil fuel system.

- As part of the Oregon Resilience Plan, the Oregon Department of Geology and Mineral Industries (DOGAMI) completed an Earthquake Risk Study For Oregon's Critical Energy Infrastructure Hub[2] containing useful information about the petroleum hub and its operability following an earthquake – with some implications for performance following other natural hazards.

1 Willamette Water 2100 is a research project currently underway, designed to evaluate the effects of climate change, population growth, and economic growth on the water resources of the Willamette basin. It is a partnership project of Oregon State University, University of Oregon, and Portland State University that will provide greater clarity and specificity about climate change impacts on water and forest resources in our region. More information is available online at: http://water.oregonstate.edu/ww2100

2 http://www.puc.state.or.us/docs/dogamiceihubreport-8-1-12-r1.pdf

- The 2012 Oregon Energy Assurance Plan[3] offers insights into the existing risks to energy infrastructure and systems statewide.

1.5 Mitigation Strategy Summary

Based on the existing Eugene-Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan as well as findings from the Eugene-Springfield Climate and Hazards Vulnerability Assessment, emergency management staff and a broad group of regional partners have developed a number of mitigation actions as summarized below.

1.5.1 Prioritization of Mitigation Actions

High priority mitigation actions are indicated in bold type. Eugene and Springfield Emergency Management staff placed a higher priority on a small number of mitigation actions using the following information:

- Findings from the vulnerability assessment indicate actions that bolster the *transportation* and *electricity* sectors are of particular importance because these sectors are crucial to the operation of all other sectors. Actions that support these systems were raised in priority.

- During the vulnerability assessment process, sector experts determined which hazards posed the greatest risk to their sectors. Ultimately, those hazards of greatest concern were earthquake, winter storm, flood and wildfire events. Therefore, these hazards were given greater priority.

- Finally, many community members took time to provide feedback through an online survey to provide input on local hazard mitigation priorities (Survey results detailed in Appendix B). Respondents indicated winter storms and earthquakes are the hazards that the two city governments should prioritize. Respondents also indicated a strong preference for actions that protect utilities and critical facilities.

Based on these criteria and an understanding of local conditions, emergency managers selected those actions most likely to mitigate these priority vulnerabilities.

Additional detail about each of the mitigation actions is listed in Appendix A, within the action item table. A full description of the status of actions from the 2009 version of the Eugene-Springfield NHMP can be found in Appendix E.

3 http://www.oregon.gov/energy/docs/Oregon%20State%20Energy%20Assurance%20Plan%202012.pdf

Table 1-2. Summary of Mitigation Actions

	Action Name	Mitigation Action
Dam Failure	Dam Safety Evacuation	See Multi Hazard: Evacuation
	Dam Safety Notification	Once evacuation routes are established, A) develop and install robust notification system(s); and B) create a community awareness campaign to increase awareness of dam risks among all residents and specifically i) transient student population, and ii) non-English speaking residents.
	Inundation Maps For Planning	Seek digital versions of inundation maps from Army Corps of Engineers. Seek permission to add inundation maps as a layer within local jurisdiction GIS programs.
	Dam Seismic Assessment	Obtain details of the most recent dam seismic assessments for the dams upstream of Eugene-Springfield.
Earthquake	**Local Transportation Infrastructure Seismic Evaluation**	**Over the next 5 years, A) utilize accepted Oregon Department of Transportation methodology, as-built drawings and physical inspections to evaluate Eugene and Springfield bridges (both vehicular and pedestrian) for seismic vulnerability, and record results centrally; B) Develop a prioritized list of bridges (cross-referenced with critical travel corridors) to be retrofitted or replaced; C) Seek funding to implement retrofitting and replacement.**
	Seismic Evaluation of Critical Facilities	**Over the next 5 years, A) Develop a prioritized list of critical facilities, consistent with the critical infrastructure and key resources developed by the Federal Emergency Management Agency, such as the Eugene Airport, the Eugene-Springfield Metropolitan Wastewater Management Commission Water Pollution Control Facility, the underground wastewater and stormwater collection and conveyance systems, and regional 9-1-1 and radio communication systems, to be inspected for seismic vulnerability; B) Develop a prioritization of facilities to be evaluated for seismic stability; C) Utilizing building and infrastructure construction drawings and individual inspections, evaluate these facilities for seismic vulnerability and record the inspection results centrally; and 4) Develop a prioritized list of facilities/services to be retrofitted, relocated, or replaced.**
	Seismic Evaluation of Non-Critical Facilities (FEMA 154)	Develop a seismic rapid visual screening program for public buildings and begin implementing screening to inform local mitigation, response, continuity of operations and recovery planning efforts.

	Action Name	Mitigation Action
Earthquake	Non-Structural Seismic Evaluation (FEMA E74)	Develop a program to systematically assess and retrofit non-structural components of public facilities.
	Home Seismic Retrofits	Explore the possibility of developing a home seismic upgrade/retrofit program for Eugene-Springfield. Consider a marketing program, incentives, loans, rebates or other support options.
Flood	**Flood Maps**	**Actively seek FEMA updates to the Eugene-Springfield floodplain maps.**
	Flood Control Levee Certification and Maintenance	**Seek and maintain certification of levees and other flood control structures within Eugene and Springfield.**
	Flood Insurance Study	Continue to support FEMA in updating the flood insurance study in selected areas, including Amazon and Cedar Creeks and the McKenzie River.
	Repetitive Loss Records	Ensure that the accurate locations of repetitive loss properties have been registered with FEMA.
	Explore Flood Mitigation Actions with Property Owners (upon request)	Provide flood risk literature for outreach. Send annual mailer to residents living within the 100 year floodplain describing actions property owners can take to protect themselves from flooding.
Flood	Maintain Frequent Stormwater Flooding Location Inventory	Maintain inventory of locations in the Eugene-Springfield Metro area subject to frequent urban stormwater (not riverine) flooding.
	Upgrade Culverts	For locations with repetitive flooding and significant damages or road closures, determine and implement mitigation measures such as upsizing culverts or storm water drainage ditches.
	NFIP Compliance	Continue compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinances.
HazMat	HazMat Locations	Ensure that first responders have readily-available, site-specific knowledge of hazardous chemical inventories in the Eugene-Springfield Metro Area.
	HazMat Preparedness	Enhance emergency planning, emergency response training and equipment to address hazardous materials incidents.
Landslide	Landslide Mapping	Update regional landslide risk maps using available LiDAR data.
	Landslide Planning	Use available data to determine areas and buildings at risk to landslides and propose comprehensive and land use policies accordingly.

	Action Name	Mitigation Action
Multi-Hazard	Emergency Fuel Distribution Plan	Once the fossil fuel sector assessment is completed, develop a Eugene-Springfield emergency fuel distribution plan that considers A) the likely local fuel available during specific scenarios (earthquake, winter storm, mass evacuation); B) the needs for transportation fuels and natural gas (including backup generators) of both public *and* private (hospital, communications, others) essential systems as well as those of neighboring communities supplied by the Eugene Kinder Morgan / Williams Pipeline fuel terminal; and C) the existing on-site fuel storage and operation capacity of those critical services.
Multi-Hazard	Community Recovery Planning	Develop appropriate and necessary community recovery plans.
	Local Electricity Generation	1) Develop a plan to improve control of EWEB electric generation in the event of a regional outage (for example: given a regional outage, develop ability to direct locally generated power to critical facilities such as water treatment plants and hospitals). 2) Encourage small scale local electricity generation that can be operated independently of the regional and/or local grid in the event of a local or regional power outage (for example: install local (non-fossil fuel) electricity generation in support of critical facilities so they can operate during an outage).
	Downed Power Lines	**Over the next five years, 1) identify critical transportation corridors (including primary emergency, evacuation, and access routes) and electric distribution routes; 2) develop a list of key backbone transmission and distribution routes that serve critical customers and enable efficient restoration to the broader distribution system; 3) develop a long-term plan to underground, relocate, or "harden" key electric distribution lines along critical corridors (including feasibility assessment and prioritization); 4) seek funds and opportunities to relocate power poles and power lines, or harden existing facilities, where feasible and appropriate, to reduce interruption to the transportation system and to reduce risk of outages from severe winter storms or earthquakes.**

	Action Name	Mitigation Action
Multi-Hazard	Credentials	Explore a strategy to facilitate credentialing of non-traditional partners during an emergency hazard event.
	Broadcast Radio Communications	Review existing communication tools between Emergency Managers and radio stations. If none yet exist, develop a low-tech, direct communication line between staff at Bicoastal Media (1120 KPNW, the radio station that has been heavily hardened with FEMA dollars) and Eugene-Springfield and Lane County Emergency Managers.
	Continuity of Operations Plans	**1) Identify priority work groups and facilities in need of continuity of operations plans.** **2) Develop continuity of operations plans for the top priority work groups or facilities.**
	Staffing for Critical Systems	Review policies, procedures and plans from other public agencies with high seismic vulnerability. Research their strategies to ensure staff availability following a significant hazard event. Assess options to apply these strategies in Eugene-Springfield to ensure the availability of critical staff following a significant hazard event.
	Local Food Availability	Work with coalition of food suppliers to consider options to address these food supply concerns. Consider developing common messaging and marketing strategies to increase awareness of the need for individuals to store adequate emergency food and water supplies.
	Water Source	EWEB is actively seeking to develop alternate sources of drinking water. EWEB's Strategic Plan and Water Capital Improvement Plan call for alternate sources to be developed over the next ten years. EWEB has been issued a conditional permit on the Willamette River and has obtained a groundwater use permit. EWEB is assessing interest of potential partners, and will develop at least one additional water supply by 2022. The cities of Eugene and Springfield support EWEB's purchase of property, construction of infrastructure and financing of this project.
	Evacuation	Develop a community evacuation plan to address multiple hazards. Develop routes, notification system and community awareness plan. Work with Lane County to coordinate routes and evacuation plans.
Multi-Hazard	**Fossil Fuel Sector Assessment**	**Develop a list of critical information needs pertaining to the regional fuel transmission and distribution system. Develop a plan to acquire the necessary information to A) better understand the factors that could disrupt the regional fossil fuel supply and B) ensure essential emergency functions can be sustained.**
	Water Storage	Explore options to increase drinking water storage in public buildings including A) essential facilities (if needed) and B) potential public sheltering facilities.

	Action Name	Mitigation Action
	Vulnerable Populations	Compare relevant NHMP hazard risk maps with the relevant vulnerable population maps developed for the Lane Livability Consortium. Prioritize map combinations to provide results most informative to the mitigation actions within the NHMP.
	Lane Preparedness Coalition	Continue to support/develop public and private sector partnerships to foster hazard mitigation activities.
	Community Education and Outreach	Maintain and continue to deliver existing education programs aimed at mitigating the risk posed by hazards. Provide information about the NHMP and collect feedback on the NHMP from audiences and interested parties.
	72 Hour Kits	Continue to encourage community members and city employees to prepare and maintain 72 hour kits.
Wildfire	Springfield Wildfire Plan	Eugene-Springfield Fire/EMS continue development of a Springfield-specific wildfire hazard plan that is consistent with mutual and automatic response agreements for the region. This plan will include A) threshold events that require evacuation notification; B) fire management plans that include all county wide fire resources until they are exhausted; and C) a requirement for escalation to State conflagration response. The plan will include coordination with aerial suppression resources and hourly costs for suppression aircraft during initial stages of an incident.
	Wildfire Risk and Building Codes	**1) Over the next 5 years, utilize the Oregon Department of Forestry's Criteria (OAR Chapter 629, Division 44) to develop a "Fire Hazard Zone" map of the areas of high fire danger in the Eugene-Springfield area. 2) Cities of Eugene and Springfield adopt the "Fire Hazard Zone" map. 3) Implement increased building code requirements for construction/repair in the identified high fire risk areas.**
Winter Storm	**Downed Power Lines**	**See Downed Power Lines under Multi-Hazard.**
	Tree Trimming	Continue tree trimming efforts especially for transmission lines and trunk distribution lines.
	Property Owner Education	Continue to educate private property owners about dangers of vegetation near distribution lines and service drops.
	Backup Power	Encourage critical facilities in the Eugene-Springfield Metro Area to have backup power and emergency operations plans to deal with power outages.
	Undergrounding Utilities in New Developments	Continue policy requiring new developments to locate power lines underground.
Volcano	Ash Fall	None at this time.

1.6 Plan Implementation and Maintenance

This section details the formal process that will ensure that the Eugene-/Springfield 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 Eugene and Springfield will integrate public participation throughout the plan maintenance and implementation process.

1.6.1 Plan Review and Adoption

After the plan is locally reviewed and deemed complete, the Emergency Managers will submit it to the State Hazard Mitigation Officer at the Oregon Military Department, Office of Emergency Management (OEM) who will also review the plan. Once OEM concurs that the plan is complete, OEM will submit it 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. Following acceptance by FEMA, the city councils of Eugene and Springfield will adopt the plan via resolution. At that point Eugene and Springfield will retain eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program, and the Flood Mitigation Assistance Program.

1.6.2 Plan Implementation

1.6.3 Convening

Emergency Management staff from both Eugene and Springfield will jointly convene an implementation group for the Eugene-Springfield Natural Hazards Mitigation Plan.

As conveners, Eugene and Springfield staff are responsible for:

- Coordinating steering committee meeting dates, times, locations, agendas, and member notification;
- Documenting outcomes of Committee meetings;
- Serving as a communication conduit between the steering committee and key plan stakeholders;
- Incorporating, maintaining, and updating the jurisdiction's natural hazard risk GIS data elements;
- Submitting future plan updates to OEM for review; and

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

1.6.4 Implementation Coordination

City of Eugene and City of Springfield Emergency Management staff will lead the implementation of the NHMP. These staff will:

- Evaluate funding opportunities such as the Pre-Disaster Mitigation Grant Program, Hazard Mitigation Grant Program, and Flood Mitigation Assistance Program;
- Consult with partner agencies, businesses and organizations on implementation projects;
- Convene the NHMP subcommittee of the Lane Preparedness Coalition;
- Document successes and lessons learned;
- Evaluate and update the Natural Hazards Mitigation Plan following a disaster; and
- Evaluate and update the Natural Hazards Mitigation Plan in accordance with the prescribed maintenance schedule.

1.6.5 Implementation Coordination Support

The cities of Eugene and Springfield have identified the NHMP Subcommittee of the Lane Preparedness Coalition as the supporting body for implementation of the mitigation plan. The responsibilities of this group include:

- Review opportunities for funding natural hazard risk reduction projects;
- Engage additional stakeholders and other relevant hazard mitigation organizations and agencies to implement the identified action items; and
- Develop and coordinate ad hoc and/or standing subcommittees as needed.

As of October 2014, members of the Lane Preparedness Coalition include the following organizations:

- Bethel School District
- Central Lane 911
- City of Cottage Grove
- City of Eugene
- Eugene School District 4J

- Eugene-Springfield Community Emergency Response Team (CERT)
- Eugene Water & Electric Board
- Lane Council of Governments
- Lane County Public Health
- Lane Education Service District
- McKenzie Willamette Hospital
- Oregon OHA
- PeaceHealth Medical Group
- Red Cross
- University of Oregon

The NHMP subcommittee can be made up of members from any or all of these organizations. Regular participants can be seen in meeting attendance listed in Appendix B, Planning and Public Process.

1.6.6 Plan Maintenance

The cities of Eugene and Springfield NHMP implementation coordination team is required to meet at least two times each year. Eugene and Springfield emergency management staff schedule four meetings each year and typically meet every quarter. During these meetings the NHMP implementation coordination team reviews progress on mitigation actions, discusses implementation challenges and opportunities, invites guest presenters to provide technical information, reviews progress at each meeting and reviews priorities annually (as detailed below under Annual Review and Update).

At least once each year, staff from Eugene and Springfield brief the full Lane Preparedness Coalition on progress on the NHMP.

Plan maintenance is a critical component of the natural hazard mitigation plan as it ensures that this plan will maximize the two cities' efforts to reduce the risks posed by natural hazards.

1.6.7 Annual Review and Update

The convening and coordination groups named above will use at least one meeting (of four) each year to review and maintain the NHMP, including the following tasks:

- Review progress toward mitigation goals made over the previous year;
- Review and re-evaluate priority mitigation actions remaining;
- Annually review and adjust priorities, as needed;

- Consider new mitigation actions for inclusion within the plan;
- Consider adjustments to existing mitigation actions that would improve feasibility, add critical detail, or refocus the strategy; and
- Consider additional implementation partners as necessary, and develop a plan for their inclusion.
- Review public outreach conducted over previous year, as outlined within multi-hazard action *Community Education and Outreach*; and
- Identify opportunities for outreach over the coming year.

1.6.8 Public Involvement

The cities of Eugene and Springfield and local NHMP implementation partners will continue to share information about, and gather input on, the Natural Hazards Mitigation Plan. At least twice each year the cities will host presentations for the public that a) provide information about the NHMP, b) describe progress toward implementation, and c) collect feedback on the NHMP. These presentations will be conducted as part of ongoing outreach through a) the Eugene Springfield CERT program, an education and coordination program for residents seeking to volunteer in their neighborhood following a disaster, and b) the Lane Preparedness Coalition, a coalition of agencies, businesses, non-profits, and residents interested in disaster preparedness. LPC Full Coalition meetings are hosted multiple times each year and provide in-depth engagement opportunities for the interested public.

2 Hazard Descriptions

2.1 Hazard Descriptions

The cities of Eugene and Springfield are subject to the following natural hazards:

- Earthquake
- Flood
- Landslide
- Volcano
- Wildfire
- Winter Storm

In addition, the Eugene-Springfield NHMP addresses two "non-natural" hazards that present significant potential exposure consequences on their own. These two hazards could also result in exposures triggered by or following a natural hazard event:

- Dam Failure
- Hazardous Materials

The following sections identify and profile the location, extent, previous occurrences and future probability of each hazard listed above. Additional information about each hazard can be found in the Oregon Natural Hazards Mitigation Plan – Region 3: Regional Profile. The mapped location, extent and vulnerability information is located in Section 3 of this plan.

2.2 Earthquake

Eugene and Springfield categorize the probability of a Cascadia Subduction Zone (CSZ) event as moderate and the probability of intraplate and crustal earthquakes as low over the next 100 years. Given the potential for damage and the probability of a CSZ occurrence, Eugene and Springfield are primarily focused on a potential CSZ event for earthquake mitigation planning purposes. The vulnerability to earthquake in Eugene-Springfield is high.

2.2.1 Causes and Characteristics of the Hazard

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 four sources:

1) the offshore Cascadian Subduction Zone;
2) deep intraplate events within the subducting Juan de Fuca Plate;
3) shallow crustal events within the North American Plate; and
4) earthquakes associated with renewed volcanic activity.

An earthquake would impact the entire Eugene-Springfield metro and surrounding areas. The specific hazards associated with an earthquake include the following:

Ground Shaking

Ground shaking is defined as the motion of 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 faults 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.

Severity

The severity of an earthquake is dependent upon a number of factors including: 1) the distance from the earthquake's source (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.

Maps showing the location of various earthquake related hazard are located in Section 3.

2.2.2 History of the Hazard in Eugene-Springfield

Pre-historic earthquakes have occurred in Oregon as offshore Cascadia Subduction Zone earthquakes of approximately 8-9 magnitude. Approximate years for the earthquakes are the following:

- 1400 BCE
- 1050 BCE
- 600 BCE
- 400 CE
- 750 CE
- 900 CE

Oral records from Native Americans and geologic evidence have shown that the most recent Cascadia Subduction Zone (CSZ) earthquake occurred in January 1700 with an approximate magnitude of 9.0. The earthquake generated a tsunami that struck Oregon, Washington and Japan and destroyed Native American villages along the Oregon coast. There are no known reports of earthquake damage in Eugene-Springfield in recent history. A map of local historic earthquakes is included in Section 3, within the hazard maps.

2.2.3 Probability of Future Occurrence

The state estimates earthquake probability for the mid-Willamette Valley region in two ways. First, the state uses a probabilistic model that takes into account all that is known about earthquake probabilities on all Oregon faults. This model presents an expected level of damage associated with an earthquake that has a 2-percent chance of occurring in the next 50-years. This probabilistic model suggests that the Eugene-Springfield area can expect the partial collapse of weak buildings and the movement of unsecured wood-frame houses.

While all earthquakes possess the potential to cause major damage, subduction zone earthquakes pose the greatest danger due to the severity, duration and extent of ground shaking. Within Oregon, a major CSZ event

could generate an earthquake with a magnitude of 9.0 or greater, likely resulting in significant damage and loss of life in Eugene-Springfield. Another way to assess the probability of earthquake for Oregon communities west of the Cascades is to consider the CSZ event independently.

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

Eugene-Springfield categorizes the probability of a CSZ event as moderate and categorizes the probability of intraplate and crustal earthquakes as low. Given the potential for damage and the probability of occurrence, Eugene-Springfield is primarily focused on a potential CSZ event for earthquake mitigation planning purposes.

2.2.4 Vulnerability Assessment

In 2013 and 2014 the cities of Eugene and Springfield conducted a climate and hazards vulnerability assessment to inform this NHMP. The assessment team met with local and regional experts in each of the following sectors: drinking water, healthcare and public health, electricity, transportation, food, housing, communication, stormwater, wastewater, natural systems, and public safety. The assessment identifies the following specific earthquake-related vulnerabilities:

- Except for natural systems, all sectors are extremely sensitive to a magnitude 9.0 CSZ earthquake event.
- Very little has been done to prepare any systems, infrastructure or personnel to handle the initial impact and ongoing response and recovery that will follow a CSZ event.
- Exceedingly limited staff availability in the aftermath of a severe earthquake will create problems and challenges that are difficult to predict or mitigate.
- Every sector will experience substantial failures and interruptions that are unfamiliar and therefore difficult (though not impossible) to plan for.

- Very few Eugene and Springfield residents have first-hand experience with a major earthquake, making it difficult to describe the potential experience and results.

Additional system vulnerability details are included in Section 4 as part of the Hazard and Climate Vulnerability Assessment Report.

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 a total of 3,349 buildings, giving each a low, moderate, high or very high rating for collapse potential in the event of a high magnitude earthquake. The RVS assessed a total of 174 buildings in the Eugene-Springfield area. The full data set can be found on http://www.oregongeology.org/sub/projects/rvs/SSNA-abridged-data.pdf.

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.[4] To fully assess a building's collapse potential, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help prioritize which buildings to survey.

Table EQ.1 shows the number of buildings surveyed in Eugene and Springfield with their respective rankings.

Table 2-1. Building level of collapse potential for Eugene and Springfield

City	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100 %)
Eugene	56	52	29	0
Springfield	28	4	3	2

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

More recently, Oregon published the *Oregon Resilience Plan*. Findings in the plan suggest that communities in the Willamette Valley can expect the following potential impacts to critical service sectors following a CSZ event:

4 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.

Table 2-2. Critical service impacts	
Critical Service	**Estimated Time to Restore Service**
Electricity	1 to 3 months
Police/Fire Stations	2 to 4 months
Drinking Water	1 year
Critical Service	**Estimated Time to Restore Service**
Sewer	1 month to 1 year
Top-priority Highways (partial restoration)	6 to 12 months
Healthcare Facilities	18 months

Source: Oregon Resilience Plan; Eugene-Springfield Hazard and Climate Vulnerability Assessment

Earthquake impact analysis conducted for prior versions of this plan indicate that many buildings will have no damage or light to moderate damage, with heavy damage concentrated in vulnerable buildings (wood frame buildings with cripple walls, unreinforced masonry, etc.). At the time, casualties were expected to include up to 30 deaths and roughly 1,600 injuries in Eugene-Springfield. Casualties will be higher in a daytime event than a nighttime event because mostly wood-frame residential buildings have a lower life-safety risk. Refer to the risk analysis section below for HAZUS-based property and casualty loss estimates.

The Eugene-Springfield steering committee ranked their vulnerabilities to crustal, intraplate and subduction earthquake events as ‘high’. This would indicate more than 10% of the population would be impacted in the event of an earthquake.

2.2.5 Risk Analysis

HAZUS

The Oregon Department of Geology and Mineral Industries (DOGAMI) has developed two earthquake loss models for Oregon based on the two most likely sources of seismic scenarios: (1) the Cascadia Subduction Zone event (CSZ) and (2) an M6.5 arbitrary crustal earthquake. Both models are based on HAZUS-MH software currently used by FEMA as a means of determining potential losses from earthquakes.

The CSZ event is based on a potential 9.0 earthquake generated off the Oregon coast. The model does not take into account a tsunami, which would likely develop from the earthquake event. The M6.5 arbitrary crustal earthquake scenario does not look at a single earthquake (as in the CSZ model). Rather, it encompasses many faults, each with a 2% chance of producing an earthquake in the next 50 years. The model assumes that each fault will produce a single “average” earthquake during this time.

DOGAMI investigators caution that the models contain a high degree of uncertainty and should be used only for general planning purposes. Also, individual cities were not modeled. Despite their limitations, the models do provide some approximate estimates of damage. Results for Lane County are found in Tables 2-3, 2-4, and 2-5.

Table 2-3. Estimated losses from M9 CSZ and a local crustal event

Region 3 Counties	Building Value (Billions)	Total Building-Related Losses From A 9.0 Csz Event (Billions)	Total Building-Related Losses From A Crustal Earthquake (Billions)
Lane	$21.055	$5.0	$3.4

Table 2-4. Estimated losses associated with a magnitude 8.5-9.0 subduction event

Categories	Lane
Injuries (5 pm time period)	3,945
Deaths (5 pm time period)	264
Displaced Households	7,633
Economic Losses For Buildings	$4,652 million
Operational the day after: Fire stations[5] Police Stations Schools Bridges	 100% 100% 100% 84%
Economic Loss to Infrastructure: Highways Airports Communications	 $211 million $13.3 million $0.33 million
Debris Generated (thousands of tons)	2,000

Source: DOGAMI, 2008, *Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates*.

5 While this screening applies statewide, there are at least three fire stations within Springfield that have not undergone any degree of seismic retrofit and may be vulnerable in a significant seismic event.

Table 2-5. Estimated losses associated with an arbitrary magnitude 6.5-6.9 crustal event

Categories	Lane County
Injuries (5 pm time period)	1821
Deaths (5 pm time period)	96
Displaced Households	7,716
Economic Losses: Buildings	$3,351.03 million (2008 dollars)
Operational the day after: Fire stations Police Stations Schools Bridges	 100% 91% 99% 97%
Economic Losses: Infrastructure Highways Airports Communications	(2008 dollars) $106 million $16 million $0.63 million
Debris Generated:	1,000,000 tons

Source: DOGAMI, 2008, *Geologic Hazards, Earthquake and Landslide Hazard Maps, and Future Earthquake Damage Estimates*.

2.2.6 Existing Hazard Mitigation Activities

Eugene and Springfield have taken steps to mitigate earthquake risks. Efforts include:

- Enforcement of the International Building Codes and Oregon State Structural Specialty Code, which both address earthquake mitigation measures for new construction.
- Creating a team which would be responsible for checking bridges after the event of an earthquake. This team includes the Oregon Department of Transportation, Lane County, and the cities of Eugene and Springfield. The team has held table top and field exercises within the past year and hopes to do so every other year.
- The City of Eugene moved police, fire and city management and administration functions out of City Hall due to seismic deficiency of the building. Eugene is currently in the process of designing a new city hall.

2.3 Flood

The probability for riverine flooding in Eugene-Springfield is moderate and the probability is high for stormwater system flooding. A moderate probability indicates that one riverine flooding event is likely in the next 35 to 75 years. A high probability indicates that one stormwater flooding event is likely within the next 10 to 35 years. The vulnerability in Eugene-Springfield for riverine flooding is moderate and for stormwater system flooding it is low. A moderate vulnerability indicates that between 1% and 10% of the population would be impacted, and a low vulnerability indicates that less than 1% of the population would be impacted.

2.3.1 Cause and Characteristics of the Hazard

The Eugene-Springfield considers two primary flood hazard categories: riverine flooding and stormwater system (urban) flooding. Riverine flooding occurs when water overtops the banks of a naturally occurring waterway, while urban flooding is most often caused by inadequate stormwater drainage systems or maintenance.

The Eugene-Springfield area is subject to flooding from several sources, including:

1) Riverine flooding from the Middle Fork of the Willamette River, the Willamette River, and the McKenzie River;
2) Riverine flooding from numerous smaller creeks and sloughs;
3) Local stormwater drainage flooding.

Flooding in Eugene and Springfield typically occurs in December and January. Events are usually associated with La Niña conditions, which result in prolonged rain and rapid snowmelt on saturated or frozen ground. This sudden influx of water causes rivers to swell, forcing tributary streams to back up and flood communities. Eugene-Springfield is largely protected from riverine flooding by multiple upstream flood control dams in both the McKenzie and Willamette River watersheds.

2.3.2 History of the Hazard in Eugene-Springfield

Flooding has been recorded in the Eugene-Springfield area ever since the first European settlers arrived in the area in the mid-1800s.

The FEMA Flood Insurance Study for Lane County (June 2, 1999) summarizes the history of major historical floods in the Eugene-Springfield area. Major floods occurred in 1861, 1890, 1945, 1956, 1964 and 1996. The 1964 flood was the largest flood event recorded in Lane County.

Notably, the construction of flood control dams in the 1940s-1960s has substantially reduced the potential for significant riverine flooding in Eugene-Springfield. These dams have reduced the expected 100-year stream discharges (volume of water flowing in the rivers). Accordingly, expected flood elevations and overall flood potential for major events along the rivers have been substantially reduced.

In addition to the flood control dams, the U.S. Department of Agriculture Soil Conservation Service (now known as the Natural Resource Conservation Service) and Lane County constructed a flood control levee in 1960 to protect a large area of Springfield from McKenzie River flooding. Ownership and maintenance responsibilities for this levee transferred to the City of Springfield in 1983. This levee, known today as the 42nd Street Levee, successfully contained the January 1964 and February 1996 flood events.

The flood hazard areas shown on the current Flood Insurance Rate Maps (FIRM) for Eugene-Springfield assume that the dams are operating properly. Dam failure hazards are not addressed by the FIS or the FIRM.

Despite the reduction in flood potential from construction of the dams, the Eugene-Springfield area continues to have flood risk from major rivers as well as from the numerous creeks and sloughs running through the area. Flood risk on these smaller streams has not been reduced by the dams on the larger rivers.

A historic statewide flood event with local impacts occurred in February 1996. Unusually heavy rains over the four-day period from February 5th to February 8th resulted in significant flooding on numerous rivers and streams throughout western Oregon. During the event, rising waters in the McKenzie River forced the evacuation of about 1,200 to 1,500 people in low-lying areas of Springfield. In the Springfield/Thurston area along the McKenzie River about 35-40 homes were damaged, along with about 20 private roads and bridges and about 20 vehicles.

Widespread flooding was also experienced in the Mohawk Valley from Marcola to Springfield, with flooded homes on Sunderman Road and Goat Road. The Springfield Golf Course suffered substantial damage, with about 6 inches of silt and debris deposited on the greens and fairways. There were widespread road closures in Lane County and Interstate 5 had water flowing across it just north of Eugene near the Boston Mill Road overpass.

The most recent significant flood event occurred in December of 2005. Days of heavy rains led to flooding on the Mohawk River near

Springfield. The flood stage of the Mohawk is 15 feet. On December 31st, the river was at 18 feet.

No major flood events have occurred within the Eugene-Springfield metro boundary since the previous update to this plan in 2009.

2.3.3 Risk Assessment

How Hazard Areas are Identified

FEMA Flood Insurance Rate Maps (FIRMs) are the most comprehensive resource for identifying hazards in the Eugene-Springfield area. The Eugene-Springfield area's most recent FIRM was developed on June 6, 1999. It is common knowledge that the Eugene-Springfield metro area flood maps are based on outdated information. The availability of LiDAR data and other technologies offers superior ability to project and map riverine flooding in the area. Eugene and Springfield are actively working with FEMA and the state of Oregon to identify resources needed to update the Eugene-Springfield regulatory floodplain maps.

Notably, some areas within Springfield have recently been re-mapped. These include the Willamette River through the southern portion of Glenwood along with the confluence of the Middle Fork and Coast Fork of the Willamette River, and the area surrounding the newly-constructed RiverBend Hospital.

Flood-prone areas of the Eugene-Springfield area include the FEMA-mapped floodplains for major rivers including the Mohawk, McKenzie and Willamette (including the Middle Fork and the Coast Fork). FEMA-mapped floodplains also include areas along Amazon Creek, Mill Race and several smaller creeks (mostly in the western portion of Eugene).

Historical experience and hydrologic/hydraulic modeling suggests that the most problematic areas for local stormwater drainage flooding in Eugene are the Amazon Creek, Willow Creek and Laurel Hill basins in the south hills. Drainage problems in these areas are exacerbated by relatively thin, impermeable soils.

Maps showing the location of the floodway and 100-year floodplains are included in Section 3.

2.3.4 Probability of Future Occurrence

The probability for riverine flooding in Eugene-Springfield is moderate and the probability is high for stormwater flooding. A moderate probability indicates that one riverine flooding event is likely in the next 35 to 75 years. A high probability indicates that one stormwater flooding event is likely within the next 10 to 35 years.

2.3.5 Change in Future Probability

Global climate change may lead to increased risk of flood within the Willamette River Basin. Warmer winter temperatures will lead to more precipitation falling as rain instead of snow, which reduces the amount of water stored as snow and increases wintertime river flows. There is also a possibility of heavier precipitation events that could exacerbate the risk of flooding. The Oregon Climate Adaptation Framework[6] lists 11 risks including "Increased frequency of extreme precipitation events and incidence and magnitude of damaging floods." The Army Corps of Engineers operates several dams upstream of Eugene-Springfield, with the specific aim of mitigating flood risk. They are preparing a study to better understand the future risk of flood and the ability of dams to mitigate any change in flood risk[7].

2.3.6 Vulnerability Assessment

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

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

B. Much flooding happens outside of the mapped 100-year floodplain. First, the 100-year flood is by no means the worst possible flood. For flooding along the Willamette River, the 500-year flood is 4 feet higher than the 100-year flood. Second, many flood-prone areas flood because of local stormwater drainage conditions. Such flood-prone areas have nothing to do with the 100-year floodplain boundaries.

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

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6 The Oregon Climate Adaptation Framework. Oregon Department of Land Conservation and Development. December 2010. http://www.oregon.gov/energy/GBLWRM/docs/Framework_Final_DLCD.pdf

7 A memo from the Army Corps of Engineers regarding the purpose and extent of the study can be found in Appendix F.

D. Areas protected by FEMA-accredited flood control levees, such as Springfield's 42nd Street Levee, were originally mapped as being protected from the 100-year flood event. However, in response to numerous levee failures during Hurricane Katrina, levees now must also be certified as being structurally adequate to retain their accreditation as flood control structures. In the event that Springfield is unable to obtain certification for the 42nd Street Levee, the next update of the flood control maps for this reach of the McKenzie River will be prepared as if the levee was not in place. This would greatly increase the area of the city within the mapped 100-year floodplain.

In Oregon, residential development is explicitly prohibited or restricted within the special flood hazard area. Specifically, Oregon Administrative Rule 660-008-0005 provides for needed housing that is "…suitable, available and necessary for residential uses." Land that "is within the 100-year flood plain" is not considered "suitable and available" under the buildable land definition. As such, residential vulnerability to the flood hazard is low.

As noted above, Eugene and Springfield are in the process of identifying resources to update flood-hazard information through new mapping. Once complete, a thorough quantification of vulnerable structures can be completed, provided that resources are available.

The recent Hazard and Climate Vulnerability Assessment confirmed these scores. Specifically, the assessment found that while flood events have the potential to cause severe loss and damage in localized areas, flooding is not likely to result in significant damage to critical systems or systemic failures across multiple sectors. The reason vulnerability to this hazard is rated as moderate for riverine flooding relates to the primary impacts and potential inconvenience for many members of the population (transportation impacts, drain on emergency response resources, etc.). Refer to Section 4 for specific vulnerabilities related to flooding.

2.3.7 National Flood Insurance Program Participation

Eugene and Springfield both participate in the National Flood Insurance Program (NFIP). Eugene's initial Flood Hazard Base Map is dated June 7, 1974 and its initial Flood Insurance Rate Map (FIRM) is dated September 26, 1986. As mentioned above, the current effective FIRM date is June 2, 1999. As of November 6, 2014, the city has 1,003 NFIP policies in force at a total value of $282,375,600. There have been 17 claims total, 10 of which are closed and 7 of which closed without payment. Total loss payments amount to $116,465.04. Eugene's last Community Assistance

Visit (CAV) occurred November 17, 2011. No visits or Community Assistance Contacts (CACs) have occurred since 1991. There have been 632 Letters of Map Change in Eugene.

Eugene also participates in the FEMA Community Rating System (CRS) program. The City has a CRS classification of 7 which translates to a 15% reduction to all NFIP policy premiums in Eugene.

Springfield's initial Flood Hazard Base Map is dated June 18, 1971 and its initial FIRM is dated September 27, 1985. Like Eugene, Springfield's current effective FIRM is dated June 2, 1999. As of November 6, 2014, Springfield has 142 NFIP policies valued at $41,431,500. There have been 27 claims, 22 of which are closed and 5 of which closed without payment. There have also been 8 BCX claims for property damage outside the mapped special flood hazard area. Total loss payments amount to $402,491.98. Springfield's last CAV occurred on July 6, 2006. There have been no CACs since that time. There have been 76 Letters of Map Change in Springfield.

2.3.8 Repetitive Flood Loss Properties

There are no properties on FEMA's repetitive loss or severe repetitive loss lists within Eugene or Springfield's jurisdictional boundaries. Notably, the prior edition of this plan (and the current FEMA database) identified four repetitive loss properties with Springfield addresses. Subsequent research has determined that all of the identified repetitive loss impacted properties are located outside the Springfield city limit and urban growth boundary. The City of Springfield is working with the state floodplain coordinator to notify FEMA and have the error corrected in the FEMA database, as described in the Flood Mitigation Action section under *Repetitive Loss Records*.

2.3.9 Existing Hazard Mitigation Activities

Historically, the focus of local stormwater maintenance practices has been limited to drainage and flood control. More recently, the focus has widened to include management of riparian vegetation by allowing it to remain in streams and channels for the beneficial effects of slowing runoff for filtration and sedimentation.

Eugene and Springfield have actively pursued several flood hazard mitigation activities in an effort to reduce vulnerability to damage and disruption from flooding events. Efforts include:

- Both cities participate in the National Flood Insurance Program, which enables property and business owners to qualify for federally underwritten flood insurance.

- Eugene is a participant in the Community Rating System (CRS) program and has a rating of 7.
- Both Eugene and Springfield have Stormwater Management Plans. The first goal of these plans is to protect citizens and property from urban flooding through planning for and building adequate stormwater systems.

Springfield owns, operates and maintains the 42nd Street Levee to protect a large area of the city from McKenzie River flooding.

2.4 Landslide

The probability of landslide is high in Eugene and moderate in Springfield. Springfield's probability rating is lower due to the fact that Springfield has fewer dramatic changes in elevation; vulnerability to landslide is low in both cities.

2.4.1 Landslide Causes and Characteristics

The term "landslide" refers to a variety of slope instabilities that result in the downward and outward movement of slope-forming materials including rocks, soils and artificial fill. The Eugene-Springfield area is susceptible to four types of landslides:

1) Rockfalls are abrupt movements of masses of geologic materials (rocks and soils) that become detached from steep slopes or cliffs. Movement occurs by free-fall, bouncing and rolling. Falls are strongly influenced by gravity, weathering, undercutting or erosion.
2) Rotational slides are those in which the rupture surface is curved concavely upwards and the slide movement is rotational about an axis parallel to the slope. Rotational slides usually have a steep scarp at the upslope end and a bulging "toe" made of the slid material at the bottom of the slide. Roads constructed by cut and fill along the side of a slope are prone to slumping on the fill side of the road. Rotational slides may creep slowly or move large distances suddenly.
3) Translational slides are those in which the moving material slides along a more or less flat surface. Translational slides occur on surfaces of weaknesses, such as faults and bedding planes or at the contact between firm rock and overlying loose soils. Translational slides may creep slowly or move large distances rather suddenly.

4) Flows are plastic or liquid in nature and the slide material breaks up and flows during movement. This type of landslide occurs when a landslide moves downslope as a semi-fluid mass, scouring or partially scouring rock and soils from the slope along its path. A flow landslide is typically rapid-moving and tends to increase in volume as it moves downslope and scours out its channel.

Landslide impacts are limited geographically to the area where the slide occurs. Landslides in Eugene-Springfield tend to be small slides or slumps near waterways or slides related to development activity. The potential for larger slides does exist in the south hills of Eugene and Springfield. Rockfall events are primarily limited to quarry sites where rock has been exposed (e.g. the west face of Skinner's Butte).

The primary factors that could affect or increase the likelihood of landslides in Eugene-Springfield are:

- Natural conditions and processes including the geology of the site, rainfall, water action, seismic activity 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 stormwater management and excess runoff due to increased impervious surfaces.
- Change or removal of vegetation on very steep slopes due to timber harvesting, land clearing and wildfire.

The water content of soils/rock is a major factor in determining the likelihood of sliding for any given slide-prone location. Thus, most landslides happen during rainy months, when soils are saturated with water. Winter storms with intense rainfalls are the most common trigger for landslides in the Eugene-Springfield area.

2.4.2 History of the Hazard in Eugene-Springfield

The Eugene-Springfield area has experienced small landslides throughout its history. Given the regional topography, the majority of these incidents have occurred in the south hills of the two cities. For a list of landslides occurring in recent decades, refer to Table 2-6.

Table 2-6. Historic landslide events in or near Eugene-Springfield

Date	Event
February 1996	Heavy rains and rapidly melting snow contributed to hundreds of landslides and debris flows across the state.
January 2008	The 64-acre Frazier landslide occurred near the City of Oakridge, approximately 50 miles from Eugene. The landslide disrupted freight and Amtrak service south of Eugene-Springfield until May 2008.
February 2008	On South 67th and Ivy, alongside Potato Hill in Springfield, a landslide threatened homes during construction of the Mountain Gate subdivision. Four homes were evacuated for fear of landslide from a recently constructed roadway embankment. Residents were advised to evacuate until the hazard was removed. The roadway embankment was reconstructed in March 2008.

The following list summarizes Eugene landslide events recorded in the past 5-years:

Moon Mountain – This was a development-related slide that threatened a private residence and impacted the City of Eugene right-of-way and stormwater system. The slide mitigation strategy entailed removing 8-10' of fill off of the slide area, installing a 20' deep French-drain and diverting surface water away from the slide.

Videra Park – This was a development- related slide that threatened private residence and City of Eugene wastewater and stormwater lines. The slide mitigation strategy entailed removing 6-8' of fill material by placing it back into the excavation for the dwelling and stabilizing the surface with seed and mulch.

The Highlands – Woodcutter Way – A leaking water main triggered slope movement. The slide mitigation strategy entailed installation of drains, placing a large rip-rap at the slide's toe and stabilizing the surface.

Local creek bank failures – (primarily along the Amazon Creek) – Within the past 5 years, Eugene Parks and Open Space staff have observed between 5 and 7 slides and slumps along major waterways. Slide mitigation strategies have entailed completion of roughly 80,000 linear feet of willow planting along channel banks, in addition to repairs to the slides and slumps. In 2013-2014, Eugene Public Works completed a stabilization and enhancement project along 1,800 linear feet of the Amazon Creek that widened the channel and created a flood bench, slowing the velocity of the water during high water events.

2.4.3 Risk Assessment

Where are Hazard Areas Located?

Specific areas that have had historical problems with debris flows and/or landslides within the Eugene-Springfield area are summarized below in Table 2-7. A more detailed landslide hazard assessment requires a site-specific analysis of the slope, soil, rock, vegetation and groundwater characteristics. Such assessments are often conducted prior to major development projects in areas with moderate to high landslide potential, to evaluate the specific hazard at the development site.

Table 2-7. Debris flow and landslide problem areas in Eugene-Springfield
Eugene
Capital-Essex Lane
Dillard Road
Brookside Drive
Cresta de Ruta
Goodpasture Island Road
Springfield
Thurston Hills area
Willamette Heights area
Kelly Butte area

2.4.4 Probability of Future Occurrences

The probability of a landslide occurring in the Eugene-Springfield area depends upon a number of factors, including steepness of slope, slope composition (i.e. soil type), local geology, vegetative cover, human activity and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides, and most landslides occur during rainy months of the year. The Eugene-Springfield steering committee rated the probability of a landslide occurrence as high in Eugene and moderate in Springfield. Springfield's probability rating is lower due to the fact that Springfield has fewer dramatic changes in elevation. A high rating means that one incident is likely in a 10 to 35 year period; a moderate rating means that one incident is likely in a 35 to 75 year period.

2.4.5 Vulnerability Assessment

Landslides can occur during any season in the Eugene-Springfield area. Given local development patterns, residential and public land uses are the most likely to be impacted by landslides. In Oregon, residential development is explicitly prohibited or restricted in areas with steep slopes. Specifically, Chapter 197 of the Oregon Revised Statute in the Oregon Administrative Rules provides for needed housing that is

"…suitable, available and necessary for residential uses." Lands that "(c) [have] slopes of 25 percent or greater" are not considered "suitable and available" under the buildable land definition. As such, residential vulnerability to landslides is low.

The Eugene-Springfield steering committee rated the cities' vulnerability to landslides as low, meaning that 1% of the population and/or regional assets would be affected by a landslide event.

2.4.6 Existing Hazard Mitigation Activities

In Eugene and Springfield, mitigation of the landslide hazard is accomplished through land use and development regulations. Both require geotechnical analysis of steep slopes prior to development in order to determine whether or not a development is appropriate for the area.

2.5 Volcano

The probability of volcanic activity impacting Eugene-Springfield is low; vulnerability to volcanic activity is moderate for Eugene and high for Springfield.

2.5.1 Causes and Characteristics of the Volcano

The Cascades, which run from British Columbia through Washington, Oregon and into northern California, contain more than a dozen major volcanoes and hundreds of smaller volcanic features. In the past 200 years, seven of the Cascade volcanoes in the United States have erupted, including Mt. Baker, Glacier Peak, Mt. Rainier, Mount St. Helens, Mt. Hood, Mt. Shasta and Mt. Lassen.

Over the past 4,000 years, Oregon has experienced three eruptions of Mt. Hood, four eruptions in the Three Sisters area, and two eruptions in the Newberry Volcano area. Minor eruptions have taken place near Mt. Jefferson, at Blue Lake Crater, in the Sand Mountain Field (Santiam Pass), near Mt. Washington and near Belknap Crater. During this time period, the most active volcano in the Cascades has been Mount St. Helens with about 14 eruptions.

Volcanic eruptions often involve several distinct types of hazards to people and property, as evidenced by the Mount St. Helens eruption in 1980. Major volcanic hazards include lava flows, blast effects, pyroclastic flows, ash flows, lahars, landslides and debris flows. Some of these hazards (e.g. lava flows) only affect areas very near to the volcano. Other hazards may affect areas 10 to 20 miles away from the volcano, while ash falls may affect areas many miles downwind of the eruption site. The primary volcanic hazards of concern for Eugene-Springfield are:

- **Ash falls** result when explosive eruptions blast rock fragments into the air. Such blasts may include tephra (solid and molten rock

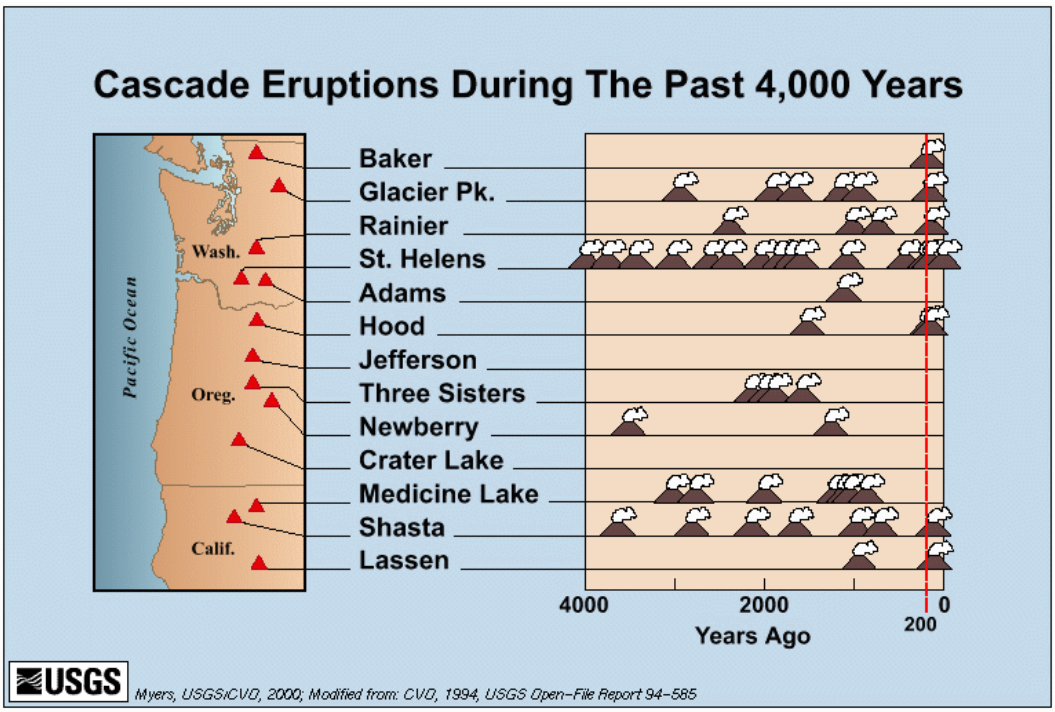
fragments). The largest rock fragments (sometimes called "bombs") generally fall within two miles of the eruption vent. Smaller ash fragments (less than about 0.1") typically rise into the area forming a huge eruption column. In very large eruptions, ash falls may total many feet in depth near the vent and extend for hundreds or even thousands of miles downwind.

- **Lahars** are common during eruptions of volcanoes with heavy loading of ice and snow. These flows of mud, rock and water can rush down channels at 20 to 40 miles an hour and can extend for more than 50 miles. For some volcanoes, lahars are a major hazard because highly populated areas are built on lahar flows from previous eruptions.

2.5.2 History of the Hazard

The history of volcanic activity in the Cascades is contained in its geologic record and the age of the volcanoes vary considerably. Figure 2-1 shows the history of volcanic events in the Cascades.

Figure 2-1. Historic Cascade Eruptions



Source: *W.E. Scott et al., 1997,*
http://vulcan.wr.usgs.gov/Volcanoes/Cascades/EruptiveHistory/cascades_eruptions_4000yrs.html

In Oregon, awareness of the potential for volcanic eruptions was greatly increased by the 1980 eruption of Mount St. Helens in Washington, which killed 57 people. The sonic boom from the eruption was heard in Eugene-

Springfield. In this eruption, lateral blast effects covered 230 square miles and reached 17 miles northwest of the crater. Pyroclastic flows covered six square miles and reached 5 miles north of the crater. Landslides covered 23 square miles. Ash accumulations were 10 inches deep at 10 miles downwind, 1 inch deep at 60 miles downwind, and ½ inch deep at 300 miles downwind. Lahars affected the North and South Forks of the Toutle River, the Green River, and ultimately the Columbia River as far as 70 miles from the volcano.

There are no known damage impacts from volcanoes in Eugene-Springfield in recorded history.

2.5.3 Risk Assessment

How Hazard Areas are Identified

Scientists utilize a range of techniques to identify areas subject to volcanic hazard impacts. For more information on volcano hazard identification in Oregon, refer to the Oregon Natural Hazards Mitigation Plan.

Several of the 20 active volcanoes in Oregon are located along the crest of the Cascades near the eastern boundary of Lane County. These volcanoes include the Three Sisters and Mount Jefferson. The active volcanoes that pose the most threat to the Eugene-Springfield area are the Three Sisters, which are approximately 50 miles away. Lava flow, pyroclastic flows, debris flows and avalanches from an eruption in the Sisters will be limited to the immediate area of the eruption and will not impact Eugene and Springfield. However, hazard zone maps for the Three Sisters show that landslides, debris flows, lahars and snowmelt runoff from an eruption could enter the McKenzie River and its tributaries. This would cause flooding on the McKenzie that could extend to the Thurston area on the east side of the Eugene-Springfield metro area.

Lahars can occur both during an eruption and when a volcano is quiet. The water that creates lahars can come from melting snow and ice (especially water from a glacier melted by a pyroclastic flow or surge), intense rainfall, or the breakout of a summit crater lake. Some lahars contain so much rock debris (60 to 90% by weight) that they look like fast-moving rivers of wet concrete. Historically, lahars are one of the deadliest volcano hazards. Close to their source, these flows are powerful enough to rip up and carry trees, houses and huge boulders miles downstream. Farther downstream they can entomb in mud everything in their path. In Eugene-Springfield, lahar impacts are expected to be very similar to the FEMA-mapped floodplains of the McKenzie River.

Lahars running through the McKenzie River could also lead to high turbidity in the water, causing degradation of water quality and operational problems at water treatment plants. While this could impact the City of Eugene, which currently relies on the McKenzie River as its sole source of

drinking water, EWEB has developed procedures to manage high-turbidity events and is actively seeking alternate sources of drinking water, as outlined in the multi-hazard mitigation action *Water Source*. The Eugene Water and Electric Board is currently developing a plan to establish a second source of drinking water. Minimal impact is expected in the upper Willamette tributaries, presenting low risk to the Springfield Utility Board's treatment plant on the middle fork of the Willamette.

Ash fall could extend to the Eugene-Springfield area from an eruption in the Sisters, as well as from other eruptions including Mount St. Helens. In all but the most extreme events, ash falls in the Eugene-Springfield Metro Area are likely to be very minor, with an inch or less of ash likely.

There is also a possibility that a major eruption in the Cascades could affect public water supplies via heavy ash falls or lahars into streams and rivers upstream from public water supply intakes.

2.5.4 Probability of Future Occurrence

The latest update to the Oregon Natural Hazards Mitigation Plan indicates that the annual probability of the South and Middle Sister entering a new period of eruptive activity is estimated from 1 in several thousand to 1 in 10,000. However, the ability to calculate the probability of a volcanic eruption is limited due to the fragmented nature of the geologic history for these volcanoes.

Of note, uplift was discovered in South Sister in 2001 when geologists and volcanologists observed that an area roughly 10 miles in diameter had risen by roughly 4 inches at its center. The center of this area was roughly 3 miles from the summit of the South Sister volcano. Uplift continued at roughly 1 inch per year until 2004, and since that time the uplift has continued at roughly one half inch per year.[8] While this uplift is significant, it does not indicate that an eruption is imminent.

Given the presence of active volcanoes in the Cascades that could impact the Eugene-Springfield area, including the Three Sisters and Mount St. Helens, Eugene and Springfield estimate the probability of a new volcanic occurrence as moderate. A moderate rating means that one incident is likely within a 35 to 75 year period.

