REGION 2

Northern Willamette Valley / Portland Metro[1]

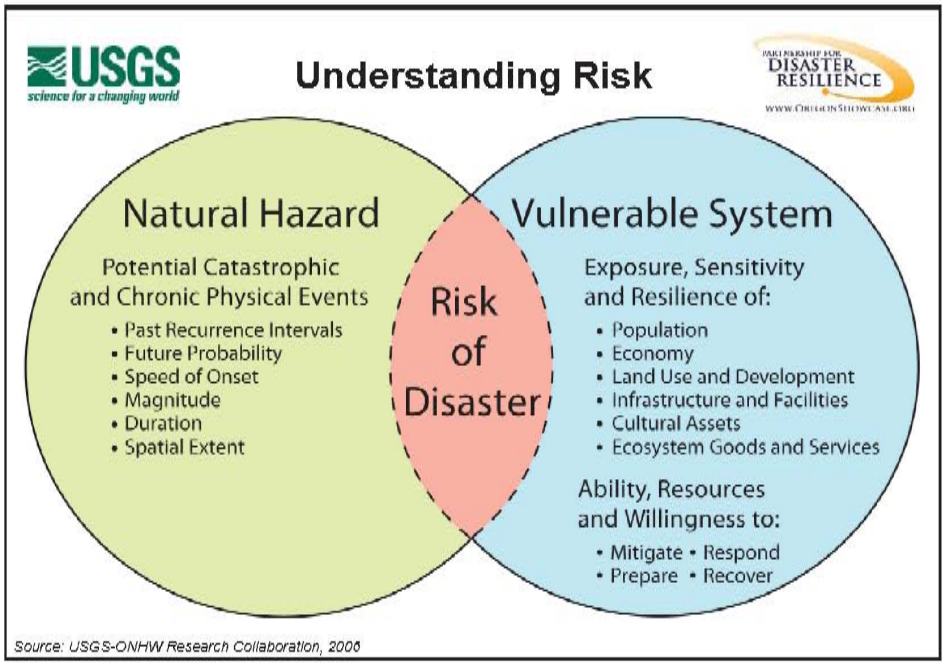
Regional Profile

[1] Includes the counties of Columbia, Clackamas, Multnomah and Washington.

Introduction and Purpose

Oregon faces a number of natural hazards with the potential to cause loss of life, injuries and substantial property damage. A natural disaster occurs when a natural hazard event interacts with a vulnerable human system. The following quote and graphic summaries the difference between natural hazards and natural disasters:

> Natural disasters occur as a predictable interaction among three broad systems: natural environment (e.g., climate, rivers systems, geology, forest ecosystems, etc.), the built environment (e.g., cities, buildings, roads, utilities, etc.), and societal systems (cultural institutions, community organization, business climate, service provision, etc.). A natural disaster occurs when a hazard impacts the built environment or societal systems and creates adverse conditions within a community. [i]



It is not always possible to predict exactly when a natural disaster will occur or the extent to which they may impact the community. However, communities can minimize losses from disaster events through deliberate planning and mitigation. A report submitted to Congress by the National Institute of Building Science's Multi-hazard Mitigation Council (MMC) highlights that for every dollar spent on mitigation society can expect an average savings of $4.[ii]

How to use this Report

The Partnership for Disaster Resilience (*Partnership*) at the University of Oregon's Community Service Center developed this report as part of a regional planning initiative funded by the Pre-Disaster Mitigation Grant Program. In addition to serving as a regional resource for local planning initiatives, this also serves as the regional profile for the State's Enhanced Natural Hazard Mitigation Plan. This report is intended to be used as a planning process document by communities developing local natural hazard mitigation plans. This regional report should be reviewed and updated by locals using the best available local data as the local plans serve as the foundation for the State Plan.

The information in this report should be paired with local data to identify issues for which mitigation action items can be developed. The report can be used in conjunction with assistance from *Partnership* staff to develop and document community specific action items. For more information on *The Partnership* or the training series see: www.oregonshowcase.org.

Regional Overview

The Northern Willamette Valley / Portland Metro region (Region 2 as identified in the State's Natural Hazard Mitigation Plan) includes Clackamas, Columbia, Multnomah and Washington Counties. This region is at relatively high risk from floods, landslides, wildfires, and winter storms. It also faces moderate to high risk from earthquakes, and volcanic activity. The extensive urban infrastructure in parts of the region means natural hazard events can lead to power outages, building collapse, dam failures and HAZMAT operations.

Organization of Report

This report includes four main sections that work together to develop a comprehensive picture of the region and its sensitivity to natural hazards.

Regional Maps

Critical Infrastructure Map

Using 2003 data from Oregon Department of Transportation, this map shows the approximate location of critical infrastructure, including schools, hospitals, bridges, dams, and power stations. Knowing the location of critical infrastructure is important when determining the sensitivities of the region.

County Hazard Risk Analysis Maps

These maps depict the county's perceived risk for each natural hazard. Data for these maps comes from the County Hazard Risk Analysis in which each county develops risk scores for Oregon's major natural hazards. Scores are current as of March 2004

Regional Profile and Sensitivity Analysis

Using the best available data, the regional profile includes a *Geographic Profile*, which provides a physical description of the region, a *Demographic Profile* that discusses the population in the Northern Willamette Valley / Portland Metro region, an *Infrastructure Profile* that addresses the region's critical facilities and systems of transportation and power transmission, and an *Economic Profile* that discusses the scale and scope of the regional economy with a focus on key industries. In addition to describing characteristics and trends, each profile section identifies the traits that indicate the region's sensitivity to natural hazards.

The data sources used in this section are all publicly available. This report examines the Northern Willamette Valley / Portland Metro region as a whole and by individual counties when possible.

Regional Hazards Assessment

The regional natural hazard risk assessment section describes historical impacts, the general location, extent, and severity of past natural hazard events as well as the probability for future events. This information is aggregated at the regional level and provides counties with a baseline understanding of past and potential natural hazards.

These assessments were based on best available data from various state agencies related to historical events, repetitive losses, county hazard analysis rankings, and general development trends. The risk assessment was written in 2003 as part of the State Natural Hazard Mitigation Plan, and updated in 2012 as part of the State's Plan Update.

Regional State Facilities Tables

The state of Oregon has prepared an analysis of state owned and managed facilities. This analysis is a first step at assessing which state owned structures are most vulnerable to the various hazards identified by region. From this overview, it is clear that a more detailed assessment in the future will yield a clearer picture of those structures specifically threatened by certain disasters and the potential damage that may occur.

North Willamette Region

Encompassing the Portland metropolitan area, the North Willamette region is home to nearly half of the state's population. In 2010, the population of the region had increased 14% since 2000. Seventy-four percent of the region's population lives in incorporated areas and 26% live in unincorporated areas. The older the house, the greater risk of damage from natural disaster, and 30% of the region's housing was built before 1960. Twenty-eight percent were built between 1960 and 1980, and 41% after 1980. Transportation networks are another important consideration in hazard mitigation. In very dramatic fashion, flooding and landslides (which occur frequently in this region) can impact roads, bridges and railways. The average commute for workers in the region is 25 minutes each way. Seventy percent of residents in this region drive alone to work, 10% carpool, and 7% use public transportation. Most bridges in the area have not been seismically retrofitted, creating significant risk to the commuting population in areas at risk from earthquakes.

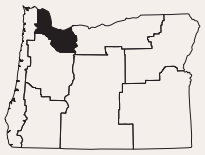
REGION FACTS

Population: 2010 Census

Total	1,690,397
Rural	454,712
Urban	1,235,680

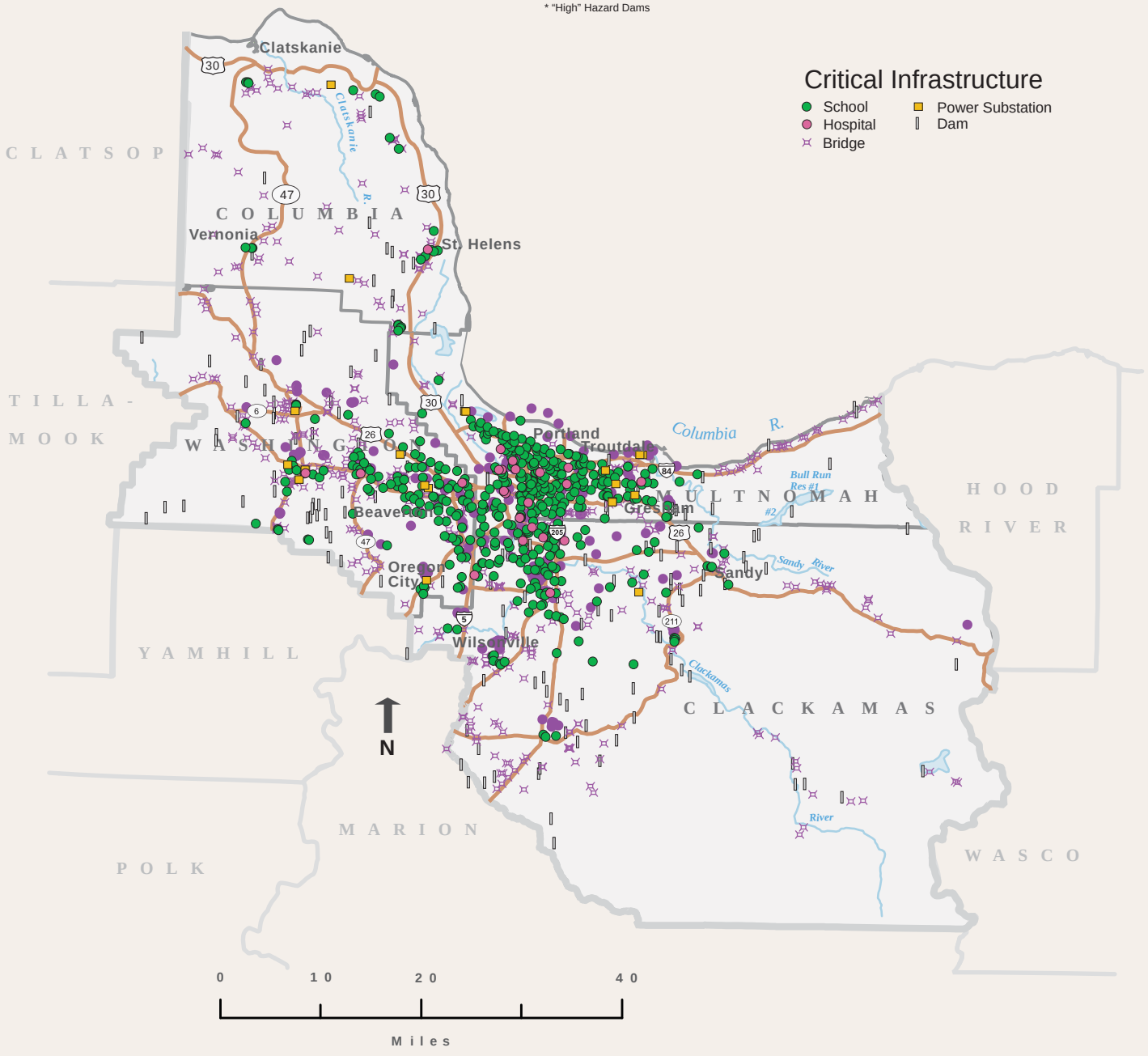
Housing:

Single-Family	66%
Multi-Family	31%
Mobile Homes	4%
Boat, RV, Van, etc	>1%



County	# of Hospitals	# of Hospital Beds	Police Stations	Fire & Rescue Stations	Power Plants	Dams*	Bridges
Clackamas	3	418	11	10	0	6	284
Multnomah	7	2339	11	43	0	7	454
Washington	2	279	14	23	0	3	306
Columbia	0	0	7	7	1	0	122

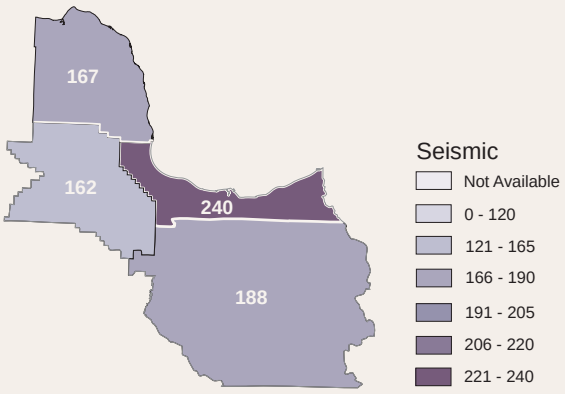
* "High" Hazard Dams



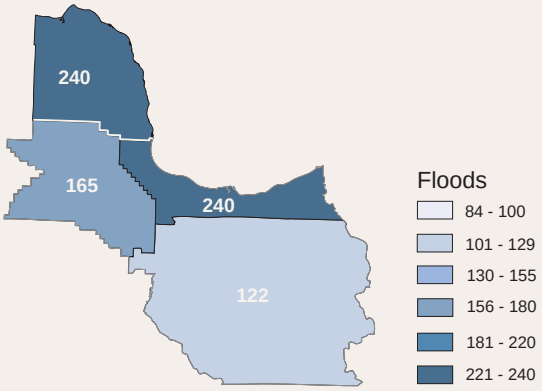
As part of the County Hazard Risk Analysis, each county develops risk scores for Oregon's major natural hazards. This score, ranging from 24 (low) to 240 (high), reflects the County's perceived risk for the particular hazard. Scores are current as of November 2008.

To obtain the most current scores, see http://www.oregonshowcase.org or contact Oregon Military Department– Office of Emergency Management http://www.oregon.gov/OMD/OEM.

