

# **Regional Climate and Hazards Vulnerability Assessment**

**In support of:**

## **Eugene-Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan**



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**Prepared for:**

City of Eugene  
940 Willamette #200  
Eugene, Oregon 97401

City of Springfield  
225 Fifth Street  
Springfield, Oregon 97477

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### **Project Manager**

Matt McRae, City of Eugene

### **Vulnerability Assessment Steering Group**

Steve Adams, Institute for Sustainable Communities

Forrest Chambers, City of Eugene

Myrnie Daut, City of Eugene

Felicity Fahy, Eugene Water and Electric Board

Josh Foster, Oregon Climate Change Research Institute

Dr. Patrick Luedtke, Lane County Public Health

Babe O'Sullivan, City of Eugene

Ken Vogeney, City of Springfield

Jeff Weber, Oregon Department of Land Conservation and Development

Joe Zaludek, City of Eugene

### **Vulnerability Assessment Sector Experts**

In addition to the steering group 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 complete list of these participants can be found at the end of this document.

### **Community Service Center**

This project utilized extensive support and expertise provided by the Oregon Partnership for Disaster Resilience, a program of the University of Oregon's Community Service Center.

Josh Bruce, Interim Director, Oregon Partnership for Disaster Resilience

Mike Howard, Program Specialist, Oregon Partnership for Disaster Resilience

Adams "AJ" Bernhardt, Student Intern

Casey Hagerman, Research Associate

Jack Heide, Research Associate

Emily Kettell, Research Associate

Nick Metzler, Research Associate

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<sup>1</sup> This Climate and Hazards Vulnerability Assessment Report is Section 4 of the Eugene-Springfield Multi-Jurisdictional Natural Hazards Mitigation Plan

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### 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.

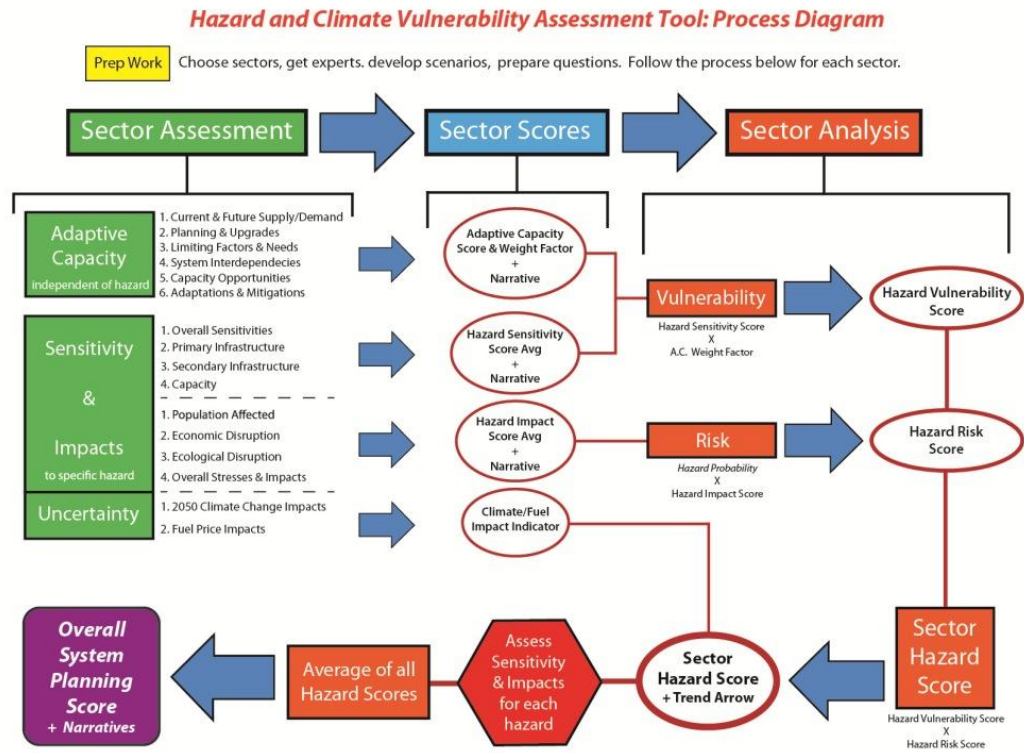
### **Geographic Boundaries**

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<sup>2</sup> 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.

