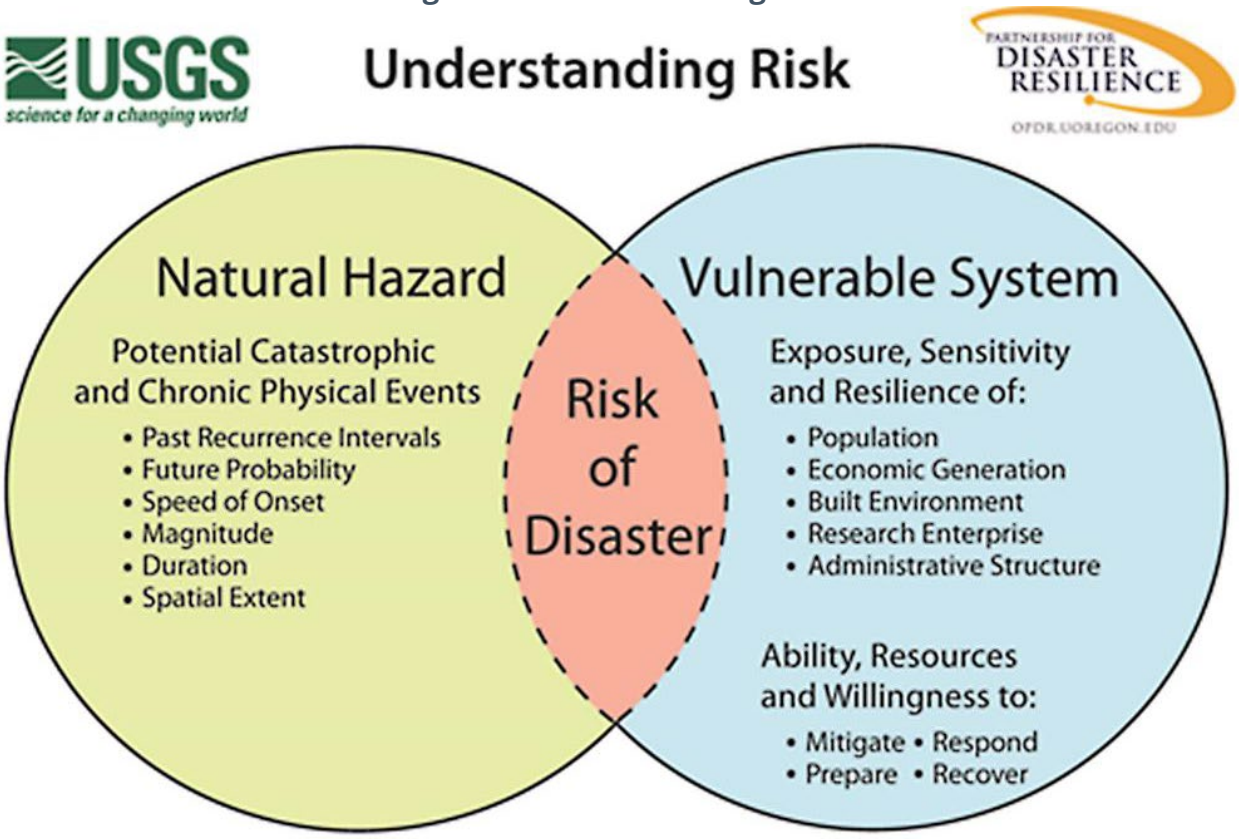
Section 3: Natural Hazard Identification and Risk Assessment

This section of the NHMP addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards.

The information presented below, and community characteristics presented in the Deschutes Community Profile presented in Section 2, will be used as the local level rationale for the risk reduction actions identified in Section 4 – Mitigation Strategy. The risk assessment process is graphically depicted in Figure 3-1 below. Ultimately, the goal of hazard mitigation is to reduce the area where hazards and vulnerable systems overlap.

Figure 3-1 Understanding Risk[1]



What is a Risk Assessment?

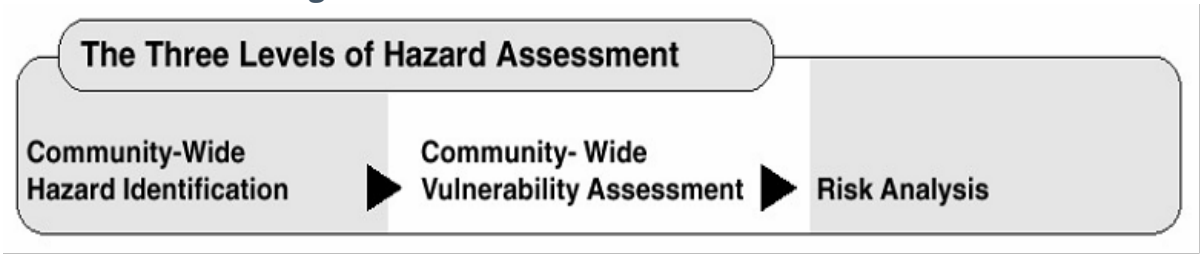
A risk assessment consists of three phases: hazard identification, vulnerability assessment, and risk analysis, as illustrated in the following graphic.

- **Phase 1:** Identify hazards that can impact the jurisdiction. This includes an evaluation of potential hazard impacts – type, location, extent, etc.

[1] Oregon Partnership for Disaster Resilience

- **Phase 2:** Identify important community assets and system vulnerabilities. Example vulnerabilities include people, businesses, homes, roads, historical places, and drinking water sources.
- **Phase 3:** Evaluate the extent to which the identified hazards overlap with, or have an impact on, the important assets identified by the community.

Figure 3-2 Three Phases of Risk Assessment[2]



This three-phase approach to developing a risk assessment should be conducted sequentially because each phase builds upon data from prior phases. However, gathering data for a risk assessment need not occur sequentially.

Hazard Analysis Methodology

This NHMP utilizes a hazard analysis methodology that was first developed by FEMA circa 1983 and gradually refined by the Oregon Department of Emergency Management over the years.

The methodology produces scores that range from 24 (lowest possible) to 240 (highest possible). 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%.

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.

In this analysis, severity ratings and weight factors are applied to the four categories of history, vulnerability, maximum threat (worst-case scenario), and probability as demonstrated below.

History

Weight factor for category =2

[2] Planning for Natural Hazards: Oregon Technical Resource Guide, 1998.

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

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

LOW = 0 to 1 event in the past 100 years, scores between 1 and 3 points
MODERATE = 2 to 3 events in the past 100 years, scores between 4 and 7 points
HIGH = 4+ events in the past 100 years, scores between 8 and 10 points

Probability

Weight factor for category = 7
Probability is the likelihood of future occurrence within a specified period.

LOW = one incident likely within 75 to 100 years, scores between 1 and 3 points
MODERATE = one incident likely within 35 to 75 years, scores between 4 and 7 points
HIGH = one incident likely within 10 to 35 years, scores between 8 and 10 points

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 = < 1% affected, scores between 1 and 3 points
MODERATE = 1 - 10% affected, scores between 4 and 7 points
HIGH = > 10% affected, scores between 8 and 10 points

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 = <5% affected, scores between 1 and 3 points
MEDIUM = 5-25% affected, scores between 4 and 7 points
HIGH = >25% affected, scores between 8 and 10 points

Each of the four categories is then weighted to produce a score. The weighted factors are as follows:

1. History (SR x 2)

2. Vulnerability (SR x 5)
3. Maximum Threat (SR x 10)
4. Probability (SR x 7)

The analysis considers both objective data and subjective factors. The method produces an outcome in which the hazard types can be compared against one another to prioritize overall hazard risk. Table 3-1 below demonstrates the results of this analysis. "WF" refers to weight factor.

Table 3-1 Hazard Analysis Matrix – Deschutes County[3]

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank
Winter Storm	20	50	100	70	240	#1
Wildfire (Incl Smoke)	20	50	80	70	220	#2
Windstorm	18	25	70	70	183	#3
Extreme Heat	6	25	80	63	174	#4
Earthquake (Cascadia)	2	50	100	14	166	#5
Drought	20	15	60	70	165	#6
Volcano	2	40	100	7	149	#7
Flood	10	15	30	56	111	#8
Earthquake (Crustal)	2	20	70	7	99	#9
Landslide	20	5	10	42	77	#10

As shown in Table 3-1, the Winter Storm hazard scored the highest overall threat score with 240 points out of a total of 240 possible points. This is due to the historic and projected frequency of Winter Storm in Deschutes County, along with the community's continued growth, which increases the amount of infrastructure and population exposed to severe winter weather. The Wildfire hazard scored the second-highest overall risk score with 220 points. This elevated score reflects its extensive historical occurrence, very high vulnerability across the County, significant potential maximum threat, and a high probability of reoccurrence within the next 10-35 years.

Completing the hazard analysis required knowledge of the hazards, including history of occurrences, impacts on property and populations, indicators of future probability, and how risks vary throughout the plan area. This knowledge and input from the NHMP Steering Committee was coupled with historical and probability data to develop a score for each hazard.

Natural Hazards Profiles

Deschutes County identifies ten natural hazards that could have an impact on the County (as shown in Table 3-2). Table 3-2 shows the hazards identified in the County in comparison

[3] Deschutes County NHMP Steering Committee, 2026.

to the hazards identified in the State of Oregon NHMP for Central Oregon (Region 6), which includes Deschutes County.

Table 3-2 Deschutes County Hazard Identification[4]

Deschutes County	State of Oregon NHMP Region 6 Central Oregon
Winter Storm	Drought
Wildfire (Includes Smoke)	Earthquake
Windstorm	Extreme Heat
Extreme Heat	Flood
Earthquake (Cascadia)	Landslide
Drought	Volcano
Volcano	Wildfire
Flood	Windstorm
Earthquake (Crustal)	Winter Storm
Landslide	

The following subsections describe the relevant information for each hazard. For additional background on the hazards, vulnerabilities, and general risk assessment information for hazards in Central Oregon (Region 6), refer to the State of Oregon NHMP, Region 6, Central Oregon Risk Assessment (2020).

Drought

Location and Extent

Drought is typically measured in terms of water availability in a defined geographical area. It is common to express drought with a numerical index that ranks severity. The Oregon Drought Severity Index is the most used drought measurement in the state because it incorporates both local conditions and mountain snowpack. The Oregon Drought Severity Index categorizes droughts as mild, moderate, severe, and extreme.

When droughts occur they can be problematic, impacting community water supplies, wildlife refuges, fisheries, and recreation. There is a high probability that Deschutes County will experience drought in the near future and it will likely impact the entire County. Deschutes has received drought declarations in 24% of the years since 1992.[5] The latest drought declaration for Deschutes County was issued by the Governor on April 21, 2026 as Executive Order 26-07.

Precipitation in Oregon follows a distinct spatial and temporal pattern; it tends to fall mostly in the cool season (October–March). The Cascade Mountains block rain-producing weather patterns, creating a very arid and dry environment east of these mountains. Moist

[4] Deschutes County NHMP Steering Committee (2021) and State of Oregon NHMP, Region 6: Central Oregon (2020).
[5] State of Oregon NHMP, Region 6. 2020.

air masses originating from the Pacific Ocean cool and condense when they encounter the mountain range, depositing precipitation primarily on the inland valleys and coastal areas.[6]

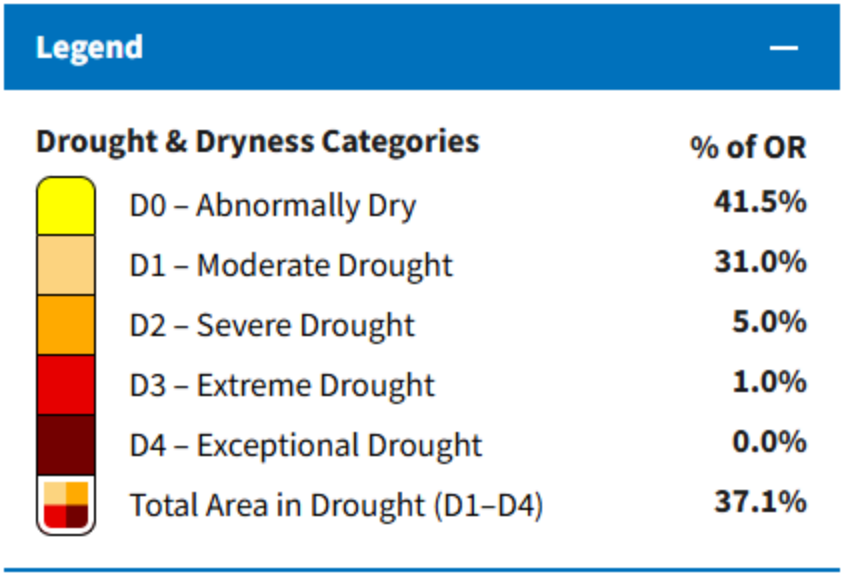
Drought is typically measured in terms of water availability in a defined geographic area. It is common to express drought with a numerical index that ranks severity. Most federal agencies use the Palmer Method which incorporates precipitation, runoff, evaporation, and soil moisture. However, the Palmer Method does not incorporate snowpack as a variable. Therefore, it does not provide a very accurate indication of drought conditions in Deschutes County, although it can be very useful because of its long-term historical record of wet and dry conditions.[7]

With climate change, snow droughts—the type of drought in which snowpack is low, but precipitation is near normal—are expected to occur more often. The 2015 drought in Deschutes County was a "snow drought" and serves as a good example of what future climate projections indicate may become commonplace by mid-21st century.[8] Going forward, drought indices that can account for a changing climate, such as the Standard Precipitation-Evapotranspiration Index (SPEI), may provide a more accurate estimate of future drought risks.

The Oregon Drought Severity Index, included below, is the most used drought measurement in the state because it incorporates local conditions and mountain snowpack. The Oregon Drought Severity Index categorizes droughts as *mild, moderate, severe, extreme, and exceptional*.

Figure 3-3 The Oregon Drought Severity Index[9]

[6] Ibid.
[7] Ibid.
[8] The Third Oregon Climate Assessment Report. 2017. https://pnwcirc.org/sites/pnwcirc.org/files/ocar3_finalweb.pdf
[9] https://www.drought.gov/states/oregon accessed December 15, 2025



Hazard History

Oregon records, dating back to the late 1800s, clearly associate drought with a departure from expected rainfall. Concern for mountain snowpack, which feeds the streams and rivers, came later. When droughts occur they can be problematic, impacting community water supplies, wildlife refuges, fisheries, and recreation. It is reasonable to assume that there is a high probability that Deschutes County will experience drought in the near future. Since 1992, Deschutes County has experienced drought declarations in approximately 24% of years—equivalent to roughly one out of every four years.

The following table is, in part, from the State of Oregon 2025 NHMP. Deschutes County is in Region 6; drought declarations not impacting Deschutes were omitted. It is not clear from the available information if all Region 6 droughts included a drought declaration in Deschutes County:

Table 3-3 History of Droughts[10]

Date	Location	Description
1929-1931	Region 1-3, 5-7 (1929-1930); Region 6 and 7 (1930-1931) (Extreme Drought)	The 1920s and 1930s, the Dust Bowl, were a period of prolonged, mostly drier than normal conditions across much of the state and country; moderate to severe drought affected much of the state.
1939	Statewide	The 1920s and 1930s, the Dust Bowl, were a period of prolonged mostly drier than normal conditions across much of the state and country.
1977	N. & S. Central and Eastern Oregon	The water year was significantly drier than normal, but temperatures were near normal.

[10] State of Oregon Natural Hazards Mitigation Plan 2025 p.59

1994	Regions 4-8	In 1994, Governor's drought declaration covered 11 counties located within Regions 4-8.
2001	Southern, Eastern OR	Jefferson, Wheeler, Crook, Deschutes, Klamath, and Lake Counties under a Governor-declared drought; in 2001, 18 counties were declared statewide.
2002	Southern and Eastern Oregon	Counties declared in 2001 remained in effect; Governor added five additional counties in 2002, bringing the total to 23 counties.
2003	Southern and Eastern Oregon	Jefferson, Deschutes, and Lake Counties' drought declarations expired June 23, 2003; Governor issued new drought declarations for Wheeler and Crook Counties and extended Klamath drought order through December 2003.
2004	Eastern Oregon	Klamath County under a Governor drought declaration; three other counties declared in neighboring regions.
2005	Regions 5-7	Governor declared drought in Wheeler, Crook, Deschutes, Klamath, and Lake Counties; all Region 5 counties declared as well as two counties in Region 7.
2007	Regions 6-8	Governor declared drought in Lake County, along with five other counties in Regions 6 and 7.
2010	Region 6	Governor declared drought for Klamath County and "contiguous counties."
2012	Region 6	Governor declared drought for Lost River Basin only, located within Klamath and Lake Counties.
2013	Regions 5-8	Governor declared drought for Klamath County along with four other counties.
2014	Regions 4, 6-8	Governor declared drought in 10 counties including Crook, Wheeler, Klamath, and Lake.
2015	Statewide	All 36 Oregon Counties receive federal drought declarations, including 25 under Governor's drought declaration.
2018	Regions 1, 4-8	Klamath, Lake, and Wheeler County receive Governor's drought declarations, including 8 other counties in 5 other regions.
2020	Regions 1,6	Governor-declared drought in 15 counties. Lowest SPEI on record (-1.74).
2021	Regions 1, 3-8	Governor-declared drought in 26 counties. Most of Oregon was in severe drought and over 25 percent of the state was in exceptional drought at the peak

		of the drought in September. Warmest July on record.
2022	Regions 4 - 8	Governor-declared drought in 17 counties.
2023	Regions 1, 4-8	Governor-declared drought in 13 counties.
2024	Regions 6-8	Governor-declared drought in 4 counties. Second warmest July on record.

Table 3-4 Deschutes County Governor Declared Droughts Since 1991[11]

Drought Year	County	Governor Declaration Date	Federal Declaration Date	Executive Order
1991	Deschutes	4/11/1991	-	91-05
1992	Deschutes	9/3/1992	-	92-21
1994	Deschutes	7/6/1994	-	94-09
2001	Deschutes	8/13/2001	-	01-17
2002	Deschutes	-	-	01-17
2005	Deschutes	5/25/2005	-	05-06
2010	Deschutes	3/16/2010	-	10-03
2015	Deschutes	5/22/2015	4/22/2015	15-05
2020	Deschutes	7/1/2020	4/18/2020	20-31
2021	Deschutes	6/8/2021	-	21-12
2022	Deschutes	4/25/2022	-	22-07
2023	Deschutes	3/23/2023	-	23-08

The figure below shows the State of Oregon's current drought conditions monitored according to the National Integrated Drought Information System. The measurement shown displays the percent area of drought severity conditions. It indicates that all of Deschutes County is currently classified as being in either severe or extreme drought.

Figure 3-4 U.S. Drought Monitor - Oregon[12]

[11] Oregon Water Resources Department – Public Declaration Status Report https://apps.wrd.state.or.us/apps/wr/wr_drought/declaration_status_report.aspx
[12] U.S. Drought Monitor, https://drought.gov/states/oregon, Accessed June 2, 2026.

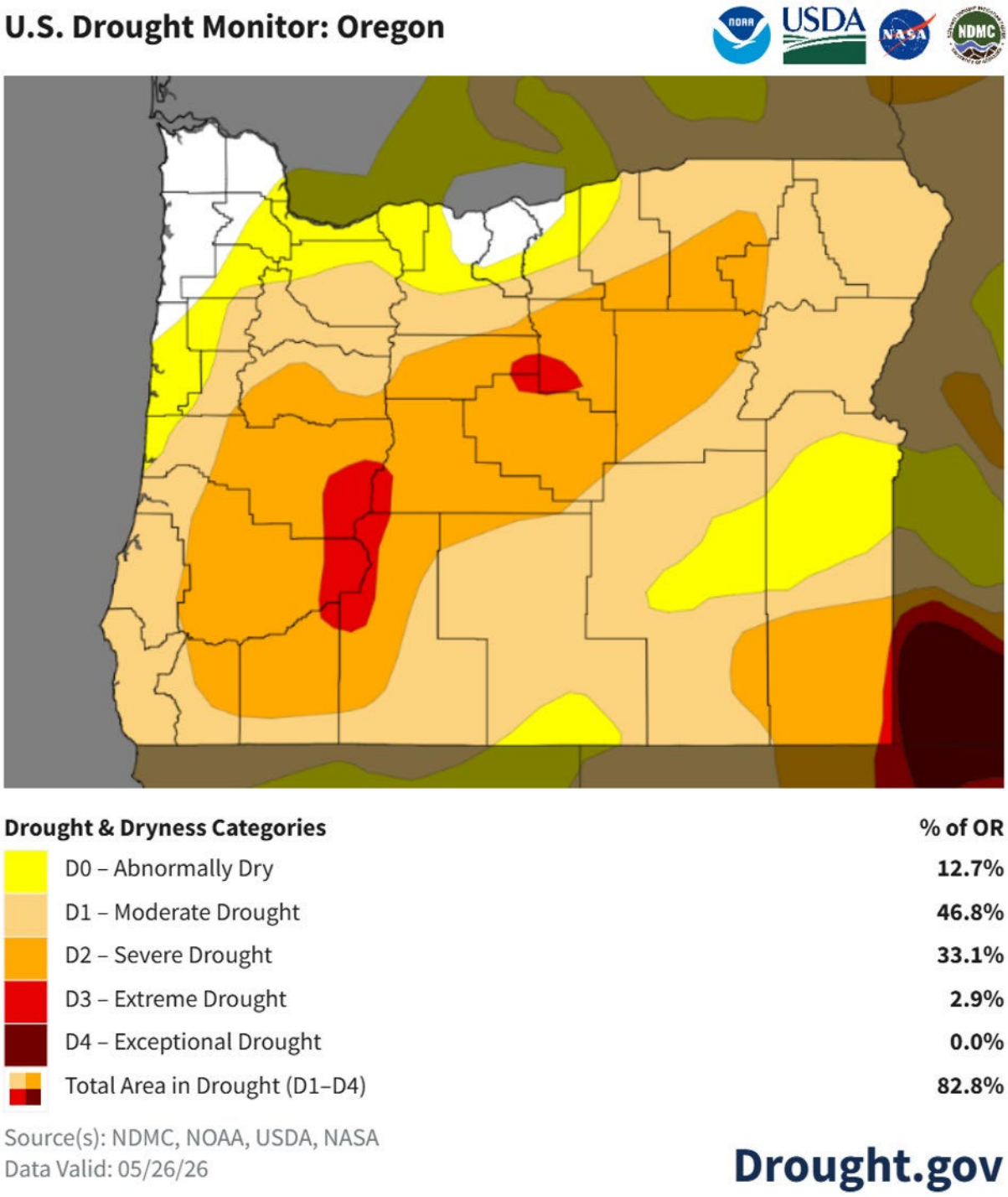


Figure 3-5 Example of Historically Observed Impacts of Different Severities of Drought[13]

[13] https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?OR

Category	Examples of historically observed impacts
D0	Ski season is impacted
D1	Some fields are left fallow
	Water levels begin to decline; recreation and other uses impacted
D2	Fire risk increases
	Marshes are drying up, little water is available for waterfowl and wildlife; bears are moving into urban areas
	Pastures are brown; hay yields are down and prices are up; producers are selling cattle
	River flows are low and tributaries are running dry; conservation efforts begin in irrigation districts
D3	Low oxygen and high river water temperatures are affecting fish
	Planting is delayed
	Pumping well water increases; wells are going dry; homeowners are trucking in potable water
	Reservoirs and lakes are very low compared to normal; irrigation water is scarce
	Waterfowl disease outbreaks increase
	Wldfire activity is high

Future Conditions

Droughts are expected to remain frequent and severe. All indications suggest that their occurrence in the future will be at least as frequent as in the past, particularly in Central Oregon where they have occurred often.