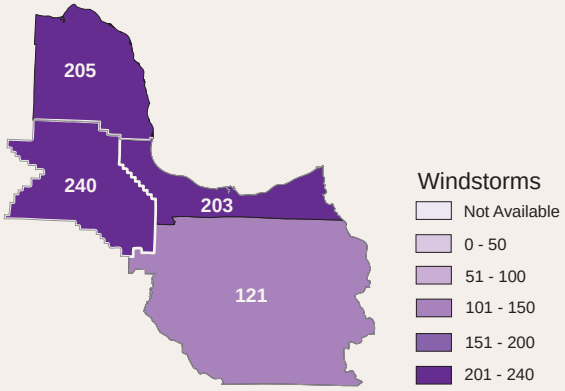
Seismic



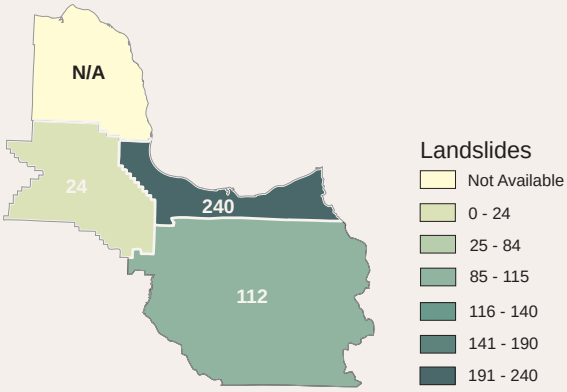
Floods



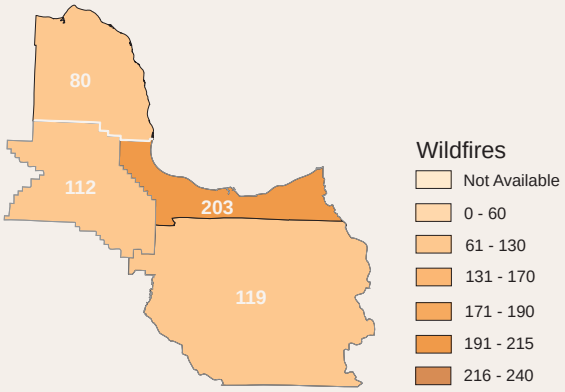
Windstorms



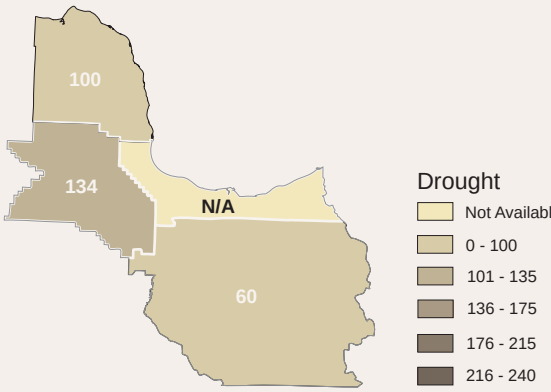
Landslides



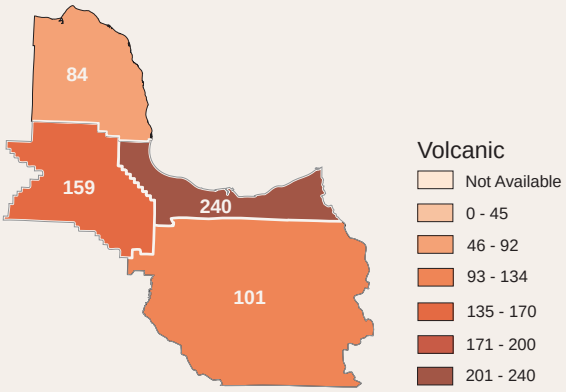
Wildfires



Drought



Volcanic



Regional Profile and Sensitivity Analysis

Section 1: Geography and Climate

The four-county area of the Northern Willamette region is approximately 3,684 square miles. The western side of the region begins at the coast and includes the Coast Range. To the west, the region ends in the foothills of the Cascades and includes Mount Hood. The Cascades are volcanic in origin and are drained by hundreds of creeks, streams, rivers and lakes. The major river in the region is the Columbia. Average annual precipitation in the region ranges from over 180 inches in the wettest parts of Columbia County to about 30 inches in the rain shadow of Mount Hood. [iii]

Section 2: Demographic profile

This section describes the Northern Willamette region in terms of its population, demographics and development trends. Data is followed by a discussion of characteristics that indicate community vulnerability to natural hazards. Identifying populations that are particularly vulnerable enables communities to design targeted strategies to reduce their risk. Reviewing development trends provides further guidance on how communities can accommodate growth in a manner that increases resilience to natural hazards.

Population and Demographics

In 2010, the population of the Northern Willamette/Portland Metro region was 1,690,397 representing an increase of 13.6% since 2000. This rapid growth in the Willamette Region (including the Portland Metropolitan area) is projected to continue at a rate of 1.9% per year over the next 20 years, according to the Oregon Office of Economic Analysis.[iv] Table 1 displays the population change in each Northern Willamette/Portland Metro region county.

Table 1. Population Growth, Northern Willamette Region, 2000-2010

County	2000 Population	2010 Population	2000-20010 Population Change	% Change 2000-2010
Clackamas	338,391	375,992	37,601	11.1%
Columbia	43,560	49,351	5,791	13.3%
Multnomah	660,486	735,344	74,858	11.3%
Washington	445,342	529,710	84,368	18.9%
Regional Total	1,487,779	1,690,397	202,618	13.6%

Sources: U.S. Census Bureau: 2000 Census Summary File 1. U.S. Census Bureau: 2010 Census Summary File 1.

Median household income can be used to compare economic areas as a whole, but does not reflect how the income is divided among area residents. Table 2 illustrates the median household income for the Northern Willamette Region, which was $57,581 in 2009. This is above the 2009 national average of $51,425

and the state's average of $49,033. The 16.3% median household income growth between 2000 and 2009 in the region is smaller than the 19.8% State and 22.5% national increase.[v]

Table 2. Median Household Income, Central Region, 2000 and 2009

County	2000	2009	% Change 2000-2009
Clackamas	52,670	62,030	17.8%
Columbia	47,133	56,903	20.7%
Multnomah	43,153	49,171	13.9%
Washington	55,139	62,218	12.8%
Regional Average:	49,524	57,581	16.3%

Source: U.S. Census Bureau. 2005-2009. American Community Survey – 5 year estimates

The impact in terms of loss and the ability to recover varies among population groups following a disaster. Historically, 80% of the disaster burden falls on the public.[vi] Of this number, a disproportionate burden is placed upon special needs groups, particularly minorities, and the poor.

In 2009, 13.5% of the nation's population was living in poverty, which was higher than the Northern Willamette regional poverty level of 12.0%. Oregon's state poverty average was 13.6%, slightly higher than the Northern Willamette and national averages.[vii] Table 3 details the county and regional poverty rates in 2009.

Table 3. Poverty Rates, Northern Willamette Region, 2007

	Total Population in Poverty		Children Under 18 in Poverty	
County	Number	%	Number	%
Clackamas	33,205	8.9%	10,244	11.3%
Columbia	4,284	8.9%	1,212	10.1%
Multnomah	106,122	15.5%	30,150	20.2%
Washington	50,091	9.8%	16,711	12.4%
Regional Average	--	12.0%	--	15.1%

Source: U.S. Census Bureau. 2005-2009. American Community Survey – 5 year estimates

Low-income populations may require additional assistance following a disaster because they may not have the savings to withstand economic setbacks, and if work is interrupted, housing, food, and necessities become a greater burden. Additionally, low-income households are more reliant upon public transportation, public food assistance, public housing, and other public programs, all which can be impacted in the event of a natural disaster.

The age of the population is also an important consideration in hazard mitigation planning. In 2010, 30.2% of the regional population was under 14 or over 65 years of age.[viii] Table 4 provides a breakdown of the percentages of youth and elderly in the Northern Willamette region counties.

Table 4. Youth and Senior Populations, Northern Willamette Region, 2010

	0-14		65-74		75+	
County	**Number**	**%**	**Number**	**%**	**Number**	**%**
Clackamas	72,391	19.13%	28,451	7.6%	22,780	6.1%
Columbia	9,502	17.53%	4,063	8.2%	2,820	5.7%
Multnomah	127,425	21.5%	41,016	5.6%	36,407	5.0%
Washington	113,830	19.1%	28,725	5.4%	24,384	4.6%
Regional Total and Average %	323,148	19.1%	102,255	6.0%	86,391	5.1%

Source: U.S. Census Bureau. 2010 Census.

The elderly individuals in the region may require special consideration due to increased sensitivities to heat and cold, possible reliance upon transportation for medications, and comparative difficulty in making home modifications that reduce risk to hazards.

Young people also represent a potentially vulnerable segment of the population. In the Northern Willamette region nearly 20% of the population is within the 0-14 year age range. Special considerations should be given to young populations and schools, where children spend much of their time, during the natural hazard mitigation process. Children are more vulnerable to heat and cold, have fewer transportation options, and require assistance to access medical facilities.

Special consideration should also be given to populations who do not speak English as their primary language. Non-English speaking populations can be harder to reach with preparedness and mitigation information materials. They are less likely to be prepared if special attention is not given to language and culturally appropriate outreach techniques. In the Northern Willamette region, most citizens speak English as their primary language. However, in every county in Oregon, Spanish is the second most prominent language. Table 5 shows the percentage of the individuals in the Northern Willamette region who speak English less than "very well". On average, 8.4% of the total population in the Northern Willamette region speaks English less than "very well".[ix]

Table 5. Population over age 5 that Speaks English less than "Very Well", Northern Willamette Region, 2009

County	**% Population**
Clackamas	4.7%
Columbia	1.4%
Multnomah	9.4%
Washington	10.6%
Regional Average	8.4%

Source: US Census Bureau, 2005-2009 American Community Survey – 5 year estimates

The impact in terms of loss and the ability to recover may also vary among minority population groups following a disaster. Table 6 provides a breakdown of the percentages of minorities in the Northern Willamette region.

Table 6. Population by Race*, Northern Willamette Region, 2010

County	Hispanic/ Latino	Asian	African American	Native American	Total
Clackamas	7.7%	3.7%	less than 1%	less than 1%	13%
Columbia	4.0%	less than 1%	less than 1%	1.3%	6.6%
Multnomah	10.9%	6.5%	5.6%	1.1%	24.1%
Washington	15.7%	8.6%	1.8%	less than 1%	26.8%

Source: U.S. Census Bureau, 2010 Census[x]

* Racial data is not mutually exclusive or exhaustive, respondents may identify with more than one race including races not in this table

HOUSING AND DEVELOPMENT

To accommodate rapid growth, communities engaged in mitigation planning should consider the vulnerability of the community's housing stock and development patterns. Eliminating or limiting development in hazard prone areas, such as floodplains, can reduce vulnerability to hazards, and the potential loss of life and injury and property damage. Oregon has been successful in developing land use goals that incorporate mitigation while preserving rural and protected lands within urban growth areas. Communities in the process of developing land for housing and industry need to ensure that these goals are being met to prevent future risks.

The urban and rural growth pattern impacts how agencies prepare for emergencies as changes in development can increase risks associated with hazards. The Northern Willamette region is growing more urban, with 1.2% percent population growth in incorporated areas between 2000 and 2010. Columbia County experienced the most rapid urbanization during the time period with an 5.5% increase in urban population.[xi] Table 8 illustrates the trend in urban area population growth in the Northern Willamette counties between 2000 and 2010.

Table 7. Urban/Rural Populations, Northern Willamette Region, 2000-2010

County	% Incorporated Population 2000	2010	% Change 2000-2010
Clackamas	48.2%	52.6%	4.4%
Columbia	50.9%	56.4%	5.5%
Multnomah	97.9%	97.9%	0.0%
Washington	57.7%	58.3%	0.6%
Regional Average	73.1%	74.0%	0.9%

Source: Portland State University Population Estimates, 2010

In addition to location, the character of the housing stock also affects the level of risk that communities face from natural hazards. Table 9 provides a breakdown by county of the various housing types available in 2009.[xii] Mobile homes and other non-permanent housing structures, which account for around 4% of the housing

in the Northern Willamette region, are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing these types of structures.

Table 8. County Housing Profile, Northern Willamette Region, 2009

County	Single-Family	Multi-Family	Mobile Homes	Boat, RV, Van, etc.
Clackamas	72.4%	20.8%	6.6%	Less than 1%
Columbia	75.0%	10.1%	14.3%	Less than 1%
Multnomah	62.0%	35.8%	2.0%	Less than 1%
Washington	65.7%	31.4%	2.8%	Less than 1%
Regional Average	65.8%	30.5%	3.6%	Less than 1%

Source: U.S. Census Bureau. 2005-2009. American Community Survey – 5 year estimates

Table 8 shows that the majority of the housing stock is in single-family homes and this trend is continuing with new construction. In 2010, an estimated 69% of new housing was single-family units.[xiii] This trend suggests that hazard mitigation efforts should provide outreach and information that specifically addresses preparedness in detached housing units.

Mobile residences make up nearly 4% of housing in the region. In many disaster events, moveable structures are likely to shift on their foundations and create hazardous conditions for occupants.[xiv] Because they require less infrastructure, mobile homes are more likely to be located in remote areas where wildfire danger is greater. The roadway infrastructure needs of occupants of RVs and small mobile homes should be considered when planning evacuation routes.

Aside from location and type of housing, the year housing structures were built has implications for community vulnerability. The older a home is, the greater the risk of damage from natural disaster. This is because structures built after the late 1960s in the Northwest and California used earthquake resistant designs and construction techniques. In addition, FEMA began assisting communities with floodplain mapping during the 1970s, and communities developed ordinances that required homes in the floodplain to be elevated to one foot over Base Flood Elevation. Knowing the age of a structure is helpful in targeting outreach regarding retrofitting and insurance for owners of older structures. Table 9 illustrates the percentage of homes built per county during certain periods of time.[xv]

Table 9. Housing-Year Built, Northern Willamette Region, 2009

County	Pre-1939 - 1959	1960-1979	1980 – 2009
Clackamas	19%	33%	47%
Columbia	42%	28%	30%
Multnomah	48%	24%	28%
Washington	11%	31%	58%

Source: U.S. Census Bureau. American Community Survey 5-Year Estimates.

Section 3: Infrastructure Profile

This section of the report describes the infrastructure that supports Northern Willamette region communities and economies. Transportation networks, systems for power transmission, and critical facilities such as hospitals and police stations are all vital to the functioning of the region. Due to the fundamental role that infrastructure plays both pre- and post-disaster it deserves special attention in the context of creating more resilient communities. The information that is provided in this section of the profile can provide the basis for informed decisions about how to reduce the region's infrastructural vulnerabilities to natural hazards.

