WASHINGTON COUNTY, OREGON

HAZARD ANALYSIS

I. Introduction

Any jurisdictional Emergency Operations Plan (EOP) must be based on a thorough analysis of the natural and technological hazards that can affect that jurisdiction. Only with a clear understanding of the hazards can appropriate response and recovery policies, plans, and procedures be prepared.

This document is Washington County's hazard analysis and is the foundation upon which the County's EOP and departmental implementing procedures are developed. The method used to analyze the hazards facing the County does not predict the occurrence of a particular event, but rather, serves to provide a sense of hazard priorities, or relative risk. By quantifying and comparing the risks of various hazardous events, the County can focus its planning efforts in those areas of greatest concern.

The hazard analysis is formatted to provide background information on the County's geography, demography, and hazards, a description of the analysis methodology, and a summary of the hazards listed in order of risk rating. A Hazard Analysis Worksheet is attached at the end of the document.

II. Geographic and Demographic Description

Washington County is located in northwestern Oregon, just west of the city of Portland. It is bordered by Tillamook County on the west, Yamhill and Clackamas counties on the south, Clackamas and Multnomah counties on the east, and Columbia County on the north.

The County occupies an area of 727 square miles and has a 2014 population of 562,998. All or parts of 16 incorporated cities lie within the County, and about 58% of the total population are city residents. The largest cities in the County are Beaverton and Hillsboro with 2014 populations of 95,109 and 99,393 respectively. The County Seat is located in the city of Hillsboro.

The County is very rural on the west and heavily developed on the east. The agricultural and nursery industries dominate in the rural areas and light manufacturing and retail industries dominate in the urban areas. The County serves as home to a number of "high tech" companies including Intel, Tektronix, and TriQuint, other large companies including Genentech, Columbia Sportswear, and SolarWorld, and also houses the world headquarters for the Nike Corporation.

From an elevation of 120 feet above sea level at Tualatin, the County rises to 3,464 feet at South Saddle Mountain on its western boundary.

Dominant features of the County landscape are the Coast Range Mountains on the west, the Tualatin Mountains on the north, the West Hills of Portland on the east, and the Chehalem Mountains on the south. Also prominent are Cooper and Bull Mountains in the southeast and Bald Peak in the southwest. The agriculturally rich Tualatin Valley lies between the mountain ranges and hills.

The County's only significant watercourse is the Tualatin River. Rising from its headwaters in the Coast Range, the river meanders through the Tualatin Valley in an east-southeast direction to its confluence with the Willamette River at the city of West Linn in Clackamas County. A number of tributary creeks flow through the valley and drain into the Tualatin River. The largest of these creeks are Gales, Dairy, McKay, Rock, Beaverton, and Fanno. Another important feature of the Tualatin River watershed is Scoggins Dam. Located on Scoggins Creek in western Washington County, the dam controls roughly 5% of the Tualatin River watershed. The dam is owned by the U.S. Bureau of Reclamation and operated by the Tualatin Valley Irrigation District. Its primary purposes are to provide drinking and irrigation water, recreation, and flood control.

Major highways in the County include Interstate 5, which runs north/south in east County; State Highway 26, which runs from southeast to northwest and links Portland to the coast; State Highway 6, which branches off Highway 26 in west County and runs westerly to the coast; State Highway 217, a bypass route linking Interstate 5 to Highway 26 in east County; and State Highway 47, which runs north/south and links the west County cities of Banks, Forest Grove, and Gaston to Columbia and Yamhill counties.

The Hillsboro Airport, which is operated by the Port of Portland, is the busiest general aviation airport in the State.

The Portland and Western Railroad provides limited rail freight service in the County and the Tri-County Metropolitan Transit District (Tri-Met) provides light rail commuter service from Hillsboro to Portland, east Multnomah County, and Clackamas County, and commuter rail service from Beaverton to Wilsonville.