2.5.5 Vulnerability Assessment

The Eugene steering committee rated the vulnerability to a volcanic event as moderate, meaning that 1-10% of the population and/or regional assets could be impacted by a volcanic event. This moderate rating is due to the fact that the impacts of an eruption for Eugene would be limited to ash fall

[8] USGS, *Three Sisters, Oregon Information Statement*, April 11, 2007, http://vulcan.wr.usgs.gov/Volcanoes/Sisters/WestUplift/information_statement_04-11-07.html.

and a decrease in water quality from the McKenzie River. The Springfield steering committee listed its vulnerability as high given that large portions of Springfield are located in the McKenzie River floodplain and that any lahars that enter the McKenzie River could flood portions of the city. A high vulnerability means that more than 10% of the population or regional assets would be affected.

2.6 Wildfire

The probability of wildfire is high in Eugene-Springfield; vulnerability is moderate in Eugene and low in Springfield

2.6.1 Causes and Characteristics of Wildfires

Fire is an essential part of Oregon's ecosystem, but it is also a serious threat to life and property particularly where urban areas encroach upon forested, open range or grassland areas. Wildfires occur when fire impacts large vegetated areas that require a suppression response.

In this region, changes in historic vegetation, climate and fire occurrence are resulting in changes to the patterns and character of fire. In short, *the risks and potential impacts of wildfire are increasing*.

Oregon wildfires

Recent major wildfires in Oregon include the Long Draw fire and the Miller Homestead fire. The Long Draw and Miller homestead fires of 2002 began because of lightening and dry thunderstorms, and they burned over 7,000 acres in southeastern Oregon.[9] The Bureau of Land Management owns a majority of the land burned; however, forty property owners who owned mainly agricultural land were affected.[10] The Miller homestead fire alone caused over $8 million in damage.[11]

Fires in other parts of the West

The Black Forest fire occurred in Colorado in 2013, and damaged 595 homes. 498 of those homes were completely destroyed.[12] It cost nearly $8.5 million to contain the Black Forest fire.[13] The Carlton Complex fire

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9 Blackwood, Jeff D. *Long Draw/Miller Homestead Fire Review*. April 2013. http://www.blm.gov/or/news/files/long-draw.pdf
10 Oregon.gov. *Governor Kitzhaber announces funds to help repair fences, re-seed land, and retail rural jobs in Southeastern Oregon.* *http://www.oregon.gov/gov/media_room/pages/press_releases/press_060613.aspx*
11 Bureau of Land Management. *BLM Oregon Post-Fire Recovery Plan.* August 23, 2012. http://www.blm.gov/or/districts/burns/plans/files/MilleESRPlan_1.pdf. *http://www.denverpost.com/colorado/ci_23518579/officials-511-homes-burned-black-forest-fire*
12 FEMA. *Colorado Black Forest Wildfire*. http://www.fema.gov/media-library-data/c25715894278ad44c82ddd9d0c7e3243/PDA_Report_FEMA-4134-DR-CO.pdf
13 The Denver Post. *Officials: 511 homes burned in Black Forest Fire.* June 2013. *http://www.denverpost.com/colorado/ci_23518579/officials-511-homes-burned-black-forest-fire*

occurred in Washington in 2014, damaged over 300 homes, and cost the state over $23.3 million in damages, bringing the total damages from wildfires in Washington to over $50 million in 2014.[14]

Wildfires are not just a rural phenomenon. The impact on urban areas from wildfire can be huge. In 1990, Bend's Awbrey Hall fire destroyed 21 homes, caused $9 million in damage and cost over $2 million to suppress. In 1991, the Oakland Hills firestorm killed 25 people, injured 150 others, destroyed 3,791 dwelling units and resulted in roughly $1.5 billion in economic losses. The 1996 Skeleton fire in Bend burned over 17,000 acres and damaged or destroyed 30 homes and structures.

Wildfire can be divided into three categories: interface, wildland and firestorms.

- Interface fire occurs where wildland and developed areas come together at the wildland-urban interface, with both vegetation and structural development combining to provide fuel.
- A wildland fire's main fuel source is natural vegetation. Often referred to as forest or rangeland fires, these fires often 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 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.

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

- 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 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.

[14] The Oregonian. *Washington Wildfire-Fighting Costs Soar past $50 Million for Season.* July 27, 2014. http://www.oregonlive.com/pacific-northwest-news/index.ssf/2014/07/washington_wildfire-fighting_c.html

- 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. By 2030, climate change is expected to result in average annual temperature increases of 2-4°F, reduced precipitation in spring, summer and fall, and an increase in extreme heat events. These changes will likely result in an increase in wildfire frequency and intensity.

- The degree of urban development influences the amount of fuel available.

2.6.2 History of the Hazard

While some small wildfires have been recorded by the Eugene and Springfield fire departments, there is no history of large wildfires in the immediate area.

2.6.3 Risk Assessment

How Hazard Areas are Identified

The Eugene-Springfield area is bordered by grassland, agricultural land and forest. The wildfire hazard is primarily located in the south hills of both Eugene and Springfield where forested areas interface directly with homes, businesses and infrastructure. Other areas, like northeast Springfield, have large areas with high vegetative fuel loads that interface with or are located very close to developed and developing built areas.

For wildfire hazard maps, refer to Section 3.

Probability of Future Occurrence

The Eugene-Springfield steering committee identified the probability of a wildfire occurring in the Eugene-Springfield area as high, given the high fuel load in nearby forested areas, hilly topography and dry summers. A high probability means that one event is likely to occur within a 10 to 35 year period.

Change in Future Probability

Global climate change is expected to increase the length and severity of summer drought, increase summer high temperatures and increase summer low temperatures. All of these changes are expected to *increase* the future probability of wildfires in the Eugene-Springfield area.

Vulnerability Assessment

The hazard identification section above lists the areas in Eugene and Springfield that could be exposed to wildfire. These areas could be vulnerable to wildfire, depending on the following factors:

1. Amount of vegetative fuel loads on the property, and the degree of continuity of fuel load (i.e. amount of significant firebreaks). If properties are surrounded by large amounts of fuel without significant firebreaks, vulnerability to wildfire is greater. Risk may be particularly high if the fuel load is grass, brush and smaller trees. These types of vegetation have very low moisture levels in short-duration drought periods.
2. Degree of slope. Steeper slopes cause fire to spread more rapidly than on flatter terrain.
3. Fire suppression capacity. Limited fire suppression capacity includes limited water supply for fire suppression purposes, limited firefighting personnel and apparatus, and typically long response times for fire alarms. These limitations increase vulnerability to wildfire events.
4. Access for firefighting apparatus and resident evacuation. Limited access and egress increases vulnerability.
5. Construction materials.
6. Maintenance of firebreaks and defensible zones around structures.

Given the amount of residential development in the south hills of Eugene, the Eugene steering committee rated their vulnerability to wildfire as moderate, meaning that a wildfire could impact 1-10% of the population and/or local assets in Eugene. The Springfield steering committee rated the vulnerability of the wildfire hazard in Springfield as low given the smaller amount of development in the south hills and northeastern areas of Springfield. A low rating means that less than 1% of the population and/or regional assets would be affected.

The recent Hazard and Climate Vulnerability Assessment confirmed these scores. Specifically, the assessment found that while wildfire events have the potential to cause severe loss and damage in localized areas, the wildfire hazard is not likely to result in systemic failures across multiple sectors or significant damage to critical systems. Refer to Section 4 for specific vulnerabilities related to the wildfire hazard.

Risk Analysis

The 2008 update to the Lane County Community Wildfire Protection Plan's (CWPP) risk assessment identifies specific neighborhoods in

Eugene and Springfield as areas at risk. These areas of concern include the South Hills neighborhoods in Eugene, the southwest Eugene/Spencer Creek area, Thurston Hills in Springfield and the Harbor Drive/South 2nd area in Springfield.[15]

Table 2-8 shows the percentage of each community at risk by risk category.

Table 2-8. CWPP Communities at Risk Summary for Eugene-Springfield

Community At Risk	Total Acreage	Percentage of Community at Risk		
		High	Medium	Low
Eugene	37,747	2.1	17.7	80.2
Springfield	9,445	3.9	15.8	80.2

Source: Lane County Community Wildfire Protection Plan, 2008

2.6.4 Existing Mitigation Activities

In 2010, the Springfield and Eugene Fire Departments began operating under an intergovernmental agreement to share the services of key administrative positions in both departments. In 2014, the two departments merged into one department. This union has facilitated better sharing and utilization of resources, and it has facilitated better communication related to wildfire planning. For example, Eugene Springfield Fire offers educational campaigns to inform residents about actions they can take to reduce wildfire hazards on their property. In addition, Eugene Springfield Fire and EMS completed a South Hills fire plan in 2012 that addresses specific wildfire hazards in Eugene's South Hills. A similar wildfire plan is currently under development for the wildfire-prone areas of Springfield.

2.7 Winter Storm

The probability of winter storms and severe weather in Eugene-Springfield is high; vulnerability to winter storms and severe weather is also high.

2.7.1 Causes and Characteristics of the Hazard

Winter storms affecting the Eugene-Springfield area are primarily characterized by a combination of heavy rains and high winds. Heavy rains can result in flooding, as well as debris slides and landslides. High winds commonly result in tree falls that primarily affect the electric power system, but they can also affect buildings, vehicles and the transportation system. Winter storms can also involve ice and snow, most commonly at elevations higher than the immediate Eugene-Springfield area. The most likely effects of snow and ice events are road closures limiting access and egress to and from the Eugene-Springfield area. Closures especially affect

15 Lane County. *Lane County Community Wildfire Protection Plan*, (Eugene, OR: 2008), 2-9, 2-11.

roads to higher elevations, such the highways into the Cascades or over the Coast Range. Winter storms with heavy wet snow and ice storms also may result in power outages from downed transmission lines and/or poles.

Average annual snowfall gauged by the Eugene Airport weather station is 6.4”. Since the weather station was established in 1939, maximum monthly snowfall has been 47.1” (January 1969), with maximum seasonal snowfall also at 47.1” (1969). Maximum monthly snowfalls for February, March, November and December are 8.8”, 10.8”, 6.0” and 10.2”, respectively.

2.7.2 History of the Hazard in Eugene-Springfield

Major winter storm events do occur occasionally. Major snow storms affecting the Willamette Valley occurred in 1884, 1892, 1909, 1916, 1919, 1937, 1950, 1969, 1989, 2002, 2004, 2008, 2010, 2012, 2013 and 2014. January 1950 snowfalls were especially high, with 54” in Albany and 36” in Eugene. The Columbus Day storm of 1962 is known as the most damaging winter storm to ever hit the area, with buildings damaged and transportation networks disrupted. In January 1969, Eugene had 47” of snow. In December 2008, March 2012 and February 2014, significant snow and ice disrupted electrical service and transportation systems throughout the Willamette Valley.

For the Eugene-Springfield area, most winters result in little snowfall. Major storms of 10” or more snow typically occur every 10 to 20 years. There are few practical mitigation actions for such infrequent major snow storms other than commonsense measures applicable to many hazards. These commonsense measures include encouraging residents to maintain emergency supplies of food and water for a few days and purchasing emergency generators for critical facilities.

Table 2-9: Significant Eugene-Springfield winter storm events since 1990

Date	Location	Comments
February 11-16, 1990	Statewide	**Heavy Snow:** Average of 8 inches across the Willamette Valley
December 16-17, 1992	Western Oregon	**Heavy Snow**
February 18-19, 1993	Northwestern Oregon	**Heavy Snow:** 6 to 12 inches snow fell in the Willamette Valley
Winter 1998-1999	Statewide	**Series of Snow Storms:** One of the snowiest winters in Oregon history
August 4, 1999	Eugene/Springfield	**Hail Storm**

February 7, 2002	Lane County	**Wind Storm:** Sustained winds and peak gusts at the Eugene Airport of 49 mph and 70 mph. This windstorm was a Federally-declared disaster. Damages of public properties were greater than $6 million. Utility lines, vehicles and buildings were damaged because of fallen trees.
March 12, 2002		**Snow**
Date	**Location**	**Comments**
December 2003-January 2004		**Snow**
NOTE: the following events were compiled from the list of Eugene Public Works Emergency Command Center activations between 2009 and 2014		
December 2008-January 2009	Southern Willamette Valley	**Heavy Snow/Ice Event. Federal Disaster Declaration**
November 23-24, 2010	Cascades and Foothills in Lane County	**Heavy Snow**
December 27-29, 2010	Cascades and Foothills in Lane County	**Ice Event:** Road icing
March 13, 2011		**Rain storm: Downed trees**
January 17 to 21, 2012		**Snow and Ice event. Federal Disaster Declaration (DR-4055)**
March 21-24, 2012	Southern Willamette Valley	**Heavy Snow:** Eugene received eight inches of snow in eight hours. Reports of trees down, powerlines down, local roads closed.
November 19-20, 2012	Eugene/Springfield	**Local flood response**
January 10, 2013	Lane County	**De-icing event:** Freezing Temps
December 4-13, 2013	Central & Southern Willamette Valley	**Heavy Snow & Extreme Cold:** 8-9 inches of snow recorded in Creswell. De-iced
February 6-24, 2014	Northwest Oregon	**Heavy Snow & Freezing Rain:** Reports of up to 0.75 inches of ice in Eugene. **Federal Disaster Declaration (DR-4169)**
March 5-6, 2014	Northwest Oregon	**Windstorm prompted by a cold front moving down from Washington.**

Sources: City of Eugene, Oregon Weather Book.

For completeness, the plan briefly addresses other severe weather events including hail, severe heat, lightning strikes and tornadoes.

Hail

Hail events are possible in the Eugene-Springfield area, generally during summer thunderstorms. However, hail damage is generally minor and few practical mitigation alternatives are applicable to hail.

Severe Heat

Severe heat is possible, though historically rare, in Eugene and Springfield. When they do occur during the summer months, heat events tax utility systems and endanger the health of some citizens, particularly the elderly, the very young, and those with compromised health. The summer of 2014 set a new record for the number of days with high temperatures over 90 degrees[16]. According to Kathie Dello at the Oregon Climate Change Research Institute, these are the types of conditions we should expect to see in the future.

Climate change is expected to increase both summertime high temperatures and the summertime low temperatures[17] that allow natural cooling of homes, buildings, and surfaces that absorb heat like concrete and asphalt. Most residents in Eugene-Springfield lack mechanical cooling systems, putting them at greater risk of heat illness during an extreme heat event.

Lightning

Lightning strikes also occur in the Eugene-Springfield area. Lightning strike damage to buildings or infrastructure is generally minor and few practical mitigation alternatives are applicable to lightning, other than installing lightning arrestors on critical facilities subject to lightning damage. For Oregon, however, casualties from lightning are very low, with totals of only 7 deaths and 19 injuries reported over a 35 year period (NOAA). Thus, the level of risk posed by lightning strikes, while not zero, is very low. Public education about safe practices during electrical storms is the only available mitigation measure to reduce casualties from lightning.

Tornadoes

Tornadoes also do occur occasionally in Oregon. However, Oregon is not among the 39 states with any reported tornado deaths since 1950. NOAA

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16 http://registerguard.com/rg/news/local/32166313-75/hot-summers-better-get-used-to-em.html.csp

17 The Oregon Climate Adaptation Framework. Oregon Department of Land Conservation and Development. December 2010. http://www.oregon.gov/energy/GBLWRM/docs/Framework_Final_DLCD.pdf

records (Portland office) show four historical tornadoes in Lane County. On November 24, 1989, a tornado touched down in the south hills of Eugene, uprooting several tall fir trees, and damaging utility lines and a camper, but causing no injuries. Another poorly documented tornado may have occurred in 1975 near Eugene, with very minor damage. In 1984, a small tornado was reported near Junction City with damage to a barn and shelter. In 1937, a possible tornado uprooted hundreds of trees and demolished summer homes and camps near McKenzie Bridge.

2.7.3 Risk Assessment

How are Hazard Areas Identified?

All areas of the Eugene-Springfield Metro area are susceptible to winter storm damage.

Probability of Future Occurrence

The Oregon NHMP Hazard Profile for the region Eugene-Springfield indicates that the probability of winter storms in the area is high – winter storms occur annually in the region. Two or more severe winter storm events occur each decade on average.

Eugene-Springfield list the probability for local winter storms as 'high,' which indicates that at least one event is likely within a 10 to 35 year period.

Vulnerability Assessment

In 2013 and 2014 the City of Eugene and Springfield conducted a Climate and Hazards Vulnerability assessment to inform this NHMP. The assessment team met with local and regional experts in each of the following sectors: Drinking water, Health Care and Public Health, Electricity, Transportation, Food, Housing, Communication, Stormwater, Wastewater, Natural Systems, and Public Safety.

Findings from the assessment confirmed that in Eugene-Springfield severe winter storm events have the potential to cause region-wide cascading system failures. Much of the Metro area's regional adaptive capacity stems from Eugene and Springfield's ability to draw resources, personnel, and expertise from nearby communities, particularly during an emergency. This capacity is severely restricted during winter storm events. Specifically, severe winter storms disrupt two of the three sectors that all other sectors depend upon for efficient functionality:

Electricity and Transportation. This is especially true if the storm lasts more than a couple of days and especially if snow and ice accumulations are significant.

Additional system vulnerability details are included in Section IV: Risk and Vulnerability.

Many buildings, utilities, and transportation systems in the Eugene-Springfield area are vulnerable to winter storm damage. This is especially true in forested areas, along tree-lined roads and electrical transmission lines, and on residential parcels – where trees have been planted or left for aesthetic purposes – as ice-loading and high winds often accompany winter storms.

Fallen trees are especially troublesome. They can block roads and rails for long periods, which can affect emergency operations and delay restoration of critical services. In addition, uprooted or shattered trees can down power and/or utility lines, effectively bringing local economic activity and other essential activities to a standstill. Much of the problem may be attributed to a shallow or weakened root system in saturated ground. Many roofs have been damaged or destroyed by uprooted trees growing next to a house. In some situations, strategic pruning may be the answer. Eugene and Springfield work with utility companies in identifying problem areas and establishing a tree maintenance / removal program and assessing opportunities for relocating utility lines

The Eugene-Springfield Steering Committee rates winter storm vulnerability as 'high', indicating a winter storm would impact more than 10% of the region's population.

Risk Analysis

The Initial Damage Assessment for the February 2014 Winter Storm in Lane County (DR-4169-OR) was $7.1 million. Post-disaster damage estimates can be found following presidentially-declared disasters.

Existing Hazard Mitigation Activities

Eugene and Springfield are participating in winter storm mitigation activities.

- Development Codes: Both jurisdictions require utilities in all new subdivision developments to be installed underground. This assists in the prevention of damaged power and communication lines during an event.
- Tree-Trimming: The Eugene Water & Electric Board and the Springfield Utility Board engage in tree-trimming around power lines.
- Building Codes: Eugene and Springfield Building Codes adhere to the Oregon Structural Specialty Code guidelines for new development.

2.8 Dam Failure

The probability of dam failure impacting Eugene-Springfield is low; vulnerability to a dam failure event is high.

2.8.1 Characteristics of Dams

Dams are impervious structures that block the flow of water in a river or stream and thereby impound water behind the dam. Large modern dams are almost always embankment dams (built primarily from soil, rock, or mixtures) or concrete dams.

Dams are built for many purposes including water storage for potable water supply, flood control, hydroelectric power generation, agricultural irrigation, fire suppression, navigation, recreation, and others. While dams are typically multifunctional, serving two or more of these purposes, the Army Corps of Engineers prioritizes flood mitigation when operating Willamette Basin dams.

Large modern dams almost always have control mechanisms such as gated spillways or outlet pipes for releasing water in a controlled fashion. Typically, dams are operated to smooth natural variations in water flow. During high water flow periods, water is stored behind a dam, while in low water flow periods, water is released to increase flows. Controlled releases typically result in lower peak (flood) flows and higher minimum flows than in uncontrolled streams. The specific patterns of water storage and release vary from dam to dam, depending on the primary purpose(s) of the dam and on a wide variety of economic, regulatory and environmental considerations.

Modern dams, whether embankment dams or concrete dams, are typically constructed on a foundation, which may be concrete, natural rock or soils, or compacted soils. Dams are usually constructed along a constricted part of a river valley to minimize cost. Dams are also connected to the surrounding natural valley walls, which become the abutments of the dam structure itself.

Embankment dams are commonly termed earthfill or rockfill dams, depending on the primary material used in their construction. Embankment dams are broad flat structures, typically at least twice as wide at the base as their height. Depending on the permeability of the materials used in an embankment dam, impervious layers may be added to the upstream side of the structure or in the center core of the structure. Embankment dams are subject to erosion by running water. Thus, modern embankment dams always have erosion-resistant materials used in the water release and control mechanisms of the dam. Typically, concrete spillways with concrete or steel gates are used to control releases. Many dams also have outlet pipe systems with concrete or steel pipes as part of the water release control system.

Modern concrete dams fall into two major classes: gravity dams and arch dams. Concrete gravity dams are designed on principles similar to embankment dams. Concrete gravity dams are broad structures, generally triangular in shape with a flat base, a narrow top, a flat upstream side and a broad sloping downstream side. Much of these dams' capacity to impound water arises from the weight of the dam. Typically, gravity dams are keyed into bedrock foundations and abutments to increase the stability of the dam.

Concrete arch dams rely primarily on the strength of concrete to impound water. Concrete arch dams are much thinner in cross section than concrete gravity dams and are always convex on the upstream side and concave on the downstream side because concrete is much stronger in compression than in tension. With this arch design, the pressure of impounded water compresses the concrete and makes the dam stronger. Like concrete gravity dams, concrete arch dams are also keyed into bedrock foundations and abutments to provide stability. A less common variation of a concrete arch dam is a concrete buttress dam. Buttress dams are arched or straight dams with additional strength provided by buttresses perpendicular to the long axis of the dam.

2.8.2 Causes of Dam Failure

Dam failures can occur at any time in a dam's life; however, failures are most common when water storage for the dam is at or near design capacity. At high water levels, the water force on the dam is higher and several of the most common failure modes are more likely to occur. Correspondingly, for any dam, the probability of failure is much lower when water levels are substantially below the design capacity for the reservoir.

For embankment dams, the most common failure mode is erosion of the dam during prolonged periods of rainfall and flooding. When dams are full and water inflow rates exceed the capacity of the controlled release mechanisms (spillways and outlet pipes), overtopping may occur. When overtopping occurs, scour and erosion of either the dam itself and/or the abutments may lead to partial or complete failure of the dam. Especially for embankment dams, internal erosion, piping or seepage through the dam, foundation, or abutments can also lead to failure. The dams in the Willamette River Basin were designed to open the spillways only infrequently during severe events. The spillways are being used more frequently now, causing wear on spillway parts and leading to greater maintenance needs and greater risk of spillway failure. For smaller dams, erosion and weakening of dam structures by growth of vegetation and burrowing animals is a common cause of failure.

For embankment dams, earthquake ground motions may cause dams to settle or spread laterally. Such settlement does not generally lead, by itself,

to immediate failure. However, if the dam is full, relatively minor amounts of settling may cause overtopping to occur, with resulting scour and erosion that may progress to failure.

For any dam, improper design or construction or inadequate preparation of foundations and abutments can also cause failures. Improper operation of a dam, such as failure to open gates or valves during high flow periods can also trigger dam failure. For any dam, unusual hydrodynamic (water) forces can also initiate failure. Landslides into the reservoir, which may occur on their own or be triggered by earthquakes, may lead to surge waves which overtop dams or hydrodynamic forces which cause dams to fail under the unexpected load. Earthquakes can also cause seiches (waves) in reservoirs that may overtop or overload dam structures. In rare cases, high winds may also cause waves that overtop or overload dam structures.

Concrete dams are also subject to failure due to seepage of water through foundations or abutments. Dams of any construction type are also subject to deliberate damage via sabotage or terrorism. For waterways with a series of dams, downstream dams are also subject to failure induced by the failure of an upstream dam. If an upstream dam fails, then downstream dams also fail due to overtopping or due to hydrodynamic forces.

A National Research Council study[4] of dam failures in the United States and Western Europe from 1900 to 1969 compiled historical data on the observed probability of failure as a function of type of dam. Dam failures are quite common in the United States. For example, FEMA data from Tropical Storm Alberto (1994) show 230 dam failures in the State of Georgia from this single event.[18] Fortunately, most dam failures are of small dams where the failure poses little or no risk to life safety and only minor, localized property damage.

2.8.3 History of the Hazard in Eugene-Springfield

There have been no reported dam failures in Oregon that have impacted Eugene-Springfield.

2.8.4 Risk Assessment

How are Hazard Areas Identified?

Although the likelihood of failure is very low, all dams upstream from the Eugene-Springfield area have the potential of causing widespread flooding should they fail. The dams that could cause the greatest loss of life and economic loss have been inventoried by the Army Corps of Engineers in the National Inventory of Dams (NID). The NID lists approximately

18 FEMA [Federal Emergency Management Agency]. 1999- National dam safety program (http://www.fema.gov/mit/ndspweb.htm).

79,000 dams in the US that have the potential to cause significant damage. The NID rates each dam either a high, significant, or low hazard classification depending on the probable impacts if a dam fails, but is not based on whether the dam is unsafe or likely to fail. A High Potential Hazard classification is the only classification that takes into account whether people are at risk downstream from the dam in the inundation area, if the dam were to fail.

In Lane County, there are nine dams in the High Potential Hazard Category meaning that people are at risk from a dam failure and there would be significant economic and environmental losses. Lane County's 9 High Potential Hazard dams are listed below in Table 2-10, and all dams, except Fern Ridge, are upstream from the Eugene-Springfield area.

Table 2-10. NID High Potential Hazard Dams Lane County

County	Dam Name	River	NID City	NID Height (feet)	NID Storage (acre feet)
Lane	Cottage Grove	Coast Fork Willamette River	COTTAGE GROVE	103	50,000
Lane	Dexter	Middle Fork Willamette River	EUGENE	117	29,900
Lane	Fall Creek	Fall Creek	SPRINGFIELD	205	125,000
Lane	Dorena	Row River	COTTAGE GROVE	154	131,000
Lane	Lookout Point	Middle Fork Willamette River	EUGENE	276	477,700
Lane	Blue River Dam	Blue River	SPRINGFIELD	312	89,000
Lane	Hills Creek	Middle Fork Willamette River	OAKRIDGE	341	356,000
Lane	Cougar	South Fork McKenzie River	SPRINGFIELD	519	219,000
Lane	Fern Ridge	Long Tom River	EUGENE	49	121,000

The extent of the flood hazard from these dams depends on which dam fails, how much water is behind the dam at the time of failure, time of day, the degree to which the dam failed, and the dam's proximity to population centers. For example, in a worst case scenario, if the Hills Creek Dam were to fail catastrophically, the volume of water released would breach the Lookout Point Dam and Dexter Dam. If just the Dexter dam failed, the volume of water released would be significantly less, as would the damage to the Eugene-Springfield area.

In 2010 and 2011, the Portland District of the U.S. Army Corps of Engineers updated the Dam Failure Inundation Maps and the Emergency Action Plans for their nine projects in Lane County. Although copies of these maps have been provided to Lane County and the cities of Eugene and Springfield for emergency planning purposes, distribution of the maps is restricted because they contain sensitive information. Persons wishing to obtain copies of the maps should contact the Portland District of the U.S. Army Corps of Engineers.

Probability of Future Occurrence

To evaluate the probability of a dam collapse upstream from the Eugene-Springfield area, the type of dam for each of the 9 high hazard potential dams in Lane County should be considered. Table 2-11 provides additional information on the type of dam.

Table 2-11. Additional Data on NID High Hazard Potential Dams

County	Dam Name	River	Storage (acre feet)	Date Built	Dam Type	EAP	Owner
Lane	Cottage Grove	Coast Fork Willamette	50,000	1942	RE	Y	Corps
Lane	Dexter	Middle Fork Willamette	29,900	1955	RE	Y	Corps
Lane	Fall Creek	Fall Creek	125,000	1965	ER	Y	Corps
Lane	Dorena	Row River	131,00	1949	RE	Y	Corps
Lane	Lookout Point	Middle Fork Willamette	477,700	1953	RE	Y	Corps
Lane	Blue River Dam	Blue River	89,000	1968	RE	Y	Corps
Lane	Hills Creek	Middle Fork Willamette	356,000	1962	RE	Y	Corps
Lane	Cougar	South Fork McKenzie	219,000	1964	ER	Y	Corps
Lane	Fern Ridge	Long Tom	121,000	1941	RE	Y	Corps

The NID dam type classification includes the following types of dams:

RE: rockfill/earthfill embankment dams, primarily rockfill (fill >3" size)

ER: rockfill/earthfill embankment dams, primarily earthfill (fill <3" size)

Lane County's high hazard potential dams were completed between 1941 and 1968. All dams are rockfill/earthfill embankment dams, except Cougar which is an earthfill/rockfill embankment dam. All dams are operated by the US Army Corps of Engineers and all have emergency operations plans in place. All Corps dams are maintained on a regular schedule and undergo regular inspections, with major re-inspections every five years. Furthermore, the Corps is highly experienced in the construction, operation, and maintenance of dams.

For embankment dams the most common failure modes are overtopping, foundation failures, and seepage through the dam. However, all of the Corps dams were designed and built with specific flood capacities. In addition, the Hills Creek Dam likely has the capacity to withstand floods at least as large as a 1,000 year flood event without expected damage. The other Corps dams have similar margins of flood design safety. Under normal or flood conditions, the probability of failure of the Corps operated dams appears highly unlikely. However, all of Lane County's dams were designed and built in the 1940s to 1960s before seismic design standards were put in place.

Seismic considerations were completely absent in the design of Dorena and Fern Ridge dams. The others were explicitly designed to ground shaking levels of 0.10 g, which is the maximum seismic design level for any of the Corps dams in western Oregon. In contrast, the current Corps seismic design levels for dams at these sites (i.e., if new dams were to be built today) would be 0.21 g to 0.24g for the dams in eastern Lane County and 0.35 g for Fern Ridge. Thus, current seismic design requirements are for levels of ground shaking about two times higher than the probable design levels for most of these dams and about three times higher for Fern Ridge. To ensure that the probability of dam failures in Lane County remains low, the Army Corps of Engineers conducts regular seismic evaluations of each of the dams, and ensures that all dams meet current safety requirements.

The probability of catastrophic failure of these dams is impossible to estimate with any accuracy, from present data. Most likely, the probability is less than 0.1% per year (less than once in 1,000 years, on average) and perhaps substantially less. The Army Corps of Engineers indicates that Lane County's Dams all meet seismic standards and flood standards and that the probability of a dam failure is low, meaning that one incident is likely in a 75 to 100 year period. The Eugene and Springfield steering committees agree with this assessment.

Vulnerability Assessment

Eugene and Springfield are both highly vulnerable to inundation from a flood should one of the dams collapse. Both the Eugene and Springfield steering committees rate both cities as highly vulnerable to flooding events caused by dam

failure, meaning that more than 10% of the population or regional assets could be affected.

Risk Analysis

Detailed loss estimates for possible failures of these dams are beyond the scope of this mitigation plan. Detailed damage and casualty estimates have not been made for catastrophic dam failures affecting Lane County. However, given the large inundation areas, high water depths, and the logistical difficulties in evacuating over 250,000 people to safe ground, it is not difficult to imagine that a truly catastrophic dam failure could potentially result in 1,000 or more deaths and losses in the tens of billions of dollars.

Existing Mitigation Activities

The Army Corps of Engineers conducts annual inspections of all dams that it owns, has completed Emergency Action Plans for all dams should they fail, and completes thorough evaluations of each dam every five years. All these actions have help to significantly reduce the probability that a dam will fail.

2.9 Hazardous Materials

The probability of a hazardous materials incident in Eugene-Springfield is high; vulnerability to such an event is moderate.

2.9.1 Causes and Characteristics of the Hazard

For mitigation planning, 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. The impacts of hazardous materials may be short-term with negative effects immediately or in a few seconds, minutes or hours or they may be long-term with negative effects in days, weeks, or in some cases years after exposure. Hazardous materials also include materials that may cause negative impacts on the environment or on animal or plant species.

Hazardous materials vary widely in their toxicity to humans. Some hazardous materials are highly toxic so that even brief exposures to small amounts may be dangerous or even fatal. Other hazardous materials are much less toxic and negative effects may occur only after exposure to large amounts over longer time periods. The technical term “toxic,” which is widely used to describe hazardous materials, is simply a synonym for the more common terms “poison” or “poisonous.”

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.

For mitigation planning purposes, the toxicity of particular hazardous materials is an important measure of the potential impact of hazardous materials on affected communities, but not the only important measure.

Other characteristics of hazardous materials, especially the quantity of material and the ease of dispersal of the material may be as important as or more important than toxicity in governing the level of potential threat to a community. For example, a small quantity of a very toxic solid hazardous material in a research laboratory may pose a much smaller level of risk for a community than a large quantity of a less toxic gaseous material in an industrial site upwind from a populated area.

The severity of any hazardous material release incident for an affected community depends on several factors, including:

a. the toxicity of the hazardous material,

b. the quantity of the hazardous material released,

c. the dispersal characteristics of the hazardous material,

d. the local conditions such as wind direction and topography, soil and ground water characteristics and proximity to vulnerable resources such as public drinking water resources,

e. the population of nearby areas likely to be affected by hazardous materials incidents, and

f. the efficacy of response and recovery actions.

There are three principal modes of human exposure to hazardous materials:

a. **Inhalation** of gaseous or particulate materials via the respiratory (breathing) process,

b. **Ingestion** of hazardous materials via contaminated food or water, and

c. **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 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 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 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.

Asphyxiants are substances which interfere with breathing. Simple asphyxiants 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 asphyxiants 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. Signs and symptoms include drowsiness, weakness, fatigue, and incoordination, 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 2-12.

Table 2-12. 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

2.9.2 History of the Hazard in Eugene-Springfield

Large-scale hazardous materials events have been rare. Small-scale or household spills or events are also deemed to be relatively uncommon.

2.9.3 Risk Assessment

At the present time, there isn't reliable data for assessing the level of risk posed by hazardous materials.

How are Hazard Areas Identified?

Just about any area within the Eugene-Springfield area may have hazardous materials on or around it. The railroad passing through Eugene-Springfield moves a number of hazardous substances in large quantities. Results from an Extremely Hazardous Substance Plan that is currently under development will help identify those areas with greater risk.

Probability of Future Occurrence

At least 289 hazardous materials incidents of varying magnitude have occurred in the Eugene-Springfield area over the last 5 years, with a roughly even distribution of incidents for each year. Given the increasing populations of both Eugene and Springfield there is no reason to believe that this number will noticeably drop.

The Eugene and Springfield Steering Committee listed the probability of a hazardous material incident as 'high'.

Vulnerability Assessment

As mentioned above, many areas with the Eugene-Springfield area may contain hazardous materials, though areas that transport and store such materials and the areas around them are especially vulnerable. These areas include the railroad that runs through Eugene and Springfield as well as any pipelines in the area.

The Eugene and Springfield Steering Committee estimate the vulnerability to hazardous material incidents as 'moderate'.

Risk Analysis

Due to insufficient data, Eugene and Springfield are unable to perform a quantitative risk assessment at this time. The cities will be completing a risk assessment as data and resources become available.

Community Hazard Issues

What is susceptible to damage during a hazard event?

The potential impacts of hazardous materials incidents on the Eugene-Springfield area are summarized below.

Table2-13. Potential Impacts of Hazardous Material Incidents on the Eugene-Springfield area

Inventory	Probable Impacts
Portion of Eugene-Springfield Metro Area affected	Most hazmat incident impacts would be localized near source of spill, but major spills could have extensive evacuation zones and affect a significant portion of the Eugene-Springfield Metro Area.
Buildings	Negligible impact, except for near incidents which involve explosions.
Streets within Metro Area	Temporary street closures likely
Roads to/from Metro Area	Temporary road closures likely
Electric power	Negligible impact, except for near incidents which involve explosions
Other Utilities	Negligible impacts, except for incidents which spilled hazmat into rivers upstream from water intakes for Eugene-Springfield water systems
Casualties	Potential for casualties (deaths and injuries), depending on location and identity of hazmat material(s) involved, time of day and effectiveness of evacuations.

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 the Eugene-Springfield area. This detailed inventory information along with data hazardous materials being transported within or through the Eugene-Springfield area, provides the basic data for specific inventory awareness and is integrated into Eugene Springfield Fire Department.

Eugene and Springfield are in the process of developing an Extremely Hazardous Substance plan with the Local Emergency Planning Committee that will aid in response.

In addition, Springfield Utility Board has created a Wellhead Protection program that limits what types of hazardous materials may be kept near wellheads. This is important as Springfield gets the vast majority of its water from wells.

3 Maps

3.1 Eugene-Springfield Hazard Maps

The maps in this section describe the location and intensity of individual hazards including earthquake, flood, urban wildfire, and landslide. The maps were updated by Lane Council of Governments using federal funds.

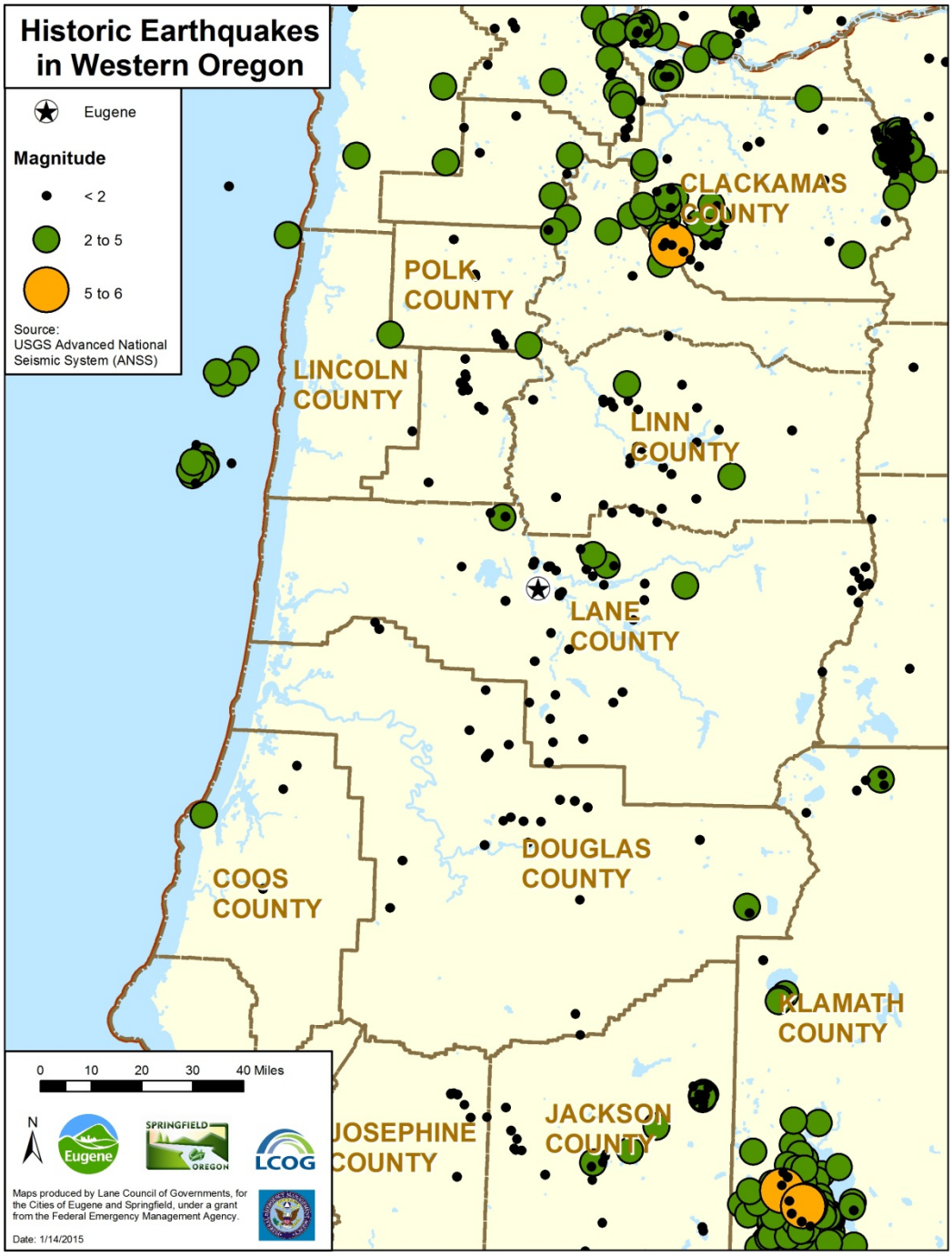
A description of the map and source data is contained within each map.

A complete description of the history, probability, and risk of each hazard is discussed within Section 2, Hazard Descriptions.

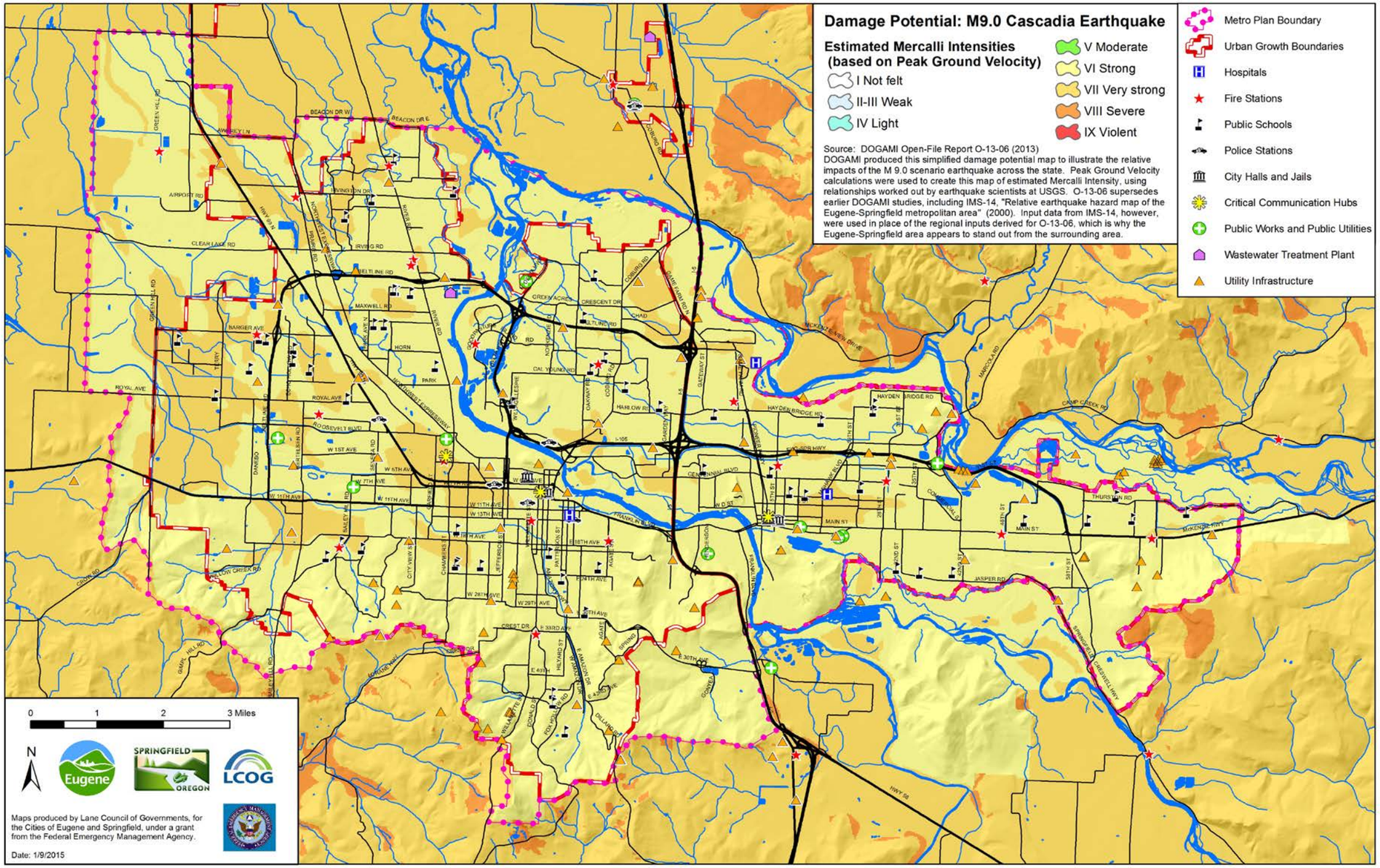
The following maps are included:

- Historic Earthquakes in Western Oregon
- Earthquake Damage Potential
- Relative Fire Hazard
- Flood Hazard Areas
- Chronic Urban Flooding
- Landslide Hazard Areas
- Landslide Susceptibility
- Liquefaction Susceptibility
- Metro Land Use Zones
- Metro Transportation System

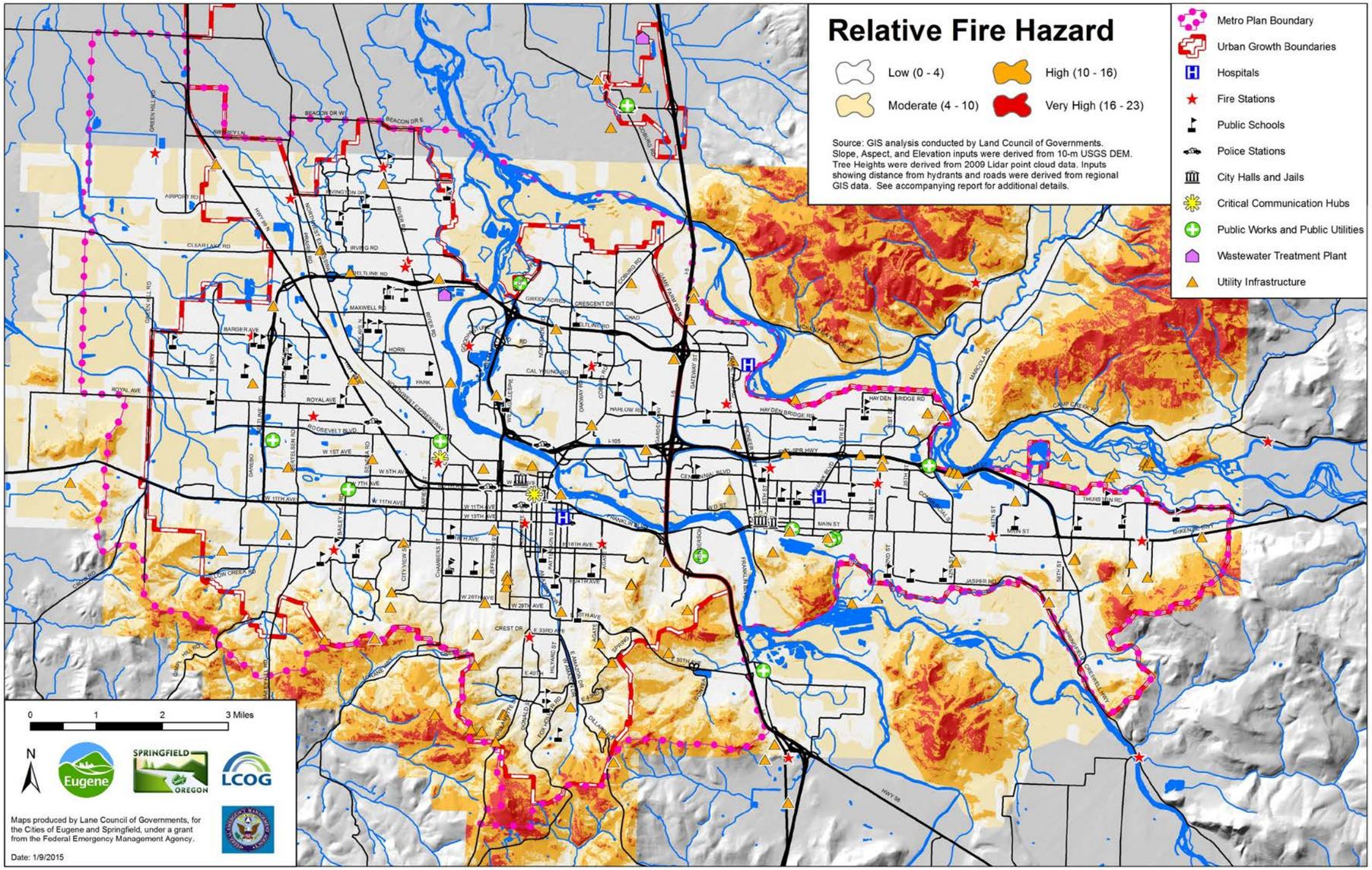
3.1.1 Historic Earthquakes in Western Oregon