TRANSPORTATION

The Northern Willamette Region encompasses the Portland metropolitan area and is home to nearly half of the state's population. Workday commuters can maximize the optimal capacity of transportation infrastructure during peak hours and increase the risk of traffic congestion and accidents. Emergency events can further disrupt automobile traffic and shut down local transit systems, making local and/or regional evacuations difficult. Hazards such as localized flooding can render roads unusable. Likewise, a severe winter storm has the potential to disrupt the daily driving routine of thousands of people.

According to Census 2009 American Community Survey data, the average commute for workers in the Northern Willamette Region is 25 minutes each way. 80% of commuters travel by personal vehicle; 70% ride alone and 10% carpool. About 7% of commuters in Northwest Region counties with a transit system (Clackamas, Multnomah and Washington Counties) use public transit.[xvi] The area is serviced by a regional transit system (Tri-met) that provides both bus and light rail service through the greater Portland Metropolitan area. The light rail transit system (MAX) provides mass transportation in an east and west direction between Hillsboro (Washington County), downtown Portland and the east Portland suburb of Gresham (Multnomah County). Tri-met has future plans to extend the MAX rail system to provide additional service within Clackamas County.

Roads and Bridges

The region's major expressway is Interstate 5 (I-5). I-5 runs north/south through the Portland Metropolitan area and the Willamette Valley and is the main passage for automobiles and trucks traveling from Washington to California. Other major highways that service this region include:

- Interstate 84: Interstate 84 is the main transportation route for automobiles and trucks traveling from Oregon to the central and eastern states. It originates in Portland and runs eastward.
- Interstate 205: intersects with Interstate 5 in Clackamas County and creates an eastern loop around Portland through Multnomah County. It rejoins Interstate 5 in Washington State.
- US Highway 26: intersects U.S. Highway 101 in Clatsop County and connects the coastal region with Portland and points farther east.

Daily, transportation infrastructure capacity in the Northern Willamette region is stressed by maintenance, congestion, and oversized loads. Natural hazards can further disrupt automobile traffic and create gridlock. This makes evacuations difficult.

The condition of bridges in the region is also a factor that affects risk from natural hazards. Most bridges are not seismically retrofitted, which is a particularly important issue for the Northern Willamette region because of its risk from earthquakes. Incapacitated bridges can disrupt traffic and exacerbate economic losses because of the inability of industries to transport services and products to clients. Table 10 shows the number of state, county, and city maintained bridges, and the number of historic covered bridges in the region. The bridges in the region are part of the state and interstate highway and maintained by the Oregon Department of Transportation.

Table 10. Bridge Inventory, Northern Willamette Region

County	State Highway Bridges	County Highway Bridges	City/Municipal Highway Bridges	Historical Covered Bridges	Total
Clackamas	113	155	16	0	284
Columbia	31	82	9	0	122
Multnomah	282	44	127	1	454
Washington	119	154	33	0	306

Source: Oregon Department of Transportation, 2011

Railroads

Railroads are major providers of regional and national cargo and trade flows. Railroads that run through the Northern Willamette region provide vital transportation links from the Pacific to the rest of the country. The Portland & Western (P&W) and the Union Pacific Railroad (UP) are the two major railroads in the region. The Port of Tillamook Bay runs a line that connects Portland to the coast. Burlington Northern Santa Fe (BNSF) runs a line between Portland and Seattle. Oregon Pacific runs a line in Clackamas County.

The P&W and UP lines run a similar north-south route through the Portland Metro area. North of Portland, the P&W runs through Columbia County and terminates in Clatsop County. The UP continues north to Spokane. To the south, the UP runs through Oregon to Southern California where the tracks turn east and continue to Texas.[xvii]

Sixteen million tons of goods produced in Oregon are shipped out of state by railroad per year. The goods include lumber and wood products, pulp and paper, and miscellaneous mixed shipments.[xviii] Over 23 million tons of products originating in other states are annually shipped into Oregon by rail including wood, farm products, coal, and waste materials.[xix] More than 22 million tons of products are shipped through Oregon annually by rail. More than 6 million tons of these products include grains and soybeans transported from the Northern Midwest to Washington.[xx]

Rails are sensitive to icing from the winter storms that can occur in the Northern Willamette region. For industries in the region that utilize rail transport, these disruptions in service can result in economic losses. As mentioned above, the potential for rail accidents caused by natural hazards can also have serious implications for the local communities if hazardous materials are involved.

Airports

The Northern Willamette region has one primary commercial service airport, two reliever airports, eight general aviation airports and one public helipad. Table 12 shows the number and designation of the airports in the Northern Willamette region.

Table 11. Public Airports, Northern Willamette Region, 2011

County	Commercial Service	Reliever Airport	General Aviation	Helipad
Clackamas			4	
Columbia			2	
Multnomah	1	1		1
Washington		1	2	
Total	1	2	8	1

Source: FAA Airport Master Record (Form 5010)[xxi]

Portland International Airport (PDX) is the busiest airport in the state. Trips through PDX make up 90% of passenger movement and over 95% of freight movement through the state. Portland-Hillsboro Airport and Portland Troutdale Airport are designated as reliever airports by the FAA. Flight availability out of the Portland-Troutdale airport is often restricted because PDX take off and approach paths cross directly above the smaller airport.

Flights face the potential for closure from a number of natural hazards that are common in the Northern Willamette region, including windstorms and winter storms. Airports have strict guidelines regarding when conditions are safe for flight.

Critical Facilities

Critical facilities are those facilities that are essential to government response and recovery activities (e.g., police and fire stations, public hospitals, public schools). Critical facilities in the Northern Willamette region are displayed in Table 13 by county.

Table 12. Critical Facilities, Northern Willamette Region

County	Hospitals # of Hospitals	Hospitals # of Beds	Police Stations	Fire & Rescue Stations	School Districts & Colleges
Clackamas	3	408	11	17	10 districts-1 Com. College-2 Universities
Columbia	0	0	7	5	5 districts
Multnomah	7	2339	10	43	8 districts-2 Com.Colleges-19 Universities
Washington	2	279	14	24	7districts- 4 Universities

Sources: Oregon Association of Hospitals and Health Systems, Local Sheriff Offices, Oregon State Fire Marshall, Oregon Department of Education. Table updated December 2011.

In addition to those listed in Table 12, there are other critical and essential facilities that are vital to the continued delivery of key governmental services or that may significantly impact the public's ability to recover from emergencies. Some of these facilities, such as correctional institutions, public services buildings, law enforcement centers, courthouses, juvenile services buildings, public works facilities, and other public facilities should be detailed in local and regional mitigation plans.

Power Generation and Transmission

The Northern Willamette region is an important throughway for oil and gas pipelines and electricity transmission lines, connecting Oregon to California and Canada. The infrastructure associated with power generation and transmission plays a critical role in supporting the regional economy.

The Bonneville dam is the largest dam in the Northern Willamette region. Positioned across the Columbia River, the Bonneville has a maximum generating capacity of 250 megawatts (mw.). The dam stores 277,000 acre feet of water.[xxii]

Dam failures can occur at any time and are quite common. Fortunately, most failures result in minor damage and pose little or no risk to life safety. However, the potential for severe damage and fatalities does exist, and the National Inventory of Dams (NID) has developed a listing of High Threat Potential Hazard dams for the nation. The state has developed a complementary inventory of dams in Oregon. Table 13 lists the dams included in these inventories.

Table 13. Power Plants and Dams, Northern Willamette Region

County	Power Plants	Dams	
		# of Dams	# High Threat
Clackamas	0	71	6
Columbia	1 – 650 MW	12	0
Multnomah	1-250 MW	26	7
Washington	0	95	4

Source: Oregon Department of Energy, National Inventory of Dams.[xxiii]

The electric, oil, and gas lines that run through the Northern Willamette region are privately owned. A network of electricity transmission lines running through the Northern Willamette region allows Oregon utility companies to exchange electricity with other states and Canada.[xxiv] Most of the natural gas Oregon uses originates in Alberta, Canada. One main natural gas transmission pipeline, owned by PG&E, runs through the Northern Willamette region.[xxv] This line may be vulnerable to severe, but infrequent natural hazards, such as earthquakes.

Section 4: Economic Profile

The following economic profile addresses the regional economy and its sensitivities to natural hazards. The sensitivities that are relevant to the Northern Willamette region are a function of the types and diversity of industries and the composition of businesses that are present. To highlight key industries, this report will look at:

The largest revenue sectors, since interruptions to these industry sectors would result in significant revenue loss for the region.

The largest employment industries, since interruptions to these industry sectors would result in high unemployment in the region.

The industry sectors with the most businesses, since interruptions to these industry sectors would result in damage to the most businesses regionally.

By examining these key industry sensitivities and other economic sensitivities, such as industry diversity and the number of small businesses that exist in the Northern Willamette region, informed decisions can be made about how to mitigate risk.

Economic Overview

The Northern Willamette region is the economic center of Oregon. Between 1995 and 2000, employment in this region increased by approximately 84,000 jobs, attributed primarily to the high-tech industry. The high-tech industry boom, Portland's high quality of life, and affordable housing resulted in an increased population rate and additional employment opportunities in other industry sectors.

According to the Oregon Employment Department, there was a 9% unemployment rate in the Region 2 in October, 2011.[xxvi] The unemployment rate was highest in Columbia County at 10.1%.[xxvii] In 2007, the Oregon Economic and Community Development Department recognized Columbia County as one of ten "economically distressed" counties.[xxviii] The Portland area also saw a noteworthy increase in employment – an increase of 2.3%from the first quarter of 2010 to the first quarter of 2011.[xxix]

Looking towards the future, the high tech industry, electronics, transportation, metals, healthcare, administrative, finance and retail trade sectors will continue to grow at a moderate rate and develop to provide goods, services and work opportunities for the area residents. As of 2010, the region employed 802,682 people with a combined payroll of over 38 billion dollars. Table 14 displays the payroll and employee figures per county.

Table 14. Employment and Payroll, Northern Willamette Region, 2010

County	# of Employees	Annual Payroll	Average Pay
Clackamas	136,805	$5,766,675,559	$42,153
Columbia	9,664	$311,735,769	$32,324
Multnomah	421,452	$19,898,507,268	$47,214
Washington	234,762	$12,675,106,283	$53,991
Total	802,682	$38,652,024,879	$48,154

Source: Oregon Employment Department.[xxx]

In 2010, there were 42,979 businesses in the Northern Willamette region. Of these, 87%, or 37,556, were small businesses with less than 20 employees.[xxxi] The prevalence of small businesses in the Northern Willamette region is an indication of sensitivity to natural hazards because small businesses are more susceptible to financial uncertainty.[xxxii] When a business is financially unstable before a natural disaster occurs, financial losses (resulting from both damage caused and the recovery process) may have a bigger impact than they would for larger and more financially stable businesses.[xxxiii]

The economic diversity of the businesses in the Northern Willamette region varies markedly between counties. Clackamas, Multnomah and Washington Counties are all in the top quarter of economic diversity. Columbia County has a more homogenous economy. Low economic diversity means that certain industries are dominating the economic structure of the community, and are therefore extremely important to the Northern Willamette region. Table 15 displays the diversity ranking for each county with 1 being the most diverse economic county in Oregon, 36 being the least diverse economic county in Oregon.

Table 15. Economic Diversity Ranking, Northern Willamette Region, 2009

Economic Diversity Index Ranking		
County	**Rank**	**Value**
Clackamas	1	.855
Columbia	12	.485
Multnomah	2	.838
Washington	6	.656

Source: Oregon Employment Department[xxxiv]

An economy that is heavily dependent upon a few key industries may have a more difficult time recovering after a natural disaster than one with a more diverse economic base. While a community with a diverse economic base may suffer from an industry sector being damaged during a natural disaster, they have a broader base of operating industry sectors to continue to rely upon. However, a community that relies upon specific key industry sectors may have a harder time recovering their economic base if one of those key industry sectors is damaged. Recognizing that economic diversification is a long-term issue, more immediate strategies to reduce vulnerability should focus on risk management for the dominant industries.

KEY INDUSTRIES

Key industries are those that represent major employers, major revenue generators, and for the purposes of hazard mitigation planning, industries that are represented by a high number of businesses. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry specific discussions below. Identifying key industries in the region enables communities to target mitigation activities towards those industries' specific sensitivities.

It is important to recognize that the impact that a natural hazard event has on one industry can reverberate throughout the regional economy. The effect is especially great when the businesses concerned belong to a basic sector industry. Basic sector industries are those that are dependent on sales outside of the local community; they bring money into a local community via employment. The farm and ranch, information, and wholesale trade industries are all examples of basic industries. Non-basic sector industries are those that are dependent on local sales for their business, such as retail trade, construction, and health and social assistance.

Basic sector businesses have a multiplier effect on a local economy, whereby the jobs and income they bring to a community allow for the creation of new non-basic sector jobs. Their presence can therefore help speed the recovery process following a natural disaster. If, on the other hand, basic sector industry production is hampered by a natural hazard event, the multiplier effect could be experienced in reverse. In this case, a decrease in basic sector purchasing power results in lower profits (and potentially job losses) for the local non-basic businesses that are dependent on them.

High Revenue Sectors

Businesses in the Northern Willamette region primarily engage in secondary and tertiary economic sector industries. In 2007, the three industries in the Northern Willamette region with the highest revenue were Manufacturing, Wholesale Trade, and Retail Trade.[xxxv] Combined, these three industries generate over 100 billion in revenue.

Within individual counties in the Northern Willamette region, however, the industries' relative contribution to revenue differs. Washington County generates the most manufacturing revenue within the region, while Multnomah County generates the most Wholesale and Retail Trade revenue within the region. Table 16 shows the county revenue that is contributed by various sectors.

Table 16. Revenue of Top Sectors, Northern Willamette Region, 2007

County	Total Revenue* (in Thousands)	Wholesale Trade	Manufacturing	Retail Trade	Health Care
Clackamas	$ 19,898,459	27%	28%	26%	9%
Columbia	$ 1,423,749	7%	58%	25%	4%
Multnomah	$ 61,238,728	36%	17%	16%	10%
Washington	$ 50,229,653	22%	48%	17%	5%
Regional Total & Average	$ 132,790,589	29%	31%	18%	8%

Source: U.S. Census, Economic Census. 2007

*The US Census did not disclose revenue figures in some counties where a sector was represented by only a few businesses. These totals and percents represent the closest estimate.