In the 1990s, Central Oregon experienced an annual number of 186 dry days (days without measurable precipitation). This number is expected to increase to 192 by 2050.[14] This increase will lead to a decline in both the availability and quality of water for domestic and agricultural use. As a result, drier natural vegetation will increase the risk of wildfires, reduce crop yields, and lead to fewer or even complete loss of some plant species.

Data suggests that drought risk will likely increase over the twenty-first century on the western slopes of the Cascade Range and the southern Coast Range, decrease in the Deschutes and John Day basins in north-central Oregon, and change little elsewhere in the state. However, due to a shift in the seasonal distribution of precipitation, drought risk during summer is likely to increase statewide.[15]

One of the main aspects of the probability of future occurrences is its reliance on historic climate trends to predict future climate trends. Many counties in eastern Oregon are experiencing more frequent and severe droughts than is historically the norm, and many climate predictions see this trend continuing. Temperatures in the Pacific Northwest region increased in the 20th Century by about 2.2°F and are projected to increase by an average of 5°F by the 2050s and 8.2°F by the 2080s, with the greatest seasonal increases in summer.

[14] https://www.oregon.gov/oweb/resources/Pages/Water-and-Climate.aspx
[15] https://www.oregon.gov/odf/forestbenefits/documents/oregon-climate-assessment.pdf

Precipitation in Oregon is expected to increase in winter and decrease in summer.[16] The predicted increase in winter temperatures will reduce snowpack, which in turn will have effects on spring runoff. In this scenario, the mainstem of the Upper Deschutes River would remain more resilient compared to some of its dominantly snow-fed tributaries such as the Little Deschutes River, Whychus Creek and to a lesser extent Tumalo Creek.[17] These tributaries may respond to projected climate changes similarly to other Oregon rivers.

Vulnerability Assessment

Rural areas are much more dependent on water for irrigation for agricultural production. Landowners in rural or less-populated areas are often reliant on individual, privately owned wells as a drinking water source. Counties east of the Cascades are more prone to drought-related impacts. Deschutes County is less vulnerable to some drought impacts than other counties in the Region because its water source is a large aquifer system in the High Cascades which stores precipitation regardless of whether it is rain or snow. However, droughts can still be problematic. Potential impacts to community water supplies are the greatest threat. The aquifer is affected by long-term periods in which drought occurs in consecutive years. These extended periods of drought can impact forest conditions and set the stage for potentially destructive wildfires. Additional impacts are described in the Community Hazard Issues section.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having **a "low" vulnerability to drought hazards**, meaning less than 1% of the region's population or assets would be affected by a major emergency or disaster. Oregon has yet to undertake a statewide comprehensive risk analysis for drought, to determine probability or vulnerability for a given community. However, based upon available information the Oregon NHMPs Regional Risk Assessment rates Deschutes County's vulnerability to drought as high.[18]

Risk Assessment

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It is a temporary condition and differs from aridity because the latter is restricted to low rainfall regions and is a permanent feature of climate. It is rare for drought not to occur somewhere in North America each year. Despite achievements in the science of climatology, estimating drought probability and frequency continues to be difficult. This is because of the many variables that contribute to weather behavior, climate change, and the absence of historic information. 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. Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of**

[16] Ibid.
[17] Gannett, M.W., and Lite, K.E., Jr., 2004, Simulation of regional ground-water flow in the upper Deschutes Basin, Oregon: U.S. Geological Survey Water-Resources Investigations Report 03–4195, 84 p.
[18] Ibid.

experiencing a drought is "high," meaning one incident is likely within the next 10–35-year period. Oregon has yet to undertake a statewide comprehensive risk analysis for drought to determine probability or vulnerability for a given community. However, based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[19]

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2-6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a particular hazard. Based on the matrix the **drought hazard is rated #6, out of 10 rated hazards, with a total score of 165**.

Earthquake

According to the Pacific Northwest Seismic Network (PNSN): The seismology lab at the University of Washington records roughly 1,000 earthquakes per year in Washington and Oregon. Between one or two dozen of these cause enough ground shaking to be felt by community members. Most are in the Puget Sound region, and few cause any damage. However, based on the history of damaging past earthquakes and our understanding of geologic history of the Pacific Northwest, we are certain that damaging earthquakes magnitude 6 or greater) will recur in our area, although we have no way to predict whether this is more likely to be today or years from now.[20]

Location and Extent

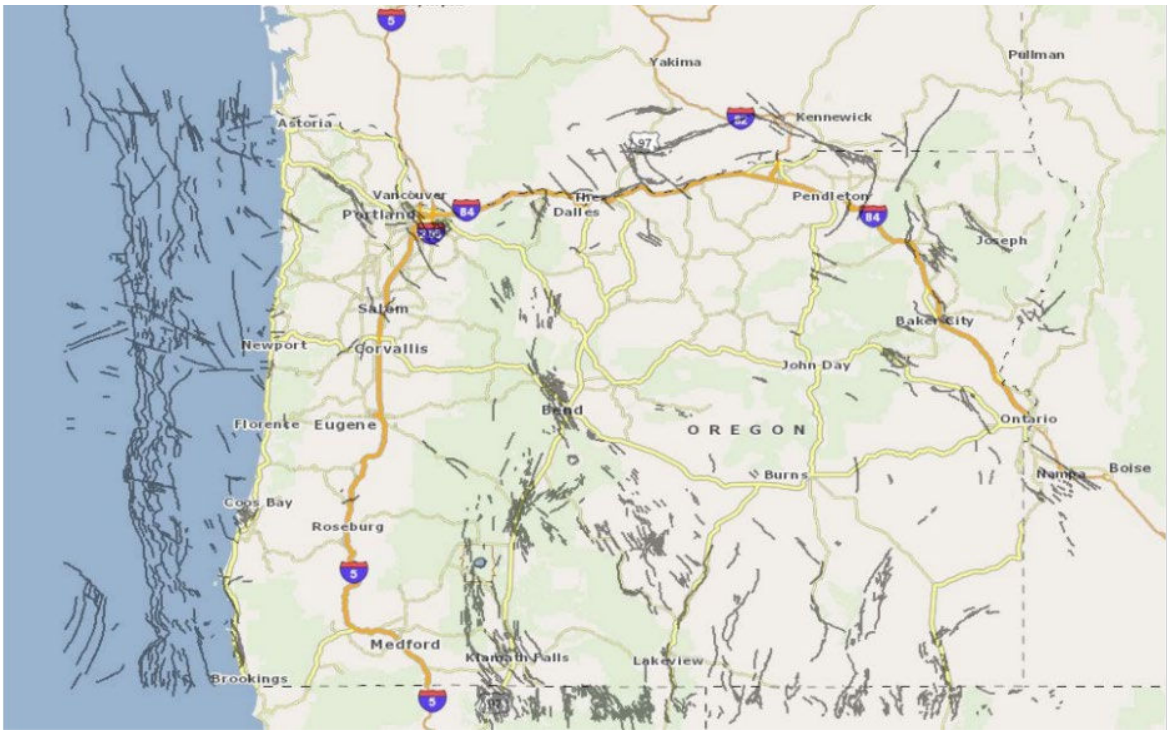
The geographical position of Deschutes County makes it susceptible to earthquakes from four sources (see Figure 3-6), though expert opinions vary regarding the degree of susceptibility from each. The four sources include:

1. The offshore Cascadia Subduction Zone,
2. Deep intraplate events within the subducting Juan de Fuca Plate,
3. Shallow crustal events within the North American Plate, and
4. Earthquakes associated with renewed volcanic activity.

The map below illustrates the location of active fault lines in and around the State of Oregon.

Figure 3-6 Active Fault Lines for Oregon[21]

[19] *2020 Oregon Natural Hazard Mitigation Plan*. Department of Land Conservation and Development, 2021.
[20] University of Oregon, Pacific Northwest Seismic Network
[21] Oregon HAZUS. Accessed December 2024.

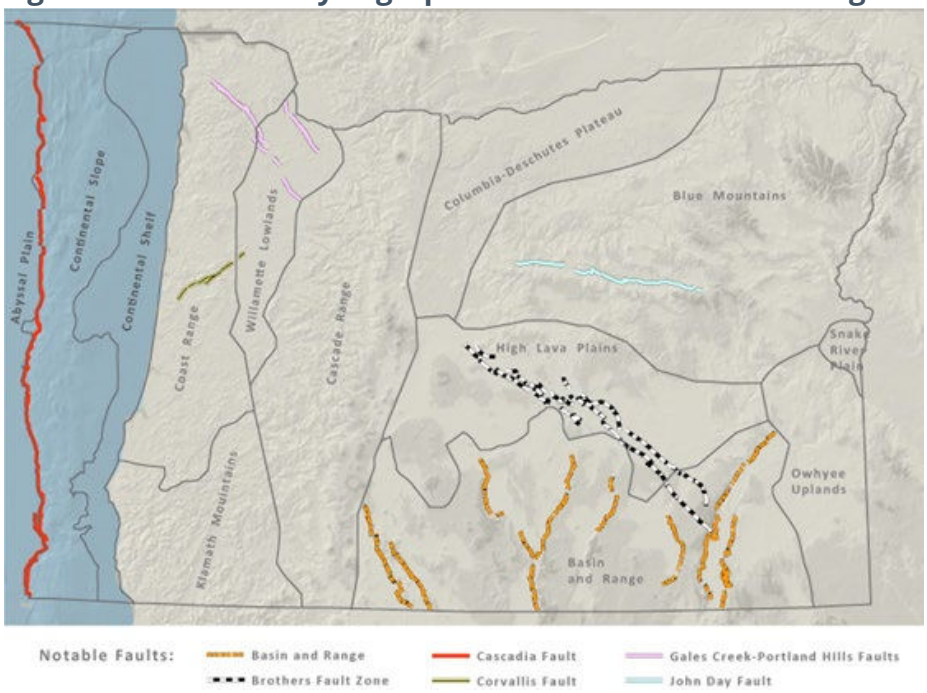


Seismic events were once thought to pose little or no threat to Oregon communities. However, recent earthquakes and scientific evidence indicate that the risk to people and property is much greater than previously thought.

All types of earthquakes in the region have some tie to the subducting, or diving, of the dense, oceanic Juan de Fuca Plate under the lighter, continental North American Plate. There is also a link between the subducting plate and the formation of volcanoes some distance inland from the offshore subduction zone.

The map below illustrates that Central Oregon includes portions of five physiographic provinces including the High Cascades, Blue Mountains, Basin and Range, High Lava Plains, and Deschutes-Columbia Plateau. Consequently, its geology and earthquake susceptibility varies considerably. There were several significant historical earthquakes in the region; however, all have been in Klamath and Lake Counties. Additionally, Deschutes, Klamath and Lake Counties contain geologically active faults. The region historically experienced crustal and intraplate earthquakes. Prehistorically subduction zone earthquakes centered outside Central Oregon. Given the evidence, the most catastrophic future earthquakes are likely to originate either along shallow crustal faults in the region or the offshore Cascadia Subduction Zone. Four types of earthquakes, specifically subduction zone, intraplate, crustal, and volcanic occur in the region and are described below.

Figure 3-7 The Five Physiographic Provinces of Central Oregon[22]



Subduction Zone Earthquakes

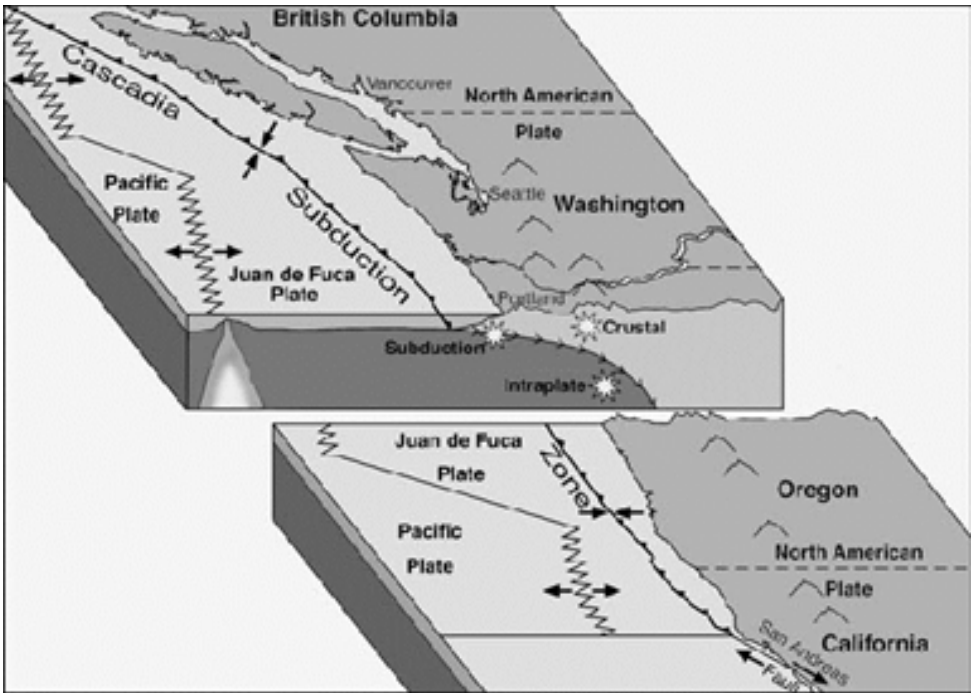
The Pacific Northwest is located at a convergent plate boundary, called the Cascadia Subduction Zone (CSZ, see Figure 3-8), where the Juan de Fuca and North American tectonic plates meet. It extends from British Columbia to northern California. Earthquakes are caused by the abrupt release of slowly accumulated stress. The two plates are converging at a rate of about 1.5 inches per year.[23]

Figure 3-8 Cascadia Subduction Zone[24]

[22] Oregon Department of Geology and Mineral Industries. https://www.oregongeology.org/pubs/ims/ims-028/faults.htm. Accessed March 2021. Oregon: A Geologic History - The Big Picture: Plate Tectonics and Hot Spots.

[23] Interagency Hazard Mitigation Team. 2020. Oregon Natural Hazards Mitigation Plan. Salem, OR: Oregon Military Department – Office of Emergency Management

[24] Shoreland Solutions. Chronic Coastal Natural Hazards Model Overlay Zone. Salem, OR: Oregon Department of Land Conservation and Development (1998) Technical Guide-3.



Although no large, recent earthquakes occurred along the offshore Cascadia Subduction Zone, similar subduction zones worldwide produce large “megathrust” earthquakes with magnitudes of 8 or larger. They occur because the oceanic crust "sticks" as it is being pushed beneath the continent, rather than sliding smoothly. Over hundreds of years, large stresses build up, which are released suddenly in “megathrust” earthquakes. Such earthquakes typically produce a minute or more of strong ground shaking and are quickly followed by numerous large aftershocks.

Historic subduction zone earthquakes include the 1960 Chile earthquake (magnitude 9.5), the 1964 southern Alaska earthquake (magnitude 9.2), the 2004 Indian Ocean earthquake (magnitude 9.0) and the 2011 Tohoku earthquake (magnitude 9.0). Geologic evidence shows that the Cascadia Subduction Zone has generated great earthquakes of similar magnitude, most recently in 1700.[25]

While all four types of earthquakes can cause major damage, subduction zone earthquakes pose the greatest danger. A major CSZ event could generate an earthquake with a magnitude of 9.0 or greater resulting in devastating damage and loss of life in western Oregon. Such earthquakes may cause great damage to the coastal areas of Oregon as well as inland areas in western Oregon. Damage to Deschutes County will be less severe, however, it is expected that the impact of such an event will greatly affect eastern Oregon.

[25] Interagency Hazard Mitigation Team. 2020. Oregon Natural Hazards Mitigation Plan. Salem, OR: Oregon Military Department – Office of Emergency Management

Deep Intraplate Earthquakes

Deep intraplate earthquakes occur at depths of 18 to 60 miles below the earth's surface in the subducting oceanic crust and can reach magnitude 7.5.[26] This type of earthquake is more common in the Puget Sound region; in Oregon these earthquakes occur at lower rates, and one occurred at damaging magnitudes.[27] The February 28, 2001 Nisqually earthquake (magnitude 6.8) in Washington State was a deep intraplate earthquake. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah.[28]

Shallow Crustal Earthquakes

These are the most common earthquakes and occur in the North American Plate at relatively shallow depths of 6-12 miles below the surface.[29] When crustal faults slip, they can produce earthquakes of magnitudes up to 7.0. Although most crustal fault earthquakes are smaller than 4.0 and generally create little or no damage, some of them can cause extensive damage. The 1993 Klamath Falls earthquakes (magnitude 6.0 and 5.9) were crustal earthquakes.[30]

> "Due to the amount of faulting in the area, [the 1993 Klamath Falls earthquake] is just business as usual for such a geologically active region. Historic evidence, combined with geologic evidence for large numbers of earthquakes in the prehistoric past, suggest that one or more earthquakes capable of damage (magnitude 4-6) hit south-central Oregon every few decades, so it pays to be prepared."
>
> James Roddey, DOGAMI

Volcanic Earthquakes

Volcanic earthquakes are usually smaller than magnitude 2.5, roughly the threshold for shaking felt by observers close to the event. Swarms of small earthquakes may persist for weeks to months before eruptions, but little or no earthquake damage would occur to buildings in surrounding communities. Some volcanic related swarms may include earthquakes as large as about magnitude 5. For the communities of Bend, La Pine, and Sunriver, shallow earthquakes in the magnitude 4-5 range located beneath Newberry Volcano would cause walls to rattle or windows and dishes to vibrate. Both Newberry and the Three Sisters volcanoes routinely experience small magnitude earthquakes that are not felt.

Hazard History

A summary of significant earthquake events in Oregon and the Eastern Cascade region is found in the table below.

[26] Planning for Natural Hazards: Oregon Technical Resource Guide, Community Planning Workshop, (July 2000), p. 8-8.
[27] Interagency Hazard Mitigation Team. 2020. Oregon Natural Hazards Mitigation Plan. Salem, OR: Oregon Military Department – Office of Emergency Management
[28] Hill, Richard. "Geo Watch Warning Quake Shook Portland 40 Years Ago." The Oregonian. October 30, 2002.
[29] Madin, Ian P. and Zhenming Wang, Relative Earthquake Hazard Maps Report, DOGAMI, 1999.
[30] Earthquake probabilities and hazards in the U.S. Pacific Northwest

Table 3-5 Selected Earthquakes, M 5.0+ (1971-2014)[31]

Date	Location	Magnitude	Comments
Approximate years: 1400 BCE, 1050, BCE 600, BCE 400, 750, 900	Offshore, Cascadia Subduction Zone	Probably 8.0-9.0	Based on studies of earthquakes and tsunamis in Willapa Bay, WA. These are the midpoints of the age ranges for these six events.
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.
April 1906	North of Lakeview, OR	5.0	Also produced three aftershocks.
April 1920	Crater Lake	5.0	
January 1923	Lakeview, OR	6.0	
March 1958	Southeast of Adel, OR	4.5	Damage unknown
1968	Adel	4.7-5.1	Damage to homes. 20 earthquakes of M4 or greater were recorded between 5/28/68 & 6/24/68.
September 20, 1993	Klamath County	5.9 and 6.0	Two deaths, $10 million damage, including county courthouse; rockfall is induced by ground motion.

The Klamath County earthquakes on September 21, 1993, caused two deaths and approximately 7.5 million dollars in damage. One person was killed when a boulder crushed the car he was driving in an earthquake-induced rock fall, and another person died of a heart attack. More than 1,000 homes and commercial buildings were damaged.[32]

Deschutes County routinely has small earthquake events. The earthquakes shown in the figure below are relatively insignificant events below M 5.0. Larger listed events may have been felt slightly but resulted in little to no structural/property damage. There is no historic record of significant crustal earthquakes centered in Deschutes County during the past 150 years, although Oregon has experienced crustal earthquakes that originated outside the county. Recent earthquake events in Deschutes County include a two-day swarm of 100 to 200 small, unfelt earthquakes in the Three Sisters region (shown below on the left side of the map) in April 2004. Additionally, seismometers on Newberry Volcano have recorded numerous small, unfelt earthquakes since being installed in 2011.

[31] Ivan Wong and others, "A Look Back at Oregon's Earthquake History, 1841-1994," in Oregon Geology, (1995), 125-139; Niewendrop and others, "Map of Selected Earthquakes for Oregon, 1841 through 2002," DOGAMI, (2003).
[32] USGS, Earthquake Hazards Program,

Figure 3-9 Earthquake Epicenters (1971-2008)[33]

Future Conditions

There are several approaches to calculating the probability of earthquake occurrence, the most common of which is based on the average rate of past events. By assuming that a certain event occurs at a constant rate in an arbitrary period of time, scientists can estimate the likelihood of such an event in the next given number of years. The probability for each of the types of earthquakes in our region are discussed in this section.[34]

The Cascadia Subduction Zone (CSZ) generates an earthquake on average every 250-500 years. However, as with any natural processes, the average time between events can be misleading. Some of the earthquakes may have been 150 years apart while some occur closer to 1,000 years apart.[35] Establishing a probability for crustal earthquakes is difficult given the small number of historic events in the region. Earthquakes generated by volcanic activity in Oregon's Cascade Range are possible, but likewise unpredictable. Mitigation action calls for study of the probability of earthquake events specific to Deschutes County.

According to the 2025 Oregon NHMP, the return period for the largest of the CSZ earthquakes (Magnitude 9.0+) is 530 years with the last CSZ event occurring 325 years ago in January of 1700. The probability of a 9.0+ CSZ event occurring in the next 50 years ranges from 7-12%. Notably, 10-20 "smaller" Magnitude 8.3-8.5 earthquakes occurred over the past 10,000 years that primarily affected the southern half of Oregon and northern California. The average return period for these events is roughly 240 years. The combined probability of any CSZ earthquake occurring in the next 50 years is 37 - 43%.

[33] Oregon HazVu: Statewide Geohazards Viewer (HazVu), accessed December 2025.
[34] https://pnsn.org/education/seismology/earthquake-prediction
[35] Y. Wang & J.L. Clark, Special Paper 29, Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses. 1999. DOGAMI.

The 1999 report *Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Damage,* looks at two different scenarios. The first is a Cascadia Subduction Zone event of magnitude 8.5 and the second is referred to as the 500 Year Model. It is defined as,

> Every part of Oregon has earthquakes. The 500 year model is an attempt to quantify the risk across the state. This estimate does not look at a single earthquake. Instead, this study includes many faults, each with a 10 percent chance of producing an earthquake in the next 50 years. It assumes each fault will produce a single "average" earthquake during this time. More and higher magnitude earthquakes than used in this study may occur.[36]

It is not feasible at this time to predict when central Oregon or Cascadia will have another moderate to large earthquake. The statistical uncertainty associated with calculating earthquake recurrence intervals are as large as or larger than the calculated recurrence interval. Deschutes County's Natural Hazards Mitigation Steering Committee hypothesizes that the County's **probability of experiencing a crustal earthquake is "low"**, meaning one incident is likely within the next 75-100 year period; the committee hypothesizes that the County's **probability of experiencing a Cascadia earthquake is also "low."** Based upon available information, the Oregon NHMP's Regional Risk Assessment rates Deschutes County's probability of earthquake as moderate.[37]

The two maps included below from the Oregon Natural Hazards Mitigation Plan (pages 79 and 80) illustrate that Deschutes County is in transition area from moderate risk to the west and relatively low risk to the east.

