HAZARD IDENTIFICATION AND VULNERABILITY ANALYSIS (HIVA)

Walla Walla County, Washington

EARTHQUAKE

Hazard Overview

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up and the rock slips suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that we feel during an earthquake. A fault is a fracture or zone of fractures between two blocks of rock. Faults allow the blocks to move relative to each other. This movement may occur rapidly, in the form of an earthquake - or may occur slowly, in the form of creep. Most faults produce repeated displacements over geologic time. During an earthquake, the rock on one side of the fault suddenly slips with respect to the other.

The effects from earthquakes are caused by ground shaking, surface faulting and ground failure. Experience has shown that several types of landslides take place in conjunction with earthquakes. The most abundant types of earthquake-induced landslides are rock falls and slides of rock fragments that form on steep slopes. Shallow debris slides forming on steep slopes and soil and rock slumps and block slides forming on moderate to steep slopes also take place, but they are less abundant.¹

Liquefaction occurs when soil becomes soft and liquid-like during very strong ground shaking. Wet or low-lying areas are susceptible to liquefaction. As a result, the soil may be unable to fully support structures on the surface. What we feel as ground shaking during an earthquake is really waves of energy passing through the ground. These waves are much like the waves that radiate outward from a stone thrown into a pool of water.

If liquefaction-susceptible soil is water saturated, strong earthquake shaking causes the water pressure in the soil to increase as the waves of energy pass. If the ground shakes long enough, the water pressure may increase until it equals the weight of the overlying soil. When this occurs the soil and water mix and the soil floats temporarily. The shockwaves passing through the soil are not attenuated by the soil and the likelihood of damage to structures increases.

To estimate your susceptibility to liquefaction, see Liquefaction Risk map on page 5.

¹ Facing Geologic and Hydrologic Hazards -- Earth Science Considerations: U.S. Geological Survey Professional Paper Hays, W.W., ed., 1981,.

History and Probability of Occurrence

Earthquakes have long been a part of Washington State. *"Earthquakes are recorded by the University of Washington Seismograph Network. Most of Washington's earthquakes occur within the Puget Sound region and along the western side of the Cascade Mountains. Eastern Washington is a area of generally low seismicity – except for the Oregon-Washington border area."*²

A geological system called the <u>Olympic-Wallowa Lineament</u> (OWL) stretches from the Olympic Mountains to the Wallowa Mountains through Walla Walla County. The OWL is a series of geological features that indicate a history of earthquake action.

Two fault systems are located in Walla Walla County. The <u>Hite Fault System</u> is located along the foothills of the Blue Mountains stretching generally north and south. The <u>Wallula Fault System</u> stretches from the Wallula Gap on the Columbia River toward Touchet. A map extract showing the location of these faults is shown here.



<u>The 1936 Milton Freewater Earthquake</u>. *"At 11:05 P.M., July 15, 1936, the region around Walla Walla was so shaken by an earthquake that many persons left their beds for the outdoors in haste and perturbation. The writer's house at*

² Washington State Earthquake Hazards, by Linda Noson, Anthony Qamar and Gerald Thorsen.

the northern city limits of Walla Walla shook, rattled, rumbled, groaned and squeaked, but suffered no permanent damage. Many chimneys were broken, several houses were moved on their foundations, stacks of boxed and canned goods and shelf wares were scattered over floors with some damage.³³

"The Milton Freewater earthquake was the most destructive earthquake of the eastern Washington-Oregon border region since the late 1800s (Shannon and Wilson, Inc., 1975). Its intensity was greatest at Milton Freewater, State Line and Umapine in Oregon. Moderate damage occurred in Athena and Milton. Windows broke, walls cracked, chimneys collapsed, a two-story concrete house near Umapine lost part of its second story, and some standing railroad cars near Milton were derailed. Two schools in Umapine were damaged. Water issued from cracks as much as 60 meters long. Numerous after shocks were reported until November 1936. This earthquake was felt widely in parts of Idaho."⁴ This earthquake was estimated to have been a magnitude of 6.1 on the Richter scale.

As mentioned above another significant earthquake occurred west of Walla Walla in 1882. Its magnitude is not known, but it has been estimated to have been about magnitude 6.



³ The State-Line Earthquake at Milton and Walla Walla, by Benj. H. Brown, 1936 article in Seismological Society of America Bulletin.

Washington State Earthquake Hazards, by Linda Noson, Anthony Qamar and Gerald Thorsen.

