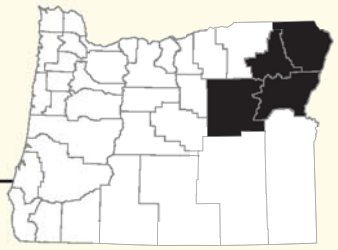
PARTNERS *for* DISASTER RESISTANCE RESILIENCE

Region 7: Northeast Oregon

Profile and Risk Assessment

Baker, Grant, Union, and Wallowa Counties



Photos: Gary Halvorson, Oregon State Archives

ONHW Oregon Natural Hazards Workgroup

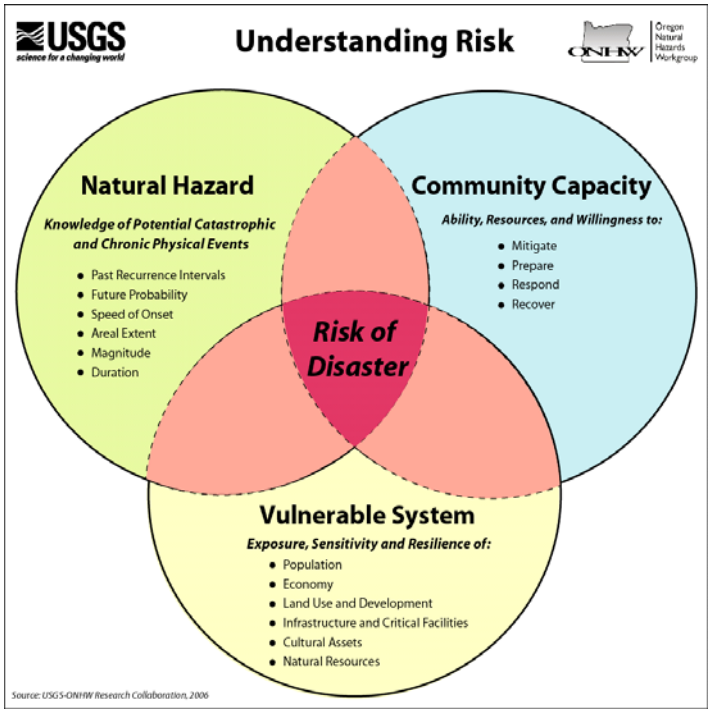
Region 7: Northeast Oregon Natural Hazard Risk Profile

Baker, Grant, Union & Wallowa Counties

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 summarizes 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 (e.g., 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.* [1]



It is not always possible to predict exactly when natural disasters 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 $4.00.[2]

How to use this Report

The Oregon Natural Hazards Workgroup (ONHW) at the University of Oregon's Community Service Center developed this report as part of the regional planning initiative funded by the Pre-Disaster Mitigation Grant.[*] 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 the ONHW Sample Action Item Report to develop and document the community's action items. The Sample Action Item Report lists potential mitigation activities by category, such as population, economy, understanding of risk, and implementation. The report also provides state and national level rationale on why the sample action may be appropriate.

Regional Overview

The Northeast region (Region 7 as identified in the state's natural hazard mitigation plan) includes Baker, Grant, Union and Wallowa Counties. This region is at relatively high risk from wildfires, flooding, and winter storms. It also faces moderate to high risk from drought, earthquake and windstorms. Wallowa County is also at risk from landslides in steep sloped areas along state highways. Other risks for the region, though with less frequent occurrence, are the effects of earthquakes and ash from a Mt. Saint Helens volcanic eruption.

Organization of Report

This report includes three sections that present a comprehensive profile of the region and its sensitivity to natural hazards.

Regional Maps

Critical Infrastructure Map- Updated maps coming soon

Using 2003 data from Oregon Department of Transportation, this map shows the approximate location of critical infrastructure, including

[*] FEMA Pre-Disaster Mitigation Agreement Number – EMS-2006-PC-0003

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- Updated maps coming soon

These maps depict the counties' 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 2006.

Regional Profile and Sensitivity Analysis

Using the best available data, the regional profile includes a *Geographic Profile*, which provides a physical geographic overview of the region, a *Demographic Profile* that discusses the population in the Northeast 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 Northeast region as a whole and by individual counties when possible. Much of the demographic data was sourced from the 2000 U.S. Census; the economic data came from the 2002 Economic Census, the Bureau of Economic Analysis and the Oregon Department of Agriculture. State agency reports and plans and websites for private companies were also important sources of information.

Regional Hazards Assessment

The regional natural hazard risk assessment section describes historical impacts, 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.

ONHW Potential Action Item Report

This is a separate report produced by the Oregon Natural Hazards Workgroup at the University of Oregon. This report contains two main sections: (1) a series of explanations about what action items are, what purposes they serve, and how to create them; and (2) a series of potential actions addressing all the natural hazards Oregon communities face. The actions include a statewide and national rationale, based on research, for the action and ideas for

implementation and are designed to serve as a starting point for local communities as they discuss, develop and prioritize local risk reduction strategies. Communities will ultimately want to develop more detailed action items based on regional or locally specific data. This portion of the report will be available at the second plan development work session in January.

Northeast Region

The Northeast Oregon region has experienced a five percent increase in population since 1990. The population in this area has grown at less than half of the rate of other areas in the state since 1990. Seventy percent of the region's population lives in incorporated areas, and 30% live in unincorporated areas. Twenty-nine percent of the region's houses were built before 1960, 31% between 1960 and 1980, and 24% were built after 1980. The impact of a disaster can disrupt automobile traffic and shut down local transit systems across the region, making evacuation difficult. The average commute for workers in this region is 17 minutes each way. Seventy-two percent of the region's workers drive alone to work. Twelve percent carpool, seven percent walk or use other means, and nine percent work at home. Most bridges in the area have not been seismically retrofitted, creating significant risk to the commuting population in areas at risk from earthquakes.

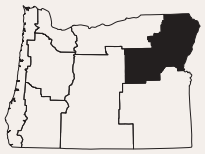
REGION FACTS

Population:

