

# Earthquakes: An Everyday Threat in Island County<sup>1</sup>

[Appendix A](#), *Earthquake Magnitude and Intensity*

[Appendix B](#), *Geology of Earthquake Hazards*

[Appendix C](#), *Tsunamis*

Island County is in earthquake country. During calendar year 2012 there were 291 earthquakes in and around Island County—most could not be felt. Earthquakes can occur at any time of the year and magnitudes greater than M6 usually result in strong ground motion with a possibility of a ground surface rupture, [slope failure](#) (landslide or rockslide), and/or liquefaction (see [Appendix A](#)). M6 earthquakes since 1929 are scarce as shown in the following table:

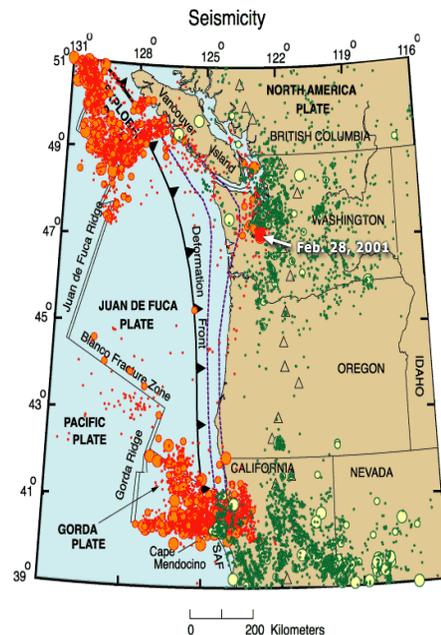
M6.0	Bremerton	1939
M7.4	Courtenay BC	1946
M7.1	Olympia	1947
M6.5	Tacoma	1965
M6.8	Olympia	2001

Here earthquakes are the result of plate tectonics. The Juan de Fuca plate is forcing its way under the North American plate on which the Olympic Mountains, Puget Lowlands and Cascades

ride. Earthquakes can occur at the subduction zone fault and deeper in the earth along the plane between the oceanic plate and the crustal plate (see [Appendix B](#)). Near surface quakes happen along faults in the Puget Lowlands as a result of the subduction stresses that generate deformation (strain) in the glacial debris, sediments and underlying basement formation(s). On July 10, 2013 Island County was fortunate to have some of the world's experts<sup>2</sup> on earthquakes and tsunamis advise emergency managers and first responders on the seismic risks Island County residents might face. This article highlights some of the discussion points.

**The primary hazard** intrinsically associated with earthquakes is ground-shaking. When the elastic energy stored in the crust is released by the earthquake and motion on the fault, the stored energy causes the ground to vibrate, or accelerate back and forth. The range of cumulative events associated with earthquakes is controlled chiefly by the magnitude and location of the event, tempered by a suite of other, interrelated factors including:

- “Short faults make small earthquakes; long faults make bigger earthquakes,” Dr. Brian Sherrod, USGS—faults that may impact Island County are discussed in [Appendix B](#).
- proximity to the epicenter (strong shaking produced by an M7 earthquake becomes half as strong at a distance of 8 miles, a quarter as strong at a distance of 17 miles, an eighth as strong



modified from Weaver and Shedlock, 1986

<sup>1</sup> Compiled by Jim Rich, Island County DEM volunteer, 7/23/2013 with Eric Brooks, Deputy Director DEM.

<sup>2</sup> Brian F. Atwater, PhD, USGS & UW (unable to attend due to schedule conflict—continues to advise); Chris Goldfinger, PhD, Professor Oregon State University; John Schelling, Earthquake/Tsunami Program Manager for Washington State Emergency Management Division; Brian L. Sherrod, PhD, USGS & UW; Terry Swanson, PhD, Department of Earth & Space Science, UW; Vasily Titov, PhD, PMEL NOAA; Tim Walsh, PhD; DNR Division of Geology and Earth Resources.

- at a distance of 30 miles, and a sixteenth as strong at a distance of 50 miles);
- nature of the substrate—soil type, solid rock, unconsolidated sediments, saturated sediments, organic material (peat)—see DNR [Site Class map](#) for Island County;
- building style (e.g., unreinforced masonry buildings vs. reinforced masonry or wood frame buildings);
- age and type of structures (buildings built after 1985 have the benefit of more stringent building codes);
- time of day;
- proximity to bodies of water—submarine earthquakes with vertical displacement may cause a tsunami when greater than M8 in subduction zones and greater than M7 on local faults (see [Appendix C](#)).