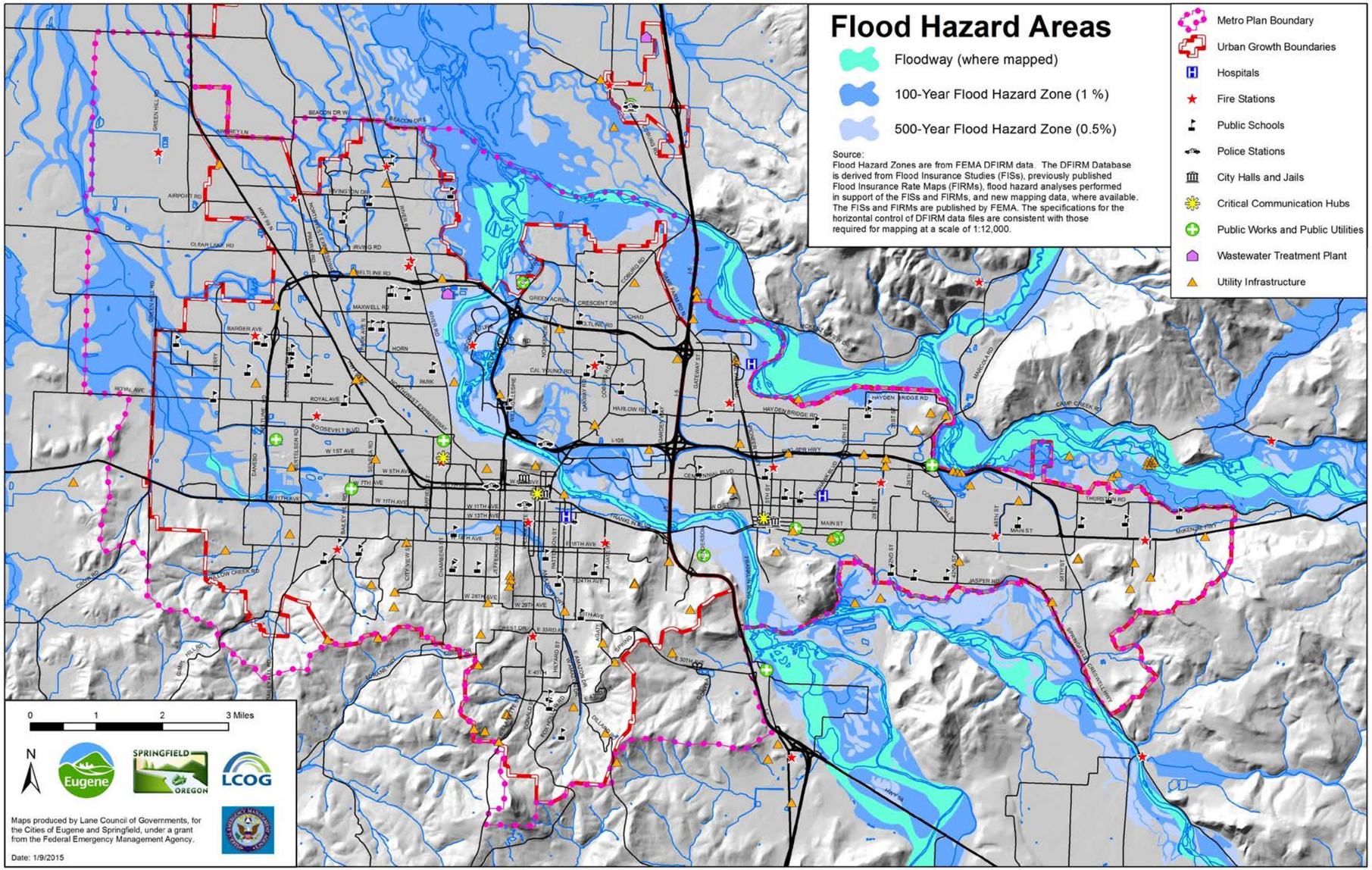
3.1.2 Earthquake Damage Potential



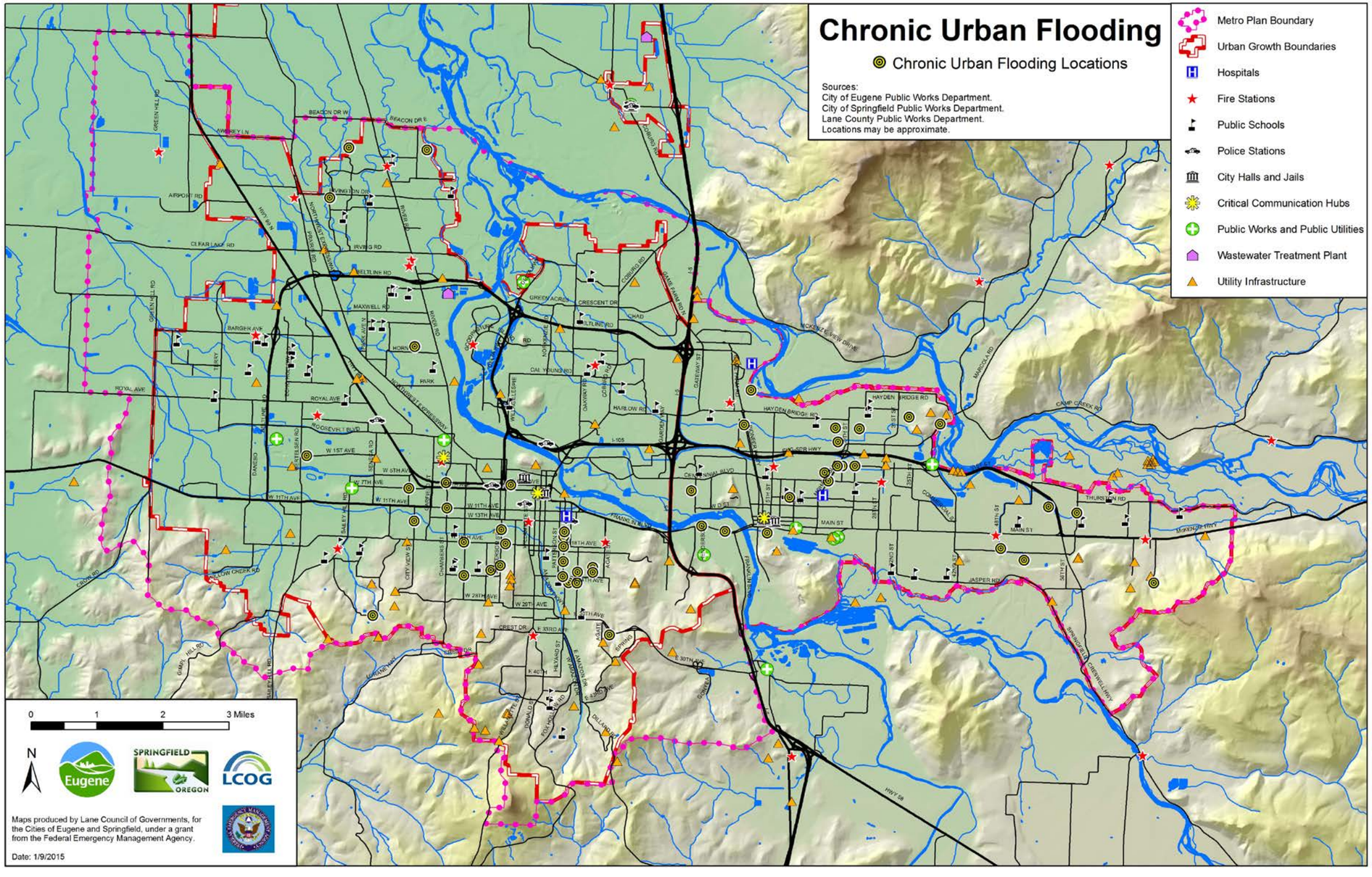
3.1.3 Relative Fire Hazard



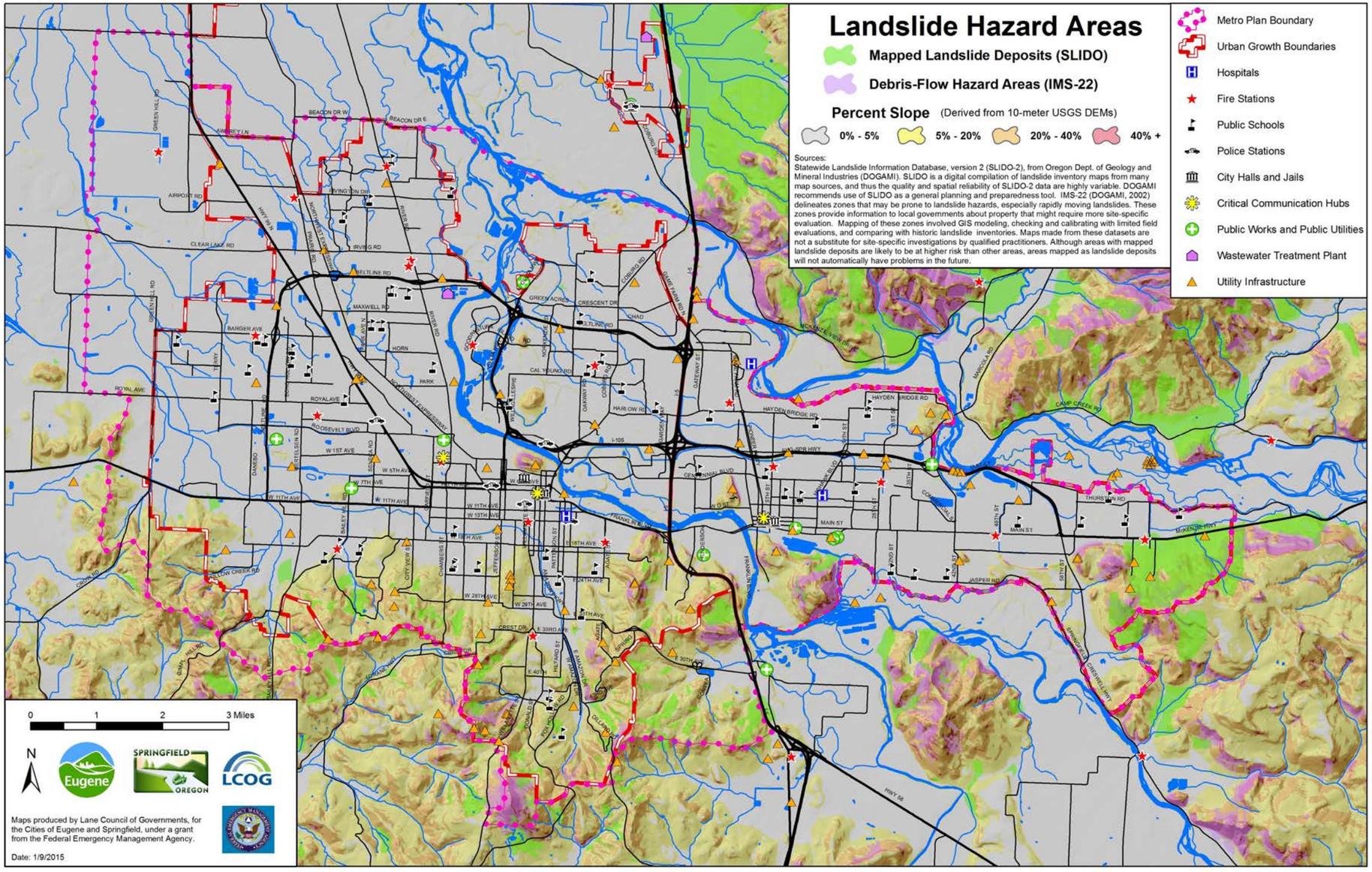
3.1.4 Flood Hazard Areas



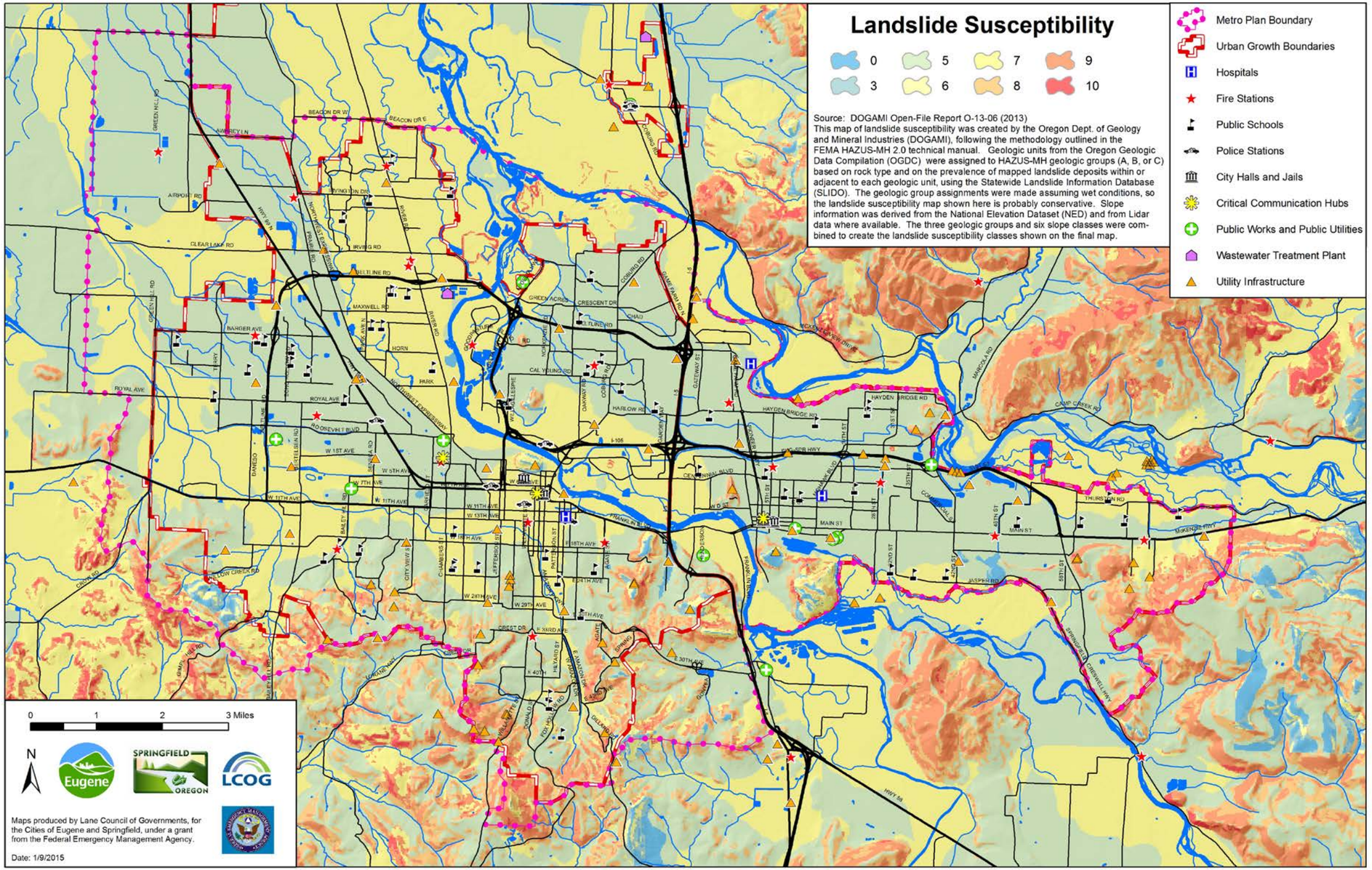
3.1.5 Chronic Urban Flooding



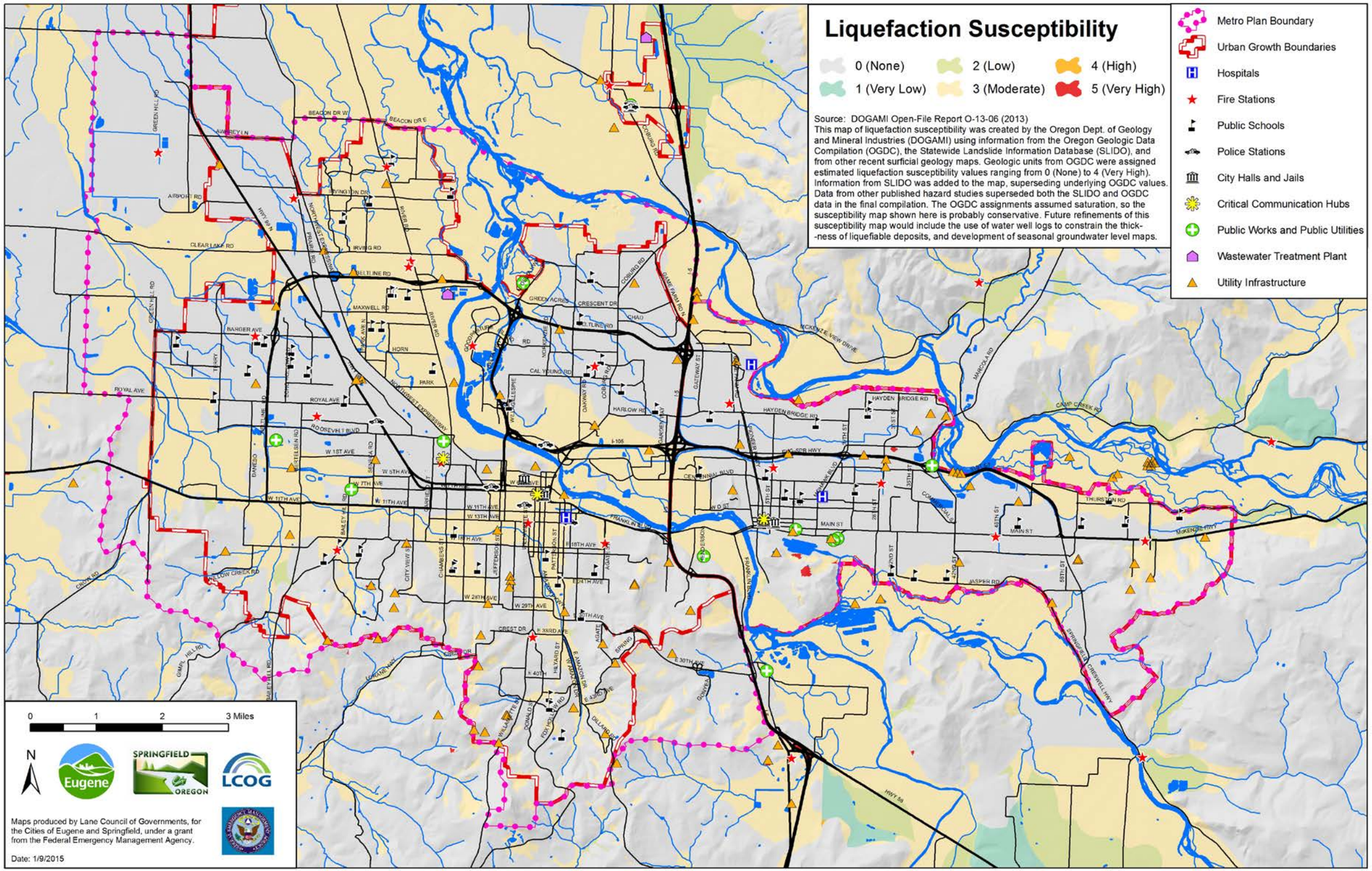
3.1.6 Landslide Hazard Areas



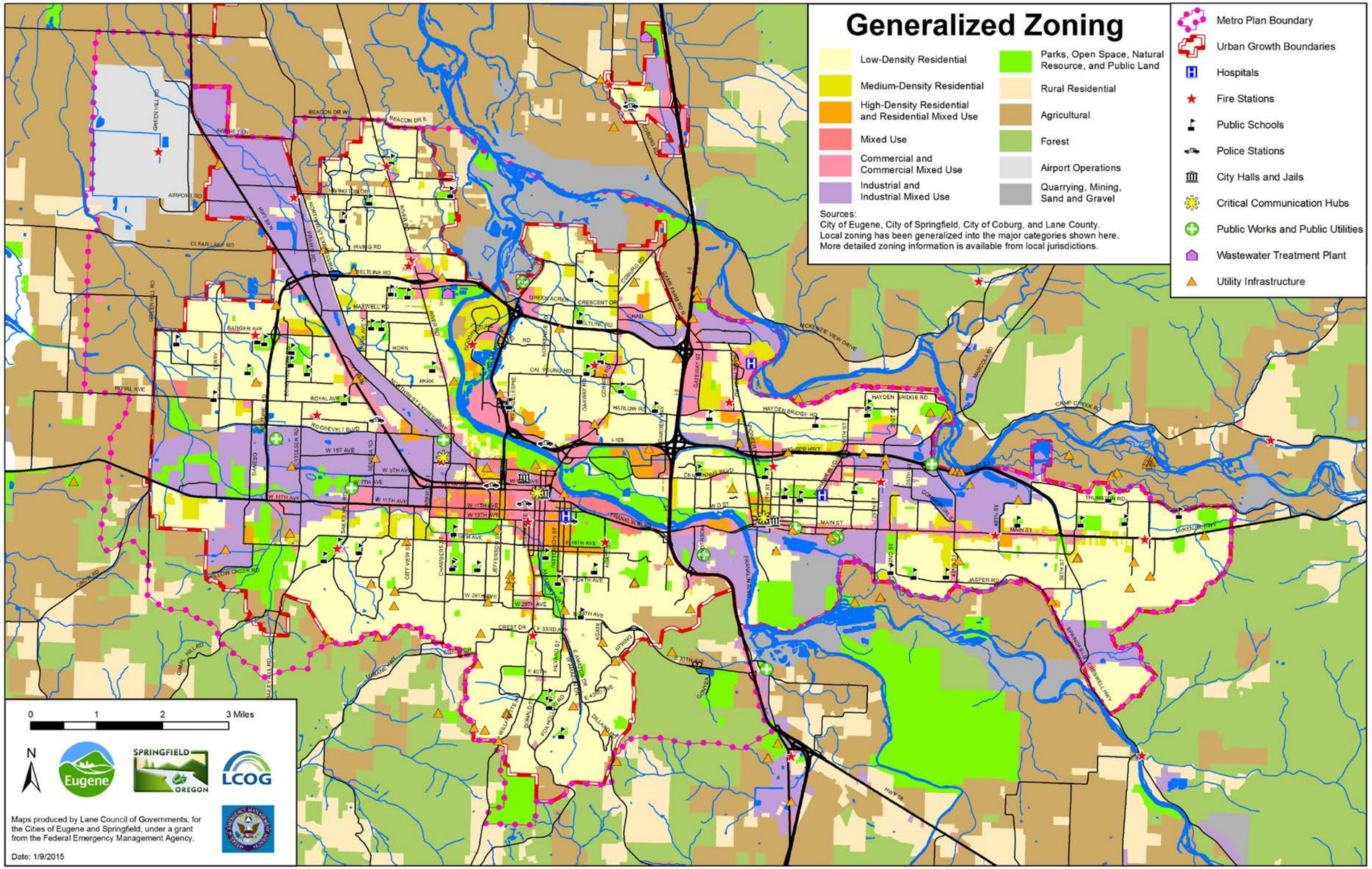
3.1.7 Landslide Susceptibility



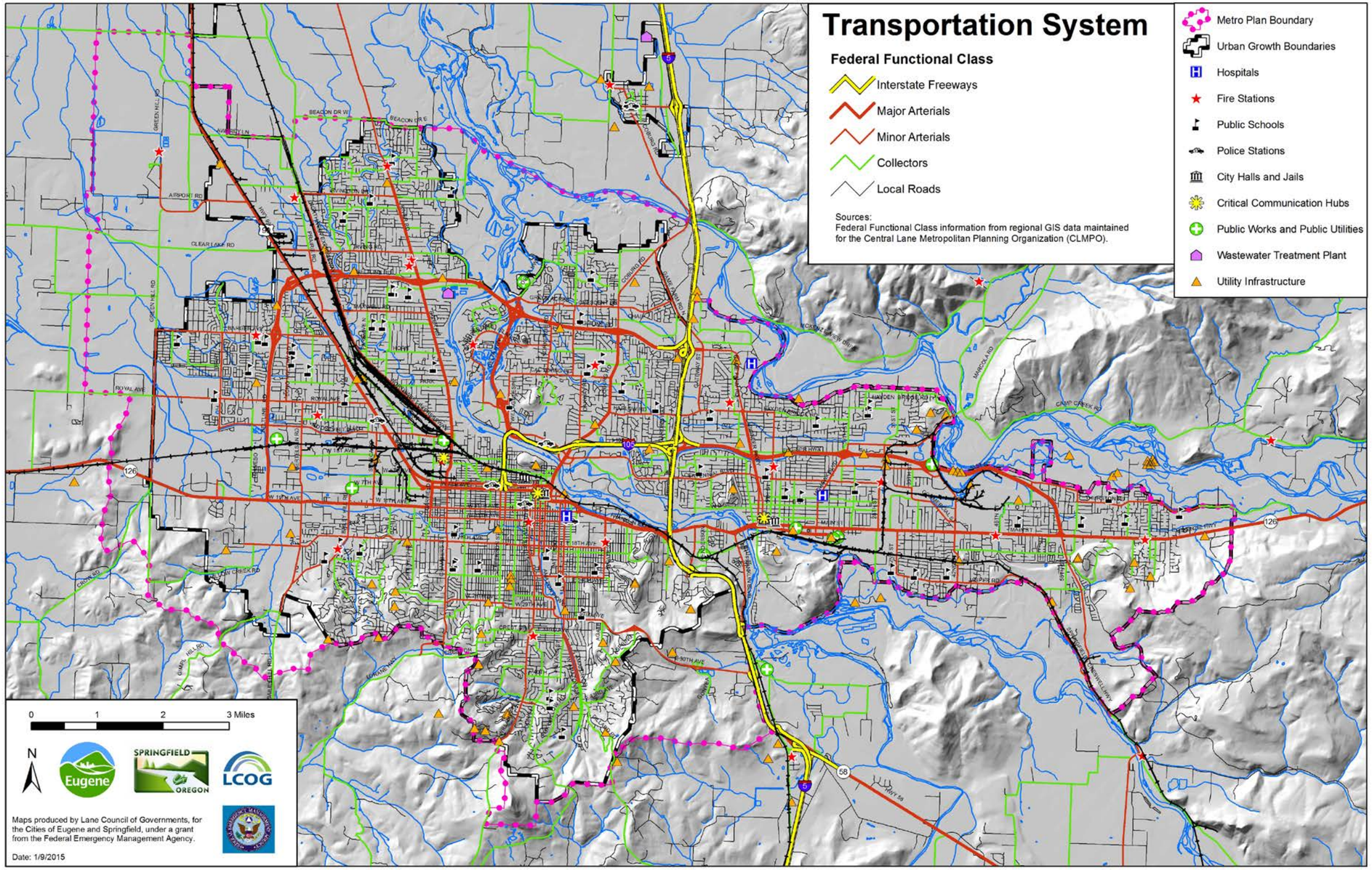
3.1.8 Liquefaction Susceptibility



3.1.9 Metro Land Use Zones



3.1.10 Metro Transportation System



3.2 Vulnerable Population Maps

The following tables summarize peer-reviewed research indicating what variables are most important when considering populations vulnerable to both Natural Hazards and Climate Change. These populations are particularly important for natural hazards planning as they are often disproportionately affected by hazard events. Therefore, it is important that planners pay particular attention to the locations and characteristics of these populations. Following the tables are the related maps of the Eugene-Springfield metro region that were readily available. These maps are a product of the Lane Livability Consortium, a metro area collaboration funded by a grant from the US Department of Housing and Urban Development (HUD).

Table 3-1. Natural Hazard Social Vulnerability Factors

Number	Indicator	References
1	Age	1, 2,3,4,5
2	Income	1,2,6
3	Residence	2,6
4	Tenure	2, 7
5	Employment	8
6	English Skills	7, 8
7	Household Type	4,5,7,8
8	Disability	2,8
9	Home Insurance	
10	Health Insurance	
11	Debt and savings	
12	Car	1,5,8
13	Gender	2,5,9
14	Injuries (hazard specific)	10
15	Residence Damage (hazard specific)	10

References

1	G. F.White and H. J. Heinz. *The Hidden costs of Coastal Hazards*. H. John Heinz III Center for Science, Economics and the Environment. Island Press, Washington, USA, 2000.
2	B. Phillips. *Holistic Disaster Recovery: Ideas for building local sustainability after a natural disaster*, chapter Chapter 6: Social and Intergenerational Equity. Natural Hazards Research Center, University of Colorado, Colorado, USA, 2001.
3	P. Buckle. A framework for Assessing Vulnerability. *The Australian Journal of Emergency Management*, 13(4):21–26, 1995.
4	D. King and C. MacGregor. Using social indicators to measure community vulnerability to natural hazards. *Australian Journal of Emergency Management*, 15(3):52–57, 2000.
5	K. Granger, T. Jones, and G. Scott. Community Risk in Cairns: a multi-hazard risk assessment. Technical report, Geoscience Australia, Commonwealth Government of Australia, Canberra, Australia, 1999.
6	R. Bolin and L. Stanford. Shelter, Housing and Recovery: A Comparison of U.S.

	Disasters. *Disasters*, 15(1):24–34, 1991.
7	B. H. Morrow. Identifying and Mapping Community Vulnerability. *Disasters*, 23(1):1–18, 1999.
8	P. Buckle. Assessing resilience and vulnerability in the context of emergencies: Guidelines. Technical report, Department of Human Services, Victoria, Melbourne, Australia, 2000.
9	M. Fordham. The Place of Gender in Earthquake vulnerability and mitigation. In *Second Euro Conference on Global Change and Catastrophic Risk Management - Earthquake Risks in Europe, Austria*, Laxenburg, Austria, 2000.
10	Federal Emergency Management Authority. HAZUS 99 Technical Manual. Technical report, Federal Emergency Management Authority Agency, (FEMA), United States Government, Washington, USA, 1999.

Source: Dwyer, A., Zoppou, C., Nielsen, O., Day, S., Roberts, S., 2004. Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards. *Geoscience Australia Record 2004/14*. Table title: *The thirteen socio-economic indicators and two hazard indicators used in this study to establish the vulnerability of a person within a household to natural hazard impacts.*

Table 3-2. Climate Change Social Vulnerability Factors

Category	Vulnerability Factor(s)/ Vulnerable Population	References
Socioeconomic	Low Income	1, 2, 3, 4, 5
	People of color (ethnic minorities)	3, 5, 7
	Women	5
Age	Elderly	5
	Children	5
Housing Conditions	Home renters	4
	Flammable roof, vegetation within 10 meters of home	8, 9
Isolation	Language ability/linguistic isolation	10
	Isolation from public agencies for fear of interacting with public agencies	10
	Geographic isolation	11
Other	No health insurance	12
	No vehicle	13
	Disabled (or family member disabled)	5, 13
	Institutionalized populations	11, 14

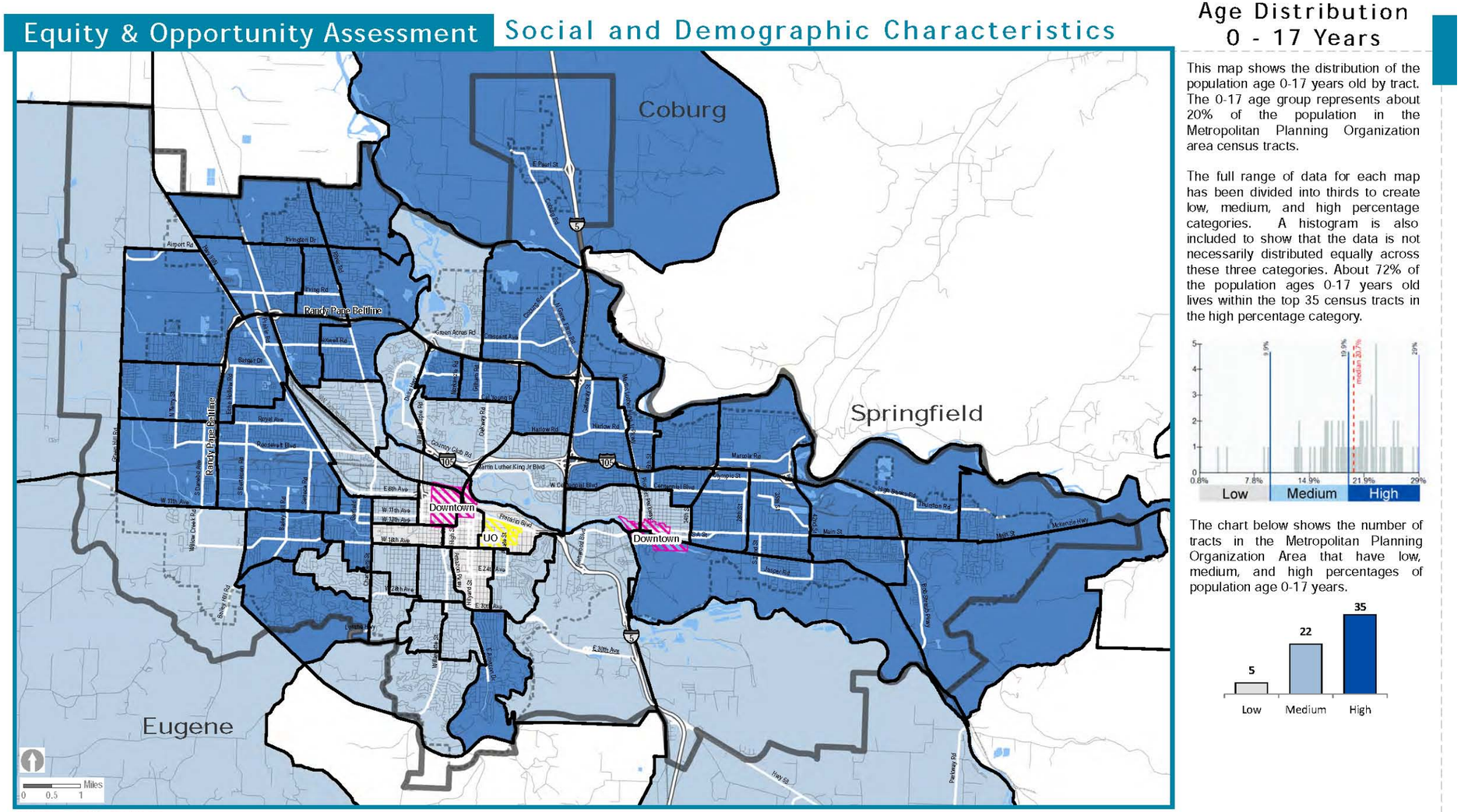
References	
1	Bolin, R., and P. Bolton. 1986. *Race Religion and Ethnicity in Disaster Recovery*. Monograph No. 42. Boulder: University of Colorado, Institute of Behavioral Science.
2	Fothergill, A., and L. Peek. 2004. "Poverty and Disasters in the United States: A Review of Recent Sociological Findings." *Natural Hazards* 32:89–110.
3	Blanchard-Boehm, D. 1997. *Risk Communication in Southern California: Ethnic and Gender Response to 1995 Revised, Upgraded Earthquake Probabilities*. Research Report. Bolder, Colorado: Natural Hazards Research and Applications Information Center.
4	Collins, T. W., and B. Bolin. 2009. "Situating Hazard Vulnerability: People's Negotiations with Wildfire Environments in the U.S. Southwest." *Environmental Management* 44:441–455.
5	Hajat, S., K. L. Ebi, R. S. Kovats, B. Menne, S. Edwards, and A. Haines. 2003. "The Human Health Consequences of Flooding in Europe: A Review." *Health San Francisco* 30: 185–196
6	Perry, R., and A. H. Mushkatel. 1986. *Minority Citizens in Disasters.* Athens: University of Georgia Press.
7	Phillips, B., and M. Ephraim. 1992. "Living in the Aftermath: Blaming Processes in the Loma Prieta Earthquake." Working Paper No. 80. IBS. Boulder: University of Colorado, Natural Hazards Research and Applications Information Center.
8	Collins, T. W. 2005. "Households, Forests, and Fire Hazard Vulnerability in the American West: A Case Study of a California Community." *Environmental Hazards* 6:23–37.
9	Howard, R. A., D. W. North, F. L. Offensend, and C. N. Smart. 1973. *Decision Analysis of Fire Protection Strategy for the Santa Monica Mountains: An Initial Assessment*. Menlo Park, California: Stanford Research Institute.
10	Wang, T., and L. Yasui. 2008. *Integrating Immigrant Families in Emergency Response, Relief, and Rebuilding Efforts*. Baltimore, Maryland: Annie E. Casey Foundation.
11	Moser, S., and J. Ekstrom. 2010. *Developing Adaptation Strategies for San Luis Obispo County: Preliminary Climate Change Vulnerability Assessment for Social Systems.* Technical Report Prepared for the Local Government Commission and the San Luis Obispo Stakeholder Workshop on May 20, 2010.
12	Bovbjerg, R., and J. Hadley. 2007. "Why Health Insurance is Important." *Health Policy Briefs*. The Urban Institute. Washington, D.C.
13	Brodie, M., E. Weltzien, D. Altman, R. Benson, and J. Benson. 2006. "Experiences of Hurricane Katrina Evacuees in Houston Shelters: Implications for Future Planning." *American Journal of Public Health* 95 (5): 1402–1408.
14	Caruson, K., and S. A. MacManus. 2008. "Disaster Vulnerabilities: How Strong a Push Toward Regionalism and Intergovernmental Cooperation?" *The American Review of Public Administration* 38 (3): 286–306. http://arp.sagepub.com/content/38/3/286.full.pdf+html.

Source: Social Vulnerability to Climate Change in California. A white paper from the California Energy Commission's California Climate Change Center. Prepared by Pacific Institute, July 2012

The following maps are contained within this section of the Eugene-Springfield Natural Hazards Mitigation Plan:

- Children 17 and Under
- Population Experiencing a Disability
- Female Headed Households
- Households Without Access to a Vehicle
- Income and Poverty: Economic Vulnerability
- Latino and Minority Households
- Manufactured Homes
- Households in Poverty
- Residents Living in Rental Housing
- Seniors 80 and Older

3.2.1 Children 17 and Under



Age Distribution 0 - 17 Years

This map shows the distribution of the population age 0-17 years old by tract. The 0-17 age group represents about 20% of the population in the Metropolitan Planning Organization area census tracts.

The full range of data for each map has been divided into thirds to create low, medium, and high percentage categories. A histogram is also included to show that the data is not necessarily distributed equally across these three categories. About 72% of the population ages 0-17 years old lives within the top 35 census tracts in the high percentage category.

The chart below shows the number of tracts in the Metropolitan Planning Organization Area that have low, medium, and high percentages of population age 0-17 years.

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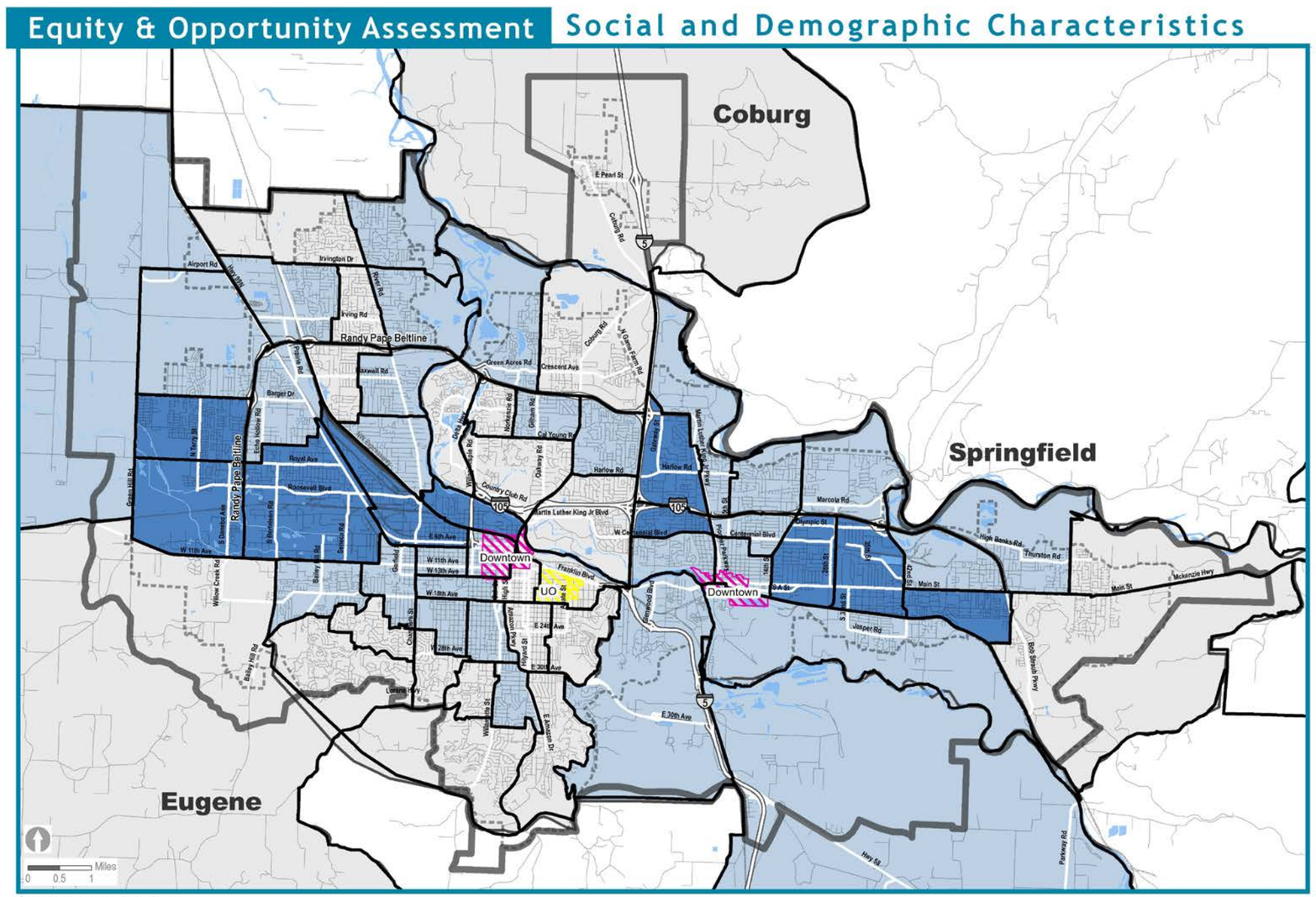
building smarter communities together

Map date: 0/14/13 Map data: U.S. Census Bureau, Census 2010 Table P12
Caution: This map is based on imprecise source data, subject to change, and for general reference only.
The work that provided the basis for this map was supported by funding under an award with the U.S. Department of Housing and Urban Development. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government.

Metropolitan Planning Organization Area boundary
Urban Growth Boundaries

Percent of the Population 0-17 Years old
Low: 0.8% - 9.9%
Medium: 10% - 19.9%
High: 20% - 29%

3.2.2 Population Experiencing a Disability

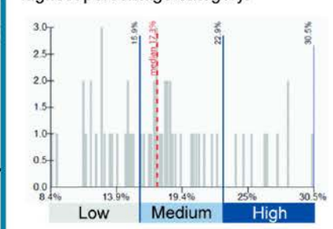


Population with a Disability

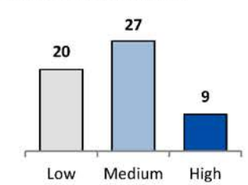
This map shows the percent of the population (Census 2000) age 5 and over with a disability. About 18% of the people in the Metropolitan Planning Organization area census tracts reported a disability in the 2000 Census. As of time of publication of this map, updated data on populations with a disability was not available at the tract level.

In the U.S. Census, a disability can be described as a physical, mental or emotional impairment that is expected to be of a long or indefinite duration, impedes the ability of the person to live independently, and/or is of a nature that the ability could be improved by more suitable housing.

The full range of data for each map has been divided into thirds to create low, medium, and high percentage categories. A histogram is also included to show that the data is not necessarily distributed equally across these three categories. About 27% of the population with disabilities live within the top 9 census tracts in the highest percentage category.



The chart below shows the number of Census 2000 tracts in the Metropolitan Planning Organization Area that have low, medium, or high percentages of populations with disabilities.



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Map date: 3/6/14 Map data: U.S. Census Bureau, Census 2000 QTP21. Caution: This map is based on imprecise source data, subject to change, and for general reference only.
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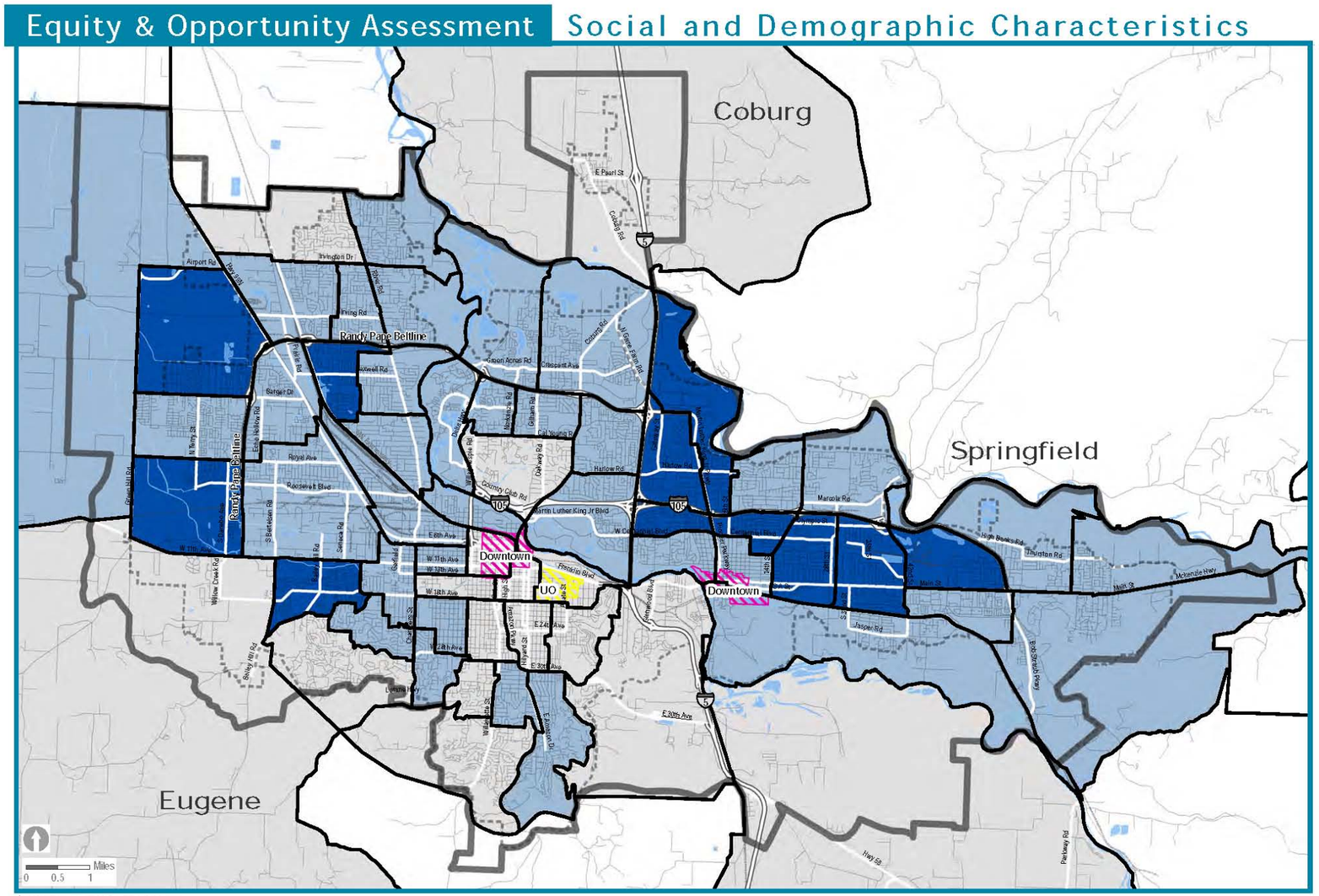
- Census 2010 Tracts
- Metropolitan Planning Organization Area boundary
- Urban Growth Boundaries

Percent of the Population with a Disability - Census 2000 Tract

- Low: 8.4% - 15.9%
- Medium: 16% - 22.9%
- High: 23% - 30.5%

3.2.3 Female Headed Households

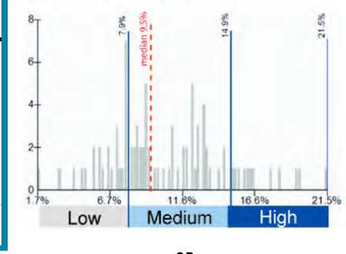


Female Headed Households

This map shows the percent of households that have a female headed household with no husband present in the 2010 Census. These households represent 11% of total households in the Metropolitan Planning Organization Area census tracts. For this map, a female headed-household is a home where the householder is female, is related to one or more people in the house, and there is not a husband present.

A family household is a home whose householder is related to one or more people in the same house by birth, marriage or adoption. A home with a male or female householder with no husband or wife present is one way to estimate the number of homes with single parents. Unmarried partner households can include opposite or same-sex couples and can be recorded in the Census as family or non-family households.

The full range of data for each map has been divided into thirds to create low, medium, and high percentage categories. A histogram is also included to show that the data is not necessarily distributed equally across these three categories. About 27% of the female headed households are in the top 11 census tracts in the high percentage category.



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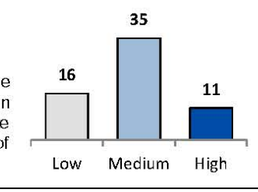
Map date: 8/15/13 Map data: U.S. Census Bureau, Census 2010, Table P18.
Caution: This map is based on imprecise source data, subject to change, and for general reference only.
The work that provided the basis for this map was supported by funding under an award with the U.S. Department of Housing and Urban Development. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government.

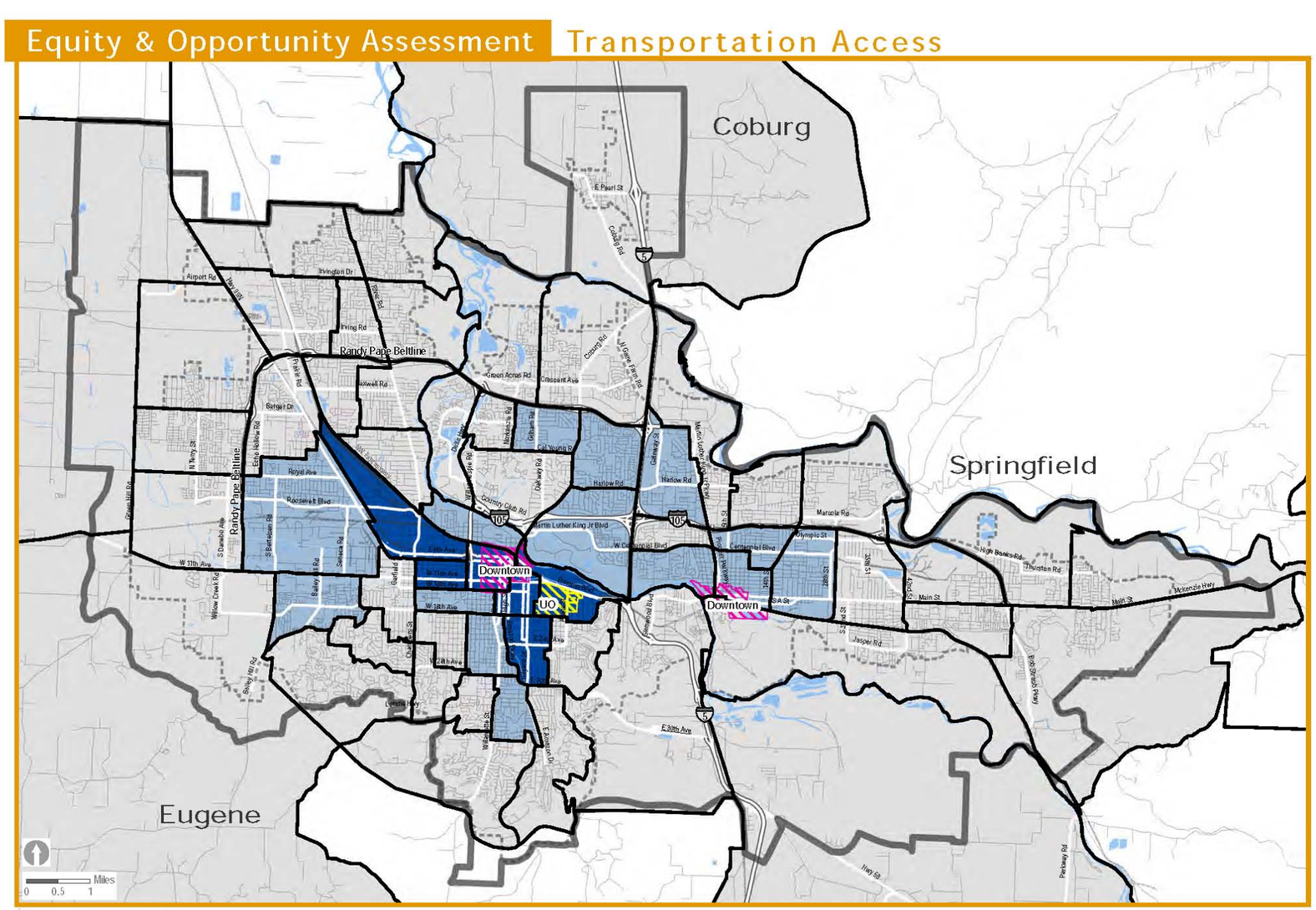
- Census 2010 Tracts
- Metropolitan Planning Organization Area boundary
- Urban Growth Boundaries

Percent of Single, Female Headed Households
- Low: 1.7% - 7.9%
- Medium: 8% - 14.9%
- High: 15% - 21.5%

The chart to the right shows the number of tracts in the Metropolitan Planning Organization Area that have low, medium, or high percentages of single, female headed households.



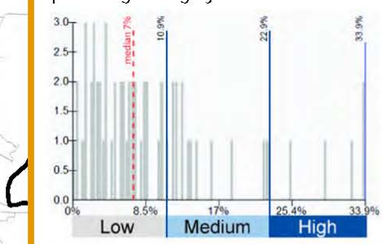
3.2.4 Households Without Access to a Vehicle



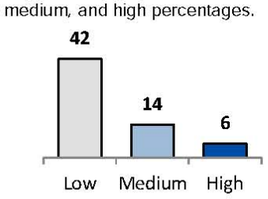
Households with No Vehicles

This map shows the percentage of households without a vehicle. About 10% of households do not have a vehicle in the Metropolitan Planning Organization area census tracts.

The full range of data for each map has been divided into thirds to create low, medium, and high percentage categories. A histogram is also included to show that the data is not necessarily distributed equally across these three categories. About 30% of the households without vehicles are in the top 6 census tracts in the highest percentage category.



The chart below shows the number of tracts in the Metropolitan Planning Organization Area that have low, medium, and high percentages.



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Map date: 9/11/13 Map data: U.S. Census Bureau, ACS 2007-11, Table B25044
Caution: This map is based on imprecise source data, subject to change, and for general reference only.
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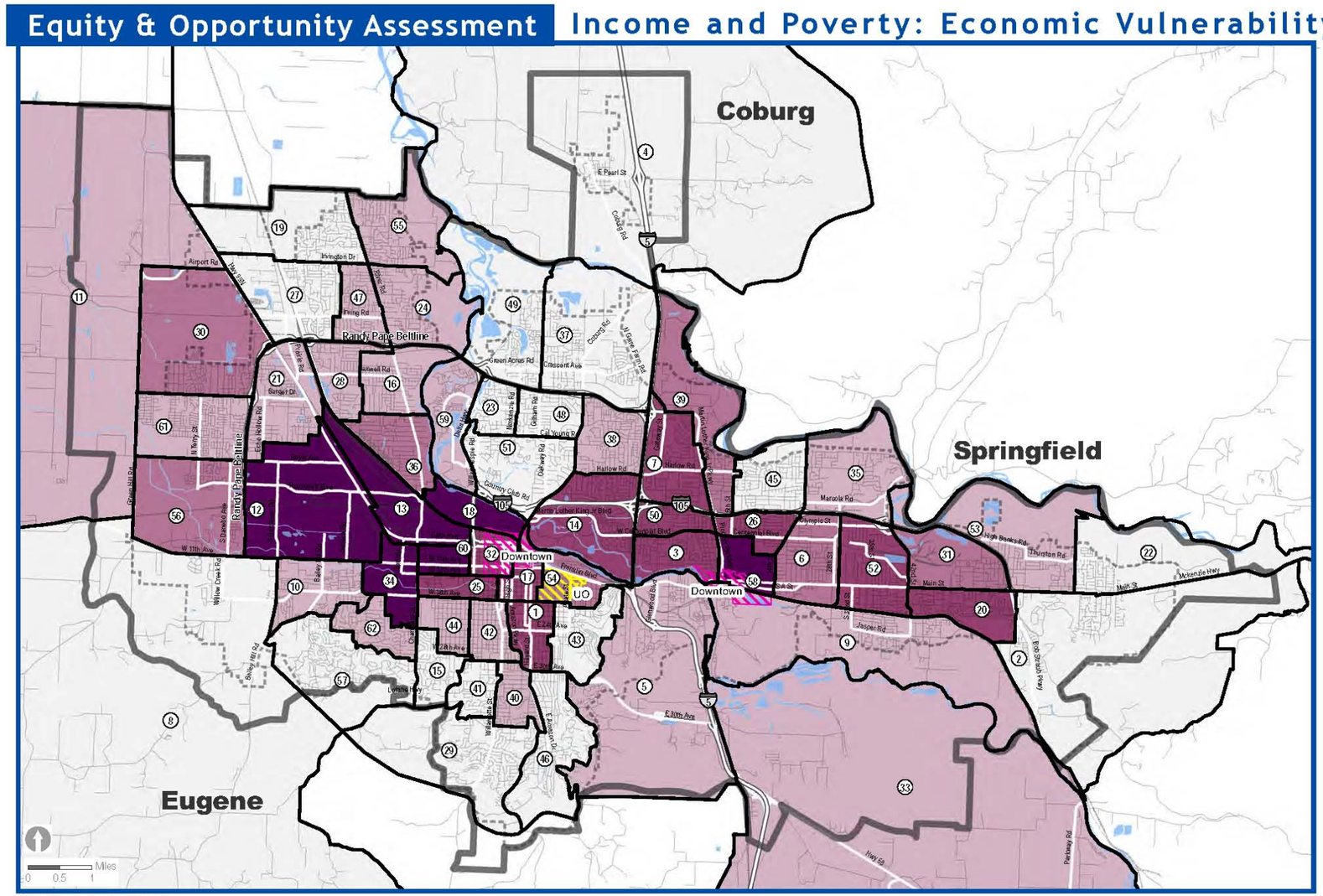
- Census 2010 Tracts
- Metropolitan Planning Organization Area boundary
- Urban Growth Boundaries

Percentage of Households without Vehicles
- Low: 0% - 10.9%
- Medium: 11% - 22.9%
- High: 23% - 33.9%

3.2.5 Income and Poverty: Economic Vulnerability



Composite

This map shows the economic vulnerability composite ranking of all tracts in the Income and Poverty set. Each category in the data set is classified by equal intervals and categorized with low, medium, or high rankings (except Poverty). The composite adds together all these rankings for each tract and is displayed with an equal interval distribution.

The dark areas on the map show Census tracts that have a high composite value. Meaning that these areas could indicate where residents may have lower incomes, have greater need for food assistance, and/or may experience more poverty than other areas of the community.

Data included in the Income and Poverty category are shown in the table below.