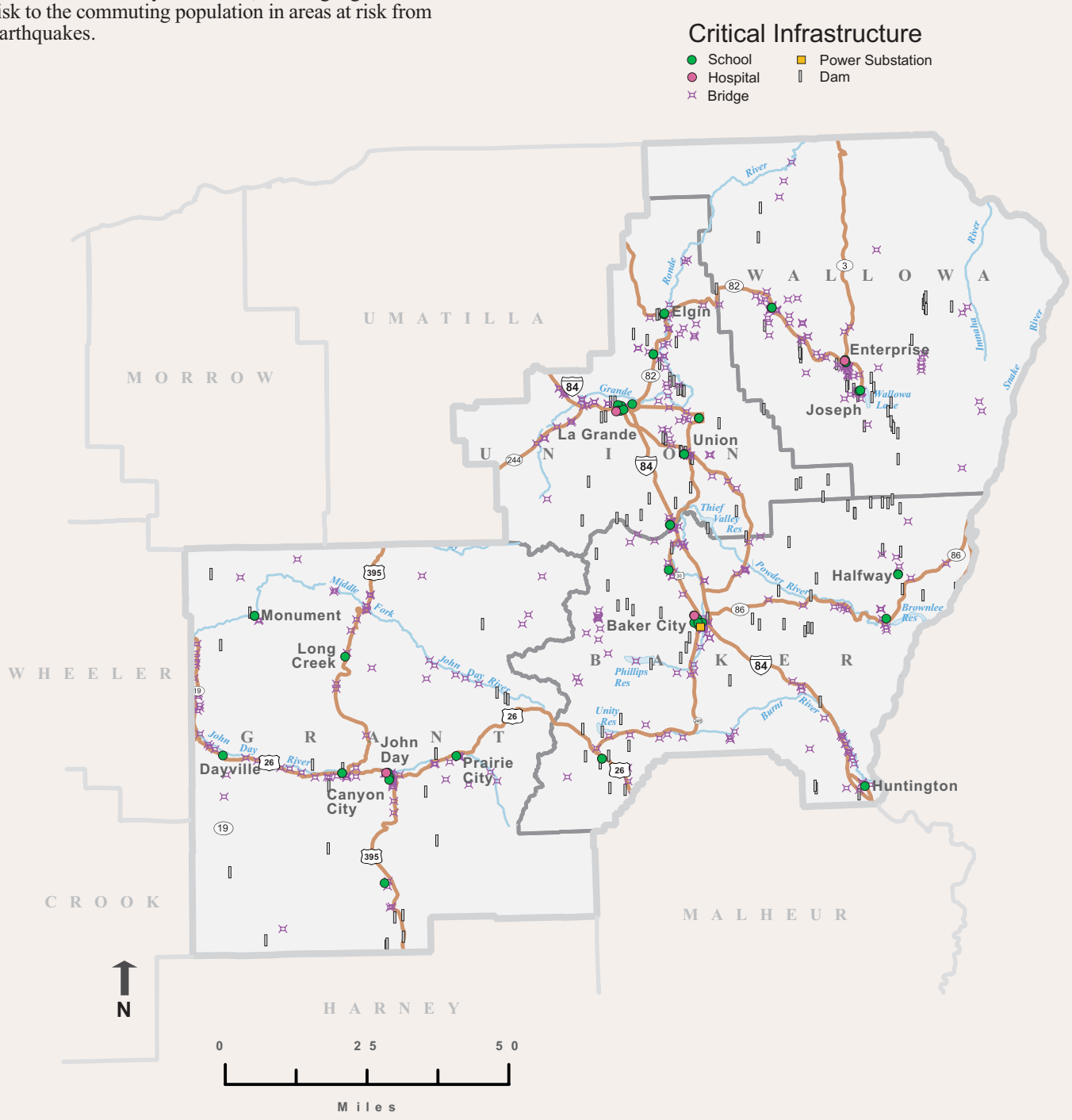
Total	56,432
Rural	17,528
Urban	38,904

Housing:

Single-Family	70%
Multi-Family	11%
Mobile Homes	19%
Boat, RV, Van, etc	>1%



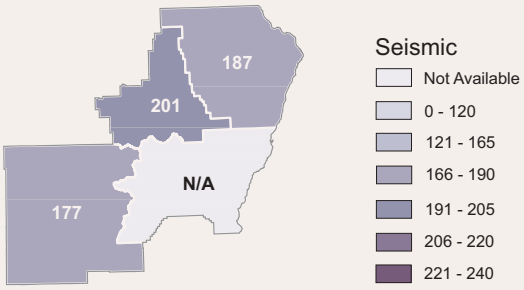
County	# of Hospitals	# of Hospital Beds	Police Stations	Fire & Rescue Stations	Power Plants	Dams	Bridges
Baker	1	36	3	13	0	47	281
Grant	1	22	3	6	0	14	152
Union	1	63	4	7	0	19	194
Wallowa	1	25	3	4	0	5	132



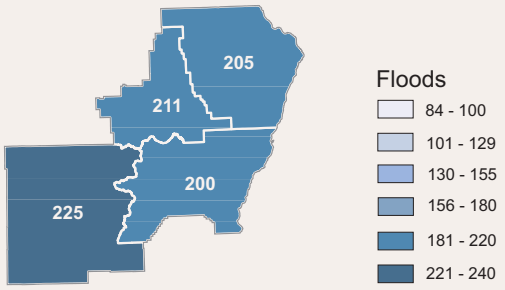
As part of the County Hazard Risk Analysis, each county develops risk scores for Oregon's major natural hazards. This score, ranging from 24 (low) to 240 (high), reflects the County's perceived risk for the particular hazard. Scores are current as of July 2003.

To obtain the most current scores, see http://www.oregonshowcase.org or contact Oregon State Police – Office of Emergency Management http://www.osp.state.or.us/oem/.

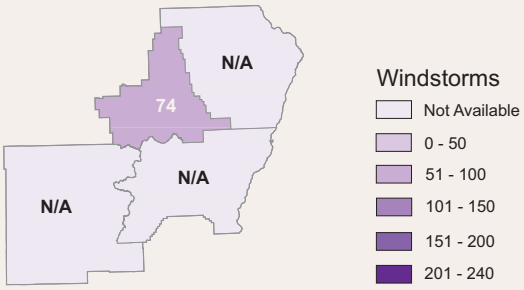
Seismic



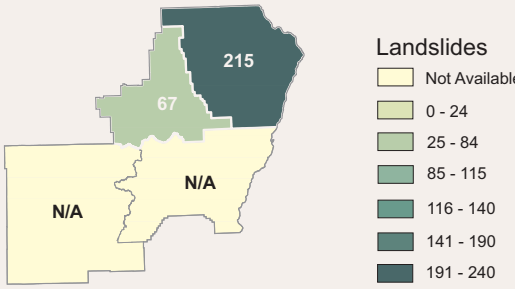
Floods



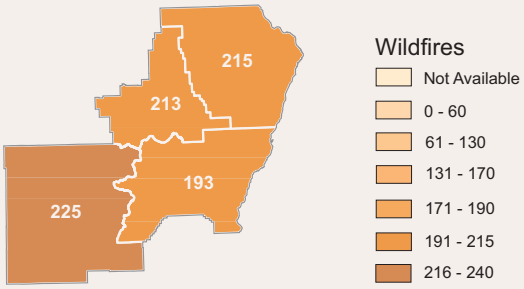
Windstorms



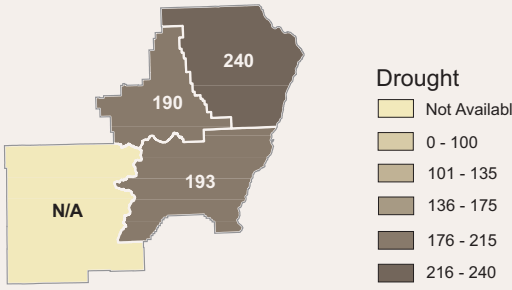
Landslides



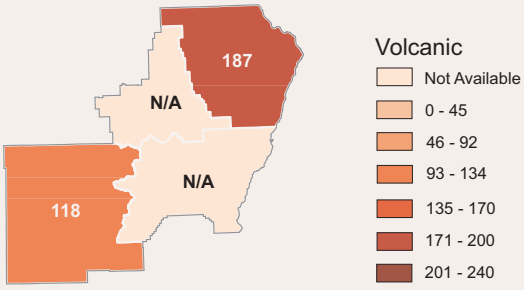
Wildfires



Drought



Volcanic



Regional Profile and Sensitivity Analysis

Section 1: Climate and Geography

The four-county area of the Northeast region is approximately 12,765 square miles. The region is bordered by the Snake River to east and the Columbia River to the north. Columbia River Basalt lava flows formed the high plateaus of the region and the Blue and Wallowa Mountains and the Steens Mountain are all in the region. Average precipitation in the mountainous regions ranges from 50-80 inches a year, but is less than 20 inches for the surrounding high desert. Major rivers in the region include the John Day, Grand Ronde, and the Snake.[3]

Section 2: Demographic Profile

This section describes the Northeast 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 2005, the estimated population of the Northeast region was 56,265, representing a slight population loss of -1% since 2000. According to the Oregon Office of Economic Analysis, the Northeast region is projected to grow at a slower rate than Oregon overall, and is projected to maintain a fairly stable population over the next 20 years. Table 1 displays the population change in each Northeast County, along with their respective Average Annual Growth Rates (AAGR).

