7-2 Final Project Submission: Preliminary Report of Environmental Findings

Executive Summary

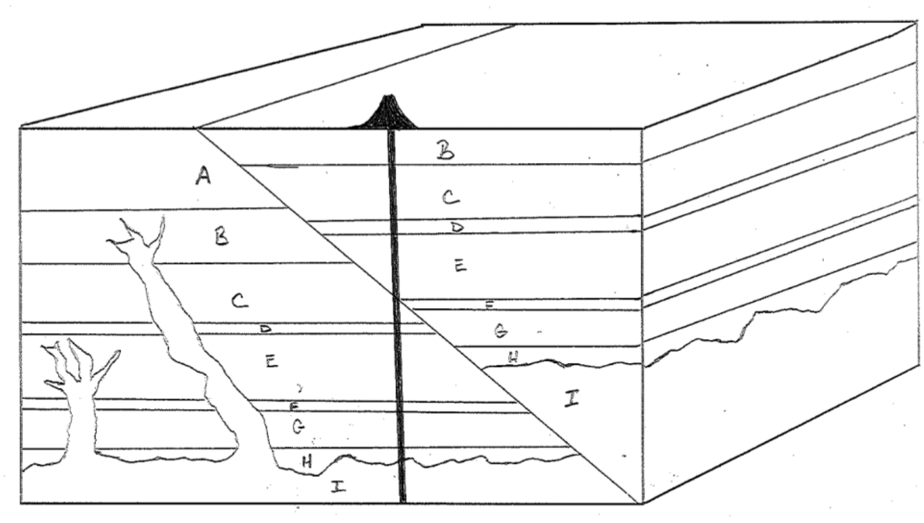
The Report of Environmental Findings provides a comprehensive view of the region's (1) geology, (2) streams, (3) tectonic activity, and (4) historical weather patterns.

1. The geology section talks about the region's geology, its composition, how they were deposited, and the soil content.
2. The stream section talks about the stream landscape processes and the flood plain created by the streams.
3. The tectonic section talks about the impact from the fault that traverses the region and the risks that it creates from earthquakes and volcanic activity.
4. The historical weather section evaluates historical weather patterns to determine the flood plain and provides a risk analysis of floods at various stages of the flood gauge.

All this information provided can be used to help plan for future land development of the area and mitigate risks where necessary.

Basic Geology

Rock Stratigraphy



(Figure 1.1)

The table below corresponds to the image to the left. The stratigraphic layer labels are presented in alphabetic order from the surface to the deepest stratigraphy's.

Stratigraphic Layer Label	Rock Type	Deposition Notes
A	Limestone	After layer B was deposited, sea levels rose to cover this area in a shallow sea. As sea levels receded, the calcite from marine life precipitated through water which hardened to form limestone.
B	Sandstone	After the sea receded and limestone formed in layer C, the area remained dry long enough for rocks to erode through the normal erosion processes such as wind, water, and ice. Over time, these created an abundance of sand. This sand was compacted and cemented together.
C	Limestone	After layer D was deposited, sea levels rose to cover this area in a shallow sea. As sea levels receded, the calcite from marine life precipitated through water which hardened to form limestone.

D	Coal	After the siltstone formation of layer E, an abundance of plant life thrived in a swamp or a bog. This life died and was buried in sediments. This burial put immense pressure on the decaying organic material, which then hardened to form coal.
E	Siltstone	Siltstone is formed from fine silty sediments that compress and harden when water percolates over it. Silty sediments are typically deposited in river deltas as they join the ocean.
F	Coal	After the sandstone formed from layer G, an abundance of plant life thrived in a swamp or a bog. This life died and was buried in sediments. This burial put immense pressure on the decaying organic material, which then hardened to form coal.
G	Sandstone	This layer of rock was initiated by erosion of rock to create an abundance of sand sediments. Over time, this sediment was compacted from the weight of sand and sediments above it. Then water percolated through the sand and cemented it together to form sandstone.
H	Schist	Layer H was formed as immense pressure from the layers above compressed the original rock. This immense pressure also creates heat. Over time, this rock went

		through a metamorphosis to create schist.
I	Granite; Volcano and Vent = Andesite	Layer I was caused by magma cooling to form granite. As magma pushed its way upward in the stratigraphic layers through volcanic vents it cooled to form Andesite.

