

# **HAZARDS, RISKS AND VULNERABILITIES FACING KLAMATH COUNTY, OREGON**

**June 2016**

## **BACKGROUND AND OVERVIEW**

This hazard analysis methodology was first developed by FEMA circa 1983, and gradually refined by Oregon Emergency Management (OEM) over the years. During 1984, the predecessor agency to OEM (Emergency Management Division) conducted workshops around the State of Oregon that resulted in all of Oregon's 36 counties producing an analysis using this methodology. Since then, several cities have also conducted an analysis using this method.

The methodology produces scores that range from 24 (lowest possible) to 240 (highest possible), one order of magnitude from lowest to highest. Vulnerability and probability are the two key components of the methodology. Vulnerability examines both typical and maximum credible events, and probability endeavors to reflect how physical changes in the jurisdiction and scientific research modify the historical record for each hazard. Vulnerability accounts for approximately 60% of the total score, and probability approximately 40%.

For local governments, conducting the hazard analysis described in this document is a useful early step in planning for hazard mitigation, response, and recovery. This method provides the jurisdiction with a sense of hazard priorities, or relative risk. It doesn't predict the occurrence of a particular hazard, but it does "quantify" the risk of one hazard compared with another. By doing this analysis, planning can first be focused where the risk is greatest.

Among other things, this hazard analysis can:

- help establish priorities for planning, capability development, and hazard mitigation;
- serve as a tool in the identification of hazard mitigation measures;
- be one tool in conducting a hazard-based needs analysis;
- serve to educate the public and public officials about hazards and vulnerabilities; and
- help communities make objective judgments about acceptable risk.

Klamath County Emergency Management revised and updated the vulnerability analysis for Klamath County in June of 2016, with the last iteration of the analysis having been done in February of 2012.

## **KLAMATH COUNTY DESCRIPTION**

Klamath County, Oregon is located in the south central portion of Oregon bordered on the south by the State of California, to the west, by Jackson County, Oregon, to the northwest by Douglas and Lane Counties, Oregon and to the east by Lake County, Oregon.

The county has an estimated population of 66,810 (US Census Bureau 2013) and covers an area of 6,135 square miles. The principal population area is the City of Klamath Falls with a population of 21,495. The Klamath Falls Urban Growth Boundary covers roughly twice the area of the City, and puts the population just over 41,000.

Klamath County is exposed to three categories of hazards: natural, technological, and man-made. These hazards generate a wide spectrum of potential emergencies or disasters that pose risks to the lives and properties of the citizens of, and visitors to, Klamath County.

## **HAZARDS IDENTIFIED AND EVALUATED**

### **SEVERE WINTER STORMS, DUST STORMS, EXTREME TEMPERATURES, AND WINDSTORMS**

Winter storms are destructive and dangerous weather events which may include snow, freezing rain, ice, high winds, and/or temperatures that drop below normal. They have potential to cause damage, serious social disruption, or loss of human life. The major problems that winter storms cause are power outages and traffic accidents. There is a very high probability that Klamath County will be negatively affected by at least one winter storm condition on an annual basis.

Dust storms occur most frequently in arid regions of Central and Eastern Oregon. With wind speeds of at least 25 miles per hour, dust storms can spread over hundreds of miles and rise over 10,000 feet. Airborne dust particles, or dust aerosols, alter the climate by intercepting sunlight traveling toward the earth's surface. Dust storms impact air quality, erode topsoil, and increase fine sediment loading in creeks and rivers. Dust storms can also damage equipment and engines and can cause vehicle collisions. In April of 2001, Highway 97 about five miles north of Klamath Falls was closed for approximately six hours following three separate crashes; eleven cars were involved, sending nine people to the hospital. The accidents were due to severely limited visibility caused by high winds blowing dust from a recently plowed field across the highway. Therefore dust storms are a viable hazard in Klamath County.

Windstorms can be coupled with winter storms, dust storms, or thunder storms, or be stand-alone events. Severe winds are typically those with speeds greater than 59mph. Winds of this strength generally happen several times a year in the most susceptible parts of Klamath County, which include higher elevations in the western, eastern, and northern parts of the County. Typical windstorm damage includes downed trees (especially when coupled with saturated soils), power outages, minor building damage such as lost shingles, and damage to structures or items that are not anchored or are already damaged in some way.