Table 1. Population Growth, Northeast Region, 2000-2005

County	2000 Population	2005 Population	2000-2005 Population Change	% Change 2000-2005	AAGR 2000-2005
Baker	16,741	16,500	-241	-1.4%	-0.3%
Grant	7,935	7,685	-250	-3.2%	-0.6%
Union	24,530	24,950	420	1.7%	0.3%
Wallowa	7,226	7,130	-96	-1.3%	-0.3%
Regional Total	**56,432**	**56,265**	**-167**	**-1.1%**	**-0.2%**

Source: Portland State University, Population Estimates, 2005.

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 displays the median household income for the Northeast region, which was $32,980 in 2003. This is below the

national average of $43,318 and the state's average of $42,593. The negative one percent median household income growth between 2000 and 2003 in the region is smaller than the two percent State and three percent National growth over the same time period.

Table 2. Median Household Income, Northeast Region, 2000 and 2003

County	2000	2003	% Change 2000-2003
Baker	$31,316	$30,469	-2.7%
Grant	$33,369	$32,837	-1.6%
Union	$35,129	$35,607	1.4%
Wallowa	$33,257	$33,005	-0.8%
Regional Average:	**$33,268**	**$32,980**	**-0.9%**

Source: U.S. Census Bureau Small Area Income Poverty Estimates, 2000 and 2003

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.[4] Of this number, a disproportionate burden is placed upon special needs groups, particularly minorities, and the poor.

In 2003, 13% of the nation's population was living in poverty, the same as the Northeast regional poverty level of 13%. Oregon's state poverty average was 12%, slightly less than the Northeast regional average. While the median household incomes are lower in the region than the state as a whole, the similar poverty rate may be due to a lower cost of living in the Northeast region. Table 3 details the county and regional poverty rates in 2003.

Table 3. Poverty Rates, Northeast Region, 2003

	Total Population in Poverty		Children Under 18 in Poverty	
County	Number	%	Number	%
Baker	2,325	14%	778	22%
Grant	928	13%	301	18%
Union	3,098	13%	967	18%
Wallowa	852	12%	262	19%
Regional Average		**13%**		**19%**

Source: U.S. Census Bureau Small Area Income Poverty Estimates, 2003

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 2004, 35% of the regional population was under 14 or over 65 years of age.[5] Table 4 provides a breakdown of the percentages of youth and elderly in the Northeast region counties.

Table 4. Northeast Region Youth and Senior Populations, 2004

	0-14		65-74		75+	
County	**Number**	**%**	**Number**	**%**	**Number**	**%**
Baker	2,754	17%	1,631	10%	1,634	10%
Grant	1,377	18%	725	10%	623	8%
Union	4,711	19%	1,884	8%	1,845	7%
Wallowa	1,094	15%	701	10%	729	10%
Regional Total and Average %:	**9,936**	**17%**	**4,941**	**9%**	**4,831**	**9%**

Source: Portland State University Population Estimates, 2005

The high percentage of elderly individuals, particularly in Baker and Wallowa Counties, require special consideration due to their sensitivities to heat and cold, their reliance upon transportation for medications, and their comparative difficulty in making home modifications that reduce risk to hazards.

Young people also represent a vulnerable segment of the population. In every county in the region, at least 15% 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. These 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 Northeast 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 that 1% percent of the total population over age 5 in the Northeast region speak English less than "very well."

Table 5. Northeast Region Population over age 5 that Speaks English less than "Very Well", 2000

County	%Population
Baker	2%
Grant	1%
Union	2%
Wallowa	1%
Regional Average:	**1%**

Source: US Census Bureau, 2000 Census Summary File 4

Housing and Development

To accommodate rapid growth, communities engaged in mitigation planning should consider the vulnerability of a 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. If Measure 37 is upheld, it may impact the ability of communities to regulate land-use protection measures in communities. Communities in the process of developing land for housing and industry need to ensure that land-use and protection 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 Northeast region is growing more urban, with just over one percent population growth in incorporated areas between 2000 and 2005, versus a one percent population loss in unincorporated areas during the same time period. Table 6 illustrates the trend in urban area population growth in the Northeast counties between 2000 and 2005.

Table 6. Urban/Rural Populations, Northeast Region, 2000-2005

	% Incorporated Population		% Change
County	**2000**	**2005**	**2000-2005**
Baker	69%	71%	2%
Grant	62%	65%	3%
Union	75%	77%	0%
Wallowa	56%	58%	2%
Regional Average:	**66%**	**67%**	**1%**

Source: Portland State University Population Estimates, 2005

In addition to location, the character of the housing stock also affects the level of risk that communities face from natural hazards. Table 7

provides a breakdown by county of the various housing types available in 2000. Mobile homes and other non-permanent housing structures, which account for 27% of the housing in Grant County, are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing these types of structures.

Table 7. County Housing Profile, Northeast Region, 2000

County	Single-Family	Multi-Family	Mobile Homes	Boat, RV, Van, etc.
Baker	72%	10%	17%	1%
Grant	65%	7%	27%	1%
Union	68%	17%	14%	Less than 1 %
Wallowa	73%	8%	18%	Less than 1 %

Source: U.S. Bureau of the Census, Profile of Housing Characteristics 2000.

Table 7 shows that the majority of the housing stock is in single-family homes and this trend is continuing with new construction. In 2002, an estimated 99% of new housing was single-family units.[6] This trend suggests that hazard mitigation efforts should provide outreach and information that specifically addresses preparedness in detached housing units.

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 8 illustrates the percentage of homes built per county during certain periods of time.

Table 8. Housing, Year Built, Northeast Region

County	1939 or earlier - 1959	1960-1979	1980-2000
Baker	50%	27%	23%
Grant	43%	34%	23%
Union	45%	34%	21%
Wallowa	46%	27%	27%

Source: U.S. Bureau of the Census, Profile of Housing Characteristics 2000.

Section 3: Infrastructure Profile

This section of the report describes the infrastructure that supports Northeast 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 vulnerability of Northeast infrastructure to natural hazards.

Transportation

The Northeast region includes an important transportation corridor, I-84. I-84 connects Portland with Idaho and the east, and is an important freight route because it connects to barge freight transportation along the Columbia River. There are two primary modes of transportation in the region: highways and railroad. There are also many small airports scattered throughout the region that are used primarily for passenger service.

Roads and Bridges

There are two major highways that run through the Northeast region. I-84 is a major transportation corridor that connects Portland with eastern Oregon and beyond. State Highway 82 connects the very northeastern part of the State with I-84.[7]

Many commercial entities make use of the highways in the Northeast region. Trucks transported over 10 million tons of freight along I-84 in 2002 and the average daily truck volume was more than 3,000.[8]

Highways are also heavily utilized by local traffic. According to the 2000 Census, 72% of workers in the Northeast region commute by driving alone. The average commute for workers in the Northeast region is just over seventeen minutes each way.[9] Additionally, in 2003, 25% of employees living in counties in the Northeast region worked outside of their home county.[10] A severe winter storm has the potential to disrupt the daily driving routine of thousands of people.