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<sup>2</sup> See the [Oregon Resilience Plan](#): Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. Report to the 77th Legislative Assembly.



- *Exceedingly limited staff availability* in the aftermath of a severe earthquake will create problems and challenges that are difficult to predict or solve for.
- 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<sup>3</sup>.
- There is an existing conflict among fresh water users that are all critically dependent on summer water availability for:

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<sup>3</sup> 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>

- fisheries,
- hydroelectricity generation,
- 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<sup>4</sup> in the valley over the next 25 years - will likely place further strain on fresh water resources. Stresses

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<sup>4</sup> Environmental Migrants and the Future of The Willamette Valley: A Preliminary Exploration. USP 594: Planning in the Pacific Northwest Fall 2011

would be even greater if the Valley population grows more quickly than projections suggest.

### 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.

<b>Sector</b>	<b>Average Adaptive Capacity</b>	<b>Rating</b>
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.

<b>Sector</b>	<b>Average Adaptive Capacity</b>
Housing	2.31
Public Safety	2.51
Public Health	2.75

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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.

<b>Table 4-6. Three Lowest Self-Evaluation Scores</b>	
<b>Sector</b>	<b>Estimated Adaptive Capacity</b>
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.

<b>Table 4-7. The Three Systems With the Greatest Discrepancies Between Averaged and Self-Evaluated Adaptive Capacity Scores</b>	
<b>Sector</b>	<b>Percent Difference in Estimated vs. Average Adaptive Capacity</b>
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.

<b>Table 4-8. Hazard Sensitivities</b>				
<b>Sector</b>	<b>Earthquake</b>	<b>Flood</b>	<b>Wildfire</b>	<b>Winter Storm</b>
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

<b>Table 4-9. Hazard Impacts</b>				
<b>Sector</b>	<b>Earthquake</b>	<b>Flood</b>	<b>Wildfire</b>	<b>Winter Storm</b>
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	
<p><b>Critical Interdependencies:</b> Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</p> <ul style="list-style-type: none"> <li>■ Electricity</li> <li>■ Natural systems</li> <li>■ Transportation</li> <li>■ Fossil Fuels</li> </ul>	<p><b>Crucial Vulnerabilities:</b> Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</p> <ul style="list-style-type: none"> <li>■ EWEB has a single source for water and a single treatment and filtration plant</li> <li>■ EWEB, SUB, and RWD manage extensive transmission lines.</li> <li>■ All systems operate aging infrastructure including extensive underground pipe system.</li> <li>■ Single regional source for chlorine (Washington)</li> </ul>
<p><b>Major Findings:</b></p> <p>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.</p> <p>An earthquake will have catastrophic impacts to the system. Other hazards are of much lower concern.</p> <p>SUB's and RWD's water systems could be severely impacted by a large flood event</p> <p>All systems have inerties 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).</p> <p>Groundwater and surface water sources can be contaminated without the immediate knowledge of system managers.</p> <p>Regionally, the system has access to groundwater and two major rivers.</p>	

### **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 28<sup>th</sup> Street railroad tracks
- West system - south of Oregon route 126 and west of the 28<sup>th</sup> 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 plant 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	
<b>Critical Interdependencies:</b> <b>Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</b>	<b>Crucial Vulnerabilities:</b> <b>Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</b>
<ul style="list-style-type: none"> <li>■ Transportation</li> <li>■ Waste Water</li> <li>■ Wholesale/Retail Medical Supply Sector</li> <li>■ Energy</li> <li>■ Drinking Water</li> <li>■ Communication</li> <li>■ Public Safety</li> </ul>	<ul style="list-style-type: none"> <li>■ Reliance on highly skilled human labor</li> <li>■ Dependence on specialized equipment and access to laboratory and pharmaceutical services</li> <li>■ Demand for service currently at or exceeding available supply</li> <li>■ Highly regulated sector experiencing major regulatory transition</li> <li>■ Primary care physicians are actively leaving the Lane County area.</li> </ul>
<b>Major Findings:</b> <p>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.</p>	