Figure 3-10 Earthquake Risk Rating from the NRI: Risk Index Rating from the Federal Emergency Management Agency, National Risk Index for Earthquake[38]

[36] https://d3itl75cn7661p.cloudfront.net/dogami/sp/SP-29.pdf Earthquake Damage in Oregon
[37] https://mil.wa.gov/asset/62bc6bf87b6dc
[38] Federal Emergency Management Agency, National Risk Index for Earthquake. Ranking based on national percentiles. Last updated by FEMA in March 2023. Data accessed on February 12, 2025 from National Risk Index | FEMA.gov.

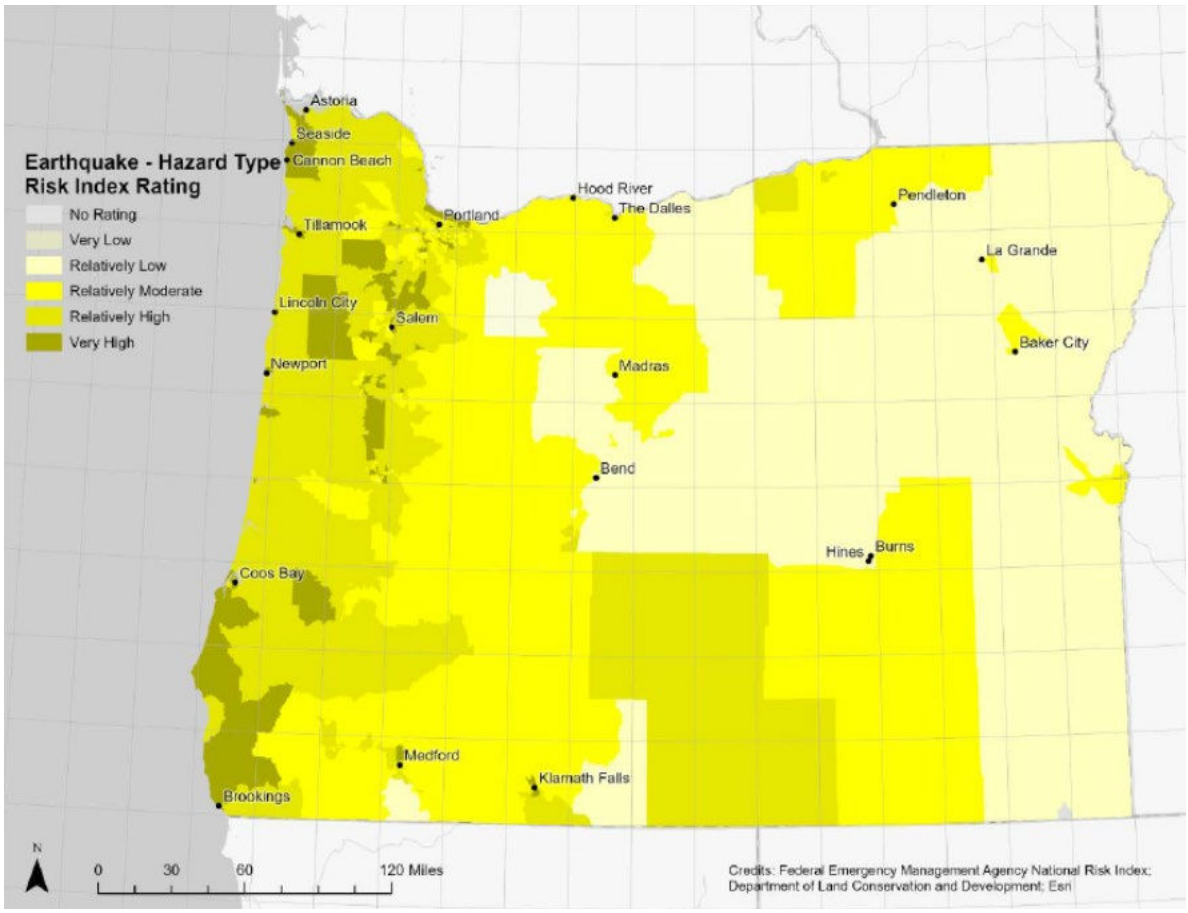
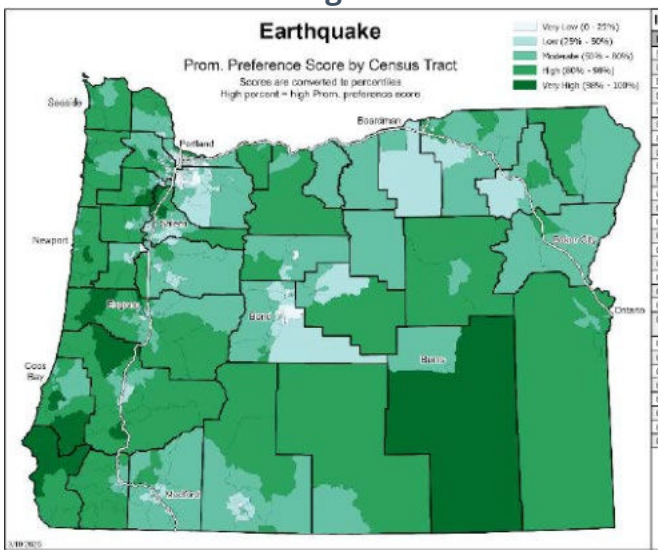


Figure 3-11 Earthquake Results of Oregon Risk Assessment Using PROMETHEE Ranking with Socioeconomic Indicators Included[39]



Indicators used for the hazard Hazard indicators are worth 35% of the total weight.

Hazard	Indicator Name	Direction	Weight	Short Description
Earthquake	LQ_pct_bld	1	0.035	Pct. SBFD buildings exposed to Moderate to Very High liq.
Earthquake	LQ_pct_CF	1	0.035	Pct. critical facilities exposed to Moderate to Very High liq.
Earthquake	EQCSZ_pct_CF	1	0.035	Pct. of red or yellow-tagged critical facilities (CSZ Deterministic).
Earthquake	EQ25_pct_CF	1	0.035	Pct. of yellow-tagged critical facilities (2500 Probabilistic).
Earthquake	Hist_LQ_ct	1	0.035	Pct. historic buildings exposed to Moderate to Very High liq.
Earthquake	Hwy_LQ_pct	1	0.035	Major roadway miles exposed to Moderate to Very High liq.
Earthquake	Erpk_NRI_afr	1	0.035	Earthquake risk from NRI.
Earthquake	LQ_Haz_Area	1	0.035	Area of tract in high or very high liquefaction hazard.
Earthquake	Bridges_LIQ	1	0.035	Number of bridges in the high or very high liquefaction hazard.
Earthquake	PGA_2500	1	0.035	Average shaking in tract from 2500-year probabilistic earthquake.
General	EP_MINRITY	1	0.046	Percentage of Black, Indigenous, and People of Color (2020 Census)
General	HousingTenure	-1	0.046	Housing tenure from the US Census.
General	EP_MOBILE	1	0.046	Percentage of people that live in mobile homes
General	Medianyrblt	-1	0.046	Median year built of general building stock based on HAZUS default.
General	HospEuclDist Mile	1	0.046	Distance from tract centroid to nearest hospital.
General	NatResecJobs	1	0.046	Rate of natural resource jobs.
General	PRCDD_PE	1	0.046	Community Resilience Estimate
General	Hosp_Beds	-1	0.046	Estimated number of hospital beds based on square footage.
General	Pct_Adherents	-1	0.046	Percentage of members to a religious group.
General	Mitigation	-1	0.046	Number of mitigation projects (grouped by zip code and evenly distributed to overlaying tracts)
General	Watch	-1	0.046	Neighborliness: Will watch neighbor's house
General	CountyTax	-1	0.046	County tax rate
General	CityTax	-1	0.046	City tax rate
General	Cultural	-1	0.009	Number of cultural-related buildings
General	Favors	-1	0.009	Neighborliness: Willing to do favors for neighbor
General	Advice	-1	0.009	Neighborliness: Seeks advice from neighbor
General	Parties	-1	0.009	Neighborliness: Attended parties that occur in neighborhood
General	Visits	-1	0.009	Neighborliness: Has visited neighbor's house

[39] NEED CITATION

Vulnerability Assessment

The Oregon Department of Geology and Mineral Industries (DOGAMI) has developed two earthquake loss models for Oregon based on the most likely sources of seismic events: 1) the CSZ, and 2) combined earthquake events. Both models are based on HAZUS, a database 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 consider a tsunami, which is a likely secondary effect. 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 building 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. Flooding as a secondary impact is also possible in around the South Sister uplift. Current research being conducted in this area will determine potential impact and flooding potential.

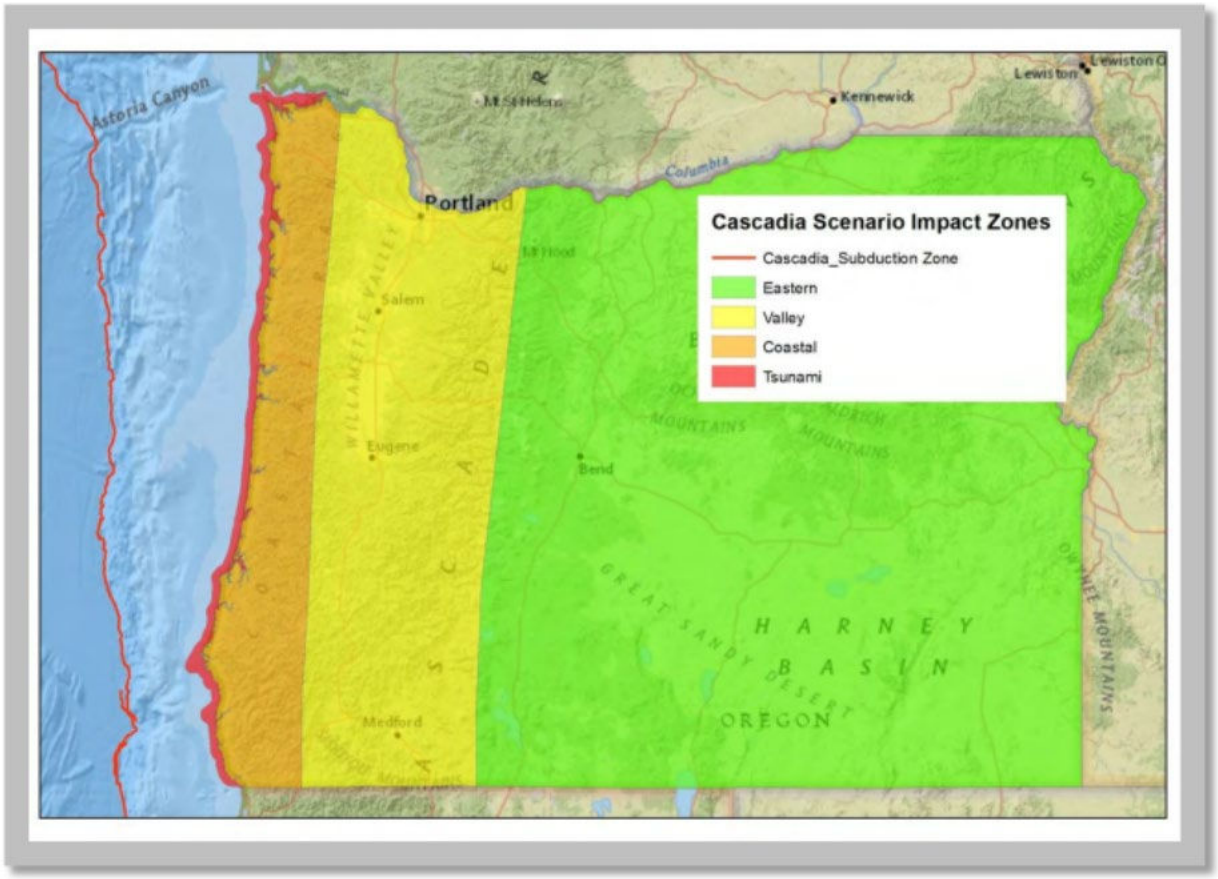
According to FEMA's Region 10 Cascadia Subduction Zone (CSZ) Earthquake and Tsunami Plan from 2022, the Eastern Cascade Geographic Reference Area (GRA) is likely to experience the following from a CSZ:

- Direct impacts from the earthquake are minimal, and there are no direct impacts from tsunami.
- Impacts to Coastal and I-5/Inland GRAs may cause indirect supply chain issues.
- Transportation routes may be cut off due to landslide issues in Coastal and I-5/Inland GRAs.

The map below indicates that the direct impacts from a CSZ would be light in Deschutes County.

Figure 3-12 Cascadia Scenario Impact Zones[40]

[40] https://www.oregon.gov/oem/documents/oregon_resilience_plan_final.pdf



Impact zones for the magnitude 9.0 Cascadia earthquake scenario. Damage will be extreme in the Tsunami zone, heavy in the Coastal zone, moderate in the Valley zone, and light in the Eastern zone.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"moderate" vulnerability to the crustal earthquake hazard,** meaning 1-10% of the region's population or assets would be affected by a major emergency or disaster; the committee rated the County as having a **"high" vulnerability to the Cascadia earthquake hazard,** meaning more than 10% of the region's population or assets would be affected by a major emergency or disaster. The Oregon NHMP's Regional Risk Assessment rates Deschutes County's vulnerability to earthquakes as very low.[41]

Risk Assessment

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2-6 of the Risk Assessment (Volume I, Section 2) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of

[41] Ibid.

hazard priorities but does not predict the occurrence of a particular hazard. Based on the matrix, the **Cascadia earthquake hazard is rated #5, out of 10 rated hazards, with a total score of 166; while the crustal earthquake hazard is rated #9, out of 10 rated hazards, with a total score of 99.**

Extreme Weather Events

Deschutes County is threatened by hazards broadly categorized as extreme weather events almost every year. Storms bring heavy rains, strong winds, hail, lightning, and occasionally ice and snow. Flooding, and less commonly, landslides can also accompany severe rainfall. Severe storms can create conditions that disrupt essential regional systems such as public utilities, telecommunications, and transportation routes. Wind, snow, and ice associated with severe winter storms can knock down or otherwise damage trees, power lines, and utility services. Freezing winter temperatures can damage agricultural crops and utilities. Lightning poses a risk to life and can result in property damage. Hailstorms also pose a risk to people, property, and agricultural production in Deschutes County. Tornados are very uncommon in Deschutes County but have resulted in damage and fatalities in other eastern Oregon Counties.

Severe storms can affect all parts of Deschutes County. However, varied elevations and topography of the County contribute to the unpredictability of storms depending on the location. The Cascade Mountains, located along the western portions of the County, regularly receive the highest amounts of snowfall, and the strongest wind gusts in the County.

The most frequent severe weather-related hazards in Deschutes County are thunderstorms, snow, wind, ice, extreme heat, and freezing temperatures. Occasionally, storms from the Pacific bring rain during the warmer months with the most severe rainstorms coming in the form of thunderstorms. While tornadoes are very infrequent and pose a relatively small risk to Deschutes County, there is a slight potential for this hazard as well.

Extreme Heat Hazard

Location and Extent

Central Oregon is no stranger to hot days in the warm season (May-September), with temperatures frequently climbing to, or exceeding, 95 to 100 degrees (Table 3-11), these temperatures normally do not represent a major threat to the public.[42] One consideration is the apparent temperature, or how the temperature actually feels when combined with humidity. Given the high desert climate of the region, humidity is often quite low (15% or less), leading the apparent temperature to be lower than the actual temperature. In such cases, the temperature feels cooler than it is due to the very low humidity. This lessens the danger of heat in these regions in the absence of higher humidities. In addition to low

[42] https://www.wpc.ncep.noaa.gov/heatrisk/

humidities leading to lower apparent temperatures, they also lend to rapidly cooling conditions during the overnight hours. It is not uncommon for some of the hottest days in Central Oregon to be coupled with cool nights where lows fall into the 50s and even 40s. This shortens the potential duration of heat events and related human exposure, making extreme heat a rather lower risk in this region. The extreme heat event of June 2021 discussed below was impactful and it is also likely to remain a rare occurrence. Figure 3-16 below illustrates danger levels associated with varying heat indices. Humidities are frequently too low to warrant extreme heat in Deschutes County.

Hazard History

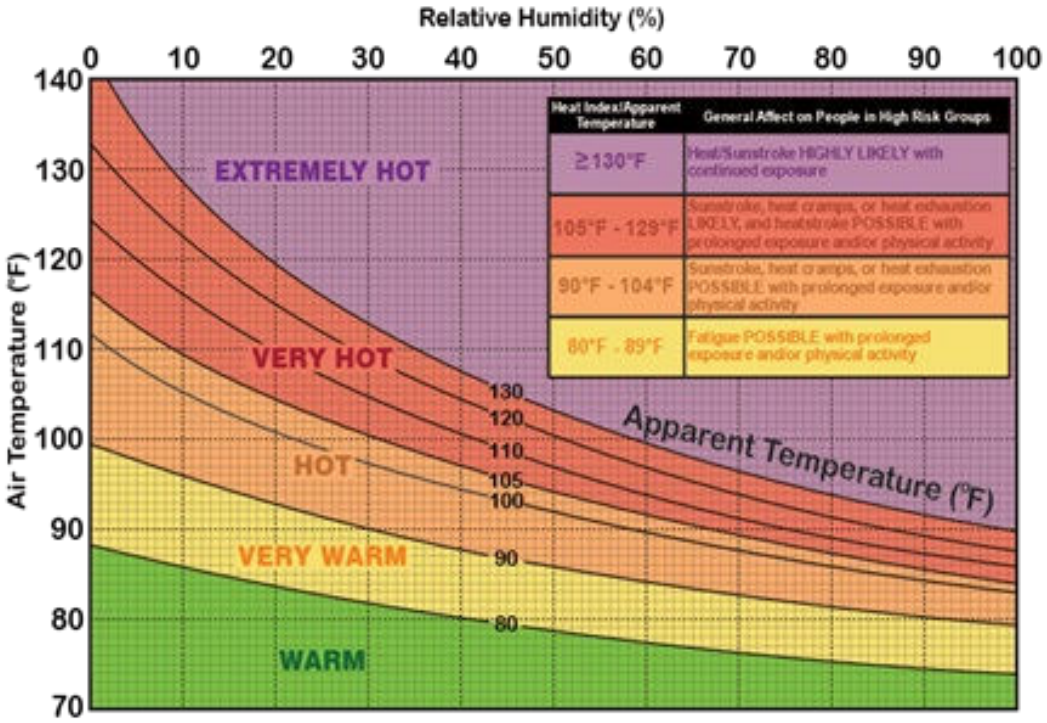
As noted in the table below, 95°F days occur on average several times per year in Deschutes County while 100°F days occur much less frequently. Ranging from once every three years in Bend and two times per year in Redmond.

Table 3-6 Average Extreme Heat Days Per Year[43]

Location (Period of Record)	Average 95+ Degree Days Per Year	Average 100+ Degree Days Per Year
Bend (1948-2025)	2.8	0.33 (once every 3 years)
Redmond Airport (1948-2025)	11	2.3
Sisters (1958-2021)	7	1
Sunriver (1998-2022)	5.4	0.7 (once every 1.5 years)

Figure 3-13 Danger Categories Associated with Apparent Temperature[44]

[43] XMACIS 2000-2020
[44] Marcus Austin, NOAA (2021)



Place holder

Future Conditions

Future Climate Variability

One of the main aspects of the probability of future occurrences is its reliance on historic climate trends to predict future climate trends. Temperature increases will occur throughout all seasons, with the greatest variation occurring during summer months. This information was considered while developing the probability of extreme heat occurrence for the County.

Across the majority of Oregon by the mid-twenty-first century, the mean annual number of days with a heat index above 90°F is projected to increase by 15-30 days assuming moderate increases in emissions of greenhouse gases and 25-40 days assuming higher increases in emissions.[45]

Deschutes County is likely to experience extreme heat in the future and therefore a rank of "high" probability (score value of 9) was assigned by the Steering Committee to this hazard.

Vulnerability Assessment

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a "moderate" vulnerability (score value of 5) to extreme heat.

[45] 2025 Oregon Natural Hazards Mitigation Plan p. 45

The Steering Committee defined "affected population" to be the percentage of the total population that is unable to mitigate heat risk (e.g. people without air conditioning, outdoor workers, people experiencing homelessness, etc.).

A significant heat event occurred in June 2021 in Oregon and across the Northwest due to a climactic phenomenon known as a heat dome. 116 deaths in Oregon were attributed to this heat wave, primarily in the Portland metro area. Deschutes County experienced extremely high temperatures, including less relief from overnight cooling, but no fatalities attributed to heat were reported during the summer of 2021. Multiple factors may have played a role: the high desert climate is accustomed to hot temperatures during the summer, whereas in western parts of the state the climate is milder; the population is less dense and there are few high-rise residential buildings where high risk groups are impacted; the County is also relatively affluent and many community members may be well-resourced enough to withstand heat waves more readily than in less-affluent communities.

Risk Assessment

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring.

It is difficult to define the impacts of acute yet prolonged heat events on the roads and other infrastructures.

Extreme Heat ranked #4 out of 10 hazards with a total score of 174.

Windstorm

Location and Extent

Extreme winds occur throughout Oregon. The most persistent high winds take place along the Oregon Coast and in the Columbia River Gorge. High winds in the Columbia Gorge are well documented. The Gorge is the most significant east-west gap in the Cascade Mountains between California and Canada. Wind conditions in central Oregon are not as dramatic as those along the coast or in the Gorge, yet they can cause dust storms or be associated with severe winter conditions such as blizzards. Most of the destructive surface winds striking Oregon are from the southwest. Some winds blow from the east but most often do not carry the same destructive force as those from the Pacific Ocean. East winds can, however, create unusually volatile fire weather environments, especially through the Cascades. Additionally, if winds are strong from the east/northeast, the unusual wind direction can topple trees and other vegetation that is not used to or rooted for such winds.

Winds associated with thunderstorms are short-lived, but strong winds not associated with thunderstorms can last several hours. Although windstorms can affect the entirety of Deschutes County, they are especially dangerous in developed areas with significant tree stands and major infrastructure, especially above-ground utility lines. Severe windstorms may knock down trees and power lines, damage homes, businesses, public facilities, and create mass quantities of storm related debris.

Though tornadoes are not common in Oregon, these events do occasionally occur and sometimes produce significant property damage and even injury.[46] Tornadoes are the most concentrated and violent storms produced by earth's atmosphere, and can produce winds in excess of 300 mph. They have been reported in most of the counties throughout the state since 1887. At least six tornadoes were documented in Deschutes County, with the most intense occurring in 1989 and rated EF1 (71-112 mph winds). Most tornadoes are caused by intense local thunderstorms occurring between April and October. While tornadoes can result in much more severe damage than straight line winds, the damage is usually confined to a narrow path of a quarter mile or less. Damaging straight line winds pose a greater risk as they occur more frequently and over a broader area.