The County is home to Pacific University with campuses in Forest Grove and Hillsboro, Portland Community College in the Rock Creek area, and a research facility associated with Oregon Health and Sciences University. The research facility includes the Regional Primate Center.

III. Changing Conditions in Washington County

Washington County's population has grown significantly over the past several years and is projected to continue to grow. This increase in population also means growth in services, infrastructure and human needs, all of which can be susceptible to negative impacts from hazardous events. In addition, Washington County is continuing to experience changes in climate. This hazard analysis attempts to take these and other

changing conditions into consideration by capturing a history of previous occurrences and estimating the probability of future occurrences of each particular hazard. Actual occurrences in the future will be used to update this hazard analysis every five years.

IV. Hazard Identification and Classification

All areas of the County may be subject to the effects of natural and technological (human-caused) hazards. This hazard analysis seeks to identify, evaluate, and categorize the hazards that are most likely to have a disastrous impact on the citizens and property of Washington County. The hazards include:

A. Natural Hazards

1. Weather – Weather hazards include flood, windstorm, drought, severe winter storm, and tornado.
2. Geologic – Geologic hazards include earthquake, landslide, and volcanic eruption.
3. Fire – Natural fire hazards include wildfire and urban interface fire.
4. Pandemic – Pandemic hazards include a worldwide outbreak of influenza or other disease in humans.

B. Technological Hazards

1. Utility – Utility hazards include failure or disruption of electrical, telephone, water, gas, fuel oil, sewer, or sanitation systems.
2. Hazardous Materials – HAZMAT hazards include the uncontrolled release of gases, explosives, corrosives, flammable liquids and solids, oxidizers, poisons, or radioactive materials at fixed sites or during transportation.
3. Transportation – Transportation hazards include incidents involving aircraft, rail systems, watercraft, motor vehicles, or pipelines.
4. Terrorism/Civil Disturbance – Terrorism/Civil disturbance hazards include unlawful demonstrations, and riots.
5. Dam Failure – Dam failure hazards include the uncontrolled release of water from natural or human-made impoundments.

V. Hazard Analysis Methodology

The methodology used in this hazard analysis recognizes that many hazards occur together or as a consequence of others (e.g., dam failures cause flooding and earthquakes may cause landslides) and seeks only to address each hazard as a singular event.

Each of the hazards examined by this analysis is “scored” using a formula that incorporates four rating criteria and weight factors and three levels of severity. For

every hazard, scores for the four rating criteria (i.e., Event History, Vulnerability, Maximum Threat, and Probability) are determined by multiplying each criterion's severity rating by its weight factor. The rating criteria scores for the hazard are then summed to provide a total score for that hazard. Definitions and values for the rating and severity criteria and weight factors are noted below.

In this analysis, *severity ratings* are applied to the four categories of history, vulnerability, maximum threat (worst-case scenario), and probability based as follows:

LOW = choose the most appropriate number between 1 to 3 points
MEDIUM = choose the most appropriate number between 4 to 7 points
HIGH = choose the most appropriate number between 8 to 10 points

Weight factors also apply to each of the four categories as shown below.

HISTORY (weight factor for category = 2)

History is the record of previous occurrences. Events to include in assessing history of a hazard are events for which the following types of activities were required:

- The EOC or alternate EOC was activated;
- Three or more EOP functions were implemented, e.g., alert and warning, evacuation, shelter, etc.;
- An extraordinary multi-jurisdictional response was required; and/or
- A "Local Emergency" was declared.

LOW – score at 1 to 3 points based on… 0 - 1 event past 100 years
MEDIUM – score at 4 to 7 points based on… 2 - 3 events past 100 years
HIGH – score at 8 to 10 points based on… 4 + events past 100 years

VULNERABILITY (weight factor for category = 5)

Vulnerability is the percentage of population and property likely to be affected under an “average” occurrence of the hazard.