**Cascading events** associated with moderate to large-magnitude earthquakes are numerous, disparate and could in their own right - e.g., tsunami, fire, landslide - be catastrophic:

- broken gas lines, electrical power lines—initiating fires. Fires that begin as a result of earthquake activity are often uncontrollable and can cause the most damage. Flammable materials or debris released from the earthquake feed the flames of the fire, thus causing it to spread out of control;
- broken water lines or wells hampering fire-fighting efforts or result in local flooding;
- collapsed bridges and disrupted routes of transportation;
- landslides—debris flows (collectively referred to as mass wasting events—see [Landslides](#) on DEM website);
- liquefaction (see DNR [liquefaction map](#) for Island County);
- building collapse;
- dam breach or rupture (generally not an issue in Island County);
- failure of communications systems;
- tsunami or seiche—the maximum wave height expected on the western shore of Whidbey Island from an event on Cascadia is [about 2m](#) (6 ft). Very few very low lying areas on western Whidbey will be at risk. Dr. Vasily Titov, NOAA, developed the model that has been validated by many global events (see [Appendix C](#), Tsunamis);
- reactivation of other fault systems, both related and unrelated, leading to additional seismicity, see table in [Appendix A](#).

**Aftershocks** will often follow an earthquake, see [Appendix B](#). They may be as strong or even stronger than the initiating event, see [Appendix A](#). First responders can expect to answer aide calls as a result for several weeks. The frequent shaking can demoralize everyone and steps will have to be taken to deal with the angst.

**Direct damage** to infrastructure during an earthquake results from several engineering factors for which [expanded information is available](#) and [more here](#). Building codes provide the first line of defense against future earthquake damage and help to ensure public safety. Records of building response to earthquakes, especially those from structures that failed or were damaged, have led to many revisions and improvements in building codes. If your home was built after 1985 the building codes incorporated many of the lessons learned. Still, you should review the [Earthquake Home Retrofit Handbook](#) and complete easy non-structural risk reduction projects. Step-by-step demonstration videos are accessible [here](#).

**Personal Risk**—people become trapped under the rubble and debris that is generated from the earthquake. Falling structures and flying glass leads to the worst casualties. In fact, the worst thing to do during an earthquake is to rush out into the street. The danger from being hit by falling glass and debris is many times greater in front of the building than inside. To best protect yourself from flying debris and building contents, the most important thing you can do is to drop, cover, and hold on. You can practice this technique during the Great Washington ShakeOut annual earthquake and tsunami drill. You can register for the drill and learn more about this technique and other earthquake safety tips [here](#). Also remember that if you are near the water or in a low-lying area (this map shows areas that have a designated tsunami [evacuation areas](#)) immediately move to higher ground after the shaking stops. Stay there until officials announce it's safe to return. Tsunami inundation in Island County regardless of whether it is from Cascadia (arrives in about 2 hours) or on a local fault (arrives in minutes) is not expected to exceed 8 to 9 feet. When other alternatives are not available and if you live in or have immediate access to a substantially built building then consider evacuating vertically—go to the second floor. If you wait until you can see the wave front or the water receding to an extremely low tide level you waited too long. You can't out run it!

Consider that 55% of injuries in the 1994 Northridge California quake were caused by falling objects, such as TVs, pictures and heavy light fixtures—mostly preventable injuries with a minimal amount of effort. Every home should have a completed copy of the [Earthquake Safety Checklist](#). And, because things change, get it out and go through it every year when you change your smoke detector batteries.

**Lifelines** are structures that are important or critical for a community to function, such as roadways, pipelines, power lines, sewers, communications, fuel delivery and port facilities. Emergency managers have developed detailed plans to deal with disruption of these vital services in the event of an untoward incident including an earthquake. There is a cadre of professionals devoted to lifeline engineering. Recovery after an earthquake is detailed in this link to [Resilient Washington State: A Framework for Minimizing Loss and Improving Statewide Recovery after an Earthquake](#).

Remember, what you do today will determine how quickly you and your family recover from the next damaging earthquake. By being prepared, you will have peace of mind knowing that you have done everything you could to protect yourself and your loved ones. Most preparedness literature advises that you have supplies on hand to sustain you and your family for 3 to 7 days. We live on islands. Be prudent, keep enough non-perishable food on hand to last two weeks to a month. Don't forget one gallon of water per person per day.