Wholesale trade generated nearly $40 billion in revenue for the Northern Willamette Region, nearly 30% of the regional total. Wholesale trade is closely linked with retail trade but it has a broader client base, with local and non-local businesses as the typical clientele. Local business spending will be likely to diminish after a natural disaster, as businesses repair their properties and wait for their own retail trades to increase. Distanced clients may have difficulty reaching local wholesalers due to transportation disruptions from a natural disaster. Both would adversely impact the profitability of this sector.

In 2007, the *Manufacturing* sector generated over $41 billion in the Northern Willamette region, about 31% of the regional revenue.[xxxvi] Manufacturers are highly dependent upon the transportation network in order to access supplies and send finished products to outside markets. As base industries, they are not dependent on local markets for sales, which contribute to the economic resilience of this sector.

The R*etail Trade* sector generated over $24 billion in revenue in 2007 and is the third largest in the Northern Willamette region. It contains small businesses that tend to be more sensitive to hazard induced costs. Retail trade is also largely dependent on wholesale trade and the transportation network for the delivery of goods for sale. Disruption of the transportation system could have severe consequences for retail businesses. Retail trade typically relies on local residents

and tourists and their discretionary spending ability. Residents' discretionary spending diminishes after a natural disaster when they must pay to repair their homes and properties. In this situation, residents will likely concentrate their spending on essential items that would benefit some types of retail (e.g. grocery) but hurt others (e.g. gift shops). The potential income from tourists also diminishes after a natural disaster as people are deterred from visiting the impacted area. In summary, depending on the type and scale a disaster could affect specific segments of retail trade, or all segments.

Major Employment Sectors

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

The five sectors in the Northern Willamette region with the most employees in 2010 were Government (14%), Retail Trade (10%), Manufacturing (11%), Health Care and Social Assistance (11%), and Professional and Technical Services (14%).[xxxvii]

Within the four Northern Willamette counties, the percent of county employment by various sectors differs. For example, Washington County leads the region in percentage of Manufacturing employment; Columbia County provides the most government jobs; and Multnomah County employs the most people in Health Care. Table 17 shows the distribution of each county's employees across the five largest regional employment sectors.

Table 17. Total Employment and Percent of Employment by Top Sectors*, Northern Willamette Region, 2010

County	Total Employment	Retail Trade	Health Care	Manufacturing	Government	Professional and Technical Services
Clackamas	136,805	12%	12%	11%	12%	11%
Columbia	9,664	14%	11%	13%	22%	6%
Multnomah	421,452	9%	15%	7%	17%	15%
Washington	234,762	12%	12%	17%	10%	14%
Regional Total & Average	802,682	10%	13%	11%	14%	14%

Source: Oregon Employment Department.[xxxviii]

Sectors that are anticipated to be major employers in the future also warrant special attention in the hazard mitigation planning process. Between 2005 and 2016, the largest job growth in the Northern Willamette region is expected to occur in health care, and professional and business services sectors.[xxxix]

Health Care is one of the top employment sectors in the Northern Willamette region, and is projected to grow more than any other economic sector by 2016. The health care sector includes critical medical facilities, which are vital in the response and recovery phases of a disaster. If medical facilities are not prepared for natural hazard events, the ability of the community to recover can be diminished.

The *Professional and Business Services* sector is sensitive to a loss of power from a disaster and to disruptions of physical transmission cables (phone lines, etc.). There may also be a disruption of employees' ability to work as a result of damages/problems at home. If prepared and organized, however, this sector has the potential to have moderate resilience to many disasters. Some of the targeted consumers of this sector's services are located outside the region and their purchasing power would not be impacted by a localized natural disaster. The sector may also be more insulated from disruptions to the transportation network than others because there is a potential for many of the employees to work from home and because some services are offered via internet and phone.

Common Business Types

Identifying sectors that are represented by a large number of businesses can guide the development of targeted mitigation strategies for those sectors. The most numerous businesses in Region 2 are in Professional, Scientific, and Technical Services at 19% (11,026); Health Care and Social Assistance at 9% (5,525); Retail Trade at 9% (5,505); Construction at 9% (5,152) and Wholesale Trade at 8% (4,810).[xl]

The *Retail Trade* and *Professional Services* sectors warrant attention to their specific vulnerabilities. First, it should be noted that the majority of these businesses in the region have fewer than 20 employees; small businesses tend to face more financial uncertainty than larger ones. These businesses may therefore

be particularly sensitive to any temporary decreases in demand following a moderate natural hazard event.

In the event of wildfires, floods, earthquakes, or other types of destructive natural disasters, residents are more likely to demand construction services and primary sector products. The demand for the tertiary services provided by retail trade and professional services may decrease. These businesses should create a plan to remain economically solvent through a natural hazard event.

Regional Profile and Sensitivity Conclusion

Information presented in the Demographic, Infrastructure, and Economic Profiles can be used to help communities identify areas of sensitivity and vulnerability to natural hazards. Once the areas of sensitivity are identified, communities should identify appropriate action items.

[i] LeDuc, A. "Establishing Mitigation as the Cornerstone for Community Resilience", 2006 Risk Management Yearbook, Public Entity Risk Institute. Fairfax, VA. 2006

[ii] National Institute of Building Science's Multi-hazard Mitigation Council. "Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities" 2005

[iii] Loy, William G., ed. Atlas of Oregon. 2001. University of Oregon Press.

[iv] Oregon Office of Economic Analysis, "Long-Term County Forecast," http://www.oregon.gov/DAS/OEA/demographic.shtml#Long_Term_County_Forecast, accessed January 5, 2012.

[v] US Census Bureau, "Economic Characteristics," 2005-2009 American Community Survey 5-Year Estimates. http://www.census.gov

[vi] Hazards Workshop. Session Summary #16. Disasters, Diversity, and Equity. Annual Hazards Workshop, (July 12, 2000). University of Colorado, Boulder. Peggy Stahl, FEMA Preparedness, Training and Exercise Directorate.

[vii] US Census Bureau, "Economic Characteristics," 2005-2009 American Community Survey 5-Year Estimates. http://www.census.gov

[viii] US Census Bureau, "Age Groups and Sex," 2010 Census. http://www.census.gov

[ix] US Census Bureau, "Social Characteristics," 2005-2009 American Community Survey 5-Year Estimates. http://www.census.gov

[x] Ibid.

[xi] Portland State University Population Research Center, "(2010) Oregon Population Report," http://www.pdx.edu/prc/annualorpopulation.html, (Accessed January 5, 2012).

[xii] US Census Bureau, "Housing Characteristics," 2005-2009 American Community Survey-5 Year Estimates, http://www.census.gov.

[xiii] US Census Bureau, County Building Permits, 2010

[xiv] Emergency Plans for Mobile Home Parks, Governor's Office of Emergency Services, California, 1997, http://www.oes.ca.gov/Operational/OESHome.nsf/PDF/Emergency%20Plans%20for%20Mobilehome%20Parks/$file/Feat5.pdf

[xv] US Census Bureau, "Housing Characteristics," 2005-2009 American Community Survey-5 Year Estimates, http://www.census.gov.

[xvi] US Census Bureau, "Economic Characteristics," 2005-2009 American Community Survey-5 Year Estimates, http://www.census.gov.

[xvii] BNSF Railway website. http://www.bnsf.com/.

[xviii] Oregon Rail Plan: An Element of the Oregon Transportation Plan, 2001. http://www.oregon.gov/ODOT/RAIL/docs/railplan01.pdf.

[xix] Ibid.

[xx] Ibid.

[xxi] Federal Aviation Administration, "Airport Facilities Data," Airport Data (5010) and Contact Information, http://www.faa.gov/airports_airtraffic/airports/, accessed January 5, 2012.

[xxii] Loy, W.G., ed. 2001. *Atlas of Oregon*, 2nd Edition. Eugene: University of Oregon Press.

[xxiii] Oregon Water Resources Department, "Dam Inventory Query," http://apps2.wrd.state.or.us/apps/misc/dam_inventory/, accessed January 5, 2012.

[xxiv] Loy, W.G., ed. 2001. *Atlas of Oregon*, 2nd Edition. Eugene: University of Oregon Press.

[xxv] Ibid.

[xxvi] Oregon Employment Department, "Labor Force Data: Unemployment Rate, Portland-Vancouver-Beaverton MSA June 201," http://www.qualityinfo.org/olmisj/labforce, accessed January 5, 2012.

[xxvii] Oregon Employment Department, "Labor Force Data: Unemployment Rate Columbia County, October 2011." http://www.qualityinfo.org/olmisj/labforce?key=startregion&areacode=4101000000, accessed December 12, 2011.

[xxviii] Oregon Economic & Community Development Department, "2007 Distressed Areas and Associated Index Values," http://www.oregon4biz.com/distlist.htm, accessed January 7, 2009.

[xxix] Oregon Employment Department, "Labor Force Data: Unemployment Rate (multiple counties), October 2011." http://www.qualityinfo.org/olmisj/labforce?key=startregion&areacode=4101000000, accessed December 12, 2011.

[xxx] Oregon Employment Department, "2010 Covered Employment and Wages Summary Report," (multiple counties) http://www.qualityinfo.org/olmisj/CEP, accessed December 12, 2011.

[xxxi] Oregon Employment Department, "2010 Covered Employment and Wages Size-of-Firm Report"(multiple counties). http://www.qualityfinfo.org/olmisi/CEP. Accessed January 5, 2012.

xxxii Alesch, Dan, et al. 2001. Organizations at Risk: What Happens When Small Businesses and Non-for-Profits Encounter Natural Disasters. https://www.riskinstitute.org/peri/index.php?option=com_bookmarks&task=detail&id=182

[xxxiii] Ibid.

[xxxiv] Oregon Employment Department, Hachman Diversity Index, 2009, 2006, 2003, 2001, and 1999.

[xxxv] US Census Bureau Economic Census 2007,

[xxxvi] Ibid.

[xxxvii] Oregon Employment Department, "Second Quarter 2010 Covered Employment and Wages Summary Report," (multiple counties) http://www.qualityinfo.org/olmisj/CEP, accessed December 12, 2011.

[xxxviii] Oregon Employment Department, "2010 Covered Employment and Wages Summary Report," (multiple counties), http://www.qualityinfo.org/olmisj/CEP, accessed December 12, 2011.

[xxxix] Oregon Employment Department, Workforce Analysis, 2005

[xl] Oregon Employment Department, "Second Quarter 2010 Covered Employment and Wages Summary Report," (multiple counties), http://www.qualityinfo.org/olmisj/CEP, accessed December 12, 2011.

REGION 2

Northern Willamette Valley / Portland Metro[1]

Hazards Assessment

[1] Includes the counties of Columbia, Clackamas, Multnomah and Washington.

DROUGHT

Characteristics and Brief History

Droughts are not uncommon in the State of Oregon, nor are they just an "east of the mountains" phenomenon. They occur in all parts of the state, in both summer and winter months. Droughts appear to be cyclic, and can have a profound effect on the State's economy, particularly the hydropower and agricultural sectors. The environmental consequences also are far-reaching, including insect infestations in Oregon forests and reduced stream flows to support endangered fish species. Severe drought conditions preceded the four disastrous Tillamook fires (1933, 1939, 1945, 1951) and pitted farmer against fish protection groups during the Klamath County drought of 2001. In recent years, the State has addressed drought emergencies through the Oregon Drought Council. This interagency (state/federal) council meets to discuss climate outlooks, water and soil conditions, and to advise the Governor as the need arises. Significant droughts are depicted in Table 1.

TABLE 1. SIGNIFICANT DROUGHTS

DATE	DESCRIPTION
1904-1905	A drought period of about 18 months throughout Oregon
1917-1931	A very dry period, punctuated by brief wet spells in 1920-21 and 1927 throughout Oregon
1939-1941	A three-year intense drought in Oregon
1976-1981	Intense drought in western Oregon; 1976-77 single driest year of century
1985-1997	Generally a dry period, capped by statewide droughts in 1992 and 1994
2000-2001	General statewide drought

Source: Taylor, George H., and Ray Hatton, 1999, *The Oregon Weather Book*.

Probability

Oregon's drought history reveals many short-term and a few long-term events. The average recurrence interval for severe droughts in Oregon is somewhere between 8 and 12 years. Table 1 (above) provides an overview of severe droughts in Oregon.

The probability that Region 2 will experience droughts is depicted in Table 2 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials. These scores are based on the perceptions of area emergency managers.

The scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

In some cases, the county either did not score a particular hazard or considered it to be of minimal concern. These instances are noted in the chart below with a dash (-).

TABLE 2. Probability Assessment of Drought

	Clackamas	Columbia	Multnomah	Washington
Probability	M	M	-	L

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

The region's vulnerability to drought is depicted in Table 3 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials. These scores are based on the perceptions of area emergency managers.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

In some cases, the county either did not score a particular hazard or considered it to be of minimal concern. These instances are noted in the chart below with a dash (-).

TABLE 3. Vulnerability Assessment of Drought

	Clackamas	Columbia	Multnomah	Washington
Vulnerability	L	L	-	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

EARTHQUAKE

Characteristics and Brief History

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

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

Region 2 has had seven crustal earthquakes of magnitude 4 or greater since 1877 (Table 4). The region's largest earthquakes were the 1877 M5.3 and the 1962 M5.2. In addition, the region has been shaken historically by crustal and intraplate earthquakes and prehistorically by subduction zone earthquakes centered outside the area. A few examples are in Table 3. There is good reason to believe that the most devastating future earthquakes would probably originate along shallow crustal faults in the region and along the Cascadia Fault Zone. Deep-seated intraplate events, as occurred near Olympia, Washington in 1949 and 2001 (Table 4), could generate magnitudes as large as M7.5, but have been rare in the region's historical record.

Earthquake associated hazards include severe ground shaking, liquefaction of fine-grained soils, and landslides. The severity of these effects depend on several factors, including the distance from the earthquake source, the ability of soil and rock to conduct seismic energy and the degree (angle) and composition of slope materials. Earthquakes produced through volcanic activity could reach magnitudes of 5.2. However, the Cascade volcanoes are some distance away from populated centers, which tends to lessen the concern.

Since Oregon adopted the International Building Code 2003 (IBC 2003), it no longer uses the seismic zones to define the hazard. The IBC 2003 uses the maps from the USGS earthquake program, which depict a much more accurate spatial distribution of the hazard. The old Uniform Building Codes (UBC) maps displayed the hazard as spatially changing along county boundaries.

