Earthquake and Liquefaction

Hazard Description

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Its epicenter is the point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could occur. Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses.

Liquefaction is a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. The National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. NEHRP soil types define the locations that will be significantly impacted by an earthquake. NEHRP Soils B and C typically can sustain low-magnitude ground shaking without much effect. The areas that are most commonly affected by ground shaking have NEHRP Soils D, E and F.

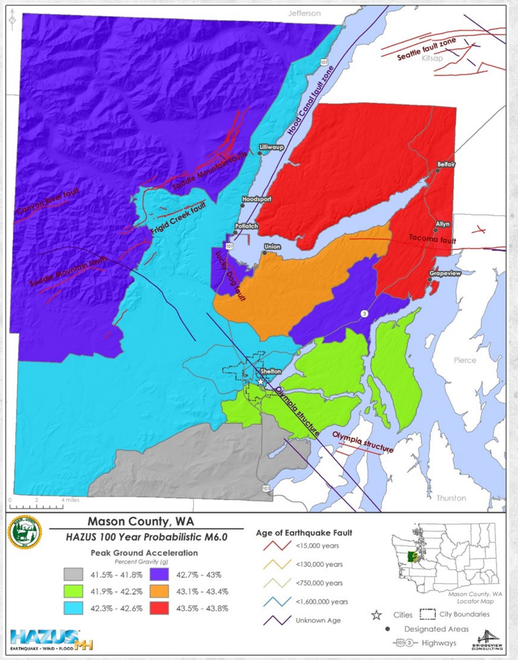
Soil liquefaction maps are useful tools to assess potential damage from earthquakes. When the ground liquefies, sandy or silty materials saturated with water behave like a liquid, causing pipes to leak, roads and airport runways to buckle, and building foundations to be damaged. In general, areas with NEHRP Soils D, E and F are susceptible to liquefaction. Areas susceptible to liquefaction are primarily low-lying marine or formerly tidal areas and filled areas. Areas with Peat do not "liquefy" like fill soil or mud, but earthquake shaking and vibration can cause it to fail and slump away from piling, supports, and foundations. The maps below illustrates the active earthquake faults in the area, along with the soils type.

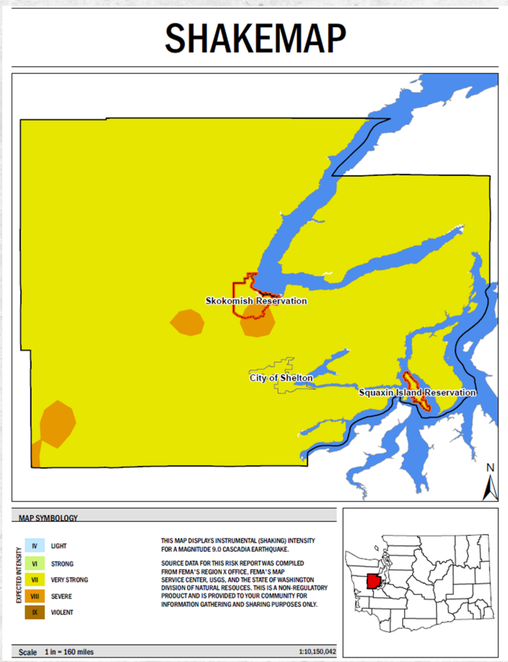
Shake Map

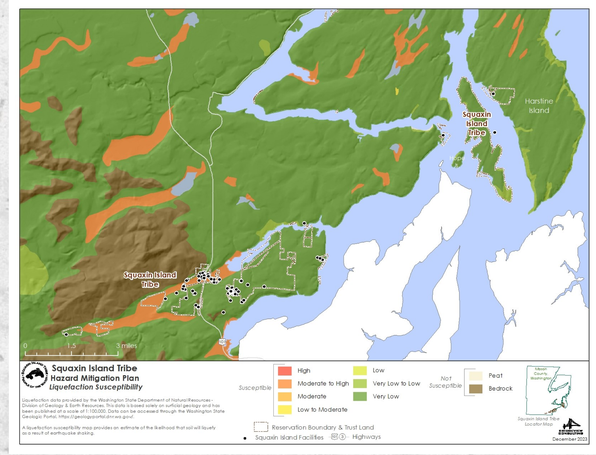
A shake map is a representation of ground shaking produced by an earthquake (Peak Ground Acceleration). The information it presents is different from the earthquake magnitude and epicenter released after an earthquake. The shake maps focus on the ground shaking rather than describing the earthquake source. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the seismic waves from the earthquake due to variations in the earth's crust. A shake map shows the extent and variation of ground shaking in a region immediately following significant earthquakes.

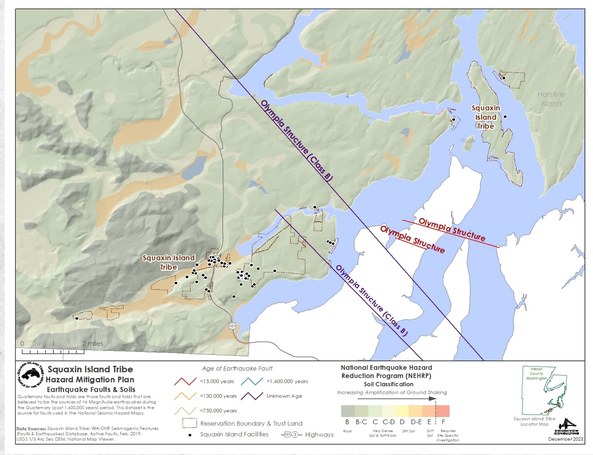
Ground motion and intensity maps are derived from peak ground motion recorded on seismic sensors. Color-coded intensity maps are derived from relations between peak ground motions and Modified Mercalli intensity. Earthquake scenario maps describe the expected ground motions and effects of hypothetical large earthquakes for a region.

The scenario chosen for this plan is the Cascadia Subduction Zone earthquake (FEMA, RiskMap 2017), and the 100-year Probabilistic Map. These scenarios were created by USGS. The maps below illustrate the impact of a probabilistic 100-year scenario, and Cascadia Subduction Zone on Mason County as a whole.









How often do Earthquakes occur in our state?

Earthquakes occur nearly every day in Washington. Most are too small to be felt. Large earthquakes are less common but can cause significant damage to the things we count on in everyday life, such as buildings, roads, bridges, dams, and utilities. Washington has the second highest risk in the U.S. to large and damaging earthquakes because of its geologic setting. The last major earthquake we had in Washington was the Nisqually Earthquake, which occurred on February 28, 2001 (Disaster Number 1361).