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.<sup>5</sup> Likewise, government reimbursements

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<sup>5</sup> 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	
<b>Critical Interdependencies:</b> <b>Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</b>	<b>Crucial Vulnerabilities:</b> <b>Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</b>
<ul style="list-style-type: none"> <li>■ Transportation</li> <li>■ Natural Systems</li> <li>■ Residential and business customers</li> <li>■ Communication</li> </ul>	<ul style="list-style-type: none"> <li>■ Aging infrastructure</li> <li>■ Dependency on BPA for power</li> <li>■ Lead time on ordering critical equipment (e.g. high-voltage transformers)</li> <li>■ Lack of skilled labor</li> </ul>
<b>Major Findings:</b> <p>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 &amp; Electric Board (EWEB).</p> <p>Demand is low relative to current sector supply and capacity. However, the ability to add new hydropower generation is limited.</p> <p>The distribution system is highly interconnected resulting in system redundancy through power re-routing strategies.</p> <p>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.</p> <p>Earthquake is of major catastrophic concern for the sector.</p> <p>Wildfire and flood could both have minor impacts on the system, but are not a high concern overall.</p> <p>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.</p>	

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 distributors 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.

<b>Table 4-14. Transportation Sector Summary Table</b>	
<b>Critical Interdependencies:</b> <b>Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</b>	<b>Crucial Vulnerabilities:</b> <b>Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</b>
<ul style="list-style-type: none"> <li>■ Business and Industry</li> <li>■ Energy/Fuel</li> <li>■ Communications</li> <li>■ Housing</li> </ul>	<ul style="list-style-type: none"> <li>■ 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.</li> <li>■ Large scale, expensive infrastructure is very slow to change or adapt to new needs or demands.</li> <li>■ The system relies exclusively on fossil fuels for construction, operation, and maintenance activities.</li> <li>■ 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.</li> <li>■ There are few redundancies for E/W auto traffic using Hwy 126.</li> </ul>
<b>Major Findings:</b> <ul style="list-style-type: none"> <li>■ The built system relies heavily on institutional standards for guidance, causing delayed implementation of new design or construction practices.</li> <li>■ 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.</li> <li>■ There is a widespread need for well-considered evacuation plans for a variety of hazards.</li> </ul>	

### 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	
<b>Critical Interdependencies:</b> <b>Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</b>	<b>Crucial Vulnerabilities:</b> <b>Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</b>
<ul style="list-style-type: none"> <li>■ Electricity</li> <li>■ Transportation</li> <li>■ Fossil Fuel</li> <li>■ Natural systems</li> </ul>	<ul style="list-style-type: none"> <li>■ The majority of food consumed in Eugene-Springfield is stored in Portland and travels down I-5 by truck and trailer.</li> <li>■ Grocery stores stock only a three day supply of food</li> <li>■ External influences on agriculture and transportation sector have an undue influence on the price and availability of food in Eugene-Springfield</li> </ul>
<b>Major Findings:</b> <p>Local growers are impacted by flooding but flood is not a significant concern to the local food sector as a whole.</p> <p>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.</p> <p>An earthquake will have catastrophic impacts to the system. Other hazards are of much lower concern.</p>	