TABLE 4. SIGNIFICANT EARTHQUAKES

DATE	LOCATION	MAGNITUDE (M)	COMMENTS
Approximate Years 1400 BCE*, 1050 BCE, 600 BCE, 400, 750, 900	Offshore, Cascadia Subduction Zone (CSZ)	Probably 8.0 –9.0	Based on studies of earthquake and tsunami at Willapa Bay, Washington. These are the mid-points of the age ranges for these six events. * BCE: Before the Common Era
January, 1700	CSZ	Approx. 9.0	Generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast
October, 1877	Portland area	5.2	Two events were reported that day. The estimated felt area was approximately 41,000 square kilometers. Chimney damage reported
February, 1892	Portland area	5.0	No major damage occurred
December, 1941	Portland area	4.5	Felt by most Portland residents. Shattered windows and cracked plaster in Hillsboro and Sherwood.
April, 1949	Olympia, WA	7.1	Significant damage in Washington. Minor damage in NW Oregon
December, 1953	Portland area	4.5	Cracked plaster and caused objects to fall in Portland.
November, 1961	Portland area	5.0	Principal damage from cracked plaster
November, 1962	Portland area	5.5	Shaking lasted up to 30 seconds; chimneys cracked; windows broken; furniture moved
December, 1963	Portland area	4.5	Books and pictures fell in Plains
March 25, 1993	Scotts Mills	5.6	On Mt. Angel-Gales Creek fault. $30 million damage (including Oregon Capitol Building in Salem) (FEMA-985-DR-OR)
February, 2001	Nisqually, WA	6.8	Felt in the region, no damage reported

Source: Wong, Ivan and Jacqueline Bolt, November 1995, A Look Back at Oregon's Earthquake History, 1841-1994, *Oregon Geology* pp. 125-139.

Probability

Scientists estimate the chance in the next 50 years of a great subduction zone earthquake is between 10 and 20 percent, assuming that the recurrence is on the order of 400 +/- 200 years. These events are estimated to have an average recurrence interval between 500 and 600 years, although the time interval between individual events ranges from 150 to 1000 years. The last CSZ event occurred approximately 300 years ago.[2]

Establishing a probability for crustal earthquakes is difficult because of the small number of recorded events. However, based on the seven M4 and greater earthquakes centered in the region during the last 125 years, an average recurrence interval would be 22 years. The time interval between individual events varied from one to 49 years. Earthquakes generated by volcanic activity in Oregon's Cascade Range are possible, but are unpredictable.

The following probability estimates are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 5. Probability Assessment of Earthquakes

	Clackamas	Columbia	Multnomah	Washington
Probability	H	L	H	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

Region 2 is especially vulnerable to earthquake hazards for two reasons: (1) much of the area is susceptible to earthquake-induced landslides, liquefaction, and severe ground shaking, and (2) the region contains the bulk of Oregon's population and built environment.

In 2007, DOGAMI completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon Legislature in Senate Bill 2 (2005). RVS is a technique used by the Federal Emergency Management Agency (FEMA), known as FEMA 154, to identify, inventory, and rank buildings that are potentially vulnerable to seismic events. DOGAMI surveyed a total of 3,349 buildings, giving each a 'low,' 'moderate,' 'high,' or 'very high' potential of collapse in the event of an earthquake. It is important to note that these rankings represent a probability of collapse based on

[2] Oregon Geology, 2002.

limited observed and analytical data and are therefore *approximate* rankings.[3] To fully assess a building's potential of collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to survey.

Table 6 below shows the number of buildings surveyed in each county with their respective rankings.

TABLE 6. REGION 2 BUILDING COLLAPSE POTENTIAL

	Level of Collapse Potential			
County	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100 %)
Clackamas	123	48	40	6
Columbia	19	13	15	3
Multnomah	68	118	116	29
Washington	81	69	80	6

Source: DOGAMI Seismic Needs Assessment, available at http://www.oregongeology.org/sub/projects/rvs/default.htm.

The Oregon Department of Geology and Mineral Industries (DOGAMI) has also developed two earthquake loss models for Oregon based on the two most likely sources of seismic events: (1) the Cascadia Subduction Zone (CSZ), and (2) combined crustal events (500-year model). Both models utilize HAZUS, a software program developed by the Federal Emergency Management Agency (FEMA) as a means of determining potential losses from earthquakes. The CSZ event is based on a potential M8.5 earthquake generated off the Oregon coast. The model does not take into account a tsunami, which probably would develop from such an event. The 500-year crustal model does not look at a single earthquake (as in the CSZ model); it encompasses many faults, each with a 10% chance of producing an earthquake in the next 50 years. The model assumes that each fault will produce a single "average" earthquake during this time. Neither model takes unreinforced masonry buildings into consideration.

DOGAMI investigators caution that the models contain a high degree of uncertainty and should be used only for general planning purposes. Despite their limitations, the models do provide some approximate estimates of damage. Results are found in Table 7.

Metro[1] has likewise evaluated earthquake potential and losses for its three-county area (Clackamas, Multnomah, Washington). The analysis (1998) included an inventory of over 50,000 commercial and multi-family dwellings at risk. Single-family dwellings within the Metro boundary were not evaluated because their structural similarity (Metro, 1998).

[3] State of Oregon Department of Geologic and Mineral Industries, Implementation of 2005 Senate Bill 2 Relating to Public Safety, Seismic Safety and Seismic Rehabilitation of Public Building, May 22, 2007, iv.

[1] Metro is the elected regional government that serves more than 1.3 million residents in Clackamas, Multnomah, and Washington counties, and the 24 cities in the Portland metropolitan area.

Other useful resources for planning for earthquakes include the following:

Maps of earthquake hazard areas: DOGAMI has mapped urban areas and relative Environmental Quality hazard maps for all of the Region 1 counties except Lane and Lincoln counties. DOGAMI has only mapped urban areas for these two counties.

Map of coastal critical facilities vulnerable to hazards: DOGAMI has developed these maps for all Region 1 counties.

Environmental Geology of Land Use Geology maps: DOGAMI has developed these maps for all Region 1 counties.

Nuclear energy/hazardous waste sites inventories: No Region 1 counties have nuclear facilities.

TABLE 7. PROJECTED DOLLAR LOSSES BASED ON A M8.5 SUBDUCTION EVENT AND A 500-YEAR MODEL

	A. 8.5 CSZ EVENT				B. 500-YEAR MODEL			
COUNTIES►	**Multnomah**	**Washington**	**Columbia**	**Clackamas**	**Multnomah**	**Washington**	**Columbia**	**Clackamas**
INJURIES	1,521	555	36	128	8,659	2,910	150	1,402
DEATHS	28	10	0	2	186	62	3	29
DISPLACED HOUSEHOLDS	2,803	2,062	94	426	13,777	7,666	326	2,525
ECONOMIC LOSSES FOR BUILDINGS[2]	$1.9 billion	$931 million	N/A	$316 m	$9.2 billion	$3.8 billion	$267 mil	$2.1 billion
OPERATIONAL "DAY AFTER" THE QUAKE								
Fire Stations	78%	66%	Unknown	84%	N/A[3]	*	*	*
Police Stations	76%	64%	45%	84%	N/A	*	*	*
Schools	81%	64%	63%	84%	*	*	*	*
Bridges	94%	79%	82%	90%	*	*	*	*
ECONOMIC LOSSES TO								
Highways	$21 million	$15 m	$2 mil	$6 m	$437 m	$61 m	$10 mil	$74 m
Airports	$2 million	$5 m	$2 mil	$3 m	$12 m	$23 m	$8 mil	$32 m
Communications	$3 million	$752,000	$97,000	$232,000	$31 m	$4 m	$950,000	$4 m
DEBRIS GENERATED (THOUSANDS OF TONS)	1,598	763	57	237	6,745	2,817	184	1,588

Source: DOGAMI, 1999, Special Paper 29: Earthquake Damage in Oregon

Table 7 Notes:

[1]Every part of Oregon is subject to earthquakes. The 500-year model is an attempt to quantify the risk across the state. The estimate does not represent a single earthquake. Instead, the 500-year model includes many faults, each with a 10% chance of producing an earthquake in the next 50 years. The model assumes that each fault will produce a single "average" earthquake during this time. More and higher magnitude earthquakes than used in this model may occur. (DOGAMI, 1999).

[2]There are numerous un-reinforced masonry structures (URMs) in Oregon, the currently available default building data does not include any URMs. Thus, the reported damage and loss estimates may seriously under-represent the actual threat" (page 126 – 1998, DOGAMI)

[3]Because the 500-year model includes several earthquakes, the number of facilities operational the "day after" can not be calculated

The region's vulnerability to earthquakes is depicted in Table 8 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 8. Vulnerability Assessment of Earthquakes

	Clackamas	Columbia	Multnomah	Washington
Vulnerability	H	H	H	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

FIRES IN THE WILDLAND/URBAN INTERFACE

Characteristics and Brief History

There is extensive forested land in Columbia, Clackamas, Multnomah, and Washington counties, both in undeveloped National Forest land and developing urban/wildland interface areas. All of it is at risk, but especially within the interface areas. In recent years, the cost of fire suppression has risen dramatically. A large number of homes have been threatened or burned, more fire fighters have been placed at risk, and fire protection in wildland areas has been reduced. These factors have prompted the passage of Oregon Senate Bill (SB) 360 (Forestland / Urban Interface Protection Act, 1997). This bill: (1) establishes legislative policy for fire protection, (2) defines urban/wildland interface areas for regulatory purposes, (3) establishes standards for locating homes in the urban/wildland interface, and (4) provides a means for establishing an integrated fire protection system.

Table 9 describes significant fires affecting the region.

TABLE 9. SIGNIFICANT FIRES

Year	Name of Fire	Counties	Acres Burned	Remarks
1902	Columbia	Clackamas / Multnomah	170,000	

Source: Brian Ballou, 2002, A Short History of Oregon Wildfires, Oregon Department of Forestry, unpublished.

Probability

The natural ignition of forest fires is largely a function of weather and fuel; Human-caused fires add another dimension to probability. Dry and diseased forests can be mapped accurately and some statement can be made about the probability of lightening strikes. Each forest is different and consequently has different probability/recurrence estimates.

This document defines wildfire as an uncontrolled burning of forest, brush, or grassland. Wildfires have always been a part of these ecosystems, sometimes with devastating effects. Wildfire may result from natural causes (e.g., lightening strikes), a mechanical failure (Oxbow Fire), or human-causes (unattended campfire, debris burning, or arson). Most wildfires can be linked to human carelessness.

The intensity and behavior of wildfire depends on a number of factors including fuel, topography, weather, and density of development. There are a number of often-discussed strategies to reduce the negative impacts of these phenomena. They include land-use regulations, management techniques, site standards, building codes, and a recently passed Oregon Forestland-Urban Interface Fire Protection Act (1997). All of these things have a bearing on a community's ability to prevent, withstand, or recover from a wildfire event.

The probability that Region 2 will experience fires in interface areas is depicted in Table 10 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 10. Probability Assessment for Fires in Interface Areas

	Clackamas	Columbia	Multnomah	Washington
Probability	M	M	H	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

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

Each year a significant number of people build homes within or on the edge of the forest (urban/wildland interface), thereby increasing wildfire hazards. In Oregon, there are about 240,000 homes worth around $6.5 billion within the urban/wildland interface. Such development has greatly complicated firefighting efforts and significantly increased the cost of fire suppression.

A number of Region 2 communities (incorporated and unincorporated) are within or adjacent to areas subject to serious wildfire hazards. These communities have been designated “Interface Communities” and are shown in Table 11. A detailed community inventory of factors that affect vulnerability is important in assessing risk and is beyond the scope of the statewide assessment.

When assessing the risks from natural hazards, established mitigation practices already provide benefits in reduced disaster losses. It is important for communities to understand the benefits of past mitigation practices when assessing their risks, being mindful of opportunities to further reduce losses.

Possible mitigation practices include:

- Identify and map current hazardous forest conditions such as fuel, topography, etc.;
- Identify forest / urban interface communities - List of interface communities, Federal Register, 08/17/01. V. 66, N. 160;
- Identify and map Forest Protection Districts;
- Identify and map water sources;
- Implement effective addressing system in rural forested areas;
- Clearly mark evacuation routes;

- Identify and locate seasonal forest users. Initiate information program through schools, summer camps, forest camping grounds, lodges, etc;
- Identify and map bridges that can (and can not) support the weight of emergency vehicles. This is a basic requirement for fire suppression;
- Form committees to implement Oregon Senate Bill 360. This is required in Oregon Senate Bill 360; and
- Create road standards in interface areas to reflect fire suppression needs. Roads must be wide enough for fire suppression vehicles to turn around. Road grades cannot be too steep for large, heavy vehicles.

TABLE 11. WILDLAND/URBAN INTERFACE COMMUNITIES

COUNTIES			
Clackamas	**Columbia**	**Multnomah**	**Washington**
Beaver Creek	Alston	Bonneville	Buxton
Bull Run	Clatskanie	Burlington	Cherry Grove
Cedarhurst Park	Columbia City	East Metro	Gales Creek
Colton	Deer Island	Holbrook	Gaston
Dickey Prairie	Goble	Lower Columbia Gorge	Glenwood
Eagle Creek	Mist-Birkenfeld	Portland Metro	Stimson Mill
Estacada	Pittsburg	Shelternoon	Timber
Fallsview	Prescott	Skyline	Tualatin Valley
Firgrove	Qunicy	Warrendale	
Government Camp	Rainier		
Hoodland Corridor	St. Helens		
Maple Grove	Scappoose		
Molalla	Spitzenburg		
Molino	Swedetown		
Redland	Vernonia		
Sandy	Warren		
Springwater Timber Grove	Yankton		

Source: August 17, 2001, Federal Register, v.66, n. 160

The region's vulnerability to fires in the wildland/urban interface is depicted in Table 12 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 12. Vulnerability Assessment for Fires in Interface Areas

	Clackamas	Columbia	Multnomah	Washington
Vulnerability	M	M	M	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

FLOOD

Characteristics and Brief History

The northern Willamette Valley (including the Portland Metro area) has a lengthy flood history. The Willamette and Columbia Rivers have produced numerous floods, some of which are shown in Table 13. Most Willamette River flooding is a winter phenomenon. The common pattern includes the accumulation of heavy wet snow in higher elevations followed by a mild, rainy, weather system. The resulting snowmelt on saturated or frozen ground sometimes produces devastating flood conditions. These conditions would be worse were it not for many dams (used for, among other purposes, flood control) on the upper reaches of the Willamette and some of its tributaries.