Hazard History

The Columbus Day storm in 1962 was the most destructive windstorm ever recorded in Oregon in both loss of life and property.[47] Damage from this event was the greatest in the Willamette Valley, where the storm killed 38 people and caused over $200 million in damage. A similar storm today would impact a population nearly six times larger and cause billions of dollars in damage. Windstorms occur yearly; more destructive storms occur once or twice per decade. The following table shows windstorms that affected Deschutes County between 1951 and 2020.

[46] https://data.statesmanjournal.com/tornado-archive/
[47] John Dodge (2018). A Deadly Wind: The 1962 Columbus Day Storm. Oregon State University Press

Table 3-7 Partial History of Significant Windstorms (1951 to 2020)[48]

Date	Affected Area	Comments
November 1951	Statewide	Widespread damage, transmission and utility lines, wind speeds 40-60 mph, bursts 75-80 mph.
December 1951	Statewide	Wind speeds up to 60 mph in Willamette Valley, 75 mph gusts; damage to buildings and utility lines.
December 1955	Statewide	Wind speeds 55-65 mph, with 69 mph gusts. Considerable damage to buildings and utility lines.
November 1958	Statewide	Wind speeds up to 51 mph, with 71 mph gusts. Major highways blocked by fallen trees.
October 1962	Nearly Statewide	Oregon's most notorious and destructive windstorm, the Columbus Day Storm, produced a barometric pressure low of 960 mb.
March 1971	Most of Oregon	Storm center moved into NW Washington, bringing color front heading east and damaging winds on March 26.
November 1981	Pacific Northwest	Back-to-back storms on the 13th and 15th of November.
January 1990	Statewide	Severe windstorm.
December 1991	NE and Central Oregon	Severe windstorm.
December 1995	Statewide	Strongest windstorm since November 1981; barometric pressure of 966.1 mb at Astoria, and an Oregon record low 953 mb off the coast; major disaster declaration FEMA-1107-DR-OR.
April 2003	Deschutes County	$10,000 in property damage.
November 2003	Deschutes County	$2,000 in property damage.
October 2005	Central Oregon	A strong wind gust blew a Ponderosa Pine tree over onto a home in southeast Bend. The property damage from this event is estimated at $50,000.
November 2005	Central Oregon	A strong wind gust blew over a Ponderosa Pine tree which fell on two mobile homes causing extensive damage at Sisters Mobile Home Park. The property damage from this even was estimated at $40,000.

[48] Oregon State Natural Hazard Mitigation Plan 2020, Taylor, G.H. and Hatton, R.R., 1999, The Oregon Weather Book, A State of Extremes: Corvallis, Oregon, Oregon State University Press, NOAA Storm Events Database

June 2006	Jefferson, Deschutes, and Crook Counties	Strong winds and hail caused $7 million in insurance claims for damage to automobiles and homes.
October 2007	Central Oregon	A cold front brought strong winds with gusts 40-50 mph which knocked down trees and power lines in Sisters. One tree fell onto a house.
January 1, 2009	Central Oregon	A downslope windstorm generated high winds with gusts between 65 and 70 mph in and around Bend and other Central Oregon locations.
March 31, 2009	Central Oregon	A strong low-pressure system brought high winds to areas east of the Cascades. Wind gusts of 70-75 mph occurred north of Sisters with damage to trees, power lines, and blowing dust.
May 3, 2010	Central Oregon	Damaging winds toppled trees and power lines in the Bend area.
November 22, 2011	Central Oregon	A strong storm system brought damaging winds that toppled trees and power lines in the Bend and Sisters area and forced the closure of Shevlin Park.
November 19, 2012	Central Oregon	Widespread strong winds toppled several trees in the Bend area, knocking down power lines.
May 4, 2013	Deschutes County	Strong winds brought down numerous trees and some power lines, resulting in a fast-moving grass fire that burned 160 acres.
January 11, 2014	Deschutes County	High winds with a strong cold front resulted in downed trees and power lines with outages affecting over 10,000 people. Wind gusts were measured around 60 mph.
December 11, 2014	Central Oregon	A powerful storm system generated downslope winds of 60 mph, resulting in downed trees and power lines around the Bend and Redmond areas.
February 6-9, 2015	Central Oregon	Two wind events occurred back-to-back, one associated with a warm front on the 6th, and another on the 9th associated with the downslope windstorm off the Cascades. In both instances, wind gusts of 55-60 mph occurred across parts of Deschutes County, damaging trees and power lines.
November 17, 2015	Central Oregon	A strong low-pressure system brought wind gusts of 60 to 65 mph to the region.

December 7 and 21, 2015	Central Oregon	A downslope wind event on the 7th brought 60 mph winds, downing several trees and causing power interruptions. On the 21st, winds of 60-65 mph were felt in Deschutes County with a measured gust to 64 mph at Redmond Airport. Tree damage was also reported in Tumalo.
December 19, 2017	Deschutes County	A strong cold front brought damaging wind gusts to Deschutes County. Numerous trees and power lines were affected in and around Bend, resulting in power loss to around 2,000 people.
February 17, 2018	Deschutes County	A powerful storm system brought damaging wind gust to portions of Deschutes County. A wind gust of 66 mph was recorded 1 mile NNE of Sisters with at least one large tree blown down.
August 9, 2019	Deschutes County	Thunderstorms produced quarter sized hail and wind gusts to 60 mph, leading to minor roof damage on the west side of Redmond.
February 23, 2020	Deschutes County	A strong cold front brought intense winds to Central Oregon. Winds of 45 to 55 mph were common with stronger gusts around 60 mph affecting Bend. Downed trees and lines resulted in power outages and some minor damage to homes and vehicles.
May 30, 2020	Deschutes County	A significant severe thunderstorm moved from south to north on the west side of Highway 97. The storm brought hail ranging from golf ball to baseball sized, and damaging straight line winds of 70 to 90 mph. The winds downed numerous trees and power lines, resulting in some structural damage as well.
September 7-November 1, 2020	20 Counties	Disaster declaration related to the straight-line wind event that caused the Labor Day fires. Providing for federal public assistance for Deschutes County and others affected by the fire.

Future Conditions

Climate models for the Pacific Northwest consistently show that overall wind patterns will change and timing and intensity on seasonal scales could increase. Of note, is a model-predicted change in timing of fall storms (strong winds followed by precipitation) to later in the year, which has implications for wildfires.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a windstorm event is "high,"** meaning one incident is likely within the next 10-35-year period. Based upon available information, the Oregon NHMP's Regional Risk Assessment supports this probability rating for Deschutes County.[49]

Vulnerability Assessment

Many buildings, utilities, and transportation systems within Deschutes County are vulnerable to wind damage. This is especially true in open areas, such as natural grasslands and farmlands. It is also 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.

Fallen trees are especially hazardous. They can block roads and railways for long periods of time, impacting emergency operations. In addition, up-rooted or shattered trees can down power and/or uproot 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. In Deschutes County, trees are more likely to blow over during the winter (wet season). Also, irrigation wheel lines frequently get tangled in windstorms, and ultimately affect agricultural economy.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"moderate" vulnerability to windstorm hazards;** meaning between one and ten-percent of the region's population or assets would be affected by a majority emergency or disaster (particularly if utility lines are damaged). Based upon available information the Oregon NHMP's Regional Risk Assessment rates Deschutes County's vulnerability to windstorms as "low."[50]

Risk Assessment

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2-6 of the Risk Assessment (Volume I) shows the County's Hazard Analysis

[49] *2020 Oregon Natural Hazard Mitigation Plan*. Department of Land Conservation and Development, 2020.
[50] Ibid.

Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a particular hazard. Based on the matrix the **windstorm hazard is rated #3 out of 10 rated hazards with a total score of 183.**

Winter Storm

Location and Extent

The National Climatic Data Center has established climate zones in the United States for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the Pacific Ocean give the state diversified climates. Deschutes County is primarily located within Zone 7: South Central Area, southern and western portions of the County are located within Zone 5: High Plateau. The climate in Zone 7 generally consists of wet winters and dry summers.[51] These wet winters result in potentially destructive winter storms that produce heavy snow, ice, rain, freezing rain, and high winds. Severe storms affecting Oregon with snow and ice typically originate in the Gulf of Alaska or in the central Pacific Ocean. Winter storms occur over eastern Oregon regularly from November through February.[52] Cold arctic air sinks south along the Columbia River basin, filling the valleys with cold air.[53]

Winter storms occur in all parts of the County. The extent depends upon air temperatures, the level of moisture in the atmosphere, and elevation.

A severe winter storm is generally a prolonged event involving snow and cold temperatures. The characteristics of severe winter storms are determined by the amount and extent of snow, air temperature, and event duration. Severe storms have various impacts in different parts of the County. There may be a 20-degree temperature difference from Terrebonne in the north part of the County and La Pine in the south part of the County. The National Weather Service Pendleton Office monitors stations and provides public warnings on storm, snow, and cold temperature events as appropriate.

A small portion of south-western Deschutes County is in Zone 5 (High Plateau), as defined by the Climate of Oregon. This zone is bordered by the Cascades on the west and several minor mountain ranges on the south and east and comprises much of Klamath County and parts of Lake and Deschutes Counties. The Plateau receives a significant amount of snow due to high elevations and cool temperatures. Its distance from the coast, coupled with its location downwind of the Cascades causes a lower annual precipitation than the mountainous areas surrounding it.[54]

The majority of Deschutes County is in South Central Zone 7. This zone is the largest of the Oregon climatic divisions, is a vast area of high desert prairie punctuated by several

[51] Oregon Climate Service, "Climate of Deschutes County,"
[52] Oregon State Natural Hazards Mitigation Plan "Winter Storms Chapter", 2020
[53] Ibid.
[54] https://digitalcollections.library.oregon.gov/nodes/view/291187

mountain ranges and isolated peaks and is predominantly livestock country. In addition to beef cattle, there are large numbers of sheep, dairy herds, horses, and swine. There are large amounts of land under irrigation as well, particularly in Crook, Deschutes, Jefferson, and Klamath Counties. Among the major field crops grown are potatoes, alfalfa and other hay crops, mint, wheat, oats, barley, and onions. In the remaining counties comprising this zone (Grant, Harney, and Lake), irrigated acreage is much smaller; grazing lands and dry land farming dominate.

Updated NOAA 1991–2020 U.S. Climate Normals, as shown in Table 3-9, indicate that Deschutes County generally has low annual precipitation at lower elevations, with markedly wetter and snowier conditions at higher elevations. Lower-elevation stations such as Redmond Airport, Bend, Barnes Station, and Sisters record about 8 to 15 inches of annual precipitation, while higher-elevation and Cascade-influenced locations such as Sunriver, Wickiup Dam, Odell Lake-East, Three Creeks Meadow SNOTEL, Irish Taylor SNOTEL, and Hogg Pass SNOTEL receive substantially greater totals, ranging from about 19 inches to more than 77 inches annually. Available snowfall normals, as shown in Table 3-8 also show strong elevation-based differences, from less than 10 inches annually at Prineville and about 22 to 31 inches at Bend and Barnes Station, to nearly 74 inches at Wickiup Dam and more than 190 inches at Odell Lake-East. This pattern demonstrates that the severity and extent of winter storm impacts in Deschutes County are closely tied to elevation and geography, with the most significant snow and winter weather hazards concentrated in higher-elevation and western portions of the County.

Table 3-8 Total Snowfall Normal (Inches)[55]

Weather Station	Total Snowfall (Inches)												
	J	A	S	O	N	D	J	F	M	A	M	J	Annual
Prineville	0	0	0	0	1.1	1.5	1.8	3.2	0.9	0.3	0	0	8.8
Bend	0	0	0	0.2	2	5.3	6.4	5.5	1.5	0.7	0	0	21.6
Barnes Station	0	0	0	0.6	4.5	9.6	5.9	6.2	2.3	1.2	0.2	0	30.5
Keno	0	0	0	0.3	6.6	14.7	12.1	10.6	5.8	1.9	0.2	0	52.2
Lakeview 2 NNW	0	0	0	0.8	8.2	10.3	12.5	10.8	5.3	5.7	1.6	0.1	55.3
Wickiup Dam	0	0	0	0.8	8.9	20.7	17.9	14.9	8.4	2	0.3	0	73.9
Odell Lake – East	0	0	0	0.4	22.7	60.4	48.8	28.6	22	6.5	1	0.1	190.5

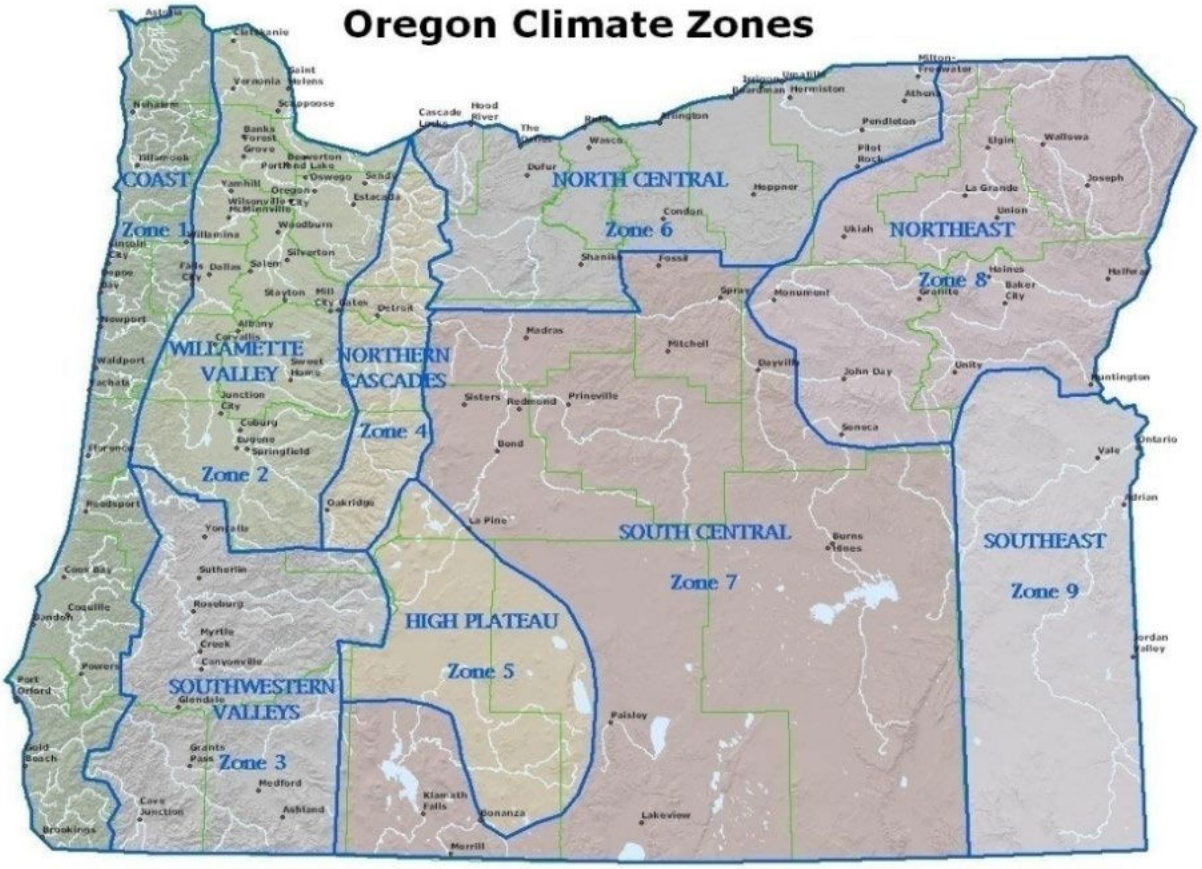
Table 3-9 Total Precipitation Normal (Inches)[56]

Weather Station	Total Snowfall (Inches)												
	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Redmond Airport	0.98	0.66	0.58	0.71	1.2	0.64	0.4	0.46	0.37	0.68	0.81	0.97	8.46
Prineville	1.06	0.8	0.91	0.76	1.38	0.85	0.4	0.36	0.31	0.95	1.22	1.33	10.33
Riley 10 WSW	1.03	1.04	0.96	1.03	1.27	0.88	0.42	0.22	0.4	0.79	1.02	1.35	10.41
Bend	1.41	0.99	0.7	0.79	0.97	0.68	0.44	0.35	0.31	0.65	1.26	2.07	10.62
Barnes Station	1.52	1.04	1.06	1.1	1.44	0.94	0.49	0.44	0.43	0.91	1.31	1.78	12.46
Lakeview 2 NNW	1.88	1.6	1.38	1.54	1.37	0.83	0.32	0.19	0.62	0.96	1.66	2.07	14.42
Sisters	1.74	1.36	1.31	0.77	1.53	1.01	0.55	0.6	0.54	1.09	2.17	2.53	15.2
Keno	2.88	1.96	1.84	1.64	1.32	0.69	0.31	0.43	0.5	1.29	2.44	3.59	18.89
Sunriver	2.86	1.91	1.54	1.16	1.71	1.09	0.52	1.55	0.75	1.44	2.43	3.16	19.12
Wickiup Dam	2.97	2.04	1.72	1.25	1.32	0.9	0.45	0.59	0.61	1.45	2.6	3.62	19.52
Odell Lake – East	5.73	4.7	3.34	1.91	1.84	1.02	0.52	0.45	0.96	2.62	4.69	6.05	33.83
Three Creeks Meadow*	6.76	4.8	4.63	3.02	2.28	1.05	0.55	0.68	1.1	3.24	6.08	7.94	42.13
Irish Taylor*	9.81	7.08	7.71	6.05	4.19	2.68	0.67	0.78	2.06	5.06	9.67	11.36	67.12
Hogg Pass*	11.96	7.96	8.93	6.59	4.62	2.84	0.68	0.63	2.6	6.41	11.26	12.7	77.18

*SNOTEL

[55] COOP and SNOTEL, using the latest normal (19991-2020 U.S. Climate Normals
[56] Ibid.

Figure 3-14 Oregon Climate Divisions[57]



The principal types of winter storms that occur in Deschutes County include:

Snowstorm

Snowstorms require three ingredients: cold air, moisture, and an upper or lower-level storm system. The result is snow; small ice particles that fall from the sky. In Oregon, the further inland and north one moves, or the higher in elevation, the more snowfall can be expected. Blizzards are included in this category.

Ice Storms

Ice storms are a type of winter storm that forms when a layer of warm air is sandwiched by two layers of cold air. Frozen precipitation melts when it hits the warm layer and refreezes when hitting the cold layer below the inversion. Ice storms can include sleet (when rain refreezes before hitting the ground) or freezing rain (when rain freezes once hitting the ground).

[57] file:///C:/Users/kstahley/Downloads/SR_no._919_OCR.pdf The Climate of Oregon Climate Zone Seven South Central Area.

Extreme Cold

Low temperatures accompany many winter storms. This can be particularly dangerous because snow and ice storms can cause power outages, leaving many people without adequate heating.

Hazard History

Destructive storms producing heavy snow, ice and cold temperatures occurred throughout the County's history, most notably in 1916, 1920, 1937, 1950, 1985, 1986, 1988, 1990, 1992-93 and the winter of 1998-99. More recently, the winters of 2010-11, 2013-14, 2016-17, and 2019 were especially active with numerous winter storm occurrences. All these active storm years were marked by drifting snow and cold temperatures. Records also indicate people and communities were generally prepared and equipped to cope with the extreme weather conditions.

The severe winter storm of 1950 impacted the entire state of Oregon. While many places experienced high winds, cold weather, and snow, the impact in Deschutes County was high snowfall and drifts. Transportation of supplies imported to the Deschutes Basin was limited.[58] The most significant storms that affected Deschutes County and neighboring counties are listed below.

[58] Taylor, George H. and Hannan, Chris, The Oregon Weather Book, (1999) Oregon State University Press.

Table 3-10 Significant Winter Storm History for Deschutes and Nearby Counties[59]

Date	Location	Event	Comments
December 22, 1861	Pacific Northwest	Snowstorm Cold Weather	Very snowy winter: temperatures ranged from 0°F to -30°F. Over ten thousand cattle in eastern Oregon and Washington starved to death. Storm produced between 1 and 3 feet of snow.
February 1933	All of Oregon	Cold Weather	Coldest February to date for eastern Oregon. Seneca and Ukiah reached -54°F, the record low for Oregon.
January 25-30, 1969	Entire State	Snowstorm	Heavy snow throughout the state.
January 9-11, 1980	Entire State	Snowstorm	Series of strong storms across state. Many injuries and power outages.
February 1986	Central/Eastern Oregon	Snowstorm	Heavy snow, traffic accidents, broken power lines.
February 11-16, 1990	Entire State	Snowstorm Strong Winds	Heavy snow throughout the state.
November 1993	Cascade Mountains	Snowstorm	Heavy snow throughout the region.
Winter 1998-1999	Entire State	Snowstorm	One of the snowiest winters in Oregon history (snowfall at Crater Lake ~49 feet).
January 10, 2000	Central Oregon	Heavy Snow	11 inches of new snow fell in La Pine at an elevation of 4,200 feet.
May 6, 2002	Central Oregon	Extreme Cold Wind Chill	Area low temperatures dipped into the mid-teens and 20s across central and north central Oregon.
October 30-31, 2002	Central Oregon	Extreme Cold Wind Chill	An arctic front moved through the region. Many locations broke records for the month of October.
January 4-5, 2004	Central Oregon	Cold Wind Chill	An arctic air mass moved south setting daily record low temperatures for January 5.
November 21-24, 2010	Central Oregon	Heavy Snow	A powerful arctic front brought widespread heavy snow to much of Central Oregon. Snow totals ranged from 7 to 10+

[59] Oregon Weather Book, NOAA Storm Events Database, http://www.ncdc.noaa.gov/stormevents/, Accessed April 30, 2021.

		Cold Temperatures	inches in many areas including Bend and La Pine. In the wake of the heavy snow, bitter cold settled in with sub-zero low temperatures on November 24.
November 12-24, 2014	Northern and Central Oregon	Ice Heavy Snow	A warm frontal system and abundant moisture interacted with a shallow Arctic airmass, bringing a mixed mode of freezing rain and snow. Freezing rain eventually transitioned to heavy snow with hefty accumulations in many areas. Ice accumulations ranged from 0.5 to 1 inch, with nearly an inch observed in Bend. Snow totals included 20 inches near Redmond and 21 inches in Sisters.
January 3-4, 2017	Central Oregon	Heavy Snow	A strong winter storm system brought bouts of heavy snow to much of central and east-central Oregon.
February 23-25, 2019	Northern and Central Oregon	Heavy Snow	A prolonged period of winter weather occurred as a moist southwesterly flow continued to bring moisture into an unseasonably frigid airmass east of the Cascades. This resulted in multi-day snow totals of 1 to 3 feet in some areas including Sisters (40 inches), Bend (33 inches), and Redmond (30 inches). The heavy snow resulted in at least a few roof failures in the Bend area.
November 26-27, 2019	Central Oregon	Heavy Snow	An early season winter storm brought snow totals of 6 to 10 inches in many areas of Central Oregon.
February 12-16, 2021	Northern and Central Oregon	Heavy Snow	Several storm systems moved into the Inland Northwest in the wake of an unusually cold Arctic intrusion. This resulted in several rounds of moderate to heavy snow across much of northern, central, and eastern Oregon. Heavy snow fell in many areas with total accumulations between 10 and 24 inches.