Food Stamps/SNAP Recipients
Free and Reduced Lunch Recipients
Median Household Income
Poverty Rate

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Map date: 12/2/13
Caution: This map is based on imprecise source data, subject to change, and for general reference only.
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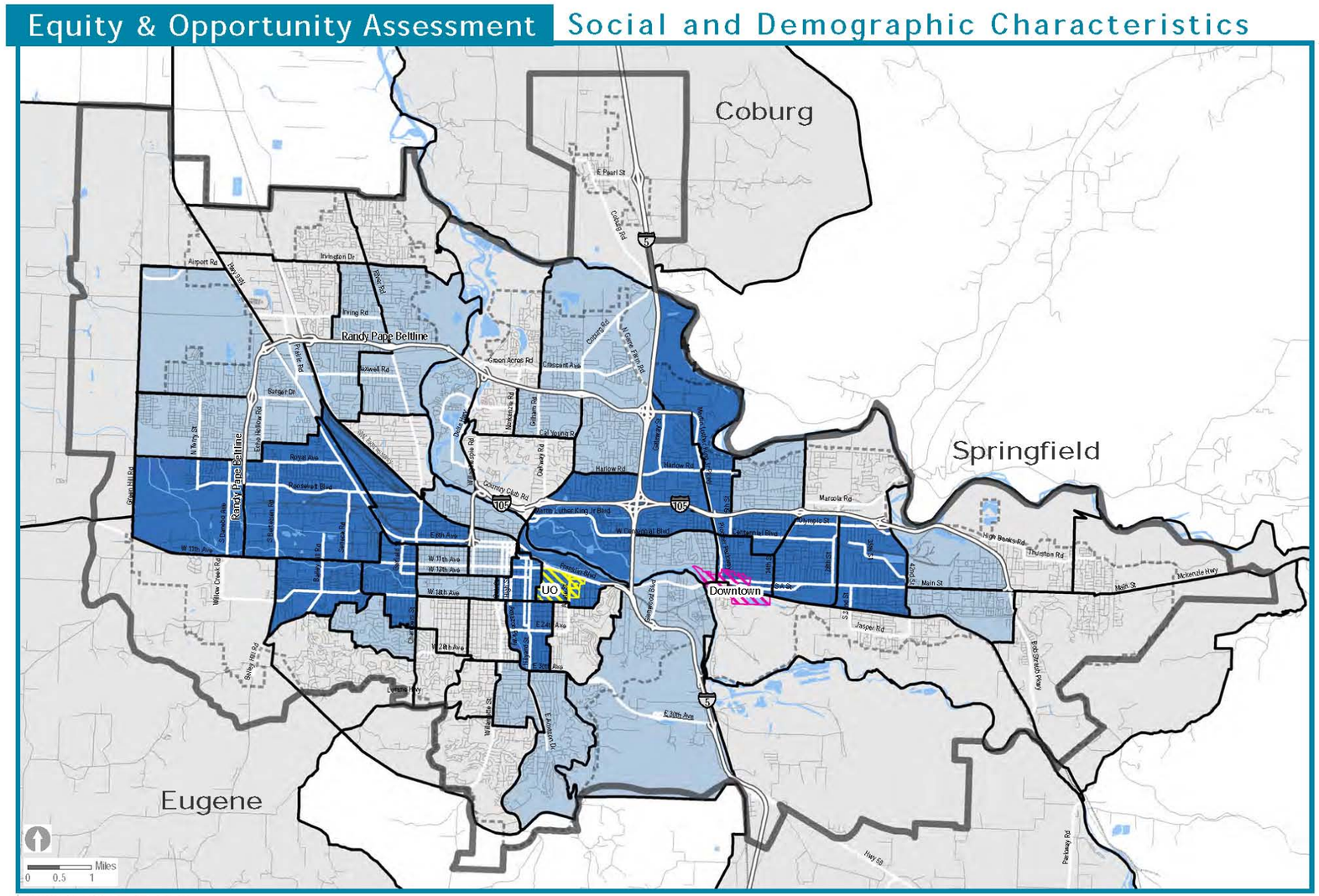
- Census 2010 Tracts
- Metropolitan Planning Organization Area boundary
- Urban Growth Boundaries

Economic Vulnerability
- Less Economic Vulnerability
- Moderate Economic Vulnerability
- More Economic Vulnerability

3.2.6 Latino and Minority Households

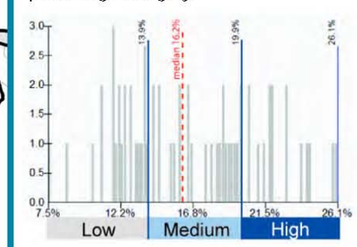


Latino & Minority

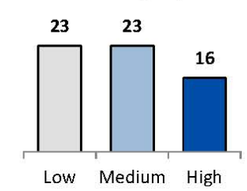
This map shows the percent of the population who identified in the 2010 Census as Latino and/or Minority. In the 2010 Census, about 17% of the population in the Metropolitan Planning Organization Area identified as Latino and/or Minority.

For this analysis, minority is defined by including population counts for people who identify as a non-white, non-hispanic single race and people that identify with more than one race. People of any race can identify as Latino, which is separately counted in the census as Ethnicity.

The full range of data for each map has been divided into thirds to create low, medium, and high percentage categories. A histogram is also included to show that the data is not necessarily distributed equally across these three categories. About 39% of the Latino and Minority population lives in the top 16 census tracts in the high percentage category.



The chart below shows the number of tracts in the Metropolitan Planning Organization Area that have low, medium, and high percentages of Latino and/or Minority Populations.



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Map date: 8/15/13 Map data: U.S. Census Bureau, Census 2010, Table P2
Caution: This map is based on imprecise source data, subject to change, and for general reference only.
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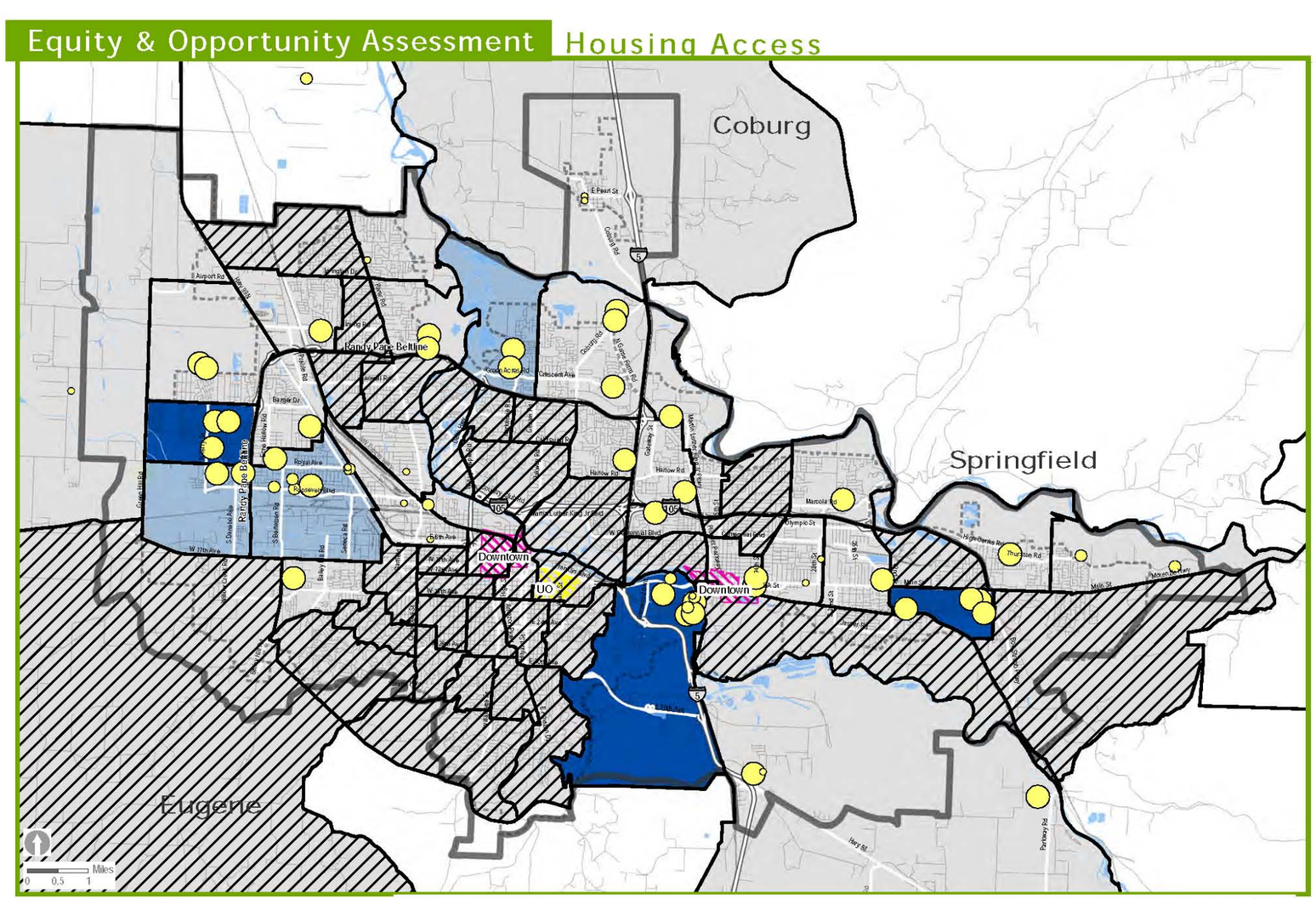
- Census 2010 Tracts
- Metropolitan Planning Organization Area boundary
- Urban Growth Boundaries

Percent of Population that are Latino and Minority
- 7.5% - 13.9%
- 14% - 19.9%
- 20% - 26.1%

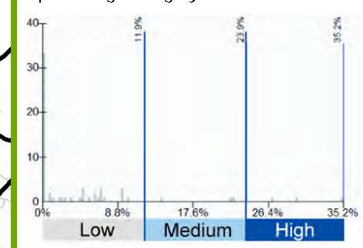
3.2.7 Manufactured Homes



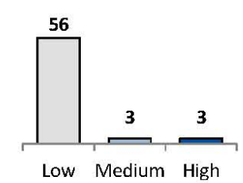
Manufactured Home Parks

This map shows manufactured home park units as a percentage of total housing units in the Metropolitan Planning Organization area census tracts. About 5% of all housing units in the Metropolitan Planning Organization area census tracts are in manufactured home parks.

The full range of data for each map has been divided into thirds to create low, medium, and high percentage categories. A histogram is also included to show that the data is not necessarily distributed equally across these three categories. About 39% of manufactured homes in parks are in the top 3 tracts in the highest percentage category.



The chart below shows the number of tracts in the Metropolitan Planning Organization Area that have low, medium, or high percentages of housing that are manufactured dwelling spaces.



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Map date: 8/27/13 Map data: Regional GIS, State of Oregon OHCS
Caution: This map is based on imprecise source data, subject to change, and for general reference only.
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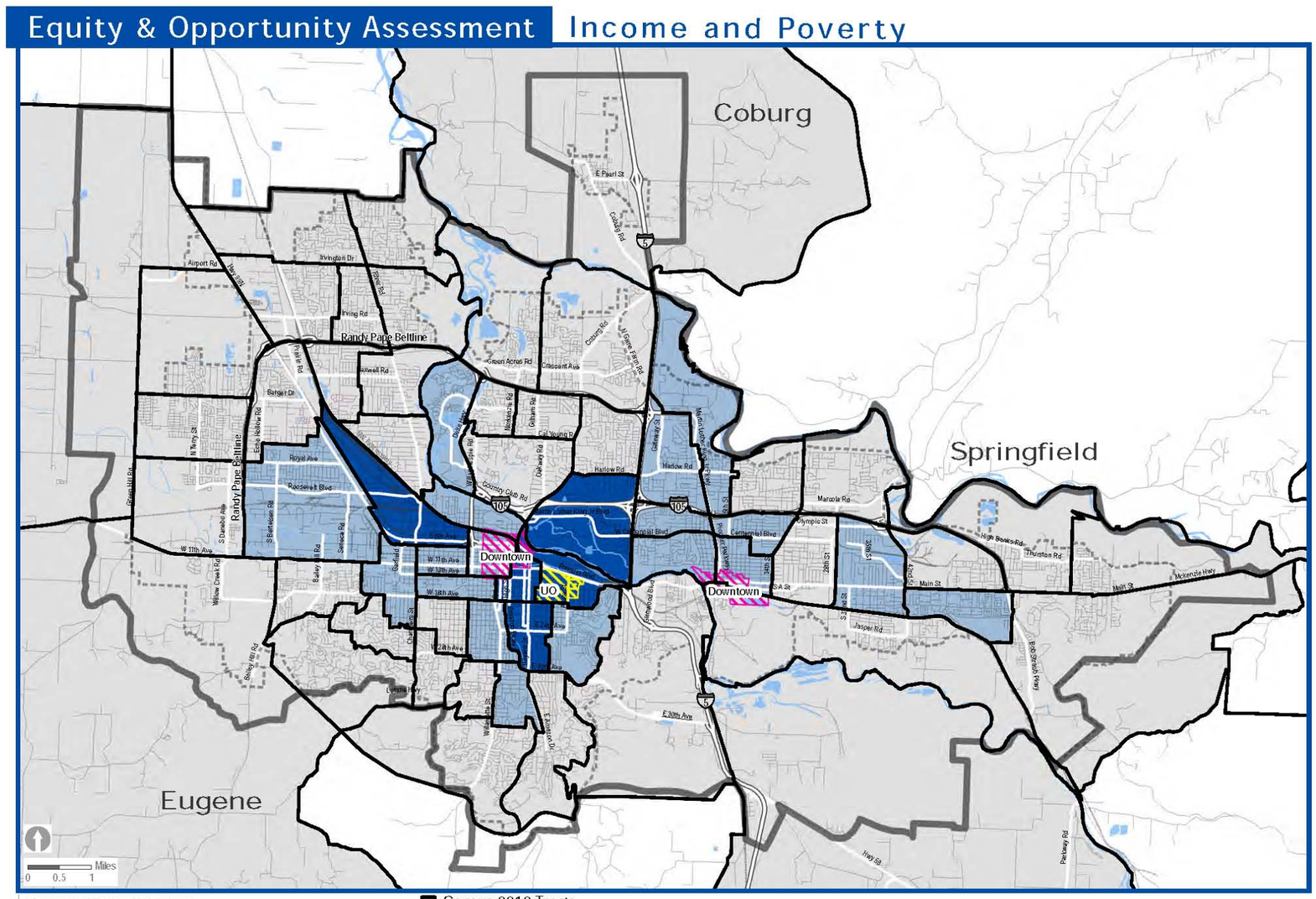
- Census 2010 Tracts
- Metropolitan Planning Organization Area boundary
- Urban Growth Boundaries

Units in Manufactured Home Parks as a Percentage of Total Housing Units
- Low: 0% - 11.9%
- Medium: 12% - 23.9%
- High: 24% - 35.2%

Manufactured Dwelling Parks by Size
- 4 - 19
- 20 - 49
- 50 - 398

- Tracts with no Manufactured Home Parks

3.2.8 Households in Poverty



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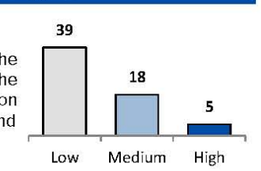
Map date: 9/9/13 Map data: U.S. Census Bureau, ACS 2007-11, Table B17021.
Caution: This map is based on imprecise source data, subject to change, and for general reference only.
The work that provided the basis for this map was supported by funding under an award with the U.S. Department of Housing and Urban Development. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government.

- Census 2010 Tracts
- Metropolitan Planning Organization Area boundary
- Urban Growth Boundaries

Percent of Population in Poverty

- Low: 2.3% - 19.9%
- Medium: 20% - 39.9%
- High: 40% - 68.7%

The chart to the right shows the number of tracts in the Metropolitan Planning Organization Area that have low, medium, and high percentages of poverty.



Poverty

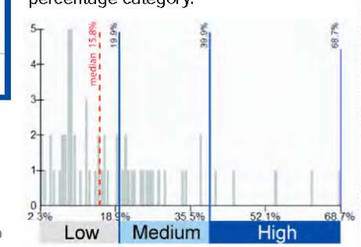
This map shows the percent of the population in poverty. About 19% of the population in the Metropolitan Planning Organization Area census tracts are in poverty.

Poverty status is determined people in housing units and noninstitutional group quarters. It is not calculated for people in college dorms, military quarters, institutional quarters and for unrelated people under 15 years old.

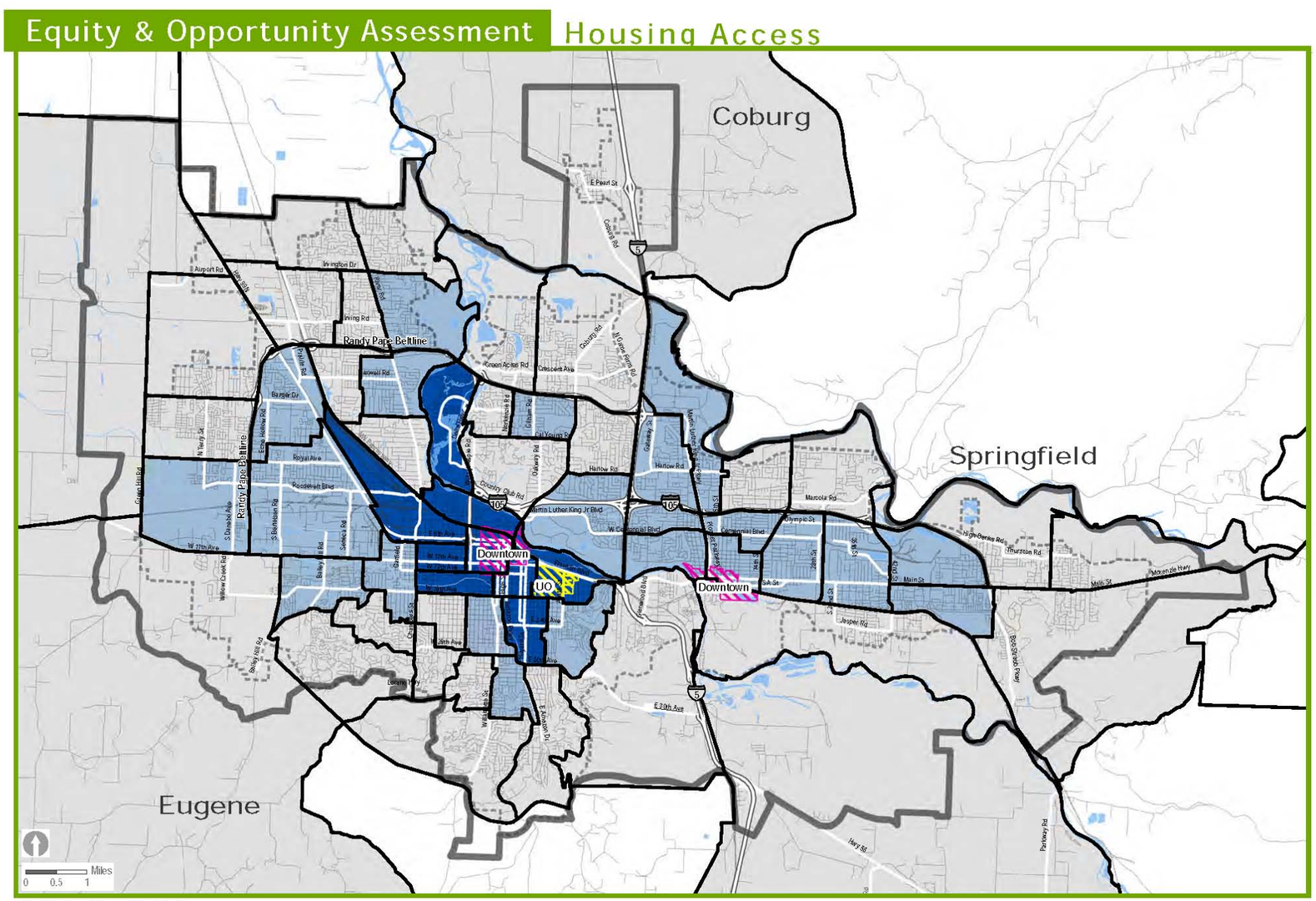
For this map, the data was classified with defined breaks of 0-19.9%, 20%-39.9%, and 40% and over. This classification is based on thresholds set by the U.S. Department of Housing and Urban Development (HUD) and the U.S. Census Bureau. Areas of poverty, as defined by the U.S. Census Bureau, are areas tracts with 20% or more of the population in poverty. Areas with extreme poverty, as defined by HUD, are tracts with 40% or more of the population in poverty.

In the Metropolitan Planning Organization area census tracts, 37% of the population live in areas of poverty, defined as tracts with over 20% of the population in poverty. About 5% of the population live in tracts where the population experiences extreme poverty, defined as tracts where 40% or more of the population is in poverty.

A histogram is also included to show how the data is distributed in the three categories. About 25% of the population in poverty live in the top 5 census tracts of the highest percentage category.



3.2.9 Residents Living in Rental Housing

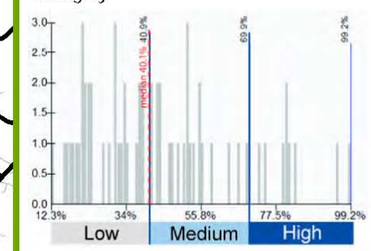


Renter Occupied Households

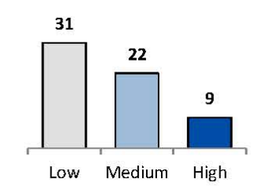
This map shows the percent of occupied households that are renter occupied. About 45% of housing in the Metropolitan Planning Organization area census tracts are renter occupied.

Data for this map is from the Census 2010 which represents a full count of households.

The full range of data for each map has been divided into thirds to create low, medium, and high percentage categories. A histogram is also included to show that the data is not necessarily distributed equally across these three categories. About 26% of renter households are in the top 9 tracts in the highest percentage category.



The chart below shows the number of tracts in the Metropolitan Planning Organization Area that have low, medium, or high percentages of renter occupied households.



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Map date: 8/28/13 Map data: U.S. Census Bureau, Census 2010, Table H4
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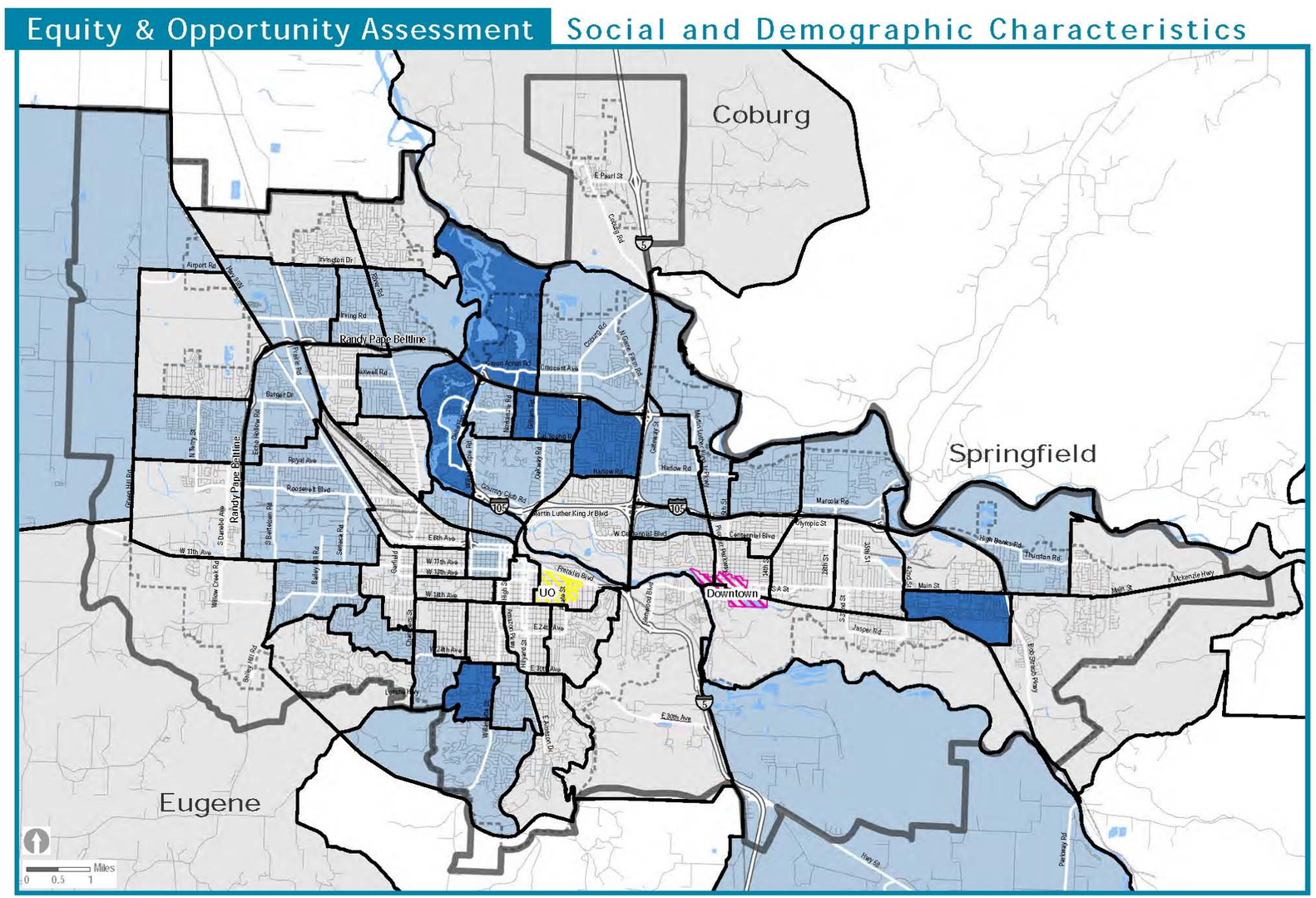
- Census 2010 Tracts
- Metropolitan Planning Organization Area boundary
- Urban Growth Boundaries

Percentage of Households that are Renter Occupied
- Low: 12.3% - 40.9%
- Medium: 41% - 69.9%
- High: 70% - 99.2%

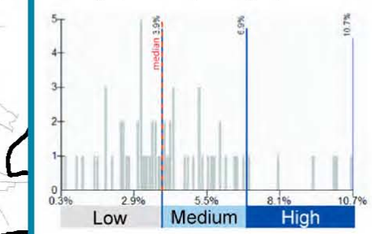
3.2.10 Seniors 80 and Older



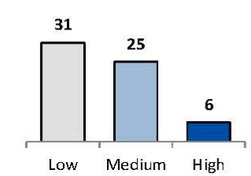
Age Distribution 80 Years and Over

This map shows the distribution of the population age 80 years and over by tract.. The 80-plus age group represents about 4% of the population in the Metropolitan Planning Organization area census tracts.

The full range of data for each map has been divided into thirds to create low, medium, and high percentage categories. A histogram is also included to show that the data is not necessarily distributed equally across these three categories. About 18% of the population ages 80 years and over lives within the top 6 census tracts in the high percentage category.



The chart below shows the number of tracts in the Metropolitan Planning Organization Area that have low, medium, and high percentages of population age 80 years and over.



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Map date: 8/14/13 Map data: U.S. Census Bureau, Census 2010, Table P12
Caution: This map is based on imprecise source data, subject to change, and for general reference only.
The work that provided the basis for this map was supported by funding under an award with the U.S. Department of Housing and Urban Development. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government.

- Census 2010 Tracts
- Metropolitan Planning Organization Area boundary
- Urban Growth Boundaries

Percent of the Population Age 80 Years and Over
- Low: 0.3% - 3.9%
- Medium: 4% - 6.9%
- High: 7% - 10.7%

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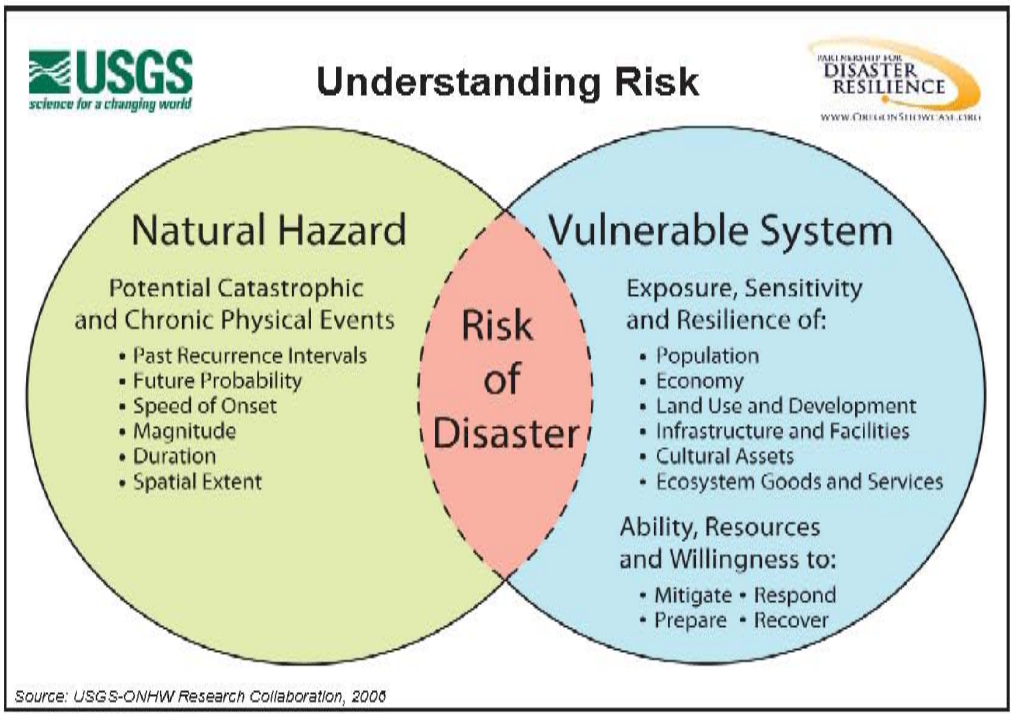
4 Risk and Vulnerability

4.1 Assessing Risk

The foundation of the Eugene-Springfield Natural Hazards Mitigation Plan is the vulnerability and risk assessment. Risk assessments provide information about the areas where the hazards may occur, the value of existing land and property in those areas, and an analysis of the potential risk to life, property, and the environment that may result from natural hazard events.

This section identifies and profiles the location, extent, previous occurrences, and future probability of natural hazards that can impact the participating jurisdictions, as highlighted in Figure 4-1 below.

Figure 4-1. Understanding Risk



Source: USGS – The Partnership for Disaster Resilience Research Collaborative, 2006

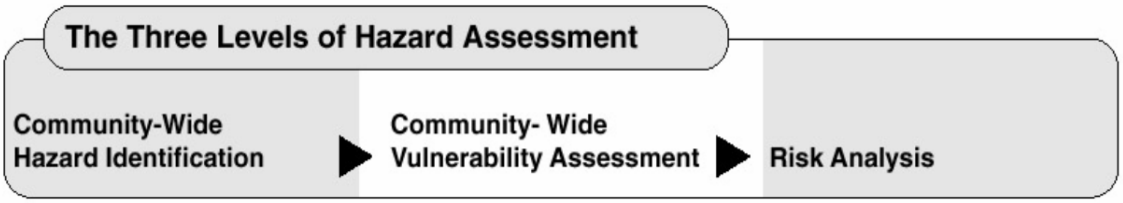
This section drills down to local level information and results in an understanding of the risks the communities face. In addition to local data, the information here relies upon the Region 3 (Willamette

Valley) Regional Risk Assessment in the Oregon Natural Hazards Mitigation Plan.

4.1.1 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 4-2. The 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 and is largely explained in Section 2, Hazard Descriptions, and the Hazard Maps located in Section 3. 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.[19]

The second phase, vulnerability assessment, combines the information from the identified hazards with an evaluation 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 component is described in detail in Section 4.2. This step can also assist in identifying necessary 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.[20]

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. This component is also described in Section 4.2 for the four hazards (earthquake, winter storm, flood, wildfire) that were included in that process.

19 Burby, R. 1998. Cooperating with Nature. Washington, DC: Joseph Henry Press. Pg. 126.
20 Burby, R. 1998. Cooperating with Nature. Washington DC: Joseph Henry Press. Pg. 133.

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.

4.1.2 Probability and Vulnerability Assessments

Table 4-1. Hazard Analysis Methodology

Probability	
High	One incident likely within 10-35 yrs
Med	One incident likely within 35-75 yrs
Low	One incident likely within 75-100 yrs
Vulnerability	
High	More than 10% of the population or assets to be affected
Med	1% - 10% of population or assets to be affected
Low	Less than 1% of population or assets to be affected

In Section 2 each hazard's probability of future occurrence within Eugene-Springfield is described, as well as a brief statement of the metro region's overall vulnerability to each hazard. To facilitate connections with the State of Oregon's probability and vulnerability rating systems, Eugene-Springfield used the same rating scales as provided within the Oregon office of Emergency Management's Hazard Analysis Methodology template, and are listed below. Probability estimates are based on the frequency of previous events, and vulnerability estimates are based on potential impacts of the hazard to the cities of Eugene and Springfield.

4.1.3 Risk Matrix

Below is the summary risk assessment matrix providing an overview of each hazard and the associated risk in the Eugene-Springfield area. Within Section 4.2 that follows, you will find a summary description of an in depth vulnerability assessment conducted in the region that provides more detail about some of the risks that are of greater concern.

Table 4-2. Summary Risk Assessment

Hazard	Vulnerability	Probability
Winter Storm*	H	H
Flood: Riverine	M	M
Flood: Stormwater	L	H
Wildfire: Eugene	M	H
Wildfire: Springfield	L	H
Landslide: Eugene	L	H
Landslide: Springfield	L	M
HazMat incident	M	H
Earthquake: Subduction Zone	H	M

*Winter storm includes snow, ice, and wind
**Dam failure is not included in Lane County's hazard assessment

4.2 Risk and Vulnerability

4.2.1 Project Background

Vulnerability Assessment Process

City of Eugene and City of Springfield staff, with support from Oregon Partnership for Disaster Resilience, convened meetings with representatives from each of the sectors listed below. The team met for six hours with each sector. Working from a standard list of questions, the team collected information about the adaptive capacity and sensitivity to specific hazards. The sector summaries below are the result of these interviews and reflect the conversations and thinking of the participants. The Participant List at the bottom of section 4.2 catalogs those system managers who provided their expertise.

Sector Summaries

The sector summaries contain short, three- to four-page sector assessment summaries for the following sectors within the Eugene-Springfield metro area:

- Drinking Water
- Health Care and Public Health
- Electricity
- Transportation
- Food
- Housing
- Communication
- Stormwater
- Wastewater
- Natural Systems
- Public Safety

Hazards

The sector summaries describe sensitivities to earthquake, flood, wildfire, winter storm, climate change, and rising fuel prices. Because of limited meeting time with system experts, the assessment does *not* reflect all hazards for all sectors. The flood scenario used does *not* include dam failure and associated inundation. It reflects river flooding due to precipitation and snow melt as well as some impacts of urban street flooding. Hazard scenarios are included at the end of this document.

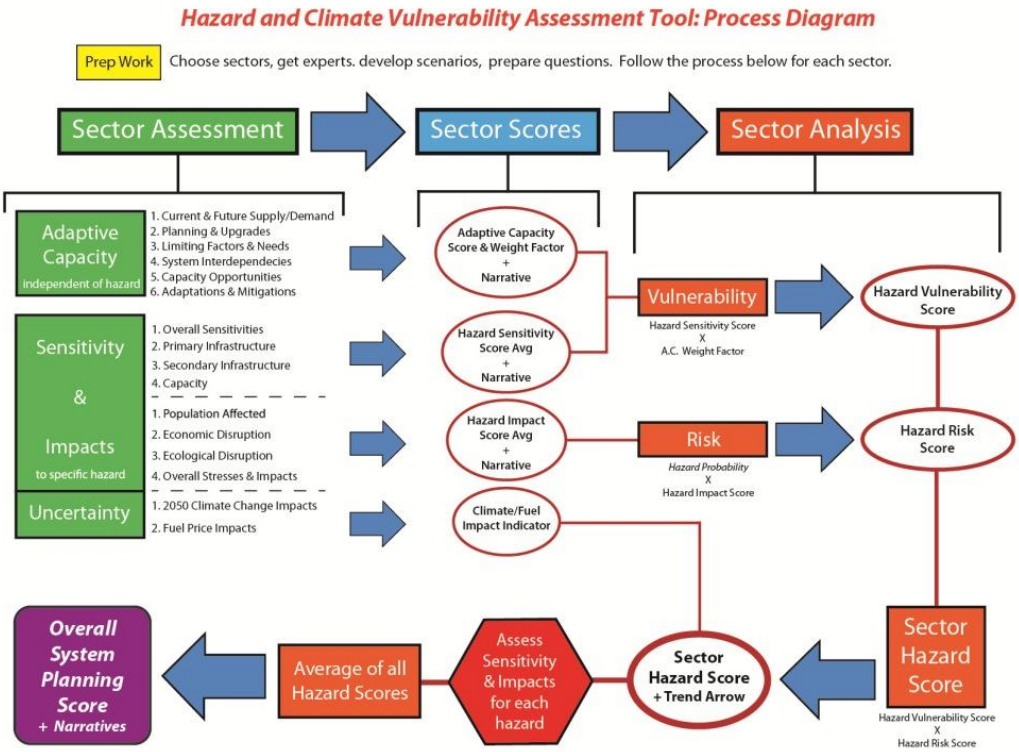
Geographic Boundaries

The geographic boundary for this assessment is the area within the Eugene urban growth boundary and Springfield urban growth boundary. Due to the regional nature of some systems and hazards, areas outside of this boundary are discussed within several of the summaries.

More Information

The information summarized herein reflects information provided by key sector stakeholders during the assessment process. All meeting notes from each meeting are available from the City of Eugene upon request.

Figure 4-3. Process Diagram



Source: Oregon Partnership for Disaster Resilience

4.2.2 High Level Findings

Below is a list of high level findings from the Eugene-Springfield Climate and Hazards Vulnerability Assessment. This does not represent all of the lessons learned or all of the important information collected during the assessment. It is a short collection of some of the common themes that emerged from across multiple sectors.

Overall

A. There exists a unique culture of collaboration and information sharing within our community. Overall, this increases our adaptive capacity in a number of areas. Information sharing is particularly visible within the *Health*, *Public Safety*, *Electricity*, and *Transportation* sectors. There is a noticeable willingness to share information within other sectors as well, including both *Food* and *Communications*.

B. Participants voiced the value in hazard planning and exercises. Multiple participants in multiple sectors indicated they valued the assessment and many stated their support for continuing this discussion and engaging in multi-sector planning and exercises.

C. Many sectors are heavily dependent on *resources* and *decisions* made *outside* of the Eugene-Springfield area, most notably the *Food, Electricity,* and *Fossil Fuel* sectors.

D. There are three sectors that are fundamental to the operation, maintenance, and restoration of all other sectors; those are: *Electricity, Transportation,* and *Fossil Fuels*.

E. For several sector managers, finding and keeping qualified staff is an important concern over the next decade with few obvious solutions.

F. There is a high level of interdependence among all sectors. Nearly every sector relies on several other sectors in order to function, with *Stormwater* and *Natural Systems* being the least dependent on other sectors.

Hazard Specific Findings

Specific hazards of lower concern

While flood and wildfire events have the potential to cause severe loss and damage in localized areas as well as inconvenience for many and a drain on emergency response resources, these hazards are *not* likely to result in systemic failures across multiple sectors.

Both severe earthquake *and* severe winter storm events have the potential to cause region-wide cascading system failures.

Much of our regional adaptive capacity stems from our ability to draw resources, personnel, and expertise from nearby communities, particularly during an emergency. This capacity is *severely restricted* during region-wide events including a Cascadia earthquake, and winter storm events and to a lesser degree, severe flooding.

Earthquake

The impacts resulting from a 9.0 Cascadia Earthquake[21] will be staggering

- Except for *Natural Systems,* all sectors are *extremely* sensitive to an earthquake of this magnitude.
- Very little has been done to prepare any systems, infrastructure, or personnel to handle the initial impact and ongoing response and recovery that will follow that event.
- *Exceedingly limited staff availability* in the aftermath of a severe earthquake will create problems and challenges that are difficult to predict or solve for.

21 See the Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. Report to the 77th Legislative Assembly.

- Every sector will experience substantial failures and interruptions that are unfamiliar and therefore difficult (though not impossible) to plan for.
- Very few locals have first-hand experience with a major earthquake, making it difficult to describe the potential experience and results.

Winter Storm

- Severe winter storms disrupt two of the three sectors that all the rest depend upon: Electricity and Transportation, especially if the storm lasts more than a couple of days and especially if snow and ice accumulate.

Dam Failure

- While not the focus of this phase of the regional vulnerability assessment, participants repeatedly articulated a broad concern about the potential consequences of a dam failure.

Climate Change

- The sectors most likely to experience negative impacts associated with climate change are *Natural Systems, Drinking Water,* and to a lesser extent, *Food, Electricity,* and *Public Health.*
- Several sector managers in the *Drinking Water* sector, the *Public Health* sector, and *Natural Systems* are actively planning for the impacts of climate change. For the most part, other sectors are not.
- Most *built* community sectors don't appear to be at severe risk from projected climate-related impacts such as increasing temperatures, reduced snowpack, or changes in precipitation. However, the region's natural systems are *highly* sensitive to climate change and the resulting secondary impacts on community sectors and the regional economy could become substantial.
- Climate change appears to have the greatest overall negative impact on regional forest and water resources[22].
- There is an existing conflict among fresh water users that are all critically dependent on summer water availability for:
    - fisheries,
    - hydroelectricity generation,

22 Willamette Water 2100 is a research project currently underway, designed to evaluate the effects of climate change, population growth, and economic growth on the water resources of the Willamette basin. It is a partnership project of Oregon State University, University of Oregon, and Portland State University that will provide greater clarity and specificity about climate change impacts on water and forest resources in our region. More information is available online at: http://water.oregonstate.edu/ww2100

- domestic use,
- agricultural irrigation.

Those existing conflicts are expected to be exacerbated by:

Reduced snowpack resulting in:

- lower summer stream flows
  - reduced summer hydropower
  - stress on fish populations
- reduced summer water available to cascade forests
  - increased water stress on cascade forests

Increased summer temperatures resulting in:

- increased water temperatures
  - stress on fish populations
- increased water stress on cascade forests
- increased demand for summertime agricultural irrigation

Extended summer drought resulting in:

- extended lower summer stream flows
  - reduced summer hydroelectric generation
- increased water stress on cascade forests
- increased demand for summertime agricultural irrigation.

Population

While not a focus of this assessment, the added pressures from an increasing Willamette Valley population – adding 1.2 million people[23] in the valley over the next 25 years - will likely place further strain on fresh water resources. Stresses would be even greater if the Valley population grows more quickly than projections suggest.

23 Environmental Migrants and the Future of The Willamette Valley: A Preliminary Exploration. USP 594: Planning in the Pacific Northwest Fall 2011

Fossil Fuels

- All but one group indicated their sectors rely heavily on fossil fuels and fossil fuel-derived products to operate. *Health Care, Food, Water, Transportation, Public Safety, Electricity,* and *Housing* appear most dependent.
- *Natural Systems* was the only sector that had a low dependency on fossil fuels to function
- There is not yet widespread planning for how sectors will manage the rising fuel prices that are anticipated in the coming decades. Most indicate that the added cost will just be passed on to the customer. A notable exception is *Public Safety,* where sector managers indicated service levels would be reduced as there is no customer base or political will to absorb cost increases.
- Nearly every group pointed out that the rate of fuel price increase makes all the difference. A slow increase in prices is manageable; a sharp increase in prices would strain sectors – some of them dramatically.
- Almost all backup power systems in Eugene-Springfield rely on diesel or natural gas transported by pipeline from Portland and beyond.
- There is an information gap regarding the fossil fuel sector. Because we were unsuccessful at convening representatives from this sector, there is a need for more information about how this sector operates.
    - As part of The Oregon Resilience Plan, the Oregon Department of Geology and Mineral Industries (DOGAMI) completed an Earthquake Risk Study For Oregon's Critical Energy Infrastructure Hub containing useful information about the petroleum hub and its operability following an earthquake – with some implications for performance following other natural hazards.
    - The 2012 Oregon Energy Assurance Plan offers insights into the existing risks to energy infrastructure and systems statewide.

4.2.3 Scoring Summary

Introduction

This section describes the scoring results from the Eugene/Springfield Climate and Hazards Vulnerability Assessment. The results are intended to be used to inform the prioritization of infrastructure improvements, hazard mitigation strategies or climate adaptation strategies. Ultimately, the results should help establish a course towards adaptive local and regional networks, and a more resilient community as a whole.

Findings

The following findings highlight the major takeaways from the *scoring component* of the Eugene/Springfield Climate and Hazards Vulnerability Assessment.

The majority of the sectors evaluated have a moderate adaptive capacity.

Every sector except for *Public Safety* and *Housing* measured Medium on the adaptive capacity scale. While OPDR expected more of a spread with the scale that ranges from *Very Low* to *Very High*, we were pleasantly surprised to find most sectors were in the medium range. This suggests that overall, the sectors across Eugene and Springfield are somewhat adaptable to changing conditions. While many of the sectors are dependent on hard infrastructure (roads, storm sewers, electric lines, etc.), they have incorporated organizational and/or operational flexibility.

A Cascadia level earthquake will, by far, be the most damaging to all of the sectors.

The sensitivity and impact scores for earthquake were significantly higher than other hazards for almost all the sectors in Eugene and Springfield. This demonstrates the major effects that a major seismic event would have on the region.

Housing and Public Safety are the least adaptive sectors.

Housing and *Public Safety* were the only two (of eleven) sectors to score Low on the adaptive capacity scale. *Public Safety* faces major hurdles due to limited personnel, a constraint that proves the single most important barrier to providing adequate services in the event of a disaster. The Low adaptive capacity score in the *Housing* sector is due to a) the typical resident's lack of knowledge about housing (construction, operation and repair) and b) the historic lack of awareness of local seismic activity.

Drinking Water, Transportation and Public Safety have the highest system planning scores, and subsequently should be considered for prioritized funding.

These three sectors filtered out to the top of the final scoring. The adaptive capacity scores, combined with the hazard sensitivity and impact scores create an overall sector score. This overall score ranks the sectors against each other in terms of the most vulnerable overall.

The Transportation sector reports Very High (5.0) impacts from *earthquake* and *winter storm* hazards.

Out of all of the sectors assessments for sensitivity and impacts, *Transportation* was the *only* sector that received a score of 5, and in more than one category.

The relative lack of equipment and resources to deal with winter storms and snow events in particular, puts the Eugene-Springfield area at disadvantage during winter storms, as evident during the two snow events during winter 2013-2014.

The impacts from earthquake are twofold: 1) While ODOT is actively working to ensure that I-5 bridges are seismically sound, few *local* bridges have been seismically evaluated or upgraded to withstand a significant seismic event. In a metro area separated by rivers, the loss of bridges could lead to isolated communities, long response times, and slowed recovery. 2) With so many goods, services, and systems reliant on a functioning transportation network, the impacts of an impaired transportation system have the potential to ripple across multiple sectors, magnifying the risks.

The availability of qualified personnel is the single biggest threat to the resilience of some sectors.

When discussing adaptive capacity and the effects of a large scale seismic event, sector specialists reported that a lack of personnel is a major concern. This was most evident in in the *Public Safety* and *Electricity* sectors, where staffing levels are currently at a minimum - posing a risk in the wake of a regional natural hazard.

Adaptive Capacity

Adaptive capacity is defined as a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects. In short, it reflects a sector's ability to adapt to changing circumstances**.** The adaptive capacity questions were asked in a series of six sections. The score of each section was averaged, and then all six section scores were again averaged to obtain an overall adaptive capacity score. Table 4-3 contains the ranking system used in the adaptive capacity scoring.

Table 4-3. Adaptive Capacity Ranking System

Score	Ranking
1.00 – 1.99	Very Low
2.0 – 2.74	Low
2.75 – 3.24	Medium
3.25 – 3.99	High
4.00 – 5.00	Very High

Table 4-4 contains the average adaptive capacity scores, overall, for the sectors. Sorted alphabetically, 9 out of 11 sectors have a rating of medium. *Public Safety* and *Housing* have a score of Low. The range of the averaged scores was 2.31-3.21, on a scale of 1.0-5.0. Note, the digit in the hundredth place does not translate to a level of precision—it is used to further differentiate the scores from each other, i.e. so they can be ranked.

Table 4-4. Average Adaptive Capacity Scores

Sector	Average Adaptive Capacity	Rating
Communication	3.21	Medium
Electric	2.94	Medium
Drinking Water	2.99	Medium
Food	2.80	Medium
Housing	2.31	Low
Natural Systems	2.76	Medium
Public Health	2.75	Medium
Public Safety	2.52	Low
Stormwater	3.04	Medium
Transportation	3.12	Medium
Waste Water	3.17	Medium

Comparison

After the adaptive capacity scores were calculated, OPDR looked for ways to compare sectors. The adaptive capacity eventually became a multiplier that influences the overall sector planning score, however we thought a base level comparison of the sectors would be useful. The three metrics for comparison are:

- the *lowest averaged score*,
- the *lowest self-evaluation score*, and
- the *greatest discrepancy* between the scores (i.e. the difference between the scores provided by system managers and the scores assigned by the project team based on the narrative.)

Table 4-5 contains the lowest overall averaged adaptive capacity scores.

Table 4-5. Three Lowest Averaged Adaptive Capacity Scores

Sector	Average Adaptive Capacity
Housing	2.31
Public Safety	2.51
Public Health	2.75

Table 4-6 highlights the three lowest adaptive capacity scores based on self-evaluation.

Stakeholders were asked “Based on the discussion in this section, how would you rate the adaptive capacity of your sector for this section.” In other words, it is a measure of what stakeholders thought of their own sector, with a lower adaptive capacity meaning it is more challenging for the sector to change based on the circumstances.

Table 4-6. Three Lowest Self-Evaluation Scores

Sector	Estimated Adaptive Capacity
Housing	1.92
Food	2.08
Public Safety	2.33

Table 4-7 shows the systems with the greatest discrepancy between the averaged score and the self-evaluation score provided by system managers. The system manager's self-evaluation of their own sector was compared to the overall score that was calculated for that sector. Here a bigger percent difference indicates the system managers felt their sector was in better condition than the average scores would suggest.

Table 4-7. The Three Systems With the Greatest Discrepancies Between Averaged and Self-Evaluated Adaptive Capacity Scores

Sector	Percent Difference in Estimated vs. Average Adaptive Capacity
Natural Systems	-48%
Public Health	-15%
Transportation	-12%

Sensitivity and Impacts

The second half of the assessment measured the sector's sensitivity and impacts to three hazards. Earthquake and Flood were assessed for all sectors, then either wildfire or winter storm was assessed depending on which hazard was expected to be most detrimental to the system. Table 4-8 and Table 4-9 list the sectors in relation to the sensitivity and impacts of various hazards. The top three sectors for earthquake and flood are highlighted in bold, while the top two are highlighted for wildfire and winter storm.

Table 4-8. Hazard Sensitivities

Sector	Earthquake	Flood	Wildfire	Winter Storm
Drinking Water	4.67	2.00	4.14	
Public Health	4.25	3.63		
Waste Water	4.00	3.13		
Electric	4.13	2.38	2.75	
Transportation	4.25	2.88		
Stormwater	3.50	3.50	2.63	
Food	3.75	1.67		
Housing	3.67	2.67	2.50	
Communications	4.50	1.75		
Natural Systems	3.50	2.50	3.00	
Public Safety	4.50	3.55		3.83

Table 4-9. Hazard Impacts

Sector	Earthquake	Flood	Wildfire	Winter Storm
Communications	3.75	1.50		
Drinking Water	4.40			
Electric	3.80	1.90	2.00	
Food	2.33	1.67		2.33
Housing	3.71	2.00	1.36	
Natural Systems	2.39	2.11	2.67	
Public Health	4.17	2.67		
Stormwater	4.18	3.36	1.64	
Transportation	5.00	2.00		5.00
Waste Water	4.00	2.75		2.25

Overall System Analysis

The adaptive capacity scores combine with the hazard sensitivity and impact scores to obtain an overall system planning score. Table 4-10 contains the overall system planning scores, ranked from highest to lowest. Drinking Water, Transportation and Public Safety received the highest total scores based on this assessment, suggesting they should be considered for prioritization for hazard mitigation activities in Eugene-Springfield. *The absolute numbers do not imply greater or lesser significance.* Rather, the numbers should be used to provide a method to rank sectors in comparison with each other.

Table 4-10. System Planning Scores

Sector	System Planning Score
Drinking Water	**61.6**
Transportation	**47.0**
Public Safety	**42.2**
Public Health	**41.1**
Waste Water	**31.7**
Stormwater	**30.7**
Electric	**25.7**
Communications	**24.5**
Housing	**22.4**
Natural Systems	**21.7**
Food	**19.7**

Conclusion

When considering sectors to address for hazard mitigation, emergency managers, planners, system managers and public officials should bear in mind the results of this assessment. Importantly, the *Housing* and *Public Safety* sectors experience relatively low adaptive capacity compared to other sectors. Overall, the *Drinking Water*, *Transportation*, and *Public Safety* sectors are in greatest need of attention.

4.2.4 Sector Summaries

4.2.4a Drinking Water

Sector Summary

The *Drinking Water* sector in Eugene-Springfield consists of three primary public utility providers: Eugene Water & Electric Board (EWEB), Springfield Utility Board (SUB) and Rainbow Water District (RWD). Some residents in the area rely on private domestic wells, but this assessment does not address private wells.

Table 4-11. Drinking Water Summary Table

Critical Interdependencies:	Crucial Vulnerabilities:
Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on: ■ Electricity ■ Natural systems ■ Transportation ■ Fossil Fuels	**Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:** ■ EWEB has a single source for water and a single treatment and filtration plant ■ EWEB, SUB, and RWD manage extensive transmission lines. ■ All systems operate aging infrastructure including extensive underground pipe system. ■ Single regional source for chlorine (Washington)

Major Findings:

The EWEB drinking water system has relatively low short-term adaptive capacity. Planned long-term changes will mitigate some of the existing vulnerabilities and increase adaptive capacity over time.

An earthquake will have catastrophic impacts to the system. Other hazards are of much lower concern.

SUB's and RWD's water systems could be severely impacted by a large flood event

All systems have interties that allow one utility to share water supply with another. This adds adaptive capacity as utilities can support each other to some degree during extreme events (assuming not all utilities are impacted at the same time).

Groundwater and surface water sources can be contaminated without the immediate knowledge of system managers.

Regionally, the system has access to groundwater and two major rivers.

Primary Agencies and Organizations

Eugene Water & Electric Board (EWEB)
Springfield Utility Board (SUB)
Rainbow Water District (RWD)

System Description

EWEB

EWEB, a publicly owned utility, provides treated drinking water to residential, commercial, industrial, and public sector customers in the Eugene. The utility maintains a senior water right to collect water from a single source on the McKenzie River. EWEB efforts to diversify water supply sources include a groundwater permit issued in 2008 and a surface water permit issued in 2013 on the Willamette River upstream of Eugene. Water permits will not be certificated until water from these sources is distributed for municipal use.

Water is collected via a dual intake pump located at Hayden Bridge in Springfield and delivered to a nearby treatment plant. The water treatment plant pre-treats, filters and treats the raw water for consumption. Two large transmission lines co-located in a single, seven-mile long trench deliver water to the Eugene city limit.

From there, primary, secondary and tertiary distribution pipes deliver water to customers. The distribution network contains approximately 800 miles of pipe (of various types) located throughout Eugene. EWEB maintains three primary reservoirs to store water, and a number of smaller reservoirs. Pressure to deliver the water is controlled largely from the filtration plant which is capable of serving approximately 85% of EWEB consumers. A system of pumps and reservoirs serve EWEB's remaining consumers.