Deposition Analysis

The region was once an estuary, where the river meets the sea. The evidence of siltstone and coal in the stratigraphic layers suggests that the area could have been a river delta and that fine silty sediments were once being deposited into the sea. Coal suggests there were several distributaries and that it was once a swampy area. The ingress and egress of limestone from stratigraphic layers A and C suggest that the sea levels rose and receded due to climate change events, such as ice ages and periods of warming. Before these periods of sea level changes river delta deposition, there was volcanic activity deep below the surface. This volcanic activity is evidenced by the presence of granite and andesite.

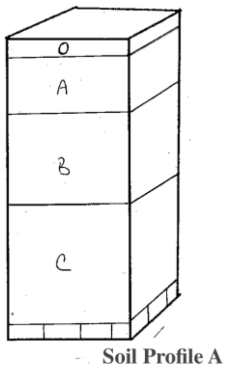
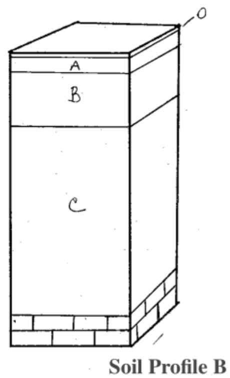
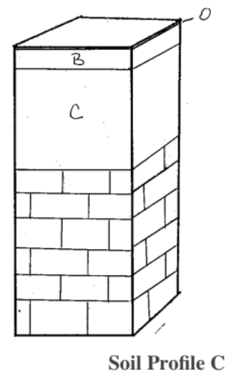
Relative Dating

In the stratigraphy profile the youngest stratigraphic layer is layer A. This layer is a limestone layer closest to the surface that is uninterrupted. The second youngest layer is layer I. While this granite layer starts deeper in the profile, it extrudes through all the other layers in the profile apart from layer A. The extrusion is an Andesite rock and is the second youngest rock in the profile. The remaining layers; B through H; have an age that corresponds to the order in which they were deposited. Layer B being the third youngest stratigraphic layer and layer H being the oldest.

Geologic Features

The stratigraphic profile details a fault that exists through all the layers. The right side of the fault is pushing up. This is a *thrust fault* (Lutgens et al., 2021, pp. 133). The A layer on the right side of the fault has eroded away and no longer exists. Layer I has extruded through layers H to layer B. This extrusion was caused by magma flowing through voids in the rock and cooling to form Andesite.

Soils

		
(Figure 1.2) Soil Profile A	(Figure 1.3) Soil Profile B	(Figure 1.4) Soil Profile C

The “A” soil profile's location has a thick horizon of surface soil, followed by a thick horizon of rock material, and lastly, a thick horizon of parental rock material. The “B” soil profile’s location has a thin horizon of surface soil, followed by a medium thickness horizon of rock material, and lastly a thick horizon of parental material. The “C” soil profile has no surface soil horizon, followed by a very thin rock material horizon, and a thick horizon of parental material. Erosion is occurring in soil profile’s B and C with the deposition of eroded sediments in soil profile A.