Future Conditions

The significant increase in population and growth in tourism as a local industry brought challenges to the region in recent years. Both shifts brought new populations to the area, particularly those with little or no experience living and working in severe weather conditions. This condition impacts shelter, access to medical services, transportation, utilities, fuel sources, and telecommunication systems. In severe winter storm conditions, travelers must seek accommodations, sometimes in communities where lodging is limited or overextended. A significant number of supplies, including food and fuel, are transported into the Deschutes Basin in severe weather conditions. These necessities are often limited when road conditions are unfavorable. Likewise, unfavorable road conditions make emergency response operations more difficult, which disproportionately impacts people who may already be vulnerable.

Recent shifts in climate patterns beginning in the 1960's have resulted in snowfall and cold weather shifts. While there have been record snowfalls, they are less frequent. The number of severe cold days has been fewer and less frequent. Fluctuating temperatures within storm events also creates the likelihood of ice dams, which can result in an increased flood threat as snows melt.

The recurrence interval for significant winter storms throughout Oregon is about every 13 years; however, there can be many localized storms between these periods. Winter storms do occur in eastern Oregon regularly from November through February. Deschutes County experiences winter storms nearly every year.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a winter storm event is "high,"** meaning one incident is likely within the next 10–35-year period. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[60]

Vulnerability Assessment

In Deschutes County, extreme cold and heavy snow can disrupt farming practices. Likewise, schools have trouble heating their buildings. The constant freezing and melting of snow around manholes often lead to potholes, and power outages can be frequent in adverse weather. Finally, extreme cold can cause breaks in water pipelines when temperatures drop below 10° F. Specific estimates of property and infrastructure damage for winter storm events are not readily available.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County **as having a "high" vulnerability to winter storm hazard**s; meaning that more than 10% of the region's population or assets would be affected by a major emergency or disaster.

[60] 2020 Oregon Natural Hazard Mitigation Plan. Department of Land Conservation and Development, 2020.

Based upon available information the Oregon NHMPs Regional Risk Assessment supports this vulnerability rating for Deschutes County.[61]

Risk Assessment

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2-6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a particular hazard. Based on the matrix, the **winter storm hazard is rated #1 out of 10 rated hazards, with a total score of 240.**

Flood Hazard

Location and Extent

Flooding results when rain and snowmelt create water flow that exceeds the carrying capacity of rivers, streams, channels, ditches, and other watercourses. In Oregon, flooding is most common from October through April when storms from the Pacific Ocean bring intense rainfall. Most of Oregon's destructive natural disasters were flood related.[62] Flooding can be exacerbated when rain is accompanied by snowmelt and frozen ground. The spring cycle of melting snow is the most common source of flood in the region.

Anticipating and planning for flood events is an important activity for Deschutes County. Federal programs provide insurance and funding to communities engaging in flood hazard mitigation. The Federal Emergency Management Association (FEMA) manages the National Flood Insurance Program (NFIP) and the Hazard Mitigation Grant Program (HMGP). The NFIP provides flood insurance and pays claims to policyholders who have suffered losses from floods. The HMGP provides grants to help mitigate flood hazards by elevating structures or relocating or removing them from flood hazard areas. These programs provide grant money to owners of properties who have suffered losses from floods, and in some cases, suffered losses from other natural hazard events.

Flood Sources

The principal flood sources in Deschutes County include the Deschutes River, Little Deschutes River, Paulina Creek, and Whychus Creek.[63]

Flood Types

The principal types of floods that occur in Deschutes County include:

- Rain-on-Snow Flooding

[61] Ibid.
[62] Taylor, George H. and Chris Hannan. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press. 1999
[63] FEMA, Deschutes County Flood Insurance Study, revised September 28, 2007.

- Spring/Snowmelt Flooding
- Ice Jams/Frazil Ice
- Flash Flooding
- Dam Failure

The most commonly occurring of these potential flooding events in Deschutes County is a rain-on-snow event.[64]

Hazard History

Generally, river flooding has not historically been a serious problem in Deschutes County. This is mostly due to the porous nature of irrigation diversion canals, the underlying volcanic rock that has a large capacity for water storage, and reservoir retention. Consequently, the discharge rate for the Deschutes River is very low considering the size of its basins. Regular flooding events have occurred, however, near the headwaters of Tumalo Creek and in the Tumalo community. Along Whychus Creek, the city of Sisters frequently experiences flooding, with the most significant event occurring in 1964 and the most recent event occurred in December 2025.

In December 2025, a winter storm caused rapid rises on Whychus Creek near Sisters, prompting local flood notifications and preparedness measures. The City of Sisters warned of localized flooding potential associated with rainfall, saturated soils, and runoff from upstream snow-covered areas. Deschutes County Sheriff's Office Search and Rescue was deployed to assist community members with sandbagging. There was no reported damage due to the flooding, but the incident illustrates that winter rain and rain-on-snow conditions can produce short-notice creek flooding concerns in the Sisters-area even when impacts are localized.

The flood season on the Deschutes River extends from November through July (larger floods downstream of the Little Deschutes River typically occur in November and December). The flood of record on the Deschutes River upstream of the Little Deschutes River occurred on July 30, 1956 (discharge of 2,280 cfs, approximately a 40-year event); the flood of record on the Deschutes River downstream of the Little Deschutes River occurred on November 27, 1909 (discharge of 5,000 cfs at Benham Falls stream gage). The largest flood since 1958 occurred downstream of the Little Deschutes River in December 1964 (discharge of 3,470 cfs at Benham Falls stream gage, approximately a 175-year event).

The flood season on the Little Deschutes River extends from October through June with most occurrences between April and June. Generally, there are more days above bankfull stage during the spring (during spring snowmelt floods) than winter. The flood of record occurred in December 1964 (discharge of 3,660 cfs at RM 28.1 north of La Pine, greater than a 500-year event). There are ten bridges within the FIS study area for the Little

[64] Ibid.

Deschutes River, of those only the Ranch Bridge (RM 15.1) may be over topped by the 1-percent-annual-chance flood (100-year flood event); however the Vandervert Ranch Bridge (RM 3.1), Lazy River South Ranch Bridge (RM 16.6), Stearns Ranch Bridge (RM 28.1), and the Masten Bridge (RM 39.9) and their approaches may also be over topped by the 0.2-percent-annual-chance flood (500-year flood event).

The flood season on Whychus Creek extends from November through April (larger events generally occur in November and December). The flood of record occurred on December 25, 1980 (discharge of 2,000 CFS at RM 26.6, approximately an 80-year event). Debris deposition on agricultural land damaging irrigation diversion works, bank erosion, and property damage in Sisters are the principal flood concerns. There are 12 bridges within the FIS study area for Whychus Creek, of those only the Ranch Bridge (RM 16.3) and the Elm Street Bridge (RM 21.8 in Sisters) may be over topped by the 1-percent-annual-chance flood (100-year flood event); however the ranch bridges at RM 19.3 and RM 19.4 and their approaches may also be over topped by the 0.2-percent-annual-chance flood (500-year flood event).

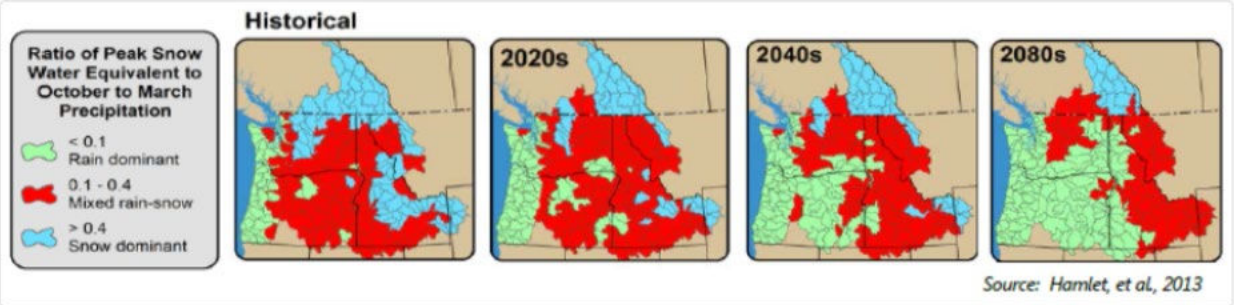
The Whychus Creek stream corridor is particularly vulnerable to obstructions to flood flows due to unconsolidated volcanic deposits that make up the streambed and banks that are prone to erosion. This concern is exacerbated in areas that are at, or below, the elevation of the streambank (see Sisters Addendum for more information). In addition, there is the potential for the moraine dam at Carver Lake to fail during an earthquake, volcanic event, or avalanche/landslide (the lake contains approximately 740-acre feet of water). There have been three observed failures of the dam in the recent past.

Future Conditions

Different from temperature, there is great uncertainty in the effects of future climate variability on precipitation in Oregon. In general, rainfall producing storms should become more extreme, but occur less frequently. With increased winter temperatures there has been less snowpack overall, and this trend is expected to continue. This may mean that there will be more intense short duration storms, but possibly less likely long duration storms in Central Oregon (localized flooding may increase, large river flooding may decrease).

Figure 3-15 [65]

[65] https://www.oregon.gov/owrd/programs/climate/pages/default.aspx#:~:text=Increased%20air%20temperatures%2C%20changing%20precipitation,users%20adapt%20to%20climate%20change.



Extreme precipitation will bring an increase in the frequency and intensity of floods due to stronger storms and the shift from snowfall to rainfall during warmer winters. An increase in flooding leads to greater exposure to waterborne and vector-borne diseases. OWRD is currently funding two studies looking at extreme precipitation in Oregon, and how that has been or might be affected by future climate variability. Preliminary results indicate that the existing methods used to calculate probable maximum precipitation do not reflect meteorological processes and orographic conditions in Oregon. The results of this study should be completed in 2026. Prior to the OWRD study there had been no observation of non-stationarity (change in extreme precipitation) apparent in Oregon.

USGS scientists and US Army Corps of Engineers studies indicate the county is at a low level of risk for catastrophic flooding. Potentially, the Little Deschutes and Whychus Creek are most vulnerable; however greater risks are related to future volcanic eruptions (see Volcano section for additional information).

The Federal Emergency Management Agency (FEMA) has mapped the 10, 50, 100, and 500-year floodplains in the Region 6 counties of Oregon. This corresponds to a 10%, 2%, 1% and 0.2% chance of a certain magnitude flood in any given year. In addition, FEMA has mapped the 100-year floodplain (i.e., 1% flood) in the incorporated cities. The 100-year flood is the benchmark upon which the National Flood Insurance Program (NFIP) is based.

As such, Deschutes County's Natural Hazards Mitigation Steering Committee believes the County's **probability of experiencing a flood is "high,"** meaning one incident is likely within the next 10-35 year period. Oregon's NHMP Regional Risk Assessment rates Deschutes County's probability of flood as low.[66]

[66] *2020 Oregon Natural Hazard Mitigation Plan*. Department of Land Conservation and Development, 2020.

High Hazard Potential Dams

Failure of dams usually results in flooding more severe than other types of floods, as they store and release months to years' worth of water at a given time. Failures of dams can be catastrophic if there are people in the area.

Due to this risk, there are state and federally managed dam safety programs. The Oregon Water Resources Department (OWRD) is the state authority for dam safety with specific authorizing laws and implementing regulations for dams. Oregon's dam safety laws were rewritten in 2019. This law and new regulations both became operative on July 1, 2020.

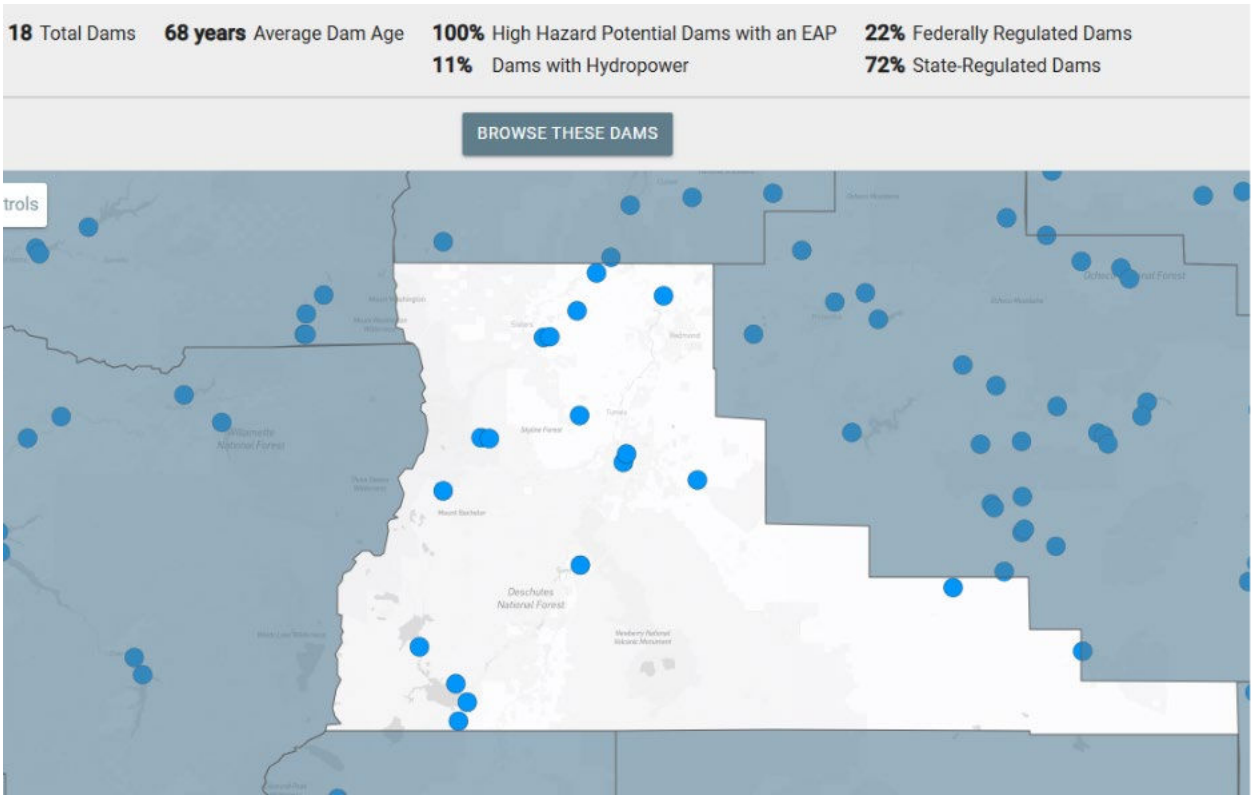
OWRD coordinates on but does not directly regulate the safety of dams owned by the Federal government or most dams used to generate hydropower. In coordination with the Oregon Department of Emergency Management, OWRD is the Oregon Emergency Response System contact in the event of a major dam emergency. Oregon's statutory size threshold for dams to be regulated by OWRD is at least 10 feet high and storing at least 3 million gallons. Oregon's new dam safety laws were developed considering the joint Association of State Dam Safety Officials and FEMA's Model State Dam Safety Program. Oregon uses the three recommended hazard ratings, High, Significant, and Low, and requires Emergency Action Plans for dams rated high hazard.

Location and Extent

While relatively uncommon, dam failures have occurred in many parts of Oregon. The OWRD Dam Safety Program recorded at least 55 dam failures in the State. Many of these failures had very little or no impact on people, structures, or properties. However, 21 dam failures had more serious to tragic effects.

Figure 3-16 Dams of Deschutes County Oregon[67]

[67] https://nid.sec.usace.army.mil/nid/#/



State Regulated Dams

Oregon regulates non-Federally owned dams, including dams on Federal lands with a non-Federal water right. The two State regulated dams currently rated as high hazard are shown below in Table 3-16.

Table 3-11 State Regulated Dams Located in Deschutes County[68]

Dam Name	Dam Height	Normal Storage	Max Storage	River	Hazard
Mckenzie Canyon Dam	18	89	89	Squaw Creek	Significant
Fehrenbacker Reservoir 2	16	350	350	Dry River	Low
Upper Tumalo Reservoir	11	1100	1100	Tumalo Creek	Low
Squaw Creek ID Reservoir	18	500	600	Squaw Creek	Low
Cyrus Reservoir	17	113	80	Squaw Creek	Low
North Canal Diversion	**33**	**30**	**40**	**Deschutes River**	**High**

[68] https://apps.wrd.state.or.us/apps/misc/dam_inventory/

Bend Hydro (Mirror Pond)	16	100	100	Deschutes River	Hight
Redmond Sewage Pond (Lagoon)	19	286	286	City Sewage Effluent	Low
Sunriver Effluent Lagoon	**30**	**202.4**	**244**	**Off Channel**	**High**
Bradetich Reservoir	11	83.5	0		Low
Eagle Crest	16	23	23		Low
Sparks	19	35	55		Significant

Federal Owned and Regulated Dams

Federal dams are not eligible for HHPD funding. Information on these dams can be obtained directly from the Federal owners. The County coordinated on Emergency Action Plan exercises for the two high hazard Federal dams in Deschutes County, showed in Table 3-17. The dam safety authority and operator for the two Federal dams in Deschutes County is the Bureau of Reclamation.

Table 3-12 Deschutes County Federally Owned Dams[69]

Dam Name	NID ID	State Regulated Dam	Federally Regulated Dam	Federal Agency Involvement Regulatory	Hazard Potential Classification	EAP Prepared
Wickiup Dam	OR00276	No	Yes	Bureau of Reclamation	High	Yes
Wickiup South Dike	OR00276	No	Yes	Bureau of Reclamation	Low	Yes
Wickiup East Dike	OR00276	No	Yes	Bureau of Reclamation	High	Yes
Crane Prairie Dam	OR00279	No	Yes	Bureau of Reclamation	High	Yes

NID = National Dam Inventory
EAP = Emergency Action Plan

[69] https://nid.sec.usace.army.mil/nid/#/dams/search/sy=@countyState:Deschutes,%20Oregon&viewType=detail&resultsType=Dam%20Details&advanced=false&hideList=false&eventSystem=false

HHPD Risk Assessment

With risk assessment now an important dam safety function, Oregon dam safety staff developed and implemented an assessment protocol for use on State regulated dams to support FEMA grant processes. Seventeen high hazard dams with known or suspected major safety deficiencies were assessed – none located in Deschutes County.

The assessments included quantitative evaluation of events associated with failures, loadings in those events, and loss of life from catastrophic failure. Events assessed in this project include flood, high water earthquake, and landslides above the reservoir or dam. Existing file information was comprehensively reviewed during this project, with special inspection elements based on information and gaps in the dam safety program files for those dams. The product is a consistent procedure and includes a rating of confidence in the information. Results are calculated in terms of expected loss of life on an annualized basis. Much more detail on the risk assessment can be found in Report EMW-2019-GR-0029, which is available from the Oregon dam safety program.

All state regulated dams are routinely inspected by the Oregon Department of Water Resources, Dam Safety Program. The Sunriver Effluent Dam and North Canal Dam were inspected in 2025. Neither of them is in poor condition and they pose no significant risk to life and infrastructure.

[70],[71] *are citations for the first and third paragraphs of HHPD Risk Assessment, respectively.*

National Flood Insurance Program (NFIP)

The Deschutes County Flood Insurance Rate Maps (FIRMs) were modernized in September 2007. The table below shows that as of January 2021, Deschutes County (including the incorporated cities) has 267 National Flood Insurance Program (NFIP) policies (90 of these are for properties developed before the initial FIRM) in force and eight total paid claims. The first Community Assistance Visit (CAV) for Deschutes County was on July 22, 1994 (the most recent CAV was in Sisters on April 26, 2004). The County and cities are not members of the Community Rating System (CRS). The table displays the number of policies by building type and shows most residential structures with flood insurance policies are single-family homes with only 14 non-residential structures with flood insurance policies. According to data from 2021, the proportion of single-family homes (excluding condominiums) within the mapped special flood hazard area (SFHA, floodplain) that have flood insurance (the market penetration rate) for Deschutes County is 12.7%.

The Community Repetitive Loss record for Deschutes County, Bend, La Pine, Redmond, and Sisters identifies zero repetitive loss buildings, zero severe repetitive loss buildings, and zero total repetitive loss claims.

[70] https://olis.oregonlegislature.gov/liz/2019I1/Downloads/CommitteeMeetingDocument/209060
[71] https://apps.wrd.state.or.us/apps/misc/dam_inventory/

At the time of this update, no finalized nationwide National Flood Insurance Program (NFIP) change was identified that would require substantial revision to this subsection. However, FEMA's ongoing Oregon NFIP/Endangered Species Act (ESA) integration process remains relevant to future floodplain management in the state. Interim compliance measures took effect on December 1, 2024, and FEMA released an updated Draft Implementation Plan and Draft Environmental Impact Statement (EIS) in late 2025. If finalized, this process could introduce additional floodplain development and mitigation standards in Oregon, including potential "no net loss" expectations for mapped floodplain areas. As of this plan update, FEMA's process remains pending completion of a Final EIS and Record of Decision, so this is best characterized as a regulatory development to monitor rather than a finalized program change requiring local plan or ordinance revision.

Table 3-13 Flood Insurance Detail[72]

Jurisdiction	Current FIRM Date	Initial FIRM Date	Total Policies	Pre-FIRM Policies	Policies by Building Type				Minus Rated A Zone
					Single Family	2-4 Family	Other Residential	Non-Residential	
Deschutes	-	-	218	90	208	3	1	1	14
County*	9/28/2007	9/29/1986	126	66	126	0	0	0	11
Bend	9/28/2007	9/4/1987	60	21	50	3	1	1	1
La Pine	9/28/2007	9/28/2007	1	1	1	0	0	0	0
Redmond	9/28/2007	9/28/2007	0	0	0	0	0	0	0
Sisters	9/28/2007	9/29/1986	31	2	31	0	0	0	2

*Portion of entire County under County jurisdiction.

Jurisdiction	Insurance In Force	Total Paid Claims	Pre-FIRM Claims Paid	Substantial Damage Claims	Repetitive Loss Buildings	Severe Repetitive Loss Buildings	Total Paid Amount	CRS Class Rating	Last CAV
Deschutes	$67,891,200	8	5	0	1	0	$65,507	-	-
County*	$36,129,300	3	1	0	1	0	$15,115	NP	7/22/1994
Bend	$21,792,700	5	4	0	0	0	$50,392	NP	7/20/1994
La Pine	$280,000	0	0	0	0	0	$0	NP	N/A
Redmond	$0	0	0	0	0	0	$0	NP	N/A
Sisters	$9,689,200	0	0	0	0	0	$0	NP	4/26/2004

*Portion of entire County under County jurisdiction.
NP = Not Participating
N/A = Information Unavailable/Not Applicable

[72] Information compiled by FEMA, January 2021

Vulnerability Assessment

Growth rates described in the Community Profile section of this Plan project a continued growth pattern that will place additional development, business, and human life at risk.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"low" vulnerability to the flood hazard,** meaning less than 1% of the region's population or assets would be affected by a major emergency or disaster. Based upon available information, the Oregon NHMPs Regional Risk Assessment rates Deschutes County's vulnerability to flood as very low.[73]

Sisters is vulnerable to economic loss in the event of road closures. Locally high velocities, damming, erosion, and sediment deposit could cause considerable property damage and possible loss of life. Flooding across roadways could prove to be especially dangerous and damaging.[74]

Risk Assessment

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2-6 of the Risk Assessment (Volume I, Section 2) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a particular hazard. Based on the matrix the **flood hazard is rated #8 out of 10 rated hazards, with a total score of 111.**

Landslide Hazard

Location and Extent

Landslides are a major geologic threat in almost every state in the United States. In Oregon, a significant number of locations are at risk from dangerous landslides and debris flows. While not all landslides result in property damage, many landslides do pose serious risk to people and property. Increasing population in Oregon and the resultant growth in home ownership has caused the siting of more development in or near landslide areas. Often these areas are highly desirable to prospective homeowners owing to their location along the coast, rivers and on hillsides.