The physical system is supported by planners, engineers, operators and technicians. Revenue to operate, maintain and improve the system is generated through user fees and other public funding mechanisms. An elected board sets policy and governs decisions made by the utility.

SUB and RWD

SUB provides treated drinking water to residential, commercial, industrial, and public sector customers in Springfield. RWD primarily serves residential customers in the northern areas between the Springfield city limits and urban growth boundary, and provides wholesale water to SUB for north and west Springfield. Together, SUB and RWD serve a population of approximately 65,000 people. They source water from 35 wells at 7 distinct locations – with most wells located adjacent to rivers – as well as a surface water source on the Middle Fork Willamette River. Most of SUB's water comes from the Thurston and Willamette wellfields, and most of RWD's water comes from I-5 and Chase wellfields.

The SUB/RWD system includes a variety of treatment facilities at different locations, depending on the needs at each individual source. Facilities include a granular activated carbon (GAC) plant, slow sand filtration, ultraviolet light, and pH adjustment. All sources receive chlorine disinfection.

The utilities operate three separate distribution systems:

- North system - north of Oregon route 126
- East system - east of the 28th Street railroad tracks
- West system - south of Oregon route 126 and west of the 28th Street railroad tracks

The three distribution systems together make up a network of approximately 250 miles of pipe (of various types) located throughout Springfield. SUB and RWD maintain eight reservoirs (storage tanks), and SUB maintains eight pump stations.

As with EWEB, the physical system is supported by a staff of water professionals that includes engineers, operators, and other technicians. SUB and RWD are publicly-owned systems. Revenue to operate, maintain, and improve the system is generated primarily through user fees. Elected boards set policy and govern utility decisions.

EWEB/SUB/RWD Interconnections

There are three interties between EWEB and SUB/RWD and three interties between SUB and RWD.

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

EWEB

Overall, the EWEB drinking water system has low short-term adaptive capacity. Primary contributing factors include:

- Single water source
- Single filter plant
- Lengthy transmission distance (seven-miles) in collocated transmission lines
- Aging infrastructure, in particular 800-miles of aging, expensive, in-ground pipes and numerous reservoirs in various conditions

- Limited store of chlorine and reliance on one Washington State supplier for chlorine, an essential product to make water safe for drinking

SUB and RWD

Overall the SUB and RWD systems have medium to high adaptive capacity. Primary factors increasing adaptive capacity include:

- Water supply from a large number of distributed wells, increases options and flexibility during an extreme event
- SUB and RWD have set up their systems with adequate water resources to handle future demand
- Established, funded pipe replacement program
- SUB is operating debt free and the current board is committed to remaining debt free

Primary factors reducing SUB and RWD adaptive capacity include:

- While SUB has adequate water supply, in order to increase capacity, SUB will need to acquire easements for transmission lines and build transmission lines and new treatment facilities
- Aging infrastructure: 250 miles of expensive, underground pipes
- If they fail or need replacement, reservoirs are expensive and difficult to replace
- Limited store of chlorine gas and rely on one Washington State supplier for chlorine, an essential product to make water safe for drinking
- Environmental regulations for water utilities are substantial and increasing

Adaptive Capacity Findings

A large portion of the drinking water sector infrastructure is aging in place. Technological advancements are difficult to implement due to overall cost of infrastructure replacement; system components are underground, most often located within transportation rights-of-way, and many components require custom design and manufacture.

The *Drinking Water* sector is highly dependent on *Electric Systems*, *Transportation* and *Natural Systems*. Severe snow and ice or a large earthquake can inhibit delivery of crucial supplies and can slow needed repairs. Snow and ice or an earthquake can also cut off electricity supply, reducing or eliminating the

ability to pump water from sources to treatment facilities. Degradation of natural water quality will compromise the ability to deliver safe drinking water.

Long-term planning and management strategies are being considered to increase the resilience of all three drinking water systems. EWEB is planning for increased population and is actively pursuing options to diversify the water supply sources. The water division of EWEB manages a 10-year Capital Improvement Plan that projects $200 million in expected expenditures.

SUB's ten-year plan, which projects $50 million in capital improvement expenditures, includes seismic upgrades, pipe replacement, transmission lines, treatment facilities, and upgrades to aging infrastructure. SUB's capital improvements incorporate ongoing upgrades to the supervisory control and data acquisition (SCADA) system that provides knowledge and capabilities that will strengthen system reliability and resilience. A five-year vehicle plan accompanies the ten-year plan to ensure the necessary equipment is available to complete the capital improvement projects.

RWD's ten-year plan calls for approximately $9 million in projected expenditures, which include seismic upgrades to reservoirs and pipe replacements to diversify transmission system resiliency.

EWEB is exploring options to further expand the water system interties between the EWEB (Eugene) and SUB/RWD (Springfield) systems. Seismic upgrades to the water treatment plan and transmission capacity increases are also being discussed. All of these considerations will need to be balanced against the ability of the community to bear the costs associated with the improvements.

Contamination to SUB/RWD groundwater supplies can be difficult to detect in some situations. SUB/RWD manage this risk through implementation of a preventive hazardous material management program that is incorporated into the municipal development code.

Vulnerability and Risk

Flood

EWEB

Risks to the EWEB drinking water system from a major flood event are low. *No catastrophic impacts to the EWEB drinking water are anticipated with a major flood event.*

Most of EWEB's critical drinking water infrastructure is located outside the 500-year flood zone or is already designed for and located in the river. The primary flood vulnerability identified by EWEB is the main pump at the Hayden Bridge intake. If flood water levels rose above Hayden Bridge (requiring a 500-year or larger event), flood waters could damage or destroy the pump, thereby eliminating

EWEB's ability to obtain water from the McKenzie. This scenario is considered extremely unlikely.

To a lesser extent, flood related debris in the McKenzie River could cause a temporary problem at the intake. However, EWEB is aware of this possibility and is prepared to respond quickly if it occurred. System stakeholders also indicated that flood impacts to transportation infrastructure could limit their ability to access drinking water infrastructure.

Lastly, a significant flood event could have minor, temporary impacts on the filtration process due to increased water turbidity. However, such impacts would be internal and would not influence the delivery of water to customers.

SUB/RWD

Risks to the SUB/RWD drinking water system from a major flood event are high. *There are likely to be significant impacts to the SUB/RWD drinking water system with a major flood event.*

A significant portion of SUB/RWD's wells are within the 100-year flood zone. A 100-year flood would likely cause failure at Thurston, Weyco, Willamette, Sports Way, I-5, and Chase wells (SUB/RWD's major water sources with a total capacity of 22 million gallons per day or about 90% of total system capacity), leaving only three wells at Q Street, Maia, and SP. This impact may cause SUB/RWD to implement curtailment plans.

A flood of this scale could result in intake damage, contamination of wells, and equipment damage if motors become submerged, leading to an inability to pump and deliver water.

Wildfire

EWEB

Risks to the EWEB drinking water system from a wildfire event are low to moderate. *No catastrophic impacts to the EWEB drinking water are anticipated with a major wildfire event.*

The EWEB drinking water system has a low to medium sensitivity to wildfire. Stakeholders cited some concerns related to water turbidity. These concerns stem primarily from ash contaminating the water and clogging filtration and treatment systems during a wildfire event or longer-term turbidity impacts associated with post fire erosion. However, stakeholders indicated that these concerns are minor.

The system stakeholders also raised concerns associated with wildfire suppression efforts. The use of fire retardants and other chemical suppressants could contaminate the river. In addition, firefighting efforts rely heavily on potable water to suppress fires within the urban growth boundary. The need for potable water could potentially impact water availability (primarily reservoir served areas in the south hills) during a wildfire event occurring in or near the city.

Lastly, stakeholders indicated that wildfire related interruptions to the electricity grid could have major impacts. The water system is a major consumer of power for pumping and treatment. If power supply was compromised, EWEB's ability to treat and deliver water would be impacted.

SUB/RWD

Risks to the SUB/RWD drinking water system from a wildfire event are low. *No catastrophic impacts to the SUB/RWD drinking water are anticipated with a major wildfire event.*

Because SUB relies primarily (and RWD relies entirely) on groundwater sources, sedimentation or debris in surface waters will have a smaller effect on water supplies. Some impact from turbidity might be expected at some wells adjacent to rivers, and the intake on the Middle Fork Willamette River may need to be temporarily shut down. The impacts described for EWEB above related to wildfire suppression and interruptions to the electricity grid would apply to SUB/RWD as well.

Earthquake

EWEB

Sensitivity of the EWEB drinking water system to an M9.0 Cascadia earthquake is very high. *A major earthquake would have catastrophic impacts to the drinking water system.*

The EWEB drinking water system is highly sensitive to an earthquake hazard. The system's entire primary and secondary infrastructure is within the hazard zone. Because much of the system is constructed of relatively inflexible material (concrete, metal and plastic), and requires undisrupted connectivity to function, it is highly vulnerable to ground motion, shaking and soil liquefaction.

EWEB maintains approximately 800 miles of pipeline in its transmission and distribution system. Managers anticipate a large number of breaks and therefore a large number of services would be affected by an earthquake of this magnitude.

EWEB's main water transmission pipes are of critical concern. Replacement of critical parts and infrastructure could take *up to a year to replace* due to the customized nature of parts.

When this event occurs, curtailment plans will go into effect providing drinking water to only vital systems (e.g. drinking, fire suppression) and critical facilities (e.g. hospitals). Significant damage to the Hayden Bridge intake, the filter plant or the main transmission lines will cripple the entire EWEB system until repairs can be made. Damage to the electrical grid would also render the drinking water system inoperable.

SUB/RWD

Sensitivity of the SUB/RWD drinking water system to an M9.0 Cascadia earthquake is very high. *A major earthquake would have catastrophic impacts to the drinking water* system.

In general, the concerns described above for EWEB's system apply to the SUB/RWD system as well. Both above-ground facilities (reservoirs and pump stations) and below-ground infrastructure (wells and pipes) are susceptible to damage. SUB and RWD have completed a seismic evaluation of reservoir vulnerabilities. Projects to fortify storage facilities are pending over the next several years, which will help reduce some of the risk. For SUB and RWD, a significant portion of the piping system is cast iron, which is more brittle than ductile iron and increases the risk of failure in an earthquake.

SUB/RWD/EWEB

Earthquake-related damages may cause the release of hazardous materials. Those releases could pose a contamination risk if they occur within the drinking water source areas for any of the systems.

All water systems rely on skilled staff to maintain and repair systems. If employees are unable to get to work or are occupied taking care of their families following a large earthquake, emergency response and service restoration will be hampered.

Climate Change and Fuel Price Impacts

Climate change impacts have the potential to exacerbate the impacts of flooding and wildfire on the drinking water sector. Climate change will most likely mean less available water, especially during summer months due to reduced snowpack, at the same time there is increased demand due to higher summer temperatures and an extended summertime drought.

Flooding will still pose little threat to EWEB but will have increasing impact on the SUB/RWD systems.

Wildfire sensitivities and impacts will increase, placing further strain on the EWEB system, as well as to SUB/RWD, though to a lesser degree, during wildfire events.

Even with projected reductions in summertime river flows, water availability for EWEB is not perceived to be a critical concern. This is in part because of the unique geology of the McKenzie River watershed that stores water underground and maintains relatively constant flow. While direct impact on water supply appears minimal, lower summer flows and warmer water temperatures will impact fish populations and could lead to increased water use restrictions and therefore reduced availability. At the same time, predicted rising temperatures and an extended summer drought will likely result in greater demand for water for agricultural irrigation. Lower river levels could result in less aquifer recharge and lower static water levels, resulting in lower well production as wells are throttled.

Fuel price increases will likely translate to higher costs for operations and maintenance, including the cost of parts and fueling vehicles, which in turn could translate into higher consumer rates for all three water utilities.

4.2.4b Health Care and Public Health

Sector Summary

The health sector is tasked with providing health services throughout the Eugene-Springfield metropolitan area through multiple agencies and service providers (e.g. hospitals, pharmacies, clinics, etc.). This sector also includes public health programs, typically managed at the state and county level that oversee prevention programs, monitoring, and disease management at the regional level. The system is complex, consisting of multiple layers of public and private service providers.

Table 4-12. Health Summary Table

Critical Interdependencies: **Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:**	**Crucial Vulnerabilities:** **Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:**
■ Transportation ■ Waste Water ■ Wholesale/Retail Medical Supply Sector ■ Energy ■ Drinking Water ■ Communication ■ Public Safety	■ Reliance on highly skilled human labor ■ Dependence on specialized equipment and access to laboratory and pharmaceutical services ■ Demand for service currently at or exceeding available supply ■ Highly regulated sector experiencing major regulatory transition ■ Primary care physicians are actively leaving the Lane County area.
Major Findings: The Health Care and Public Health systems maintain strong collaborative partnerships across service providers, both public and private. Hospitals and emergency care providers are designed to be very adaptable to short-term and some medium-term emergency (surge) situations. Redundancies are built into the system with the ability to scale up additional temporary capacity as needed. Federally Qualified Health Centers (i.e. Public Health Centers) are consistently maintaining high volumes with overflow going to emergency rooms or urgent care.	

The health system is heavily reliant on highly skilled personnel (including specialized, primary and secondary caregivers) as well as specialized laboratory and diagnostic equipment.

The sector is heavily regulated at the local, state, and federal level. Implementation of the Affordable Care Act nationally and Oregon Health Plan in Oregon is bringing a lot of immediate challenges but should result in greater certainty, once implemented.

The public health sector expects significant changes in both demand for and provision of care. For example, more residents will have access to health care with commensurate increases in demand. However, how this is balanced between the public and private sector care providers is unknown.

Climate change will increase the presence of and introduce new communicable and exotic diseases.

The entire health system requires revenue from taxes or fees (public health) and insurance reimbursements (private medical) to operate. The system is constantly changing and, as a result, is accustomed to dealing with new and emerging issues.

Most residents feel their health needs are being met until they need service – at which point many are unsatisfied with the level of service.

Primary Agencies and Organizations

- PeaceHealth
- McKenzie-Willamette Hospital
- Eugene-Springfield Emergency Medical Services
- Lane County Health and Human Services
- Residential care facilities
- Federally qualified health centers

System Description

The Eugene-Springfield health sector includes multiple public and private organizations. The public sector includes: public health, behavioral health, clinics, and emergency medical services (including transport). The private sector includes: hospitals, clinics, pharmacies, and assisted living homes. These organizations generally provide health services throughout the community and region.

The sector is heavily regulated at the local, state, and federal level. In addition, the health sector nationally is undergoing a period of significant change due to implementation of the Affordable Care Act. The new law has three primary goals: (1) increase health care quality and outcomes, (2) decrease costs, and (3) provide higher consumer satisfaction. Implementation of the law is expected to increase access to health care, thereby increasing demand on a system that is already at or exceeding capacity.

This sector is dependent on rapid access to specialized diagnostic equipment and laboratory services. The sector also relies on highly trained personnel being able to report to work.

Notably, stakeholders report that general practice and specialist physicians are currently leaving or are not willing to relocate to our region. As a result, the local health system is experiencing limited availability of certain types of qualified staff.

The health sector is the largest employer in the region and continued growth of the sector is forecast.

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

In many respects, the health care sector is highly adaptable. Designed to be responsive to short-term and some medium-term emergencies (high degree of surge capacity), stakeholders emphasized the sector's ability to provide care in a variety of triage situations. Because it is part of a national system, local health care providers can call on state and federal resources when needed. Stakeholders cited reports of improved health outcomes, a high degree of local collaboration and a system built on a triage/emergency response model to support their assessment that the system is adaptable. Stakeholders also emphasized that responding to climate change is pushing adaptation strategies throughout the sector. Adaptive capacity in the Eugene-Springfield health sector is strong, largely due to *extensive collaborative partnerships* forged between both private and public service providers. These relationships are instrumental in providing quality health care services and responding to emergency events.

However, due to the size and complexity of the sector, local health care providers are limited in their ability to make local changes. For example, the sector is heavily regulated and providers must comply with minimum "standards of care" established at the state and federal level.[24] Likewise, government reimbursements

[24] The "quality of care" standard is a regulatory measure set by federal and state agencies. It determines the level of health care services a health care entity is required to provide to patients with a given illness or injury. While the regulation helps standardize the treatment process, adherence to the measure is compromised when the system is overwhelmed in a disaster. Given

for care (Medicare and Medicaid) are often below the cost of providing care. These un-recouped costs are spread throughout the system, driving the price of care up for non-subsidized consumers and private insurance providers. Current demand on the sector locally is at or exceeding capacity. Universal health care and how services are paid for is a long-term issue. In the future, payments will likely be tied to patient outcomes.

Supply and waste stream functionality also limit the sector's ability to adapt. The health system is a heavy user of the electricity, water, wastewater and transportation systems. It is also dependent on a wide variety of medical supplies provided by the private sector. While the health system is designed to continue functioning for 48 to 96 hours if one or more of those systems is not available, the standard of care rapidly deteriorates if access to primary support services cannot be re-established. As an example, the sector relies heavily on "just in time" delivery of medicines and pharmaceuticals. There are no local pharmaceutical stockpiles and strategic national stockpiles of critical pharmaceuticals are three to 24 hours away. The strategic stockpiles do not include supplies of standard prescription drugs available through the network of local pharmacies.

Key adaptation constraints include:

- The health system heavily relies on *revenue generated from services provided* in both the public and private health sectors. Emergency events strain these revenue sources, hampering the ability for service providers to collect revenues from individuals and insurance companies.
- Healthcare supplies and medications are consolidating under fewer and fewer companies, creating *singular supply chains*. Reliance on these supply chains is compromised in emergency events, making it difficult to receive critical supplies and medications. Facilities maintain a limited stockpile of medication that may last only 24-48hrs in an emergency event.
- *Maintaining and recruiting qualified health care professionals* remains a challenge to both private and public entities as described above.

Vulnerability and Risk

Flood

Risks to the health sector from a major flood event overall are low.
No catastrophic impacts to the health care sector are anticipated with a major flood event – however there would likely be challenges as described below.

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the expectation of limited staffing and supplies, compliance with the "quality of care" standard becomes difficult.

Public health is negatively affected during a major flood as the risk of exposure to toxins and infectious disease increases. Surface waters can become contaminated from chemical spills as water inundates homes and businesses, picking up both industrial and household chemicals. A major flood is expected to overwhelm the regional wastewater treatment facility resulting in release of untreated sewage into major waterways. Following a major flood, those homes and businesses in the affected area are likely to experience unhealthy levels of mold.

Transportation access (ingress and egress) is the primary flood concern for health care providers. With major flooding, access to the region's hospitals could be limited. Localized flooding could also limit emergency responder access to certain parts of town. Impacts include limited ability to: receive and treat patients at area hospitals and clinics; maintain supplies and medications; and ensure medical staff can get to work.

The PeaceHealth River Bend Hospital lies very near the McKenzie river and may experience restricted access and may lose complete access to their Annex building (it was flooded in the 1996 flood). The annex houses PeaceHealth's laboratory, supplies, and medical records. Limited access to the Annex would be a significant detriment to providing essential services and "quality of care."

McKenzie Willamette hospital is well outside the flood zone. However, its backup generators for electricity are located in the basement. This is a concern for any localized flooding or stormwater system failure near the hospital.

Other potential flood sensitivities and impacts identified by the sector stakeholders include:

- Sheltering of displaced populations,
- Post flood health concerns (e.g. water borne disease, mold, toxic material abatement, etc.),
- Access to drugs through pharmacies could be impacted if there are supply chain disruptions or limits on access to the pharmacies themselves, and
- Potential short-term impacts to other on-demand medical supply chains.

Wildfire

Risks to the health sector from a major wildfire are low. *No catastrophic impacts to the health care sector are anticipated with a major wildfire event.*

Public Health is negatively affected by wildfires in the region. Warm temperatures that typically accompany wildfires, along with dense smoke create extremely unhealthy air conditions. The young, old, and those with chronic respiratory ailments will be most negatively impacted. A fire in the wildland

urban interface (such as the South Hills of Eugene) would not likely affect a large portion of the population. There are obvious and extreme risks to those with homes in the affected area but the rest of the population is likely to be relatively unaffected. Smoke from a local fire would likely be pulled out of the metro area by prevailing winds, reducing impacts on the local population.

Local Health Care systems are not likely to be heavily impacted by a wildfire event. Wildfires within the region may reduce the ability to respond to emergency calls in rural areas if roadways are blocked by fire. If a wildfire occurred in the wildland urban interface, hospitals would likely experience a spike in patients with burns or injuries from smoke inhalation, but the number of patients is not likely to overwhelm local emergency treatment capabilities.

Earthquake

Risks to the health sector from a M9.0 Cascadia earthquake are very high. *A major earthquake would have catastrophic impacts on multiple parts of the health care sector*.

The Health system is highly sensitive to impacts associated with a M9.0 Cascadia earthquake. Planning for this event is a high priority for the sector; the sector uses the M9.0 scenario as its worst case scenario.

Public health would be affected in multiple ways. The risk of disease will increase as safe drinking water becomes scarce because sewage and chemicals such as petroleum are likely to contaminate local surface waters and ground water. Existing drinking water systems will be damaged and inoperable for a period of months and up to a year. Sanitary sewer systems are expected to fail and similarly be inoperable for a period of months increasing the likelihood of the spread of infectious disease. Electrical systems will be inoperable resulting in failure of refrigeration systems and food spoilage. Fresh food will become unavailable after a period of days and many may have trouble getting adequate nutrition for a period of time. Shelters damaged in the earthquake will lack heating and cooling, increasing the likelihood of environmental injuries such as hypothermia or overheating. These and other stresses are expected to negatively impact the physical and mental health of large portions of the population.

An earthquake event would significantly impact the delivery of health care. Critical staff may become unavailable if tending to the needs of their own families. Supply chains of critical supplies will be cutoff, and essential equipment may not function without a consistent supply of electricity. A surge of patients is expected to overwhelm the local system, forcing existing staff to work long and continuous shifts. Staff reductions beyond 20% are not sustainable long-term, particularly in certain skill positions. The need to bring in medical staff from outside the region following this event is almost certain.

With crippled transportation systems, the availability of medications, medical supplies, and equipment and lab services will be compromised. As noted above,

the sector also relies heavily on the sanitary sewer and solid waste hauling. If wastewater and medical waste pickup is not available, the ability of the hospitals to function is severely compromised.

Finally, stakeholders expect that essential equipment for imaging and diagnosis could be damaged or destroyed, limiting both the functionality of labs and ability to meet a minimum standard of care. These losses are primarily related to the loss of secondary (non-structural) systems within the hospital. For example, the pharmacy at RiverBend hospital uses a giant robotics system and runs 24-hours a day, seven days a week. Earthquake shaking would be expected to damage that system. Numerous other examples of equipment losses, either from damage or needed recalibration, are expected. Some highly specialized equipment (e.g. the Gamma Knife) may take years to replace due to cost. Insurance claims and payees ability to provide revenue into the system may be suspended to provide immediate care and these costs may never be recovered. Patient tracking and billing systems are off site, so communication infrastructure becomes a critical vulnerability. Local communication is also a crucial link in the health care system that needs to function following a seismic event.

Climate Change and Fuel Price Impacts

Climate adaptation strategies are driving planning and system changes across the health sector.

The climate factors of greatest concern for health are warmer winters, warmer summers, increased flooding, and increased wildfire.

As temperatures increase, the region may begin to see exotic and foreign diseases not previously present in the Pacific Northwest. Physicians may or may not be prepared or familiar with these emergent diseases.

Increasing temperatures are expected to increase the frequency of heat related illnesses and injuries. Heat waves cause the greatest risk to the young, the old, the obese, people who are living alone and those without access to air conditioning.

Increased incidents of wildfire in the region will decrease air quality and cause respiratory challenges, particularly for the young, the old, and those who suffer from chronic respiratory ailments.

Rising fuel prices would increase the cost of hospital operations, emergency medical services, and transportation. Increasing fuel costs are already accounted for in annual budgets of some local health care providers. Expensive fuel translates into higher costs for transportation *and* supplies and equipment. Because of the need for sterile tools, health care providers rely heavily on disposable plastics and products made of stainless steel, products that depend heavily on fossil fuels for production.

4.2.4c Electricity

System Summary

The electric sector in the greater Eugene-Springfield area is comprised of five local utilities and one federal agency. Key components of the region's infrastructure include power generation (e.g. dams), high-voltage transmission lines, substations, distribution lines, transformers, breakers, poles and meters.

Table 4-13. Electric Summary Table

Critical Interdependencies: **Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:**	**Crucial Vulnerabilities:** **Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:**
■ Transportation ■ Natural Systems ■ Residential and business customers ■ Communication	■ Aging infrastructure ■ Dependency on BPA for power ■ Lead time on ordering critical equipment (e.g. high-voltage transformers) ■ Lack of skilled labor

Major Findings:

The vast majority of electricity generation for the area is provided by the Bonneville Power Administration (BPA), with some local generation capacity through the Eugene Water & Electric Board (EWEB).

Demand is low relative to current sector supply and capacity. However, the ability to add new hydropower generation is limited.

The distribution system is highly interconnected resulting in system redundancy through power re-routing strategies.

The electricity sector is heavily reliant on highly skilled personnel (engineers, line workers, etc.). Due to retirements and a lack of trained people entering the field, workforce availability is a growing concern.

Earthquake is of major catastrophic concern for the sector.

Wildfire and flood could both have minor impacts on the system, but are not a high concern overall.

Wind storms and severe winter storms are a major chronic hazard for the sector, associated with damage to overhead power lines and the resulting local power losses. The assessment did not address wind or winter storms due to lack of time.

Climate change could impact both supply of and demand for power. Decreases in river volumes, whether due to drought or low snow pack, will limit hydropower availability in the region, particularly on the Columbia River, a primary source of hydropower. Increased summer temperatures are expected to drive up demand for electricity to operate air conditioning.

Rising fuel prices will impact the sector and costs will likely be passed on to power customers.

Many customers view electricity as a right, not a commodity. Customers have increasing expectations about reliability while continually seeking lower rates.

Primary Agencies & Organizations

- Eugene Water & Electric Board
- Springfield Utility District
- Emerald People's Utility District
- Lane Electric Cooperative
- Blachly-Lane County Cooperative Electric Association
- Bonneville Power Administration

System Description

The electric sector in the greater Eugene-Springfield area is comprised of five local utilities and one federal agency. The local agencies are primarily responsible for the distribution of electricity to residential, commercial, industrial and institutional customers. Electric facility construction and maintenance is a key component of this sector's responsibility. The vast majority of electricity generation for the area is provided by the Bonneville Power Administration (BPA), with some local generation capacity through the Eugene Water & Electric Board (EWEB).

EWEB primarily serves the City of Eugene, with some extended distribution to approximately 3,000 customers up the McKenzie River valley. The area's largest electricity provider with approximately 91,000 customers, EWEB maintains 40 substations and an average load of 300 megawatts (MW). EWEB has capacity to deliver roughly one-million MW of power.

Springfield Utility Board (SUB) is the Springfield counterpart to EWEB. They serve approximately 32,000 customers and maintain nine substations. Three rural utilities make up the remaining service area in Eugene-Springfield Metro and surrounding areas of Lane County. Lane Electric Coop (LEC), Emerald People's Utility District (EPUD), and Blachly-Lane (B-L) all are distributers of electricity. These rural providers maintain fewer substations, but more miles of transmission

line. In general, the capacity to deliver power is far exceeding local demand. The notable exception is Blachly-Lane's biggest substation, which is currently near capacity. However, they are already moving forward with plans to construct a new substation.

With the exception of EWEB, none of the local electricity providers generate their own power. Therefore, almost all local power is purchased from the Bonneville Power Administration (BPA). BPA operates 31 hydroelectric projects and one nuclear power plant. Operating as a branch of the Department of Energy, BPA is a federal agency funded by rate-payers. EWEB buys the majority (80-percent) of its power from BPA; remaining power is generated by hydro and other renewable energy projects owned by the utility.

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

The majority of the electric sector has a medium to high adaptive capacity due to the highly networked nature of the system and large amount of generation and distribution capacity. However, a few critical vulnerabilities limit the overall adaptability of the sector at a regional scale.

Similar to the transportation sector, the average daily demand is drastically less than the maximum capacity. Additional capacity is based on 20-year population projections and planning is done well in advance of increased consumer demand.

EWEB's system are run completely in parallel, meaning if there is damage along one line, or at one substation, the power can be re-routed via other lines. Similarly, SUB has the capability to support single contingency events within the system at the transmission, substation transformer, and distribution feeder level. In addition, EWEB serves as a secondary system to both SUB, as well as the smaller, more rural utilities.

The electric sector is very responsive to customer needs. While this encourages power reliability, regular upgrades, and quick repairs, the desire to keep rates low reduces the implementation of long-term plans that could increase resilience.

In the Northwest, electricity is primarily generated by hydroelectric dams including 12 large dams on the Columbia River. This provides low-cost, clean, renewable energy to the region but the lack of diverse electric generation facilities is a potential vulnerability. Eighty percent of EWEB's electricity, and 100% of the other utility's electricity is generated by BPA and is largely hydroelectric. Therefore, regulatory, environmental or physical constraints that impact the Columbia River could have significant impacts on local electricity.

Finally, the electric sector is experiencing a shortage of applicants with the necessary skills. As with many other trades, the majority of electric line workers

are expected to retire in the next five years. This, in combination with a limited pool of people interested in trade work, is resulting in low availability of line workers.

Vulnerability and Risk

Flood

Sensitivity of the electric sector to a major flood event is low. *No catastrophic impacts to the electric sector are anticipated with a major flood event.*

Inherently, electric transmission and distribution infrastructure is well protected, either buried underground or on overhead power lines. Nearly all of the substations for the five local utilities are out of the floodplain and therefore would not be compromised. For some of the utility companies operating in rural areas, access to their substations could become a problem if landslides are triggered by heavy rains. While this illustrates a critical interdependence with the transportation sector, flood sensitivity remains low.

Wildfire

Sensitivity of the electric sector to a large wildfire is low. *A major wildfire event is not expected to have major impacts on the electric sector.*

Similar to flooding, the electric sector has a low sensitivity to wildfire. The primary concern related to this hazard is power lines (transmission or distribution) that cross areas of forest. This makes the sector slightly more sensitive to wildfire than flooding. However, the utility companies are proactive in trimming and maintaining appropriate buffers.

Sensitivity to the wildfire hazard is largely based on the location of critical infrastructure. Only a small percentage of the system needs to be damaged before the entire sector is affected. However both EWEB and SUB systems are redundant so if there is damage to one area, power can be rerouted through other lines. EWEB also acts as a redundant system for other those utilities that do not have parallel systems.

Earthquake

Sensitivity of the electric sector to a M9.0 Cascadia earthquake is high. *A major earthquake could have catastrophic impacts on multiple parts of the electric sector, especially if the event impacts critical components (e.g. high-voltage transformers, dams, major percentage of distribution, etc.).*

A major earthquake event would likely impact major parts of the generation, transmission and distribution systems. Stakeholders expressed particular concern for substations, underground lines and other physical infrastructure (e.g. poles). Should a small number of utility poles fail, they will tend to pull others down with them, creating a cascading impact. Impacts to the transportation network would

limit access to infrastructure, further hampering repairs. It is assumed that BPA could be off-line for months given this earthquake scenario.

The extent of damage to critical infrastructure will dictate how long it takes to bring the sector back on line. There are no stockpiles of major equipment locally, since equipment is expensive and largely made to order. Much of the specialty equipment takes months to manufacture and would be in high demand across the entire region following a regional earthquake of this magnitude.

The extreme dependency of other sectors on the electric grid (energy, public health, communications) makes these vulnerabilities even more significant. For example, without electricity fuel cannot be pumped into vehicles needed for emergency response, repair, or recovery. This situation is further exacerbated by the Northwest's reliance on hydroelectric power. If one or more dams on the Columbia River were to fail, the resulting effects are unknown. There is currently no written earthquake recovery plan for the electric sector.

Climate Change and Fuel Price Impacts

Important climate related impacts include: low snow pack or low rain years, changes in the Endangered Species Act for aquatic species, and increases in the number of wildfires.

Power generation is a primary concern related to climate change. Because BPA is so heavily reliant on hydropower generation across the Columbia River basin, any climate related reductions in river water volumes could reduce power availability, increase price or both.

EWEB owns power generating facilities on the McKenzie River, a river with a unique geology that results in underground storage and slower release of water. This would help mitigate the effects of lost snow pack, but EWEB would still see reduced power availability from climate change.

Stakeholders also noted that while there is a significant amount of existing capacity to meet new demand, the capacity to actually increase power generation is much lower. The interplay between the cost of power across primary types (e.g. hydro, gas, coal, nuclear) could also be impacted significantly as a result of climate change. Hydro-power is worth more as the price of fossil fuels increase. Conversely, higher prices could impact usage and demand.

Temperature increases specifically can directly impact transmission line ratings and capacity. This is an issue currently. Climate change could intensify the incidence and duration of these issues. In addition, higher temperatures will result in increased system load related to air conditioning. All of that is carried by the electric grid (as opposed to winter when gas, wood and other heating options can offset the demand for power during cold spells).

Fuel price increases will impact the cost to maintain and repair the system. The electricity industry relies on trucks and heavy equipment to service infrastructure.

With revenue generated by rate-payers and ever-increasing pressure to keep rates down, the increase cost of fuel puts a strain on operating budgets. Cost increases will get passed on to the consumer.

Fuel price increases will also increase the number of electric cars. As a result, electricity demand will go up. Higher energy prices across the board may stimulate an increase in distributed generation. Notably, a more distributed electricity system will result in higher adaptive capacity and more resilience overall.

4.2.4d Transportation

System Summary

The transportation sector within Eugene-Springfield is comprised of the road and bridge network, public transit network including buses and long distance trains, and the Eugene airport. These assets are operated and maintained primarily by public entities, with the exception of the freight and passenger rail network. The road and bridge network, in addition to the local bus network, comprise the majority of the transportation sector within the area. Agencies responsible for maintaining and operating these facilities are public and include the Oregon Department of Transportation (ODOT), Lane County Public Works, Eugene Public Works, Springfield Public Works, and the Lane Transit District (LTD). While most of the road and bridge network is automobile centric, these agencies are also responsible for constructing and maintaining the bike and pedestrian infrastructure in the region.

Table 4-14. Transportation Sector Summary Table	
Critical Interdependencies: Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:	**Crucial Vulnerabilities: Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:**
■ Business and Industry ■ Energy/Fuel ■ Communications ■ Housing	■ The automobile transportation system relies heavily on gas tax revenue to fund maintenance. This creates a financial risk to the system as automobile traffic decreases and as vehicles become more efficient and people shift to alternate modes of travel. ■ Large scale, expensive infrastructure is very slow to change or adapt to new needs or demands. ■ The system relies exclusively on fossil fuels for construction, operation, and maintenance activities. ■ Hwy 99 provides a key backup route for N/S traffic on I-5 but could only service a fraction of the traffic moving on I-5. ■ There are few redundancies for E/W auto traffic using Hwy 126.
Major Findings: ■ The built system relies heavily on institutional standards for guidance, causing delayed implementation of new design or construction practices. ■ The adaptive ability of the transportation system arises from using different vehicles on the same road system – but vehicles are privately owned and adoption of new technologies is unpredictable. Road designs influence the diversity of vehicles being used. ■ There is a widespread need for well-considered evacuation plans for a variety of hazards.	

Primary Agencies and Organizations

- Oregon Department of Transportation
- City of Eugene
- City of Springfield
- Lane County
- Lane Transit District

System Description

The transportation sector within Eugene-Springfield includes air transportation (passenger and freight), rail transportation (passenger and freight), roads for light vehicles, freight vehicles, buses and bicycles, and sidewalks for pedestrian traffic.

Roads are classified into four categories based on the number of *average daily trips*. The Appropriate Level of Service (ALS) is determined for roads and intersections. All roads in the region currently meet the pre-determined ALS except for Beltline Highway at Coburg Rd.

Multi-use paths serve non-motorized transportation modes. Much of the bicycle network consists of on-street bicycle lanes.

Lane Transit District, with 180 operators, operates conventional bus routes, a Bus Rapid Transit system that operates on fixed routes, and a *Dial a Ride* program for alter-abled customers.

The traffic management systems in both cities use controllers on the street that automate operation but do not adapt to changing traffic conditions. The system also connects to a central facility that uses a central server, software, and staff to manage traffic.

Adaptive Capacity
Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

Overall, the transportation sector has a *low* level of adaptive capacity. Primary factors reducing adaptive capacity include:

- The automobile transportation system relies heavily on gas tax revenue to fund maintenance. This creates a financial risk to the system as automobile traffic decreases and as vehicles become more efficient and people shift to alternate modes of travel.
- Hwy 99 provides a key backup route for north-south traffic on I-5 but could only service a fraction of the traffic moving on I-5. Many conditions that would cause traffic problems on I-5, such as flood, earthquake, and winter storm, would also affect road conditions on Hwy 99. However Hwy 99 would provide a good back up for isolated problems like toxic chemical spills or auto accidents.
- There are few redundancies for regional east-west auto traffic using Hwy 126.
- Large scale, expensive infrastructure is very slow to change or adapt to new needs or demands.

Large road and bridge construction projects are constrained in a number of ways:

- Rising fossil fuel prices are increasing the material, equipment, and labor costs, pushing up on construction cost of already expensive projects.
- Projects are highly dependent on federal funds that are becoming increasingly unreliable.
- Project planning and construction is highly technical and reliant on specially trained staff and specialized equipment.
- Projects require exceptionally long planning lead times.
- In many cases, the lack of available public right of way creates a significant design constraint.

State and local governments rely heavily on federal funding to make repairs following a natural disaster. The distribution of funds for recovery and reconstruction is decreasing, increasingly politically charged, and will not cover the full replacement value of the asset.

Some local transit routes reach capacity during peak times – but this can be remedied by adding buses on these routes if funds are available.

Vulnerability and Risk

Flood

The transportation system overall is not especially vulnerable to flood. This is due in part to the localized nature of flooding resulting in just a portion of the system being directly impacted.

Those portions of the road network more vulnerable to flood are rural highways, local streets with chronic flooding conditions, local streets in the 500 year flood plain, and several off-street bike and pedestrian routes.

If I-5 were compromised, freight traffic would be interrupted as there are significant capacity limits on the primary alternate route, 99W, where it crosses the Willamette River at Harrisburg.

A number of transportation specialists questioned the accuracy of the flood maps provided.

Winter Storm

The airport, local streets and highways are extremely sensitive to winter storms, particularly those that bring snow and ice. Because impacts are widespread across the region – and usually include surrounding agencies, the number of qualified staff available for response can be limited.

Winter storms resulting in heavy winds can result in fallen trees and downed power lines, causing closure to that portion of the system until power lines are removed. Downed power lines can also bring power outages that shut down fuel pumps.

Earthquake

The transportation system is extremely sensitive to a M9.0 Cascadia earthquake. Earthquake recovery times for roadways would be weeks to months or even years, depending on the road in question.

Primary concerns include:

- Bridge collapse
  - The post-earthquake serviceability of bridges built prior to the 1990s is questionable. The newly constructed I-5 bridge over the Willamette may be the only usable bridge in the area.
- Landslides

- Liquefaction
- Rockfalls
- Road blockage due to debris and fallen utility poles.

An earthquake of this magnitude would affect all communities in the region and all systems in the region, meaning that there is likely to be an *extremely limited* number of qualified personnel and materials available for response and recovery operations. Availability of staff for response and recovery is likely to be exacerbated due to staff tending to the needs of their own families.

Operational tolerances for railroads are very small so minor misalignments in tracks make rails unusable. Similarly, operational tolerances for runways are very small and cracks in runway surfaces limits take-off and landing for fixed wing aircraft.

The secondary impacts of broken pipes (under the roads) and downed power lines will substantially slow both the response and recovery.

Climate Change and Fuel Price Impacts

Extreme heat can cause worker safety risks and long term heat events can reduce the durability of asphalt road surfaces.

Reduced snowpack will reduce the need for plowing on high elevation roads.

Heavy downpours create a backup in the stormwater system that causes temporary localized flooding over roads.

If regulations are increased to protect species (fish for example) this creates more regulatory hurdles and associated design and operational constraints.

The system relies exclusively on fossil fuels for construction, operation, and maintenance activities. Increasing oil prices increases the cost of asphalt and reduces the ability to do basic maintenance. At the same time, higher fuel prices will likely reduce the amount of driving people do, reducing gas tax revenues currently used for maintenance.

Higher fuel prices will likely shift some freight traffic to rail because it is more fuel efficient. For the same reason, it may also spur additional interest in developing high speed rail from Eugene to Vancouver.

The speed of increase in fossil fuel price is a big variable and a big unknown. If prices increase over a longer period of time, systems and practices can adjust, however sharp increases in price over short time periods can be extremely disruptive.

4.2.4e Food

System Summary

The food sector includes local grocery stores, food processors, local and regional wholesalers and distributors, food storage in Portland and Eugene, local food growers, and local restaurants.

Not included in this assessment are the hundreds of out-of-region growers and processors that are responsible for producing and processing the majority of the food that is consumed locally.

Table 4-15. Food Sector Summary Table

Critical Interdependencies: Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:	Crucial Vulnerabilities: Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:
■ Electricity ■ Transportation ■ Fossil Fuel ■ Natural systems	■ The majority of food consumed in Eugene-Springfield is stored in Portland and travels down I-5 by truck and trailer. ■ Grocery stores stock only a three day supply of food ■ External influences on agriculture and transportation sector have an undue influence on the price and availability of food in Eugene-Springfield
Major Findings: Local growers are impacted by flooding but flood is not a significant concern to the local food sector as a whole. With the potential impact on electricity supply and the critical dependence on tractor trailers to distribute food from Portland to Eugene, winter storms can have a significant impact on the local food system. An earthquake will have catastrophic impacts to the system. Other hazards are of much lower concern.	

Primary System Managers

- Grocery stores
- Food processors
- Food storage and logistics companies
- Regional food distributors
- Local and regional growers

System Description

The local food sector is comprised of multiple private players typically categorized into sub-groups including: food producers (crops and livestock), food processors, food storage (cold storage, warehouses), food distribution, and retail food sales (dozens of grocers, more than 100 restaurants, and three school districts).

While the Eugene-Springfield area is known as a leader in the local food movement, the vast majority of the food consumed locally is grown and processed elsewhere.

Food is harvested and either shipped to a processor or a storage facility. Large amounts of storage crops are stored near the area where they were grown. Large amounts of staples used in Eugene-Springfield are stored in centralized distribution facilities primarily located in Portland and the San Francisco Bay Area. Food is then shipped to grocery stores and restaurants almost exclusively by truck and trailer, where it is sold to individuals.

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

Overall, the food sector has a moderate level of adaptive capacity.

Primary factors supporting adaptive capacity include:

- Diversified food producers covering huge geographic area relying on a well- established distribution network.
- Local ethic of information sharing among local actors in the food sector.

Primary factors reducing adaptive capacity include:

- Food supplies rely almost completely on I-5 to bring in food from the north and south.

- Limited stores of food in local grocery stores (three day supply if road-based resupply is disrupted).
- Current high rates of hunger locally, indicating food supply is not equitably distributed.
- External influences on agriculture and transportation sector have an undue influence on the availability of food in Eugene-Springfield.
- Heavy reliance on aging transportation infrastructure.
- System reliance on fossil fuels and exposure to increasing fuel prices.

Other Adaptive Capacity Findings

The majority of the food consumed locally is grown, processed, and stored out of the area, but only a small percentage of the food consumed locally is produced overseas.

While most grocery stores use "just in time" delivery and hold only a three-day supply of food, most have additional capacity to store more food (up to six days supply) if they have advanced notice.

In order to keep food fresh, restaurants similarly keep no more than 4 days of food on hand at any one time.

The region is well supplied with food, but it is not distributed equitably. Currently, 39% of people living in Lane County are eligible for emergency food boxes (food bank donations).

Technology is allowing, and the Federal government is requiring improved tracking of food from farm to table that will enhance the ability to identify sources of food poisoning. The cost of implementing this technology will affect businesses and will be passed onto the consumer.

Within the recent economic downturn, the food sector remained the strongest economic sector in Lane County. The Eugene-Springfield area hosts a number of national brand food processors including processors of non-dairy foods that are responding to dietary preferences and demand for allergen-free foods.

The Eugene-Springfield area has a notable ethic of information sharing within the food and agriculture sector. According to one participant, "In many other parts of the country, this [vulnerability assessment] meeting would never happen."

For growers, maintaining access to non-patented seed is a growing concern.

Eugene-Springfield is fortunate to be located along a primary transportation corridor between California and Washington, both of which are significant food producing states.

Vulnerability and Risk

Flood

The food sector as a whole is mostly insensitive to flooding. Grocers, processors, restaurants, storage are primarily located outside the flood plain.

Because the best soils occur near the river, however, many local growers are extremely sensitive to flooding, particularly if they are growing winter crops. During wet years, growers may have to plant crops late in the season and growers risk losing topsoil, crops, livestock, and equipment in the flood zone. However, because most of the food consumed locally is imported, this flood risk does not translate into significant risk to the food system in Eugene and Springfield.

Winter Storm

The food sector as a whole is very sensitive to winter storms, particularly those storms that bring snow and ice.

Growers can lose infrastructure (greenhouses for example), crops, and livestock, particularly during extreme cold.

Grocery stores and restaurants rely heavily on food shipped in on Interstate 5. In the case of a closure of I-5, alternate routes can only handle a small portion of the traffic and alternate routes are similarly affected by winter storms. Winter driving conditions slow highway traffic, causing truck drivers to attain their legal maximum hours of driving (10 hours driving in a 24 hour period) before products arrive at their destination. This slows movement of all goods shipped by tractor trailer, including food destined for grocer's shelves.

During winter storms, more residents travel to nearby grocery stores by foot. This favors those residents who live within walking distance of a grocery store and can compound challenges for those who do not.

Earthquake

Sensitivity of the food sector to a M9.0 Cascadia earthquake is very high. *A major earthquake would have catastrophic impacts to the food sector*.

The loss of electricity, availability of diesel fuel, and damaged transportation infrastructure are the primary concerns for grocers. Existing grocery stores are mostly new and should remain standing; however shelving is not typically bolted down. Broken food containers and defrosting foods are likely to result in spoilage of significant amounts of stock. This loss of product, coupled with disrupted distribution and expected runs on food suggest grocery stores will likely be out of food within a day or two of a major earthquake.

There are over 130 bridges and overpasses on I-5 between Eugene and Portland.

Like all sectors, grocery stores will likely experience limited availability of trained staff, as employees will be tending to their families first and foremost.

Local growers may have relatively little impact from a significant earthquake and, depending on the season, could be a source of food for some residents if coordination and transportation were worked out.

If an earthquake occurred during the summer, damage to critical irrigation systems and the potential for hazardous materials spills into open waterways would be a concern.

Climate Change

The crops grown locally are already changing due to climate change and will continue to do so in the future. The uncertainty about the timing and degree of change creates increased risk for growers. Local growers will be impacted by changes in plant and animal pests and diseases and intensification of storms.

Increased drought in Oregon and in other parts of the country will have a significant impact on agricultural productivity and food prices. This upward pressure on prices will be the primary climate impact to grocers.

Fuel Price Impacts

Transportation of food relies almost exclusively on fossil fuels.

Food production relies heavily on fossil fuel to operate equipment, for manufacture of conventional fertilizers and pesticides, and to produce feed for livestock.

Fuel surcharges are already being added to food invoices and these costs are passed on to the consumer. As prices increase, consumer preferences are likely to shift toward home food preparation and lower-cost foods.

4.2.4f Housing

Sector Summary

The housing sector includes owned and rental homes, both single family and multi-family structures, manufactured homes, assisted care facilities, and transitional and temporary housing. For sheltering purposes, this sector also includes hotels and other temporary accommodations.

Banking and financial institutions were unable to attend the assessment meetings.

Table 4-16. Housing Sector Summary	
Critical Interdependencies: **Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:**	**Crucial Vulnerabilities:** **Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:**
■ Electricity ■ Transportation ■ Drinking water ■ Sanitary sewer	■ The majority of residents do not have the necessary insurance to replace housing after catastrophe. ■ Even if adequately insured to rebuild, the loss of jobs due to a catastrophe may result in foreclosure of insured properties. ■ Economic crises, separate from natural catastrophe, may similarly result in foreclosures
Major Findings: Housing not only provides shelter but acts as the primary delivery mechanism to access other essential services including drinking water, electricity, and sanitation. There is currently very little, if any, excess housing stock in the Eugene-Springfield area. After a disaster many of those displaced will shelter by staying with family and friends, meaning social structures and relationships are an important factor in providing access to emergency shelter. All natural hazards will disproportionately affect vulnerable populations such as seniors, lower income populations, those with limited access to an automobile, and those with limited English skills. Economic disruption resulting from a large percentage of housing being unfit for occupancy will ripple through the community and cause financial stress even for those following financial best practices and thought to be prepared. College student population may transfer away from community institutions if inadequate housing exists due to catastrophic event.	

Primary Agencies & Organizations

- Home Builders' Association
- Realtors
- Housing and Community Services Agency of Lane County
- St Vincent DePaul
- City of Eugene
- City of Springfield
- Insurance providers
- Lending institutions

Sector Description

- The Eugene-Springfield area consists of approximately 90,000 housing units, approximately two-thirds of which were built before 1980. For homeowners, a significant portion of a family's net worth is tied to their home meaning housing is both shelter and a significant source of financial stability. Unlike other sectors, housing is widely dispersed, privately owned, and highly individualized.

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

Overall, the housing sector has a *low* level of adaptive capacity.

Primary factors reducing adaptive capacity include:

- Housing design and construction is a process that typically takes a year or more to complete – and is not very flexible.
- Home construction is an increasingly complex process with a high degree of regulation and requiring specialized skills. The current system does not make Do It Yourself construction feasible for most households.
- Because housing is long-lasting, the overall local housing stock does not undergo significant change except in the realm of new construction.

- Builders want to stick with the materials and techniques that they are familiar with, meaning there is slow adoption of new technologies.
- Changes in trends of sizes, types, styles of houses occur very slowly.

Affordability

State and federal regulations have a huge influence on the cost of building, insurance, and overall affordability of housing. In the Eugene-Springfield area, affordable housing is full, with long waiting lists. This is influenced by several factors:

- Incomes in the area are lower than average and poverty rates have doubled in the last 40 years and remain high;
- The median household income in the region does not match the median housing cost, resulting in 50% of renters and 25% of owners in the area paying more than 30% of their income for housing – defined as “housing burdened”. This results in compromising on cost of food, health care, transportation, and other necessities.
- Construction costs alone (the price of materials and utility infrastructure, but leaving out the cost of land) are above people's ability to pay;
- Long standing federal subsidies for affordable housing have recently diminished.
- Energy costs for home heating are increasing.

Construction

Due to changes in construction techniques and technology, the seasonal nature of construction has been reduced over the last few decades. Construction now goes on year-round. The exception is earth-moving and excavation, which typically cannot be done from about November to April due to wet, sticky, saturated soils.

When people seek an energy efficient home or a home with new technologies, rather than conducting retrofits, they tend to sell their existing home and build new. This results in fewer homes receiving the necessary energy efficiency upgrades.

Oregon land use law limits the amount of new land available for home sites and other uses, yet redevelopment is more expensive than building on “green fields” that haven’t been developed. This results in somewhat higher costs for housing.

There is currently very little, if any excess housing stock in the area. The UO student population (and enrollment rates) have a huge influence on the availability

and affordability of rental housing and, due to UO calendar, the rental market peaks during the school year and slows substantially during the summer.

Some who work in Eugene-Springfield seek less expensive housing in outlying communities including Coburg, Cottage Grove, and Veneta.

Eugene has a complaint-driven rental housing code that requires property owners to meet basic standards of health and safety.

Insurance

Flood and earthquake are the largest areas of exposure, due to residents who are uninsured for catastrophic loss. In the case of home owners, the level of insurance coverage is typically dictated by lenders. A *very* low proportion of renters maintain renter's insurance.

The time necessary to settle all claims in the event of a catastrophic or far-reaching event will further slow recovery. Insurance may also not be adequate for necessary upgrades to comply with newer codes and standards.

Post-disaster recovery

Post-disaster recovery commonly creates a spike in demand for building permits. In communities undergoing post-disaster recovery, contractors will commonly move in from out of the area and an uncommonly large percentage of contractors may build without the necessary permits, particularly if the permitting system is unable to accommodate requests, and if enforcement is lax. Price gouging by unscrupulous contractors is a related concern that could be addressed by setting standards in advance of a large hazard event.

The cost of repairing or reconstructing a home after a significant disaster can far exceed the current assessed value. This is due to limited availability of materials and skilled workers after a disaster and because homes are required to be rebuilt to the newest state code, typically entailing increased expense.

Shelters

The capacity of organizations (Red Cross and others) to shelter the population will be exceeded if more than one-quarter of the population needs to be sheltered, and possibly before then. Extremely large-scale events affecting large portions of Eugene-Springfield have the potential to overwhelm immediate sheltering resources.

Following a disaster many residents access shelter by staying with family and friends. For this reason, social structures and relationships are an important factor in providing access to emergency shelter.

Vulnerability and Risk

Flood

Sensitivity of the housing sector to flood is relatively low. *A significant flood would have significant localized affects but impacts would not be widespread.*

There is a relatively small proportion of the Eugene-Springfield population that lives in the flood zone. Those residents in the flood zone could experience extreme financial hardship, while those residents outside the flood zone would be minimally affected.

Statewide only about one in six dwellings in the mapped floodplain are covered by flood insurance. Existing FEMA flood maps are the regulatory driver for flood insurance – but do not reflect the real risk for any one owner. For those who *are* in the flood zone, flood insurance rates are expected to increase substantially in the near term due to changes in the National Flood Insurance Program (NFIP). The NFIP exempts mobile home parks from the requirement of being insured in floodways. Mobile homes are considered "portable" and in Oregon are registered as vehicles, not homes. In reality, they are not readily portable – so they are at increased risk in a flood event.

Wildfire

Sensitivity of the housing sector to wildfire is relatively low. *A wildfire in the fire-prone portions of town would have catastrophic localized affects but impacts would not be widespread.*

Most home insurance policies cover damage due to a wildfire and there is a relatively small proportion of the population who live in areas that are highly susceptible to wildfire. Of those who do live in a highly susceptible area, only a small portion would be expected to lose homes because those areas will experience extensive fire suppression.

Earthquake

Sensitivity of the housing sector to a M9.0 Cascadia earthquake is very high. *A major earthquake would have catastrophic impacts to the housing sector.*

The Eugene-Springfield metro area experiences earthquakes so infrequently that the community is ill-prepared for the impacts – in contrast to areas of California that experience significant earthquakes frequently, resulting in a high degree of awareness and preparedness.

