

The Tsunami Warning System – How Does It Work?

Have you wondered how the basic tsunami warning system works in our area? First, a key concept – there are two sources of tsunami for Washington coastal waters – a distant source and a local source.

A local source – if you feel violent shaking for several minutes, head for higher ground. **The earthquake is your warning.** The most likely source for a violent earthquake of this magnitude is from the [Cascadia Subduction Zone](#) just off our coast. The last associated earthquake was estimated to be 9.0 in magnitude on Jan 26, 1700, and was similar to the Dec 26, 2004 Sumatra 9.0 magnitude earthquake and subsequent Indian Ocean Basin tsunami as well as the Mar 11, 2011 Japan 9.0 magnitude earthquake and tsunami.

What To Do? - Simulations show the initial tsunami wave from the 1700 event reached the coast in 20 to 30 minutes – so time is limited. Geologic history showed waves with this event were as high as 30 feet. So you must get at least that high above sea level.

To top it off, the earthquake will also result in the coastal area subsiding as much as six feet, meaning the ground and roadways will likely be very uneven, and you are now that much lower to sea level. Since the roads will be in pieces, evacuation must be on foot. Another form of evacuation is vertical evacuation into a sturdy building of at least three stories and climb to at least the third story.

Other area earthquake faults could produce such strong violent quakes, such as the Seattle fault that produced a tsunami in Puget Sound about 1100 years ago. Yet, the most likely source for a local tsunami is the Cascadia Subduction Zone off our coast.

A Distant Source – The perimeter of the Pacific Ocean Basin, nicknamed the Ring of Fire, has a number of earthquake sources that can produce strong earthquakes of 7.0 magnitude or greater. During the 20th century, there were three 9.0 magnitude or greater quakes, the last was the 1964 Alaskan quake of 9.2 magnitude that produced a tsunami throughout the Pacific Basin. These kind of earthquakes permit a lead time of hours before their subsequent tsunami reaches the Washington coastline. Tsunamis from distant locations like Japan or Chile will take over 10 hours to get here, while from Alaska, only three to six hours.

Tsunamis generated from both sources of earthquakes do penetrate into the Puget Sound region via the Strait of Juan de Fuca and up coastal rivers, harbors and bays, but lose energy as they move further inland.

What To Do? - A Tsunami Warning System has been put into place to help minimize loss of life and property. The [West Coast/Alaska Tsunami Warning Center](#) in Palmer, Alaska monitors for earthquakes and subsequent tsunami events. If a tsunami is generated, they issue tsunami watches and warnings, as well as tsunami information bulletins for Alaska, British Columbia and Washington, Oregon and California.

The [Pacific Tsunami Warning Center](#) in Ewa Beach, Hawaii provides the same service for the Aloha state as well as all other American territories in the Pacific. They also serve as the [International Tsunami Warning Center](#) for over two dozen other member countries in the Pacific and Indian Ocean Basins as well as the Caribbean.

Both of the tsunami warning centers use earthquake information, tide gauges and now a new tool from NOAA – tsunami detection buoys, developed by NOAA's [Pacific Marine Environmental Lab](#). A total of 39 buoys are now deployed worldwide with nearly two dozen in the north Pacific to help scientists determine whether a tsunami has been generated and moving across the Pacific before reaching North American coastlines – another tool in the tsunami warning centers warning toolbox to help avoid false alarms. The dense buoy network helps provide backup to each other since the buoys do suffer outages in the harsh north Pacific Ocean.

Upon receipt of tsunami watches and warnings, coastal [National Weather Service](#) (NWS) offices such as those in [Seattle](#) and [Portland](#), activate the [Emergency Alert System](#) (EAS) via [NOAA Weather Radio](#). All broadcasters (TV, AM/FM radio, cable TV) receive the tsunami EAS message simultaneously as well as those with weather radio receivers in homes, businesses, schools, health care facilities, etc. In Washington state, All-Hazard Alert Broadcast (AHAB) outdoor siren systems located in remote coastal areas are activated by Washington State Emergency Management as well as local authorities, alerting people in those more isolated locations.

Upon receipt of tsunami watch and warning messages, local emergency management officials can decide to activate EAS to evacuate low-lying coastal areas in advance of the initial tsunami wave. Their EAS messages are also received by broadcasters, weather radio receivers and AHABs to help provide widespread dissemination of these messages. Follow the directions provided by your area emergency management officials – they will help save your life and those of your loved ones.

If you want your own tsunami warning message receipt system, obtain a weather radio receiver with EAS-programmable features. They are available from most radio electronic retailers and on the [Internet](#).

Education is another key element in the tsunami warning system. Many coastal areas have designated tsunami inundation zones and marked evacuation routes to assist residents and visitors to higher ground. Emergency management officials also distribute tsunami education information, conduct community meetings and workshops, and many more awareness activities.

The National Weather Service recognizes communities with strong tsunami warning and awareness programs through the [TsunamiReady](#) Community program. Such communities are recognized for their efforts to enhance their tsunami warning system, widespread use of weather radio receivers and community awareness activities. TsunamiReady road signs are also a part of NWS recognition.