### 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.



<b>Table 4-16. Housing Sector Summary</b>	
<b>Critical Interdependencies:</b> <b>Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</b>	<b>Crucial Vulnerabilities:</b> <b>Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</b>
<ul style="list-style-type: none"> <li>■ Electricity</li> <li>■ Transportation</li> <li>■ Drinking water</li> <li>■ Sanitary sewer</li> </ul>	<ul style="list-style-type: none"> <li>■ The majority of residents do not have the necessary insurance to replace housing after catastrophe.</li> <li>■ Even if adequately insured to rebuild, the loss of jobs due to a catastrophe may result in foreclosure of insured properties.</li> <li>■ Economic crises, separate from natural catastrophe, may similarly result in foreclosures</li> </ul>
<b>Major Findings:</b>  <p>Housing not only provides shelter but acts as the primary delivery mechanism to access other essential services including drinking water, electricity, and sanitation.</p> <p>There is currently very little, if any, excess housing stock in the Eugene-Springfield area.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>College student population may transfer away from community institutions if inadequate housing exists due to catastrophic event.</p>	

### **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	
<b>Critical Interdependencies:</b> <b>Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</b>	<b>Crucial Vulnerabilities:</b> <b>Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</b>
<ul style="list-style-type: none"> <li>■ Electricity</li> <li>■ Transportation</li> </ul>	<ul style="list-style-type: none"> <li>■ 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</li> <li>■ 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.</li> <li>■ 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.</li> </ul>
<b>Major Findings:</b>  <p>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.</p> <p>There is a local broadcast radio station that, using federal funds, has been hardened to survive substantial earthquake and electromagnetic pulse.</p>	



### **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.

<b>Table 4-18. Public Safety Summary Table</b>	
<b>Critical Interdependencies:</b> <b>Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</b>	<b>Crucial Vulnerabilities:</b> <b>Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</b>
<ul style="list-style-type: none"> <li>■ Fossil Fuel</li> <li>■ Transportation</li> <li>■ Communications</li> <li>■ Drinking Water</li> <li>■ Non-Profits</li> </ul>	<ul style="list-style-type: none"> <li>■ Hazards that impact the entire region reduce the availability of resources from partner agencies and neighboring jurisdictions.</li> <li>■ Extended events (more than 12 hours) tap available local surge capacity</li> <li>■ The systems are heavily reliant on fossil fuels to operate</li> </ul>
<b>Major Findings:</b> <p>Some local law enforcement services including Oregon State Police and Lane County Sheriff's Office are currently operating at 90% - 100% of capacity</p> <p>Public Safety operations currently rely heavily on partner agencies for mutual aid during daily operations and extreme events.</p> <p>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.</p> <p>Law enforcement agencies struggle to find interested and qualified applicants.</p> <p>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</p>	

### **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 2<sup>nd</sup> 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 4<sup>th</sup> 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.

## **Eugene-Springfield Climate and Hazards Vulnerability Assessment**

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**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 18<sup>th</sup> 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.

## **Eugene-Springfield Climate and Hazards Vulnerability Assessment**

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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<sup>6</sup>.
- 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

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<sup>6</sup> 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	
<b>Critical Interdependencies:</b> Systems of all types are dependent on other systems in order to function. Natural Systems are <i>substantially less dependent</i> 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:	<b>Crucial Vulnerabilities:</b> Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:
<ul style="list-style-type: none"><li>■ Transportation</li><li>■ Fossil fuel</li><li>■ Communications</li></ul>	<ul style="list-style-type: none"><li>■ Natural systems are not directly vulnerable to many natural hazards but secondary impacts from flood or earthquake could be significant.</li><li>■ Climate change poses far greater threat to natural systems than do individual natural hazards like flood, wildfire, or earthquake.</li></ul>

### **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<sup>7</sup>, 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**

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<sup>7</sup> 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	
<b>Critical Interdependencies:</b> <b>Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</b>	<b>Crucial Vulnerabilities:</b> <b>Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</b>
<ul style="list-style-type: none"> <li>■ Natural Systems</li> <li>■ Sanitary Sewer</li> <li>■ Transportation</li> <li>■ Governance</li> </ul>	<ul style="list-style-type: none"> <li>■ An extreme precipitation event or large flood could cause water to back up in the piped system and could result in infrastructure damage.</li> </ul>
<b>Major Findings:</b> <p>The Eugene and Springfield stormwater systems are gravity fed requiring no electricity to operate.</p> <p>Of all the built systems assessed, the stormwater system is the least susceptible to natural hazards.</p> <p>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.</p> <p>Surface-based stormwater collection and conveyance systems are much more resilient to earthquakes than subsurface infrastructure.</p>	

## 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.<sup>8</sup> The Eugene Comprehensive Stormwater Master Plan is also available on line.<sup>9</sup>

### **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 find 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

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<sup>8</sup>

<http://www.ci.springfield.or.us/pubworks/EnvironmentalServices/Stormwater/StormwaterManagementPlan.pdf>.