LOW – score at 1 to 3 points based on… < 1% affected
MEDIUM – score at 4 to 7 points based on… 1 - 10% affected
HIGH – score at 8 to 10 points based on… > 10% affected

MAXIMUM THREAT (weight factor for category = 10)

Maximum threat is the highest percentage of population and property that could be impacted under a worst-case scenario.

LOW – score at 1 to 3 points based on… < 5% affected
MEDIUM – score at 4 to 7 points based on… 5 - 25% affected
HIGH – score at 8 to 10 points based on… > 25% affected

PROBABILITY (weight factor for category = 7)

Probability is the likelihood of future occurrence within a specified period of time.

LOW – score at 1 to 3 points based on…	one incident likely within 75 to 100 years
MEDIUM – score at 4 to 7 points based on…	one incident likely within 35 to 75 years
HIGH – score at 8 to 10 points based on…	one incident likely within 10 to 35 years

VI. Hazard Analysis

Based on the analysis methodology outlined above, the following hazards present the greatest risk to Washington County.

A. Winter Storm 240 points

A severe winter storm is generally a prolonged event involving snow and/or ice that causes power outages, transportation and economic disruptions, and high risk for injuries and loss of life. The event is also typified by a need to shelter and care for adversely impacted individuals. The characteristics of the hazard are determined by a number of meteorological factors including the amount and extent of snow or ice, air temperature, wind speed, and event duration.

Washington County experienced severe winter storms with substantial snowfall in 2008, 1950, 1937, 1919, and 1909. The 2008 winter storm, which blanketed the County with over 20 inches of snow in the week before Christmas, resulted in a Presidential Disaster Declaration. The 1950 winter storm deposited 40+ inches of snow in Hillsboro and nearly 60 inches in Forest Grove. The County has also experienced numerous, but less severe, snow/ice storms that have significantly impacted power and transportation (e.g., winter ice storms of 2014, 2004, 1980, and 1979. Given the growth in population and development that has occurred since 1950, any severe winter storm of the magnitude that struck in 1950 would have major impacts today.

B. Utility Failure 207 points

To rise to the level of major emergency or disaster, a utility failure would typically be an extended duration event impacting a broad segment of the County's population. Such might be the case in an extended power outage involving Portland General Electric (PGE), Forest Grove Light and Power, and West Oregon Electric Cooperative, a disruption in natural gas delivery from Northwest Natural, or a loss of water supply from Portland's Bull Run System or the county's Joint Water Commission. A short duration event involving a widespread loss of telephone service may also rise to the level of a major emergency if it hampers

the public's ability to access the 911 system. One possible future cause for a utility failure is space weather, such as a geomagnetic storm.

Depending on the type and extent of disruption and other conditions such as weather, a utility failure can have a broad range of impacts. Although vulnerable and special populations are at highest risk from utility disruptions, all citizens in the County would be significantly impacted by a widespread interruption of government, business, and non-profit services. Utility failures of significant proportion typically arise from other hazard events such as floods or earthquakes, but may occur as standalone events. Utility failures from floods and earthquakes are not included in this section.

Washington County has not had a history of standalone utility failure incidents; however, the 1993 West Coast brownout did have impacts within the County.

C. Windstorm 206 points

A windstorm is generally a short duration event involving straight-line winds and/or gusts in excess of 50 mph that causes power outages, transportation and economic disruptions, significant property damage, and high risk for injuries and loss of life. The event can also be typified by a need to shelter and care for adversely impacted individuals. Unlike a tornado, a windstorm generally has broader, but less destructive impact.

Washington County has suffered several destructive windstorms in the past (most notably the Columbus Day storm in 1962 and the windstorm of December 12, 1995). Both caused extensive damage to public and private property and the 1995 event led to a Presidential Disaster Declaration for the County. A substantial windstorm occurred on December 14, 2006, but did not result in a presidential declaration. Another substantial windstorm occurred December 11, 2014 which resulted in an activation of the Land Use and Transportation Department Operations Center.