Following is a diagram, briefly depicting the tsunami warning system process as well as specific terminology and links to more information.

Terminology and Links for more Information

Tsunami - Tsunamis are ocean waves produced by earthquakes or underwater landslides. The word is Japanese and means "harbor wave," because of the devastating effects these waves have had on low-lying Japanese coastal communities. Tsunamis are often incorrectly referred to as tidal waves, but a tsunami is actually a series of waves that can travel at speeds averaging 450 (and up to 600) miles per hour in the open ocean.

In the open ocean, tsunamis would not be felt by ships because the wavelength would be hundreds of miles long, with an amplitude of only a few feet. This would also make them unnoticeable from the air. As the waves approach the coast, their speed decreases and their amplitude increases. Unusual wave heights have been known to be over 100 feet high. However, waves that are 10 to 20 feet high can be very destructive and cause many deaths or injuries.

From an initial tsunami generating source area, waves travel outward in all directions much like the ripples caused by throwing a rock into a pond. As these waves approach coastal areas, the time between successive wave crests varies from 5 to 90 minutes. The first wave is usually not the largest in the series of waves, nor is it the most significant. Furthermore, one coastal community may experience no damaging waves while another, not that far away, may experience destructive deadly waves. Depending on a number of factors, some low-lying areas could experience severe inland inundation of water and debris of more than 1,000 feet.

Tsunami Watch – **Issued to alert emergency management officials and the public of an event that may later impact the watch area.** The watch area may be upgraded to a warning or advisory – or canceled – based upon updated information and analysis of the event. Emergency management officials and the public should prepare to take action. Watches are normally issued based on seismic information without confirmation that a destructive tsunami is underway.

Tsunami Warning – **Issued when a potential tsunami with significant widespread inundation is imminent or expected.** Warnings alert the public that widespread, dangerous coastal flooding accompanied by powerful currents is possible and may continue for several hours after arrival of the initial wave. Warnings also alert emergency management officials to take action for the entire tsunami hazard zone. Appropriate actions to be taken by local officials may include the evacuation of low-lying coastal areas, and the repositioning of ships to deep waters when there is time to safely do so. Warnings may be updated, adjusted geographically, downgraded or cancelled. To provide the earliest possible alert, initial warnings are normally based only on seismic information.

Tsunami Advisory – **Issued due to the threat of a potential tsunami that may produce strong currents or waves dangerous to those in or near the water.** Coastal regions historically prone to damage due to strong currents in bays, harbors and inlets induced by

tsunamis are at the greatest risk. The threat may continue for several hours after the arrival of the initial wave, but significant widespread inundation is not expected for area under an advisory. Appropriate actions to be taken by local officials may include closing beaches, evacuating harbors and marinas, and the repositioning of ships to deep waters when there is time do safely do so. Advisories are normally updated to continue the advisory, expand/contract affected areas, upgrade to a warning, or cancel the advisory.

Emergency Alert System – <http://www.fcc.gov/eb/eas/>

Emergency Alert System in Washington - <http://www.wsab.org/eas/eas.html>

All-Hazards NOAA Weather Radio – <http://www.nws.noaa.gov/nwr/>

All-Hazards NOAA Weather Radio in Washington state –

- National Weather Service - <http://www.wrh.noaa.gov/sew/nwr1.php>

- Washington State Emergency Management –

http://www.emd.wa.gov/publications/pubed/noaa_weather_radio.shtml

All-Hazard Alert Broadcast (AHAB) – A self-sufficient wind or solar powered warning system located in remote locations. It activates a brilliant blue US Coast Guard light and siren heard for at least a mile upon receipt of an emergency message, such as a tsunami watch or warning. It also records and repeats the verbal emergency message for those near the AHAB.

Tide Gauge – An instrument that measures the alternate rising and falling of the waters of the ocean, and of bays, rivers, etc., connected therewith. The tide ebbs and flows twice in each lunar day, or the space of a little more than twenty-four hours.

Seismometer –

<http://earthquake.usgs.gov/learn/glossary/?term=seismograph>

Cascadia Subduction Zone –

<http://www.pnsn.org/outreach/earthquakesources/csz>

Pacific Marine Environmental Lab – <http://www.pmel.noaa.gov/>

(includes tsunami and tsunami monitoring links)

Tsunami Detection Buoys – <http://www.ndbc.noaa.gov/dart.shtml>

(located in the north Pacific Ocean)

West Coast/Alaska Tsunami Warning Center – <http://wcatwc.arh.noaa.gov/>

(responsible for coastal waters from Alaska to California, including Washington)

Pacific Tsunami Warning Center – <http://www.prh.noaa.gov/ptwc/>

(responsible for all American interests in the Pacific, including Hawaii)

International Tsunami Warning Center – <http://www.prh.noaa.gov/itic/>
(responsible for the other 25 member nations in the Pacific Ocean Basin)

Tsunami Web Portal - <http://www.tsunami.gov/>

NOAA – National Oceanic and Atmospheric Administration – <http://www.noaa.gov>

National Weather Service – <http://weather.gov>

National Weather Service Seattle – <http://weather.gov/seattle>

National Weather Service Portland – <http://weather.gov/portland>