Landslides are common, naturally occurring events in various parts of Oregon. In simplest terms, a landslide is any detached mass of soil, rock, or debris that falls, slides or flows down a slope or a stream channel. Landslides are classified according to the type and rate of movement and the type of materials that are transported.

[73] Ibid.
[74] USGS Open File Report 87-41, *Hydrologic Hazards Along Whychus Creek From a Hypothetical Failure of the Glacial Moraine Impounding Carver Lake Near Sisters, Oregon*

In a landslide, two forces are at work: 1) the driving forces that cause the material to move down slope, and 2) the friction forces and strength of materials that act to retard the movement and stabilize the slope. When the driving forces exceed the resisting forces, a landslide occurs.

Landslides can be grouped as “on-site” and “off-site” hazards. An “on-site” slide is one that occurs on or near a development site and is usually relatively slow moving. Slow moving slides cause the most property damage in developed areas. On-site landslide hazards include features called slumps, earthflows and block slides. “Off-site” slides typically are rapidly moving and begin on steep slopes at a distance from homes and development. A 1996 “off-site” slide in southern Oregon began a long distance away from homes and roads, traveled at a high velocity and resulted in five fatalities and a number of injuries, in addition to substantial property damage.

Landslides are classified based on causal factors and conditions and exist in three basic categories: Falls, Slides, and Flows. Falls move rock and soil that detaches from a steep slope or cliff and falls through the air and/or bounces or rolls down the slope. Slides exist where the slide material moves in contact with the underlying surface. Last, flows are characterized as plastic or liquid in nature where the slide material breaks up and flows during movement.

Rapidly moving flow landslides are often referred to as debris flows. Other terms given to debris flows are mudslides, mudflows, or debris avalanches. Debris flows frequently take place during or following an intense rainfall event on previously saturated soil. Debris flows usually start on steep hillsides as slumps or slides that liquefy, accelerate to speeds as high as 35 miles per hour or more, and travel down slopes and channels onto gentle sloping or flat ground. Most slopes steeper than 70 percent are at risk for debris flows.

The consistency of a debris flow ranges from watery mud to thick, rocky, mud-like, wet cement which is dense enough to carry boulders, trees and cars. Separate debris flows from different starting points sometimes combine in canyons and channels where their destructive energy is greatly increased. Debris flows are difficult for people to outrun or escape from and present the greatest risk to human life. Debris flows have caused the most damage in rural areas and were responsible for most of the landslide-related deaths and injuries during the 1996 storms in Oregon.

Conditions Affecting Landslides

Natural conditions and human activities can both play a role in causing landslides. Certain geologic formations are more susceptible to landslides than others. Locations with steep slopes are at the greatest risk of slides. However, the incidence of landslides and their impact on people and property can be accelerated by development. Developers who are

uninformed about geologic conditions and processes may create conditions that can increase the risk of or even trigger landslides.

There are four principal factors that affect or increase the likelihood of landslides:

1. Natural conditions and processes including the geology of the site, rainfall, wave and water action, and seismic tremors-including earthquakes and volcanic activity.
2. Excavation and grading on sloping ground for homes, roads, and other structures.
3. Drainage and groundwater alterations that are natural or human-caused. Human activities that cause slides include broken or leaking water or sewer lines, water retention facilities, irrigation and stream alternations, ineffective storm water management, and excess runoff due to increased impervious surfaces.
4. Change or removal of vegetation on very steep slopes due to timber harvesting, land clearing, and wildfire.

Hazard History

Although most landslides occur in the undeveloped forested areas of the county, landslides may also occur in more developed areas. The fatalities and losses resulting from the 1996 statewide 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.

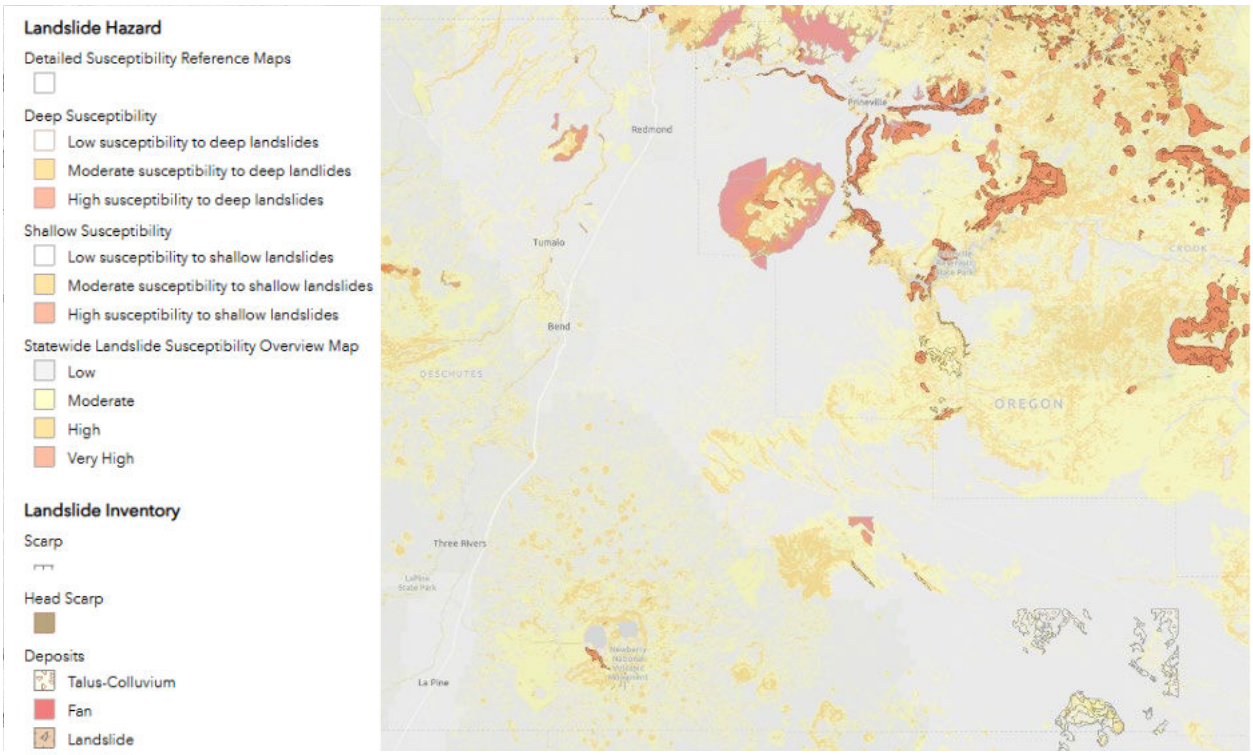
There is no history of major landslides in Deschutes County within developed areas. At times small debris falls have occurred, however, these have typically not caused major disruptions of normal activity (see figure below). In undeveloped areas the risk of landslides and avalanches is highest within the forested areas and in the Three Sisters Wilderness. There have been recorded landslides that affected the Carver Lake moraine dam and other rural areas; however, this activity has not led to major disruptions of normal activity.

DOGAMI maps the State Landslide Information Layer for Oregon (SLIDO). Figure 3-25 relies on the 2012 SLIDO data and shows Deschutes County landslides identified on published maps. The database contains only landslides located on these maps. Many landslides aren't located or on these maps, therefore they are not in the database. The database does not provide information about relative hazards. The map shows landslide events are sparse, mostly occurring in non-populated areas.[75]

Figure 3-17 Mapped Landslides and Landslide Susceptibility[76]

[75] DOGAMI. Statewide Landslide Information Database for Oregon (SLIDO-2). http://www.oregongeology.org/sub/slido/index.htm

[76] https://gis.dogami.oregon.gov/maps/hazvu/



Future Conditions

There is likely to be little change in the overall occurrence of landslides for Deschutes County in the future. Many of the mapped landslides appear to have occurred in the Pleistocene and may move but at slower rates. There should be no change for rockfall type. After a wildfire there may be some increase in shallow landsliding and subsequent debris flows (though debris flows are much more common in western and northeast Oregon than in central Oregon). Future changes in climate are expected to result in increased variability and severity of weather events, including drought and rainfall, which will increase the *chances* of wildfires and landslide activity.

Vulnerability Assessment

The probability of rapidly moving landslides occurring depends on several factors; these include steepness of slope, slope materials, local geology, vegetative cover, human activity, and water. There is a strong correlation between intense winter rainstorms and the occurrence of rapidly moving landslides (debris flows); consequently, the Oregon Department of Forestry tracks storms during the rainy season, monitors rain gages and snow melt, and issues warnings as conditions warrant. Given the correlation between precipitation / snow melt and rapidly moving landslides, it would be feasible to construct a probability curve. Many slower moving slides present in developed areas have been identified and mapped; however, the probability and timing of their movement is difficult to quantify. The installation of slope indicators or the use of more advanced measuring techniques could provide information on these slower moving slides.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"low" vulnerability to landslide hazards;** meaning less than 1% of the region's population or assets would be affected by a major emergency or disaster. Oregon NHMP's Regional Risk Assessment supports this vulnerability rating for Deschutes County ("very low").[77]

Risk Assessment

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2-6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a particular hazard. Based on the matrix the **landslide hazard is rated #10 out of 10 rated hazards with a total score of 77.**

Volcano Hazard

Location and Extent

Deschutes County lies within the "ring of fire," an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the ring of fire, generated by continental plates moving against each other. Volcanoes occur most frequently at the boundaries of these plates and volcanic eruptions occur when molten material, or magma, rises to the surface.

Active volcanic areas in the Cascades that have the most potential to impact Deschutes County and the broader region include Mt. St. Helens, Mt. Rainier, Mt. Shasta, Mt. Hood, the Three Sisters, Lassen Volcanic Center, Newberry Volcano, Mt. Baker, Glacier Peak, Crater Lake, and Long Valley Caldera. These are all ranked as "very high threat" volcanoes by the U.S. Geological Survey.[78] Due to this, Deschutes County should consider the impacts of volcano-related activity on the region.

Figure 3-18 Potentially Active Volcanoes of the Western United States[79]

[77] Ibid.
[78] Ewert, Diefenbach, and Ramsey, *2018 update to the U.S. Geological Survey national volcanic threat assessment*, Scientific Investigations Report 2018-5140. https://doi.org/10.3133/sir20185140
[79] USGS. http://www.volcano.si.edu/reports/usgs/maps.cfm#usa

Past volcanic activity in Deschutes County and throughout the Pacific Northwest created three distinct types of volcanoes or volcanic areas:

1. Stratovolcanoes are tall, cone-shaped, and often glaciated volcanoes that tend to erupt explosively. In the Western United States, they are located in Alaska, Washington, Oregon, and northing California.[80]
2. Shield volcanoes have a broad, shield shape and tend to erupt fluid lava that can travel many miles, but violent explosive eruptions are also possible. Several volcanoes with potential threat to Deschutes County are shield volcanoes, including Newberry Volcano and Mount Bachelor.[81],[82]
3. Lava fields, also called dispersed volcanic fields or distributed volcanic fields, are regions containing widely distributed clusters of tens to hundreds of volcanic vents that tend to erupt as cinder cones and lava flows that can travel many miles. Lava

[80] Ibid.
[81] Ibid.
[82] Central Cascades Volcano Coordination Plan, 2019: https://www.oregon.gov/oem/documents/central_cascades_coordination_plan.pdf

fields are found in nearly every U.S. state west of the Rocky Mountains, including Oregon.[83],[84],[85]

Figure 3-19 Volcanic Hazards from Stratovolcanoes[86]

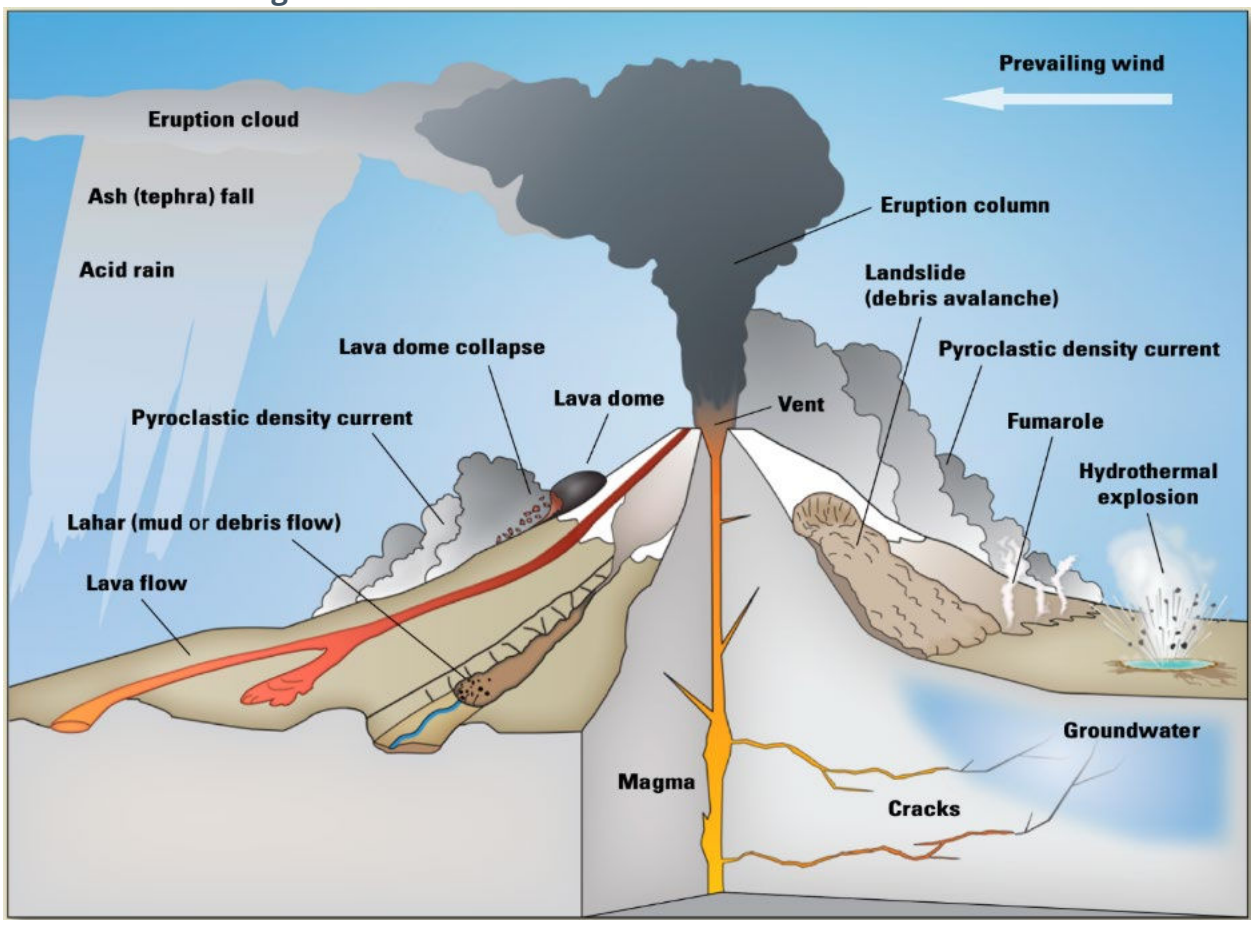


Figure 3-20 Volcanic Hazards from Shield Volcanoes and Lava Fields[87]

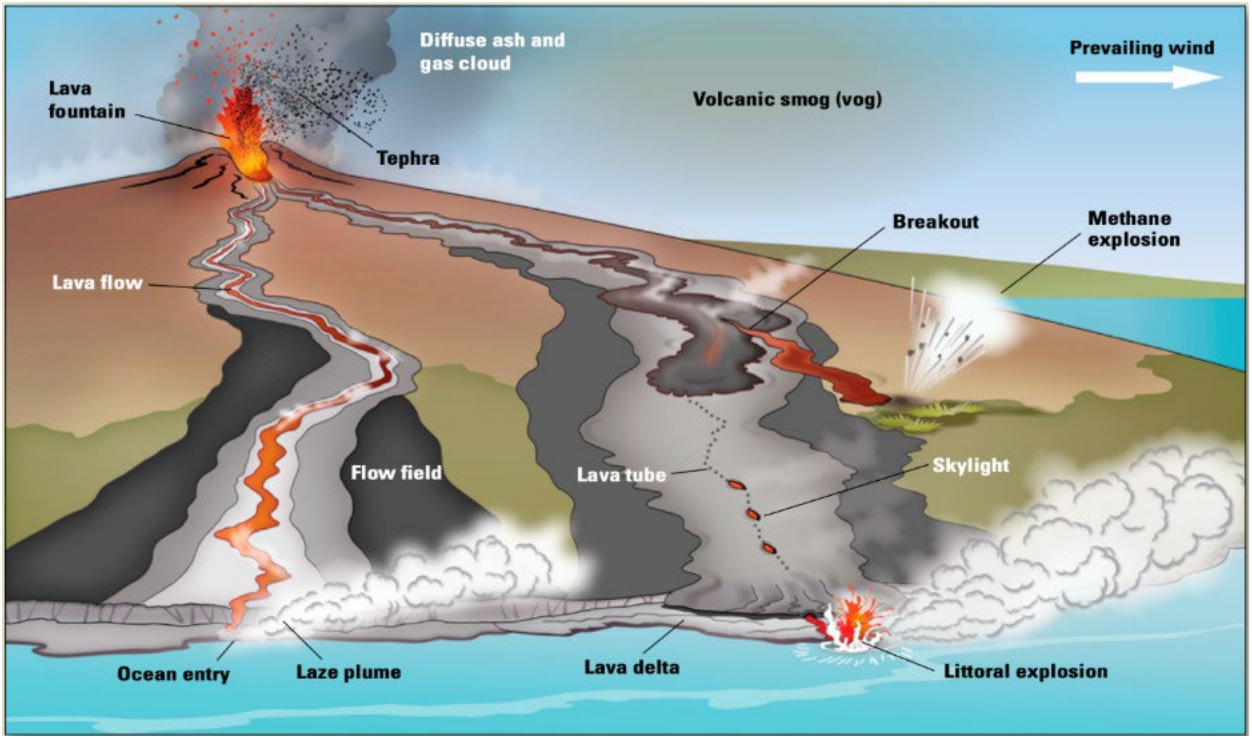
[83] Stovall, Driedger, Westby, and Foust, Living with Volcano Hazards, USGS Fact Sheet 2018-3075. https://doi.org/10.3133/fs20183075

[84] Central Cascades Volcano Coordination Plan, 2019: https://www.oregon.gov/oem/documents/central_cascades_coordination_plan.pdf

[85] Dispersed volcanic fields are found through the western U.S.: https://www.usgs.gov/observatories/yvo/dispersed-volcanic-fields-are-found-through-western-us

[86] Stovall, Driedger, Westby, and Foust, Living with Volcano Hazards, USGS Fact Sheet 2018-3075. https://doi.org/10.3133/fs20183075

[87] Stovall, Driedger, Westby, and Foust, Living with Volcano Hazards, USGS Fact Sheet 2018-3075. https://doi.org/10.3133/fs20183075



Hazard History

No eruptions occurred in Deschutes County in the past 1,000 years; however, numerous eruptions happened in the previous millennium, including several at Three Sisters and one at Newberry Volcano. The most devastating effects of these events were restricted to what is now Wilderness or largely undeveloped areas, but tephra fall from these eruptions probably deposited less than one-quarter inch to one-half inch of gritty ash in areas that are now densely populated.

Some recent events include tephra and lava from the Big Obsidian Flow eruption at Newberry Volcano, multiple eruptions of tephra and lava from South Sister, and multiple cinder cone eruptions and lava flows in the McKenzie Pass and Santiam Pass area.

All Cascade volcanoes are characterized by long periods of quiescence (inactivity) and intermittent activity. These characteristics make predictions, recurrence intervals, and probability of future eruptions very difficult to ascertain.

Figure 3-21 Eruptive and Major Debris-Flow and Flood Events in the Central Cascades of Oregon During the Past 14,000 Years[88]

[88] Ewert, Diefenbach, and Ramsey, *2018 update to the U.S. Geological Survey national volcanic threat assessment*, Scientific Investigations Report 2018-5140. https://doi.org/10.3133/sir20185140

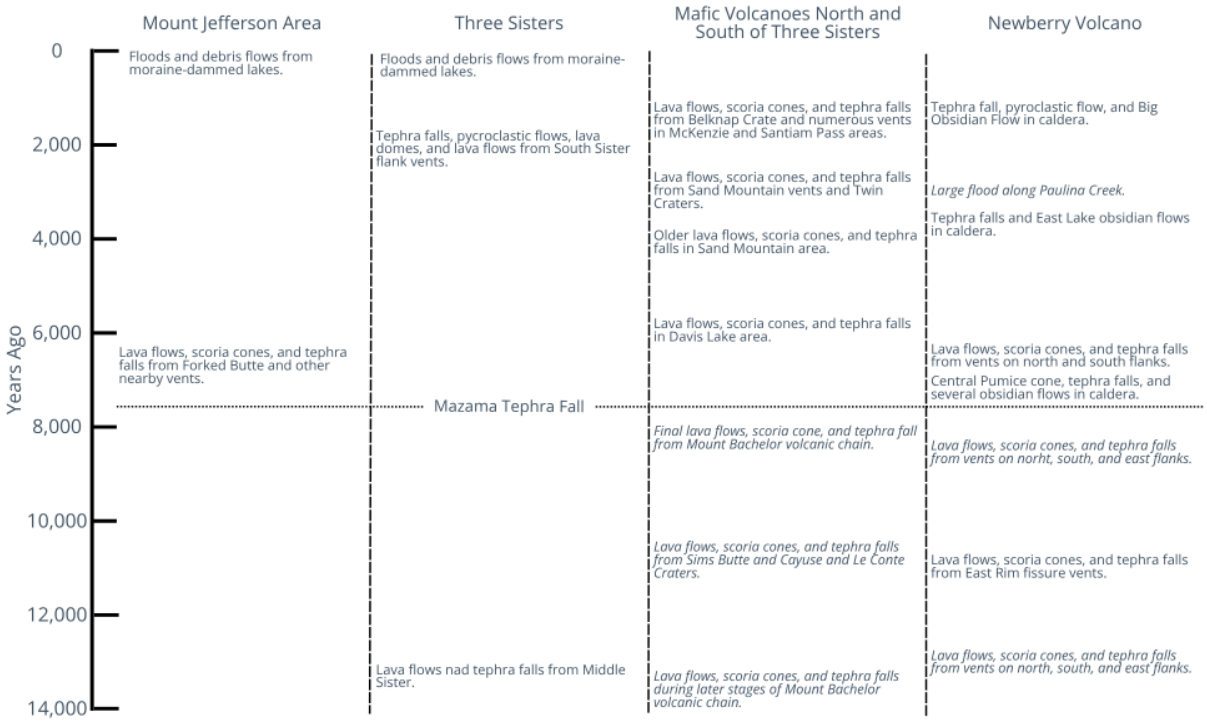


Table 3-14 Regional Volcanic History[89]

Volcano	Comment
Three Sisters	The Three Sisters are located just west of Bend. In 2001, scientists discovered a broad area of uplift west of South Sister that rises a few inches per year since the 1990s and is an indication of an active magmatic system. Uplift rates vary, with a new pulse starting in 2020-2021. Geochemistry data indicates magmatic activity in the region predates the past few decades. There is no immediate danger of a volcanic eruption or other hazardous activity. However any renewed activity has the potential to become dangerous to surrounding communities.
Newberry Volcano	Newberry Volcano is located east of the Cascade Range and about 20 miles south of Bend. It is about 400,000 years old and has erupted thousands of times from the summit caldera and on the flanks of the volcano. The most recent eruption was 1,300 years ago. Future eruptions are likely to include lava flows, lava domes, pyroclastic flows, lahars, and ashfall. Most effects would be felt within, or up to a few miles beyond, the existing caldera. Lava flows could impact areas tens of miles from the eruptive center and

[89] https://www.usgs.gov/volcanoes/three-sisters/science/modern-deformation-and-uplift-sisters-region

	ash could impact areas hundreds of miles from the volcano.
Mount Mazama/Crater Lake	Crater Lake is in the south-central region of Oregon. About 7,700 years ago, Mount Mazama erupted violently, leaving the caldera that Crater Lake now occupies. The most recent volcanic eruption was about 5,000 years ago and occurred within the caldera. No eruptions have occurred outside the caldera since 10,000 years ago. The probability of another caldera-forming eruption is very low, as is the probability of eruptions occurring outside the caldera.