Extreme temperature events can occur during any season in Klamath County. The mean winter temperature is 29 degrees Fahrenheit, although periods of below zero temperatures have occurred, almost on an annual basis. The most likely effects from extreme cold are water pipe damages and damages to crops. The mean summer temperature is 68 degrees Fahrenheit, but typically Klamath County sees 90-100 degree days in July and August. Days with temperatures at 100 degrees or higher are rare, with an average occurrence of two or less days per year. Extreme heat effects crops. Both extreme cold and heat effect populations at risk, including the elderly and the economically challenged, and the homeless.

### **EARTHQUAKES**

Earthquakes are sudden releases of energy from the Earth's crust that create seismic waves, manifesting in shaking and sometimes displacement of the ground. Klamath County, like the rest of Oregon, is considered a high-risk area for seismic activity, as confirmed by the Federal Emergency Management Administration and by the United States Geological Society.

The type of earthquake that has the most impact on Klamath County is shallow ground movement associated with the Klamath Basin and Cascade Mountain Range areas of the western United States. Additionally, Klamath County will feel the effects of a catastrophic Cascadia Subduction Zone earthquake, with shaking equivalent to a 4.0-6.0 magnitude earthquake.

On September 20, 1993, the Klamath Basin sustained a 6.0 earthquake, which took two lives and caused considerable damage (excess of \$10 million) in downtown Klamath Falls, including the total loss of the county courthouse. A landslide occurred next to Klamath Lake on Highway 97, which was responsible for one of the lost lives. This is the highest recorded quake in Oregon history since settlement of the state by non-native Americans. Un-reinforced masonry buildings represent the largest vulnerability to another event such as this.

### **DROUGHT**

Droughts are not just a summer-time phenomenon; winter droughts can have a profound impact on the state's agricultural sector, particularly east of the Cascade Mountains. Below- average snowfall in Oregon's higher elevations has a far-reaching effect on the entire state, especially in terms of hydroelectric power generation, irrigation, recreation, and industrial uses. Oregon is continuously confronted with drought and water scarcity issues, despite its rainy reputation. These events generally affect areas east of the Cascades and some specific locales across the state. Severe or prolonged drought can impact Oregon's public health, infrastructure, facilities, economy, and environment.

Drought produces conditions of climatic dryness severe enough to reduce soil moisture and water below the minimum necessary to sustain plant, animal and human life systems. The major effects from drought are: culinary water shortages, increased potential for wild land fires, damage or total loss of crops, civil unrest and economic consequences to all sectors of communities. Historically, Klamath County has declared more disasters for drought than any other Oregon county.

### **POWER FAILURE**

Power resources, both transmission and distribution, have become the most important element of infrastructure in our economy. The interruption of power causes widespread disruption of services immediately to any community.

Power transmission from and to California and the northwest is dependent on the Bonneville Power Administration (BPA) transmission lines crossing Klamath County. Malin is the major hub for controlling all power between the two regions.

### **TELECOMMUNICATIONS FAILURE**

Telecommunications can fail in data transfer, communications, or processing brought about by physical destruction of computers or communications equipment, or a performance failure of software running such equipment, either through poor design or sabotage. A failure of this type may cause severe economic damage and/or may pose life threatening situations to airport Radar, 9-1-1, and other critical communications infrastructure. The dependence of society upon telecommunications and technology is ever increasing as the "Information Age" steadily expands.

### **PUBLIC HEALTH EMERGENCIES**

A public health emergency constitutes a disease or condition, natural or man-caused, such as an epidemic of influenza virus which spreads widely and infects a large proportion of the human population and has high mortality rates. In Oregon, three pandemics have occurred in the last 90 years, in 1918, 1957 and 1968. Scientists predict that another pandemic will happen, although they cannot say exactly when (from the 2008 Oregon Pandemic Influenza Plan).

Klamath County Public Health usually leads the local planning efforts for health-related emergencies, and did so during the H1N1 outbreak in 2010 and the Ebola preparedness and planning event in 2015.