The Columbia River Estuary is the second largest river in the United States and the largest river to flow into the eastern North Pacific.[4] Columbia River floods usually occur in the early summer and are associated with seasonal runoff from melting snow. Although unusually extreme, the Vanport Flood (1948) provides an example of such an event. The 20-day flood was the greatest single disaster in the recorded history of the Columbia River Basin. The toll was 32 dead and 7 missing in the Portland area. Flooding occurred when the Columbia River broke through a dike surrounding the community of Vanport and forced 50,000 people to evacuate their homes. Economic losses reportedly exceeded $100 million. Vanport, a Vancouver-Portland suburban community,[5] was not rebuilt. Prolonged winter rain, debris dams, and breeched dikes have produced flood conditions at several Columbia County locations. Tidal influences are observed on the Columbia River inland to the Bonneville Dam and on the Willamette in Portland.

A very common Willamette Valley phenomenon involves tributary stream back-up during periods of high water. In short, tributary streams cannot enter swollen main stem rivers during periods of high water. This forces the tributary streams out of their banks with predictable results. During the February 1996 flood, dams controlled Columbia River flows. This allowed the Willamette River to enter the Columbia, averting flooding in downtown Portland. Other streams produced widespread flooding throughout the region. Table 14 summarizes the sources of flooding for each of the major rivers in the region.

[4] Columbia River Estuary, NOAA.

[5] The largest public housing project ever built in the United States, PCC (Portland Community College).

TABLE 13. SIGNIFICANT FLOODS

DATE	LOCATION	DESCRIPTION	TYPE OF FLOOD
12/1861	Coastal Rivers	The "Great Flood"; largest flood of known magnitude on the Willamette River. Every town on the river was flooded or washed away. Widespread damage.	Rain on snow (ROS) / snow melt (SM)
12/1862	Willamette River Basin	Widespread flooding.	ROS
02/1890	Willamette Basin	Second largest flood of known magnitude. Water levels in Portland: 22.3 ft.	ROS
06/1894	Main stem Columbia	Largest flood ever observed on the river. Current small in Portland. Little damage.	SM
01/1923	Willamette & Columbia Rivers	Rain and mild weather. Widespread damage to roads & railroads.	ROS
12/1937	Willamette Basin	Considerable flooding; landslides.	ROS
12/1945	Willamette Basin / NW Oregon	Very warm temperatures. Considerable flood damage.	ROS
06/1948	Main stem of the Columbia	Vanport near Portland was completely destroyed.	SM
12/1955	Columbia River & Willamette Basin	Strong winds / flooding. Five fatalities.	ROS
12/1964	Entire State	Record-breaking December rainfall. Widespread damage. Warm temperatures.	ROS
01/1972	Willamette and Sandy Rivers	Widespread damage. Many fish destroyed, buildings, etc. Five fatalities.	ROS
01/1974	Western Oregon	Mild storms followed heavy snow and freezing rain. Nine counties declared disasters.	ROS
01/1978	Willamette River and NW Oregon	Intense rain / snowmelt. Widespread flooding.	ROS
02/1986	Entire state	Numerous homes evacuated. Intense rain and melting snow.	SM
02/1987	Western Oregon	Willamette and tributaries. Mud slides, flooded highways, damaged homes.	ROS
01/1990	Western Oregon	Ten rivers in eight counties flooded. Many bridges washed away.	ROS
02/1996	NW Oregon	Warm temperatures / record breaking rains. Widespread flooding[6]	ROS

Source: Taylor, George H., and Ray Hatton, 1999, The Oregon Weather Book, Pp. 96-10; National Climatic Data Center

[6] FEMA-1099-DR-OR. 1996.

TABLE 13. SIGNIFICANT FLOODS (con't.)

DATE	LOCATION	DESCRIPTION	TYPE OF FLOOD
12/1996	Western Oregon	Mild subtropical moisture led to extensive flooding. 14 county disaster.	ROS
1/2006	Washington County	Tualatin River in Dilley and Farmington reached above flood stages	Riverine
11/2006	Clackamas County	Heavy rain caused the Sandy River and Clackamas River to flood, causing damage in Estacada and Oregon City. Total county-wide damages of $3 million.	Riverine
12/2007	Washington County	Flooding of the Tualatin River following heavy rainfall from a Tropical Storm. Old Hwy 47 and Hwy 47 closed temporarily, total of $2.3 million in damages	Riverine
12/2007	Columbia County	Flooding of the Nehalem River caused widespread damage in Vernonia, flooding numerous homes and causing a total of $36 million in damages for Columbia County.	Riverine
01/2009	Washington County	Severe winter storm/snow event which included snow, high winds, freezing rain, ice, blizzard conditions, mudslides, and landslides.	
01/2011	Clackamas County	Severe winter storm, flooding, mudslides, landslides, and debris flows.	

Source: Taylor, George H., and Ray Hatton, 1999, *The Oregon Weather Book,* Pp. 96-10; National Climatic Data Center,

TABLE 14. PRINCIPAL RIVERINE FLOOD SOURCES

Clackamas	Columbia	Multnomah	Washington
Willamette River & Tributaries	Clatskanie R	Columbia and Willamette Rivers & Tributaries	Willamette River and Tributaries
Abernethy Cr	Columbia R	Sandy River	Tualatin River
Clackamas River	Conyers Cr	Multnomah Channel	Fanno Cr
Clear Cr	McNulty Cr	Johnson Cr	Summer Cr
Dear Cr	Milton Cr	Fairview Cr	Ash Cr
Eagle Cr	Multnomah Ch	Columbia Slough	Rock Cr
Johnson Cr	Nehalem Cr	Ponding within Drainage Dist.	Cedar Cr
Kellogg Cr	Rock Cr	#1	Butternut Cr
Milk Cr	Scappoose Cr	Beaver Cr	Dawson Cr
Molalla River		Fairview Cr	Beaverton Cr
Mt. Scott Cr		Kelley Cr	Bronson Cr
Nyberg Slough		Mitchell Cr	Willow Cr
Oswego Channel			Cedar Mill Cr
Phillips Cr			Johnson Cr
Pudding River			Dairy Cr
Salmon River			McKay Cr
Sandy River			Council Cr
Still Cr			Gales Cr
Tualatin River			Wapato Cr
Zig Zag River			Nyberg Slough
Tickle Cr			

Source: FEMA, Benton County Flood Insurance Study (FIS), 08/15/96, FEMA, Lane County FIS, 06/02/99, FEMA, Linn County FIS, 09/29/86, FEMA, Marion County FIS, 07/13/01, FEMA, Polk County FIS, 12/19/95, FEMA, Yamhill County FIS, 09/30/83

Probability

The Federal Emergency Management Agency (FEMA) has mapped most flood-prone streams in Oregon. The maps depict the 1% flood (100-year) upon which the National Flood Insurance Program is based. All of the Region 2 counties have Flood Insurance Rate Maps (FIRM); however, some of the maps are old and could be outdated. The FIRM maps were issued at the following times:

Clackamas, June 17,2008;

Multnomah March 18, 1986;

Washington, February 18, 2005

Columbia, August 16, 1988.

A cursory examination of Table 13 above provides some indication of flooding in Region 2. Significant flooding occurs on a fairly regular basis, at least once every 5-7 years (not all flooding is shown in Table 13). Despite this knowledge, flood losses continue to be high.

The probability that Region 2 will experience floods is depicted in Table 15 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 15. Probability Assessment of Floods

	Clackamas	Columbia	Multnomah	Washington
Probability	H	H	H	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

The region's vulnerability to flood is depicted in Table 16 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 16. Vulnerability Assessment of Floods

	Clackamas	Columbia	Multnomah	Washington
Vulnerability	M	H	H	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

LANDSLIDES / DEBRIS FLOWS

Characteristics and Brief History

Landslides and debris flows always have and always will shape Oregon's landscape. Landslides become problematic, however, when people place buildings and infrastructure in harm's way. Additionally, development practices can cause or contribute to the severity of landslides.

There are several categories of landslides, based on configuration (slide mechanism), slide materials, and rate of movement. Some slides are ancient, deep-seated, and slow moving. Others move rapidly as a mass of rock, mud, and large woody debris. All can be problematic when in the vicinity of buildings and infrastructure. Fast-moving landslides, or debris flows, occur throughout Oregon, but are especially noteworthy in the Cascade and Coast Ranges.

Debris flows (mudslides, mudflows, debris avalanches) are a common type of rapidly moving landslide that generally occur during intense rainfall on previously saturated ground. They usually begin on steep hillsides as slumps or slides that liquefy, accelerate to speeds as great as 35 mph or more, and flow down slopes and channels onto gently sloping ground. Their consistency ranges from watery mud to thick, rocky, mud-like wet cement, dense enough to carry boulders, trees, and automobiles. Debris flows from different sources can combine in canyons and channels, where their destructive power is greatly increased. In general, slopes that are over 25% or have a history of landslides might signal a landslide problem.

Landslides / debris flows probably accompany every major storm system that impacts western Oregon. In recent events, particularly noteworthy landslides accompanied storms in 1964, 1982, 1966, and 1996. Two major landslide producing winter storms occurred in Oregon during November 1996. Intense rainfall on recently and past logged land as well as previously un-logged areas triggered over 9,500 landslides and debris flows that resulted directly or indirectly in eight fatalities. Highways were closed and a number of homes were lost. The fatalities and losses resulting from the 1996 landslide events brought about the passage of Oregon Senate Bill 12, which set site development standards, authorized the mapping of areas subject to rapidly moving landslides and the development of model landslide (steep slope) ordinances.

In Multnomah County (including the city of Portland) landslide activity has been a recurring problem for many years. In February 1996, landslide activity that occurred in Portland and the Dodson-Warrendale area (east Multnomah County) was notable and severely impacted homeowners and transportation routes. In fact, Interstate-84 in the Columbia River Gorge was closed for a number of days by fast moving debris flows that covered the roadway and the east-west railroad tracks.

Counties with the highest percentage of reported landslides are: Lane (24%), Douglas (11%), Linn (10%), Tillamook (9%), Lincoln (8%), and Multnomah (7%).[7] Table 17 describes the history of more significant landslides and debris flows in the area.

[7] Hofmeister, 2000, *Slope Failures in Oregon*; and DOGAMI, Special Paper 34.

TABLE 17. NOTABLE LANDSLIDE / DEBRIS FLOWS

DATE	INCIDENT
03/1972	Three motorists were injured in a mud and rockslide on Interstate 5 near Portland
10/1984	Two children were killed in a rockslide along Interstate 84 near Cascade Locks. The cost of stabilizing the slide area a few years later eventually reached $4 million
09/1990	Four highway workers were injured in a landslide near Troutdale
02/1996	Heavy rains and rapidly melting snow contributed to hundreds of landslides / debris flows across the state. Many occurred on clear cuts that damaged logging roads. Interestate-84 closed at Dodson-Warrendale. (FEMA-1099-DR-OR)
12/2007	Landslide in Columbia County due to heavy rains from a strong winter storm. Landslides caused $300,000 in damages in the County. A total of $1.5 million in landslide-induced damages occurred from this storm that affected Clatsop, Columbia, Tillamook, Washington, and Yamhill counties.

Source: ODOT Emergency Operations Plan, May, 2002; Interagency Hazard Mitigation Team Report, FEMA-1099-DR-OR, June, 1997; Interagency Hazard Mitigation Team Report, FEMA-1149-DR-OR, March, 1997; George Taylor and Ray Hatton, The Oregon Weather Book, 1999; Hazards & Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org;

Probability

The probability of rapidly moving landslide occurrence depends on a number of factors; these include steepness of slope, slope materials, local geology, vegetative cover, human activity, and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides (debris flows); consequently, the Oregon Department of Forestry tracks storms during the rainy season, monitors rain gages and snow melt, and issues warnings as conditions warrant. Given the correlation between precipitation / snow melt and rapidly moving landslides, it would be feasible to construct a probability curve. The installation of slope indicators or the use of more advanced measuring techniques could provide information on slower moving slides.

The probability that Region 2 will experience landslide is depicted in Table 18 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials. The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

In some cases, the county either did not assess the probability for the hazard or found it to be of minimal concern. These instances are noted in the chart below with a dash (-).

TABLE 18. Probability Assessment for Landslides

	Clackamas	Columbia	Multnomah	Washington
Probability	H	-	H	L

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

Since 1950, at least 21 deaths have been attributed to rapidly moving landslides (i.e., debris flows). Statistically, the risk of being killed is relatively low (about .02 fatalities per 1,000 people/ year). However, the risk would be greater for that segment of the population that lives, works, or commutes through high hazard debris flow areas. The Oregon Department of Forestry has mapped all the steep slopes in Region 2 counties. The risk to any individual depends on the level of exposure and the amount of time spent in a hazardous area [8]

The region's vulnerability to landslides/debris flows is depicted in Table 19 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

In some cases, the county either did not assess the vulnerability for the hazard or found it to be of minimal concern. These instances are noted in the chart below with a dash (-).

TABLE 19. Vulnerability Assessment for Landslides

	Clackamas	Columbia	Multnomah	Washington
Vulnerability	L	-	H	L

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

[8] Henkle, J.C., and Keith Mills, 2002.

VOLCANO-RELATED HAZARDS

Characteristics and Brief History

The eastern boundaries of Clackamas and Multnomah counties coincide with the crest of the Cascade Mountains. Volcanic activity in the Cascades will continue, but questions regarding how, to what extent, and when remain. Most volcano-associated hazards are local (e.g., explosions, debris, lava, and pyroclastic flows). However, lahars can travel considerable distances down stream valleys, and wind-borne tephra (ash) can blanket areas many miles from the source.

There is virtually no risk from volcanoes in Washington County, although normal prevailing winds could shift and carry ash into that area. Clackamas and Multnomah counties are at risk and should consider the impact of volcano-related activity on small mountain communities, dams, reservoirs, energy-generating facilities, and highways. These counties also should consider probable impacts on the local economy (e.g., wood products and recreation). The communities of Government Camp, Rhododendron, and Zigzag merit special attention.