Figure 3-22 Volcanic Hazards of the Three Sisters[90]

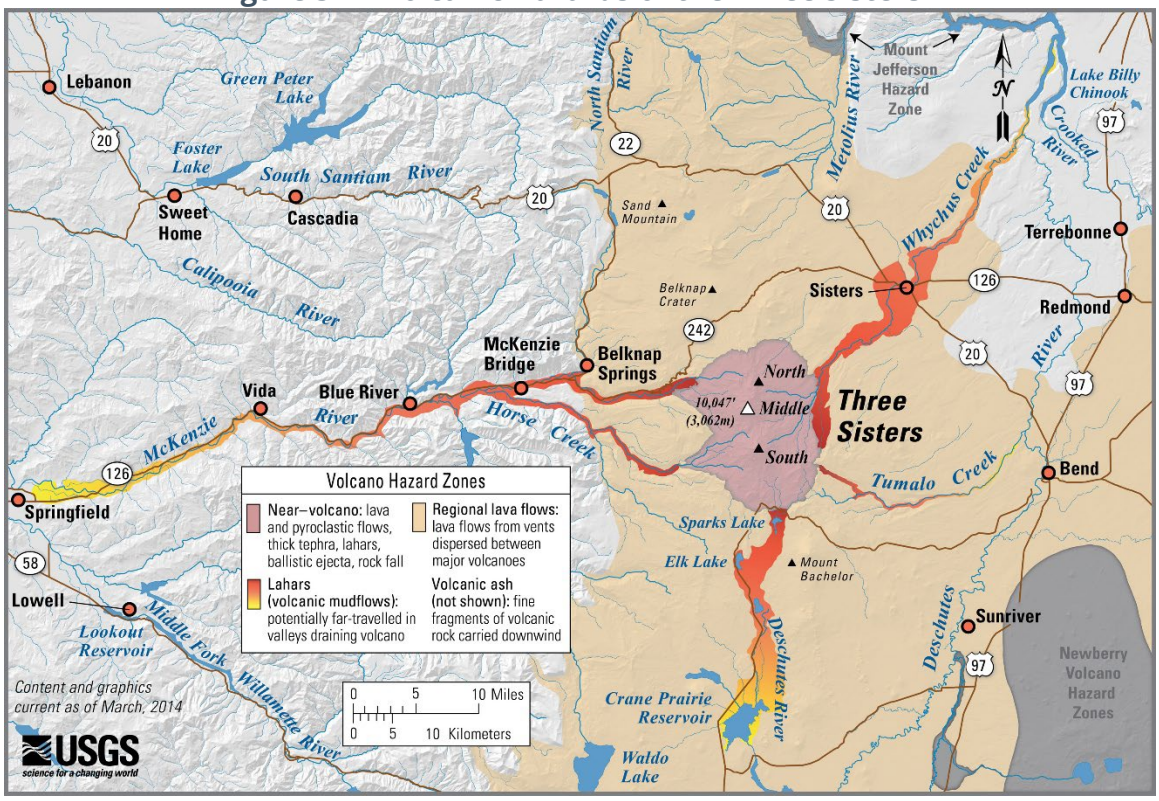
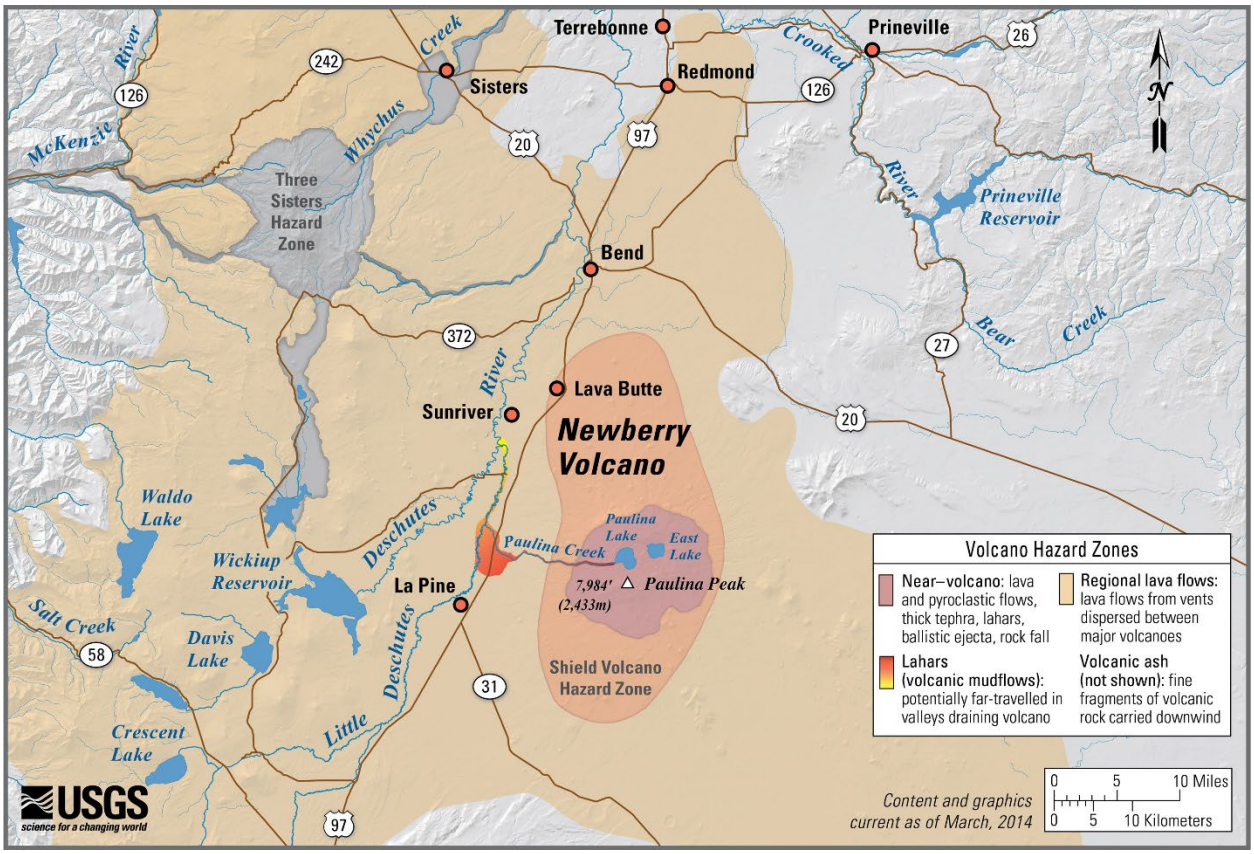


Figure 3-23 Volcanic Hazards of Newberry Volcano[91]

[90] Central Cascades Volcano Coordination Plan
[91] Central Cascades Volcano Coordination Plan



Future Conditions

The annual probability of volcanic activity in or affecting Deschutes County can only be estimated with a high degree of uncertainty, but, depending on the type of eruption, ranges from roughly 1 in 1,000 to 1 in 10,000. The US Geological Survey estimates the range of annual probabilities falls between 1 in 10,000, for some areas near the Cascade Crest around Three Sisters and on the upper flanks of Newberry Volcano, to 1 in 1,000,000 elsewhere. Because ashfall from such eruptions covers much larger areas than lava flows, the probability of ashfall affecting an area is greater.

When a volcano erupts in the region again, areas close to the erupting vent will be severely affected. For the main peaks of the Cascades, a proximal hazard zone roughly 20 kilometers (12 miles) in diameter surrounding the volcano could be affected within minutes of the onset of eruption or large landslide. Distal hazard zones that follow river valleys downstream could be inundated by lahars or debris flows generated either by melting of snow and ice during eruption or by large landslides.[92]

[92] Laenen, Antonius, Scott, K M., Costa, J. E., and Orzol, L. L., 1987, HYDROLOGIC HAZARDS ALONG SQUAW CREEK FROM A HYPOTHETICAL FAILURE OF THE GLACIAL MORAINE IMPOUNDING CARVER LAKE NEAR SISTERS, OREGON, Department of Interior, US Geological Survey, Open File Report 87-41

The annual probability of explosive eruptions at Newberry Volcano affecting the caldera and immediately adjacent areas is about 1 in 3,000 (one basaltic and three rhyolitic eruptive periods, in 12,000 years). The probability of such an eruption occurring in a 30-year period, the duration of many home mortgages or a human generation, is roughly 30 times the annual probability or 1 in 100.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a volcanic event is "low,"** meaning one incident is likely within the next 75-100-year period (or longer). Based upon available information the Oregon NHMPs Regional Risk Assessment rates Deschutes County's probability of a volcano event as "moderate."[93]

Vulnerability Assessment

All of the Pacific Northwest is vulnerable to impacts from volcanic activity. Like the rest of Central Oregon, Deschutes County has some risk of being impacted by volcanic activity in the Cascade Range. The Three Sisters and Newberry Volcano are ranked by the USGS as "very high threat" volcanoes and are among the top 20 most hazardous volcanoes in the U.S.[94] In addition, an eruption of any one of the major Cascade volcanoes could affect the county and the region with ashfall if the wind direction is unfavorable.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"high" vulnerability to volcanic hazards;** meaning more than 10% of the region's population or assets would be affected by a major emergency or disaster. Based upon available information the Oregon NHMPs Regional Risk Assessment rates Deschutes County's vulnerability to a volcano event as "moderate."[95] However, the communities of Bend, La Pine, and Sisters may be at greater risk since they are located closer to the main volcanoes and are more at risk for inundation by lava and pyroclastic flows, lahars, debris flows, or ash fall.

Risk Assessment

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2-6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a particular hazard. Based on the matrix the **volcano hazard is rated #7, out of 10 rated hazards, with a total score of 149.**

[93] 2020 Oregon Natural Hazard Mitigation Plan. Department of Land Conservation and Development, 2020.
[94] 2018 Update to the U.S. Geological Survey National Volcanic Threat Assessment https://pubs.usgs.gov/sir/2018/5140/sir20185140.pdf
[95] Ibid.

Wildfire Hazard

Location and Extent

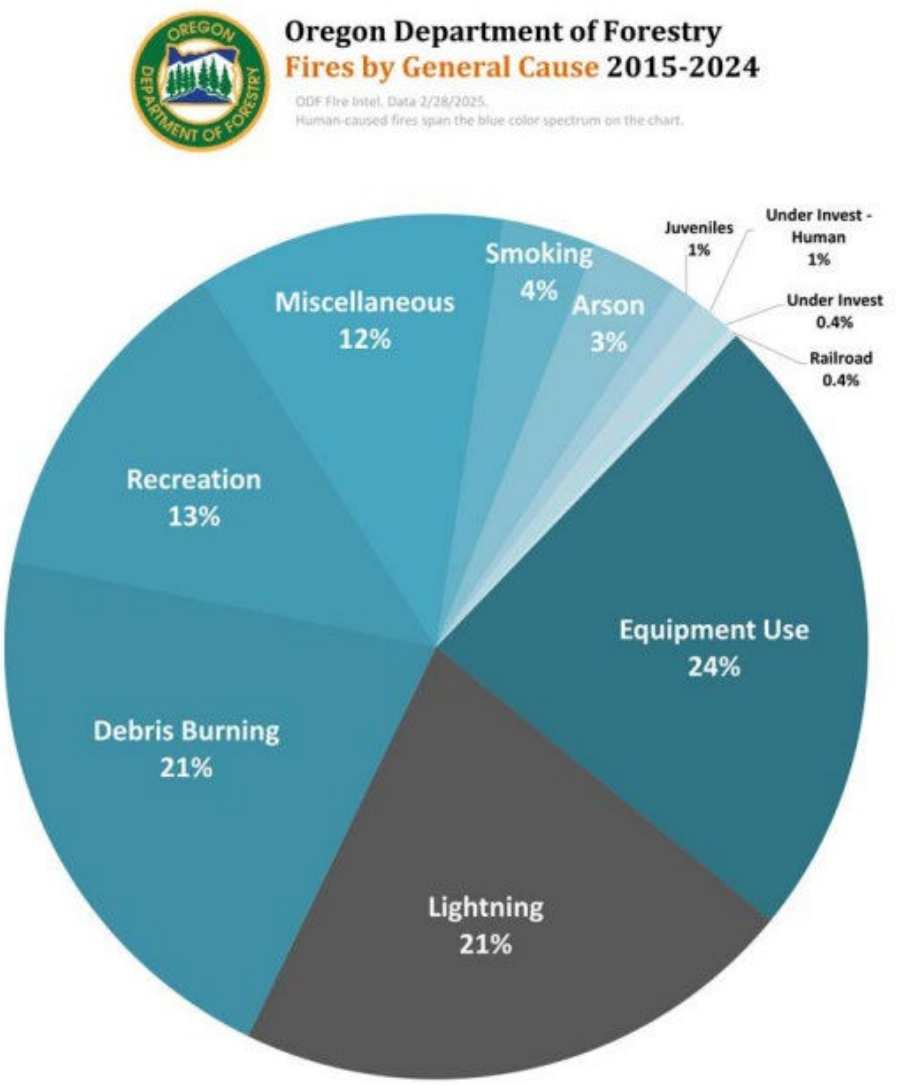
Wildfire is a recurring natural hazard in Deschutes County and an important ecological process across Central Oregon. Historically, fire helped shape forests, rangelands, and other wildland environments; however, fire exclusion, vegetation change, fuel accumulation, and continued development in fire-prone areas have increased the potential for damaging wildfire impacts. In Deschutes County, wildfire is influenced by fuel conditions, weather, topography, drought, winter snowpack, and the location and density of development.96 Detailed community-level wildfire risk assessments and priority actions are maintained in the County's seven Community Wildfire Protection Plans (CWPPs).

Many wildfires are caused by lightning, but human-caused ignitions also contribute significantly to wildfire occurrence in Oregon and Deschutes County. On private lands, common causes include debris burning, equipment use, recreational activity, and other human-caused ignitions.[97] Lightning-caused fires are often associated with larger wildfires, particularly in areas with difficult access, multiple simultaneous starts, and limited initial attack capacity.[98]

The County is particularly vulnerable to wildland urban interface (WUI) and intermix fires, where developed areas and wildland vegetation meet or intermingle. In these areas, homes, outbuildings, transportation routes, utilities, and other assets are exposed to wildfire, ember cast, and fast-moving fire behavior. Wildfire risk is increased as more people live, work, and recreate in fire-prone environments and as more development occurs in and near the WUI.

Figure 3-24 Fires By General Cause[99]

96 Science Basis for Changing Forest Structure to Modify Wildfire Behavior and Severity by Russell T. Graham, Sarah McCaffrey, and Theresa B. Jain. RMRS-GTR-120, USDA Forest Service, 2004.
97 Oregon Wildfire Readiness Guide p. 5
98 https://extension.oregonstate.edu/catalog/pub/em-9228-fire-faqs-who-owns-oregons-forests-how-does-matter-when-it-comes-fire
99 2025-2030_Oregon_Natural_Hazards_Mitigation_All-Chapters.pdf p. 210



Hazard History

Wildfire is a recurring hazard in Deschutes County. Significant wildfires have occurred repeatedly over the last two decades and have required substantial emergency management, fire service, and interagency response. Table 3-15 summarizes wildfires in Deschutes County from 2003 through 2025. In the period from 2015 to 2025 alone, there were more than 2,000 fire starts in Deschutes County resulting in more than 132,000 acres burned.

Table 3-15 Large Wildfire History (2000-2025)[100]

Wildfire Name	Year	Total Acres Burned
Flat Fire	2025	23,346
Flat Top	2024	36,472

[100] https://tools.oregonexplorer.info/Geocortex/cwpp/Oregon%20CWPP%20Report%20Deschutes%20County.pdf

Little Lava	2024	15,522
Firestone	2024	9,482
Pine	2024	6,634
0289 NE Darlene 3	2024	3,904
0892 Lucky Butte	2024	548
0353 RV McCaffery	2024	458
0913 NW	2024	248
0465 CR Jackpine	2024	178
Wickiup	2024	168
Round Mountain	2024	108
Grandview 0558 OD	2021	5,943
Darlene 0572 NE	2021	687
Rosland Road 0429 NE	2020	393
McKay Butte 0527 NE	2019	168
1144 NE Tepee	2018	2,026
0843 CS Milli	2017	24,029
1035 NE McKay	2017	1,221
Hampton	2017	832
Cougar Butte	2017	150
Pine Mountain	2016	244
0501 NW Sheridan	2016	188
Two Bulls	2014	6,904
Brown's Creek	2013	107
Pole Creek	2012	26,795
Ice Cave	2012	10,402
Shadow Lake	2011	10,402
Rooster Rock	2010	6,119
Black Butte 2	2009	578
Snow Creek 0758	2008	390
Pine Mtn Southeast	2008	370
Dry Creek	2008	110
GW	2007	8,570
Millican East	2007	2,779
Woodside Ranch	2007	597
Crooked	2007	304
Black Crater	2006	9,412
Lake George	2006	6,482
I-883	2006	1,930
Cave	2005	853
Park	2005	139
Davis	2003	21,123

18 Road	2003	3,811
Link	2003	3,592
Cache Mountain	2002	4,451
Squaw Creek	2001	110
Crane Complex	2000	713
Newberry 2	2000	548

Large wildfire history in Deschutes County also shows that fire impacts have remained significant in recent years. Figure 3-37 provides a visual summary of large wildfire history in the county. Recent incidents such as the 2025 Flat Fire demonstrate that wildfire can result in structure loss, evacuations, community disruption, and substantial response costs.

Figure 3-25 Large Wildfire History[101]

Historical trend data indicate that wildfire impacts in Deschutes County have increased over time. Table 3-16 shows acres burned by decade, with a substantial increase since 2000 and more than 104,000 acres burned between 2020 and 2025 alone. This recent period accounts for a historically significant share of total acreage burned in the County.

Table 3-16 Acres Burned by Decade[102]

Decade	Acres Burned
1900-1909	16,200
1910-1919	60,400
1920-1929	9,200
1930-1939	600
1940-1949	1,400
1950-1959	17,400
1960-1969	7,400
1970-1979	7,400
1980-1989	25,600
1990-1999	64,700
2000-2009	71,900
2010-2019	98,600
2020-2025	104,091
Summary	
1900-1999	210,300
2000-Present	202,961

[101] Deschutes County Natural Resources, Generated June 9, 2026
[102] Deschutes County Forestry (2014) and Oregon Wildfire Risk Explorer (2021)

Wildfire has also caused repeated damage to homes and other structures in Deschutes County. Table 3-17 summarizes documented structure losses since 1981, including major losses during the 1990 Awbrey Hall Fire, the 1996 Skeleton Fire, and the 2025 Flat Fire. These data demonstrate that wildfire history in Deschutes County includes not only large acreage burns, but also direct impacts to residences, other buildings, and community assets.

Table 3-17 Structures Lost to Wildland Fire[103]

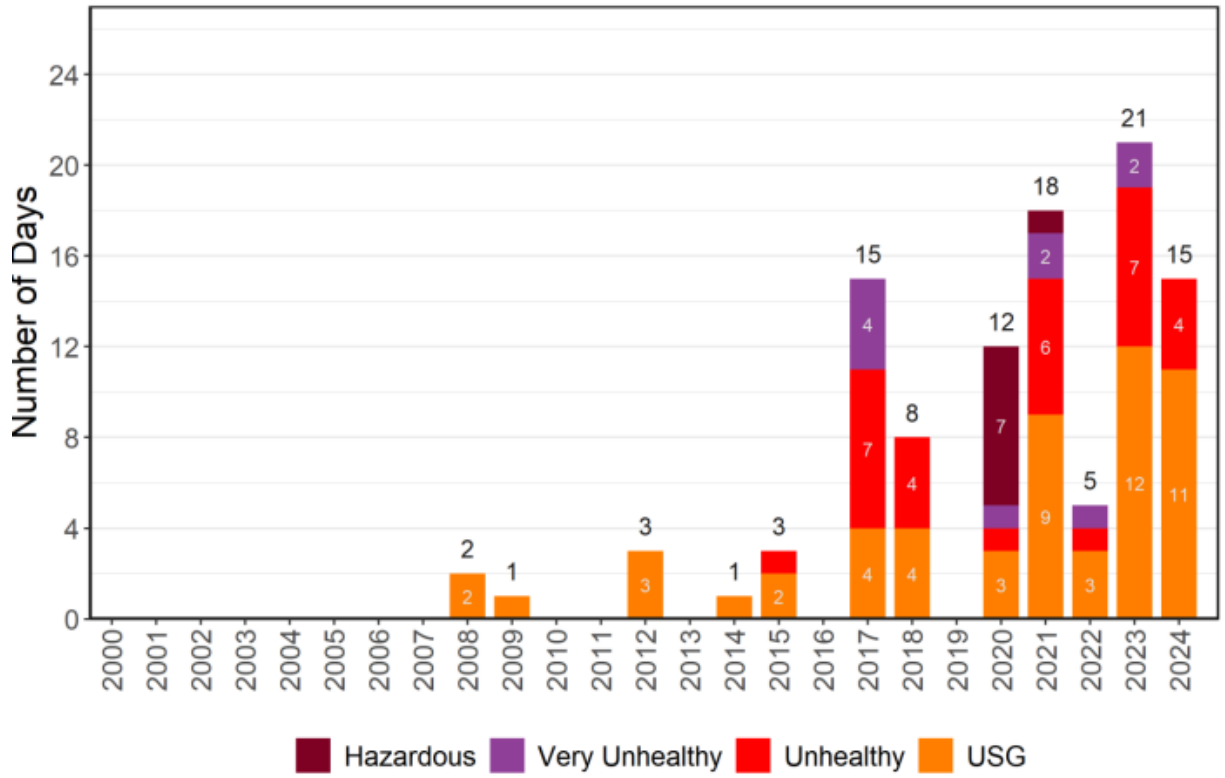
Year	Structures Lost
2025	16 (5 Homes)
2019	1
2018	3
2003	1
2002	20
2001	5
1996	30
1990	22
1981	5
Total	**103**

Deschutes County has experienced smoke-related air quality concerns since the 1980s, when monitoring identified elevated wintertime particulate levels associated with woodstoves, open burning, and burn barrels. Burn restrictions and increased natural gas use helped reduce those winter smoke impacts over time. In contrast, wildfire smoke has become a much more significant summer issue in recent years; in Bend, days with unhealthy air quality caused by wildfire smoke have increased as shown in Figure 3-26 below.

