# 2 IA 2 – Earthquake

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# Table of Contents

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| IA 2 Tasked Agencies | |
|---|---|
| **Primary Agencies** | Oregon Emergency Management |
| **Supporting Agencies** | Department of Geology and Mineral Industries<br>Oregon Department of Transportation<br>Building Codes Division<br>Water Resources Department<br>Oregon Health Division<br>Oregon Military Department<br>Department of Administrative Services<br>Department of Environmental Quality |
| **Adjunct Agencies** | American Red Cross<br>Salvation Army<br>Civil Air Patrol<br>Oregon Voluntary Organizations Active in Disaster |

# 1 Purpose

- The purpose of this annex is to provide a framework for the coordination of state resources to help ensure the safety of life and property following a catastrophic earthquake.
- This annex identifies the major response and recovery activities undertaken by the listed state and adjunct agencies in response to a catastrophic earthquake.
- More specific information on Cascadia Subduction Zone catastrophic earthquake response can be found in the State of Oregon Cascadia Subduction Zone Catastrophic Earthquake and Tsunami Operations Plan
    - More specific information on earthquakes as a hazard in Oregon can be found in the Natural Hazards Mitigation Plan located at: http://csc.uoregon.edu/opdr/stateplan

# 2 Policies

- Activation
    - Procedures in this annex will be implemented as outlined in the Oregon Emergency Operations Plan, Basic Plan.
    - Procedures in this annex may be automatically implemented under the following conditions:

- When determined necessary by OEM and the Department of Geology and Mineral Industries.
- When any area in Oregon experiences a damaging earthquake, usually a magnitude of 5.0 or greater.

- This annex identifies the major response and recovery activities undertaken by state and adjunct agencies in response to a catastrophic earthquake.

# 3 Situation and Assumptions

## 3.1 Considerations

- Oregon is considered a state that is high-risk for earthquakes.
- Three main natural hazards occur as a result of earthquake: ground shaking, liquefaction and earthquake-induced landslides.
- The severity of the associated hazards is dependent upon several factors, including: slope conditions; proximity to the fault; earthquake magnitude; the type of earthquake.
- Ground shaking is the motion or a seismic wave felt on the earth's surface, and is the primary cause of resulting damage.
- Coast areas could be subject to tsunamis immediately following an earthquake. The Tsunami Annex for the State of Oregon is a separate annex.
- Technical hazards occur with earthquakes. Specifically, fires and hazardous material spills.
- Damage caused to buildings and infrastructure varies, depending on the nature of the ground beneath the structure; building construction and age. Unreinforced masonry buildings are among the most susceptible to severe damage. Wood structures tend to withstand earthquakes better than brick or unreinforced masonry buildings.

## 3.2 Planning Assumptions

- This plan assumes an earthquake that is considered major (measuring 7.0 or greater magnitude).
- Earthquakes occur without warning and could cause significant damage, injury, loss of property and loss of life.

- Earthquakes can trigger a number of other events, such as tsunamis, landslides, hazardous material releases and spills, and conflagration fires.
- Public utilities and private infrastructure (such as power, water, sewer, natural gas networks, phone lines and towers) may be damaged and unusable immediately following an earthquake.
- Roads, bridges and highways may become impassible following a significant seismic event.
- Oregon citizens may be without food, water, shelter, heat, sanitary facilities and transportation for extended periods of time.
- Immediate evacuation of coastal communities may be necessary in the case of a tsunami.
- Areas outside of the disaster area may become overwhelmed by influx of displaced citizens who need alternate housing or shelter because of damaged communities.
- Public safety resources (including personnel) may suffer damage, injury or death causing a shortage of resources to assist with response and recovery efforts.

# 4 Concept of Operations

- In accordance with the EOP for the State of Oregon, the Emergency Coordination Center (ECC) will be fully activated.
- Tasking priorities for state resources will be determined in conjunction with local officials and approved by the State ECC.
- OEM will have the lead on coordination of resources requested from local officials.
- Requested equipment, materials, supplies and personnel will be secured through State resources and/or mutual aid agreements, or purchasing.
- State supporting agencies will respond to the ECC as required to provide response and recovery resources to local governments upon assignment from the ECC Operations Officer.

# 5 Roles and Responsibilities

## 5.1 Primary Agency: Oregon Emergency Management

- Activation and setup of the ECC in accordance with the state EOP;

- Determine the nature and scope of the disaster/emergency and provide ongoing assessment of identifiable resources needed;
- Establish and maintain contact with Support and Adjunct agencies;
- Establish and maintain contact with county emergency managers or other local officials;
- Coordinate an integrated State effort to provide assistance to the affected area(s);
- Provide situation reports to the Governor's Advisory Council or designated representatives;
- Present coordinated and accurate information to the public via the State's Public Information Officer (PIO);
- Serve as liaison between County and State; and State and the Federal Emergency Management Agency (FEMA).