There has been a slight increase of automobiles on the roads:

- Average daily traffic volume on OR 86 recorded 0.3 miles west Island City increased by 2% between 2000 and 2005 in Union County.
- Average daily traffic counts also increased by 12% between 1996 and 2005 on OR 82, 3.5 miles west of Richland in Baker County.[11]

Judging from these trends, traffic levels will continue to increase.[12]

A large increase of automobiles can place stress on roads, bridges and infrastructure within the cities, and also in rural areas where there are fewer transit roads. Natural hazards can disrupt automobile traffic and

shut down local transit systems across the area or region and make 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 Northeast 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 9 shows the number of state, county, and city maintained bridges and culverts, 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 9. Bridges and Culverts

County	State Highway Bridges	State Highway Culverts	County Highway Bridges	County Highway Culverts	City/ Municipal Highway Bridges	City/ Municipal Highway Culverts	Historic Covered Bridges	2006 Total
Baker	80	110	80	3	7	0	0	280
Grant	43	63	36	1	9	0	0	152
Union	69	54	67	0	6	0	0	196
Wallowa	21	39	58	2	11	2	0	133

Source: Oregon Department of Transportation, 2006.

Railroads

Railroads are major providers of regional and national cargo and trade flows. Railroads that run through the Northeast region provide vital transportation links from the Pacific to the rest of the country. The Union Pacific Railroad (UP) is the major railroad in the region.

UP owns the tracks that run northwest-southwest along the Columbia River, west of the Northeast region, running southwest through the region to Idaho. Several smaller tracks connect to the UP line in the Northeast region: the Blue Mountain Railroad, Idaho Northern and Pacific, and Sumpter Valley Railroad lines.[13]

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. [14] 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. [15] 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. [16]

Rails are sensitive to icing from the winter storms that are common in the Northeast 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 Northeast region has six small airports: Grant County Regional, Baker City, Enterprise, Joseph, Monument, and La Grande. The La Grande airport is the only airport in the region to transport more than 50 tons of freight annually. The La Grande Airport transported 100 tons of freight in and out of the airport in 2000. In comparison, the Eugene-Mahlon Sweet Field handled 2,000 tons and Portland International transported 165,000 tons of freight in 2000.[17]

Flights face the potential for closure from a number of natural hazards that are common in the Northeast 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 Northeast region are displayed in Table 10 by county.

Table 10. Northeast Region Critical Facilities by county

County	Hospitals		Police Station	Fire & Rescue Station	School Districts & Colleges
	# of Hospitals	# of Beds			
Baker	1	36	2	13	4 Districts
Grant	1	25	3	7	5 Districts
Union	1	49	4	7	6 Districts, 1 State University
Wallowa	1	25	1	4	4 Districts

Sources: State Hospital Licensing Department, Local Sheriff Offices, Oregon State Fire Marshall, Oregon Department of Education. Table updated July 2006.

In addition to those listed in Table 10, 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 Northeast region is an important throughway for oil and gas pipelines and electricity transmission lines, connecting Oregon to Idaho and Washington. The infrastructure associated with power generation and transmission plays a critical role in supporting the regional economy.

There are several dams along the Lower Snake River: The Brownlee Dam, Hells Canyon Dam, and Oxbow Dam. All three of these dams are owned by Idaho Power, which serves parts of the Northeast region.[18]

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 11 lists the dams included in these inventories.

Table 11. Northeast Region Power Plants and Dams by County

County	Power Plants	Dams		
		Dams† (State)	Dams‡ (National)	Threat Potential
Baker	0	92	51	6 High Threat
Grant	0	34	18	1 High Threat
Union	0	34	25	4 High Threat
Wallowa	0	9	6	2 High Threat

Sources: Oregon Department of Energy, National Inventory of Dams. Table updated July 2006.

The electric, oil, and gas lines that run through the Northeast region are privately owned. A network of electricity transmission lines running through the Northeast region allows Oregon utility companies to exchange electricity with other states and Canada.[19] Most of the natural gas Oregon uses originates in Alberta, Canada.

One major oil pipeline runs through the Northeast region, connecting Idaho and the Southwest United States with Canadian/Rocky Mountain oil field products, and one major natural gas transmission pipeline, owned by PG&E, runs through the Northeast region.[20] These

† Note: The National Inventory of Dams includes all dams with either:

a) a high or significant hazard rating

b) a low hazard dam that exceeds 25 feet in height AND 15 acre-feet storage

c) a low hazard dam that exceeds 6 feet in height AND 50 acre-feet storage

‡ Note: The State Inventory of Dams includes all dams over 10 feet in height AND 9.2 acre-feet storage

lines 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 Northeast 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 Northeast region, informed decisions can be made about how to mitigate risk.

Economic Overview

The Northeast region has several economic advantages due to its location. The region's proximity to the Columbia River, Washington, and Idaho provide good opportunities for transportation of manufactured, agricultural and forest products.

According to the Oregon Employment Department, the Northeast region economy is experiencing a slight economic upturn. Unemployment has gone slightly down in Baker, Union and Wallowa Counties during the first months of 2006. Construction, Manufacturing, and Retail Trade have grown in Union County.[21] As of 2004, the region employed 32,961 people with a combined payroll of over five hundred million dollars. Table 12 displays the payroll and employee figures per county.

Table 12. Northeast Employment and Payroll by County, 2004

County	# of Employees	Annual Payroll
Baker	8,734	$142,677,000
Grant	4,567	$79,497,202
Union	15,132	$301,950,000
Wallowa	4,528	$59,260,000
Total	**32,961**	**$583,384,000**

Source: Bureau of Economic Analysis

In 2004, there were 1,947 businesses in the Northeast region. Of these, 94%, or 1,821, were small businesses with less than 20 employees.[22]

The prevalence of small businesses in the Northeast region is an indication of sensitivity to natural hazards because small businesses are more susceptible to financial uncertainty.[23] 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.[24]

Although the Northeast region has a high percentage of small businesses, as a whole, the Northeast region has a more homogeneous economy than other Oregon regions. Many of the small businesses fall into the same categories of industry sectors. This low economic diversity means that certain industries are dominating the economic structure of the community, and are therefore extremely important to the Northeast region. Table 13 displays the diversity ranking for each county with 1 being the most economically diverse county in Oregon, 36 being the least economically diverse county in Oregon.

Table 13. County Economic Diversity Ranking, 1999

County	Economic Diversity Index Ranking
Baker	15
Grant	33
Union	14
Wallowa	30

Source: Oregon Employment Department[25]

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

The Northeast region's top revenue generating industries are a mix of basic and non-basic sectors. In 2002, the three sectors in the Northeast region with the highest revenue were Retail Trade (36%), Manufacturing (28%), and Health Care and Social Assistance (10%).[26] §

Within the individual counties in the Northeast, however, the industries' relative contribution to revenue differs. For instance, in Grant and Wallowa counties, the Farm and Ranch sector garners the second highest amount of revenue. Table 14 shows the percent of total county revenue that is contributed by various sectors.

§ Note: US Census Total Sales figures were not available for all sectors and counties in Region 5. These figures represent the closest estimate.

Table 14. Percent of Revenue in Northeast Counties by Industry, 2002

	Industry										
County	Retail Trade	Wholesale Trade	Accommodation and Food Services	Health Care/ Social Assistance	Professional, Scientific and Technology	Other (except Public Admin)	Real Estate and Rental and Leasing	Arts/ Entertainment	Administrative/ Waste Services	Manufacturing	Farm and Ranch
Baker	31%	4%	5%	12%	2%	3%	1%	0%	n/a	32%	11%
Grant	50%	6%	6%	14%	3%	2%	2%	n/a	n/a	n/a	17%
Union	34%	12%	3%	9%	n/a	1%	1%	n/a	1%	35%	4%
Wallowa	54%	n/a	6%	12%	3%	4%	2%	n/a	n/a	n/a	19%

Source: U.S. Census 2002, Oregon Department of Agriculture 2002

The *retail trade sector* in the Northeast region is primarily composed of small businesses (91%) that tend to be more sensitive to hazard induced costs due to prior financial instability. 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.