Figure 3-26 Bend Wildfire Smoke by AQI Category[104]

[103] Central Oregon Interagency Dispatch Records, 2009; https://bluemountaineagle.com/2002/08/01/winter-fire-calms-down-in-s-ore-cache-mountain-fire-hits-complex/

[104] wf2024wfTrendsRep.pdf p. 15



Note: Early-year values may reflect more limited monitoring coverage and less complete wildfire smoke attribution than in recent years. These data may underrepresent historical smoke impacts and should be interpreted with caution when comparing across the full period shown.

Overall, the historical record shows that wildfire is an ongoing and consequential hazard in Deschutes County. The frequency of fire starts, repeated occurrence of large fires, increasing acres burned, documented structure losses, and increasing smoke impacts all support the conclusion that wildfire will remain a significant hazard for county residents, property, infrastructure, and public safety systems. Recent incidents have also required substantial multi-agency response and response expenditures, demonstrating that wildfire in Deschutes County can create significant operational and fiscal impacts.

Future Conditions

The Deschutes County Natural Hazard Mitigation Plan Steering Committee believes that the probability of wildfire occurrence in Deschutes County is high. Although wildfire is most associated with the summer and early fall fire season, wildfires can occur during any month of the year when fuels are dry and weather conditions support ignition and spread. In Deschutes County, the primary fire season generally extends from June through October, but winter and shoulder-season fires can also occur during dry, windy conditions.

Both natural and human-caused ignitions contribute to wildfire occurrences in Deschutes County. Lightning-caused fires are influenced by weather and fuel conditions, while human-caused fires add to the overall likelihood of wildfire at any time of the year.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a wildfire event is "high,"** meaning at least one incident is likely within the next 10–35-year period (as the history of wildfires indicates, it is likely that Deschutes County will experience a wildfire on an annual basis). Based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[105]

Drought and unusually dry seasonal conditions can increase wildfire potential in Deschutes County. Dry winters, hot summers, and prolonged periods of low fuel moisture can increase the likelihood of wildfire occurrence and contribute to more severe fire conditions. Climate trends are also expected to influence future wildfire probability. Counties east of the Cascade Range, including Deschutes County, are experiencing more frequent and severe wildfires than has historically been typical. Increasing temperatures, especially during the summer months, are expected to contribute to drier vegetation and longer periods of elevated fire potential. These conditions were considered in assigning a high probability to future wildfire occurrence in Deschutes County.

Wildfire smoke impacts are also likely to occur in Deschutes County in the near and foreseeable future, although the timing, duration, and severity will vary from year to year. Some years may have limited smoke impacts, while others may experience several days or longer periods of degraded air quality. Because Deschutes County can be affected by both local fires and smoke from large fires elsewhere in Oregon, the Pacific Northwest, and British Columbia, the probability of recurring smoke impacts remains high. Smoke impacts are not limited to areas near an active fire.[106]

Vulnerability Assessment

Deschutes County has a high vulnerability to wildfire because development, population growth, and critical infrastructure continue to expand in and near fire-prone vegetation. Vulnerability is greatest in the wildland-urban interface (WUI), where homes, businesses, transportation routes, and other assets are located within or adjacent to forest, brush, and rangeland fuels. In these areas, wildfire can result in structure loss, evacuation, transportation disruption, utility impacts, and significant demands on public safety and emergency response systems.

105 2025 Oregon Natural Hazard Mitigation Plan. Department of Land Conservation and Development, 2025.
106 Oregon Health Authority, Wildfires and Smoke. https://www.oregon.gov/oha/PH/Preparedness/Prepare/Pages/PrepareForWildfire.aspx#health

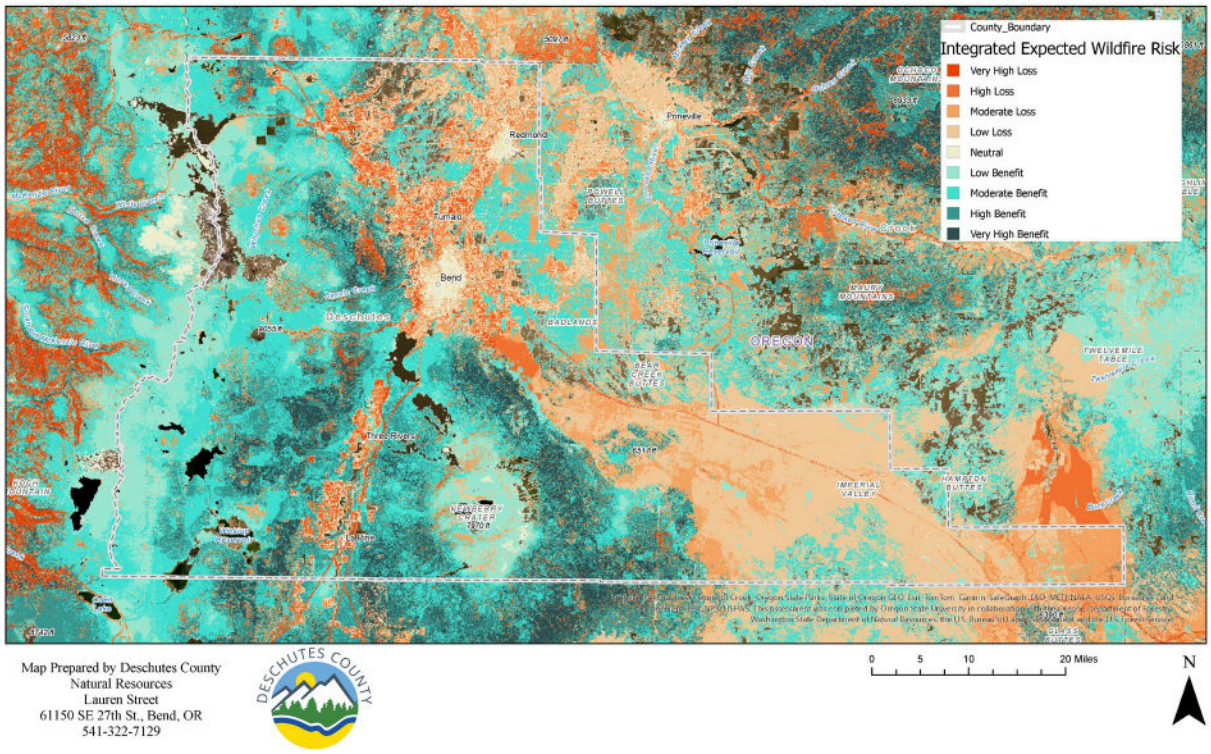
Vulnerability is also increased in areas with limited or reduced fire protection coverage. Deschutes County includes unprotected lands as well as areas served by Rangeland Fire Protection Associations (RFPAs), which provide wildland firefighting services but do not provide the full range of structural fire protection available in fire districts. These areas are defined as "under protected" by the Oregon State Fire Marshal's Office. In these areas, wildfires may become large before containment and may pose an increased threat to nearby protected areas, homes, and infrastructure.

Development in and near the wildland-urban interface increases exposure to wildfire in Deschutes County. Homes, businesses, and infrastructure located adjacent to or intermixed with fire-prone vegetation are vulnerable to structure loss, evacuation, transportation disruption, and public safety impacts. Wildfires involving both vegetation and structures can create complex and dangerous conditions for responders and the public. Vulnerability is also increased on private lands outside of fire districts or in areas with limited structural fire protection. In some locations, steep grades, narrow roads, poor road conditions, limited bridge capacity, evacuation traffic, and constrained water supply can complicate fire response and increase risk to life and property. Some wildfire-prone areas in Deschutes County remain attractive for residential development, which can increase the number of people, homes, and assets exposed to wildfire over time.[107]

Detailed local wildfire risk information is maintained in the county's seven Community Wildfire Protection Plans (CWPPs), which identify communities at risk, wildfire hazard conditions, structural vulnerability, transportation concerns, protection capability, and priority mitigation actions. For this NHMP update, the Oregon CWPP Planning Tool was used to inform the county's understanding of hazard exposure, vulnerable areas, and mitigation priorities. Figure 3-38 illustrates integrated expected wildfire risk in Deschutes County.

Figure 3-27 Deschutes County Integrated Expected Wildfire Risk Map[108]

[107] National Wildland/Urban Interface Fire Protection, Fire protection in the Wildland/Urban Interface: Everyone's responsibility, Washington D.C., (1998).
[108] Deschutes County Natural Resources, generated 6-9-2026



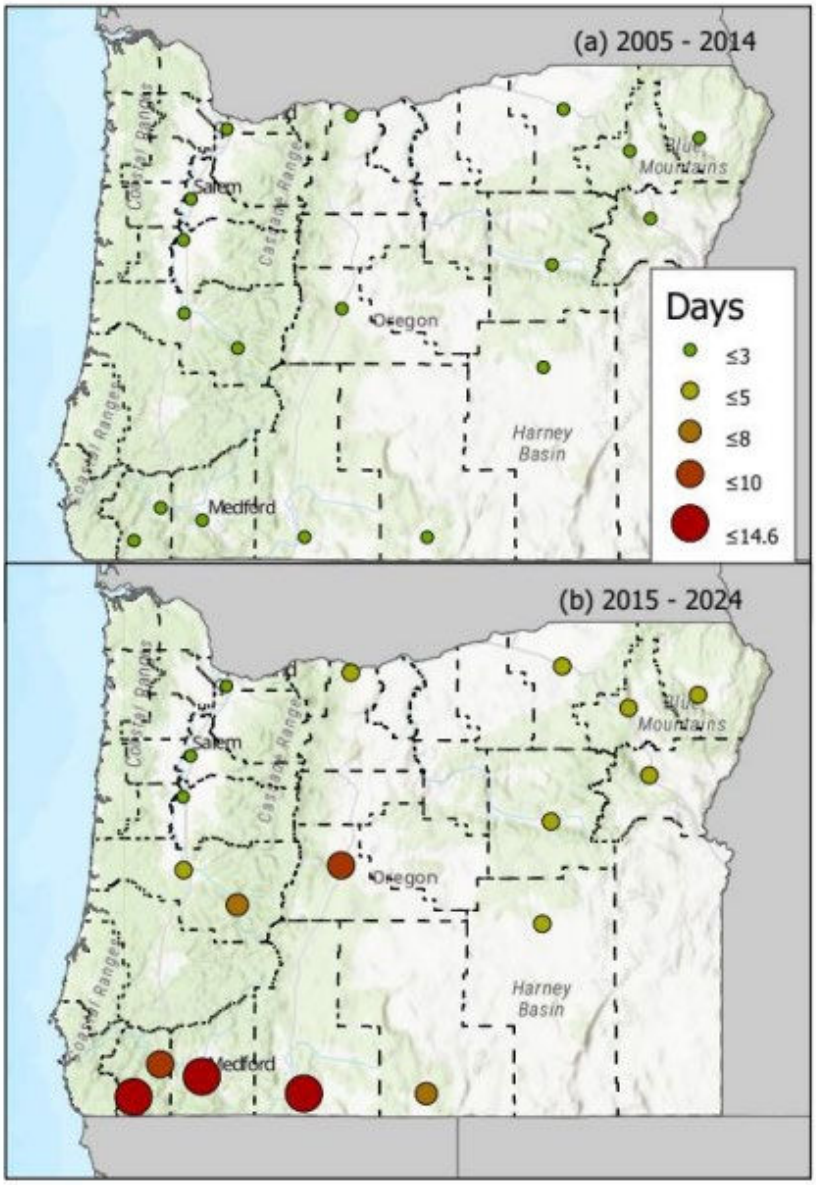
Integrated expected wildfire risk reflects the modeled net effects of wildfire, combining potential losses and potential ecological benefits. Areas classified as "Very High Benefit" are locations where wildfire is expected to provide comparatively greater net ecological benefit than loss relative to other areas in Oregon and Washington; this does not mean wildfire poses no risk to people, property, infrastructure, or air quality.[109]

Wildfire smoke can create significant health impacts in Deschutes County, particularly when fine particulate matter remains elevated for multiple days. Smoke from nearby or distant fires can affect air quality across the county and may pose greater risks for older adults, children, pregnant people, and individuals with respiratory or cardiovascular conditions. Prolonged smoke exposure can also disrupt outdoor work, school activities, recreation, and other daily activities.[110]

Wildfire smoke is an increasingly significant public health concern for residents and visitors in Deschutes County. In addition to smoke from local wildfires, the county may experience severe smoke impacts from fires elsewhere in Oregon, the Pacific Northwest, California, and British Columbia. These smoke episodes can last for multiple days and may create widespread air quality impacts and health risks within Deschutes County.[111]

[109] Oregon CWPP Planning Tool, accessed June 10, 2026
[110] Oregon Department of Environmental Quality, Air Quality Monitoring. https://www.oregon.gov/deq/aq/Pages/Air-Quality-Monitoring.aspx
111 Central Oregon Fire Info, Smoke & Your Health. https://www.centraloregonfire.org/wildfire-smoke-your-health/

Figure 3-28 Average Number of AQI Days at "Unhealthy for Sensitive Groups" or Above from Wildfire Smoke (2005-2024)[112]



Population growth has increased wildfire exposure in Deschutes County over time and is expected to continue doing so.[113] As more residents, homes, and infrastructure are added in and near wildfire-prone areas, the potential for life-safety impacts, property damage, and economic loss also increases. Vegetation conditions also increase vulnerability in some parts of the county. In lower-elevation areas near developed WUI areas, vegetation change and fuel accumulation have increased the potential for higher-intensity fire behavior, including crowning, spotting, and rapid fire spread. In addition, much of the public land in Deschutes County is classified in Condition Class 2 or 3, indicating departure from historical

[112] https://www.oregon.gov/deq/wildfires/Documents/wf2024wfTrendsRep.pdf P.12
[113] https://www.pdx.edu/population-research/sites/populationresearch.web.wdt.pdx.edu/files/2022-06/Deschutes.pdf p. 5

fire return intervals and increased potential for extreme fire behavior.[114] This combination of development pressure, vegetation conditions, and smoke exposure increases the county's overall wildfire vulnerability.

Based on the county's wildfire hazard conditions, development patterns, and exposed population and assets, the Deschutes County Natural Hazards Steering Committee **rates the county's vulnerability to wildfire as high**, meaning more than 10 percent of the county's population or assets could be affected by a major wildfire event. Available state risk information supports this vulnerability rating.

Risk Analysis

The CWPP steering committees use the Oregon Wildfire Risk Explorer tool that was created in partnership with the Oregon Department of Forestry (ODF) and the Institute for Natural Resources at Oregon State University (OSU) to undertake wildland fire risk assessments and gauge the relative risks and hazards due to wildland fire for the lands and communities within the county. This tool is intended to direct the implementation of wildfire mitigation activities to the highest priority areas and promote cross-boundary coordination.[115]

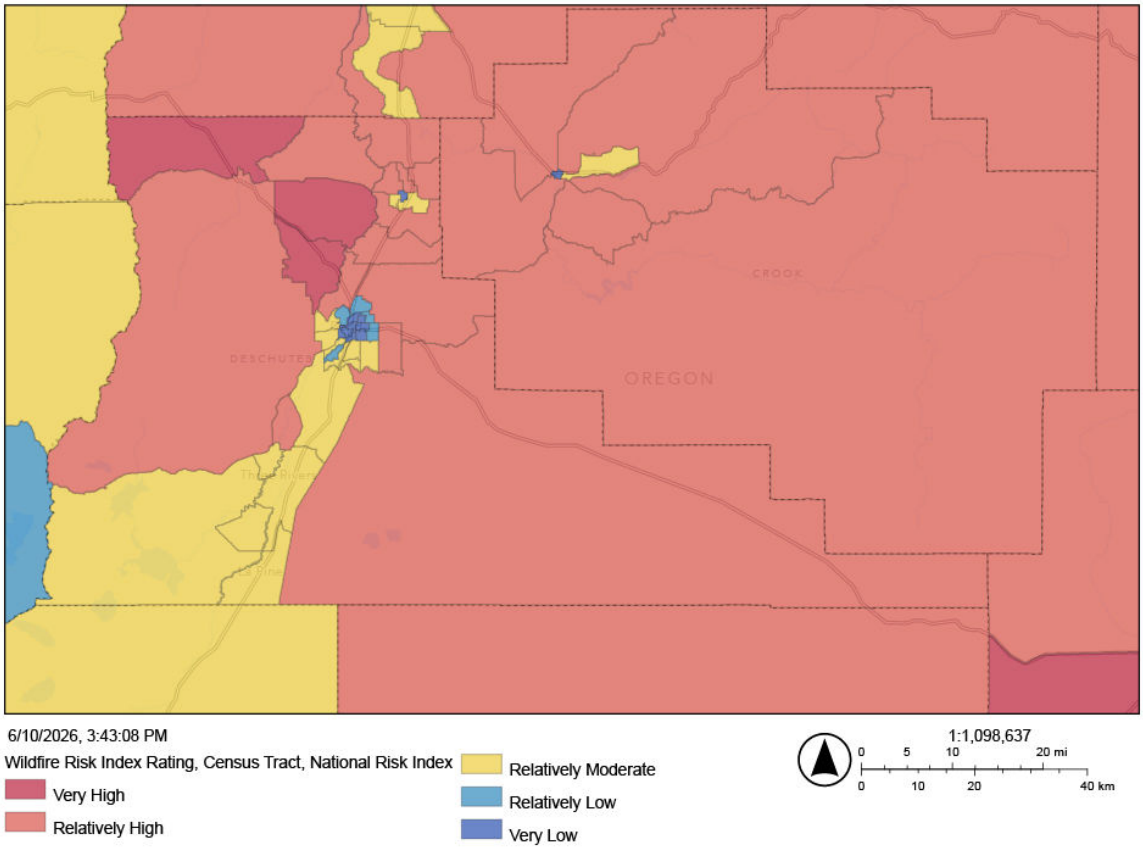
The Deschutes County NHMP Steering Committee risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2-6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities, but does not predict the occurrence of a particular hazard. Based on the matrix the **wildfire hazard is rated #2, out of 10 rated hazards, with a total score of 220.**

Additional national-scale risk information is shown in Figure 3-29.

Figure 3-29 National Risk Index for Wildfire[116]

[114] Science Basis for Changing Forest Structure to Modify Wildfire Behavior and Severity by Russell T. Graham, Sarah McCaffrey, and Theresa B. Jain. RMRS-GTR-120, USDA Forest Service, 2004.
[115] Great Sisters Country CWPP, 2025, page 4
[116] Federal Emergency Management Agency (FEMA), Resilience Analysis and Planning Tool (RAPT), accessed June 10, 2026.

National Risk Index for Wildfire by Census Tract (Deschutes County)



Federal Disaster and Emergency Declarations

Looking at past County events provides the type of hazards that caused significant damage. These trends can help inform hazard mitigation project priorities.

President Dwight D. Eisenhower approved the first federal disaster declaration in May 1953 following a tornado in Georgia. Since then, federally declared disasters were approved in each state because of natural hazard related events. As of December 2025, FEMA approved a total of 423 disaster declarations in Oregon.[117] When governors ask for presidential declarations of major disaster or emergency, they stipulate which counties in their state they want to include in the declaration. Table 3-25 summarizes the major disasters declared in Oregon, tied to Deschutes County, since 1955.

An Emergency Declaration is more limited in scope and without the long-term federal recovery programs of a Major Disaster Declaration. Generally, federal assistance and

[117] FEMA, *Declared Disasters by Year or State*, http://www.fema.gov/news/disaster_totals_annual.fema. Accessed December 24, 2025.

funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring.

Fire Management Assistance Grants (FMAG) may be provided after a state submits a request for assistance to the FEMA Regional Director at the time a “threat of major disaster” exists.

Table 3-17 FEMA Major Disaster, Emergency, and Fire Management Declarations for Deschutes County[118]

FEMA Declaration Number	Declaration Type	Declared	Incident Type	Declaration Title
FM-5610-OR	FM	8/23/2025	Fire	Flat Fire
FM-5527-OR	FM	8/2/2024	Fire	Mile Marker 132 Fire
FM-5500-OR	FM	6/25/2024	Fire	Darlene 3 Fire
FM-5394-OR	FM	6/30/2021	Fire	0419 Fire
DR-4562-OR	DR	9/15/2020	Fire	Wildfires and Straight-Line Winds
DR-4499-OR	DR	3/28/2020	Biological	COVID-19 Pandemic
EM-3429-OR	EM	3/13/2020	Biological	COVID-19
FM-5196-OR	FM	8/17/2017	Fire	Milli 0843 CS Fire
DR-4328-OR	DR	8/8/2017	Severe Storm	Severe Winter Storms, Flooding, Landslides, and Mudslides
FM-5056-OR	FM	6/8/2014	Fire	Two Bulls Fire
FM-2727-OR	FM	9/3/2007	Fire	GW Fire
FM-2659-OR	FM	7/27/2006	Fire	Black Crater Fire
EM-3228-OR	EM	9/7/2005	Coastal Storm	Hurricane Katrina Evacuation
DR-1510-OR	DR	2/19/2004	Severe Storm	Severe Winter Storms
FM-2493-OR	FM	8/20/2003	Fire	OR-Booth Fire-8-19-2003
FM-2455-OR	FM	7/29/2002	Fire	OR-Cache Mountain Fire-07/28/02
DR-1099-OR	DR	2/9/1996	Flood	High Winds, Severe Storms, and Flooding
EM-3039-OR	EM	4/29/1977	Drought	Drought
DR-184-OR	DR	12/24/1964	Flood	Heavy Rains & Flooding

[118] https://www.fema.gov/openfema-data-page/disaster-declarations-summaries-v2

Vulnerability Assessment

Community vulnerabilities are an important component of the NHMP Risk Assessment. For more in-depth information regarding specific community vulnerabilities, reference : INSERT REFERENCE SECTION.

Multi-Jurisdictional Risk Assessment

Multi-jurisdictional Risk Assessment - §201.6(c) (2) (iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

The four participating cities in Deschutes County: Bend, La Pine, Redmond, and Sisters each held local Steering Committee meetings and completed a jurisdiction specific hazard analysis. The multi-jurisdictional risk assessment information is located within the Risk Assessment section of each city's addendum.