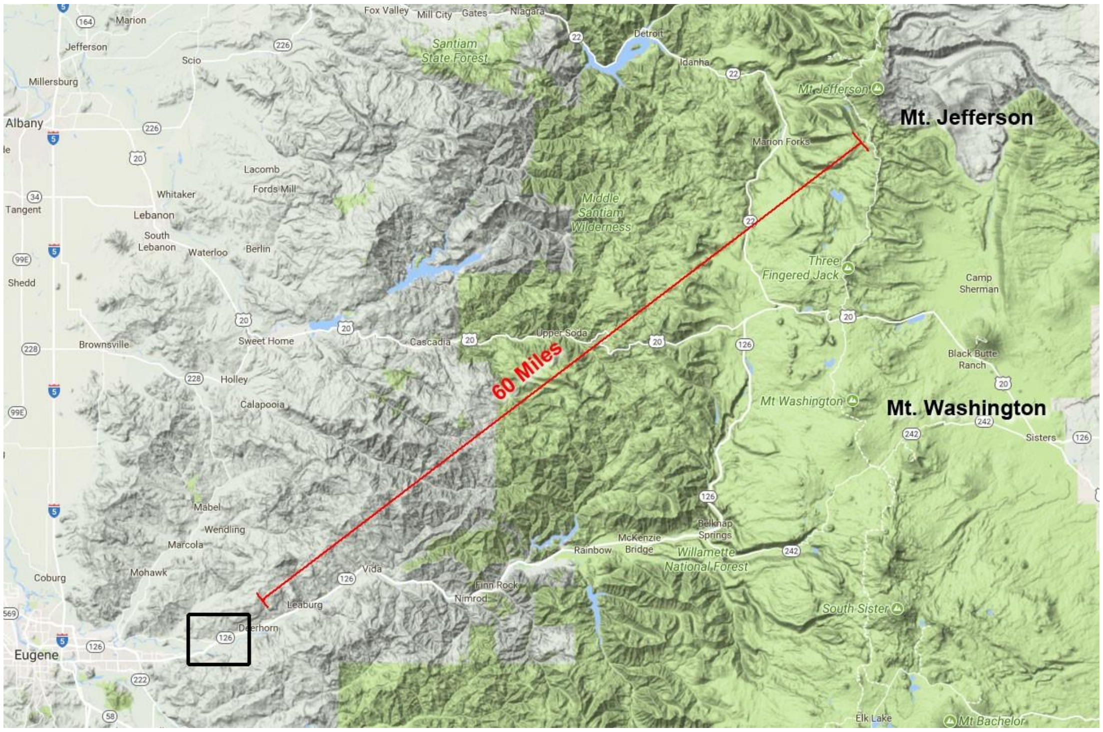
Surface Impact

Bedrocks closer to the surface provide a solid foundation for building neighborhoods on top. A neighborhood in soil profile A may see settling and foundation issues as the soil horizons compress.

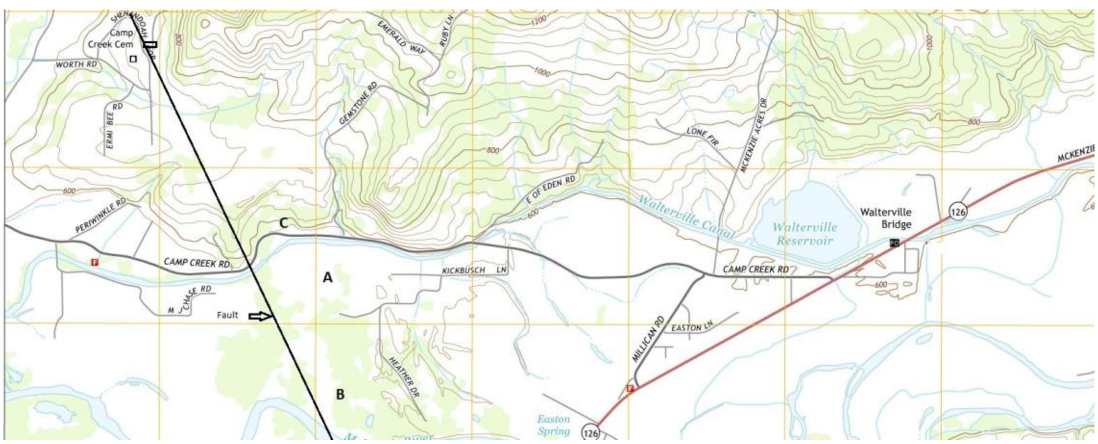
Streams

Landscape Processes and Stream Features

(Figure 2.1: Broad geographic topographic map)



(Figure 2.2: Focused area topographic map)



Oregon Highway 126 follows the path of the meandering McKinzie River. The McKinzie River has eroded a valley in the Cascade mountains. Closer to the headwaters of the McKinzie River, at Clear Lake; west of Mount Washington, the river valley is steep and narrow. Further downslope, east of Eugene, the valley is wider as the river has meandered and widened the valley. In places meandering bends meet to create a shorter path, segregating the hump to create an *oxbow lake*. Natural levees are created during flood events that deposit sediments along the river's upper banks. In several places, tributaries flow downslope into the McKinzie River, creating *alluvial fans*. There are also places where a parallel stream has been formed next to the main river channel. This parallel stream is called a *Yazoo stream*. Sporadically through the meandering river, there is evidence of braided streams. These braided streams were created when the area was glaciated and had several glacial streams that merged to create the braided stream.