The *manufacturing sector* is highly dependent upon the transportation network in order to access supplies and send finished products to outside markets. Manufactures in this region are sensitive to hazard induced disruptions to the Union Pacific railroad or I-84. As base industries they are not, however, dependent on local markets for sales, which contribute to the economic resilience of this sector.

The *health care and social assistance sector* ranges from physicians and chiropractors to family planning and kidney dialysis centers to emergency food and housing organizations and child day care services. This sector is growing in the Northeast, partly as a result of the large retirement age population.

The demand for health care and social assistance following a severe natural disaster may increase in the short term as extra health care

and housing services may be necessary. Services that are privately subsidized and sensitive to interruptions of funding may suffer following a disaster. However, the long-term economic viability of this sector should not be adversely affected by a natural disaster. The ability of their facilities' to withstand the physical impacts of a disaster and the personnel's ability to cope with a potential influx of people requiring attention after a disaster may be concerns for this sector.

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 three sectors in the Northeast region with the most employees in 2004 were Government (18%), Retail Trade (11%), and Farm (11%.)[27]**

The *farm and ranch sector* is inherently dependent on the weather and is susceptible to a variety of natural hazards that afflict the Northeast region, including flood, drought, and winter storms. These natural hazards have the capacity to devastate seasonal crops, representing a significant financial loss for the year. The Northeast region is known for its farm and ranch goods, including cherries, potatoes, wheat, mint, hay, and beef cattle.[28]

In the Northeast region, a substantial ripple effect through the economy can be anticipated following agricultural loss. This is due both to the number of people who could lose employment in the wake of crop failure and the number of supporting industries (e.g. food processing manufacturers, wholesale trade, retail trade) that could be affected. Even if not directly impacted by a disaster, agricultural producers are also sensitive to the disruption of regional transportation networks from natural disasters; they need seasonal laborers to access the area and it is imperative that perishable products are moved to market in a timely manner.

Within the four Northeast counties, the percent of employment by various sectors differs. For example, in Grant County, Government is a larger employer than the in Baker, Union or Wallowa counties. Table 15 shows the distribution of each county's employees across the five largest regional employment sectors.

** Note: The Bureau of Economic Analysis did not disclose employment figures in some counties where an industry was represented by only a few businesses. These figures represent the closest estimate.

Table 15. Percent of County Employment by the Six Largest Regional Employment Sectors, Northeast Region, 2004

	Industry					
County	Government	Health Care and Social Services	Retail Trade	Farm	Manufacturing	Accommodation and Food Services
Baker	14%	n/a	12%	12%	9%	8%
Grant	23%	n/a	9%	12%	6%	5%
Union	18%	11%	12%	8%	11%	6%
Wallowa	15%	5%	12%	14%	6%	7%

Source: Bureau of Economic Analysis 2004

Sectors that are anticipated to be major employers in the future also warrant special attention in the hazard mitigation planning process.

Between 2005 and 2014, the largest job growth in the Northeast region is expected to occur in Educational and Health Services (which includes health care and social assistance), Professional and Business Services, and Leisure and Hospitality sectors.[29]

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.

The *leisure and hospitality* sector includes accommodations, food service, and entertainment. Accommodation businesses are predominantly dependant on people who come to the area as tourists, on business, or simply passing through, and many food service businesses also serve this clientele. They rely on an open transportation network both for customers and for supplies. The businesses that primarily cater to tourists and recreationalists are also dependant on an unimpaired physical environment. Entertainment venues and restaurants that rely on local customers may suffer the same fate as other non-essential retail services; after a disaster, the local population

may lack the funds to spend it on "luxury" services such as eating at restaurants.

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. Nearly 50% of all businesses in the Northeast region fall into four industry sectors. 16% (323) of all businesses are engaged in Retail Trade, 12% (246) are engaged in Construction, 10% (207) are engaged in Other Services (except Public Administration), and 10% (198) are engaged in Accommodation and Food Services.[30]

The retail trade and health care and social assistance sectors' sensitivities to natural hazards are addressed above. The large number of businesses engaged in the *construction* industry warrants attention to its specific vulnerabilities. First, it should be noted that 96% of construction businesses in the Northeast region have fewer than 20 employees; small businesses tend 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.

However, in the event of wildfires, floods, earthquakes, or other types of destructive natural disasters, the demand for reconstruction services may be expected to increase. Business from local residents looking to re-build their homes and businesses may boost construction revenue. If transportation routes have been affected, construction businesses may have difficulty accessing necessary supplies from outside the impacted area. Protecting infrastructure and transportation will help to enable the construction sector to continue operating and re-building communities after a natural disaster.

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.

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[24] Ibid.

[25] Oregon Employment Department, "Measuring Economic Development", 2001 http://www.qualityinfo.org/olmisj/ArticleReader?itemid=00002037&print=1

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[27] Bureau of Economic Analysis, 2004

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

[29] Oregon Employment Department, Workforce Analysis, 2005

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REGION 7
NORTHEAST OREGON[1]
Hazards Assessment

[1] Includes the counties of Baker, Grant, Wallowa and Union.

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. They 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 on an irregular basis to discuss forecasts and advise the Governor as the need arises. Significant droughts are depicted in Table 1.

Recurrence

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 provides an overview of some severe droughts in Oregon.

TABLE 1. SIGNIFICANT DROUGHTS

DATE	DESCRIPTION
1904-1905	A statewide drought period of about 18 months
1917-1931	A very dry period throughout Oregon, punctuated by brief wet spells in 1920-21 and 1927
1939-1941	A three-year intense drought in Oregon
1959-1964	Primarily affected eastern Oregon
1985-1997	Generally a dry period, capped by statewide droughts in 1992 and 1994

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

Vulnerability

The probability that Region 7 will experience drought and the region's vulnerability to their effects are 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.

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.

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 2. Vulnerability and Probability Assessment of Drought

	Baker	Grant	Union	Wallowa
Vulnerability	M	H	M	H
Probability	H	H	H	H

Source: Oregon Emergency Management, July 2003, County Hazard Analysis Scores.

EARTHQUAKE

Characteristics and Brief History

The geographical position of this region makes it susceptible to earthquakes from two sources, though expert opinions vary as to the degree of susceptibility. The two sources are: (1) the off-shore Cascadia Fault Zone, and, 2) shallow crustal events within the North America Plate. 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.

When 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. Subduction zone earthquakes 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. The effects of an off-shore Cascadia Subduction Zone earthquake on this region would largely be indirect. Building damages would to none to minimal while damages to the state's overall economy would be significant. Transportation corridors, such as I-84, to areas with the greatest damages (west of the Cascades) would be heavily traveled with relief supplies, equipment and personnel moving in one direction and evacuees in the other.

Region 7 contains high mountains and broad inter-mountain valleys. Although there is abundant evidence of faulting, seismic activity is low when compared with other areas of the state. Baker County probably has the most recorded seismic activity in the region. Not surprisingly, it appears to occur in the vicinity of Hells Canyon, an area with a complex geologic history. Several significant earthquakes have occurred in the region; the 1913 Hells Canyon, the 1927 and 1942 Pine Valley - Cuddy Mountain, the 1965 John Day (M4.4), and the 1965 and 1966 Halfway (M4.3 and 4.2) (Table 3).

There are also a few identified faults in the region (Union County) that have been active in the last 20,000 years. The region has also been shaken historically by crustal earthquakes and prehistorically by subduction zone earthquakes centered outside the area (Table 3). All considered, there is good reason to believe that the most devastating future earthquakes would probably originate along shallow crustal faults in the region.