Following a significant Cascadia earthquake, very little of the housing stock is likely to be habitable. Roughly two-thirds of the local housing stock was built before 1980 - *before* builders and regulators were aware of the local seismic risk, so most homes do not have reinforcements to hold the building together or hardware to hold the building to its foundation. On the positive side, the majority

of homes in Eugene-Springfield are relatively small and wood framed – qualities that make them better able to withstand a seismic event without collapse, even if seriously damaged.

Population Displacement

Approximately 20% of households in Eugene have earthquake insurance, yet nearly every home will be affected by a Cascadia earthquake. It is unclear how many people will continue to pay the mortgage on a home if they are unemployed and their home deemed uninhabitable. For those who have earthquake insurance, if it is inadequate to bridge this significant financial gap, the insurance may provide only an illusion of security. The long-term economic disruption caused by earthquake could cause large scale displacement of families seeking work and more stable living conditions.

Recovery

Earthquake impacts will be experienced across the region and including the entire Willamette Valley and the Oregon coast. This will result in long recovery times and scarcity of materials, resources and skilled tradespeople to support recovery.

Business continuity plans for local businesses and continuity of operations plans for major area institutions (governments, schools, utilities) are essential to reducing the length of economic disruption caused by a large earthquake. Rapid access to cash, loans, credit, and insurance disbursement will be essential to increase the speed of recovery.

Residents in the region are making repairs and renovations to their homes without permits *today*. The proportion of people who would do un-permitted structural repair following an earthquake could be significant.

Post-disaster debris removal would likely have a negative impact on air and water quality. Separating toxic materials (asbestos, lead, and others) would be extremely challenging during the response and recovery phases.

Shelters

There are very few large structures (hotels, churches, or event centers) in the Eugene-Springfield area that are built to remain in service following a large earthquake. Before being used as shelters, buildings will need to be inspected by trained inspectors.

The time of year when the earthquake hits will have a significant impact on the effects to residents. Many may be able to “camp out” in their homes or yards if the earthquake occurs during warm summer months. In wet winter months, however, the options would be substantially limited.

Climate Change and Fuel Price Impacts

Increased heat events are the primary concern, as the majority of homes in the Eugene-Springfield area do not have air conditioning. Low income families, seniors, and other vulnerable populations disproportionately occupy housing that is not equipped to provide cooling and, even if it is available, air conditioning is energy intensive and adds significant costs to monthly utility bills.

Recent increases in energy prices appear to have encouraged energy conservation and seem to be influencing more energy efficient home designs. At the same time, the increase in transportation costs is already resulting in homes on the periphery losing value.

Lower income households spend a disproportionately high percentage of their income on home heating, electricity bills, and transportation costs. These households are extremely susceptible to financial disruption caused by rising energy prices and are unable to afford the new appliances, weatherization, and fuel efficient vehicles that can buffer the impacts.

Energy efficiency upgrades do not tend to be implemented on rental properties and most low income families are renting. The lowered utility costs do not tend to benefit property owners so owners don't tend to invest in energy efficiency upgrades for rentals. Renters who would benefit from lower utility costs are not in a position to pay for energy efficiency measures on properties they do not own. This is often referred to as the renter's paradox.

4.2.4g Communication

Sector Summary

The communication sector includes broadcast television and radio, telephone, cellular phone, cable, internet, two-way radio, and Ham (or amateur) radio.

Broadcast television representatives were unavailable for this assessment but according to broadcast radio representatives, the two technologies are similar in their capacities and vulnerabilities. Conventional telephone representatives did not participate. Telephone infrastructure is very similar to cable infrastructure and would be expected to respond similarly to natural hazards.

Table 4-17. Communications Sector Summary Table	
Critical Interdependencies: **Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:**	**Crucial Vulnerabilities:** **Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:**
■ Electricity ■ Transportation	■ While the broadcast radio system itself is very resilient, studio staff rely on cellular communications, phone, and internet to receive important information from officials to broadcast during and after a hazard event ■ All systems rely on electricity for operation and maintain generators for backup power. Generators rely on fossil fuels to operate leading to questions about what systems and services would be prioritized for fuel use if there were a disruption to fuel supply. ■ All systems rely on infrastructure (towers, antennae) spread across large areas – and often in remote locations. Road access to repair equipment is a primary concern.
Major Findings: Communications technologies cannot be lumped together. There are a number of significant differences. For example, broadcast radio relies on a small number of owners of very old technology using relatively inexpensive equipment, producing one-way communication that can be accessed by anyone. Cellular phone technology is comparatively expensive, relies on thousands of private individuals to own equipment, changes annually (or more frequently), and provides two-way communication but is only accessible to those who can afford access. There is a local broadcast radio station that, using federal funds, has been hardened to survive substantial earthquake and electromagnetic pulse.	

Primary Agencies and Organizations

- Television stations (KVAL, KMTR, etc.)
- Radio stations (KUGN, KLCC, etc.)
- Cellular communications providers (Verizon, AT&T, etc.)
- Municipal two-way radio communications (Cities of Springfield, Eugene)
- Cable service providers (Comcast, CenturyLink, etc.)
- Ham operators
- Telephone service providers

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

Overall, the communications sector has a high level of adaptive capacity. Primary factors supporting adaptive capacity include:

- Numerous systems utilizing a variety of technologies together create redundancy.
- All communications systems have some form of backup power to provide electricity in the event of a power outage.
- Wireless (cellular) communications systems have portable cellular towers to provide temporary service restoration in the event of an emergency.
- There is a local broadcast radio station that, using federal funds, has been hardened to survive substantial earthquake and electromagnetic pulse.
- ODOT maintains a Strategic Technology Reserve trailer locally that includes two-way radio and satellite communications equipment.

The communication systems described here are a lynchpin for effective emergency management operations.

Broadcast radio and publicly operated two-way radio communications are both financially constrained – whereas cellular phone and cable companies have the necessary resources to operate and upgrade systems.

Cellular communications

All cellular communications towers are connected to data centers that transfer information from wireless to a ground-based (cable) network. Therefore, the loss of cable network translates into a loss of cellular service.

The vast majority of cellular communications towers have backup power systems designed to operate for 4 to 8 hours and cellular systems can have quick recovery through use of portable, self-contained Cellular on Wheels and Cellular on Light Trucks. In addition national cellular service providers have nationwide systems and staff who can be called in to assist in recovery following a disaster.

Because cellular technology is constantly being upgraded, it can evolve quickly to incorporate new technology

Broadcast Radio

The broadcast system operates with few staff on very old technology using relatively inexpensive equipment and is resilient to many natural hazards. It can serve 1 person or thousands with no change in operation. However, while the broadcast radio system itself is very resilient, studio employees rely on cellular communications, phone, and internet to receive important information from officials to broadcast during and after a hazard event.

KPNW infrastructure in the region has been hardened by FEMA to survive a substantial earthquake and substantial electromagnetic pulse. While the station infrastructure is hardened, there are fewer than 5 technicians in the county and 12 in the state who have the necessary skills and experience to make repairs to the broadcast radio system. There are fewer still who have keys to access buildings to make repairs in an emergency. Finally, accessing transmitters and receivers in remote locations, commonly on exposed ridge tops, can be very difficult following a disaster.

Municipal Two-way Radio

LRIG, the Lane Regional Interoperability Group, provides two way communications extending from the Pacific all the way east to the cascade foothills and services most regional emergency response teams.

Most of the LRIG system is hosted on Comcast or other privately owned cable lines. In fact, municipal communications systems are increasingly relying on private systems, including internet and cellular technologies. Springfield, Eugene, Lane County, and school districts operate on a shared IP-based phone system.

Ham Radio

The Ham radio system is operated primarily by volunteers with volunteer owned equipment. These unpaid and knowledgeable operators are the critical link in the system that serves as a backup communication network for the worst-case

scenario natural hazards. The Ham radio system is very resilient, has a long range, and can operate with minimal equipment and minimal electric power. The system relies on numerous repeaters, including several stationed in county buildings.

Cable/Internet

Cable service providers depend on hundreds of miles of cable strung on utility poles primarily owned by EWEB. At three different sites in the metro area, cable information is transitioned to fiber optic cable running through two parallel redundant fiber optic cables that extend from Seattle, WA to San Jose, CA. On the University of Oregon campus there is a central hub servicing internet to government and schools. If this hub is damaged, it would limit internet service for these users.

Like cellular communications, many cable providers are national corporations with staff across the country who can be called in to assist in recovery following a disaster.

Vulnerability and Risk

Flood

The communications sector is not very sensitive to flood. *A significant flood would have few effects on the communications sector*.

There is very little communications infrastructure located within the flood zone. If roads became impassible, maintenance and repairs could be delayed but this is not expected to impact the system widely. While the City of Eugene Police Department headquarters is located in a flood zone, the primary dispatch facility is not.

Winter Storm

Sensitivity of the communications to a severe winter storm is high. *A severe winter storm would have widespread impacts on the communication sector*.

Storm events that bring wind or ice have significant impacts on electric, telephone, and cable lines. Snow, ice, downed trees and downed power lines slow repairs to above-ground lines and limit access to remote infrastructure such as radio and cellular communications towers, similarly slowing any necessary repairs.

Earthquake

Sensitivity of the communications sector to a M9.0 Cascadia earthquake is very high. *A major earthquake would have catastrophic impacts to the communications sector*.

Not only would long term power outages be a big challenge for all systems, limited road access to infrastructure would be a primary constraint slowing response and recovery.

The City of Eugene maintains data (required for public safety operations) back up, but all back up storage is within the Willamette Valley making the backed up data susceptible in the event of a large earthquake.

While Springfield's primary communications center is not expected to survive a large earthquake, the City of Eugene's primary communications center is built to public safety building seismic standards so it should remain functional following a large seismic event.

If one utility pole goes down due to an earthquake, it tends to pull others over with it. If utility poles fail then Comcast and telephone are lost, and there is likely a loss of power for all systems. If damaged, utility poles and power lines would also create blockage of roadways, slowing response and recovery times for communications and all other systems.

Public systems and broadcast radio lack plans to care for staff and their families in the event of an earthquake or other catastrophic disaster. Staff may not be available to support response and recovery efforts if they are tending to the needs of their families.

National companies that provide cellular communications and cable service could access technicians from other parts of the country.

Climate Change & Fuel Price Impacts

Extreme heat events are the biggest climate-related concern as most equipment requires cooling of some kind. Power loss during a heat event could result in equipment overheating and failure. While most service providers have backup generators, operating air conditioning units draws a lot of power and could draw more power than a generator can provide.

The systems described here rely to varying degrees on fossil fuels for daily operation. Fossil fuels are used for: a) moving personnel and maintenance equipment, b) production of equipment and materials, such as cable and electronics, and c) to generate some of the electric supply to power communications equipment.

4.2.4h Public Safety

Sector Summary

The Public Safety sector in Eugene-Springfield consists of Law Enforcement agencies, Fire and Emergency Medical Response Services, and Public Works Emergency Response resources.

Table 4-18. Public Safety Summary Table

Critical Interdependencies: **Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:**	**Crucial Vulnerabilities:** **Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:**
■ Fossil Fuel ■ Transportation ■ Communications ■ Drinking Water ■ Non-Profits	■ Hazards that impact the entire region reduce the availability of resources from partner agencies and neighboring jurisdictions. ■ Extended events (more than 12 hours) tap available local surge capacity ■ The systems are heavily reliant on fossil fuels to operate

Major Findings:

Some local law enforcement services including Oregon State Police and Lane County Sheriff's Office are currently operating at 90% - 100% of capacity

Public Safety operations currently rely heavily on partner agencies for mutual aid during daily operations and extreme events.

Operational flexibility is substantially reduced during a) region-wide events such as winter storms and earthquake events and b) incidents relying on special teams like HazMat or water rescue, and c) incidents that extend beyond 12 hours.

Law enforcement agencies struggle to find interested and qualified applicants.

Public Safety systems can operate over a wide variety of conditions but without qualified personnel available and a functioning dispatch system, these systems cannot function

Primary Agencies and Organizations

- Central Lane 911 call center
- Springfield Police Department
- Eugene-Springfield Fire/EMS service
- Eugene Public Works
- Lane County Sheriff's Office
- University of Oregon Public Safety
- Oregon State Police
- US Homeland Security
- Army National Guard
- Lane Transit District
- Oregon Department of Transportation

System Description

Eugene Police Department employs 180 sworn officers working in patrol, investigations, traffic enforcement, and administrative positions, with 110 civilian employees working in records, communications, crime prevention, and administrative support positions. EPD maintains 79 Marked Patrol vehicles (including sergeants, lieutenants, K-9s and SWAT sergeants) plus 58 detective/administrative or crime prevention vehicles. EPD provides 24 hour service ranging from eight to 50 officers. EPD maintains a 22-person SWAT team with three SWAT dispatchers and a Metro Explosives Disposal Unit. EPD is supported by 75 volunteers in 37 different assignments.

Central Lane 9-1-1 Communications Center located at 2nd Avenue and Chambers Street receives calls and dispatches law enforcement, fire, medical, and utility response services for 90% of the Lane County population including many rural locations. The 9-1-1 center includes a dispatch system, call recording system, telephone system, and radio system.

Lane County Sheriff's Office employs 58 sworn officers countywide with central operations in Eugene and outposts in Creswell, Veneta, and Florence. The Sheriff's Office maintains 100 vehicles, a water rescue program, a mobile command center, a SWAT team, and a search and rescue program consisting of 1 officer and 200 volunteers. The Lane County jail currently services approximately 220 beds. Lane County retains five to ten reserve officers.

Springfield Police Department employs 70 sworn officers including a 17 person SWAT team, 100 vehicles based out of the Springfield Justice Center at 230 4th Street. SPD maintains a small jail with 20 beds and retains five to ten reserve officers.

The University of Oregon employs sworn law enforcement officers and public safety officers as well as a Hazardous Materials crew and Incident management team. The UO maintains an emergency notification system for contacting students via text.

Lane Transit District provides security services for transit operations and maintains regional evacuation capacity with 180 operators and 40 foot and 60 foot buses.

Oregon Department of Transportation in Lane County maintains approximately 1800 road miles with four staff dedicated to first response, including two trained in Hazardous Materials response. Response staff operate 7 days a week.

City of Eugene Public Works employs approximately 400 staff in 6 divisions and maintains a fleet of heavy equipment including tractors, trucks, and specialized equipment. Most staff and equipment are housed at Roosevelt Yard where 130 Public Works Maintenance and 85 Parks and Open Space employees, including spill response, report for duty. Roosevelt Yard houses the City's vehicle and communication equipment repair shops and fueling stations. Public Works provides nearly 24/7 coverage with on-call supervisors available for around the clock emergency response.

Springfield Public Works employs approximately 50 staff operating out of the Public Works facility at South 18th Ave and South A Street. Public Works maintains their own dispatch service operated from Springfield City Hall.

Eugene-Springfield Fire and Emergency Medical Services employ 200 line staff, 15 fire engines, and provide local ambulance transport. Eugene-Springfield Fire/EMS provides Hazardous Materials response for the region – all the way East to Brothers, Oregon and operates two water rescue stations with three boats. Eugene and Springfield share a common Community Emergency Response Team program that has trained over 700 volunteers.

Oregon State Police are based in Springfield locally and patrol all of Lane, North Douglas, South Linn, and a sliver of Benton Counties. OSP employs 25 sworn officers and five Fish and Wildlife officers and five detectives in Springfield, as well as a small number of troopers based in Florence and Oakridge. Within this area the OSP uses 45 standard patrol vehicles and 10 4x4 trucks, two jet boats and two drift boats. OSP dispatch operates out of Salem. OSP has access to State Troopers statewide and can respond 60 patrol troopers to a location within four hours. OSP maintains a volunteer program in Florence.

Oregon National Guard and Homeland Security resources are also available when needed but not reflected in this summary.

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

Overall, the Public Safety system has a *moderate to high* adaptive capacity.

Some factors that increase regional adaptive capacity include:

- Eugene-Springfield Fire/EMS, Eugene Public Works and Springfield Public Works operations have greater staffing flexibility than the law enforcement entities.
- Eugene-Springfield Fire/EMS dispatch staff, equipment, and vehicles from a large number of stations that are distributed widely across the metro area.
- Multiple Emergency Operations Centers exist within the region, creating adequate redundancy should one or more facilities become unavailable.
- Public Safety operations in the region currently rely heavily on mutual support to meet first response needs. This standing practice builds flexibility, reduces operating costs, and maintains relationships that significantly enhance inter-jurisdictional interoperability and response capabilities during an extreme event.
- Technology upgrades allow smaller number of staff to be more effective and efficient. On the down side, this constant upgrade of technology can result in a significant drain of financial resources.
- Most policing functions are scalable so during a hazard event, even if not all resources and staff are available, some level of policing is still possible.

Factors reducing adaptive capacity include:

- Some local law enforcement services are currently operating at or near full capacity. Due to limited resources, the Lane County Sheriff's Office and Oregon State Police only respond to person crimes in progress. Eugene Police Department is staffed at 1.13 officers per thousand residents; the national average is 1.9 officers per thousand[25].
- There is limited overall surge capacity throughout the system, particularly during a) region-wide events such as winter storms and earthquake events, b) incidents relying on special teams like HazMat or water rescue, and c) incidents that extend beyond 12 hours.
- Springfield Public Works, Eugene Public Works, Eugene Police Department, Springfield Police Department, and University of

[25] As of November 2014. Statistic provided by EPD.

Oregon Police Department all dispatch staff, equipment, and vehicles from centralized facilities.

- During local incidents like a motor vehicle accident first responders can access resources from outside of the Eugene-Springfield area, if needed. However in regional events like widespread flooding or a winter storm, those extra resources are typically spoken for, thereby reducing the ability to enhance the local response capability.
- All local public safety operations provide inter-jurisdictional mutual aid to support each other during extreme events. This flexibility is reduced during incidents that extend beyond 12 hours.
- Traditional medical- or fire-related responses are easy to backfill but specialty responses like Hazardous Materials response or Water Rescue would quickly tax all available qualified local resources.
- The local population continues to grow and residents' expectations of service continues to increase, yet budgets have been flat or falling.
- Communications systems are interdependent and singular - so replacing one part often means replacing large components or the whole system – often at great expense.

Other factors influencing overall adaptive capacity:

- The two most important components of the policing system are trained staff and a functioning dispatch system. If either of these are unavailable, the system may cease to function.
- Lane County Sheriff's Office and Oregon State Police have ample equipment but are typically short on staff.
- Eugene-Springfield Fire/EMS has adequate staff (there are three complete shifts that could be called on, if needed) but would be limited by the availability of Fire Apparatus.
- Interested, qualified candidates are difficult to find. It typically takes 18 months to hire and train an officer before they can begin to serve in a law enforcement capacity. This hiring and training delay and scarcity of qualified staff constitutes a constraint on operations.
- With the widespread adoption of cellular telephones, residents appear less willing to help others and instead resort to dialing 911

for many non-emergency incidents. This has moved Public Safety services increasingly into the role of social services and away from emergency response.

- Peak demand for law enforcement and Fire/EMS occurs during holidays, special events like University football games and track events, cold and flu season and hot summer evenings. Peak demand on Public Works response services comes during wet and snowy weather. Peak demand on ODOT response services comes during summer and construction season.

Vulnerability and Risk

Flood

Risks to the Public Safety Sector from a major flood event are very high. *Severe impacts to the Public Safety Sector are anticipated with a major flood event.*

A significant portion of the Eugene Police Department's resources and equipment are located at the Police Headquarters Building located within the 100 year flood plain. While the station itself may not be flooded, access may become inhibited or cut off entirely during a 100 year flood.

During a flood event some parts of the metro area may find themselves cutoff from many services, including public safety, at least until waters recede. The flood maps associated with the Eugene-Springfield Natural Hazards Mitigation Plan can provide some idea of those areas most likely to see service impacts. Countywide, impacts can become severe, particularly near large uncontrolled rivers including the Mohawk and Siuslaw rivers, where City first response personnel are commonly asked to provide support.

Winter Storm

Risks to the Public Safety Sector due to a severe winter storm are high. *Significant impacts to the Public Safety Sector are possible with even a moderate winter storm event.*

The public safety systems rely entirely on a functioning road network to operate effectively. Power lines can create serious complications (during snow storms, wind storms, and earthquakes) to the system overall. If power lines are down and live, not only is transportation of emergency equipment and personnel inhibited, some police and/or fire staff resource may become tied up as they attend power lines to prevent people from coming in contact with live wires.

Winter storms impact the entire metro area and frequently the whole region, therefore seeking support from partner or neighboring agencies is typically an ineffective strategy to increase response capacity.

During winter storms the number of calls for police response typically drops due to the drop in vehicle traffic.

During extreme winter storms where first response resources are overwhelmed, poor road conditions can lead to significant challenges to local business and industry.

Earthquake

Sensitivity of the Public Safety Sector to an M9.0 Cascadia earthquake is very high. *A major earthquake would have catastrophic impacts to Public Safety Systems.*

As noted above, operational flexibility is substantially reduced during a) region-wide events including earthquake events, b) incidents relying on special teams like HazMat or water rescue, and c) incidents that extend beyond 12 hours. An M9.0 Cascadia event would meet all three of these criteria.

Government response to a major earthquake event depends entirely on the availability of trained fire, medical, law enforcement, and public works personnel. The availability of these individuals immediately following an M9.0 Cascadia earthquake depends on the condition and ongoing safety of their families. If the families of First Responders are not in a stable condition, the availability of first response personnel will be limited.

A large proportion of critical Public Safety facilities such as police stations and fire stations have been built to withstand a significant earthquake event. There is some question about the seismic stability of equipment within these facilities however. Most computers, equipment, and tools are not adequately secured to withstand extensive shaking.

Climate Change and Fuel Price Impacts

Climate change impacts locally include drier, warmer summers that are expected to increase the risk of wildfires in heavily forested settings in and surrounding the urban area. Large scale fires would cause a short-term spike in demand for first responder services. In this scenario, resources from around the state would become available quickly.

Increased demand for First Responders is possible due to:

- Increased frequency of extreme weather events.
- Increased risk of flooding that brings with it increased risk of waterborne illness and greater potential for drowning.
- Increased summertime temperatures that could result in increased incidents of heat illness.

- Increased smoke intrusion into the valley due to wildfires, leading to respiratory difficulties for the young, old, and those with chronic respiratory illness.

Increased frequency of heavy rain events bring increased risk of landslides, a condition that can inhibit public safety services from operating effectively.

The Public Safety Sector is heavily, if not completely reliant on gasoline and diesel to operate. An increase in fuel price would translate to higher costs for vehicle operations and maintenance, translating into higher costs of service. Recent experience suggests it would be challenging to pass these additional costs of operation onto residents – suggesting that budgets would need to be balanced by cutting staff.

4.2.4i Natural Systems

System Summary

The Natural Systems is comprised of air, water, plants, soil, and wildlife resources in and surrounding the Eugene-Springfield metro area.

Table 4-19. Natural Systems Summary Table

Critical Interdependencies: Systems of all types are dependent on other systems in order to function. Natural Systems are *substantially less dependent* on other systems compared to other sectors in this assessment. However, in order to maintain existing monitoring and management practices, this sector is dependent on:	**Crucial Vulnerabilities: Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:**
■ Transportation ■ Fossil fuel ■ Communications	■ Natural systems are not directly vulnerable to many natural hazards but secondary impacts from flood or earthquake could be significant. ■ Climate change poses far greater threat to natural systems than do individual natural hazards like flood, wildfire, or earthquake.

Major Findings:

Significant pressures on fresh water resources (and by association, fish habitat) exist today and will worsen with climate change.

Most climate change impacts are expected to exacerbate existing stresses on plant and animal communities.

Western Oregon benefits from a relatively large supply of freshwater and relatively clean air and water.

Numerous national and state laws exist that are intended to minimize impacts on natural systems but are very slow to change.

Federal budgets to manage Federal lands have decreased over the last decade. In Lane County, just over 50% of the land is federally owned, while the remaining 49% is in private ownership.

Primary Agencies and Organizations

- Non-Profits including watershed councils
- City of Eugene
- City of Springfield
- Lane County
- Oregon Department of Fish and Wildlife
- Oregon Department of Forestry
- Oregon Department of Environmental Quality
- Lane Regional Air Protection Authority
- US Forest Service
- US Bureau of Land Management
- Private land owners
- Natural Resources Conservation Service

System Description

Natural Systems covered in this summary include the approximately 3000 acres of wetlands within the Eugene-Springfield area; many miles of open waterways including the Willamette River, Amazon Creek, Spring Creek, and others; fish and wildlife (including several threatened and endangered species); the urban tree

canopy (estimated value of $120 million in Eugene alone); groundwater resources; soil; and air.

Many natural resources *outside* the metro area heavily influence conditions within the metro area. These include (but are not limited to) the regional air shed, private and public forest lands, upstream stretches of the Middle Fork Willamette, Coast Fork Willamette, McKenzie rivers, and related fish and wildlife.

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

Overall, natural systems have high adaptive capacity.

Some factors that increase regional adaptive capacity include:

- Overall, the air and water quality in the Eugene-Springfield area is very good.
- Overall, Western Oregon benefits from ample fresh water resources.
- Recent regional efforts have improved fish and wildlife habitat through restoration of wetlands, uplands, prairies, and riverine habitat.
- National and state regulations are in place that are intended to prevent overuse of regional natural resources. Oregon State Land Use Law, Endangered Species Act, Clean Water Act, Clean Air Act, to name a few.
- The McKenzie River watershed has a unique geology with significant groundwater storage. The projected reductions in snowpack associated with climate change may be less problematic here compared to other watersheds because natural groundwater storage acts to temper some of the extremes.
- Cleaner cars and reduced vehicle traffic are improving air quality locally.
- In some locations land managers are actively working to reduce wildfire risk, as resources allow, through fuels reduction and weed management.

Factors reducing adaptive capacity include:

- Within the urban forest, it takes some 15 to 30 years before a new tree begins to provide measurable stormwater, air quality, and shading benefit.
- Many of the impacts on local water quality (like sedimentation) and air quality (like wildfire smoke) originate out of the metro area so there is little local control of these sources of pollution.
- Many state and federal regulations reduce flexibility and are extremely slow to change, inhibiting the ability to adapt to changing conditions. Local regulation *can be* far faster to adapt.
- Many natural areas and water bodies are heavily impacted by invasive plant species.
- Extensive alteration of natural habitats place stress on plant and animal communities.
- Most climate change impacts are expected to exacerbate existing stresses on plant and animal communities.
- Rivers and streams on the west side of the Willamette Valley are rain fed, have very low summertime flows, and are already over-allocated.
- The most commonly planted street trees are species that depend on summer rainfall. These species are not well suited to the dry summers found in the Willamette Valley and may become more stressed as the duration and intensity of summer drought increases.
- Federal budgets to manage Federal lands have decreased over the last decade – and over 50% of all land in Lane County is federally owned.
- The benefits of natural assets in the Eugene-Springfield area are not equitably distributed. For example, the urban forest cover is fuller and air quality is better in areas of town with higher median incomes.

Other factors influencing overall adaptive capacity:

- It is exceptionally difficult to quantify the value of natural resources and the multiple benefits that they provide.
- Residents of Oregon and Eugene and Springfield, in particular, place a high value on environmental health and invest their time and resources in support of a healthy natural environment.

- All three major rivers upstream of the Eugene-Springfield area are heavily controlled by dams operated by the Army Corps of Engineers. Dams reduce the frequency of big flood events, extend water availability into the drought season, and generate electricity. Dams also have major impacts on watershed ecology by changing river temperatures, altering sedimentation patterns, altering flows, and reducing woody debris in waterways.
- Local and regional natural resource management is inherently political – and management practices are heavily influenced by economic and political pressures.
- Some natural resources can be degraded very quickly (through over harvest or toxic spill, for example) and can take years or decades to recover.
- There is existing conflict between the many uses of freshwater resources, including fish habitat, urban water needs, agricultural irrigation, recreation, and electricity generation. This conflict is particularly evident during summer months, and is expected to increase in the future as summer stream flows decrease.
- Air quality is negatively impacted when weather conditions create stagnant air. During the winter, stagnant air can result in unhealthy levels of particulate pollution, primarily from wood home heating. During hot sunny weather, stagnant air can result in elevated ground level ozone that can result in health impacts, particularly for the young, old, and those with existing respiratory illness.
- Significant natural resources in the region are under private ownership and just over 50% of the land in Lane County is publicly owned.

Vulnerability and Risk

Flood

Risks to Natural Systems from a major flood event are low. *Few negative impacts to Natural Systems are anticipated with a major flood event – and some systems may experience benefits.*

The direct impacts of a flood on natural systems may be mostly positive. The scouring, sediment movement, and movement of large woody debris can *enhance* fish and wildlife habitat. The urban forest, air quality, and soils aren't expected to experience direct negative impacts.

Negative impacts on natural systems resulting from a flood would stem from secondary impacts such as a hazardous material spill or a sanitary sewer overflow.

There would likely be an increased need for water quality monitoring following a major flood event.

Wildfire

Risks to Natural Systems due to a wildfire are moderate. *Some, mostly short-term impacts to Natural Systems are expected with a significant wildfire event.*

Wildfires will have a negative affect the plant and animal communities in the immediate area. Large fires in the cascades will impact forest but they have evolved with wildfire and typically regenerate quickly after burning. Local air quality is likely to be impaired during major wildfire events in western Oregon. A wildfire in the Eugene-Springfield area is not likely to create extensive air quality concerns locally because smoke will likely be drawn downwind and out of the metro area. Areas the metro region and in the western Cascades that are burned would likely experience increased soil erosion for a number of years, creating impacts on water quality. If used for fire suppression, chemical fire retardants can also negatively impact water quality.

Earthquake

Direct sensitivity of Natural Systems to an M9.0 Cascadia earthquake is low. *A major earthquake would have minimal direct impacts to Natural Systems. However, secondary sensitivity is high - there are likely to be significant negative impacts on air and water quality and therefore fish and wildlife due to failure of other (human-built) systems.*

Water quality is likely to be severely impaired due to contamination from toxic spills including chemical spills from industrial storage facilities, fuel spills from fossil fuel storage and distribution infrastructure, and failures of the wastewater treatment system.

Impaired air quality is likely due to industrial fires and dust from construction debris. Reductions in driving would reduce vehicle emissions potentially improving air quality for some period of time.

The time of year will be an important factor, if a significant earthquake occurs during or just before cold months, the loss of electricity and natural gas may force some to heat their homes with wood – and, if desperate, some may burn green wood that’s not seasoned, further increasing the quantity of air pollutants.

Climate Change Impacts

Two to four degree average temperature increase in 50 years is an unprecedented rate of change that will likely affect natural systems in ways we can’t anticipate. Ice core data indicate previous periods of rapid climate warming have been accompanied by widespread wildfires in the northern latitudes.

Western Oregon forests are expected to experience increased presence of wildfire due to reductions in snowpack (and therefore available summertime water),

increased temperatures (and potential for increased disease), and extended summer drought. The presence of wildfires will likely result in short-term water quality impacts and reduced air quality during summer months.

Water quality is already at risk due to multiple compounding impacts including increased urban runoff and increased human population. Increased overall temperatures will further degrade water quality.

The urban forest is at risk due to multiple compounding impacts of increasing population, increasing urban density, increasing disease, and greater extremes (heat, drought, precipitation, storm events) projected with climate change.

Fish habitat is already impacted by urban runoff that carries pollutants and increases water temperatures. Increasing water temperatures are expected due to:

- Warmer winter and summer air temperatures
- Extended summer drought resulting in increased demand on freshwater resources for agricultural irrigation.
- Lower summer flows due to reduced summer snowpack will result in water availability problems for fish.

Warmer summer temperatures lead to increased concentrations of ground-level ozone, a dangerous pollutant that impacts human health.

Warmer winter temperatures may result in reduced demand for home heating and associated reduction in wood smoke.

Plant and animal communities may be impacted by increased presence of invasive species

The warmer temperatures associated with climate change are linked with increased risk of blue-green algae blooms[26], a condition that occurs occasionally in Oregon freshwater bodies. The blooms render water bodies toxic to people and dogs.

If implemented, climate change mitigation activities will likely result in more fuel efficient vehicles and less driving overall – reducing several air pollutants including ozone and particulate pollution.

If demand for photovoltaic electricity generation increases, a rapid deployment of photovoltaic panels could have a negative impact on the urban forest if property owners remove trees to enhance solar exposure of PV panels.

Fuel Price Impacts

[26] Climate change: Links to global expansion of harmful cyanobacteria. Hans W. Paerl, Valerie J. Paul. Institute of Marine Sciences, University of North Carolina at Chapel Hill.

A spike in fuel prices would impact the budgets of local governments and land management agencies and would increase the costs of resource harvest and other management activities such as restoration programs and invasive species management.

A spike in fuel prices could result in widespread economic stress. When economic conditions contract, natural systems are impacted in several ways:

a. More people turn to wood heating as an economical way to heat their homes. This results in increased particulate pollution, particularly during times of high heating demand and stagnant air commonly experienced November through January.

b. More people turn to camping and recreational opportunities closer to home – increasing impact on local natural resources.

c. The homeless population living on National Forest land increases.

d. The homeless population living in City parks increases.

Rising fuel prices are likely to cause people to drive less, reducing several pollutants including greenhouse gas emissions, ozone, and particulate pollution.

4.2.4j Stormwater

System Summary

The stormwater systems in Eugene and Springfield manage water from any public or private land and facilities that rain falls on - “From the roof to the river.” This includes all land within the urban area – and particularly focuses on: 1) Open waterways including the Willamette River, Amazon Creek and their primary tributaries, 2) Constructed infrastructure comprised of hundreds of miles of underground pipes, thousands of catch basins, several municipally owned large mechanical water quality treatment facilities, many smaller mechanical treatment facilities and numerous vegetative systems.

While not discussed in detail here, the stormwater system includes thousands of private collection facilities including roofs and gutters, parking lots, private catch basins, water treatment facilities and dry wells.

Table 4-20. Stormwater Summary Table	
Critical Interdependencies: Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:	**Crucial Vulnerabilities: Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:**
■ Natural Systems ■ Sanitary Sewer ■ Transportation ■ Governance	■ An extreme precipitation event or large flood could cause water to back up in the piped system and could result in infrastructure damage.
Major Findings: The Eugene and Springfield stormwater systems are gravity fed requiring no electricity to operate. Of all the built systems assessed, the stormwater system is the least susceptible to natural hazards. The stormwater system is not designed to handle a 100-year flood event, so a large event will result in some local flooding and likely some damage to stormwater infrastructure. Surface-based stormwater collection and conveyance systems are much more resilient to earthquakes than subsurface infrastructure.	

Primary Agencies & Organizations

- City of Eugene
- City of Springfield
- Lane County

System Description

The stormwater systems in Eugene and Springfield effectively consist of any public or private land and facilities that rain falls on - “From the roof to the river.” The purpose of the system is to maintain water quality, limit flooding and reduce impacts on property, systems and facilities.

Eugene maintains 28-miles of open waterways, including the Willamette River, Amazon Creek and their primary tributaries. Eugene has 700 miles of underground pipes and roughly 15,000 city-owned catch basins. The system includes a small number of large mechanical water-quality treatment facilities,

between 40 and 50 smaller mechanical treatment facilities, and numerous vegetative systems (i.e. swales, filter strips, vegetative buffers, rain gardens, urban forest, etc.).

The stormwater system also consists of thousands of private collection facilities including roofs, gutters, parking lots, private catch basins, water treatment facilities and less than 100 dry wells. Importantly, all of the Eugene and Springfield stormwater systems are gravity feed (there are no stormwater pump stations in either community).

When rain falls, it is collected and conveyed to the Willamette River via these surface and sub-surface facilities. The public system is designed, constructed and maintained by each jurisdiction. Operations are supported by planners, engineers, operators and technicians. Importantly, the system is designed to handle peak storm events (e.g. the "20-year storm"). Therefore, the system has adequate capacity to handle average annual rainfall. The system is also reliant on dam control and water management upstream. In addition, soil saturation, storm intensity and prevailing weather patterns all play in to how well the system functions. System design is based on historic weather data and does not take into account short- or long-term changes in weather patterns or rainfall.

Specific information related to the Springfield system, including an inventory of facilities, is contained in the Springfield Stormwater Management Plan.[27] The Eugene Comprehensive Stormwater Master Plan is also available on line.[28]

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

The stormwater system has low adaptive capacity overall. This is largely due to the size of the system and reliance on constructed infrastructure.

On a positive note, the stormwater system consists of a mix of diverse infrastructure types. Further, because the system relies on gravity to convey water, impacts to the system are largely localized (i.e. local flooding may occur, but water will continue to finds its way downhill until it reaches the river). The ability to manage water at the surface also adds to this systems adaptive capacity.

Even so, reliance on pipes and constructed treatment facilities limits overall adaptation of the system. System components are not easily replaced because they are underground and most often located within transportation rights-of-way. Therefore, improvements generally happen infrequently and commonly timed to

27 http://www.ci.springfield.or.us/pubworks/EnvironmentalServices/Stormwater/StormwaterManagementPlan.pdf.
28 https://www.eugene-or.gov/index.aspx?NID=1643

correspond with pavement upgrades or roadway reconstruction. Many of the major components of the system require custom design and manufacture.

The stormwater system is highly dependent on natural systems (river, wetlands, vegetation) to function. The system is designed and managed to support improved water quality. Both Eugene and Springfield operate in accordance with National Pollution Discharge Elimination System (NPDES) permits for wastewater, stormwater and industrial stormwater. These NPDES permits, as well as rules established by the State and the Department of Environmental Quality, dictate the "Total Maximum Daily Load" for temperature and certain pollutants (e.g. turbidity, bacteria, dissolved oxygen).[29]

Funding

The public system is largely funded through local user fees, with limited access to federal or state grants. Therefore, politics plays a big part in how well the system is funded. City leaders must balance sometimes competing interests between flood control, infrastructure cost, water quality, natural resource protection, system enhancements, etc. While stormwater plans are continually refined and updated, the ability to maintain or upgrade the system is heavily constrained.

Land availability

Goals to increase urban density can conflict with the desire to treat stormwater onsite. Particularly in densely built locations, high land values increase the cost of constructing on-site stormwater treatment facilities.

Private systems

The size and quality of privately owned systems varies widely. Many systems require regular maintenance to function properly.

Vulnerability and Risk

Flood

Impacts to the stormwater system from a major flood event are moderate. *Many minor, some major and limited catastrophic impacts to the stormwater system are likely with a major flood event.*

A flooding event is expected to have potentially major, but largely isolated impacts on portions of the stormwater system. Open waterways are particularly

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29 The City of Eugene holds a permit under the federal Clean Water Act for the municipal stormwater it discharges directly into the Willamette River and indirectly into the Willamette River through other local waterways, including Amazon Creek. The permit, formally called the Phase I National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit, requires that the city reduce the discharge of pollutants from the municipal system to the maximum extent practicable, and includes monitoring and reporting requirements, as well as a set of best management practices that define the city's Stormwater Management Plan (SWMP).

vulnerable to erosion and culvert washouts are anticipated. Saturated soils could also result in landslides and losses within the urban forest. Sediment could reduce capacity of the piped system in some places with temporary impacts on water quality. Notably, the stormwater system is not designed to handle a 100-year storm event. Therefore, portions of the system will likely be damaged by water – e.g. pipe undermining, culvert wash outs, bank instability/erosion, pipe misalignments, sedimentation, etc.

Primary stormwater infrastructure will be heavily impacted during a major flood event. The Willamette River, Amazon Creek, Spring Creek, Flat Creek and the A1, A2 and A3 channels are all considered part of the primary stormwater infrastructure. By definition, flooding means that all of these systems will be operating beyond capacity. In addition, all of the system's primary pipe outfalls are located within the flood zone. During a flood, stormwater is expected to backup causing street flooding and sediment buildup in the piped system. Loss of a levee could be catastrophic for properties located downstream (this is primarily an issue in West Eugene).

Wildfire

Impacts to the stormwater system from a major wildfire event are low. *No catastrophic impacts to the stormwater system are anticipated with a major wildfire event.*

Overall, wildfire is not expected to have significant impacts on the stormwater system. Impacts from wildfire would come in the form of sedimentation and loss of tree canopy. These impacts are long-term and would depend entirely on where the fire is located relative major components of the stormwater system. Post-event stormwater flows will likely increase in areas within or near the burn.

Earthquake

Impacts to the stormwater system from a M9.0 Cascadia earthquake event are very high. *Major catastrophic impacts to the stormwater system are anticipated with a Cascadia earthquake event.*

The piped portion of the stormwater system is not designed for prolonged ground motion or shaking. Piped components of the primary and secondary system are expected to fail, including potential damage to the concrete portion of Amazon Creek. Constructed water treatment facilities may also experience damage.

Another major concern is cross contamination from breaks in both the drinking water and wastewater systems. These systems have minimal separation in many areas. Contamination from broken wastewater lines and capacity issues resulting from broken water mains are anticipated.

Because much of the system is underground, locating and replacing damaged infrastructure will be difficult, time consuming and costly. Service providers assume that large portions of the piped stormwater system will need to be

replaced. Notably, surface-based stormwater collection and conveyance systems are much more resilient to earthquakes. They are easier to repair and are more likely to "self-heal" if damaged. The primary constraints to daylighting existing piped systems are space and funds.

Despite the high potential for major impacts, planning for earthquakes is a low priority for stormwater system managers. Furthermore, system managers explicitly indicated that system resilience is not a priority in terms of funding decisions, nor does the Capital Improvements Program consider it.

Climate Change and Fuel Price Impacts

Climate change is a major issue for the stormwater system. Because the system is engineered based on historical records, system capacity and design do not account for changes in the amount, duration or type of precipitation. For example, current engineering specifications assume rainfall events will result in a constant flow and occur on already saturated soils. One likely outcome of climate change in our region will be more severe rainfall events after periods of prolonged dry weather. These "flashy" rainfall events can result in higher volumes over shorter timespans thereby increasing the possibility of backups, scour and erosion. Because the system is not designed for higher intensity rain events, it becomes harder to treat water for contaminants.

The stormwater group identified opportunities to increase system-wide planning, engage in scenario planning, and improve monitoring of component performance during extreme events.

Like many other systems, stormwater is highly dependent on fossil fuels. Maintenance equipment, construction equipment and many of the pipes currently require the use of fossil fuel or oil derivatives. Therefore, as prices go up, the costs to build and maintain the system rise. Fortunately, both Eugene and Springfield have made a conscious decision to construct gravity-feed systems so no energy is needed to run pumps in order for the primary system to function.

4.2.4k Wastewater

System Summary

The physical elements of the Eugene-Springfield wastewater system include the wastewater treatment plant, a collection system of pipes and a series of pumps, and a bio-solids facility and associated bio-cycle farm. The wastewater system is highly regulated by local, state and federal regulations and agencies. The wastewater system employs approximately 165 people.

The system is managed by one partnership, Metropolitan Wastewater Management Commission (MWMC) that is a partnership between three public entities: City of Eugene, City of Springfield, and Lane County.

Table 4-21. Wastewater Summary Table	
Critical Interdependencies: Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:	**Crucial Vulnerabilities: Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:**
■ Natural Systems ■ Electricity ■ Transportation	■ Three governing bodies must coordinate to take action beyond standard procedures ■ New and replacement parts are custom made and must be trucked in from out of the area. ■ Few parts manufacturers exist, and a major catastrophe is likely to create a spike in demand for parts ■ Except when new construction triggers building code requirements, officials have no control over the thousands of private connections to the system
Major Findings: The system currently operates with a high degree of customer satisfaction. The long-term planning horizon for such a massive system is challenged by changing regulations. Increasing regulations increase the cost of service. A Cascadia earthquake event will result in significant damage to the system, with repairs taking months to years to complete. The system is in a constant state of repair/upgrade, which makes large-scale repairs slightly easier because employees have practical experience. A large system failure would result in untreated wastewater entering local waterways and detrimental effects would impact Eugene-Springfield and downstream communities.	

Primary Agencies and Organizations

- Metropolitan Wastewater Management Commission (MWMC)
- City of Eugene (Operations)
- City of Springfield (Administration)
- Lane County

System Descriptions

The metropolitan wastewater system serves Eugene, Springfield and portions of Lane County that fall within metro region. Physical infrastructure includes a regional treatment facility, a biosolids management facility, a biocycle poplar farm, roughly 50 pump stations, over 1,100 miles of public collection system pipe, and thousands of privately-owned collection system pipes.

The system is managed through an intergovernmental agreement that outlines the responsibilities for each participating jurisdiction. Eugene and Springfield each manage their own collection systems. For regional treatment coordination Eugene is responsible for overall operations while Springfield is responsible for overall administration. MWMC is a separate legal entity that oversees the entire regional system (98 regionally funded staff positions). The system benefits from a number of mutual aid agreements.

Operationally, the system must meet a number of federal and state rules, regulations and standards. Discharge is managed to meet pollutant, temperature and flow standards identified under the National Pollution Discharge Elimination System permit.

Specific information related to the regional wastewater system, including the five-year Capital Improvement Plan, annual reports, budget and system "fact sheets," is available on the MWMC website: http://www.mwmcpartners.org/documents.html.

Adaptive Capacity

Adaptive Capacity is a natural, built, or human system's ability to accommodate a new or changing environment, exploit beneficial opportunities and/or moderate negative effects.

The wastewater system has a moderate adaptive capacity overall. The system benefits from:

- An established practice of continual planning and upgrades,
- Known opportunities for expanding system capacity, and
- Supportive community and partners.

Constraints on the system include:

- Expansive, immovable infrastructure that is expensive to repair, maintain, and upgrade.
- Constantly changings regulations; issues around succession planning; and
- Custom-made parts from a limited number of suppliers.

The system operates very differently during wet versus dry weather. During wet weather peak flows through the system fluctuate with rainfall, and range between 30 million gallons per day to 150 million gallons per day with rare flows of 200 million gallons per day and capacity to handle 277 million gallons of wastewater per day in the wet season. Notably, much of the wet weather volume comes from passive infiltration of rainwater via broken or damaged wastewater collection pipes (both public and private). Dry weather volume averages 30 million gallons per day with capacity to handle just under 50 million gallons per day. While there is regional variation in capacity of the collection system, participants reported only moderate demand in the collection system overall with no major collection capacity concerns identified.

Public health priorities mean problems are fixed as soon as they arise. System components are maintained on a regular basis and system managers use a 20-year planning time horizon with capacity upgrades being driven by population forecasting. Primary long-term concerns include (1) challenges serving new areas that are brought into the Urban Growth Boundary, (2) aging infrastructure (particularly where private systems connect to the public system), (3) loss of institutional knowledge through retirements and staff turnover, (4) uncertainty regarding the future of regulation, and (5) changes in private habits (e.g. water conservation, personal care products that cannot be removed from the waste stream) and technology being used (e.g. low-flow toilets). Fortunately, the wastewater system has historically seen broad community support as upgrades are pursued.

The nature of the system includes a huge network of buried pipes. This infrastructure is expensive and very difficult to repair, relocate or re-engineer. The public health and environmental implications of the wastewater system lead to strong regulations. Thus, the regulatory environment is constantly changing. For example, a recent regulatory change regarding system operations during wet weather resulted in a $196-million capital improvement upgrade. These changing regulations add to the expense and rigidity of the system and limit system manager’s ability to plan long-term.

The system benefits from broad community support and prudent system managers who are early adopters of new maintenance and operations practices and who have already identified necessary upgrades and improvements to reduce vulnerabilities.

Vulnerability and Risk

Flood

Impacts to the wastewater system from a major flood event are low to moderate, with an estimate of impacts to between five- and twenty-five-percent of the system. *Many minor, some major and limited catastrophic impacts to the wastewater system are possible with a major flood event.*

Primary concerns for the wastewater system from a significant flooding event are overflows at the treatment plant and backups in the collection system. While the system is designed to contain wastewater during normal weather events, overflows would happen with significant flooding, overflows are not legal and could be classified as a system failure. In addition to these capacity issues, several of the system's main pump stations are located in or near the 100-year flood zone and could be compromised.

A significant portion of the system's primary and secondary infrastructure is located in the flood zone. This includes key pump stations (e.g. Barger/Greenhill, Harlow, Aspen, Glenwood, Fillmore, Willakenzie and Hayden Bridge) as well as several "force mains" that cross under or over the Willamette River. Failure of the wastewater treatment plant would be catastrophic for the entire system. However, loss of a single pump station could also result in catastrophic failure of a large portion of the collection system. For example, impacts to the Willakenzie pump station would eliminate service to all of Springfield.

Winter Storm

Impacts to the wastewater system from a major winter storm are moderate. *Some major, short-term impacts to the wastewater system are anticipated with a major winter storm event.*

There are two primary concerns for the wastewater system from a significant winter storm: loss of electricity (pumps, treatment facility, etc.) and access. While most of the system's critical components have backup power sources (key exception being the biosolids plant), loss of power could result in overflows at the power plant or backups at pump stations. The system consistently experiences issues at five to eight pump stations during winter storm events.

Access is the other major consideration. Because winter storms impact the transportation network, gaining access to damaged equipment or to install mobile generators to power pump stations can be challenging. Aside from power failures impacting pumps, however, no impacts to the collection system are anticipated.

Earthquake

Impacts to the wastewater system from a M9.0 Cascadia earthquake event are very high. *Major catastrophic impacts to the wastewater system are anticipated with a Cascadia earthquake event.*

The piped portion of the wastewater system is not designed for prolonged ground motion or shaking. Piped components of the primary and secondary system are expected to fail, including potential damage to the treatment plant, pump stations, transmission lines, force mains, and significant portions of the public and private collection system. Damage to between seventy-five to one-hundred-percent of the wastewater system's physical infrastructure is expected.

Cross contamination of the drinking water system from breaks in the wastewater system is also anticipated. These systems have minimal separation in many areas. Contamination from broken wastewater lines and capacity issues resulting from broken water mains are anticipated.

Because much of the system is underground, locating and replacing damaged infrastructure will be difficult, time consuming and costly. Service providers assume that large portions of the wastewater collection and transmission systems will need to be replaced. Many critical components and pieces of equipment at the treatment facility require sensitive alignments or are designed with long shafts or cantilevered attachments. Many of these components are expected to fail due to ground motion and shaking.

Despite the high potential for major impacts, only limited discussion regarding earthquake is taking place. As a priority, planning for earthquake is low.

Climate Change and Fuel Price Impacts

From an operational perspective, climate change impacts on the wastewater system are expected to be relatively low. One outcome could be tighter regulations on discharges in the summer months resulting from lower stream flows. Conversely, treatment capacity could be an issue with extreme rainfall events.

Regarding fuel use and pricing, like many other systems, the wastewater system is highly dependent on fossil fuels. Maintenance equipment, construction equipment and many of the pipes currently require the use of fossil fuel or oil derivatives. Therefore, as prices go up, the costs to build and maintain the system rise. In addition, wastewater relies on fossil fuel derived chemicals that need to be trucked to the area. As prices go up, increases in operations and maintenance costs are passed on to the consumer in the form of higher rates. Notably, the treatment facility utilizes roughly sixty-percent of the methane gas it produces to generate electricity to run the plant.

4.2.5 Social Vulnerability

The following tables summarize peer-reviewed research indicating what variables are most important when considering populations vulnerable to both Natural Hazards and Climate Change. These populations are particularly important for natural hazards planning as they are often disproportionately affected by hazard events. Therefore, it is important that planners pay particular attention to the locations and characteristics of these populations.

The associated maps of the Eugene-Springfield metro region are available within Section 3 of the Eugene-Springfield NHMP. These maps are a product of the Lane Livability Consortium, a metro area collaboration funded by a grant from the US Department of Housing and Urban Development (HUD).

Table 4-22. Natural Hazard Social Vulnerability Factors

Number	Indicator	References (listed below)
1	Age	1, 2,3,4,5
2	Income	1,2,6
3	Residence	2,6
4	Tenure	2, 7
5	Employment	8
6	English Skills	7, 8
7	Household Type	4,5,7,8
8	Disability	2,8
9	Home Insurance	
10	Health Insurance	
11	Debt and savings	
12	Car	1,5,8
13	Gender	2,5,9
14	Injuries (hazard specific)	10
15	Residence Damage (hazard specific)	10

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Source: Dwyer, A., Zoppou, C., Nielsen, O., Day, S., Roberts, S., 2004. Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards. *Geoscience Australia Record 2004/14*. Table title: *The thirteen socio-economic indicators and two hazard indicators used in this study to establish the vulnerability of a person within a household to natural hazard impacts.*

Table 4-23: Climate Change Social Vulnerability Factors

Category	Vulnerability Factor(s)/ Vulnerable Population	References
Socio-economic	Low Income	1,2, 3, 4, 5
	People of color (ethnic minorities)	3, 5, 7
	Women	5
Age	Elderly	5
	Children	5
Housing Conditions	Home renters	4
	Flammable roof, vegetation within 10 meters of home	8, 9
Isolation	Language ability/linguistic isolation	10
	Isolation from public agencies for fear of interacting with public agencies	10
	Geographic isolation	11
Other	No health insurance	12
	No vehicle	13
	Disabled (or family member disabled)	5, 13
	Institutionalized populations	11, 14

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4.2.6 Participant List

The following individuals participated in the development of this vulnerability assessment providing information based on their specific expertise. Most participated by attending two three-hour meetings to discuss the specifics of the sector they work in.

