EMERGENCY RESPONSE PLAN – PUYALLUP, WASHINGTON

(Fabricated by the NC Geological Survey & not at all official)

Puyallup, Washington is a beautiful city of about 43,000 residents that has so much to offer for nature lovers – mountains, rivers, glaciers, hiking, and much more. It also has a lot of potential geological hazards like the volcanic mountain that looms in the background and the geologic faults that lie beneath. To keep our citizens safe from hazards, the city has an Emergency Response Plan (ERP). An ERP is a set of written procedures for a facility or a city that deals with emergencies: how to plan for them, how to minimize the impact from them, and how to recover from them. Puyallup's ERP hasn't been updated in many years and I need to prepare a new one with the help of geologists and earth scientists.

Why does Puyallup need an ERP? Puyallup is on the doorstep of Mount Rainier, an episodically active volcano in the Cascade Mountain range. At an elevation of 14,411 feet, not only is it the tallest volcano in the Cascade Mountain range but it's also the most threatening one. There are a lot of geologic hazards associated with a volcanic mountain – eruptions and lava flows, volcanic earthquakes, lahars (mudflows), flooding from glacier melt, ash fall, and landslides. We also must consider that eruptions and mudflows could disrupt our city's water supplies and earthquakes could damage our houses, buildings, and businesses. Another hidden danger are the active fault zones in this area that aren't associated with the volcano that produce medium magnitude earthquakes.

This website is a great resource to learn about the hazards associated with Mt. Rainier: usgs.gov/volcanoes/mount-rainier/volcanic-hazards-mount-rainier

What types of geologists and earth scientists are needed to help prepare the ERP?

- Geologists
- Geomorphologists
- Geophysicists
- Volcanologists
- Hydrogeologists
- Environmental Geologists

What do I need you to research for the ERP?

- The type of tectonic plate boundary in the Pacific Northwest and what this means for the types of potential eruptions from Mt. Rainier
- Volcanic eruption history
- Possibility of lahars/mudflows based on past flows
- Earthquake history associated with the tectonic fault zone
- How our water supplies can be disrupted
- The type of environmental hazards that could happen because of a large earthquake or a volcanic eruption

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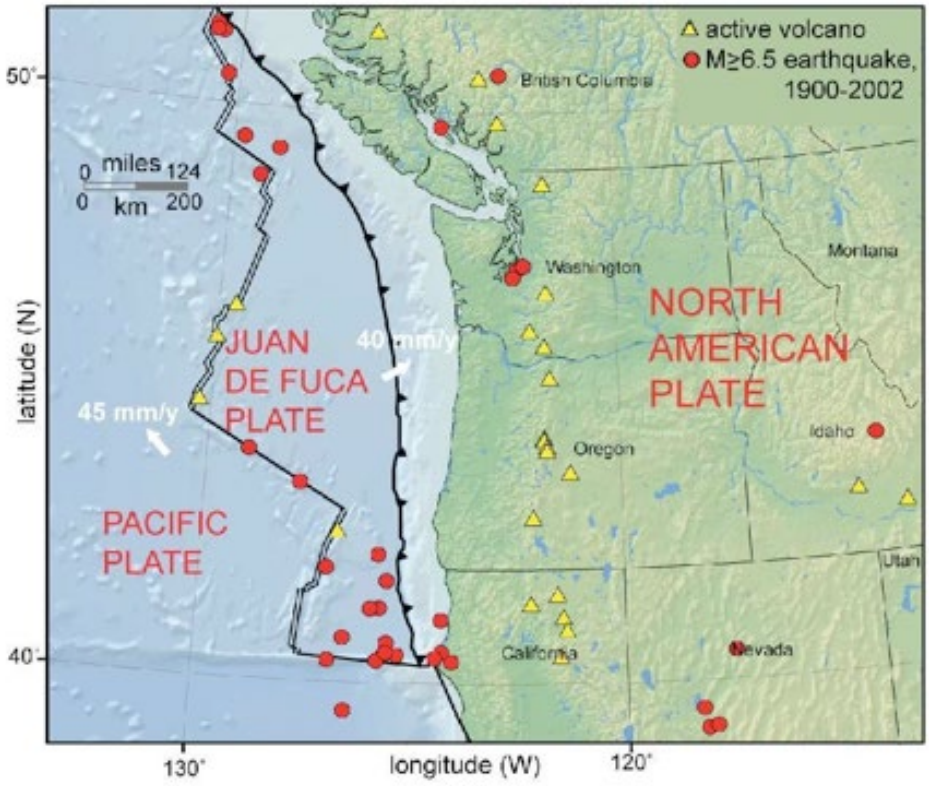
Geologists

First things first. Read the 'Volcano Fact Sheet' that is included with your handouts and then look at these two websites to learn about the types of tectonic plate boundaries:

- geology.com/plate-tectonics.shtml
- nps.gov/subjects/geology/plate-tectonics-types-of-plate-boundaries.htm

Here's a map of the Pacific northwest near Mt. Rainier. You'll notice the following tectonic plates: North American, Juan de Fuca, and the Pacific plate. Also notice the yellow triangles (active volcanoes) and the red dots (earthquakes with magnitudes greater than 6.5).