Stream Floodplain and Erosion

The floodplain widens the closer that the McKenzie River gets to Eugene. This wide floodplain will continue to widen as the bends of the river erode outward. In a meandering river, faster moving water erodes the outer banks of the river bend, while slower moving water on the inner portion of the bend will deposit sediments. Over time, this causes the floodplain to widen. Development in the floodplain would be a risk. As the river meanders outward to widen its floodplain, infrastructure and land development within the floodplain risk being damaged by perpetual erosion of the floodplain landscape.

Tectonics

In figure 2.2, a fault is identified running north-northwest on the topographical map. To the east of the fault are the Cascade Mountains, including Mount Washington and Mount Jefferson. Both mountains are volcanoes. The mountains' sudden uplift, volcanoes and area hot springs along the McKinzie River provide evidence of tectonic activity in the region. The topography suggests the west plate is moving to the east along the fault. This is a convergent plate boundary. Its geology is denser than the geology to the east of the fault. This is causing subduction in which the plate to the west of the fault is subducting under the plate on the east of the fault. This helped the mountain building event that built the Cascade Mountains. As the subducting plate travels into the asthenosphere, the rocks in the plate can melt and rise through earth's crust to create volcanoes and heat subsurface water to create hot springs.

Historical Data

Mount Jefferson Eruption History (VEI Rank)

Rank	VEI	Years Before Present
1	6	2,402
2	5	3,752
3	5	1,214
4	4	4,903
5	4	631
6	3	3,120
7	3	1,809
8	3	4,189

Fault History

Rank	Magnitude (Richter Scale)	Years Before Present
1	7.3	170
2	7.0	425
3	6.9	600
4	6.9	85
5	6.8	510
6	6.5	255
7	6.2	350

The tectonic activity in the region has historically been active. From a tectonics standpoint, the two potential hazards of the region are earthquakes and volcanic eruptions.

As the convergent plates collide into each other, they can catch each other. When this happens, pressure will build up as the plates continue to converge. When the built-up pressure is greater than the strength of the rock, the rock will break creating an earthquake.

Volcanoes erupt when pressure from gas and magma build in a volcanic in earth's crust. The built-up pressure then releases suddenly when a weak spot in earth's crust gives way. This sudden release of pressure spews gases, rocks, and sediments into the air. It can also allow magma to be released onto earth's surface creating a lava flow.

Weather

Temperature, Precipitation, and Storms

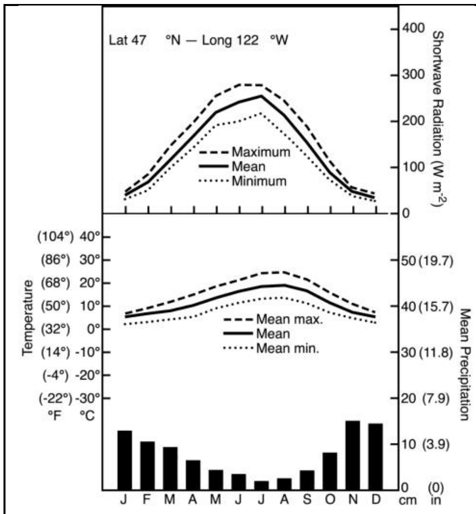


Figure 3.1: Climograph

Month	Mean Temperature	Mean Precipitation
January	5	13
February	7	11
March	8	10
April	10	8
May	14	5
June	16	3
July	18	2
August	16	3
September	15	5
October	10	8
November	8	16
December	6	15

Table 3.2: Climograph Temperature and Precipitation

The mean temperature is 11 degrees Celsius. The mean precipitation is 99 centimeters annually.