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.

Earthquake risk in Region 7 is reflected in the Uniform Building Code's (UBC) earthquake hazard maps (i.e., seismic zones 1-4). The higher the numerical designation, the more stringent the building standards become. Region 7 is within UBC Seismic Zone 2b.

TABLE 3. SIGNIFICANT EARTHQUAKES

DATE	LOCATION	MAGNITUDE (M)	REMARKS
Approximate Years 1400 BCE* 1050 BCE 600 BCE 400 CE 750 CE 900 CE	Offshore, Cascadia Subduction Zone	Probably 8-9	Based on studies of earthquake and tsunamis at Willapa Bay, Washington. These are the mid-points of the age ranges for these six events. * BCE: Before the Common Era
January, 1700	Offshore, Cascadia Subduction Zone	Approximately 9.0	Generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast
October, 1913	Hells Canyon	VI	
April, 1927	Pine Valley-Cuddy Mountain	V	
June, 1942	Pine Valley-Cuddy Mountain	V	Minor damage
August 1965	John Day	4.4	
November, 1965	Halfway	4.3	
December, 1966	Halfway	4.2	

Notes: * BCE: Before the Common Era

Sources: University of Washington. List of Magnitude 4.0 or Larger Earthquakes in Washington and Oregon 1872-2002; and Wong and Bott, November 1995, A Look Back at Oregon's Earthquake History, 1841-1994, *Oregon Geology*.

Probability

The Cascadia Subduction Zone generates an earthquake on average every 500-600 years. However, as with any natural process, the average time between events can be misleading. Some of the earthquakes may have been 150 years apart with some closer to 1,000 years apart [2]. Establishing a probability for crustal earthquakes is more difficult given the small number of historic events in the region.

[2] DOGAMI, 1999.

Vulnerability

Region 7 is moderately vulnerable to earthquake hazards due to earthquake-induced landslides and ground shaking.

The Oregon Department of Geology and Mineral Industries (DOGAMI) has developed two earthquake loss models for Oregon based on the two most likely sources of seismic events: (1) the Cascadia Subduction Zone (CSZ), and (2) combined crustal events (500-year Model). Both models are based on HAZUS, a computerized program, currently used by the Federal Emergency Management Agency (FEMA) as a means of determining potential losses from earthquakes. The CSZ event is based on a potential 8.5 earthquake generated off the Oregon coast. The model does not take into account a tsunami, which probably would develop from the 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 Tables 4-5.

TABLE 4. PROJECTED DOLLAR LOSSES BASED ON A M8.5 SUBDUCTION EVENT AND A 500-YEAR MODEL

REGION 7 COUNTIES	ECONOMIC BASE IN THOUSANDS (1999)	GREATEST ABSOLUTE LOSS IN THOUSANDS (1999) FROM A (M) 8.5 CSZ EVENT	GREATEST ABSOLUTE LOSS IN THOUSANDS (1999) FROM A 500-YEAR EVENT
Baker County	$943,000	Less than $1,000	$13,000
Grant County	$415,000	Less than $1,000	$3,000
Union County	$1,237,000	Less than $1,000	$9,000
Wallowa County	$444,000	Less than $1,000	$8,000

Source: DOGAMI, 1999, Special Paper 29, Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses.

TABLE 5. ESTIMATED LOSSES ASSOCIATED WITH A 500-YEAR MODEL

REGION 7 COUNTIES	BAKER	GRANT	UNION	WALLOWA	REMARKS
INJURIES	3	0	1	1	N/A*: The 500-year model includes several earthquakes, the number of facilities operational the day after the earthquake cannot be calculated. The HAZUS run that produced the data in this table did not account for unreinforced masonry buildings.
DEATHS	0	0	0	0	
DISPLACED HOUSEHOLDS	10	0	1	1	
OPERATIONAL THE DAY AFTER THE QUAKE Fire stations Police stations Bridges	N/A* N/A N/A	N/A* N/A N/A	N/A* N/A N/A	N/A* N/A N/A	
ECONOMIC LOSSES TO: Highways Airports Communications	$5 million $2 million $1,000	$3 million $2 million $469,900	$1 million $618,000 $$479,000	0 $3 million $116,000	
DEBRIS GENERATED (thousands of tons)	8	1	5	4	

Source: DOGAMI, 1999, Special Paper 29, Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses.

The probability that Region 7 will experience earthquakes and the region's vulnerability to their effects are depicted in Table 7 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.

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, counties either did not rank the hazard or did not find it to be a significant concern. These cases are noted with a dash (-) in the table below.

TABLE 6. Vulnerability and Probability Assessment of Earthquake

	Baker	Grant	Union	Wallowa
Vulnerability	-	H	H	H
Probability	-	M	M	M

Source: Oregon Emergency Management, July 2003, County Hazard Analysis Scores.

FIRES IN THE WILDLAND/URBAN INTERFACE

Characteristics and Brief History

Oregon has a very lengthy history of fire in undeveloped wildland and in the developing urban/wildland interface. 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 things prompted the passage of Oregon Senate Bill (SB) 360 (Forestland / Urban Interface Protection Act, 1997). The 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.

The composition of Blue / Wallowa Mountain forests varies considerably, depending on altitude, exposure, depth of soil, etc. All things considered, moisture/precipitation is the predominant factor. Each forest is different. Consequently, the probability and management of wildfire would differ from place to place. The build-up of fuel (e.g., brush, dead or dying trees) that leads to devastating wildfires is a very important factor and is the current focus of mitigation strategies. Forests are not the only consideration in wildfire management; Region 7 has extensive areas of grasslands that are subject to burning.

An assessment 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 fires. This practice, coupled with hundreds of acres of trees weakened or killed through insect infestation, has fostered a dangerous situation. Present state and nation forest practices include the reduction of understory vegetation through thinning and prescribed (controlled) burning. The Wallowa/Whitman National Forest thins and burns between 10,000 and 15,000 acres per year, mostly in low-elevation pine forests. These forests probably constitute the greatest wildfire hazard in the Blue and Wallowa Mountain region. A history of wildfire in the Blue and Wallowa mountain region would include the burning of Sumpter (Baker County) in 1912 and more recent events (Table 7).

TABLE 7. SIGNIFICANT WILDFIRES

YEAR	NAME OF FIRE	LOCATION	ACRES BURNED	REMARKS
1986	Clear	Baker, Grant, Union	6,000	Lightning caused (?)
1988	Turner	Baker, Union, Grant	8,000	
1989	Dooley Mountain	Baker	Data forthcoming	
1989	Stices Gulch	Baker	Data forthcoming	
1996	Sloan's Ridge	Baker, Grant	10,000	
1996	Wildcat	Grant	10,303	
1999	Cummings Creek	Grant		
2000	Carrol Creek	Grant	3,197	
2000	Thorn	Wallowa	4035	
2001	Monument Complex	Grant		
2001	Horse Creek	Wallowa	16,309	
2002	Malheur Complex/Flagtail	Grant	21,641	

Source: Wallowa / Whitman National Forest (Baker City), 2002; and Oregon Emergency Management, State Natural Hazard Mitigation Plan, 2003, Wildland/Urban Interface chapter.

Vulnerability

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. Interface communities at risk in Region 7 are listed in Table 8. Although no homes have been burned in recent years, the threat remains. The 1989 Stices Gulch fire (Baker County) was contained just short of residential development.