The history of volcanic activity in the Cascade Range is contained in its geologic record, and the age of the volcanoes vary considerably. Some lava flows on Washington's Mt. Rainier are thought to be older than 840,000 years; Mt. Saint Helens erupted in May 1980, and continues to be active. In short, all of the Cascade volcanoes are characterized by long periods of quiescence and intermittent activity. And these characteristics make predictions, recurrence intervals, or probability very difficult to ascertain.

Probability

Region 2 communities are closest to Mt. Hood (Clackamas County), a "composite" volcano. Composite volcanoes have wide ranging modes of eruption, making future volcanic activity difficult to predict definitively. Mt. Hood's eruptive history can be traced to late Pleistocene times (15-30,000 years ago) and will no doubt continue. However, the central question remains: When?

The most recent series of events (1900-2000) consisted of small lahars and debris avalanches; steam explosions and minor tephra falls occurred between 1856 and 1865. Mt. Hood's recent history also includes tephra, dome building, lahars, pyroclastic flows and steam explosions. These occurred approximately 200 years ago. Geoscientists have provided estimates of future activity in the vicinity of Crater Rock, a well-known feature on Mt. Hood. They estimate a 1 in 300 chance that some dome activity will take place in a 30-year period (1996-2026). For comparison, the 30-year probability of a house being damaged by fire in the United States is about 1 in 90 (Scott, W.E., et al., 1997)

The probability of 1 cm or more of tephra fall-out from eruptions throughout the Cascade Range include: Clackamas County: between 1 in 500 to 1 in 1000; Multnomah County: between 1 in 500 to 1 in 1,000; Washington County: between 1 in 1,000 to 1 in 5,000 (Sherrod, David et al, 1997). Mt. St. Helens is less than 50 air miles from some Columbia County communities and is still active. Prevailing wind direction is of paramount importance. Because the prevailing winds are westerly in Columbia County, the risk of air borne tephra is

considerably reduced. The risk of Columbia County receiving 1 cm or more of tephra varies between 1 in 5,000 to 1 in 10,000 (Sherrod, David et al, 1997).

Table 20 below summarizes the probability of volcano-related hazards for each county. Debris from the 1980 eruption of Mt. St. Helens impacted the shipping channel on the Columbia River by reducing water depth (dredging was required).

TABLE 20. PROBABILITY OF VOLCANO-RELATED HAZARDS

Volcano Related Hazards	Washington	Multnomah	Clackamas	Columbia	Remarks
Tephra (volcanic ash) (annual probability of 1cm or more accumulation from eruptions throughout the Cascade Range)	1 in 5,000 to 1 in 10,000	1 in 1,000 to 1 in 5,000	1 in 1,000 to 1 in 5,000	1 in 5,000 to 1 in 10,000	USGS Open File Report (OFR 97-513)
Lahar	No Risk	Source: Mt. Hood	Source: Mt. Hood	No Risk	USGS Open File Report (OFR 97-89)
Lava flow	No Risk	No Risk	Source: Mt. Hood	No Risk	USGS Open File Report (OFR 97-89)
Debris flow / avalanche	No Risk	Source: Mt. Hood	Source: Mt. Hood	Mt. Saint Helens*	USGS Open File Report (OFR 97-89)
Pyroclastic flow	No Risk	No Risk	Source: Mt. Hood	No Risk	USGS Open File Report (OFR 97-89)

Source: USGS Open File Report (OFR 97-89).

The probability that Region 2 will experience volcanic events is depicted in Table 21 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 21. Probability Assessment Volcanic Hazards

	Clackamas	Columbia	Multnomah	Washington
Probability	L	L	H	L

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

The region's vulnerability to volcano-related hazards is depicted in Table 22 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 22. Vulnerability Assessment Volcanic Hazards

	Clackamas	Columbia	Multnomah	Washington
Vulnerability	H	M	H	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

WINDSTORMS

Characteristics and Brief History

Extreme winds (other than tornadoes) are experienced in all of Oregon's eight regions. The most persistent high winds occur along the Oregon Coast and the Columbia River Gorge; these areas have special building code standards. Homes in Multnomah County with full exposure to the Columbia River Gorge must be designed for 90 mph wind gusts. This is not the case in the Willamette Valley, although high winds are not uncommon. A majority of the destructive surface winds in Oregon are from the southwest. Under certain conditions, very strong east winds may occur, but these usually are limited to small areas in the vicinity of the Columbia River Gorge or other low mountain passes.

The much more frequent and widespread strong winds from the southwest are associated with storms moving onto the coast from the Pacific Ocean. If the winds are from the west, they may be stronger on the coast than in the interior valleys because of the north-south orientation of the Coast Range and Cascades. These mountain ranges obstruct and slow down the westerly surface winds. The most destructive winds are those which blow from the south, parallel to the major mountain ranges. The Columbus Day Storm of 1962 was a classic example of such a storm, and its effects were so devastating that it has become the benchmark from which other windstorms in Oregon are measured.

An historic overview of other significant storms in Region 2 would include those in Table 23 (below).

TABLE 23. SIGNIFICANT WINDSTORMS

DATE	AFFECTED AREA	CHARACTERISTICS
Apr., 1931	Western Oregon	Unofficial wind speeds reported at 78 mph. Damage to fruit orchards and timber.
Nov. 10-11, 1951	Statewide	Widespread damage; transmission and utility lines; Wind speed 40-60 mph; Gusts 75-80 mph
Dec., 1951	Statewide	Wind speed 60 mph in Willamette Valley. 75 mph gusts. Damage to buildings and utility lines.
Dec., 1955	Statewide	Wind speeds 55-65 mph with 69 mph gusts. Considerable damage to buildings and utility lines
Nov., 1958	Statewide	Wind speeds at 51 mph with 71 mph gusts. Every major highway blocked by fallen trees
Oct., 1962	Statewide	Columbus Day Storm; Oregon's most destructive storm to date. 116 mph winds in Willamette Valley. Estimated 84 houses destroyed, with 5,000 severely damaged. Total damage estimated at $170 million
Mar., 1971	Most of Oregon	Greatest damage in Willamette Valley. Homes and power lines destroyed by falling trees. Destruction to timber in Lane Co.
Nov., 1981	Most of Oregon	Highest winds since 10/62. Wind speed 71 mph in Salem. Marinas, airports and bridges severely damaged
Jan., 1990	Statewide	Heavy rain with winds exceeding 75 mph. Significant damage. One fatality
Dec., 1995	Statewide	Followed path of Columbus Day Storm. Wind speeds 62 mph in Willamette Valley. Damage to trees (saturated soil a factor) and homes. (FEMA-1107-DR-OR)
Nov., 1997	Western Oregon	Wind speed 52 mph in Willamette Valley. Trees uprooted. Considerable damage to small airports.
Feb., 2002	Western Oregon	Strongest storm to strike western Oregon in several years. Many downed power lines (trees); damage to buildings; water supply problems (lack of power). Estimated damage costs: $6.14 million. (FEMA-1405-DR-OR)
June, 2004	Washington County	$100 in property damage from a tornado

Source: Taylor, George H., and Ray Hatton, 1999, The Oregon Weather Book; and FEMA-1405-DR-OR: February 7, 2002, Hazard Mitigation Team Survey Report, Severe Windstorm in Western Oregon.; Hazards & Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org ; National Climatic Data Center, Storm Events, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms.

TABLE 23. SIGNIFICANT WINDSTORMS (con't).

DATE	AFFECTED AREA	CHARACTERISTICS
Dec., 2004	Clackamas County	$6,250 in property damage *damage estimate includes areas outside of Region 2
June 2005	Multnomah County	Lightening causes $50,000 in damage.
Dec., 2005	Clackamas, Multnomah, Washington, Counties	$9,000 in property damage
Jan., 2006	Clackamas, Columbia, Washington, Multnomah	Wind storm with winds up to 58 mph, caused a total of $500,000 in damages spread out over all four counties and included Yamhill, Marion, and Polk Counties as well.
February 2006	Columbia, Multnomah, Clackamas, Washington	Strong wind storm caused $167,000 in damage for all four counties. Storm also impacted counties in Regions 3 and 1 for a total storm damage of $575,000.
May 2007	Clackamas County	Windstorm brought wind gusts up to 50 mph and produced extensive hail, causing $5000 in damages.
July 2007	Multnomah, Washington County	Heavy windstorm with 58 mph winds downed several trees, caused $5000 in damage/$1000 in damage in Beaverton.
Sept 2007	Multnomah County	Severe storm that produced hail and a tornado, caused $5000 in damages.
June 2008	Clackamas County	Severe storms produced heavy winds and hail near the Cascades, caused $5000 in damages.
March 2009	Columbia County	72 mph winds causing $20,000 in property damage.

Source: Taylor, George H., and Ray Hatton, 1999, *The Oregon Weather Book*; and FEMA-1405-DR-OR: February 7, 2002, Hazard Mitigation Team Survey Report, Severe Windstorm in Western Oregon.; Hazards & Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org ; National Climatic Data Center, Storm Events, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms.

Probability

The recurrence interval of a windstorm on the order of the Columbus Day Storm is about 100 years (Taylor, 2002); a windstorm on the order of the February 7, 2002 event has a 10 to 12 year recurrence interval.

The probability that Region 2 will experience windstorms is depicted in Table 24 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 24. Probability Assessment of Windstorms

	Clackamas	Columbia	Multnomah	Washington
Probability	M	M	H	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

Many buildings, utilities, and transportation systems within Region 2 are vulnerable to wind damage. This is especially true in open areas, such as natural grasslands or farmlands. It also is true in forested areas, along tree-lined roads and electrical transmission lines, and on residential parcels where trees have been planted or left for aesthetic purposes. Structures most vulnerable to high winds include insufficiently anchored manufactured homes and older buildings in need of roof repair. The Oregon Department of Administrative Service's inventory of state-owned and operated buildings includes an assessment of roof conditions as well as the overall condition of the structure. Oregon Emergency Management has arranged this information by county.

Fallen trees are especially troublesome. They can block roads and rails for long periods, which can affect emergency operations. In addition, up-rooted or shattered trees can down power and/or utility lines and effectively bring local economic activity and other essential facilities to a standstill. Much of the problem may be attributed to a shallow or weakened root system in saturated ground. Many roofs have been destroyed by uprooted ancient trees growing next to a house. In some situations, strategic pruning may be the answer. Prudent counties will work with utility companies in identifying problem areas and establishing a tree maintenance and removal program.

Additional considerations include ferry systems and bridges, which may be closed during high wind periods.

The region's vulnerability to windstorms is depicted in Table 25 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 25. Vulnerability Assessment of Windstorms

	Clackamas	Columbia	Multnomah	Washington
Vulnerability	L	H	M	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

WINTERSTORMS

Characteristics and Brief History

Severe winter weather in Region 2 can be characterized by extreme cold, snow, ice, and sleet. Although such conditions may be expected in the Cascade Mountains and eastern Oregon, they are considered to be unusual on the Willamette Valley floor. This is where the problem begins. Some Region 2 communities are unprepared, financially and otherwise, despite the fact that periods of cold occur with some regularity (Table 19). This is particularly true in the vicinity of Portland, where frigid air sometimes moves westward through the Columbia River Gorge. During these periods, it is not unusual for northern Willamette Valley communities to receive snow or ice storms ("silver thaws"). Severe weather conditions do not last long in Region 2; consequently, winter-preparedness is often relegated to a low priority.

Probability

Winterstorms occur with some frequency in Region 2. An historical summary of extreme winter conditions in Region 2 is shown in Table 26.

TABLE 26. SIGNIFICANT WINTERSTORMS

DATE	LOCATION	CHARACTERISTICS
Dec., 1861	Statewide	Snowfall varied between 1 and 3 feet. Did not leave Willamette Valley floor until late February
1862, 1866, 1884, 1885, 1890, 1892, 1895	Portland area / Northern Willamette Valley	Severe winter conditions, especially in the Portland area. Some record-breaking snowfalls
Jan., 1916	Statewide	Two snow storms, each totaling 5 inches or more
Dec., 1919	Portland area	3rd heaviest snowfall on record. Columbia River froze, closing navigation
1927, 1936. 1937, 1943,1949	Portland area, western Oregon	Heavy snowfalls recorded
Jan., 1950	Statewide	Heaviest snowfall since 1890. Many highway closures. Considerable property damage.
1956, 1960, 1962,	Western Oregon	Packed snow became ice. Many automobile accidents throughout the region
Mar., 1960	Statewide	Snowfall: 3-12 inches, depending on location
Jan., 1969	Statewide	Record-breaking snow falls.$3-4 million in property damage
Jan., 1980	Statewide	A series of storms bringing snow, ice, wind, and freezing rain. Six fatalities.
Feb., 1985	Statewide	Western valleys received between 2-4 inches of snow; Massive power failures (tree limbs broke power lines)
Dec., 1985	Willamette Valley	Heavy snowfall throughout valley
Mar., 1988	Statewide	Strong winds and heavy snow
Feb., 1989	Statewide	Heavy snowfall and record low temperatures.
Feb., 1990	Statewide	Average snowfall from one storm about 4 inches (Willamette Valley)
Dec., 1992	Western Oregon	Heavy snow. Interstate Highway closed.
Feb., 1993	Western Oregon	Record snowfalls
Winter 1998-9	Statewide	Series of storms. One of the snowiest winters in Oregon history
Dec., 2007	Columbia County	Resulted in Presidential Disaster Declaration. $180 million in damage in the state, severe flooding in Vernonia, power outages for several days, and 5 deaths were attributed to the storm.
Dec., 2008	Columbia	Snow and freezing rain in the Portland Metro area. $300,000 in property damage.

Source: Taylor, George and Hatton, Ray, 1999, *The Oregon Weather Book*, pp.119-122.

The probability that Region 2 will experience winterstorms is depicted in Table 27 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 27. Probability Assessment of Winterstorms

	Clackamas	Columbia	Multnomah	Washington
Probability	H	M	H	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

The region's vulnerability to winterstorms is depicted in Table 28 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 28. Vulnerability Assessment of Winterstorms

	Clackamas	Columbia	Multnomah	Washington
Vulnerability	M	H	M	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

REGION 2

Northern Willamette Valley / Portland Metro[1]

State Owned Building Inventory

[1] Includes the counties of Columbia, Clackamas, Multnomah and Washington.