- *Winter (December through February)*: Shorter days and lower sun angle result in cooler temperatures. Higher precipitation is the result of winter storms and increased frontal where polar fronts are more active.
- *Spring (March through May)*: Longer days and higher sun angle result in an increase in temperatures. A decrease in precipitation is observed. This could be due to the retreat of the polar front as the region transitions to warmer weather.
- *Summer (June through August)*: Summer is the longest days of the year with the highest sun angle of the year. The result is the hottest temperatures of the year. This time of the year also results in the lowest precipitation of the year. This could be the result of a stable high-pressure system.

- *Fall (September through November)*: After the summer solstice, days begin getting shorter and the sun is at a lower angle. The result is lower temperatures. November is the peak for precipitation. This is due to the return of the polar front.

Historical Weather Data Recurrence Intervals

Table 3.3: 24-Hour Highest Magnitude Precipitation Events from Last Event

Rank	Date	PPT Amount (Inches)
1	11/2/1917	12.09
2	11/16/1966	10.02
3	12/4/1990	9.52
4	11/16/2003	8.66
5	1/2/2009	6.75
6	12/7/2012	4.36
7	1/6/2014	4.20
8	11/14/2012	4.01
9	12/3/1918	3.86
10	11/2/2006	3.54

Table 3.4: Project Site Stream Data (Period: 1905–2014)

Rank of Annual Highest River Stage	Year of Last Rank	River Elevation Above Gauge (Feet)	Gauge Elevation Above Sea Level	River Elevation Above Sea Level	Probability of Occurring in Any Given Year
1	1917	34.11	255.83	289.9	1 in 100
2	1970	27.40	255.83	283.2	1 in 50
3	1985	26.05	255.83	281.9	1 in 33.3
4	1990	26.00	255.83	281.8	1 in 25
5	2000	25.20	255.83	281.0	1 in 20
20	2009	21.30	255.83	277.1	1 in 5
30	2012	20.60	255.83	276.4	1 in 3.4
40	2012	19.30	255.83	275.1	1 in 2.3
50	2013	18.50	255.83	274.3	1 in 2
60	2013	17.70	255.83	273.5	1 in 1.8
70	2013	17.25	255.83	273.1	1 in 1.5
80	2013	14.76	255.83	270.6	1 in 1.3
90	2014	13.00	255.83	268.8	1 in 1.1
100	2014	8.99	255.83	264.7	1 in 1

In Fall of 1917, the high-pressure system from the summer months weakened, allowing for frontal systems to blow in. A large center of low-pressure system, called a middle-latitude cyclone, converged with a high-pressure system. The result was a cloud building event that caused an abundance of precipitation. The amount of precipitation in a brief period inundated the region's streams, causing the rising waters to breach their banks, flooding the area.

Analysis of Findings

The proposed development area in question has three major risks. Those risks are (1) flooding, (2) earthquakes, and (3) volcanic activity.

Extreme precipitation events can lead to flooding of the mountain valleys that the region is contained in. Flood events can also lead to excessive erosion of the mountain slopes, creating a risk for mud slides. When evaluating proposed land development, it is important to consider these extreme precipitation events. It may be prudent to leave land undeveloped where the risk of damage to infrastructure and life is high. If it is chosen to develop elevated risk areas, civil engineering requirements may need to be taken into consideration to mitigate the risk of extreme precipitation.

The likelihood of tectonic activity must be considered. Earthquakes and volcanic eruptions can devastate property and take lives. From the historical data, major volcanic eruptions did not occur until approximately 631 B.P. The last major earthquake occurred approximately 85 B.P. These are not frequent events; thus, development of the region can continue with appropriate precautions. However, there will always be a risk of tectonic-related hazards due to the convergent plate's location.

References

Lutgens, F. K., Tarbuck, E. J., & Tasa, D. G. (2021). Foundations of Earth Science (9th ed.). Pearson Education (US). https://mbsdirect.vitalsource.com/books/9780135851609