## 5.2 Supporting Agencies

- Oregon Department of Geology and Mineral Industries (DOGAMI)
- Oregon Department of Transportation (ODOT)
- Building Codes Division
- Water Resources Division (WRD)
- Department of Human Services / Public Health (DHS)
- Oregon Military Department (OMD)
- Department of Administrative Services (DAS)
- Department of Environmental Quality (DEQ)

## 5.3 Adjunct Agencies

- American Red Cross (ARC)
- The Salvation Army
- Civil Air Patrol
- Oregon Voluntary Organizations Active in Disaster (ORVOAD)

**NOTE:** Responsibility details for State agencies can be found in the Roles & Responsibilities (ESF) section of the State of Oregon Emergency Operations Plan

(EOP). Additionally, details for state response are outlined in the State of Oregon Cascadia Subduction Zone Catastrophic Earthquake and Tsunami Operations Plan

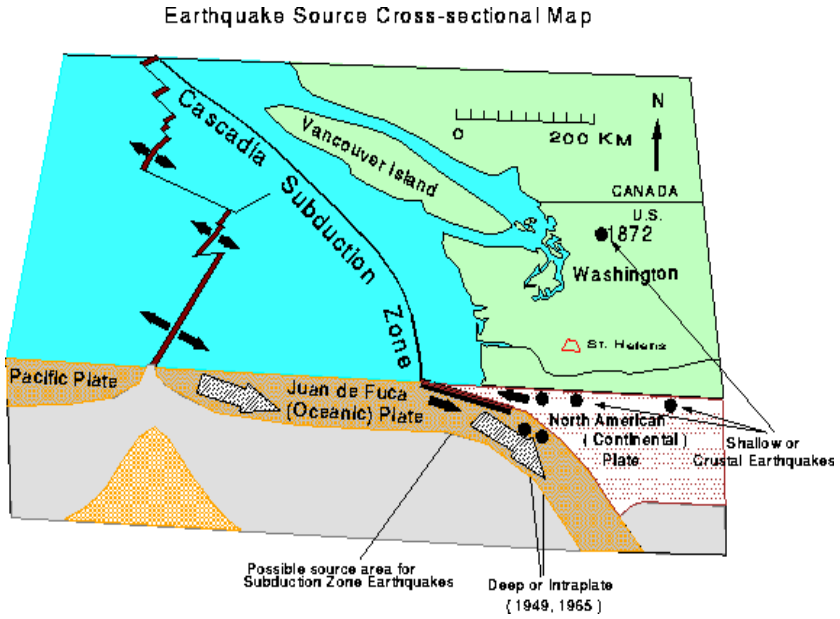
# 6 Hazard Specific Information – Earthquake

## 6.1 Definition

An earthquake is a sudden motion of the ground that may cause its rupture, shaking, and failure. Earthquakes are driven by geologic processes that produce stresses in the earth.

In the Pacific Northwest, oceanic crust is being pushed beneath (subducted) the North American continent along a major boundary parallel to the coast of Washington and Oregon. The Cascadia Subduction Zone, lies about 50 miles offshore and extends from the middle of Vancouver Island in British Columbia past Washington and Oregon to northern California. The subduction of the Juan de Fuca plate beneath the North America plate is believed to directly or indirectly cause most of the earthquakes and geologic features in Oregon.

**Figure 1 Major Tectonic Plates in the Pacific Northwest**




There are three main plate tectonic environments: extensional, transformational, and compressional. Plate boundaries in different localities are subject to different inter-plate stresses, producing three types of earthquakes: shallow, deep, and subduction. Each type has its own special hazards.

An earthquake is a sudden movement of the Earth, caused by the abrupt release of strain that has accumulated over a long time. Sometimes the movement is gradual. At other times, the plates are locked together, unable to release the accumulating energy. When the accumulated energy grows strong enough, the plates break free. If the earthquake occurs near populated areas, it may cause many deaths and injuries, and extensive property damage.

Oregon is affected by the Cascadia Subduction Zone where the Juan de Fuca plate slides underneath the North American plate. While earthquakes along this zone occur infrequently, plate movement can produce major earthquakes. In addition, Western Oregon is underlain by a large and complex system of faults that can produce damaging earthquakes; these smaller faults produce lower magnitude events, but their ground shaking can be strong and damage can be great to structures nearby.