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 8. WILDLAND/URBAN INTERFACE COMMUNITIES

Baker County	Grant County	Union County	Wallowa County
Anthony Lakes Resort	Austin	Camp Elkanah	Alder
Baker Valley	Bates	Cove	Eden
Bourne	Canyon City	Elgin	Enterprise
Cornucopia	Dayville	Hilgard	Flora
Durkee	Granite	Kamela	Freezeout Cr
Greenhorn	John Day	Medical Springs	Grouse
Halfway / Pine Valley	Long Creek	Morgan Lake	Hurricane grange
Keating	Monument	Mt. Emily	Imnaha River Woods
Powder River	Mount Vernon	Palmer Junction	Imnaha
Rattlesnake Estates	Prairie City	Perry	Joseph
Richland	Seneca	S. Fk. Catherine Cr	Lostine
Sparta		Starkey	Minam
Stices Gulch		Union	Prairie Cr
Sumpter / Sumpter Valley			Promise
			S.Fork Lostine R. Subdiv.
			Ski Run / Ski Run Road
			Troy
			Wallowa Lake Basin
			Wallowa Slope / Canyon

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

The probability that Region 7 will experience interface fires and the region's vulnerability to their effects are depicted in Table 9 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.

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 9. Vulnerability and Probability Assessment of Fires in the Interface Area

	Baker	Grant	Union	Wallowa
Vulnerability	H	H	H	H
Probability	H	H	H	H

Source: Oregon Emergency Management, July 2003, County Hazard Analysis Scores.

FLOOD

Characteristics and History

The Blue Mountain area of northeastern Oregon is quite distinct from the rest of the state in landform and climate. Nevertheless, its principal flood problems are similar to those found elsewhere in Oregon. The most damaging floods have occurred during the winter months, when warm rains from tropical latitudes melt mountain snow packs. Such conditions were especially noteworthy in February 1957, February 1963, December 1964 and January 1965. Somewhat lesser flooding has been associated with ice jams, normal spring run-off, and summer thunderstorms. Heavily vegetated stream banks, low stream gradients (e.g., Grande Ronde Valley), and breeched dikes have contributed to past flooding at considerable economic cost. Region 7 counties also have experienced flooding associated with low bridge clearances, over-topped irrigation ditches, and natural stream constrictions such as Rhinehart gorge between Elgin and Imbler (Union County).

Table 10 describes significant floods. Table 11 describes flood sources for each of the counties in the region.

TABLE 10. SIGNIFICANT FLOODS

DATE	LOCATION	DESCRIPTION	TYPE OF FLOOD
1894*	NE Oregon	Widespread flooding	Not recorded
1910*	NE Oregon	Widespread flooding	Not recorded
1917*	NE Oregon	Widespread flooding	Not recorded
1932*	NE Oregon	Widespread flooding	Not recorded
1935*	NE Oregon	Widespread flooding	Not recorded
May, 1948	Columbia Basin / NE Oregon	Unusually large mountain snow melt produced widespread flooding	Snow melt
Dec., 1955 - Jan., 1956	Snake and Columbia basins	Warm rain melted snow. Runoff on frozen ground	Rain on snow (ROS)
Dec., 1964	Entire state	Widespread, very destructive flooding. Warm rain, melted snow; runoff on frozen ground	ROS
Jan., 1974	Much of state	Warm rain / melted snow / runoff on frozen ground	ROS
Feb., 1986	Entire state	Warm rain / melted snow / runoff on frozen ground	ROS
June, 1986	Wallowa County	Severe thunderstorm / rain and hail / flash flooding	Thunderstorm
May, 1991	Union and Baker counties	Warm rain / melted snow; Considerable damage to cropland and highways. A number of bridges were destroyed	ROS
May, 1998	Eastern and central Oregon	Persistent rains; widespread damage	ROS

Source: Taylor and Hannon, 1999, *The Oregon Weather Book*, pp.96-103; and FEMA, Baker County Flood Insurance Study (FIS), 06/03/88; FEMA, Grant County Flood Insurance Study (FIS) 05/18/82; FEMA, Union County Flood Insurance Study (FIS), 04/03/96; FEMA, Wallowa County Flood Insurance Study (FIS), 02/17/88.

TABLE 11. PRINCIPAL FLOOD SOURCES

BAKER COUNTY	GRANT COUNTY	UNION COUNTY	WALLOWA COUNTY
Powder River	North Fork John Day River	Grande Ronde River	Wallowa River
Old Settler's Slough	South Fork John Day River	Catherine Creek	Minam River
Pine Creek	Middle Fork John Day River	North Powder River	Lostine River
Eagle Creek	Canyon Creek	Little Creek	Grande Ronde River
Summit Creek	Cottonwood Creek	Gekeler Slough	Wenaha River
Rock Creek	Prairie Creek	Taylor Creek	Imnaha River
Mill Creek		Fresno Creek	Hurricane Creek
Marble Creek		Clark Creek	Prairie Creek
Stices Gulch		Indian Creek	
Snake River		Wolf Creek	
Burnt River			

Sources: FEMA, Baker County Flood Insurance Study (FIS), 06/03/88; FEMA, Grant County Flood Insurance Study (FIS) 05/18/82; FEMA, Union County Flood Insurance Study (FIS), 04/03/96; FEMA, Wallowa County Flood Insurance Study (FIS), 02/17/88.

Probability

Oregon's most severe flooding occurs between November and February and most are associated with a period of intense warm rain on a heavy mountain snow pack. These periods of flooding coincide with La Nina conditions, during the winter months of which, very moist subtropical air follows a heavy, wet snowfall. Climate records indicate that La Nina conditions occur on average about every 3 to 6 years (as do their counterpart, El Nino events). Climatologists speculate that Oregon has moved from a long-term El Nino period (1975-1994) with milder, drier air, to a long-term La Nina period, characterized by cool, wet weather, abundant snow, and floods. A historical overview of flooding is shown in Table 10.

All of the Region 7 counties have Flood Insurance Rate (FIRM) maps; however, old maps do not reflect present flood conditions. The most recent FIRM maps are as follows:

- Baker – June 3, 1988
- Grant – May 18, 1982
- Union – April 3, 1990
- Wallowa – February 17, 1988

Vulnerability

The probability that Region 7 will experience floods and the region's vulnerability to their effects are 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 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.

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 and Probability Assessment of Floods

	Baker	Grant	Union	Wallowa
Vulnerability	H	H	H	H
Probability	H	H	H	H

Source: Oregon Emergency Management, July 2003, 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.

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.

Oregon's landslide / debris flow warning system primarily involves three state and one federal agency: the Oregon Department of Forestry (ODF), the Oregon Department of Geology and Mineral Industries (DOGAMI), the Oregon Department of Transportation (ODOT), and the National Oceanic and Atmospheric Administration (NOAA). The warning system is triggered by rainfall and monitored in areas that have been determined to be hazardous.

As the lead agency, ODF is responsible for forecasting and measuring rainfall from storms that may trigger debris flows. Advisories and

warnings are issued as appropriate. Information is broadcast over NOAA weather radio and on the Law Enforcement Data System. DOGAMI provides additional information on debris flows to the media; ODOT provides information concerning the location of landslides / debris flows, alternate transportation routes, etc.

Landslides / debris flows occur throughout Region 7, but to a much lesser extent than in western Oregon. In general, northeastern Oregon soil profiles are shallow and rainfall is less frequent and intense than in the western portion of the state. Most Region 7 landslides occur within the Interstate 84 corridor, State Highways 82 (Union County), 86 (Baker County), 19 (Grant County), and 3 (Wallowa County). Notable slides include the 1984 Hole-in-the-Wall slide, which dammed the Powder River (Baker County) and the often-troublesome Whopper Slide near Elgin (Union County). There is a record of landslide-associated fatalities in this region: In 1928, two people were killed in a landslide while working on a railroad near Baker City.