Two earthquakes were felt in Walla Walla County in November 1991 and July 1992. They were centered about five miles south of Walla Walla and measured 4.3 and 4.1 on the Richter scale. Minor earthquakes occur frequently in and near Walla Walla County. Although many are not felt, the historical occurrence indicated that the area is an active earthquake zone. The Earthquake History Map shows the location and strength of measured earthquakes from 1970 to 2002. These were not of sufficient magnitude to cause damage, but they do indicate that we are in an active geologic area, which is prone to earthquakes.

The largest recorded earthquake in the State of Washington occurred in Eastern Washington near Lake Chelan December 15,1872. It was estimated at a magnitude 7.0. This earthquake was felt from British Columbia, Canada, to Oregon and from the Pacific Ocean to Montana. It occurred in a wilderness area,

"It is not a	question	n of <u>if</u> ,	it is a
question of	<u>when</u> a	6.5 mag	nitude
earthquake	strikes	Walla	Walla
County."			

John Winter, Ph.D. Professor of Geology Whitman College which in 1872 had only a few inhabitants - local Indian tribes, trappers, traders, and military men. Because there were few man-made structures in the epicenter area near lake Chelan, most of the information available is about ground effects, including huge landslides, massive fissures in the ground, and a 9-meter-

high geyser. Extensive landslides occurred in the slide-prone areas of the Columbia River. One massive slide, at Ribbon Cliff (between Entiat and Winesap), blocked the Columbia River for several hours. A field reconnaissance to the Ribbon Cliff landslide area in August 1976 showed remnants of a large landslide mass along the west edge of Lake Entiat (Columbia River Reservoir), below Ribbon Cliffs and about 3 kilometers north of Entiat. Although the most spectacular landslides occurred in the Chelan-Wenatchee area, land sliding was reported throughout the Cascades.⁵

History has recorded earthquakes that would be considered "strong" which implies intensity up to 6.5 magnitude. Since those earthquakes recorded in Walla Walla County are generally shallow earthquakes, significant damage should be expected.

There is a MEDIUM likelihood that a "strong" earthquake will occur within the next 25 years in Walla Walla County.

Vulnerability

The Liquefaction Risk Map shows the relative level of risk for additional earthquake damage as a result of liquefaction.

⁵ Seismicity of the United States, 1568-1989 (Revised), by Carl W. Stover and Jerry L. Coffman, U.S. Geological Survey Professional Paper 1527, United States Government Printing Office, Washington: 1993.



The entire population, property, commerce, infrastructure and services of Walla Walla County are vulnerable to an earthquake. The scope of damage is a

function of the earthquake magnitude and level of preparedness. Damage could range from minimal to high loss of life and destruction of property. The level of preparedness is assessed at very low in Walla Walla County. Most residents are unprepared for an earthquake. Little mitigation has occurred. Since 1984 when building codes placed Walla Walla County in Seismic Zone 2-B, additional seismic reinforcement is required,

"The Wallula fault zone southwest of Walla Walla has demonstrated that it has the capability of producing earthquakes of at least magnitude 6.0. Larger earthquakes in the 6-7 range cannot be ruled out. A magnitude 6.0 or greater earthquake on this fault zone would cause widespread minor to moderate damage in the Walla Walla area especially to older unreinforced masonry buildings and structures built on soft sediment or in areas prone to liquefaction. Damage in Walla Walla from a magnitude 6.0 earthquake on the Wallula fault zone would likely be at least as severe as the damage in Seattle caused by the recent 6.8 event. The Wallula fault zone is relatively close to Walla Walla and it tends to have relatively shallow earthquakes. The focus of Wallula fault zone earthquakes is therefore quite close to Walla Walla (<15 miles) and seismic energy is not much attenuated by the time it reaches our city."

Dr. Kevin R. Pogue Associate Professor and Chair Department of Geology Whitman College

Dr. Pogue teaches courses in geophysics that include earthquake seismology and he conducts research on the geologic record ot prehistoric earthquakes in Southeastern Washington. but buildings built before that were built with little consideration for seismic reinforcement. Most all infrastructure and buildings are located in areas of high liquefaction risk. It is likely that an earthquake of a 6.5 magnitude (strong) will cause moderate loss of life and moderate damage to structures.

The ratio of population, property, commerce, infrastructure and services at risk is rated at a MEDIUM vulnerability. An important segment of population, property, commerce, infrastructure or service is exposed to the effects of a hazard. In a worse case scenario there could be a disaster of moderate to major, though not catastrophic, proportions.

Risk Rating

The risk rating for earthquake in Walla Walla County is rated at MEDIUM. This rating warrants a modest program effort to prepare for, respond to, recover from and mitigate against the hazard.

Disclaimer

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