<sup>9</sup> <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).<sup>10</sup>

### **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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<sup>10</sup> 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	
<b>Critical Interdependencies:</b> <b>Systems of all types are dependent on other systems in order to function. In order to operate, this sector is particularly dependent on:</b>	<b>Crucial Vulnerabilities:</b> <b>Each sector has a number of vulnerabilities. For this sector, the following are particularly notable:</b>
<ul style="list-style-type: none"> <li>■ Natural Systems</li> <li>■ Electricity</li> <li>■ Transportation</li> </ul>	<ul style="list-style-type: none"> <li>■ Three governing bodies must coordinate to take action beyond standard procedures</li> <li>■ New and replacement parts are custom made and must be trucked in from out of the area.</li> <li>■ Few parts manufacturers exist, and a major catastrophe is likely to create a spike in demand for parts</li> <li>■ Except when new construction triggers building code requirements, officials have no control over the thousands of private connections to the system</li> </ul>
<b>Major Findings:</b> <p>The system currently operates with a high degree of customer satisfaction.</p> <p>The long-term planning horizon for such a massive system is challenged by changing regulations.</p> <p>Increasing regulations increase the cost of service.</p> <p>A Cascadia earthquake event will result in significant damage to the system, with repairs taking months to years to complete.</p> <p>The system is in a constant state of repair/upgrade, which makes large-scale repairs slightly easier because employees have practical experience.</p> <p>A large system failure would result in untreated wastewater entering local waterways and detrimental effects would impact Eugene-Springfield and downstream communities.</p>	

### **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 changing 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
References		
1	G. F.White and H. J. Heinz. <i>The Hidden costs of Coastal Hazards</i> . H. John Heinz III Center for Science, Economics and the Environment. Island Press, Washington, USA, 2000.	
2	B. Phillips. <i>Holistic Disaster Recovery: Ideas for building local sustainability after a natural disaster</i> , 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. <i>The Australian Journal of Emergency Management</i> , 13(4):21–26, 1995.	
4	D. King and C. MacGregor. Using social indicators to measure community vulnerability to natural hazards. <i>Australian Journal of Emergency Management</i> , 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.	

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6	R. Bolin and L. Stanford. Shelter, Housing and Recovery: A Comparison of U.S. Disasters. <i>Disasters</i> , 15(1):24–34, 1991.
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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 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
<b>References</b>		
1	Bolin, R., and P. Bolton. 1986. <i>Race Religion and Ethnicity in Disaster Recovery</i> . Monograph No. 42. Boulder: University of Colorado, Institute of Behavioral Science.	



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2	Fothergill, A., and L. Peek. 2004. "Poverty and Disasters in the United States: A Review of Recent Sociological Findings." <i>Natural Hazards</i> 32:89–110.
3	Blanchard-Boehm, D. 1997. <i>Risk Communication in Southern California: Ethnic and Gender Response to 1995 Revised, Upgraded Earthquake Probabilities</i> . Research Report. Bolder, Colorado: Natural Hazards Research and Applications Information Center.
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11	Moser, S., and J. Ekstrom. 2010. <i>Developing Adaptation Strategies for San Luis Obispo County: Preliminary Climate Change Vulnerability Assessment for Social Systems</i> . Technical Report Prepared for the Local Government Commission and the San Luis Obispo Stakeholder Workshop on May 20, 2010.
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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." <i>American Journal of Public Health</i> 95 (5): 1402–1408.
14	Caruson, K., and S. A. MacManus. 2008. "Disaster Vulnerabilities: How Strong a Push Toward Regionalism and Intergovernmental Cooperation?" <i>The American Review of Public Administration</i> 38 (3): 286–306. <a href="http://arp.sagepub.com/content/38/3/286.full.pdf+html">http://arp.sagepub.com/content/38/3/286.full.pdf+html</a> .