## **WILDLAND FIRES**

Wildfires occur throughout the state and may start at any time of the year when weather and fuel conditions combine to allow ignition and spread. Wildfires impact primarily southwest, central, and northeast Oregon, with localized risks statewide. The majority of wildfires take place between June and October. Wildfires may be broadly categorized as agricultural, forest, range, or wildland-urban interface (WUI) fires. Common sources of wildfire in Oregon include lightning, equipment use, railroad activity, recreational activity, debris burning, arson, and smoking.

The West Wide Wildfire Risk Assessment (WWRA) was published in 2013. The WWRA identified that six Oregon counties each have over 1 million wildland acres at moderate risk of wildfire. 751,672 Oregonians live in wildland development areas that are at risk of wildfire. Over 12 million acres of forest are at moderate to high risk of wildfire in Oregon. The counties most vulnerable to wildfire include Deschutes, Douglas, Grant, Jackson, Jefferson, Josephine, Klamath, Umatilla, Union, Wallowa, and Wasco.

All (or portions) of five National Forest jurisdictions exist in Klamath County, reflecting that vast portions of the county are covered in forests and subject to wildland fires. More information can be found in the Klamath County Community Wildfire Protection Plan.

## **HAZARDOUS MATERIALS**

A hazardous material is defined as any substance that threatens people or property. This substance may be a toxic or poisonous chemical in any form. Hazardous materials include radioactive materials and waste, chemical materials and waste as well as communicable disease agents. The entire county is prone to a hazardous materials incident. Hundreds of users of hazardous materials have been identified throughout Klamath County.

Additionally, several high volume cross-regional natural gas lines traverse the county. A major leak and/or fire/explosion would constitute a major event.

The areas of greatest risk are on the transportation routes, which include railways and highways. All of Klamath County's major roads and railways are used for the transportation of hazardous materials. Planning for protection to communities from a hazardous materials incident must therefore include both the transportation system and the many, many fixed facilities. More information can be found by contacting the Klamath-Lake Counties Local Emergency Planning Committee through the county Emergency Management office.

## **FLOODING**

Klamath County is subject to three types of flooding: river floods, which occur when there is gradual periodic overflow of rivers and streams; flash flooding, while infrequent yet possible, which is defined as quickly rising small streams after heavy rain and/or rapid snowmelt; and urban flooding, which is defined as an overflow of storm sewer systems usually due to poor drainage, following heavy rain and/or rapid snowmelt.

Klamath County experienced flooding in December of 1996/January of 1997 along the Sprague River and Williamson River that destroyed several homes and damaged tens of others.

As of the publish date of this analysis, FEMA is in the process of updating the 100-year flood plain across Klamath County that would result in an increase from approximately 3500 tax lots in the floodplain to just over 5000 tax lots in the floodplain.

## **TERRORISM**

According to the Federal Bureau of Investigation (FBI), terrorism is the unlawful use, or threat of use, of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objective.

Klamath County has a history of terrorist activities dating back to Black Panther “safe houses” and training grounds during the 60’s and 70’s and continuing to far right-wing militia activity and actions of the Environmental Liberation Front (ELF) in more recent times. There has been some evidence of elements of both international and regional terrorist activity in Klamath County since the Millennium.

In 1999, a terrorist training camp was established by al-Qaida operatives on a small ranch in Bly. Officials have since arrested and prosecuted most of the individuals involved.

## **TRANSPORTATION INCIDENTS**

Klamath County is a west coast conduit for several transportation lines between the northwest and California. All rail traffic on the west’s two principal Class I railroads (Union Pacific and Burlington Northern Santa Fe) travels the north-south route through the county. Much of the traffic for the two companies share the same joint tracks, which concentrates the risk of major disruption. Amtrak’s Seattle to Los Angeles daily passenger train travels the route twice a day with an average load factor of around 300 passengers and crew in each direction.

Any major disruption, natural or manmade, to these major transportation arteries would impact the entire west coast of the United States.

## **DAM FAILURE**

Two dams, one creating Gerber Reservoir in Oregon and the other at Clear Lake, California, have inundation zones that impact the most populous areas of Klamath County. A failure of either or both would put up to one third of the county’s citizens at risk. The Bonanza area, Langell Valley, and the suburban area of Klamath County and the city of Merrill would all be severely affected.

The Link River Dam and the A Canal pose a large threat to the City of Klamath Falls if breached. With the exception of the Link River Dam and Clear Lake Dam, most dam and canal infrastructure in Klamath County is extremely aged and susceptible to failures from large earthquakes.