D. Pandemic/Outbreak 198 points

A pandemic is a worldwide outbreak of disease in people. Although a pandemic can be caused by a large variety of diseases, influenza is particularly suited to be the cause of a significantly devastating event, and thus is the disease considered here. The influenza virus is easily spread from person to person, and is continuously reassorting and changing. Pandemic flu is caused by a novel (new) flu virus to which humans have little or no immunity. The flu virus that causes a pandemic can spread easily, and may cause large numbers of people to get sick and die. No one can predict when a pandemic will occur or how severe it will be.

On average, an influenza pandemic has occurred every 30 to 40 years over the last 400 years. There have been four pandemics since 1900, the most deadly of

which took place in 1918. Known as the Spanish Flu, the 1918 pandemic killed 20 to 40 million people worldwide and millions more fell ill. Oregon recorded 49,297 influenza cases and 3,688 deaths between 1918 and 1920, with most occurring during the two months of October and November, 1918. The other flu pandemics occurred in 1957, 1968, and 2009-2010. Fortunately, these pandemics were much less severe than the one in 1918.

E. Earthquake 194 points

The Earth's crust is broken into massive pieces called plates that ride on semi-fluid rock below. Powerful forces generated within the Earth drive these plates. When these plates collide with, slip along, or plunge underneath each other, they produce earthquakes. Most earthquakes are minor in scale and many are too small to even feel. However, a number of quakes ranging in scale from moderate to great occur annually throughout the world and take a heavy toll on lives and property. The Pacific Northwest lies along what is known as the Ring of Fire - an area that experiences frequent earthquake and volcanic activity. The Ring of Fire has produced numerous moderate and great earthquakes this century that have taken a high toll on lives and property. They include the 9.2 Indian Ocean earthquake in 2004, the 8.8 earthquake in Chile in 2010, the 6.6 and 7.1 earthquakes in New Zealand in 2010 and 2011, and the 9.0 earthquake in Japan in 2011. Although Oregon's recorded history is relatively free of large magnitude earthquakes, its geologic history shows ample evidence of periodic, large-scale events.

Like most of Oregon, Washington County has little recorded data of significant earthquake activity. The “Spring Break Quake,” a 5.7 Richter Scale magnitude crustal earthquake centered near Molalla, shook Washington County in March of 1993 and caused limited damage. The Nisqually earthquake, a 6.8 magnitude deep, intra-plate earthquake centered near Olympia, Washington, shook the County on February 28, 2001; however, it too, caused only minor damage locally. A number of smaller magnitude events have also occurred near the County, but few, if any, have produced noticeable impacts.

Despite the record, several earthquake faults are known to run in or near the County and the Cascadia Subduction Zone is known to run just off the Oregon coast. The Cascadia Subduction Zone, where the Juan de Fuca Plate is diving beneath the North American Plate, is capable of producing great quakes of up to 9.5 magnitude. Adding to the earthquake hazard within Washington County are a number of other geological conditions that would serve to magnify the degree of shaking and the consequent damages the shaking would create. These conditions include clay/silt/loam soils, high water tables, and numerous steep slopes. Although upgrades made to the Oregon Building Codes will reduce the extent of property damage from future earthquakes, any quake of over 7.0 magnitude within Washington County can be expected to cause widespread damage to public and private facilities, mass casualties, and significant disruption

of lifeline services. In 2011, Dr. Chris Goldfinger, a marine geologist at Oregon State University in Corvallis, stated that a new study shows the Pacific Northwest has a 37% chance of being hit by a magnitude 8 or larger earthquake in the next 50 years.

F. Terrorism/Civil Disturbance 174 points

This hazard includes acts of terrorism that can result in the taking of hostages, injuries and/or deaths, damage to property, sabotage, extortion and riots, protests, strikes, and demonstrations as well as cyber-terrorism. In the case of terrorist incidents, the use of chemical, biological, or nuclear weapons as well as conventional explosives is possible. As an example, the city of Tualatin received numerous bomb threats and three threats involving the use of biological materials (i.e., Anthrax) in the 1998-99 time period.