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

### 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.



## Eugene-Springfield Climate and Hazards Vulnerability Assessment

<b>Table 4-24. Participant List</b>			
	<b>Name</b>	<b>Organization</b>	<b>Title</b>
<b>Communications Sector</b>	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
<b>Drinking Water</b>			
<b>Drinking Water Sector</b>	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

## Eugene-Springfield Climate and Hazards Vulnerability Assessment

<b>Table 4-24. Participant List</b>			
	<b>Name</b>	<b>Organization</b>	<b>Title</b>
	Sanjeev King	Springfield Utility Board	Electric Engineering Manager
	Steven Wages	Springfield Utility Board	Project Coordinator/Inspector
	Jamie Porter	Rainbow Water District	Superintendent
<b>Food</b>			
<b>Food Sector</b>	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.
<b>Housing</b>			
<b>Housing Sector</b>	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
<b>Electricity Sector</b>			
<b>Electricity Sector</b>	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

## Eugene-Springfield Climate and Hazards Vulnerability Assessment

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	PacificSource 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	

## Eugene-Springfield Climate and Hazards Vulnerability Assessment

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	

<b>Table 4-24. Participant List</b>			
	<b>Name</b>	<b>Organization</b>	<b>Title</b>
	<b>Public Safety</b>		
<b>Public Safety</b>	Krista Dillon	University of Oregon	
	Cindi Harper	Central Lane 9-1-1	
	Ted Glick	Central Lane 9-1-1	
	Ben Meigs	Eugene-Springfield Fire/EMS	
	Bill Solesbee, Lieutenant	City of Eugene Police Department	
	Richard Lewis, Captain	City of Springfield Police Department	
	Spence Slater	Lane County Sheriff's Office	
	Lt. Rob Edwards	Oregon State Police	
	Eric Johnson	City of Eugene Public Works	
	David Lindelien	Lane Transit District	
	Ken Vogeney	City of Springfield Public Works	
	Frank Williams	Lane Transit District	
	Kevin Finch	Oregon Department of Transportation	Transportation Maintenance Manager
	<b>Steering Group</b>		
<b>Steering Group</b>	Steve Adams	Institute for Sustainable Communities	
	Jeff Weber	Department of Land Conservation and Development	Coastal Conservation Coordinator
	Ken Vogeney	City of Springfield	City Engineer/Emergency Manager
	Jason York	City of Eugene	Emergency Manager
	Myrnie Daut	City of Eugene	Risk Services Director
	Forrest Chambers	City of Eugene	Interim Emergency Manager
	Felicity Fahy	Eugene Water & Electric Board	
	Josh Foster	Oregon Climate Change Research Institute	
	Joe Zaludek	City of Eugene	Deputy Chief
	Patrick Luedtke	Lane County	Chief Health Officer
	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 <sup>5</sup>
- Reduced precipitation in summer <sup>5</sup>
- Snowpack decline by 60% <sup>1</sup>
- Storm events increase in intensity with more flooding <sup>1</sup>
- Increased summer water shortages <sup>2</sup>
- Reduced summertime hydroelectric power <sup>1</sup>
- Increase in extreme heat events <sup>2</sup>
- Increase in wildfire frequency and intensity <sup>2</sup>
- Shift in growing season duration and timing <sup>1</sup>
- Earlier stream flow peaks <sup>3</sup>
- Increase in insects and plant pests <sup>2</sup>

#### **2050: Population and Energy Cost Scenario**

- Fuel prices doubled <sup>4</sup>
- Commodity, food and materials prices doubled <sup>4</sup>
- Increased city population density <sup>4</sup>

### **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](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](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](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](http://www.occri.net/OCAR)