Did you realize that the Cascade Range of mountains included so many volcanoes?

You can use the websites listed in this handout, the Volcano Fact Sheet, and any other internet resources/websites to answer the questions on the next page.

1. What type of plate boundary is occurring between the Juan de Fuca plate and the North American plate – divergent, convergent or transform?

2. Can you briefly explain what that type of plate boundary is and explain how these plates, specifically, are interacting with each other?

For the next few questions, check out this website: nps.gov/articles/mount-rainier-volcano-monitoring.htm

3. What type of volcano is Mt. Rainier?

4. Can you briefly explain how this type of volcano forms?

5. When Mt. Rainier erupts, should we expect it to be a violent and explosive eruption or an effusive slow lava flow? Can you briefly explain why?

6. What else did you learn during your research that you think should be included in the Emergency Response Plan? Why should it be included?

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Environmental Geologists/Hydrogeologists

Puyallup is a city of nearly 43,000 people. In addition to providing services like trash collection, wastewater treatment, and road maintenance, we must also supply clean drinking water. Our city obtains its drinking water from two natural springs, five deep water wells, and by a connection to the City of Tacoma. We are proud of the clean and healthy water we provide to our citizens.

Puyallup is a modern city with modern conveniences for our citizens such as grocery stores, gas stations, and industries that employ many. While these conveniences provide services and goods to our citizens, many of them are also potential hazards. Gas stations store gasoline in underground storage tanks (USTs) that are connected to dispensers above the ground. Local chemical plants like NMP Chemical Plant, Discovery Chemical, Inc., and Air Products and Chemicals, Inc. produce potentially hazardous chemicals and products.

We need to understand how a volcanic eruption, lahar (mudslide), or earthquake could impact our water supply and our fragile ecosystems. You can use any website mentioned in these handouts or any other online resource/websites to answer the following questions. You can also read the Water Resources Fact Sheet to learn more about water resources.

- epa.gov/ust/natural-disasters-and-underground-storage-tanks
- waterboards.ca.gov/ust/tech_notices/ust_earthquake_assess.pdf
- health.ny.gov/environmental/water/drinking/oxygenates_in_drinking_water
- ehs.washington.edu/resource/earthquake-planning-chemical-storage-areas-focus-sheet-202
- ehs.washington.edu/system/files/resources/earthquake-plan-chem-storage.pdf

1. There are approximately 20 gas stations in Puyallup. If an earthquake strikes our area and there is damage to our downtown structures and business, we have to prepare for gasoline leaking from underground storage tanks into the groundwater beneath us. What are some steps that gas station owners can take to check their systems to see if the USTs have been compromised?

2. Part of our city's water supply comes from deep water wells that use groundwater. If USTs at gas stations are compromised due to volcanic activity and contaminants enter our water supply, what gasoline contaminants should we look for in our water?

3. If those contaminants from question #2 are detected in our water, what steps should our citizens take to lower their exposure to the contaminants that are known to cause health problems?

4. What are some steps that our chemical manufacturers and chemical facilities can to prepare for a natural disaster such as a volcanic eruption or an earthquake?

5. Is there anything else that you learned during your research that you think is important to include in our Emergency Response Plan? Why should it be included?