Earthquakes can trigger other geologic and soils failures that contribute to damage. While surface fault rupture can produce damage to facilities and infrastructure astride the fault, losses from this are minor compared to those resulting from strong ground shaking and associated ground failures. These include landslides and slope failures, lateral spreading and slumping, and liquefaction.

## 6.2 Frequency

Historically, many earthquakes have occurred in the subducting Juan de Fuca plate deep beneath Puget Sound and at shallow depths in many places in Washington, Oregon, and British Columbia in the overlying North America plate. It is reasonable to expect future earthquakes in these areas to have magnitudes comparable to the magnitudes of past earthquakes. The biggest historical earthquakes include the shallow magnitude 7.4 earthquake in the North Cascades in 1872 and the deep magnitude 7.1 earthquake in the southern Puget Sound area in 1949. Therefore, even without the occurrence of great subduction-style earthquakes in the Pacific Northwest, Oregon is still earthquake country.

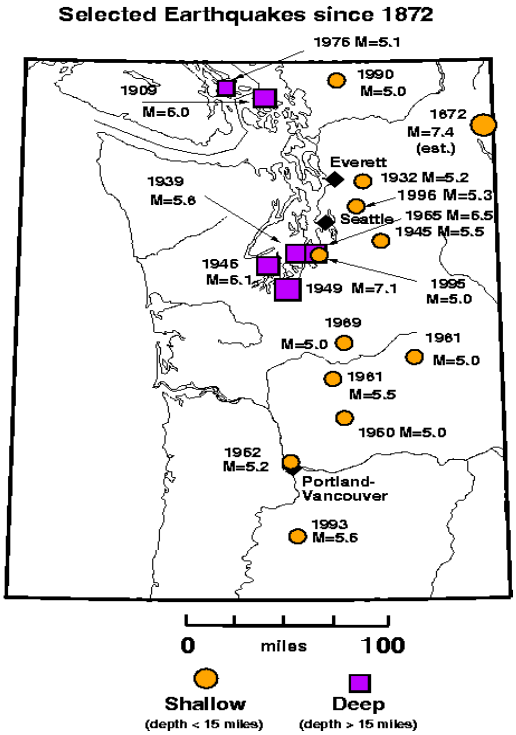
### 6.2.1 Deep Earthquakes

The two most recent damaging earthquakes in Washington, in 1965 (magnitude 6.5, located between Seattle and Tacoma), and in 1949 (magnitude 7.1, near Olympia), were roughly 40 miles deep and were in the oceanic plate. Both earthquakes caused serious damage, and were felt as far away as Montana. No aftershocks were felt. Other sizable events which were probably deep occurred in 1882, 1909, and 1939.

### 6.2.2 Shallow Earthquakes

The largest historic earthquake in Washington or Oregon occurred in 1872 in the North Cascades. This earthquake had an estimated magnitude of 7.4 and was followed by many aftershocks. It was probably at a depth of 10 miles or less within the continental crust. In 1993, a magnitude 5.6 earthquake in the Willamette Valley caused $28 million in damages (including damage to the Oregon State Capitol in Salem), and a pair of earthquakes near Klamath Falls, OR (magnitudes 5.9 and 6.0) caused two fatalities and $7 million in damages. Many other crustal sources in Washington and Oregon could also produce damaging earthquakes. Recent studies have found geologic evidence for large shallow earthquakes 1,100 years ago within the central Puget Basin.

**Figure 2 History of Recent Earthquakes in the Puget Sound**




### 6.2.3 Subduction Zone Earthquakes

Although no large earthquakes have happened along the offshore Cascadia subduction zone since our historic records began in 1790, similar subduction zones worldwide do produce "great" earthquakes - magnitude 8 or larger. These 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 which are released suddenly in great earthquakes. Such earthquakes typically have a minute or more of strong ground shaking, and are quickly followed by damaging tsunamis and numerous large aftershocks. The Alaskan earthquake of 1964 was a great subduction zone earthquake. Geologic evidence shows that the Cascadia subduction zone has also generated great earthquakes, and that the most recent one was about 300 years ago. Large earthquakes also occur at the southern end of the Cascadia subduction zone (in northern California near the Oregon border) where it meets the San Andreas Fault system; including a magnitude 7.1 earthquake in 1992, and a magnitude 6.8 (estimated) earthquake in 1873.