While there has been no history of terrorism or other instances of civil disorder rising to the level of major emergency or disaster in Washington County, the potential for such an incident exists. Terrorism has been prevalent on the international level for many years and has been on the rise domestically for the past few years. The attacks against the World Trade Center and The Pentagon; the mailed Anthrax attacks in Florida, New York, and Washington D.C.; the Oklahoma City and New York City bombings; the Rodney King riots in Los Angeles; and the WTO riot in Seattle are but a few examples of the potential that exists within the country. In October 2001, a threat to the West Coast bridges necessitated activation of the County EOC. A number of large national and international companies are based in Washington County and at least one of those companies (Nike) has been the target of protests over foreign labor practices. Additionally, a number of animal rights demonstrations/protests have been staged at the Regional Primate Center and many public buildings have been frequent targets for public and political demonstrations.

G. Flood 173 points

Washington County's flood hazard includes: 1) rapid rise flooding of creeks tributary to the Tualatin River; 2) slow rise flooding of the main stem Tualatin River; 3) flooding of streets and buildings caused by plugged culverts and storm drains or overloaded storm water systems; and/or 4) flooding of individual properties due to improper or inadequate drainage practices. The hazard generally evolves from a short duration, heavy rain event that may be compounded by heavily saturated or frozen soils and rapid melting of snow and/or ice. Flood impacts are generally concentrated along creeks and streams but may also be scattered in low-lying areas throughout the County. A flood event typically causes extensive property damage and significant transportation and economic disruptions. It may also require short-term shelter and care support for citizens displaced from their homes.

Washington County has suffered several flood events in the past. The flood of record on the Tualatin River occurred in February 1996. Significant flooding also occurred in December 2007, January 1974, December 1964, December 1955, December 1937, and December 1933. Prior to 1928, flooding was not well documented, but major floods occurred in January 1914, January 1905, February 1904, November 1896, and February 1890. The 1996 event caused millions of dollars in damage to private property, agriculture, and government infrastructure and led to a Presidential Disaster Declaration. The 2007 event also caused damages sufficient to qualify for a Presidential Disaster Declaration. As a result of the 2007 declaration, the County applied for and received Flood Mitigation Assistance (FMA) grant funds that allowed two National Flood Insurance Program (NFIP) homes to be elevated to prevent future damage and loss from floods.

A number of land development and building codes that have been put in place over the last 30 years will help to mitigate the impacts of future flood events. Those codes affect building/construction near floodplains, stream setbacks, cut and fill, and surface water management. A number of non-profit groups have also done extensive work to enhance stream flow and water quality that will help to mitigate future flood events. At the same time, however, population growth and development have soared and significantly increased the risk of loss in future flood events.

H. Drought/Water Shortage 155 points

A water shortage may arise from a number of causes but would likely derive from drought or a significant diversion/interruption of water supplies into the County. Drought involves a period of prolonged dryness resulting from a lack of precipitation. A severe drought could require that strict conservation measures be implemented to assure an adequate supply of potable water for Washington County citizens. Long term drought conditions typically have devastating consequences for agricultural and other businesses dependent on a good supply of water and place large portions of the County at risk for wildland or urban interface fires.

Although Washington County has suffered periods of drought in the past, the impacts have not been severe enough to reach major emergency or disaster proportions. The drought of 2000-01 is the worst on record in the County. Hagg Lake, the reservoir behind Scoggins Dam, fell to a record low of 9%. A combination of effective water management, significant conservation on the part of local irrigators, and adequate potable water supplies from the Bull Run system helped the County avert a major water crisis that year. A major drought affected several Oregon counties in 2015 but did not directly affect Washington County.

Diversions/interruptions of water supplies to the County could stem from failed reservoirs or wells, ruptured pipelines, or contaminated water sources.