## **VOLCANOES**

Volcanic activity can impact central Oregon, the Cascade Range, Southeast Oregon, and the Northern Basin and Range ecoregion. Potentially hazardous volcanoes in Oregon exist along the crest of the Cascade Range and to a lesser extent in the Northern Basin and Range. Volcanic hazards that can impact the state include ashfall that can travel long distances, lahars (volcanic debris flows), lava flows (streams of molten rock), pyroclastic flows and surges (avalanches of rock and gas at temperatures of 600–1500 °F), landslides, earthquakes, flooding, and channel migration.

Klamath County is home to a famous volcanic legacy with Crater Lake National Park's Mount Mazama as the centerpiece. Mount Mazama is listed by the USGS as having a threat potential of high to very high due to its ability to erupt catastrophically. Mt McLaughlin is listed as low to very low.

### **LANDSLIDES**

Landslides can be found throughout the state of Oregon, as seen in the current statewide landslide inventory database, SLIDO-2. Systematic statewide landslide mapping has not been performed; however in general the areas of the state with more relief and steeper slopes, such as the Coast Range Mountains and the Cascade Mountains, tend to have more landslides. In general counties in Oregon have hundreds to thousands of existing landslides; Klamath County has evidence 582 areas of landslide activity.

## OEM HAZARD ASSESSMENT METHODOLOGY

Sample Jurisdiction:	HISTORY	VULNERABILITY	MAX THREAT	PROBABILITY	TOTAL
HAZARD: WEIGHT FACTOR	2	5	10	7	=
Hazardous Materials	2x10 (H)= 20	5X10 (H) = 50	10X10 (H) = 100	7X10 (H) = 70	= 240
Flooding	2x10 (L) = 20	5x1 (L) = 5	10x5 (M) = 50	7x10 (H) = 70	= 145
Dam Failure	2x1 (L) = 2	5 x10 (M) =50	10x10 (H) = 100	7x1 (L) = 7	= 159
Earthquake	2 x1 (L) = 2	5x10 (H) = 50	10x10 (H) = 100	7x1 (L) = 7	= 159
Wildland Fire	2x10 (H) = 20	5x1 (L) = 5	10x5 (M) = 50	7x10 (H) = 70	= 145

*Severity ratings* are applied to the four categories of **History**, **Vulnerability**, **Maximum Threat** (worst-case scenario), and **Probability**.

### **HISTORY** (weight factor for category = 2)

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

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

**Hazard Analysis Matrix Worksheet – Klamath County February 2012**

HAZARD RISK ASSESSMENT MODEL	OEM Threat Analysis												
	History			Probability			Vulnerability (average threat)			Maximum Threat			Total Threat Score
Hazard	Severity	Weight Factor	Subtotal	Severity	Weight Factor	Subtotal	Severity	Weight Factor	Subtotal	Severity	Weight Factor	Subtotal	
Winter Storm	10	2	20	8	7	56	6	5	30	8	10	80	186
Earthquake - Crustal	6	2	12	7	7	49	5	5	25	9	10	90	176
Drought	8	2	16	8	7	56	5	5	25	7	10	70	167
Power Failure	6	2	12	7	7	49	5	5	25	8	10	80	166
Communications System Failure/Informational Technology Disruption	5	2	10	7	7	49	5	5	25	8	10	80	164
Public Health Emergency	6	2	12	8	7	56	3	5	15	7	10	70	153
Wildfire (WUI)	10	2	20	9	7	70	3	5	10	5	10	50	150
Hazmat Release	6	2	12	6	7	42	3	5	15	7	10	70	139
Flood - Riverine	8	2	16	7	7	49	4	5	20	5	10	50	135
Sewer Treatment Failure	6	2	12	6	7	42	4	5	20	6	10	60	134
Terrorism	2	2	4	6	7	42	3	5	15	7	10	70	131
Train Derailment	1	2	2	6	7	42	3	5	15	7	10	70	129
Dam Failure	6	2	12	8	7	56	3	5	15	4	10	40	123
Fire - Large Scale Urban Conflagration	7	2	14	6	7	42	3	5	15	5	10	50	121
Fuel Line Explosion/Disruption	1	2	2	5	7	35	4	5	20	5	10	50	107
Volcano	1	2	2	2	7	14	3	5	15	7	10	70	101
Civil Disturbance / Protest / Demonstration	2	2	4	6	7	42	2	5	10	4	10	40	96
Airplane Crash	3	2	6	4	7	28	2	5	10	4	10	40	84