Region 2: Northern Willamette Valley/Portland Metro State Owned Building Inventory

Agency	Building Name	County	Replacement Value	Contents Value	Total Bldg Value	Usage	Earthquake		Fire/WUI		Flood		Landslide		Windstorms		Winterstorms	
							Prob.	Vuln.	Prob.	Vuln.	Prob.	Vuln.	Prob.	Vuln.	Prob.	Vuln.	Prob.	Vuln.
Dept of Administrative Services	OSP PORTLAND FACILITY & CRIME LAB	Clackamas	16,430,090	0	16,430,090	OFFICE/CRIME LAB	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Corrections	MEDIUM SECURITY FACILITY	Clackamas	61,200,000	625,745	61,825,745	INMATE HOUSING	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Corrections	ADMINISTRATION/FOOD SERVICE	Clackamas	2,427,600	135,159	2,562,759	ADMIN/FOOD SERVICE	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Corrections	PROGRAM SERVICES	Clackamas	2,332,925	71,275	2,404,200	PROGRAM SERVICES	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Corrections	SPECIAL HOUSING	Clackamas	3,206,400	36,386	3,242,786	INMATE HOUSING	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Corrections	MINIMUM HOUSING	Clackamas	6,849,150	76,888	6,926,038	INMATE HOUSING	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Corrections	MINIMUM WORKFORCE	Clackamas	1,050,000	66,686	1,116,686	WORKFORCE	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Corrections	PHYSICAL PLANT	Clackamas	1,419,704	2,945,016	4,364,720	PLANT MAINTENANCE	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Corrections	OISC RECORDS FACILITY	Clackamas	1,485,900	243,216	1,729,116	RECORDS	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Transportation	LAWNFIELD MS DIST 2B OFFICE	Clackamas	1,126,651	563,325	1,689,976	OFFICE/ADMIN	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Transportation	GOV'T CAMP MS BLDG	Clackamas	2,019,157	11,009,578	13,028,735	MAINT STA BLDG	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Transportation	MILWAUKIE MS BRIDGE/ELEC	Clackamas	1,578,898	789,449	2,368,347	GARAGE SERVICE	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Transportation	Milwaukie Reg Office	Clackamas	5,551,128	2,775,564	8,326,692	Office, Administrative	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Transportation	Estacada Maint Station Bldg	Clackamas	2,207,784	1,103,892	3,311,676	Maintenance Station Bldg	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Transportation	Govt Camp MS House104	Clackamas	822,999	411,500	1,234,499	Residence Hall, Dormitory	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Transportation	Govt Camp Maintenance Sta Bldg	Clackamas	1,463,464	731,732	2,195,196	Maintenance Station Bldg	H	H	M	M	H	M	H	L	M	L	H	M
Dept of Transportation	Milwaukie Office Bldg	Clackamas	671,715	335,857	1,007,572	Office, Administrative	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	Clackamas ARMORY	Clackamas	5,786,357	3,328	5,789,685	ARMORY	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept		Clackamas	3,991,563	5,000	3,996,563	ADMINISTRATION	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	OMS	Clackamas	5,083,960	50,282	5,134,242	OMS	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	CSMS (NEW)	Clackamas	19,215,780	15,282	19,231,062	CSMS	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	TS-CPWITHY-MUSB	Clackamas	2,013,852	5,000	2,018,852	STORAGE	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	TS-CPWITHY-SSSCO	Clackamas	2,721,194	5,000	2,726,194	STORAGE	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	TS CAMP WITHYCOMBE	Clackamas	1,840,927	5,000	1,845,927	COMPUTER SUP	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	TS CAMP WITHYCOMBE	Clackamas	2,334,711	5,000	2,339,711	ENG/MAINT SHOP	H	H	M	M	H	M	H	L	M	L	H	M

Source: DAS data 2005

Region 2: Northern Willamette Valley/Portland Metro State Owned Building Inventory

Agency	Building Name	County	Replacement Value	Contents Value	Total Bldg Value	Usage	Earthquake		Fire/WUI		Flood		Landslide		Windstorms		Winterstorms	
Military Dept	SUPPLY DISTRIBUTION CENTER	Clackamas	3,532,954	5,000	3,537,954	WAREHOUSE	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	LAKE OSWEGO ARMORY	Clackamas	3,635,547	4,816	3,640,363	ARMORY	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	OREGON CITY ARMORY	Clackamas	2,211,164	5,000	2,216,164	ARMORY	H	H	M	M	H	M	H	L	M	L	H	M
Military Dept	ST HELENS ARMORY	Columbia	1,984,681	5,000	1,989,681	ARMORY	L	H	M	M	H	H	-	-	M	H	M	H
Dept of Administrative Services	PORTLAND ST OFFICE BLDG (NEW)	Multnomah	36,194,028	2,687,000	38,881,028	OFFICE	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Administrative Services	ALBINA OFFICE	Multnomah	4,425,852	2,500	4,428,352	OFFICE	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Administrative Services	PORTLAND BLIND COMM BLDG	Multnomah	1,781,168	7,000	1,788,168	MANUFACTURING	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Administrative Services	PORTLAND MOTOR POOL	Multnomah	1,225,880	92,273	1,318,153	MOTOR POOL	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Corrections	CRCI MAIN FACILITY	Multnomah	20,970,775	764,614	21,735,389	CORRECTIONAL FACILITY	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Transportation	E PORTLAND DMV DTC	Multnomah	1,614,137	807,069	2,421,206	OFFICE/ADMIN	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Transportation	E PORTLAND MAINT BLDG	Multnomah	1,740,875	870,438	2,611,313	FUELING STATION	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Transportation	REGION 1 HQ BLDG	Multnomah	5,243,593	2,621,796	7,865,389	OFFICE/ADMIN	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Transportation	Sylvan MS Garage	Multnomah	1,577,903	788,952	2,366,855	Storage, Miscellaneous	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Transportation	Baldock MS Maint Bldg	Multnomah	1,169,332	584,666	1,753,998	Maintenance Station Bldg	H	H	H	M	H	H	H	H	H	M	H	M
Military Dept	GRESHAM ARMORY	Multnomah	1,984,681	5,000	1,989,681	ARMORY	H	H	H	M	H	H	H	H	H	M	H	M
Military Dept	AIR GUARD BAND BLDG	Multnomah	1,549,782		1,549,782	ARMORY	H	H	H	M	H	H	H	H	H	M	H	M
Military Dept	JACKSON ARMORY	Multnomah	5,092,992	8,446	5,101,438	ARMORY	H	H	H	M	H	H	H	H	H	M	H	M
Military Dept	KLIEVER ARMORY	Multnomah	10,586,751	7,213	10,593,964	ARMORY	H	H	H	M	H	H	H	H	H	M	H	M
Oregon Institute of Technology	METRO CENTER BLDG	Multnomah	9,240,000	1,324,858	10,564,858	INSTRUCTION	H	H	H	M	H	H	H	H	H	M	H	M
Oregon Liquor Control Comm	OLCC	Multnomah	17,800,000	41,186,030	58,986,030	OFFICE & WAREHOUSE	H	H	H	M	H	H	H	H	H	M	H	M
Oregon State Univ	FOOD INNOVATION CTR	Multnomah	5,434,935	474,373	5,909,308		H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	LINCOLN HALL	Multnomah	22,283,580	1,317,758	23,601,338	CLASSROOMS/OFFICE	H	H	H	M	H	H	H	H	H	M	H	M

Source: DAS data 2005

Region 2: Northern Willamette Valley/Portland Metro State Owned Building Inventory

Agency	Building Name	County	Replacement Value	Contents Value	Total Bldg Value	Usage	Earthquake		Fire/WUI		Flood		Landslide		Windstorms		Winterstorms	
Portland State Univ	NEUBERGER HALL	Multnomah	36,714,975	2,464,232	39,179,207	OFFICE/CLASSROOMS	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	SCIENCE I	Multnomah	24,887,772	3,676,323	28,564,095	CLASSROOMS/OFFICE	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	PETER STOTT CENTER	Multnomah	25,326,180	0	25,326,180	PHYSICAL EDUCATION, RECREATION	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	SCIENCE BLDG II	Multnomah	58,239,909	0	58,239,909	CLASSROOM, LABORATORIES	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	ONDINE RESIDENCE	Multnomah	35,315,115	1,292,585	36,607,700	DORM/CLASSROOM	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	CRAMER HALL	Multnomah	39,528,060	2,581,551	42,109,611	OFFICE/CLASSROOMS	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	SMITH MEMORIAL STUDENT UNION	Multnomah	24,193,461	1,147,434	25,340,895	STUDENT UNION, DINING, OFFICES	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	MILLAR LIBRARY	Multnomah	32,139,195	48,719,915	80,859,110	LIBRARY	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	SHATTUCK HALL	Multnomah	15,453,735	4,901,875	20,355,610	CLASSROOMS	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	WEST HALL	Multnomah	21,549,000	16,767	21,565,767	STDUDENT HOUSING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	FOURTH AVENUE	Multnomah	55,855,527	321,079	56,176,606	OFFICE	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	FAB GARAGE	Multnomah	45,295,341	0	45,295,341		H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	UNIVERSITY SERVICES	Multnomah	12,307,845	4,154,304	16,462,149	OFFICE	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	PARKING STRUCTURE 2	Multnomah	4,435,080	0	4,435,080	PARKING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	SCHOOL OF EDUCATION	Multnomah	8,793,345	200,399	8,993,744	CLASSROOMS/OFFICE	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	SCHOOL OF BUSINESS	Multnomah	8,624,550	568,141	9,192,691	CLASSROOMS/OFFICE	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	HELEN GORDON CHILD CARE CTR	Multnomah	2,589,180	35,693	2,624,873	EARLY CHILDHOOD EDUCATION	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	PARKING STRUCTURE I	Multnomah	12,637,480	4,218	12,641,698	PARKING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	EAST HALL	Multnomah	3,801,930		3,801,930		H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	WEST HEATING PLANT	Multnomah	1,694,800	137,282	1,832,082	MECHANICAL/ELECTRICAL	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	UNIVERSITY CENTER BLDG	Multnomah	14,482,215	0	14,482,215	STUDENT HEALTH SERVICES, OFFICES	H	H	H	M	H	H	H	H	H	M	H	M

Source: DAS data 2005

Region 2: Northern Willamette Valley/Portland Metro State Owned Building Inventory

Agency	Building Name	County	Replacement Value	Contents Value	Total Bldg Value	Usage	Earthquake		Fire/WUI		Flood		Landslide		Windstorms		Winterstorms	
Portland State Univ	EXTENDED STUDIES	Multnomah	4,950,000	354,148	5,304,148	OFFICE	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	PARKING STRUCTURE III	Multnomah	9,370,240	21,510	9,391,750	PARKING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	PORTLAND CENTER FOR ADVANCED TECHNOLOGY	Multnomah	8,821,725	3,270,508	12,092,233	OFFICE/EDUCATION	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	HOFFMAN HALL	Multnomah	1,607,760	274,292	1,882,052	CLASSROOMS/CONFERENCES	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	SIXTH AVENUE	Multnomah	2,729,100	0	2,729,100	CLASSROOM, OFFICES	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	URBAN CENTER	Multnomah	19,470,000	0	19,470,000	OFFICE/CLASSROOMS	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	ART BUILDING	Multnomah	1,162,493	0	1,162,493	EDUCATIONAL	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	FIFTH AVE BLDG	Multnomah	1,553,700	0	1,553,700	LEASE SPACE, STORAGE	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	UNIVERSITY PLACE	Multnomah	9,030,000	1,470,000	10,500,000	OFFICE/RESTAURANT/SLEEPING ROOMS	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	PARKWAY MANOR	Multnomah	6,682,500	0	6,682,500	STUDENT HOUSING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	BLACKSTONE	Multnomah	6,708,075	0	6,708,075	STUDENT HOUSING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	MONTGOMERY COURT	Multnomah	4,765,200	2,965	4,768,165	STUDENT HOUSING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	MARY ANN BLDG	Multnomah	1,465,200	0	1,465,200	Student Housing	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	STRATFORD	Multnomah	2,524,500	0	2,524,500	STUDENT HOUSING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	ST HELENS	Multnomah	3,990,800	0	3,990,800	STUDENT HOUSING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	KING ALBERT	Multnomah	3,514,500	0	3,514,500	STUDENT HOUSING	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	ADELINE BLDG	Multnomah	1,230,900	0	1,230,900	Student Housing	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	LIBRARY EAST	Multnomah	9,782,025	1,147,434	10,929,459	LIBRARY SERVICES	H	H	H	M	H	H	H	H	H	M	H	M
Portland State Univ	SMITH MEMORIAL CTR/CAFETERIA	Multnomah	8,612,010	1,147,434	9,759,444	CAFETERIA	H	H	H	M	H	H	H	H	H	M	H	M
Univ of Oregon	WILLAMETTE BLOCK BLDG	Multnomah	7,721,835	305,300	8,027,135	INSTRUCTION/RESEARCH	H	H	H	M	H	H	H	H	H	M	H	M
Dept of Administrative Services	DEQ Health Lab.	Washington	3,981,100	0	3,981,100	Office/HEALTH lAB.	M	M	M	M	H	M	L	L	H	H	H	H

Source: DAS data 2005

Region 2: Northern Willamette Valley/Portland Metro State Owned Building Inventory

Agency	Building Name	County	Replacement Value	Contents Value	Total Bldg Value	Usage	Earthquake		Fire/WUI		Flood		Landslide		Windstorms		Winterstorms	
Military Dept	RICHARD A MILLER ARMORY	Washington	6,026,996	5,000	6,031,996	ARMORY	M	M	M	M	H	M	L	L	H	H	H	H
Military Dept	HILLSBORO ARMORY	Washington	2,249,177	5,000	2,254,177	ARMORY	M	M	M	M	H	M	L	L	H	H	H	H
Military Dept	MAISON ARMORY	Washington	5,488,599	6,229	5,494,828	ARMORY	M	M	M	M	H	M	L	L	H	H	H	H
Public Employee Retirement System	PERS HQ	Washington	7,495,381	7,121,510	14,616,891	OFFICE	M	M	M	M	H	M	L	L	H	H	H	H
	Regional Totals		**940,911,030**	**160,938,090**	**1,101,849,120**													

Source: DAS data 2005