Significant redundancy exists in most of the County water systems; however, an incident impacting multiple sources or suppliers could pose serious risks for County residents. Damage to two of the Bull Run water system's primary pipelines during the flood of 1996 did impact the amount of water the system was able to deliver to Washington County's water purveyors during that event.

Climate change forecasts highlight an increased risk for drought conditions in the Pacific Northwest. According to the U.S. National Climate Assessment report *Climate Change Impacts in the United States Highlights* "Changes in the timing of streamflow related to changing snowmelt are already observed and will continue, reducing the supply of water for many competing demands and causing far-reaching ecological and socioeconomic consequences." (See http://s3.amazonaws.com/nca2014/low/NCA3_Highlights_LowRes.pdf?download=1, page 80)

I. Volcanic Eruption (Ash Fallout) 129 points

Washington County faces no direct threat from a volcanic eruption. However, its proximity to a number of Cascade Range volcanoes places the County at risk from an ash fallout originating from such an event. The County also faces an indirect threat to its water supply based on a volcanic scenario impacting the Bull Run Water System. The impacts of a significant ash fall are substantial. Persons with respiratory problems are endangered, transportation, communications, and other lifeline services are interrupted, drainage systems become overloaded/clogged, buildings can become structurally threatened, and the economy takes a major hit. Such an event was experienced by the city of Yakima, Washington following the 1980 eruption of Mount St. Helens. Fortunately for Washington County, prevailing westerly winds carried most of the ash clouds to the east. However, the County did experience some ash fall from that event despite the prevailing winds. Any future eruption of a nearby volcano (e.g., Hood, St. Helens, Jefferson, or Adams) occurring during a period of easterly winds would likely have adverse consequences for the County.

J. Wildland/Urban Interface Fire 116 points

Approximately 13% of the land within the County is public forestland managed by the U.S. Bureau of Land Management and Oregon Department of Forestry. A larger percentage of land is woodland used for recreation or private commercial purposes. Most of these lands lie on the County's extreme north, west, and south boundaries. In addition to these lands, there are many pockets of forested land scattered throughout the County. Whether lying in rural, undeveloped areas or alongside heavily developed commercial or residential properties, these lands pose a significant wildland/urban interface fire threat.

On September 19, 2014, a significant wildfire occurred in Washington County called the Scoggins Creek Fire. While only 211 acres burned, the County EOC

was activated and multiple residents and animals were evacuated from their homes. The potential for future wildland fires will remain well into the future.

Climate change is predicted to progressively increase wildfire risk in the Pacific Northwest during the 21st century according to the U.S. National Climate Assessment report *Climate Change Impacts in the United States Highlights.* (See http://s3.amazonaws.com/nca2014/low/NCA3_Highlights_LowRes.pdf?download=1, page 81.)

K. Hazardous Materials Release 112 points

This hazard involves the release or spillage of hazardous chemicals or chemical wastes that pose a serious threat to life, property, and/or the environment. The release or spillage may also generate long-term contamination or toxicity problems. A hazardous materials incident is most commonly associated with a transportation accident (highway, rail, waterway, or pipeline) but may also arise from accidents at fixed facilities. Hazardous materials are used extensively within Washington County, particularly in agricultural, high tech, and manufacturing applications. The County has numerous SARA Title III facilities that handle various types and amounts of chemicals including many classed by the Environmental Protection Agency as Extremely Hazardous Substances (EHS). There is also one pipeline that transports petroleum products south through the County to destinations in the Willamette Valley and a series of pipelines that deliver natural gas to commercial and residential customers. Most of the hazardous materials transported within the County are moved by truck and rail and the pipelines noted above. The most serious hazardous materials incidents that might impact the County are those that would involve the release of significant quantities of extremely hazardous substances into heavily populated commercial or residential areas. Any such incident could pose acute toxicity, corrosivity, and/or flammability problems and require immediate actions to evacuate and shelter large numbers of people and/or instruct the public to shelter-in-place.