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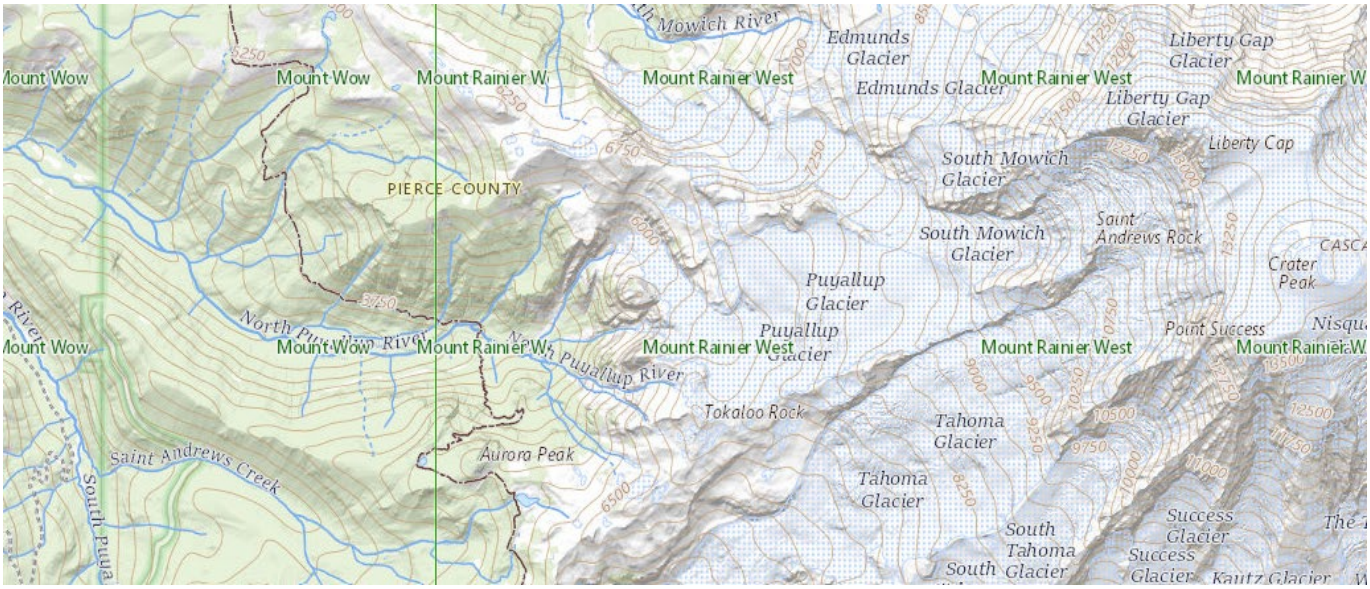
Geomorphologists

We need your help to understand how a possible volcanic eruption from Mount Rainier could change the landscape of our city. The elevation of Mt. Rainier is 14,411 feet above sea level (asl); the elevation of Puyallup is only around 500 feet asl. That's a lot of change in elevation which makes our city very susceptible to landslides, especially during and after a volcanic eruption.

Look at this topographic map below of Mt. Rainer – that's a lot of elevation change in a short distance from the peak to our town! You should also notice the number of glaciers on top of the mountain. If these were to melt due to a volcanic eruption, all that water would come rushing down the valley towards our city. We need to prepare our citizens for the potential for landslides, so the information you provide is critical for the ERP.



You can also access the topographic map of this area by going to: **https://store.usgs.gov/map-locator** and typing in Puyallup, Washington.

You can use any website mentioned in these handouts or any other online resource/website to answer the questions on the next page.

- usgs.gov/volcanoes/mount-rainier/volcanic-hazards-mount-rainier
- cityofpuyallup.org/2040/Landslides
- usgs.gov/volcanoes/mount-rainier/landslides-rockfalls-can-trigger-lahars-mount-rainier
- usgs.gov/faqs/what-landslide-and-what-causes-one
- usgs.gov/volcanoes/mount-rainier/geology-and-history-summary-mount-rainier

1. For our citizens who just moved here, can you briefly answer this question – what is a landslide?

2. Not only do we have to worry about landslides from a volcanic eruption, but there is an active fault zone nearby that causes earthquakes that can trigger landslides. Look at the Landslides section of this document: **dnr.wa.gov/publications/ger_geologic_risk.pdf** Can you tell me a little bit about one or two landslides that have occurred in Washington?

3. What are a few of the warning signs of a potential or impending landslide?

4. What should we include in the Emergency Response Plan for our citizens so that they can stay safe in the event of a landslide?

5. What else did you learn during your research that you think should be included in the Emergency Response Plan? Why should it be included?

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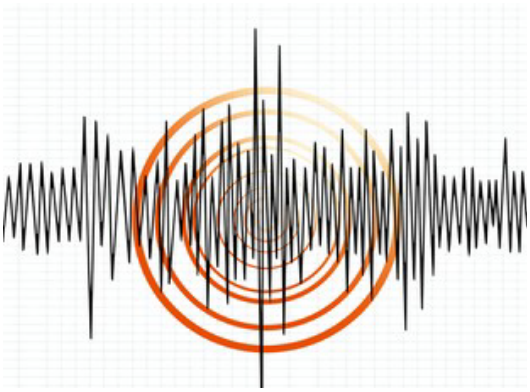
Geophysicists



In an average year, the earthquake monitoring network detects a few hundred earthquakes near Mt. Rainier. Most of the earthquakes are small in magnitude, but we'd like to know the potential for larger earthquakes to occur. Most hazards from earthquakes occur from man-made structures – being crushed in collapsed buildings, drowning in a flood from a broken dam or levee, or even being buried in a landslide.