Table 4-24. Participant List

	Name	Organization	Title
Communications Sector	Josh Halbrook	Comcast	Manager local/federal compliance
	Tim Reed	Comcast	CT 5
	Patricia Scarci	City of Eugene	IT Technical Operations Manager
	Bill Stuart	City of Eugene	Radio Communications Technician
	Rodney Lathrop	City of Springfield	IT Director
	Marcy Parker	City of Springfield	Operations Supervisor
	Bill Lundun	Bicoastal Media (Radio)	Program Director
	Robin O'Kelly	Bicoastal Media (Radio)	Director of Engineering
	Thomas Germaine	Lane County ARES/Ham Radio operations	Emergency Coordinator
	Tom Serio	Verizon Wireless	Manager, Business Continuity
	Justin Case	Oregon Smoke Signalers Association	South Willamette Valley Regional President, Oregon Chapter
	Dave Kinder	Verizon Wireless	Government Account Executive
Drinking Water			
Drinking Water Sector	Joe Moll	McKenzie River Trust	Executive Director
	Karl Morgenstern	Eugene Water and Electric Board	Source Protection and Property Supervisor
	Steve Ewing	Eugene Water and Electric Board	Water Distribution Management Technician
	Ray Leopold	Eugene Water and Electric Board	Water Treatment and Supply Supervisor
	Steve Fassio	Eugene Water and Electric Board	Control Systems Administrator
	Kevin McCarthy	Eugene Water and Electric Board	Operations Support Services Supervisor
	Ken Vogeney	City of Springfield	City Engineer
	Bob DenOuden	Eugene Water and Electric Board	Business Support Analyst
	Kevin Fahey	Eugene Water and Electric Board	Business Continuity and IT Disaster Recovery Planner
	Amy Chinitz	Springfield Utility Board	Drinking Water Source Protection Coordinator
	Michael Warren	Springfield Utility Board	Safety & Environmental Manager
	Greg Miller	Springfield Utility Board	Water Superintendent
	Dave Embleton	Springfield Utility Board	Water Quality Manager
	Ray Meduna	Springfield Utility Board	Director of Water & Electric Divisions

Table 4-24. Participant List

	Name	Organization	Title
	Sanjeev King	Springfield Utility Board	Electric Engineering Manager
	Steven Wages	Springfield Utility Board	Project Coordinator/Inspector
	Jamie Porter	Rainbow Water District	Superintendent
Food			
Food Sector	Abe Zitterkopf	Albertsons	District Manager: S. Oregon
	Nils Stark	Cornucopia restaurants	Owner
	Tom Lively	Organically Grown Co.	Senior Sales Representative
	Jeff Loyd	Market of Choice	Store Manager
	Megan Kemple	Willamette Farm and Food Coalition	Farm to School Program Director
	Sarah Means Mizejewski	Lane County Community Economic Development	Economic Development Officer
	Jason Lafferty	SnowTemp Cold Storage	General Manager
	Lynne Fessenden	Willamette Farm and Food Coalition	Executive Director
	Marc Carlson	Safeway	Store Manager: 18th Ave.
Housing			
Housing Sector	Ed McMahon	Home Builder's Association	Director
	Susan Ban	Shelter Care	Executive Director
	Stuart Ramsing	City of Eugene	Building Official
	Trevor Covington	American Red Cross	Disaster Program Manager
	Stephanie Jennings	City of Eugene	Grants Manager
	Kaarin Knudson	Rowell Brokaw Architects	Project Designer, Planning Specialist
	Michael Wisth	City of Eugene	Community Programs Analyst
	Jim Wilcox	Housing and Community Services Agency of Lane County	Energy Educator
	Cece Newell	Oregon Insurance Division	Property and Casualty Analyst
Electricity Sector			
Electricity Sector	David Pruitt	Bonneville Power Administration	Chief Substation Operator
	Tony Toncray	Lane Electric Cooperative	Manager Construction and Maintenance
	Jaime Cranmer	Emerald People's Utility District	Communications and Customer Service Manager
	Ron Dubbs	Emerald People's Utility District	Engineering and Operations
	Tod Simmons	Eugene Water and Electric Board	Energy Manager
	Mark Hankins	Eugene Water and Electric Board	Electric Line Supervisor
	Bo Mackey	Eugene Water and Electric Board	Substation & Apparatus Supervisor

Table 4-24. Participant List

	Name	Organization	Title
	Joe Jarvis	Blachly Lane	General Manager
	Sanjeev King	Springfield Utility Board	Electric Engineering Manager
	Michael Warren	Springfield Utility Board	Safety Environmental Manager
	Felicity Fahy	Eugene Water and Electric Board	Sustainability Coordinator
Health			
Health Sector	Mark Walker	McKenzie-Willamette Medical Center	Emergency Management Coordinator
	Tracy DePew	PeaceHealth Oregon	Director Emergency Management and Security Services
	Selene Jaramillo	Lane County Health and Human Services	Preparedness Coordinator
	Rick Hammel	Community Health Centers of Lane County	Systems Manager
	Deleesa Meashintubby	Volunteers In Medicine Clinic	Executive Director
	Tom Hambly	PacifcSource Health Plans (Insurance)	Wellness Consultant
	Shannon Conley	Trillium Community Health Plan	Chief Administrative Officer
	Joanna Kamppi	Eugene/Springfield Fire and Emergency Medical Services	EMS Chief
Stormwater			
Stormwater Sector	Jim Mclaughlin	City of Eugene	Public Works Maintenance Operations Manager
	Josh Colley	City of Eugene	Stormwater Service Program Manager
	Rob Hallett	City of Eugene	Stormwater Maintenance Supervisor
	John Clark	City of Eugene	Natural Resource Maintenance Supervisor
	Therese Walch	City of Eugene	Water Resource Manager
	Sandy Francis	City of Eugene	Subsurface Operations Maintenance Worker 4
	Trevor Taylor	City of Eugene	Natural Areas Restoration Supervisor
	Kevin Finney	City of Eugene	Parks and Open Space Operations Manager
	Scott Altenhoff	City of Eugene	Urban Forestry Technical Specialist 2
	Erik Burke	Friends of Trees	
	Ken Vogeney	City of Springfield	City Engineer
	Sunny Washburn	City of Springfield	

Table 4-24. Participant List

	Name	Organization	Title
	Greg Ferschweiler	City of Springfield	
	Mark Metzger	City of Springfield	
Wastewater			
Wastewater	Anette Spickard	City of Springfield	
	Ken Vogeney	City of Springfield	
	Michelle Cahill	City of Eugene	
	Ron Bittler	City of Springfield	
	Brian Conlon	City of Springfield	
	Jim Mclaughlin	City of Eugene	
	Josh Newman	City of Springfield	
	Matt Stouder	City of Springfield	
	Mike Risley	City of Springfield	
Transportation			
Transportation Sector	David Warren	Oregon Department of Transportation	Region 2 District Manager
	Frannie Brindle	Oregon Department of Transportation	Area 5 Manager
	Chuck Mueller	City of Eugene	Engineering Associate
	Steven Nicholas	City of Eugene	Airport Terminal Maintenance Manager
	Barnett Brian	City of Springfield	Traffic Engineer
	Sarah Wilkinson	Lane County	Planner
	Kevin Finch	Oregon Department of Transportation	Transportation Maintenance Manager
	Ken Vogeney	City of Springfield	City Engineer
Natural Systems			
Natural Systems	Mark Snyder	City of Eugene	Urban Forester
	Erik Burke	Friends of Trees	
	Pamela Wright	Oregon DEQ	
	Daniel Preston	US Forest Service	
	Merlyn Hough	Lane Regional Air Protection Agency (LRAPA)	
	Sally Markos	LRAPA	
	Max Hueftle	LRAPA	
	Larry Six	McKenzie Watershed Council	

Table 4-24. Participant List

	Name	Organization	Title
Public Safety			
Public Safety	Krista Dillon	University of Oregon	
Public Safety	Cindi Harper	Central Lane 9-1-1	
Public Safety	Ted Glick	Central Lane 9-1-1	
Public Safety	Ben Meigs	Eugene-Springfield Fire/EMS	
Public Safety	Bill Solesbee, Lieutenant	City of Eugene Police Department	
Public Safety	Richard Lewis, Captain	City of Springfield Police Department	
Public Safety	Spence Slater	Lane County Sheriff's Office	
Public Safety	Lt. Rob Edwards	Oregon State Police	
Public Safety	Eric Johnson	City of Eugene Public Works	
Public Safety	David Lindelien	Lane Transit District	
Public Safety	Ken Vogeney	City of Springfield Public Works	
Public Safety	Frank Williams	Lane Transit District	
Public Safety	Kevin Finch	Oregon Department of Transportation	Transportation Maintenance Manager
Steering Group			
Steering Group	Steve Adams	Institute for Sustainable Communities	
Steering Group	Jeff Weber	Department of Land Conservation and Development	Coastal Conservation Coordinator
Steering Group	Ken Vogeney	City of Springfield	City Engineer/Emergency Manager
Steering Group	Jason York	City of Eugene	Emergency Manager
Steering Group	Myrnie Daut	City of Eugene	Risk Services Director
Steering Group	Forrest Chambers	City of Eugene	Interim Emergency Manager
Steering Group	Felicity Fahy	Eugene Water & Electric Board	
Steering Group	Josh Foster	Oregon Climate Change Research Institute	
Steering Group	Joe Zaludek	City of Eugene	Deputy Chief
Steering Group	Patrick Luedtke	Lane County	Chief Health Officer
Steering Group	Babe O'Sullivan	City of Eugene	Sustainability Liaison

4.2.7 Hazard/Threat Scenarios

The following scenarios have been used to inform the assessment of system specific vulnerabilities, risks and capability to adapt. These scenarios were provided to assessment participants to provide a basis for discussion of specific hazards.

Earthquake

A major Cascadia event (9+ on Richter scale) causes significant shaking and structural damage to multiple critical facilities across the Eugene-Springfield Metro area. The event results in more than 100 fatalities locally (the majority in a single building collapse) and many more injured. Base utility outages (electric, sewer, water) affect all parts of the city and aren't expected to recover for weeks; earthquake triggered landslides and soil liquefaction have damaged underground infrastructure throughout the metro region. The I-5 corridor is damaged with several bridges out both North and South limiting access to Salem and Portland; locally, bridge and roadway damage limits transportation access throughout the metro region. Given the extensive damage to communities throughout Oregon, Washington, northern California and British Columbia, basic materials, equipment and labor needed to commence infrastructure recovery are in short supply with priority being given to larger cities and metropolitan areas. Social and economic systems are severely impaired.

Flood

Major flooding occurs along the McKenzie and Willamette Rivers over the course of a week. In some areas floodwaters greatly exceed the mapped 100-year flood zone. Evacuation orders are in place for multiple neighborhoods.

Wildfire

In late September, several large wildfires are burning on a mix of public and private lands in the McKenzie and Willamette River watersheds west of Eugene-Springfield. In addition, a local wildfire is burning just south of the Eugene city limit within the UGB; the fire has burned several homes and is threatening two subdivisions in the south hills. Mandatory evacuation orders are in place for large portions of south Eugene; Springfield is on high alert. Smoke is impacting the entire metro area. The fires are precipitated by dry winter conditions the previous two years and above average summer temperatures. Extreme heat (100+) is occurring and forecast for the next seven to ten days impacting vulnerable populations and beginning to strain local medical services.

Landslide

Several prolonged periods of intense rainfall falling on already saturated winter soils have caused multiple small landslides throughout the metro region in areas of steep slopes; primary impacts are to roadways. A larger, slow moving rotational slide is also impacting a residential area; the slide has destroyed or severely damaged several homes and is impacting a collector street. Several additional residences are threatened. Rapidly moving landslides have also occurred in adjacent counties resulting in several deaths.

Winter Storm

A cold front has created several days of low temperatures with daytime highs below the freezing point. In just two days 12 inches of snow have fallen and are capped with ½ inch of freezing rain. The weight has caused roofs on some older structures in town to collapse. Auto accidents in town have caused snarled traffic and placed high demand on public safety resources. Cold weather persists for a week and snow has exceeded the capacity of local governments to clear roads of snow and ice. Traffic on I-5 is slow and fraught with accidents. Power outages are occurring across town due to trees failing and downed power lines.

Upper Willamette Valley Climate Change Scenarios

2050: Expected Climate Impacts

- Average annual temperature increase by 3-6 degrees F [5]
- Reduced precipitation in summer [5]
- Snowpack decline by 60% [1]
- Storm events increase in intensity with more flooding [1]
- Increased summer water shortages [2]
- Reduced summertime hydroelectric power [1]
- Increase in extreme heat events [2]
- Increase in wildfire frequency and intensity [2]
- Shift in growing season duration and timing [1]
- Earlier stream flow peaks [3]
- Increase in insects and plant pests [2]

2050: Population and Energy Cost Scenario

- Fuel prices doubled [4]
- Commodity, food and materials prices doubled [4]
- Increased city population density [4]

Sources:

1. Preparing for climate change in the Upper Willamette River Basin, 2009. Climate Leadership Initiative.

http://www.theresourceinnovationgroup.org/storage/willamette_report3.11FINAL.pdf

2. Likelihood of climate risks for Oregon, from 2010 Oregon Climate Adaptation Framework.

http://www.oregon.gov/LCD/docs/ClimateChange/Framework_Final.pdf

3. Impacts of natural climate vulnerability on Pacific Northwest Climate, Climate Impacts Group, University of Washington.

http://www.ef.org/westcoastclimate/D_PNW%20impacts.pdf

4. Scenario based on extrapolation of 15 year trend (1998 to 2013)

5. Oregon Climate Assessment Report, Oregon Climate Change Research Institute (2010), K.D. Dello and P.W. Mote (eds). College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR available at: www.occri.net/OCAR

5 Mitigation Resources

Appendix A: NHMP Action Item Table
Appendix B: Planning and Public Process
Appendix C: Community Profile
Appendix D: Funding Programs
Appendix E: Status of Actions from 2009 NHMP
Appendix F: Dam Operation Climate Change Study Memo
Appendix G: Land Use and Development Trends
Appendix H: Economic Analysis of Natural Hazard Mitigation Projects

Appendix A. NHMP Action Item Table

Appendix A: NHMP Action Item Table

Hazard	Action Name	Problem Statement	Mitigation Action	Implementation Leads and Partners	Estimated Cost	Timeline
Dam Failure	Dam safety evacuation	There is not currently an evacuation plan to address dam failure – or other mass evacuation needs. Routes, notification, and awareness are all required.	See Multi Hazard: Evacuation	See Multi Hazard: Evacuation	See Multi Hazard: Evacuation	See Multi Hazard: Evacuation
	Dam safety notification	If electric supply were interrupted (due to an earthquake, for example) there are few methods to communicate with the public if a dam failure were to occur in the Southern Willamette Valley. The method to receive information from the Army Corps of Engineers a dam breach is also susceptible to failure.	Once evacuation routes are established, a) develop and install robust notification system(s); and b) create a community awareness campaign to increase awareness of dam risks among all residents and specifically i) transient student population, and ii) non-English speaking residents.	Lead: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Lane County; EWEB; Army Corps of Engineers.	Varies widely depending on notification system used	by 2025
	Inundation Maps For Planning	The Army Corps of Engineers has created inundation maps based on dam failure scenarios. Those maps are available to local emergency managers but are not in local GIS programs to facilitate evacuation planning and other emergency planning needs	Seek digital versions of inundation maps from Army Corps of Engineers. Seek permission to add inundation maps as a layer within local jurisdiction GIS programs.	Lead: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Army Corps of Engineers; Lane County	Staff time	By 2016
	Dam Seismic Assessment	The Army Corps of Engineers conducts seismic assessments of dams every 15 years. Eugene and Springfield Emergency Managers are not familiar with the results from the most recent assessment.	Obtain details of the most recent dam seismic assessments for the dams upstream of Eugene/Springfield.	Lead: City of Eugene Office of Emergency Management. Partner: Army Corps of Engineers; Lane County Sheriff's Office.	Staff time	By 2016
Earthquake	Local Transportation Infrastructure Seismic Evaluation	Long term surface transportation impairments can cause cascading system failures and can inhibit evacuation, response, and recovery. A large-scale earthquake has the potential to severely damage local bridges and other transportation infrastructure. While state and federal bridges may have had seismic inspections, there is currently no coordinated effort to inspect, record, and seismically retrofit local bridges. Additionally, some funding sources may not be available to local jurisdictions unless they have already developed a prioritized list of bridges to be retrofitted, or replaced.	Over the next 5 years, a) utilize accepted Oregon Department of Transportation methodology, as-built drawings, and physical inspections, to evaluate the Eugene and Springfield bridges (Vehicular and pedestrian) for seismic vulnerability, and record results centrally; b) Develop a prioritized list of bridges (cross-referenced with critical travel corridors) to be retrofitted or replaced; c) Seek funding to implement retrofitting/replacement.	Leads: City of Eugene Office of Emergency Management, City of Springfield Development and Public Works. Partners: Oregon Dept. of Transportation; Private engineering firms	$2,000 - $3000 per bridge with As-Built drawings; $3,000 - $5,000 w/o As-Built drawings. NOTE: Price is for assessing an individual bridge. If assessing more than one bridge, the per-bridge price will be significantly lower.	With as-built drawings, all of Eugene's 54 bridges, and seven of Springfield's 14 bridges, could be assessed in 2-3 months. Eugene has as-built drawings for about 50% of their bridges. Springfield had seismic evaluations performed on six of its' vehicular bridges in 2013/14.
	Seismic Evaluation of Critical Facilities	Many critical facilities in Eugene/Springfield have not been evaluated for seismic stability. A large-scale earthquake has the potential to severely damage local critical facilities, which can inhibit response and recovery efforts. Some funding sources may not be available to local jurisdictions unless they have already developed a prioritized list of critical facilities/services to be retrofitted, replaced, or relocated.	Over the next 5 years, A) Develop a prioritized list of critical facilities, consistent with the Critical Infrastructure and Key Resources developed by the Federal Emergency Management Agency, such as the Eugene Airport, the Eugene/Springfield Metropolitan Wastewater Commission Water Pollution Control Facility , the underground wastewater and stormwater collection and conveyance systems, and regional 9-1-1 and radio communication systems, to be inspected for seismic vulnerability; B) Develop a prioritization of facilities to be evaluated for seismic stability; C) Seek funding for evaluations; D) Utilizing building and infrastructure construction drawings and individual inspections, evaluate these facilities for seismic vulnerability and record the inspection results centrally; and E) Develop a prioritized list of facilities/services to be retrofitted, relocated, or replaced.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergenecy Management. Partners: 4J, EWEB, MWMC, Private engineering firms.	$100k - $500k	Develop the list within 1 year of plan adoption. Begin to conduct seismic evaluations of priority facilities within 5 years.
	Seismic evaluation of Non-Critical facilities (FEMA 154)	Multiple publicly-owned facilities are crucial for maintaining government operations following an earthquake. This effects both continuity of government, continuity of operations planning and response and recovery planning.	A) Develop a seismic rapid visual screening program for public buildings; B)seek funding to support screening program; C) begin implementing screening to inform local mitigation, response, continuity of operations, and recovery, planning efforts.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergenecy Management	unknown	Strive to develop rapid visual screening program by 2020
	Non-Structural seismic evaluation (FEMA E74)	All critical and non-critical facilities have non-structural components that may cause damage or injury during a seismic event.	Develop a program to systematically assess and retrofit non-structural components of public facilities. Seek funding for porgram to conduct evaluations and retrofits.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergenecy Management	unknown	Develop program by 2025
	Home seismic retrofits	Most of the homes in Eugene/Springfield were built before requirements existed for seismic construction methods. These homes will be ill prepared when a large Cascadia earthquake hits the area. Impacts to household financial stability and the local economy would be severe.	Explore the possibility of developing a home seismic upgrade/retrofit program for Eugene/Springfield. Consider a marketing program, incentives, loans, rebates, or other support options.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergenecy Management. Partner: Lane County	unknown	Consider options by 2020

Appendix A: NHMP Action Item Table

Hazard	Action Name	Problem Statement	Mitigation Action	Implementation Leads and Partners	Estimated Cost	Timeline
Flood	Flood Maps	The Eugene/Springfield metro area flood maps are based on data that is approximately 50 years old. The availability of LIDAR data and other technologies offers superior ability to project and map riverine flooding in the area. FEMA will update maps as resources allow but will prioritize communities that a) indicate an interest in updating local flood maps, and b) provide funding or other resources to support the updating of flood maps.	Actively seek FEMA updates to the Eugene/Springfield floodplain maps	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergenecy Management. Partners: Lane County, FEMA, Lane Council of Governments	unknown	Depends on FEMA timelines
	Flood control levee certification and maintenance	Eugene and Springfield both operate flood control structures. Structures need Army Corps of Engineers Certification and FEMA accredidation to be incroporated into updates of floodplain maps. The regulations surrounding certification and accredidation changed in 2013.	Seek and maintain certification of levees and other flood control structures within Eugene and Springfield	Lead: City of Springfield Development and Public Works	Unknown	unknown
	Flood Insurance Study	Eugene and Springfield do not have updated digital flood maps for Amazon Creek, Cedar Creek,or the McKenzie River. FEMA is in the process of updating the Flood Insurance Study and developing digital flood maps of these waterways.	Continue to support FEMA in updating the Flood Insurance Study, in selected areas, including Amazon and Cedar Creeks and the McKenzie River. Updated digital maps can provide easy access to flood information in the Eugene/Springfield metropolitan area and support a flood program that reflects the actual flood risk faced by the community.	Leads: City of Eugene Public Works Engineering, City of Springifeld Development and Public Works. Partner: FEMA	Unknown	Ongoing
	Repetitive Loss Records	While there are no repetitive loss properties in Eugene or Springfield, that may not yet be reflected in State and Federal databases.	Ensure the accurate locations of Repetitive Loss Properties have been accurately registered with FEMA.	Lead: City of Springfield Development and Public Works. Partners: Lane County, FEMA	Staff Time	
	Explore Flood Mitigation Actions With Property Owners (upon request)	Eugene and Springfield both have neighborhoods that are in the 100-year floodplain. However, not all structures are at risk of flooding because their main finished floor is above the base flood elevation, or other flood mitigation factors have been developed for the structure. Nevertheless, some property owners that are in the floodplain may want to develop mitigation measures to reduce their flood risk. Providing appropriate mitigation options with property owners upon their request will help inform property owners on how to reduce their risk from flooding and inform the cities of Eugene and Springfield on structures that need flood mitigation.	Provide flood risk literature for outreach. Send annual mailer to residents living within the 100 year floodplain describing actions property owners can take to protect themselves from flooding.	Leads: City of Eugene Public Works Engineering, City of Springfield Development and Public Works	Staff time, printing costs	Ongoing
	Maintain Frequent Stormwater Flooding Location Inventory	The cities of Eugene and Springfield have each developed an inventory of locations in the Eugene/Springfield Metro Area that are subject to frequent storm water flooding. In order to remain accurate and useful, the inventory should be updated regularly.	Regularly update inventory of locations in the Eugene/Springfield Metro area subject to frequent stormwater (urban, not riverine) flooding	Leads: City of Eugene Public Works, City of Springfield Development and Public Works	Staff time	Ongoing
	Upgrade culverts	Repetitive flooding can cause significant damage to roads and storm water infrastructure such as culverts, and can lead to road closures and expensive repairs. In addition, erosion caused by flooding of roads can degrade water quality.	For locations that experience regular flooding and significant damages or road closures, determine and implement mitigation measures such as upsizing culverts or storm water drainage ditches	Leads: City of Eugene Public Works, City of Springfield Development and Public Works	Varies	Varies
	NFIP compliance	The National Flood Insurance Program provides communities with federally-backed flood insurance to homeowners, renters, and business owners, provided that communities develop and enforce adequate floodplain management ordinances. In order to retain these benefits, the City of Eugene must continue to comply with NFIP requirements.	Continue compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinances.	Leads: City of Eugene Public Works Engineering, City of Springfield Development and Public Works	Staff time	ongoing
HazMat	HazMat Locations	The Disaster Mitigation Act of 2000 requires communities to identify mitigation actions that address existing buildings and infrastructure [201.6(c)(3)(ii)]. Addressing hazardous materials locations can help minimize secondary hazards following a disaster.	Ensure that first responders continue to have readily available site-specific knowledge of hazardous chemical inventories in the Eugene/Springfield Metro Area through the development of an Extremely Hazardous Substance Plan developed with the Local Emergency Planning Committee.	Lead: Eugene/Springfield Fire/EMS Partner: Oregon State Regional HazMat Response Teams	unknown	ongoing
	HazMat Preparedness	In order to provide effective response to hazardous materials incidents and maintain the safety of first responders, the cities of Eugene and Springfield need to continue emergency planning activities, response training, and equipment upgrades.	Enhance emergency planning, emergency response training and equipment to address hazardous materials incidents.	Lead: Eugene/Springfield Fire/EMS. Partners: Oregon State Regional HazMat Response Teams	Varies widely	ongoing

Appendix A: NHMP Action Item Table

Hazard	Action Name	Problem Statement	Mitigation Action	Implementation Leads and Partners	Estimated Cost	Timeline
Landslide	Landslide Mapping	Current landslide risk maps for the Eugene/Springfield area are based on dated topographic maps. LIDAR data is now available that can provide substanially better information about landslide risk in the region.	Update regional landslide risk maps using available lidar data	Lead: City of Eugene Office of Emergency Management, City of Sprinfield Development and Public Works. Partners: Oregon Department of Geology and Mineral Industries, Lane Council of Governments	$50k	Seek to complete map updates by 2020
	Landslide Planning	Depending on the type, location, severity and area affected, severe property damage, injuries and loss of life can be caused by landslide hazards. In addition, landslides can damage or temporarily disrupt utility services, roads, and other transportation / communication systems, including emergency response, fire, medical, police, etc.	Use available data to determine areas and buildings at risk to landslides and propose Comprehensive Plan and land use policies accordingly.	Leads: City of Eugene Planning Department, City of Springfield Development and Public Works. Partners: Oregon Department of Geology and Mineral Industries, Lane Council of Governments	Unknown	Ongoing during comprehensive land use updates
Multihazard	Emergency Fuel Distribution Plan	Following a significant natural hazard, there are several critical needs for available fossil fuel supplies to a) fuel emergency response vehicles, b) fuel service vehicles to repair communications systems, transportation systems, utilities, and other critical services, and c) operate generators at critical facilities including hospitals, fire stations, police facilities, and more. Many service providers indicate they expect to receive priority access to fuel following an emergency, however it is unclear how limited fuel supplies would be distributed in the wake of a significant disturbance to supplies, such as an earthquake.	Once the Fossil Fuel Sector Assessment is completed, develop a Eugene/Springfield emergency fuel distribution plan that considers 1) the likely local fuel available during specific scenarios (earthquake, winter storm, mass evacuation) 2) the needs for transportation fuels and natural gas (including backup generators) of both public and private (hospital, communications, others) essential systems as well as those of neighboring communities supplied by the Eugene Kinder Morgan / Williams Pipeline fuel terminal, and 3) the existing on-site fuel storage and operation capacity of those critical services.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Lane Transit District, Lane County, PeaceHealth, McKenzie Willamette Hospital, private hazard response and recovery contractors, EWEB, SUB, and others.	$10k-$100k depending on scope	Develop plan by 2020
	Community Recovery Planning	Eugene and Springfield currently do not maintain recovery plans to inform the recovery from any natural hazards.	List and prioritize the hazards likely to warrant recovery plans. Develop appropriate and necessary community recovery plans starting with the highest priority hazards.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partner: Lane County.	Depends on scope, number of hazards addressed, and number of partners involved	List and prioritze hazards for recovery planning by 2016. Begin working on at least one recovery plan by 2017
	Local Electricity Generation	Relatively little of the electricity used in the Eugene/Springfield area is generated locally, resulting in a) dependency on extensive transmission lines, b) little local influence on maintenance and reliability of electric generation infrastructure, c) little influence on prioritization of service restoration following a major hazard event or regional outage.	1) Develop a plan to increase local control of EWEB electric generation in the event of a regional outage (for example: given a regional outage, develop ability to direct locally generated power to critical facilities such as water treatment plants and hospitals). 2) Encourage small scale local electricity generation that can be operated independently of the regional and/or local grid in the event of a local or regional power outage (for example: install local renewable electricity generation in support of critical facilities so they can operate during an outage).	Leads: Eugene Water and Electric Board; Springfield Utility Board. Partners: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Bonneville Power Administration, Bonneville Environmental Foundation	Varies widely depending on scale.	Develop plan (part 1) by 2020. Begin implementation of part 2 by 2020
	Downed Power Lines	Downed power lines result in power failures and block critical transportation routes. The loss of electric power for a long period of time (more than 72 hours) can lead to failures of multiple critical systems including health care, water filtration, wastewater treatment, communications, transportation, and others. Impassable roadways from downed lines also inhibit emergency response and restoration of critical services, such as drinking water and health care, and is particularly problematic if fuel for backup generators cannot be delivered. The hazards most likely to impair surface transportation and disrupt electric service are severe winter storm (snow, ice, downed trees, utility pole, and wire failures) and earthquake, (downed trees, utility pole and wire failures).	Over the next five years, a) identify critical transportation corridors (including primary emergency, evacuation, and access routes) and electric distribution routes b) develop a list of key backbone transmission and distribution routes that serve critical customers and enable efficient restoration to the broader distribution system c) develop a long-term plan to underground, relocate, or "harden" key electric distribution lines along critical corridors (including feasibility assessment and prioritization) d) seek funds and opportunities to relocate power poles and power lines, or harden existing facilities, where feasible and appropriate, to reduce interruption to the transportation system and to reduce risk of outages from severe winter storms or earthquakes.	Leads: City of Eugene Public Works, City of Springfield Development and Public Works. Eugene Water and Electric Board, Springfield Utility Board, City of Eugene Public Works, Springfield Public Works, Lane Transit District.	Plan development: $10-$60k plus staff time. The cost of implementation will be estimated within the plan.	Develop plan by 2020.
	Credentials	Some critical private-party service providers may not be allowed into emergency areas following a hazard event. Several private entities such as cellular phone service providers, cable service providers and others, may need access to emergency personnel or restricted locations in order to restore service and support emergency operations in the wake of a hazard event.	Explore a strategy to facilitate credentialling of non-traditional partners during an emergency hazard event	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partner: Lane County Sheriff's Office	Staff time	Lower priority. Implement by 2025.

Appendix A: NHMP Action Item Table

Hazard	Action Name	Problem Statement	Mitigation Action	Implementation Leads and Partners	Estimated Cost	Timeline
Multihazard	Broadcast Radio communications	Broadcast radio is one of the least expensive and most resilient forms of mass communication available in our area. Significant federal investments have been made to harden local radio infrastructure. During an emergency, Broadcast Radio announcers rely on phone and internet to get reliable, timely information. If internet access and phone are not available, broadcast radio may continue to function but will not be able to access the important information in order to share it.	Review existing communication tools between Emergency Managers and radio stations. Develop a low-tech, direct communication line (such as HAM radio) between staff at Bicoastal Media (1120 KPNW, the radio station that has been heavily hardened with FEMA dollars) and Eugene/Springfield and Lane County Emergency Managers.	City of Eugene Office of Emergency Management. Partners: City of Springfield, 1120 KPNW, Lane County Sheriff's Office	$5,000 - $10,000 plus staff time	Implement by 2020.
	Continuity of operations plans	Continuity of operations plans (COOP) and procedures are necessary to assue that essential public services are provided during disasters and to provide for continuity of government. Few City work groups or facilities have COOP plans in place.	A) Identify priority work groups and facilities in need of Continuity of Operations Plans. B) Develop Continuity of Operations Plans for the top priority work groups or facilities.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partner: Lane Preparedness Coaltion	Varies widely depending on scope	Begin developing COOP plans by 2015
	Staffing for critical systems	In the aftermath of a large earthquake or other large-scale hazard event, critical staff are likely to prioritize the health and wellbeing of their families and may leave work or not report to work. Response and recovery operations for crucial services like electric, water, sanitation, transportation, and others, will be severely hampered without adequate, appropriately trained staff available.	Review policies, procedures and plans from other public agencies with high seismic vulnerability. Research their strategies to ensure staff availability following a significant hazard event. Assess options to apply these strategies in Eugene/Springfield to ensure the availability of critical staff following a significant hazard event.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Community Organizations Active in Disasters (COAD) partners	Policy review: $10,000	Policy Review by 2020
	Local food availability	Some 90% of food consumed locally is produced outside of the area. The vast majority of food consumed in Eugene/Springfield is brought in by truck and trailer on I-5 from distribution centers in San Francisco and Portland. Local grocery stores have a three-day supply of food at any one time. Severe flooding, severe winter storm or severe earthquake event can cause disruption to the resupply of local grocery stores.	Work with coalition of food suppliers to consider options to address these food supply concerns. Consider developing common messaging and marketing strategies to increase awareness of the need for individuals to store adequate emergency food and water supplies. There is some large-scale food storage in the area in the form of food storage businesses and food processors. If organized in advance, these stored food supplies could be distributed to residents in the aftermath of an emergency event. This could be developed into an "Emergency Food Distribution" plan.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Food storage businesses, food processors, Food For Lane County	Unknown	Investigate options by 2020
	Water Source	Homes and businesses in Eugene are served primarily by one publicly owned utility, EWEB. EWEB draws water from one single source on the McKenzie River and transports the water to Eugene through two large, co-located transmission pipelines. If a) the river water became contaminated or otherwise unusable, b) the filtration facility at Hayden Bridge were disrupted for any reason, or c) the transmission lines bringing water to Eugene were disrupted, water supply to Eugene residents and businesses (including water for fire suppression) could be compromised. Currently, on summer days EWEB has only enough emergency water storage to provide one or two days of water if something happens to the McKenzie River water source, EWEB's water treatment plant or transmission lines. Emergency interties with nearby utilities cannot provide enough water to meet Eugene's minimum water needs.	EWEB is actively seeking to develop alternate sources of drinking water. EWEB's Strategic Plan and Water Capital Improvement Plan call for alternate sources to be developed over the next ten years. EWEB has been issued a conditional permit on the Willamette River and has obtained a groundwater use permit. EWEB is assessing interest of potential partners, and will develop at least one additional water supply by 2022. The Cities of Eugene and Springfield support EWEB's purchase of property, construction of infrastructure, and financing of this project.	Lead: Eugene Water and Electric Board Water Operations	See EWEB for cost estimates	Develop at least one additional water supply by 2022
	Evacuation Plans	There is not currently a designated and widely known evacuation plan for mass evacuation needs, including dam safety. Designated routes, a notification system, and community awareness are all required.	Develop a community evacuation plan to address multiple hazards. Develop routes, notification system, and community awareness plan. Work with Lane County to coordinate routes and evacuation plans.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Lane County Sheriff's Office, ODOT, LTD, School Districts, auto fleet owners	varies depending on scope	Develop community evacuation plan by 2020

Appendix A: NHMP Action Item Table

Hazard	Action Name	Problem Statement	Mitigation Action	Implementation Leads and Partners	Estimated Cost	Timeline
Multihazard	Fossil Fuel Sector Assessment	During the process of conducting a community-wide hazards and climate vulnerability assessment, there emerged a gap in information regarding private fossil fuel distributors. The community as a whole, and emergency response functions depend heavily on fossil fuels to function. In order to better plan for and reduce the risk of disruptions, Eugene and Springfield need to aquire better information about the supply of fossil fuels in the area.	Develop a list of critical information needs pertaining to the regional fuel transmission and distribution system. Develop a plan to acquire the necessary information to a) better understand the factors that could disrupt the regional fossil fuel supply and b) ensure essential emergency functions can be sustained.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Lane County, DOGAMI, and private fossil fuel providers including Williams Pipeline,	Unknown	Complete assessment by the end of 2017.
	Water Storage	The supply of drinking water could be interrupted by an earthquake, water supply contamination, long-term power outage, or other natural hazards. Most locations that could serve as sheltering facilities do not currently store potable water on site, creating a need for fresh water when these sites are employed as shelters.	Explore options to increase drinking water storage in public buildings including a) essential facilities and b) potential public sheltering facilities.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Eugene Water and Electric Board, Springfield Utitlity Board, Rainbow Water District,	Varies widely depending on scale.	2020
	Vulnerable Populations	Within section 3, Maps, The Eugene/Springfield NHMP contains valuable information regarding vulnerable populations. This information has not been directly compared with each hazard or mitigation action. Mitigation actions will be more effective and will enhance community social equity when mitigation actions are analyzed throught the lens of vulnerable populations.	Compare relevant NHMP hazard risk maps with the relevant vulnerable population maps developed for the Lane Livability Consortium. Prioritize map combinations to provide results most informative to the mitigation actions within the NHMP.	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Lane Council of Governments, Lane County	Staff time and cost varies widely depending on scope	Complete by end of 2015
	Lane Preparedness Coalition	Emergency Management and hazard mitigation is less effective if done without effective collaboration and coordination.	Continue working with the Lane Preparedness Coalition to support public and private sector partnerships that result in successful hazard mitigation activities.	Lane Preparedness Coalition Members	Staff time	ongoing
	Community Education and Outreach	Not all community members are prepared for hazard events	Continue to deliver existing education programs aimed at increasing awareness and mitigating the risk posed by hazards. At least twice each year a) provide information about the NHMP, b) describe progress toward implementation, and c) collect feedback on the NHMP from audiences. Accomplish these tasks through the Eugene Springfield CERT program training events, and the Lane Preparedness Coalition Full Coalition Meetings (that include general public).	Leads: City of Eugene Office of Emergency Management, City of Springfield Office of Emergency Management. Partners: Lane Council of Governments, Eugene Water and Electric Board, Springfield Utility Board, COAD members, and others.	Staff time	ongoing
	72 Hour Kits	Eugene and Springfield are vulnerable to a number of natural hazards that could disrupt services such as utilities, transportation networks, and businesses. In some cases it may take days until vital services are restored. Preparing a 72 hour kit can help community members survive on their own without relying too heavily on emergency services.	Encourage community members and city employees to prepare and maintain 72 hour kits.	Leads: City of Eugene Office of Emergency Management, City of Eugene Public Works, City of Springfield Office of Emergency Management. Partners: Lane County, Lane Council of Governments, Eugene Water and Electric Board, Springfield Utility Board, and others.	Staff time	ongoing
Wildfire	Springfield Wildfire Plan	The City of Springfield does not have a specific plan completed that addresses wildfire in the urban interface zones of Springfield.	Eugene/Springfield Fire/EMS continue development of a Springfield-specific wildfire hazard plan that is consistent with mutual and automatic response agreements for the region. This plan will include a) threshold events that require evacuation notification; b) fire management plans that include all county wide fire resources until they are exhausted; and c) a requirement for escalation to State conflagration response. The plan will include coordination with aerial suppression resources and hourly costs for suppression aircraft during initial stages of an incident.	Lead: Eugene/Springfield Fire/EMS. Partners: City of Springfield; Lane County Fire Defense Board	This project will utilize light duty fire crews that have a working knowledge of local Wild land Urban Interface (WUI) response including the deployment of resources throughout Lane County	2017
	Wildfire risk and building codes	The south hills of Eugene and Springfield both contain heavy forest cover that results in a high fire risk, particularly at the end of a long, hot summer. Red flag warnings have occurred recently indicating high fire weather risk. Changes in climate patterns are projected to increase the risk of wildfire over time. Oregon State Building Code contains a provision for increased requirements for building construction materials and methods in areas of high fire risk. In order to be implemented locally, the area of high fire risk must be mapped and a regulatory map formally adopted by the local municipality. Currently, neither Eugene nor Springfield have created a formal map of high fire risk for the purpose of implementing this component of the Oregon Building Code.	A) Over the next 5 years, utilize the Oregon Department of Forestry's Criteria (OAR Chapter 629, Division 44) to develop a "Fire hazard zone" map of the areas of high fire danger in the Eugene/Springfield area. B) Cities of Eugene and Springfield adopt the "fire hazard zoning" map; C) Implement increased building code requirements for construction/repair in the identified high fire risk areas.	Leads: City of Eugene Office of Emergency Management and Building and Permit Services. Partners: City of Springfield Development and Public Works; Eugene/Springfield Fire/EMS; Oregon Department of Forestry; Lane Council of Governments; City of Eugene; City of Springfield.	unknown	2020

Appendix A: NHMP Action Item Table

Hazard	Action Name	Problem Statement	Mitigation Action	Implementation Leads and Partners	Estimated Cost	Timeline
Winter Storm	Downed Power Lines	See Multi-Hazard Action: Downed Power Lines	See Multi-Hazard Action: Downed Power Lines	See Multi-Hazard Action: Downed Power Lines	See Multi-Hazard Action: Downed Power Lines	See Multi-Hazard Action: Downed Power Lines
	Tree Trimming	High winds and ice during winter storms can topple trees and break limbs which in turn can result in power outages and disrupt telephone, computer, and TV and radio service.	Continue tree trimming efforts especially for transmission lines and trunk distribution lines.Both the Eugene Water and Electric Board (EWEB) and the Springfield Utility Board (SUB) trim trees on public property, as well as private property when necessary, to reduce the likelihood that tree limbs will cause future power outages. Continuing proper tree trimming for transmission lines and trunk distribution lines will help prevent power outages and damage to property from winter storms.	Leads: EWEB, SUB, BlachlyLane, EPUD, BPA	Varies	Ongoing
	Property Owner Education	High winds and ice during winter storms can topple trees and break limbs which in turn can result in power outages and disrupted telephone, internet, and cable service. While the Eugene Water and Electric Board (EWEB) and the Springfield Utility Board (SUB) manage vegetation near power lines in public areas, private property owners are responsible for informing the utility companies about vegetation on their property that must be removed.	Continue to educate private property owners about dangers of vegetation near distribution lines and service drops.	Leads: EWEB, SUB, EPUD, BPA, BlachlyLane	Low	Ongoing
	Backup Power	High winds and ice during winter storms can topple trees and break limbs which in turn can result in power outages, disrupting telephone, computer, and TV and radio service. Encouraging critical facilities to have backup power and/or emergency operations plans to deal with power outages will allow for continuous service.	Encourage critical facilities in the Eugene/Springfield Metro Area to have backup power and emergency operations plans to deal with power outages.	Leads: City of Eugene Office of Emergency Management, City of Springfield Development and Public Works. Partners: EWEB, SUB	Varies	Ongoing
	Undergrounding Utilities In New Developments	High winds and ice during winter storms can topple trees and break limbs which in turn can result in power outages and disrupt telephone, computer, and TV and radio service.	Continue policy requiring new developments to locate power lines underground.	Leads: City of Eugene Publice Works, City of Springifeld Development and Public Works. Partners: EWEB, SUB	Varies	Ongoing
Volcano	Ash Fall	Ash fall is considered a low probability event that occurs with plenty of warning in the Cascades. Actions have been taken to develop public emergency notification procedures. Water treatment capacity is deemed adequate to deal with ashfall events. Therefore, the cities of Eugene/Springfield do not have any priority actions in this category.	None at this time	n/a	n/a	n/a

Appendix B: Planning and Public Process

Part 1: Planning

Plan Development Process Overview

The primary implementation group for the Eugene-Springfield Natural Hazards Mitigation Plan is the NHMP Subcommittee of the Lane Preparedness Coalition. This group meets quarterly to coordinate implementation efforts.

The NHMP Subcommittee of the Lane Preparedness Coalition was heavily involved in the NHMP plan update process. Members participated in the vulnerability assessment, reviewed outcomes of the vulnerability assessment, developed and refined mitigation actions.

Once the vulnerability assessment process (described in Section 4.2) was completed, the NHMP Project Team (listed Section 1, page 2) and members of the NHMP Subcommittee of the Lane Preparedness Coalition proposed a number of mitigation strategies to address some of the most pressing vulnerabilities highlighted by the assessment.

These strategies were vetted through review by the NHMP project team and the NHMP Subcommittee. Following this review, those actions that needed additional refinement or review were carried forward by Project Team members who met with the partners critical to the implementation of individual actions. For example, the mitigation strategy for *Downed Power Lines* was taken forward by the EWEB Project Team member who set up meetings with staff from Eugene Public Works, Springfield Public Works, Springfield Utility Board, and EWEB to discuss the implications of the mitigation strategy and refine the language of the mitigation action, as necessary. This process was repeated for several critical mitigation actions including *Wildfire Risk and Building Codes, Continuity of Operations Plans, Local Transportation Infrastructure Seismic Evaluation, Seismic Evaluation of Critical Facilities, Landslide Mapping, Local Electricity Generation, and Water Source.* Other actions received similar review by crucial partners.

Meeting Descriptions

Below is a brief description of the meetings of the NHMP Subcommittee of the Lane Preparedness Coalition – starting with the most recent:

NHMP Subcommittee Meeting

Date: September 8, 2014 3pm to 4:30pm

Attendees:

Forrest Chambers, City of Eugene
Lisa McLaughlin, EWEB
Ken Vogeney, City of Springfield
Josh Bruce, Oregon Partnership for Disaster Resilience
Matt McRae, City of Eugene
Sanjeev King, Springfield Utility Board
James Donovan, City of Springfield
Patence Winningham, City of Eugene
Mark Walker, McKenzie Willamette Hospital
Melysa Slavkovsky, City of Eugene
Jamie Porter, Rainbow Water District
Bill Clingman, Lane Council of Governments

Topics:

- Review NHMP update timeline
- Review and discuss adjustments to NHMP goals
- Review proposed mitigation actions and necessary vetting required for individual actions
- Review the priority mitigation actions
- Discuss ongoing subcommittee involvement in the update process in October and November

NHMP Subcommittee Meeting and Vulnerability Assessment Outcomes Overview

Date: June 26, 2014 1pm to 4pm

Attendees:

NHMP subcommittee and Vulnerability Assessment Participants

Topics:

- Review key findings from Vulnerability Assessment.

- Discuss additional information needs,
- Discuss mitigation options to address key vulnerabilities

NHMP Subcommittee Meeting

Date: March 24th, 2014

Attendees:

Matt McRae, City of Eugene
Tracy DePew, PeaceHealth
Mark Walker, McKenzie Willamette Hospital
Jamie Porter, Rainbow Water District
Greg Miller, Springfield Utility Board
Sanjeev King, Springfield Utility Board
Ken Vogeney, City of Springfield
Jason York, City of Eugene
Melysa Slavkovsky, City of Eugene Public Works
Lisa McLaughlin, EWEB
Kevin Fahey, EWEB
Patence Winningham, City of Eugene

Topics:

- Review of updated hazard maps for clarity, completeness
- Review of vulnerability assessment outcomes
- Discussion of vulnerable population maps to be included in the NHMP
- Review the NHMP update timeline
- Continue work on refining mitigation action items

NHMP Subcommittee Meeting and student project reports

December 9, 2013, 3pm to 4:30pm

Attendees:

Joe Zaludek, Eugene-Springfield Fire/EMS
Matt McRae, City of Eugene
Babe O'Sullivan, City of Eugene,
Ken Vogeney, City of Springfield
Vicki Elmer, University of Oregon
Lindsay Foltz, City of Eugene

Topics: Student team reports:

-Water System mitigation actions
-Electricity system mitigation actions
-Climate change and vulnerable populations

NHMP Subcommittee Meeting

Date: June 10, 2013 3pm to 4:30pm

Attendees:

Matt McRae, City of Eugene,
Tracy DePew, PeaceHealth,
Mark Walker, McKenzie Willamette Hospital
Ken Vogeney, City of Springfield
Forrest Chambers, City of Eugene
Kevin Fahey, EWEB
Bill Clingman, Lane Council of Governments

Topics:

- Vulnerability Assessment progress and timeline
- Update timeline for NHMP
- Grant funding options
- Action item updates

NHMP Subcommittee Meeting

Date: Dec 10, 2012 3pm to 4:30pm

Attendees:

Ken Vogeney, City of Springfield
Matt McRae, City of Eugene
Tracy DePew, PeaceHealth
Mark Walker, McKenzie Willamette Hospital
Ken Vogeney, City of Springfield
Kevin Fahey, EWEB
Bill Clingman, Lane Council of Governments
Patence Winningham, City of Eugene

Topics:

- Review NHMP action items
- Discuss new steering committee members
- Climate Energy & Action Plan
- FEMA staff conference call regarding changes in flood insurance

Appendix B, Part 2: Public Process

Public involvement in the update of the Eugene-Springfield Natural Hazards Mitigation Plan has been accomplished in multiple ways:

A. Vulnerability Assessment

There was extensive stakeholder involvement from community businesses, partner agencies, and non-governmental organizations (NGOs) within the process of conducting the community climate and hazards vulnerability assessment. The Vulnerability Assessment Project Team met with a group of eight to twelve representatives from each of eleven different sectors for six hours each. This extensive effort provided rich detail and clear guidance about the priority areas for natural hazard mitigation in Eugene-Springfield. More detail about the process can be found in Section 4.2, including a full list of participants at the end of Section 4.2.

B. NHMP Subcommittee

Members of the Lane Preparedness Coalition NHMP Subcommittee are familiar with the NHMP and were heavily involved in the update of the NHMP. This group met multiple times during the update process and the updated NHMP reflects their feedback and in several cases their direct work recommending and refining actions.

C. In Depth Public Presentations

Detailed presentations were delivered to - and feedback gathered from - several interested community groups. These reflect 30 to 90 minutes of presentation and discussion.

Date	Event	Audience	# of Attendees
9/3/2014	Community Emergency Response Teams (CERT) Refresher Training	Community Members	20
10/8/2014	Lane Preparedness Coalition	Full Coalition Members	37

D. Briefs

The groups listed below were provided with brief presentations, access to copies of the 2009 Natural Hazard Mitigation Plan, an explanation of the update process, and a list of newly developed Action Items. There was a brief period for verbal feedback and attendees were encouraged to provide additional feedback through our online survey.

Date	Event	Audience	# of Attendees
9/23/2014	How Prepared Are YOU?	Community Members	44
9/30/2014	How Prepared Are YOU?	City of Eugene Employees	31
10/1/2014	CERT Refresher Training	Community Members	25

E. Public Survey

City of Eugene Emergency Management staff developed and distributed an online survey to the following stakeholder groups in Eugene and Springfield. These groups were chosen by the NHMP steering committee and represent local businesses, neighborhood leaders, and organizations that may be impacted by natural hazards in Eugene and Springfield. These groups were also asked to share the information link with their interested parties lists.

American Red Cross
Central Lane (9-1-1) Communications/Eugene Police Department
City of Eugene Staff:
Eugene Planning and Development
Eugene Public Works Maintenance
Eugene Public Works, Engineering
City of Springfield Development Services Dept.
Eugene Springfield CERT Members
Eugene Springfield Fire & Life Safety
Eugene Water & Electric Board (EWEB)
Lane Council of Governments (LCOG)
Lane Preparedness Full Coalition (LPC)
Local Emergency Planning Committee (LEPC)
McKenzie Willamette Medical Center
Lane County Community Organizations Active in Disasters (COAD) Members
Oregon Department of Forestry
Rainbow Water District
Springfield Metropolitan Wastewater Management Commission (MWMC)
Williams Northwest Pipeline

Background on the NHMP update and a link to the survey was hosted on the City of Eugene website, the Community Emergency Response Teams (CERT) website, and the Lane Preparedness Coalition website.

Results from the online and in person survey have informed prioritization of mitigation actions and continue to be collected and counted during the process of plan review. A summary of the survey results as of December 5, 2014 is detailed in the memo below.

December 5, 2014

To	**Josh Bruce, Oregon Partnership for Disaster Resilience**
From	**Emily Kettell, Oregon Partnership for Disaster Resilience**
SUBJECT	**EUGENE-SPRINGFIELD NHMP SURVEY ANALYSIS**

Overview

This memorandum presents an analysis of results from the 2014 NHMP Plan Update Survey for Eugene and Springfield. The survey was sent to key stakeholders and posted on the City of Eugene website starting October 6, 2014. The results presented in this memorandum analyze the answers from the 79 responses (as of December 4, 2014).[30] This memorandum includes information detailing natural hazard concerns and preparedness for individuals and the Cities of Eugene and Springfield.

Individual Concern and Preparedness

This section presents results from survey questions relating to individual hazard concern and preparedness.

The first question of the survey asks participants to rate their level of concern about the hazards that Eugene and Springfield face (volcano, earthquake, landslide, flood, winter storm, wildfire, hazardous materials, dam failure and other). Forty-two of the 79 respondents (53%) ranked earthquake as the hazard that is most concerning. Flood, winter storm and dam failure are the next highest hazards of concern. The least concerning hazards are volcano and landslide.

While individuals cited earthquake as the hazard that they are most concerned about, only seven of 76 respondents (9%) answered that they are most prepared for an earthquake hazard event; thirty-four respondents (about 45%) answered that they are prepared to somewhat prepared for an earthquake. Fifty respondents (65%) answered that they are most prepared for a winter storm event. Many respondents also answered that they are prepared for a flood or landslide, although the responses do not fall under the “most prepared” category.

In regards to individual concern and preparedness, the survey also asked individuals the status of their home or vehicle emergency preparedness kit. 28% percent of respondents have started working on the kit, and 36% stated that their

[30] All 79 participants did not respond to each question; therefore, there will be a varied number of respondents for each question.

kit is almost complete. Only 22% of respondents either have a complete kit or a complete kit that is inspected and refreshed.

City Mitigation Priorities

While it is important to understand individual concerns and preparedness, it is also crucial to understand the role residents expect the city to play in natural hazard preparedness.

Respondents were asked to rank the mitigation activities that Eugene and Springfield should focus their efforts on given limited resources. Most respondents, 25 of 71 (35%), stated that winter storm mitigation activities are of the highest priority. Similar to individual concerns, 24 of 71 (33%) of respondents stated that prioritizing mitigation activities for earthquakes was of the highest concern. While flood did not have the highest number of respondents who viewed it as of the most importance, it did have a consistent number of responses ranking flood mitigation activities as important.

Finally, respondents were asked to rank strategies that are most palatable to their preferences in regards to mitigation activities. Mitigation activity options include:

- Prohibit development in areas subject to natural hazards
- Use tax dollars to compensate land owners for not developing in areas subject to natural hazards
- Make my own home more disaster resistant
- Adjust public policies to safeguard local economy
- Improve the disaster preparedness of local schools
- Conduct an inventory of at-risk buildings and infrastructure
- Protect critical facilities (hospitals, fire stations)
- Enhance the function of natural features (streams, wetlands, forests) to reduce risks like flooding and landslides
- Protect historic and cultural landmarks
- Protect utilities (drinking water, electricity infrastructure)

The mitigation activities viewed as most important include the protection of utilities (40%), “make my home more disaster resilient” (21%) and the protection critical facilities (15%). Conducting an inventory of at-risk buildings and infrastructure is consistently listed as important, although not the most important mitigation activity. The activity to prohibit development in areas subject to natural hazards received a mixture of responses, most of them falling somewhere in the middle of important and not important. Using tax dollars to compensate land owners for not developing in areas subject to natural hazards and protecting historic and cultural landmarks were consistently viewed as the least important mitigation activities in the Eugene and Springfield.

Conclusion

The results of this survey conclude that individuals are most concerned about an earthquake event, followed by flood, winter storm, and dam failure. While many respondents have an emergency kit either prepared, or are in the initial stages of preparing a kit, very few respondents are most prepared for earthquake, the hazard that was cited as the most concerning.

Similarly, respondents ranked winter storm and earthquakes as hazards that require the most efforts on the part of the cities of Eugene and Springfield. Respondents ranked the protection of utilities, creating a disaster resilient home, and protecting critical facilities as the most important mitigation efforts that Eugene and Springfield could pursue.

These results present Eugene and Springfield with information to understand the preparedness of community members and the direction that community members would like to see their city pursue when considering mitigation activities. Of particular importance is individual concern and preparedness for hazards, which presents both cities with an opportunity to find ways to engage community members around topics of preparedness for hazards in which many respondents were not prepared.

Appendix C. Community Profile

Geography and Climate

The Eugene-Springfield area is located in the south end of the Willamette Valley, at the confluence of the Willamette and the McKenzie Rivers, between the Coast Range and the Cascade Mountains. The Eugene-Springfield area contains a diversity of landscapes: wetlands, rivers, lakes, creeks, riparian vegetation, grasslands, buttes, and foothills.

In addition to the Willamette and McKenzie Rivers, there are numerous creeks and a canal system running through the area as well as several large lakes and reservoirs including Fern Ridge Reservoir.