Washington County has a history of minor hazardous materials incidents, but none that have risen to the level of major emergency or disaster. However, the increased use of hazardous materials in all aspects of daily life, their increased presence within Washington County, and the proximity of commercial and residential developments to hazardous material facilities raise the probability of a significant future event. This probability is offset somewhat by stricter regulations and tougher regulatory enforcement for facilities and companies that manufacture, transport, or store hazardous materials.

L. Dam Failure 74 points

The Oregon Water Resources Department has identified four “high hazard” dams in Washington County – Scoggins Dam, Eldon Mills Dam, Kay Lake, and Walters

Reservoir. Scoggins Dam is only of those dams in the County capable of producing a major emergency or disaster event. Although located in Washington County, a failure of the Eldon Mills Dam would create an emergency or disaster for Tillamook County.

Scoggins Dam is an earth fill dam with a height of 151 feet, a crest length of 2,700 feet, and a reservoir of capacity of 60,000 acre-feet. It lies on Scoggins Creek in the west county area about 7 miles southwest of Forest Grove. Scoggins Creek drains into the Tualatin River just downstream from the city of Gaston.

A catastrophic failure of Scoggins Dam with a full or near full reservoir would have devastating consequences for developed areas, bridges, and roadways lying along Scoggins Creek and the Tualatin River from Gaston to Cornelius. Impacts would also be felt up many of the other streams that are tributary to the Tualatin River (e.g., Gales Creek, Dairy Creek, and Rock Creek). Although the water velocity would decrease substantially downstream from Cornelius, floodwater depths would still be significant below that point.

Major populated areas downstream from the dam that would be affected by such an event include: northeastern Gaston; southeastern Dilley; the southern sections of Forest Grove, Cornelius, and Hillsboro; the business district of Tualatin; the developed areas around Scholls and Rivergrove; and the rural homes all along the flood plain. Other significant properties that would sustain damage include Stimson Lumber, the Portland and Western Railroad, the Joint Water Commission treatment plant, CWS's Forest Grove sewage treatment plant, several golf courses, and a number of important highways and bridges.

Scoggins Dam has never experienced a catastrophic failure or any other event where its integrity was placed in question. Although the dam is aging, it has a good system to detect both seepage and earth movement. That system should provide sufficient warning of a problem to allow the reservoir to be drawn down to mitigate the threat. However, a seismic risk analysis conducted by the Bureau of Reclamation in 2009 showed the dam to be at risk for failure from a Cascadia Subduction Zone (i.e. 9+ magnitude) earthquake. For purposes of this hazard analysis, hazards from a failure of the dam due to a seismic event are captured under the earthquake section.

M. Transportation Accident 62 points

This hazard includes major incidents involving motor vehicles, trains, aircraft, vessels, and pipelines. Although the highest risk from this hazard would arise from the release of hazardous materials, such incidents are addressed elsewhere in this analysis. Excluding accidents involving hazardous materials, the primary risk from this hazard is an aircraft or light rail crash creating a mass casualty or mass fatality incident.

The County has no history of a transportation accident rising to the level of a major emergency or disaster; however, a vegetable oil spill on State Highway 217 in 2004 shut down traffic on both Highway 217 and Highway 26 and had a major impact on access to Providence St. Vincent Medical Center. In addition, a number of factors have combined to increase the potential for such an incident in the future. The County's location relative to the flight path for Portland International Airport, a large increase in the number of flights into and out of the Hillsboro Airport, and the operation of both light rail trains with capacity for 600 passengers and a commuter rail line place it at greater risk than in the past.

N. Tornado 34 points

Although an uncommon event in the region, a number of tornadoes are sighted each year in the Willamette Valley. Most do not touch down. When they have, they have not produced the widespread destruction seen in the Midwest and South. The most severe local tornadoes impacted the city of Aumsville in December 2010 and the city of Vancouver in April 1972 and January 2008. The 1972 tornado caused six deaths and 300 injuries. A tornado did touch down near the city of Sherwood in 1993, but its impacts were minimal.