Probability

There is a correlation between precipitation (e.g., rain or snow) and the occurrence of landslides / debris flows. Geo-engineers with the Oregon Department of Forestry estimate widespread activity about every 20 years; in western Oregon, landslides at a local level can be expected every 2 or 3 years (Mills, 2002). It is reasonable to expect a greater recurrence interval within Region 7.

Vulnerability

The probability that Region 7 will experience landslides and the region's vulnerability to their effects are depicted in Table 13 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.

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, counties either did not rank the hazard or did not find it to be a significant concern. These cases are noted with a dash (-) in the table below.

TABLE 13. Vulnerability and Probability Assessment of Landslides

	Baker	Grant	Union	Wallowa
Vulnerability	-	-	L	M
Probability	-	-	M	H

Source: Oregon Emergency Management, July 2003, County Hazard Analysis Scores.

VOLCANO-RELATED HAZARDS

Characteristics

The volcanic Cascade Mountain Range is not within Region 7 counties, consequently, the risk from local volcano-associated hazards (e.g., lahars, pyroclastic flows, lava flows, etc.) is not a consideration. However, there is some risk from air-borne tephra (volcanic ash). This fine-grained material, blown aloft during a volcanic eruption, can travel many miles from its source. The cities of Yakima and Spokane, Washington were covered with ash during the May 1980, Mt. Saint Helens eruption. Air borne tephra can reduce visibility to zero, and bring street, highway, and air traffic to an abrupt halt. The material is noted for its abrasive properties and is especially damaging to machinery.

Probability

Mt. St. Helens remains a probable source of air borne tephra. It has repeatedly produced voluminous amounts of this material and has erupted much more frequently in recent geologic time than any other Cascade volcano. It blanketed Yakima and Spokane during the 1980 eruption and it continues to be active. The location, size and shape of the area affected by tephra fall are determined by the vigor, and duration of the eruption and the wind direction. Because wind direction and velocity vary with both time and altitude, it is impossible to predict the direction and speed of tephra transport more than a few hours in advance (USGS Open File Report 95-247, p.6). Mt. St. Helens is about 250 air miles from the City of Enterprise (Wallowa County), consequently placing that community at risk. Mt. Jefferson, located about 150 miles west of the City of John Day, is a possible, but probably unlikely source. The annual probability of 1 cm or more of tephra accumulation within the Region 7 counties, from any Cascade volcano, is about 1 in 5,000 (USGS Open File Report 97-513, p.9).

Vulnerability

The probability that Region 7 will experience volcano-related hazards and the region's vulnerability to their effects are depicted in Table 14 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.

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, counties either did not rank the hazard or did not find it to be a significant concern. These cases are noted with a dash (-) in the table below.

TABLE 14. Vulnerability and Probability Assessment of Volcano-Related Hazards

	Baker	Grant	Union	Wallowa
Vulnerability	-	M	-	M
Probability	-	M	-	M

Source: Oregon Emergency Management, July 2003, 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, so much so that these areas have special building code standards. This is not the case in the Blue Mountains, although high winds in the inter-mountain valleys are not uncommon. For example, the residents of Union County's Grande Ronde Valley caution newcomers about living in the vicinity of Ladd Canyon, which is known for its high winds. And there are other such areas throughout the Region.

The 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. A historic overview of high winds affecting Region 7 is shown in Table 15.

TABLE 15. SIGNIFICANT WINDSTORMS

DATE	AFFECTED AREA	CHARACTERISTICS
Apr., 1931	N.E. 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.
Jan., 1986	N.E. Oregon	Wind gusts 80-90 mph. Heavy drifting snow in Ladd Canyon (Union Co.)
Dec., 1990	Wallowa County	Severe wind storm
Mar., 1991	N.E. Oregon	Severe wind storm
Dec., 1991	N.E. Oregon	Severe wind storm
Dec., 1992	Northeastern mtns.	Severe wind storm

Source: Taylor, George H., and Ray Hatton. (1999), *The Oregon Weather Book*. p.151-157, Hazard Mitigation Team Survey Report, *Severe Windstorm in Western Oregon*, February 7, 2002 (FEMA-1405-DR-OR)

Probability

The recurrence interval of a windstorm on the order of the Columbus Day Storm (Oct., 1962) is about 100 years.[3] Lesser windstorms can be expected annually.

[3] George Taylor, State Climatologist

Vulnerability

Many buildings, utilities, and transportation systems within Region 7 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 when uprooted trees growing next to a house fall during a windstorm. In some situations, strategic pruning may be the answer. Prudent counties will work with utility companies to identify problem areas and establishing a tree maintenance and removal program.

The probability that Region 16 will experience windstorms and the region's vulnerability to their effects are 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 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.

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 and Probability Assessment of Windstorms

	Baker	Grant	Union	Wallowa
Vulnerability	M	H	M	M
Probability	H	H	H	H

Source: Oregon Emergency Management, July 2003, County Hazard Analysis Scores.

WINTERSTORMS

Characteristics and Brief History

Within the State of Oregon, Region 7 communities are known for cold, snowy winters. This is advantageous in at least one respect: in general, the region is prepared, and those visiting the region during the winter usually come prepared. However, there are occasions when preparation cannot meet the challenge. Drifting, blowing snow has often brought highway traffic to a standstill. Also, windy, icy conditions, have often closed mountain passes and canyons to certain classes of truck traffic. In these situations, travelers must seek accommodations, sometimes in communities where lodging is very limited. And local residents also experience problems. During the winter, heating, food, and the care of livestock and farm animals are everyday concerns. Access to farms and ranches can be extremely difficult and present a serious challenge to local emergency managers. Table 17 provides an historic overview of severe winter conditions within Region 7.

TABLE 17. SEVERE WINTERSTORMS

DATE	LOCATION	REMARKS
Dec., 1861	Entire state	Storm produced between 1 and 3 feet of snow throughout Oregon
Dec., 1892	Northern counties	Between 15 and 30 inches of snow fell throughout the northern counties
Jan., 1916	Entire state	Two storms. Heavy snowfall, especially in mountainous areas
Jan., Feb., 1937	Entire state	Deep snow drifts
Jan., 1950	Entire state	Record snow falls; Property damage throughout state.
Mar., 1960	Entire state	Many automobile accidents; Two fatalities
Jan., 1969	Entire state	Heavy snow throughout state
Jan., 1980	Entire State	Series of string storms across state. Many injuries and power outages.
Feb., 1985	Entire state	Two feet of snow in northeast mountains; Downed power lines. Fatalities
Feb., 1986	Northeast mountains	Heavy snow. School closures. Traffic accidents; Broken power lines
Dec., 1988	Northeast mountains	Three blizzards in a 4-week period. 15 ft. drifts. Wind over 60 mph
Feb., 1990	Entire state	Heavy snow throughout state
Jan., 1994	Northeast mountains	Heavy snow throughout region
Jan., 1998	Northeast Oregon	Heavy snow throughout region
Winter 1998-99	Entire state	One of the snowiest winters in Oregon history (Snowfall at Crater Lake: 586 inches)

Source: Taylor, George and Ray Hatton, 1999, *The Oregon Weather Book,* p.118-122.

Probability

The recurrence interval for severe winter storms throughout Oregon is about every 13 years, however, there can be many localized storms between these periods.

Vulnerability

The probability that Region 7 will experience winterstorms and the region's vulnerability to their effects are 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.

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 18. Vulnerability and Probability Assessment of Winterstorms

	Baker	Grant	Union	Wallowa
Vulnerability	H	H	H	H
Probability	H	H	H	H

Source: Oregon Emergency Management, July 2003, County Hazard Analysis Scores.