There's speculation from scientists that an active tectonic fault zone in our region called the Western Rainier Seismic Zone (WRSZ) trends north-south for 40 miles along the western side of Mt. Rainier National Park. We'd like to know if there's a chance of an earthquake from this Zone or from anywhere else other than Mt. Rainier. This if vital information to include in our Emergency Response Plan.

Please read the Volcano Fact Sheet provided with your handouts. You may use any of the websites mentioned in this activity or any other website resources to answer the questions below.

- usgs.gov/volcanoes/mount-rainier/earthquake-monitoring-mount-rainier
- usgs.gov/news/brief-earthquake-swarm-detected-beneath-mount-rainier
- usgs.gov/volcanoes/mount-rainier/earthquake-hazards-mount-rainier
- geo.mtu.edu/volcanoes/hazards/primer/eq.html

1. We know that there are earthquakes near Mt. Rainier. Can you provide information about the most recent earthquakes that have occurred? Were they large earthquakes and did they produce any damage?

2. What is the largest earthquake that has been detected at Mt. Rainier? When did it occur and what was the magnitude?

3. What types of damages to our city can we expect if there is a large earthquake near Mt. Rainier?

4. Are there any signs that our citizens should be aware of that may signal an earthquake is about to happen?

5. I've heard about something called an "ice quake" - what is it and should the citizens of Puyallup worry about them?

6. What else did you learn during your research that you think should be included in our Emergency Response Plan? Why would it be important to include?

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Volcanologists

The Emergency Response Plan for Puyallup needs to include information on the eruption history of Mt. Rainier – how often it erupts and if an eruption is likely to happen soon. Eruptions can cause hazards such as lava flows, ash falls, lahars (mudflows) and many more. We need to have this valuable information in our ERP in order to keep our citizens safe. Please read the Volcano Fact Sheet that was included with your handouts. You can use any website mentioned in these handouts or any other online resource/websites to answer the questions below.

- usgs.gov/volcanoes/mount-rainier/geology-and-history-summary-mount-rainier
- usgs.gov/volcanoes/mount-rainier/volcanic-hazards-mount-rainier
- dnr.wa.gov/publications/ger_geologic_risk.pdf
- usgs.gov/volcanoes/mount-rainier/eruption-history-mount-rainier
- geology.com/usgs/rainier/

1. When do other volcanologists believe that Mt. Rainier began erupting? (There could be two parts to this answer)

2. When was the last *significant* eruption from Mt. Rainier? What damages occurred from this eruption? (As an added question, I'm curious what criteria you used to decide if an eruption was significant?)

3. Do other volcanologists believe that Mt. Rainier is due for an eruption? Why or why not?

4. Why is Mt. Rainer considered to be one of the most dangerous volcanoes in the U.S.?

5. Is there any other information you learned during your research that would be important to include in our Emergency Response Plan? Why should that information be included?

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Volcanologists-2

Ok, volcanologists – you have a very important job to help keep Puyallup citizens safe. The most damaging hazards from snow-capped volcanoes are lava flows, lahars (mudflows), and ash fall. Many of our citizens live and work in areas that could be in the paths of these dangerous hazards, and we need to be able to predict future flows in order to be prepared.

Start by reading the Volcano Fact Sheet that's been included in your handouts. You can use any websites noted in the handouts, the included Fact Sheets, or any additional websites or resources to answer the questions below.

- usgs.gov/volcanoes/mount-rainier/geology-and-history-summary-mount-rainier
- usgs.gov/volcanoes/mount-rainier/volcanic-hazards-mount-rainier
- dnr.wa.gov/publications/ger_geologic_risk.pdf
- geology.com/usgs/rainier/
- nps.gov/articles/mount-rainier-volcano-monitoring.htm

1. How many glaciers are atop Mt. Rainier? How does the presence of these glaciers cause additional hazards during an eruption?

2. What is a lahar and why is Mount Rainier particularly susceptible to them?

3. There have been at least two major lahars that have reached Puyallup in the past – Osceola Lahar and Electron Lahar – which have created the Puyallup River valley. Do you think damming this River will help to keep lahars from reaching Puyallup in the future? Why or why not?

4. A significant hazard associated with volcanic eruptions is ash fall. Please list a few ways that ash from a volcano can cause problems in the proximity of the volcano as well as areas far away from it.

5. Is there anything else that you learned during your research that you think should be included in the Emergency Response Plan? What should it be included?