An increase in the frequency of tornadoes is not expected unless significant changes occur in weather behavior/patterns in the Northwest. Although the likelihood that a tornadic event would cause damage or injury will increase with population growth, the worst case scenario in Washington County is still not expected to impact a very broad segment of the population.

O. Landslide 24 points

The word "landslide" is a generic term that refers to the movement of a mass of rock, debris, and/or soil. Landslides can take many forms from the slow movement of land to rapidly moving rockslides, mudflows, or debris flows. Landslides become hazards when they occur in or near developed areas of the community.

Washington County has a history of landslides. Many of these slides are slow-moving areas that have had little impact on anything but roads and culverts. Several of these slides (e.g., Dixie Mountain and Sherman's Mill) became much more active during the heavy rains and floods of 1996, but their impacts were still limited to road and culvert damage. The heavy rains of 1996 also generated many more slides throughout the County. But again, most of the slide impacts were limited to roadway damage.

The location and impacts of past slides indicate little risk to residents or developed property other than roads. Despite continuing development of the County's hillsides, well-engineered drainage systems and improved construction

techniques serve to minimize the potential for a landslide to become a major emergency or disaster event.

HAZARD ANALYSIS MATRIX
WORKSHEET

JURISDICTION: Washington County

Hazards		History WF = 2	Vulnerability WF = 5	Maximum Threat WF = 10	Probability WF = 7	Total Score
Winter Storm	WF X SR Subscore	2 X 10 = 20	5 X 10 = 50	10 X 10 = 100	7 X 10 = 70	240
Utility Failure	WF X SR Subscore	2 X 1 = 2	5 X 7 = 35	10 X 10 = 100	7 X 10 = 70	207
Windstorm	WF X SR Subscore	2 X 10 = 20	5 X 10 = 50	10 X 8 = 80	7 X 8 = 56	206
Pandemic	WF X SR Subscore	2 X 1=2 = 2	5 X 8 = 40	10 X 10 = 100	7 X 8 = 56	198
Earthquake	WF X SR Subscore	2 X 1 = 2	5 X 10 = 50	10 X 10 = 100	7 X 6 = 42	194
Terrorism	WF X SR Subscore	2 X 3 = 6	5 X 5 = 25	10 X 8 = 80	7 X 9 = 63	174
Flood	WF X SR Subscore	2 X 10 = 20	5 X 6 = 30	10 X 6 = 60	7 X 9 = 63	173
Drought	WF X SR Subscore	2 X 1 = 2	5 X 5 = 25	10 X 10 = 100	7 X 4 = 28	155
Volcanic Ash	WF X SR Subscore	2 X 1 = 2	5 X 8 = 40	10 X 8 = 80	7 X 1 = 7	129
Wildland Fire	WF X SR Subscore	2 X 3 = 6	5 X 5 = 25	10 X 5 = 50	7 X 5 = 35	116

WF = weight factor
SR = severity rating

HAZARD ANALYSIS MATRIX
WORKSHEET (Cont.)

JURISDICTION: Washington County

Hazards		History WF = 2	Vulnerability WF = 5	Maximum Threat WF = 10	Probability WF = 7	Total Score
Hazardous Materials	WF X SR Subscore	2 X 1 = 2	5 X 5 = 25	10 X 5 = 50	7 X 5 = 35	112
Dam Failure	WF X SR Subscore	2 X 1 = 2	5 X 5 = 25	10 X 4 = 40	7 X 1 = 7	74
Transportation	WF X SR Subscore	2 X 1 = 2	5 X 3 = 15	10 X 1 = 10	7 X 5 = 35	62
Tornado	WF X SR Subscore	2 X 1 = 2	5 X 3 = 15	10 X 1 = 10	7 X 1 = 7	34
Landslide	WF X SR Subscore	2 X 1 = 2	5 X 1 = 5	10 X 1 = 10	7 X 1 = 7	24

WF = weight factor
SR = severity rating