The climate for the Eugene-Springfield area is moderate. The average range of high temperature in January is 46 degrees while the average low is 34 degrees. In August, the average high is about 82 degrees with an average low of 51 degrees. The recorded annual range of daily temperatures is between 42 degrees and 64 degrees. Each year the Eugene-Springfield area receives about 38 inches of precipitation.[31]

Population and Demographics

Eugene and Springfield make up the largest cities in the Lane Metropolitan Planning Organization (MPO) area. The population for Eugene in 2012 was 158,335 people, with an annual average growth rate of 1.2%. The population for Springfield in 2012 was 59,840 with an annual average growth rate of 1%.

Within the Lane MPO, key population and demographic trends include:

- 83% of the population identifies as white (non-Latino).
- 13% of the population identifies as minority, a 37% increase since 2000.
- 8% of the population identifies as Latino, an 81% increase since 2000.
- Nearly 88% of the population only speaks English.
- About 12% of the population speaks a language other than English at home, mainly Spanish, Chinese, German, Japanese and French.
    - Of this 12%, about two-thirds of people also know English.

[31] Western Regional Climate Center. www.wrcc.dri.edu, Eugene, Oregon (352706), accessed October 29, 2014.

- Nearly 14% of people living in Eugene, Springfield or Coburg have one or more disability.
- In Eugene, 51% of all households are family households; and in Springfield 71% of all households are family households. Students living together near the University of Oregon and Lane Community College in Eugene can account for the difference in the number of family households between the two cities.
- Of all households in the Lane MPO, 16% are either male or female-headed households.
- The largest population by age in the Lane MPO are 40-39 year olds, who make up 26% of the population.[32]

The above data points out that Eugene and Springfield are becoming more diverse communities. Additional data and information regarding Eugene and Springfield's population and social demographics can be found in the Livability Lane Equity and Opportunity Assessment from July 2014. This report is incorporated herein by reference as detailed documentation of population and social demographic trends in Eugene and Springfield.[33]

Employment and Economics

Employment

Eugene and Springfield are the largest centers for employment in the Lane Metropolitan Planning Organization (MPO) area. The economy has generally been moving away from the wood product and manufacturing centers and towards a retail and service sector economy. Many jobs are now geared towards retail and services, health services, professional and business services, and leisure and hospitality. In 2012, Eugene's unemployment rate was 6.8% and Springfield's was 9%. Unemployment rates have remained generally stable since the 1990s with the highest rates peaking from 2008-2010 during the national economic downturn. Additional data and information regarding Eugene and Springfield's employment and economics can be found in the Springfield *Commercial and Industrial Buildable Lands Inventory and Economic Opportunity Analysis* (2009) and the City of Eugene *Economic Opportunity Analysis* (2010). Both reports are incorporated herein by reference as detailed documentation of employment and economic trends and forecasts in Eugene and Springfield.[34][35]

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32 US Census 2010 Block level data, Table P12.
33 Lane Livability Consortium. 2014. "Equity and Opportunity Assessment." http://www.livabilitylane.org/files/EOA_report/LLC%20EOA%20Report%207AUG14_FINAL_sm.pdf, accessed October 29, 2014.
34 ECONorthwest. 2009. *City of Springfield: Commercial and Industrial Buildable Lands Inventory and Economic Opportunity Analysis*. http://www.springfield-

Median Household Income

Median household Income for Eugene is $41,326, and $37,255 for Springfield. Both of these are lower than that of Lane County ($42,621), Oregon ($49, 850), and the US ($52, 762).

Poverty

Using data from 2009-2011, Eugene's poverty rate was 23.5, and Springfield's was 22.4. Eugene's rate is affected by a large student population attending University of Oregon and Lane Community College. When college students are removed from the calculation, the poverty rates are lowered to 16.6 for Eugene and 21.3 for Springfield.[36]

Complete information regarding employment and economic trends for Eugene and Springfield can be found in the Lane Livability Equity and Opportunity Assessment cited above in the "Population and Demographics" section of this report.

Transportation

Transportation is an important consideration when planning for emergency service provisions. Future growth within the cities will put pressure on the major and minor roads, the airport, rail systems, and the rivers. Eugene-Springfield's location in central Lane County between the Coast Range and Cascades and on the convergence of the Willamette and McKenzie Rivers has made the area a longstanding choice for transportation interchanges to occur.

Interstate 5, the major road that connects Oregon to Washington and California, runs between the cities of Eugene and Springfield. State Highway 99 also runs north-south through the city of Eugene, connecting the area to Junction City to the north and Goshen to the south. State Highway 126 runs east-west through both Eugene and Springfield connecting the cities to nearby communities such as Walterville to the east and Veneta to the west.

Union Pacific owns and operates rail that runs north-southeast through Eugene. Additionally, there is a smaller cargo rail connecting the Eugene-Springfield area to the coast. Amtrak also runs passenger trains daily through the Eugene-Springfield area.

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or.gov/dpw/CommunityPlanningDevelopment/SupportFiles/2030Plan/EconomicOpportunitiesAnalysis.pdf

35 ECONorthwest. 2010. *City of Eugene Comprehensive Lands Assessment – Appendix B: Economic Opportunity Analysis.* https://www.eugene-or.gov/index.aspx?NID=788

36 U.S. Census Bureau. 2013. "Examining the Effect of Off-Campus College Students on Poverty Rates." http://www.census.gov/hhes/www/poverty/publications/bishaw.pdf, accessed October 29, 2014.

The Eugene-Springfield area is also home to the Eugene Airport, which is the second largest airport in Oregon and the fifth largest airport in the Pacific Northwest. The Eugene Airport serves a six county region and connects the Eugene-Springfield area to large and small western cities such as Portland, Seattle, Medford, and Salt Lake City. The airport is owned and operated by the City of Eugene. [37]

Please refer to Section 3 for Eugene and Springfield transportation maps.

Land Use

Eugene contains nineteen different land use designations. Public land is scattered throughout the entire city limits. Industrial (heavy and light) is centered around Highway 99 and the Pacific Union rail yard as well as along Highway 126 heading west. The majority of the city is zoned Low-Density Residential.

Springfield has designated twenty-two different zones for land use purposes. The majority of Heavy Industrial Zoning is located in the central part of the city and in the northwest corner. Areas zoned for Public Lands & Open Space are spread throughout the city. Additionally, most of the city is zoned Low-Density Residential. Refer to Section 3 for the Eugene and Springfield Zoning maps.

Housing

In Eugene, there has been an increase in multi-family housing, due largely in part to additional student housing near the University of Oregon. Both Eugene and Springfield have seen a decline in single-family housing being built. Regardless, both cities are composed of a majority (over 50%) of single family housing, with about 30% of total housing categorized as multi-family housing. Less than 5% of Eugene, and 9% of Springfield is composed of mobile homes, boats, RVs, and vans.

In Eugene, renters occupy 49.9% of housing, and 50.1% is occupied by owners. Springfield is fairly similar with 48% of housing being occupied by renters and 52% being occupied by owners. On average, renters in Eugene have a median gross rent of about $800 a month, and about $750 in Springfield. Eugene's median gross rent is slightly higher than that of Lane County ($793) but lower than that of Oregon ($830) and the US ($871).[38] Owner costs are slightly higher. The median monthly owner costs are about $1,000 for Springfield, and about $1,300 for Eugene. Eugene's median monthly owner costs are higher than Lane County ($1,114), the US ($1,145) and Oregon (1,268).[39]

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37 City Of Eugene. 2014. "Transportation Options." http://www.eugene-or.gov/index.aspx?NID=487, accessed October 29, 2014.
38 US Census Bureau. 2007-2011. American Community Survey, table DP-4.
39 US Census Bureau. 2007-2011. American Community Survey, table B25088.

Additional information and a complete assessment of housing in Eugene and Springfield can be found in the Lane Livability Equity and Opportunity Assessment.[40]

Historic and Cultural Resources

Historic and cultural resources such as historic structures and landmarks can help to define a community and may also be sources of tourism dollars. Because of their role in defining and supporting the community, protecting these resources from the impact of disasters is important.

Eugene has 63 sites on the National Register of Historic Places and Springfield has 7. Table CP1 summarizes the historic sites in Eugene and Springfield that were built before 1900. Eugene has sixteen pre-1900 sites on the National Historic Registry, and Springfield has five.[41]

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40 Lane Livability Consortium. 2014. "Equity and Opportunity Assessment." http://www.livabilitylane.org/files/EOA_report/LLC%20EOA%20Report%207AUG14_FINAL_sm.pdf, accessed October 29, 2014.

41 National Register of Historic Places. http://www.nps.gov/nr/, accessed October 29, 2014.

Table 5-1. Pre-1900 Historic Sites

City	Site	Estimated Year Built
Eugene	Flanagan Site (specific location information restricted)	Pre-European Native American archaeological site
Eugene	Frank L. & Ida Chambers House	1891
Eugene	Chase Gardens Residential Grouping	1889
Eugene	Danie & Catherine Christian House	1885
Eugene	Christian-Patterson Rental Property	1890
Eugene	Deady Hall	1873
Eugene	Blair Boulevard Historic Commercial Area	1875
Eugene	Pioneer Cemetary	1872
Eugene	Masonic Cemetary and Hope Abbey Mausoleum	1859
Eugene	A.V. Peters House	1869
Eugene	Shelton-McMurphy House and Grounds	1888
Eugene	Smeede Hotel	1884
Eugene	Villard Hall	1885
Eugene	Benjamin Franklin Dorris House	1850-1874
Eugene	East Skinner Butte Historic District	1850-1874
Eugene	Lane County Clerk's Building	1853
Springfield	Brattain-Hadley House	1893
Springfield	Robert E. Campbell House	1870
Springfield	Dorris Ranch	1899
Springfield	Southern Pacific Railroad Passenger Station and Freight	1891
Springfield	Larimer House	1885

Source: National Register of Historic Places National Register Information System, accessed November 2014[42].

Additionally, the National Registry of Historic Places has listed Springfield's Washburne Historic District as worthy of preservation. The Washburn Historic District, established in 1985, has fifteen buildings built between 1885 and 1924.

42 http://www.nationalregisterofhistoricplaces.com/or/lane/state2.html

The Larimer House listed above is included in the Washburne Historic District.[43] Although not listed on the National Register of Historic Places, the Gray/ Jaqua house on Highway 126 east of Springfield is considered one of the oldest existing buildings in the city of Springfield and is currently being developed into a city park.

Throughout the year, the cities of Eugene and Springfield have many community events and annual traditions. A few examples include: Eugene Celebration; Eugene Marathon; track and field events at University of Oregon's Hayward Field, and the weekend markets in both Eugene and Springfield.

Critical Facilities

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

The City of Eugene owns and manages the following facilities:

- City Hall
- Eleven fire stations and a training center
- Three police stations
- Public Works facilities on Roosevelt Boulevard

The City of Eugene and the City of Springfield participate in joint management of:

- A regional wastewater treatment facility

As the Lane County seat, Eugene also contains several county government facilities including the Lane County Sheriff's Office and Lane County Jail.

The City of Springfield owns and manages the following facilities:

- City Hall
- Five fire stations
- The Springfield Justice Center Facility containing the police department, jail and courts
- The Maintenance Division facility

43 Springfield Historic Commission. "Washburne Historic District." http://www.ci.springfield.or.us/dsd/planning/hcommission/Site%26Bldgs/Washburne.html, accessed October 29, 2014.

The following utilities are also locally owned and operated and work in close partnership with the City of Eugene and the City of Springfield

- Eugene Water and Electric Board (EWEB)
- Springfield Utility Board (SUB)
- Rainbow Water District RWD

As of 2010, the Eugene and Springfield Fire Departments and Emergency Medical Services (EMS) have merged, and the departments are now jointly serving the Eugene and Springfield communities

Eugene and Springfield contain a number of significant federal facilities. In Springfield, the National Guard Resource Center houses the National Guard, Federal Reserve forces, and the dispatch center for the Forest Service's fire fighting forces. Eugene houses the U.S. District Court for the District of Oregon.

The Eugene-Springfield area is home to the following hospitals: Sacred Heart Medical Center University District; Sacred Heart Medical Center at RiverBend; and, McKenzie-Willamette Medical Center.

Government Structure

Eugene and Springfield both operate under a council-manager framework with the councils enacting policy and the city manager responsible for operations.

In Eugene, the city council consists of a mayor and eight city councilors. The city of Eugene contains the following city departments:

- ***Central Services:*** Provides centralized support for other city departments. Includes the city manager's office, municipal court, city prosecutor's office, human resources, risk services, finance; and facilities management and information services.
- ***Fire and EMS:*** Protecting and preserving life, property and the environment through prevention, education, medical, rescue, and fire suppression services.
- ***Library/Recreation/Cultural Services:*** Supports an informed society, offers opportunities for lifelong learning and health and provides cultural experiences.
- ***Planning and Development:*** Enforces zoning ordinances, works with general public to plan and monitor development activities.
- ***Police:*** Protecting, training, and enhancing the lives of the residents.

- ***Public Works:*** Provides a wide range of services and programs related to parks and open space, transportation, stormwater and wastewater infrastructure, and natural resource stewardship.

The Springfield city council consists of the mayor and six city councilors that are elected for four year terms. The mayor and council are responsible for the appointment of the city manager, city attorney, municipal court judges, and advisory committees. Springfield City Hall and the separate Justice Center contain the offices of the following city departments:

- ***Development and Public Works:*** Enforces zoning ordinances, works with general public to plan and monitor development activities. Designs, constructs, operates, and manages public infrastructure including streets, sanitary sewers, stormwater management facilities, public buildings, and other facilities.
- ***Finance:*** Manages the finances of the city and Metropolitan Wastewater Management Commission, and operates Municipal Court.
- ***Fire and Life Safety:*** Protect life, property, and environment through prevention, education, emergency/medical, rescue, and fire suppression services.
- ***Human resources:*** Supports and develops staff.
- ***Information Technology:*** Ensures the city's computer and communication systems are efficient, and up to date.
- ***Library:*** Gives the community access to reading and learning through books, computers, technology and children's cultural events.
- ***Municipal Courts:*** Enforces the municipal code and prosecutes traffic violations.
- ***Police and Jail:*** Protects lives and property by enforcing laws and preventing crimes.

The Willamalane Parks and Recreation District is responsible for managing parks within Springfield.

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 of 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 to changing conditions and needs. [44]

The Eugene-Springfield Natural Hazards Mitigation Plan includes a range of recommended action items that, when implemented, will reduce the area's vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the area'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 plan's action items through existing plans and policies increases their likelihood of being supported and getting updated, and maximizes the area's resources.

The following list documents the plans and policies already in place in the Eugene-Springfield area:

Plan: Eugene-Springfield Metropolitan Area General Plan

Date of Last Revision: updated 2010
Author/Owner: City of Eugene, City of Springfield, Lane County
Description: The Eugene-Springfield Metropolitan Area General Plan (also known as the Metro Plan) formerly served as Eugene and Springfield's comprehensive plans. Its current purpose is to provide overarching metro-wide support for the Eugene Comprehensive Plan and the Springfield Comprehensive Plan described below.
Relation to Natural Hazard Mitigation: Provides overarching policy guidance for future development and land use in the Eugene-Springfield metro area.

Plan: Eugene Comprehensive Plan

Date of Last Revision: Currently being updated (November 2014)
Author/Owner: City of Eugene
Description: The Eugene Comprehensive Plan is new. Previously the Metro Plan served as Eugene and Springfield's comprehensive plans. The plan purpose is to promote sustainability and sustainable land use development, contain urban development, promote redevelopment, protect natural resources, foster economic vitality, provide efficient and cost-effective
services, and ensure a sense of history and place.
Relation to Natural Hazard Mitigation: Provides policy guidelines for future development and land use in Eugene.

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

Plan: Springfield 2030 Refinement Plan

Date of Last Revision: Currently being updated (November 2014)
Author/Owner: City of Springfield
Description: Springfield is developing a city-wide refinement plan called the Springfield 2030 Refinement Plan that will guide growth and development for the Metro area east of Interstate 5 through the 2010-2030 planning period. Updates to the Downtown Refinement Plan, Glenwood Refinement Plan and Visioning for Main Street refinement plan updates are also underway.
Relation to Natural Hazard Mitigation: Provides land use policy and maps areas for future development in Springfield.

Plan: Public Facilities and Services Plan

Date of Last Revision: December 2001, amendments 2011
Author/Owner: City of Eugene, City of Springfield, Lane County
Description: An appendix to the Metro Plan described above, that describes the water, sewer and transportation facilities which are to support the land uses designated in the
Comprehensive Plans.
Relation to Natural Hazard Mitigation: Mitigation actions relating to water and wastewater treatment facilities should be linked to goals and policies outlined in the Public Facilities and Service Plans.

Plan: Regional Transportation Plan

Date of Last Revision: November 2007
Author/Owner: Lane County, city of Eugene, city of Springfield, city of Coburg, Oregon Department of Transportation, Lane Transit District
Description: Guides the management and development of appropriate transportation facilities in Lane County, incorporating the community's vision, while remaining consistent with state, regional, and local plans including the metro area's comprehensive plan.
Page 2-18 October, 2009 Community Profile
Relation to Natural Hazard Mitigation: Mitigation actions relating to improving transportation facilities should be linked with goals and policies expressed in the transportation system plan.

Plan: Development Code (Eugene)

Date of Last Revision: December 2005
Author/Owner: City of Eugene
Description: Interprets land use code. Outlines decision making processes, code enforcement, penalties, and non-conforming situations. It is the primary implementation tool of the Metro Plan (comprehensive plan).
Relation to Natural Hazard Mitigation: Should reflect needs and issues related to development in hazardous areas. Contains regulations for development on steep slopes

Plan: Development Code (Springfield)

Date of Last Revision: September 2007
Author/Owner: City of Springfield
Description: Interprets land use code. Outlines decision making processes, code enforcement, penalties, and non-conforming situations. It is the primary implementation tool of the Metro Plan (comprehensive plan).
Relation to Natural Hazard Mitigation: Should reflect needs and issues related to development in hazardous areas.

n: Eugene Springfield Multi-jurisdictional Emergency Operations Plan

Date of Last Revision: 2014
Author/Owner: City of Eugene, City of Springfield
Description: Details plans and policies for emergency response in all aspects of city life.
Relation to Natural Hazard Mitigation: This document is primarily response-based, but contains elements that are pertinent to mitigation

Plan: Eugene Capital Improvement Program, 2014-2019

Date of Last Revision: March 2013
Author/Owner: City of Eugene
Description: The City of Eugene's Capital Improvement Program (CIP) forecasts the City's capital needs over a six-year period based on various long-range plans, goals and policies. The program is updated every two years and provides a list of capital improvements programmed for funding in the next five years. These improvements are aimed at improving neighborhoods, providing economic growth, improving traffic safety, complying with environmental standards, and maintaining the existing infrastructure.
Relation to Natural Hazard Mitigation: Mitigation actions addressing capital improvements can be incorporated into capital improvement plans and funded appropriately.

Plan: Springfield Capital Improvement Program, 2012-2016

Date of Last Revision: 2011
Author/Owner: City of Springfield
Description: The City of Springfield's Capital Improvement Program (CIP) is a five-year Community Reinvestment Plan that describes the funding and construction of City public facilities. A fundamental purpose of the CIP is to facilitate the efficient use of limited capital resources. The stated goals for the CIP are to: Provide a balanced program for capital improvements given reasonably anticipated funding over a five-year or greater planning period and identifying the extent to which resources can meet capital needs; Improve neighborhoods; Provide for economic and community growth; Improve safety,

access, and mobility of transportation modes; Comply with environmental standards and improving environmental quality; Maintain the existing City infrastructure; and protect public health and safety.
Relation to Natural Hazard Mitigation: Mitigation items linked with capital improvements are linked with goals and policies of the capital improvement plan.

2012 Local plan comparison process

In 2012, the University of Oregon's Community Service Center evaluated local plans and policies to analyze how various local plans addressed natural hazard mitigation in Eugene and Springfield. Table 5-2 shows the various plans with natural hazard mitigation policies for both Eugene and Springfield, followed by Eugene specific plans and key points from the analysis.[45]

The following presents a summary of key findings from the analysis:

1. Numerous hazard action items in the Climate and Energy Action Plan (CEAP) and the Natural Hazard Mitigation Plan (NHMP) do not have applicable Metro Plan policies specifically referring to: multi-hazards, flood, wildfire and other hazards (heat, climate migration, drought, winter storm, volcano, dam safety, hazardous material and natural resource terrorism).

2. The hazard with the most applicable policy elements in the Metro Plan is *Flood*, and though the CEAP and the NHMP have action items denoted as *beyond the scope of the Metro Plan*, they don't fully address many of the flood mitigation policies established in the Metro Plan.

3. There is significant inconsistency between the *Other Hazards* addressed in the CEAP and the NHMP, as there is no overlap between the documented action items.

4. Of specific concern, The NHMP does not incorporate O*ther Hazards* such as: heat, climate migration or drought.

5. The CEAP addresses many hazards relevant to climate change; however it does not contain actions to address the potential for increased risk of landslides due to climate change.

6. Concerning the additional community and refinement plans, the Downtown Plan, Metropolitan Wastewater Management Commission Facilities Plan and Goal 5 Water Resources Conservation plan have no reference to any hazards.

[45] Community Service Center, University of Oregon. 2012. "City of Eugene Metro Plan Natural Hazard Policy Considerations."

7. The additional community and refinement plans do an inadequate job in addressing most of the hazards, with the exception of flood. Flood hazards reflect the most applicable action items present across the additional plans.

Table 5-2: Eugene and Springfield Plans and Natural Hazard Policies

Plan Name	# of Flood Policies and Actions	# of Landslide Policies and Actions	# of Earthquake Policies and Actions	# of Wildfire Policies and Actions	# of Other Hazards Policies and Actions	Total References
Eugene and Springfield						
Metro Plan	18	3	1	0	0	22
Natural Hazard Mitigation Plan	6	4	4	3	12	29
Metropolitan Wastewater Management Commission Facilities Plan	0	0	0	0	0	0
TransPlan	0	0	0	0	1	1
Eugene						
Climate and Energy Action Plan	21	0	0	4	15	40
Comprehensive Stormwater Management Plan	19	0	0	0	0	19
West Eugene Wetlands Plan	9	0	0	0	0	9
Downtown Plan	0	0	0	0	0	0
Capital Improvement Program	3	0	2	0	0	5
Facilities Management Division Work Plan	1	0	3	0	0	4
South Hills Study	0	6	0	0	0	6
Royal Avenue Specific Plan	3	0	0	0	0	3
Goal 5 Water Resources Conservation Plan	0	0	0	0	0	0
PROS Comprehensive Plan	1	0	0	0	0	1

Community Connectivity Capacity

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

Social Systems and Service Providers

Social systems can be defined as community organizations and programs that provide social and community-based services, such as health care or housing assistance, to 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). The cities of Eugene and Springfield 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 *Hazard and Climate Vulnerability Assessment* detailed in Section 4 presents a sector summary for each of the following sectors: drinking water, stormwater, wastewater, health care and public health, electricity, food, housing, transportation, public safety, natural resources, and communication. Information from the vulnerability assessment leads to a more comprehensive understanding of the links between sectors, as well as each sector's strengths, weaknesses, and role in the event of a natural hazard. [46]

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

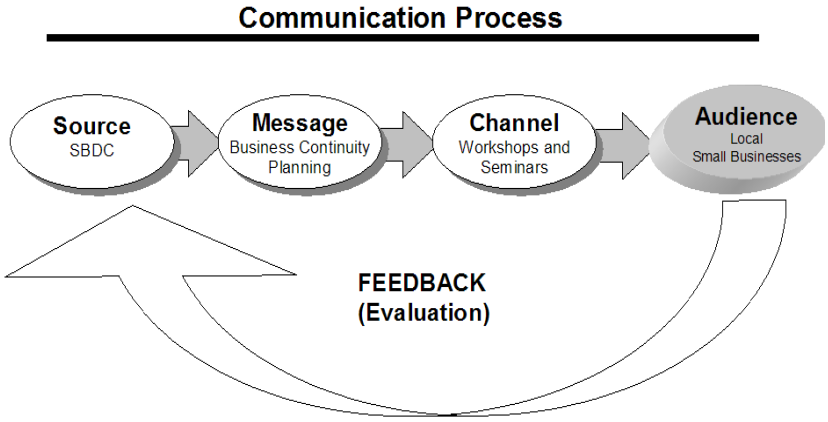
There are five essential elements for communicating effectively to a target audience:

- The source of the message must be credible,
- The message must be appropriately designed,

[46] Oregon Partnership for Disaster Resilience. 2014. "Hazard and Climate Vulnerability Assessment." http://www.livabilitylane.org/files/Vulnerability-Assessment.pdf, accessed October 29, 2014.

- The channel for communicating the message must be carefully selected,
- The audience must be clearly defined, and
- The recommended action must be clearly stated and a feedback channel established for questions, comments and suggestions.

Figure 5-1. Communication Process



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

The following table provides a list of several local service agencies and organizations within Eugene and Springfield. The table provides information on each organization or program's service area, types of services offered, populations served, and how the organization or program could be involved in natural hazard mitigation. The three involvement methods identified in the table are defined below:

- Education and outreach - organization could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.
- Information dissemination - organization could partner with the community to provide hazard related information to target audiences.
- Plan/project implementation - organization may have plans and/or policies that may be used to implement miti0gation activities or the organization could serve as the coordinating or partner organization to implement mitigation actions.

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

Table 5-3: Eugene-Springfield Community Organizations

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Eugene Chamber of Commerce 1401 Willamette St Eugene, OR 97401 (541) 484-1314	Represents the local businesses and disseminates information to businesses and visitors.	Eugene	X						Education and outreach & Information dissemination
Springfield Chamber of Commerce 101 South A Street Springfield, OR 97477 (541) 746-1651	Represents the local businesses and disseminates information to businesses and visitors	Springfield	X						Education and outreach & Information dissemination
Sacred Heart Medical Center 1255 Hilyard St. Eugene, OR 97401 (541) 686-7300	Provides healthcare to the area	Eugene, Springfield, and the surrounding area		X	X	X	X	X	Education and outreach & Information dissemination
Sacred Heart Medical Center- RiverBend 3333 RiverBend Dr. Springfield, OR 97477 (541) 222-7300	Provides healthcare to the area	Eugene, Springfield, and the surrounding area		X	X	X	X	X	Education and outreach & Information dissemination
McKenzie-Willamette Medical Center 460 G St, Springfield, OR 97477 (541) 726-4400	Provides healthcare to the area	Eugene, Springfield, and the surrounding area		X	X	X	X	X	Education and outreach & Information dissemination
Lions Club International 1075 Washington St #212 Eugene, OR 97401 (541) 484-0452	Community Organization	Eugene, Springfield, and the surrounding area	X	X	X	X	X	X	Education and outreach & Information dissemination

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Rotary Club of Eugene Eugene Hilton and Conference Center 66 E 6th Ave Eugene, OR 97401 (541) 485-5983	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Airport Rotary Club, Wings Restaurant, Eugene Airport 28855 Lockheed Dr Eugene, OR 97402 (541) 688-1406	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Emerald Rotary Club, Valley River Inn 1000 Valley River Way Eugene, OR 97401 (541) 510-3042	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Metropolitan Rotary Club, Downtown Athletic Club 999 Willamette St Eugene, OR 97401 (541) 345-3733	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Mid-Valley Rotary Club, Oregon Electric Station 27 E 5th Ave Eugene, OR 97401 (541) 484-6717	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Southtowne Rotary Club, Vet's Club 1626 Willamette St Eugene, OR 97401 (541) 689- 6872	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Eugene Delta Rotary Club, The Hilton Hotel Eugene 66 E 6th Ave Eugene, OR 97401 (541) 914-1365	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Springfield- Twin Rivers Rotary Club, Royal Caribbean Cruise 1000 Royal Caribbean Way Springfield, OR 97477 (541) 986-3277	Community Organization	Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination
Springfield Rotary Club, Holiday Inn 919 Kruse Way Springfield, OR 97477 (541) 689-2984	Community Organization	Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination
Eugene Elks Club 2470 W 11th Ave Eugene, OR 97402 (541) 338-7848	Community Organization	Eugene	X	X	X	X	X	X	Education and outreach & Information dissemination
Springfield Elks Club 1701 Centennial Blvd Springfield, OR 97477 (541) 747-2145	Community Organization	Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination
Lane County Historical Society 740 W 13th Ave Eugene, OR 97402 (541) 682-4242	Community Historical Society	Lane County, including Eugene and Springfield	X	X	X	X	X	X	Education and outreach & Information dissemination

Name and Contact Information	Description	Service Area	Population Served						Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	Families	Low-Income	
Eugene Public Library 100 W 10th Ave Eugene, Oregon 97401 (541) 682-5450	Public Library	Eugene		X	X	X	X	X	Education and outreach & Information dissemination
Springfield Public Library 225 Fifth St Springfield, OR 97477 (541) 726-3766	Public Library	Springfield		X	X	X	X	X	Education and outreach & Information dissemination
Eugene Airport 28855 Lockheed Drive Eugene, OR 97402 (541) 682-5430	Regional Airport	Eugene and Springfield	X				X		Education and outreach & Information dissemination
University of Oregon Eugene, OR 97403 (541) 346-1000	State University	Eugene and Springfield	X				X		Education and outreach & Information dissemination
Lane Community College 4000 E 30th Ave Eugene, OR 97405 (541) 463-3000	Local Community College	Eugene and Springfield	X	X			X	X	Education and outreach & Information dissemination
Lane Transit District P.O. Box 7070 Eugene, OR 97401 (541) 682-6100	Local Public Transit System	Lane County and Cities	X	X	X	X	X	X	Education and outreach & Information dissemination
United Way Lane 3171 Gateway Loop Springfield, OR 97477 (541) 741-6000	Community Organization	Lane County and Cities	X	X			X	X	Education and outreach & Information dissemination
American Red Cross Oregon Pacific Chapter 862 Bethel Drive Eugene, OR 97401 (541) 344-5244	Regional Red Cross Headquarters	Benton, Coos, Curry, Douglas, Lane, Lincoln and Linn counties	X	X	X	X	X	X	Education and outreach & Information dissemination

Appendix D: Funding Programs

Introduction

There are numerous local, state and federal funding sources available to support natural hazard mitigation projects and planning. The Oregon Natural Hazard Mitigation Plan includes a comprehensive list of funding sources (refer to Oregon NHMP Chapter 2 Section F(1)). The following section includes an abbreviated list of the most common funding sources utilized by local jurisdictions in Oregon. Because grant programs often change, it is important to periodically review available funding sources for current guidelines and program descriptions.

Post-Disaster Federal Programs

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. http://www.fema.gov/hazard-mitigation-grant-program

Physical Disaster Loan Program

When physical disaster loans are made to homeowners and businesses following disaster declarations by the U.S. Small Business Administration (SBA), up to 20% of the loan amount can go towards specific measures taken to protect against recurring damage in similar future disasters.
http://www.sba.gov/category/navigation-structure/loans-grants/small-business-loans/disaster-loans

Pre-Disaster Federal Programs

Pre-Disaster Mitigation Grant Program

The Pre-Disaster Mitigation (PDM) program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster

declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds. http://www.fema.gov/pre-disaster-mitigation-grant-program

Flood Mitigation Assistance Program

The overall goal of the Flood Mitigation Assistance (FMA) Program is to fund cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other National Flood Insurance Program (NFIP) insurable structures. This specifically includes:

- Reducing the number of repetitively or substantially damaged structures and the associated flood insurance claims;
- Encouraging long-term, comprehensive hazard mitigation planning;
- Responding to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development activities; and
- Complementing other federal and state mitigation programs with similar, long-term mitigation goals. http://www.fema.gov/flood-mitigation-assistance-program

Detailed program and application information for federal post-disaster and pre-disaster programs can be found in the FY13 Hazard Mitigation Assistance Unified Guidance, available at: https://www.fema.gov/media-library/assets/documents/33634. Note that guidance regularly changes. Verify that you have the most recent edition.

For Oregon Military Department, Office of Emergency Management (OEM) grant guidance on Federal Hazard Mitigation Assistance, visit: http://www.oregon.gov/OMD/OEM/pages/all_grants.aspx - Hazard_Mitigation_Grants

Oregon Military Department, Office of Emergency Management (OEM) contact: Dennis Sigrist**,** dennis.sigrist@oem.state.or.us

State Programs

Seismic Rehabilitation Grant Program

The Seismic Rehabilitation Grant Program (SRGP) provides state funds to strengthen public schools and emergency services buildings so they will be less damaged during an earthquake. Reducing property damage, injuries, and casualties caused by earthquakes is the goal of the SRGP. http://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/

Community Development Block Grant Program

The Community Development Block Grant Program promotes viable communities by providing: 1) decent housing; 2) quality living environments; and 3) economic opportunities, especially for low and moderate income persons. Eligible Activities Most Relevant to 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://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/com___munitydevelopment/programs

Oregon Watershed Enhancement Board

While OWEB's primary responsibilities are implementing projects addressing coastal salmon restoration and improving water quality statewide, these projects can sometimes also benefit efforts to reduce flood and landslide hazards. In addition, OWEB conducts watershed workshops for landowners, watershed councils, educators, and others, and conducts a biennial conference highlighting watershed efforts statewide. Funding for OWEB programs comes from the general fund, state lottery, timber tax revenues, license plate revenues, angling license fees, and other sources. OWEB awards approximately $20 million in funding annually. More information at:http://www.oregon.gov/OWEB/Pages/index.aspx

Federal Mitigation Programs, Activities & Initiatives

Basic & Applied Research/Development

National Earthquake Hazard Reduction Program (NEHRP), National Science Foundation.

Through broad based participation, the NEHRP attempts to mitigate the effects of earthquakes. Member agencies in NEHRP are the US Geological Survey (USGS), the National Science Foundation (NSF), the Federal Emergency Management Agency (FEMA), and the National Institute for Standards and Technology (NIST). The agencies focus on research and development in areas such as the science of earthquakes, earthquake performance of buildings and other structures, societal impacts, and emergency response and recovery. http://www.nehrp.gov/

Decision, Risk, and Management Science Program, National Science Foundation.

Supports scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society. Disciplinary and interdisciplinary research, doctoral dissertation research, and workshops are funded in the areas of judgment and decision making; decision analysis and decision aids; risk analysis, perception, and communication; societal and public policy decision making; management science and organizational design. The program also supports small grants for exploratory research of a time-critical or high-risk, potentially transformative nature. http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423

Hazard ID and Mapping

National Flood Insurance Program: Flood Mapping; FEMA

Flood insurance rate maps and flood plain management maps for all NFIP communities.
http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping

National Digital Orthophoto Program, DOI – USGS

Develops topographic quadrangles for use in mapping of flood and other hazards. http://www.ndop.gov/

Mapping Standards Support, DOI-USGS

Expertise in mapping and digital data standards to support the National Flood Insurance Program. http://ncgmp.usgs.gov/standards.html

Soil Survey, USDA-NRCS

Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation or related purposes. http://soils.usda.gov/survey/printed_surveys/

Project Support

Community Development Block Grant Entitlement Communities Program, US Department of Housing and Urban Development

Provides grants to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate- in come persons. http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/entitlement

National Fire Plan (DOI – USDA)

The NFP provides technical, financial, and resource guidance and support for wildland fire management across the United States. Addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability. http://www.forestsandrangelands.gov/

Assistance to Firefighters Grant Program, FEMA

FEMA AFGM grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. Three types of grants are available: Assistance to Firefighters Grant (AFG), Fire Prevention and Safety (FP&S), and Staffing for Adequate Fire and Emergency Response (SAFER). http://www.fema.gov/welcome-assistance-firefighters-grant-program

Emergency Watershed Protection Program, USDA-NRCS

Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp

Rural Development Assistance – Utilities, USDA

Direct and guaranteed rural economic loans and business enterprise grants to address utility issues and development needs. http://www.rurdev.usda.gov/Utilities_Programs_Grants.html

Rural Development Assistance – Housing, USDA.

The RDA program provides grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary. http://www.rurdev.usda.gov/HAD-HCFPGrants.html

Public Assistance Grant Program, FEMA.

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide assistance to State, Tribal and local governments, and certain types of Private Nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.
http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

National Flood Insurance Program, FEMA

The NFIP makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements. http://www.fema.gov/national-flood-insurance-program

HOME Investments Partnerships Program, HUD

The HOME IPP provides grants to states, local government and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons. http://www.hud.gov/offices/cpd/affordablehousing/programs/home/

Disaster Recovery Initiative, HUD

The DRI provides grants to fund gaps in available recovery assistance after disasters (including mitigation). http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/dri

Emergency Management Performance Grants, FEMA

EMPG grants help state and local governments to sustain and enhance their all-hazards emergency management programs. http://www.fema.gov/fy-2012-emergency-management-performance-grants-program

Partners for Fish and Wildlife, DOI – FWS

The PFW program provides financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats. http://www.fws.gov/partners/

North American Wetland Conservation Fund, DOI-FWS

NAWC fund provides cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats. http://www.fws.gov/birdhabitat/Grants/index.shtm

Federal Land Transfer / Federal Land to Parks Program, DOI-NPS

Identifies, assesses, and transfers available Federal real property for acquisition for State and local parks and recreation, such as open space. http://www.nps.gov/ncrc/programs/flp/index.htm

Wetlands Reserve program, USDA-NCRS

The WR program provide financial and technical assistance to protect and restore wetlands through easements and restoration agreements. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands

Secure Rural Schools and Community Self-Determination Act of 2000, US Forest Service.

Reauthorized for FY2012, it was originally enacted in 2000 to provide five years of transitional assistance to rural counties affected by the decline in revenue from timber harvests on federal lands. Funds have been used for improvements to public schools, roads, and stewardship projects. Money is also available for maintaining infrastructure, improving the health of watersheds and ecosystems, protecting communities, and strengthening local economies. http://www.fs.usda.gov/pts/

Appendix E: 2009 Action Status

Appendix E: 2009 Action Item Status

Hazard	Action Item	Status
Dam Safety Mitgation Action Items		
#1	Prepare high resoluition, digitized maps of dam failure induation areas.	Completed - US Army Corp completed and provided digital inundation maps to local jurisdictions. New Action Proposed: Turn Army COE maps into GIS layer for use when conducting emergency planning
#2	Encourage Dam Seismic assessment by Army Corps	Completed- Army corps conducts seismic assessments every 15 years. New Action Proposed : Obtain most recent dam seismic assessments

Hazard	Action Item	Status
Multi-Hazard Mitigation Action Items		
#1	Continue to support/develop public and private sector partnerships to foster hazard mitigation activities.	Completed and ongoing through Lane Preparedness Coalition meetings are held quarterly, the group has a charter and mission to hold presentations to keep the community stakeholders abreast of situations in the area. www.preparelane.org
#2	Maintain and continue to deliver existing education programs aimed at mitigating the risk posed by hazards.	Completed through education efforts of the Lane Preparedness Coalition /Ongoing
#3	Continue to educate businesses and governmental organizations about the importance of developing continuity of operations plans.	Completed through education efforts of the Lane Preparedness Coalition /Ongoing. Adding an action to address the need for COOP plans within local governments
#4	Encourage residents and city employees to prepare and maintain 72 hour kits.	Completed and ongoing
#5	Coordinate efforts with Lane Council of Governments to develop new hazard maps for the Eugene/Springfield Natural Hazards Mitigation Plan.	Completed. New maps incorporated into update of NHMP

Hazard	Action Item	Status
Flood Mitigation Action Items		
#1	Consult with property owners and explore mitigation actions for the 4 properties on FEMA's national repetitive loss list.	The repetitive loss properties are not within the City of Springfield but rather within Lane County. Remove.
#2	Support FEMA in updating the Flood Insurance Study in selected areas, including Amazon and Cedar Creeks and the McKenzie River.	In process - ongoing
#3	Compile and evaluate elevation data for structures within the 100-year floodplain as new data becomes available.	Incomplete and unclear if this is useful in the absence of updated flood maps: Remove and prioritize the update of Flood Maps for the region.
#4	For structures within the 100 year floodplain, explore mitigation options with property owners upon request.	Completed. Ongoing education is required for NFIP.
#5	Maintain and update the inventory of locations in the Eugene/Springfield Metro Area subject to frequent storm water flooding.	Completed and ongoing. Both Eugene and Springfield track those locations prone to seasonal stormwater flooding.
#6	For locations with repetitive flooding and significant damages or road closures, determine and implement mitigation measures such as upsizing culverts or storm water drainage ditches.	No repetitive loss locations within the City limits. Eugene and Springfield stormwater management plans consider actions to reduce localized flooding where necessary.
#7	Continue compliance with the National Flood Insurance Program (NFIP) through enforcement of local floodplain ordinances.	Completed/Ongoing. Eugene will continue to comply with NFIP requirements.

Hazard	Action Item	Status
Winter Storm Mitigation Action Items		
#1	Continue tree trimming efforts especially for transmission lines and trunk distribution lines.	Completed/Ongoing. EWEB has established maintenance program budgeting $3-5 Million a year for tree trimming efforts. Other surrounding utilities have simlar programs.
#2	Continue to educate private property owners about dangers of vegetation near distribution lines and service drops.	Completed/Ongoing. EWEB, SUB, and other local utilities implement education programs and mailers.
#3	Encourage critical facilities in the Eugene/Springfield Metro Area to have backup power and emergency operations plans to deal with power outages.	Ongoing
#4	Consider upgrading lines and poles to improve wind/ice loading, undergrounding critical lines, and adding interconnect switches to allow alternative feed paths and disconnect switches to minimize outage areas.	Limited implementation has occurred and depends on available funds. New strategy being developed (see multi-hazard *Downed Power Lines*)
#5	Continue to encourage cities of Eugene and Springfield to underground key power lines and new developments to include underground power lines.	Completed. There is code requiring new subdivisions to install power lines underground.

Hazard	Action Item	Status
Landslide Mitigation Action Items		
#1	Support ongoing efforts to document and monitor landslide areas and make use of data when it is available.	Changing this action to be more specific about updating maps to include LIDAR data. Actively working with DOGAMI on this action. Until now, funds have not been available. Grant funds beeing sought for this purpose.
#2	Consider landslide mitigation action items for buildings and public infrastructure subject to landslide threat and after landslide events.	Incomplete due to lack of funding.
#3	Use available data to determine areas and buildings at risk of landslides and propose Comprehensive Plan and land use policies accordingly.	Land use policies have been drafted for consideration within the update of the Eugene Comprehensive Plan. This action is currently in process and will continue into 2015
Wildland Urban Interface Mitigation Action Items		
#1	Review and update list of specific parts of the Eugene/Springfield Metro Area at high risk for urban/wildland urban interface fires because of fuel loading, topography and prevailing construction practices.	Incomplete due to lack of funding. Adjusting action to use building codes to support fire-resistant construction methods. New action: *Wildfire risk and building codes* will drive an update of maps and associated code changes
#2	Continue to review and modify evacuation routes and procedures for high risk areas and educate the public.	Completed with South Hills Fire Plan.
#3	Educate homeowners in high-risk areas about fire safe construction practices for existing and new construction.	Completed and modified. New action: *Wildfire risk and building codes,* when implemented, will *require* homeowners to use fire safe construction practices.

Hazard	Action Item	Status
Earthquake Mitigation Action Items		
#1	Educate homeowners about structural and non-structural retrofitting of vulnerable homes and encourage retrofit.	Completed: Public outreach conducted to educate property owners. Action ongoing. Proposed change in focus to developing a *home seismic retrofit program* for Eugene/Springfield.
#2	Consider seismic vulnerability assessments, and develop mitigation strategies for seismic retrofit of critical public buildings and critical utility infrastructure identified as particularly vulnerable.	Incomplete due to lack of funds. Refocus strategy to: *Seismic Evaluation of Critical Facilities* .
#3	Conduct benefit-cost analyses contingent upon funding for retrofit projects of important public facilities, including utility systems, bridges and dams and special hazard private facilities such as bulk fuel storage and hazmat facilities.	Incomplete due to lack of funding. Intent is incorporated into *Seismic Evaluation of Critical Facilities* , *Seismic evaluation of Non-Critical facilities* , and *Dam Seismic Assessments* .
#4	Encourage partners to seek funding to further assess the "probability of collapse" for critical buildings/schools listed in DOGAMI's rapid visual assessment and structurally reinforce vulnerable buildings to prevent loss of life.	Ongoing: Continuing to encourage partners to seek funding and conduct assessments. The intent of this action has been included in the new action: *Seismic Evaluation of Critical Facilities.*

Hazard	Action Item	Status
Volcano Mitigation Action Items		
#1	Update public emergency notification procedures for ash fall events.	Completed
#2	Evaluate capability of water treatment plants, including wells, to deal with high turbidity from ash falls and upgrade treatment facilities and emergency response plans to deal with ash falls.	Completed - capacity for filtration is found to be adequate
Hazardous Materials Mitigation Action Items		
#1	Ensure that first responders have readily available site-specific knowledge of hazardous chemical inventories in the Eugene/Springfield Metro Area.	Completed. Local Emergency Planning Committee established. Meeting and coordination ongoing.
#2	Enhance emergency planning, emergency response training and equipment to address hazardous materials incidents.	Completed/Ongoing

Appendix F: Dam Operation Climate Change Study

Army Corps of Engineers Memo: Flooding, Dam Operation, Willamette Valley Climate Change Study

Classification: UNCLASSIFIED
Caveats: NONE

Hi Matt [McRae],

Here is a description of the Willamette Valley CC project we will be starting. Hope this helps. If you have questions, please let us know. Thanks,

Keith Duffy, P.E.
CENWP-EC-HY
Phone: (503)808-4969
Cell: (971)322-7715

"The Army Corps of Engineers Portland District is presently going to begin a climate change study to identify how potential climate change may affect water management decisions in the Willamette Valley and Rogue River basins and formulate a general framework for a District Water Management response to climate change. The District must balance the multiple objectives of providing storage space for flood risk, refilling of projects to provide stored water for conservation season goals, meeting environmental objectives, and maximizing hydropower. To meet these objectives, it important to evaluate the current rules and operations to provide for future climate trends. Therefore, the District is funding analyses that compare general hydrologic conditions in the basins at the time they were originally designed, with current and potential future conditions.

The Corps of Engineers has contracted with the Oregon Climate Change Research Institute (OCCRI), based at Oregon State University (OSU), to perform a historical trends analysis of runoff and snow melt in the Willamette Valley and Rogue River basins based on historic records (e.g., unregulated gages, etc). OCCRI shall also provide a data set of future projections in terms of statistically significant changes, if any, of key metrics and parameters relevant to USACE water management in the Willamette Valley and Rogue River basins. The future projections shall be based on 2040 (mid-century) conditions and based on a suite of climate projection models relevant to the Pacific Northwest. The final product shall consist of a report with subject topics addressed including an evaluation of change in frequency of 'critical' weather patterns which are of concern to water management in the Willamette Valley and Rogue River basins, water management vulnerabilities and thresholds to potential future climate change, and a summary of results for the historical trends and the future projections analysis. Finally, the report

shall identify likely general impacts to water management based on these results and shall preliminarily address general responses that the District may consider for addressing the potential future climate change.

The specific objectives of the study are to:

- Identify historical trends in the Willamette Valley and Rogue River basins in changing runoff and snow melt. The trends analysis shall be based on historic records (e.g. unregulated gages etc). Understanding will allow the District to frame how information used for original project design may or may not be still appropriate for existing or future operations. It will let the District address potential future climate change and impacts to Water Management in the Willamette Valley and the Rogue River basins.
- Identify potential indicator variables that might be used to help predict basin wide hydrologic trends for a given upcoming season or water year (i.e. a wet or dry year etc.).
- Identify the specific climate change impact concerns to flood risk management, refill and 2008 Willamette BiOp operations (i.e., the vulnerabilities to climate change). The District may also request other seasonal operations other than refill be evaluated such as the conservation release season.
- Identify future projections information for the short term 2040's. This is meaningful to the District because of its immediacy and the potential for action to be taken; it is hard to plan for distant eventualities and even harder to garner federal funds for a response.
- Determine potential policy implications for planning a response to potential climate change from the water management standpoint. It is desired that the final study report will be useful to Corps Planners (e.g., at USACE Institute for Water Resources) to respond to climate change on a national or other regional level."

Appendix G: Land Use and Development Trends

The Eugene-Springfield Metro Region is growing. To accommodate the next 20 years of population growth, Eugene and Springfield will have to expand their UGBs, increase density within their UGBs, or both.

In 2009, ECONorthwest created the City of Springfield Commercial and Industrial Buildable Lands Inventory and Economic Opportunities Analysis.[47] Similarly, in 2010, ECONorthwest, Lane Council of Governments, the Ulum Group, and Winterbrook Planning prepared the Eugene Comprehensive Lands Assessment for the City of Eugene Planning and Development Department.[48]

In order to provide suitable sites for this employment growth, the City of Springfield will need to expand its UGB. The City is considering a UGB expansion to that will provide up to 640 acres designated for employment. Areas being considered for UGB expansion include the North Gateway Area, the College View Area and the Mill Race/South 28th Area. Similar to the Eugene Comprehensive Lands Assessment, the Springfield Commercial and Buildable Lands Inventory does not consider constrained land as buildable. Wetlands, floodways, slope greater than 15 percent, and riparian areas are considered Absolute Development Constraints in the analysis and are not counted as buildable land in the inventory. Land within the floodplain, the Willamette River Greenway, and Bonneville Power Administration easements are classified as constrained in the analysis but are assumed developable as permissible under current regulations and thus these lands are part of Springfield's inventory[49].

The Eugene Comprehensive Lands Assessment relies on population projections provided by Lane County that estimates Eugene will grow from 179,338 people in 2011 to 213,238 people in 2031 at an average annual growth rate of 0.88%.

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47 ECONorthwest (2009). *City of Springfield: Commercial and Industrial Buildable Lands Inventory and Economic Opportunities Analysis.* Retrieved from http://www.ci.springfield.or.us/DPW/CommunityPlanningDevelopment/SupportFiles/2030Plan/EconomicOpportunitiesAnalysis.pdf, accessed October 31, 2014.

48ECONorthwest (2010). *Eugene Comprehensive Lands Assessment.* Retrieved from https://www.eugene-or.gov/index.aspx?NID=788, accessed October 28, 2014.

49 Springfield Residential Land and Housing Needs Analysis http://www.ci.springfield.or.us/DPW/CommunityPlanningDevelopment/SupportFiles/2030Plan/ResidentialLandUseHousingElementOrd6268.pdfIt

As a result, the City of Eugene will need to further redevelop land within the UGB as well as expand the boundary for housing and employment purposes. Three areas are being considered for UGB expansion to provide the additional 534 single-family home sites needed. The three possible sites are a) the Bailey Hill/Gimpl Hill Area, b) the Bloomberg/McVay (Russel Creek/LCC Basin) Area and c) the Crest/Chambers Study Area. Importantly, none of the three areas being considered for UGB expansion are situated in the floodplain, have slopes greater than 30 percent, or include wetlands (wetlands were removed from consideration).

The Clear Lake Road Area is being considered as an area to expand the UGB for industrial and employment land needs. The site consists of 924 acres that will be broken down into light-medium industrial, campus industrial, commercial, school, and park land uses. The Clear Lake Road Area does not include land with a slope of 25% or greater, or land in the 100-year floodplain. The area is partially constrained by the presence of wetlands. Development impacts in wetland-constrained areas will be mitigated through the development of "green infrastructure" practices described in the Eugene Stormwater Master Plan.

The City of Springfield's residential housing needs have been met. Therefore, Springfield is focused on the need for industrial and employment lands. The Commercial and Industrial Buildable Lands Inventory for Springfield concludes that there will be a 32% increase in the number of employees between 2010 to 2030, equaling roughly 13,000 new jobs.

In order to provide for this growth in employment, the City of Springfield will need to expand its UGB. The UGB expansion will provide the 450 acres needed for six industrial sites, as well as 190 acres needed for eleven commercial and mixed-use sites. The two areas being considered for UGB expansion are the North Gateway Area and the College View Industrial Area. Similar to the Eugene Comprehensive Lands Assessment, the Springfield Commercial and Buildable Lands Inventory does not consider constrained land as a possibility in UGB expansion. Wetlands, floodways, slope greater than 15 percent, and riparian areas will not be included as a possibility for development. However, while considered constrained, development can occur in the floodplain, the Willamette River Greenway, and BPA Easements.

Regarding new development in areas prone to natural hazards, the Oregon land use program explicitly prohibits or restricts development in said areas. With statutory authority granted under Oregon Revised Statute Chapter 197, Oregon Administrative Rules provide for needed housing that is, "…suitable, available and necessary for residential uses."

Land that, "(a) [i]s severely constrained by natural hazards as determined under Statewide Planning Goal 7," "(c) [h]as slopes of 25 percent or greater," or "(d) [i]s within the 100-year flood plain," are not considered "suitable and available" under the buildable land definition. In practice, development is either prohibited or restricted through development regulations in such areas thereby. While the process of UGB expansion is ongoing in Eugene and Springfield, the proposed expansion sites are in compliance with the above statute. For more information on development trends in the community, see Appendix C, Community Profile.

Appendix H: 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 county planning commission, 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.

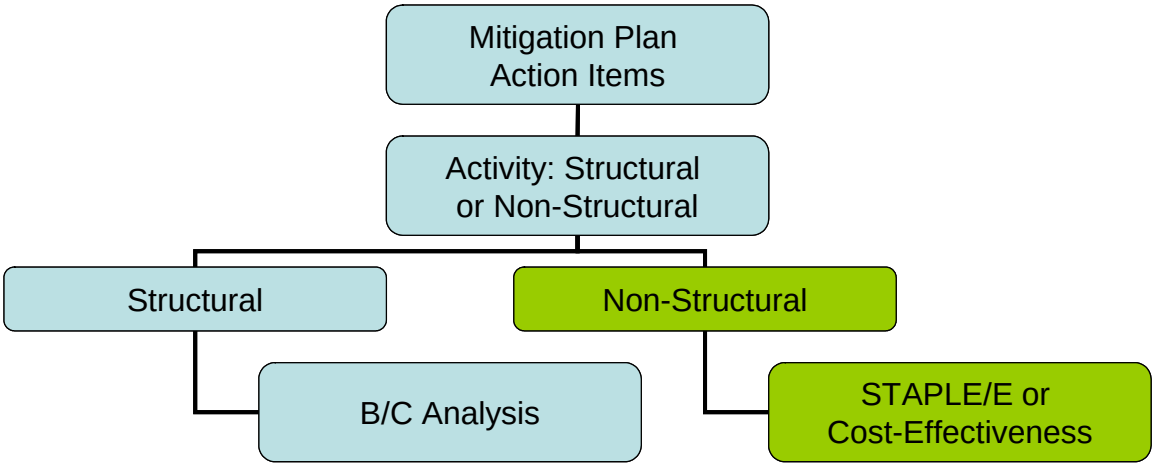
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

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 5-2. Economic Analysis Flowchart



Source: Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center, 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

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