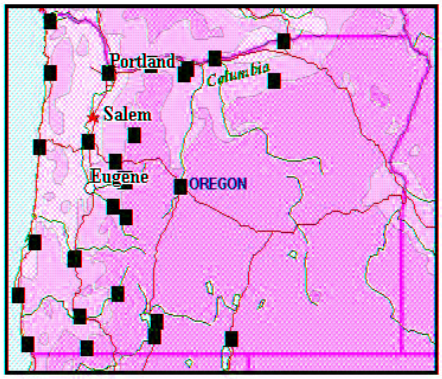
Geologic research in the last few years has shown that Oregon and Washington have probably been shaken by numerous subduction zone earthquakes during the last several thousand years. They were probably centered just off the coast of Oregon and Washington and may have been as large as magnitude 8 to magnitude 9. Such earthquakes would cause significant shaking and damage in much of western Oregon. These earthquakes occur, on average, every 300-600 years, but

scientists cannot predict whether the next such event might occur in two years or 200 years.

## 6.3 Territory at Risk

Local earthquakes are most common in the Portland metropolitan area, northern Willamette Valley, and Klamath Falls area and may threaten the coast from Coos Bay south to Brookings. We simply do not know about the risk of local earthquakes in most other parts of Oregon. All of Oregon west of the Cascades is at risk from subduction-zone earthquakes. The amount of earthquake damage at any place will depend on its distance from the epicenter, local soil conditions, and types of construction.

**Figure 3 Location of Most Significant Earthquakes in Oregon**




## 6.4 Effects

Earthquakes may range in intensity from slight tremors to great shocks and may last from a few seconds to as long as five minutes. They can come as a series of tremors over a period of several days.

The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Most casualties result from falling objects and debris as the shocks shake, damage or demolish buildings and other structures. Severe earthquakes destroy power and telephone lines and gas, sewer or water mains, which, in turn, may set off fires or trigger hazardous material incidents. Earthquakes may also cause landslides, dam failures and seismic sea waves (tsunamis).

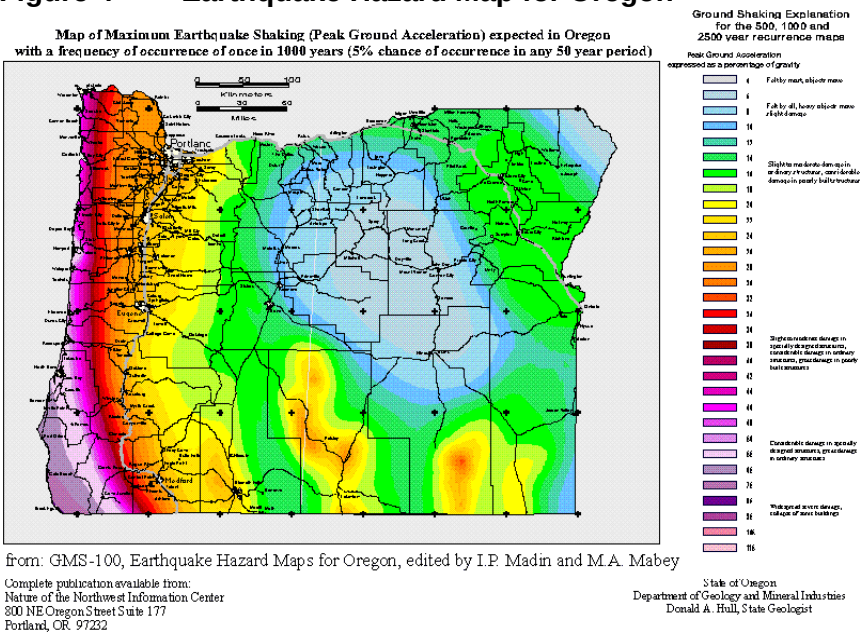
## 6.5 Predictability

Although scientists have tried for decades to predict earthquakes, no one has discovered a method which can be applied with regular success. For some areas with well-understood patterns of seismicity, it may be possible to forecast decades-long time windows when large earthquakes are likely to occur. However, the Pacific Northwest has only been monitored for a couple of decades; not long enough to allow us to see what patterns, if any, exist here. Seismologists are still trying to understand what types of earthquakes are possible here, and what kind of

shaking we will experience from future earthquakes (depending on the earthquake location and size, and the site geology and topography).

Earthquake hazards can be reduced by advance preparation; such as coordinating emergency communications and activities across jurisdictional lines, preparing personal emergency plans, and considering seismic hazards in land use plans, building codes, and planning for medical, utility, and emergency facilities.

**Figure 4 Earthquake Hazard Map for Oregon**




# 7 Supporting Documents

- State of Oregon Cascadia Subduction Zone Catastrophic Earthquake and Tsunami Operations Plan

# 8 Appendices

None at this time.