**OEM Hazard Analysis Worksheet 2016**

Hazard	History			Vulnerability			Maximum Threat			Probability			Total Threat Score
	Severity	Weight Factor	Subtotal	Severity	Weight Factor	Subtotal	Severity	Weight Factor	Subtotal	Severity	Weight Factor	Subtotal	
Drought	10	2	20	10	5	50	10	10	100	10	7	70	240
Power Failure	8	2	16	6	5	30	10	10	100	10	7	70	216
Wildfire (WUI)	10	2	20	8	5	40	7	10	70	10	7	70	200
Winter Storm	10	2	20	6	5	30	8	10	80	10	7	70	200
Public Health Emergency	6	2	12	10	5	50	8	10	80	8	7	56	198
Communications System Failure	5	2	10	10	5	50	8	10	80	8	7	56	196
Water Supply Disruption	8	2	16	8	5	40	8	10	80	8	7	56	192
Fire - Large Scale Urban Conflagration	8	2	16	10	5	50	7	10	70	8	7	56	192
Windstorm	8	2	16	5	5	25	8	10	80	10	7	70	191
Sewer Treatment Failure	5	2	10	8	5	40	8	10	80	8	7	56	186
Hazmat Release - Transportation	6	2	12	8	5	40	7	10	70	8	7	56	178
Hazmat Release - Fixed Facility	6	2	12	8	5	40	7	10	70	8	7	56	178
Earthquake - Crustal (1 min)	6	2	12	10	5	50	8	10	80	5	7	35	177
Extreme Heat Event	6	2	12	10	5	50	8	10	80	5	7	35	177
Liquid Fuel Supply Disruption	3	2	6	8	5	40	7	10	70	8	7	56	172
Information Technology Disruption	3	2	6	8	5	40	7	10	70	8	7	56	172
Dam Failure	5	2	10	8	5	40	7	10	70	5	7	35	155
Fuel Line Explosion	3	2	6	8	5	40	7	10	70	5	7	35	151
Train Derailment	3	2	6	7	5	35	6	10	60	7	7	49	150

Earthquake - Cascadia (3-5min)	1	2	2	10	5	50	8	10	80	1	7	7	139
School violence	3	2	6	5	5	25	5	10	50	8	7	56	137
Civil Disturbance / Protest / Demonstration	3	2	6	4	5	20	5	10	50	5	7	35	111
Sabotage	1	2	2	4	5	20	5	10	50	5	7	35	107
Riot	1	2	2	4	5	20	5	10	50	5	7	35	107
Flood - Riverine	6	2	12	7	5	35	3	10	30	4	7	28	105
Volcano	3	2	6	7	5	35	5	10	50	1	7	7	98
Cyber terrorism	1	2	2	4	5	20	5	10	50	3	7	21	93
Dust Storm	6	2	12	4	5	20	3	10	30	4	7	28	90
Sports/Public Event Disturbance	1	2	2	4	5	20	2	10	20	5	7	35	77
Airplane Crash	3	2	6	3	5	15	2	10	20	5	7	35	76
Landslide/Debris Flow	4	2	8	3	5	15	1	10	10	5	7	35	68
Mail/Package Bomb	3	2	6	3	5	15	2	10	20	3	7	21	62
Truck Bomb	1	2	2	3	5	15	2	10	20	3	7	21	58
Suicide Bomb	1	2	2	3	5	15	2	10	20	3	7	21	58
Improvised Explosive Device (e.g. pipe bomb)	1	2	2	3	5	15	2	10	20	3	7	21	58
Active Shooter	1	2	2	3	5	15	2	10	20	3	7	21	58
Animal / Eco-terrorism	1	2	2	3	5	15	2	10	20	3	7	21	58
Intentional Biological Agent Release	1	2	2	4	5	20	2	10	20	2	7	14	56
Intentional Radiological Material Release	1	2	2	4	5	20	2	10	20	2	7	14	56
Intentional Chemical Release	1	2	2	4	5	20	2	10	20	2	7	14	56