ES473 Environmental Geology – Willamette Valley Hydrogeology – Overview Exercise

Working in groups of 3 students at your lab tables, systematically review the powerpoint slide show at following link:
http://www.wou.edu/las/physci/taylor/g473/willamette_valley_hydro_review_exercise.ppt

The powerpoint is comprised of 25 slides total. Using a group discussion process, in your team of 3, answer the following questions for each slide.

Slides 1 and 2

Draw a sketch map and describe the physiographic distribution of the Willamette Valley from north to south. In your answer include western and eastern boundaries that define the valley; and the organization with respect to sub-basins.

What part of the physiographic framework is Monmouth-Independence situated in? What are the names of the upland areas that break the valley into the northern southern portions?

What parts of the valley are widest? What parts narrowest?

Slide 3

In cross-sectional view, from west to east, what are the approximate average elevations of peaks in the Coast Range? What are the approximate average elevations of peaks in the Cascade Range?

Using the longitudinal profile, calculate the total average river gradient (at river elevation) from Eugene to Willamette Falls. Calculate in ft/mi and dimensionless decimal percent.

Slide 4

Where are the top two highest precipitation locations in greater Willamette Basin areas? What are the highest average precip. values (inches) in the basin? What are the lowest average precip. values (inches) in the basin and where are they generally located?

What months receive the highest average precipitation? What months receive the lowest?

Slide 5

Compare the average monthly discharge on the eastern and western flanks of the Willamette Valley. Which tributaries of the valley have the highest monthly discharge? Which have the lowest?

Provide a geologic hypothesis explaining the patterns you observe.

Slide 6

Draw a sketch map and provide an overview of the tectonic setting of the Willamette Valley.

Slides 7 and 8

List the main types of geologic features associated with the Willamette Valley. What are the dominant fault orientation directions? Are there more than one?

Do you observe any North-South bounding faults that run the length of the valley? True or False: is the Willamette Valley a graben? Explain your answer and reasoning.

List the major faults in the central Willamette Valley? What are the dominant fold axis orientations?

Slide 9

Examine the generalized geologic map of the Willamette Valley. What rock units hold up the east and west flanks of the valley? Where do the CRB's occur? How far south? Describe the distribution of the Willamette Silt (Missoula floods) vs. that of river alluvium? How far south do the Willamette Silts occur?

Slide 10

Examine the cross section of the Willamette Valley. Calculate the average thickness of valley-fill alluvium in the central portion of the valley. Provide answers in feet and meters.

Slide 11

Examine the generalized cross section at approximate the latitude of south Salem. What is the primary shallow aquifer material in the area? What is the primary deep aquifer material in the area? What is the average thickness of the Willamette Silt? Does the silt act as aquifer or aquitard material?

Slide 12 and 13

In ascending order, list the primary stratigraphic units that underlie the mid-Willamette Valley in the Monmouth-Independence area.

What are the oldest rock units in the area? What are the youngest mappable geologic units?

Slides 14 and 15

When did the Missoula Flood time occur in geologic history? What is the maximum discharge that has been reconstructed (express as cubic ft/sec)

Slide 16

In ascending order, list the primary hydrogeologic units of the Willamette Valley. Hydrogeologic units refer to the permeability/porosity properties of the stratigraphic units, and their ability to either act as aquifers or aquitards.

Slide 17

What are the primary aquifer/water-bearing hydrogeologic units in the northern Willamette Valley? What are the primary aquifer/water-bearing hydrogeologic units in the southern Willamette Valley?

Slide 18

Columbia River Basalt Aquifer: where does it occur in the Willamette Valley? Is it a deep aquifer or shallow? True or False: the CRB aquifer is an important source of groundwater for Corvallis and Eugene areas (explain your reasoning).

Slide 19

An isopach map is a “thickness” contour map with lines showing equal thickness of geologic materials. Based on the isopach map, what portions of the Willamette Valley are associated with the thickest occurrence of the Willamette Confining Unit. What portions the thinnest? What is the maximum thickness in feet?

Slide 20

Examine the isopach map of the Willamette aquifer (river gravels). Where is the aquifer thickest? Where is it thinnest? Compare the western aquifer to the eastern aquifer. Which portions are thickest? What is the maximum thickness in feet?

Provide a geologic hypothesis to explain the thickness patterns that you observe.

Slide 21

Examine the isopach map of the Willamette Silt unit (Missoula Flood Deposits). Where is the unit thickest? Where is it thinnest? Compare the northern silt occurrence to the southern. Which portions are thickest? What is the maximum thickness in feet?

Provide a geologic hypothesis to explain the thickness patterns that you observe.

Slide 22

What geologic materials have the greatest hydraulic conductivity in the Willamette Valley. Based on the thickness maps and hydraulic conductivity values, what geologic materials possess the greatest production potential for groundwater resource development in the Willamette Valley? Explain your reasoning.

Slide 23

Specific capacity of a water well in the pumping rate dividing by the drawdown in the cone of depression. Good aquifers allow maximum pumping capacity, with minimum drawdown. Hence high specific capacities and high hydraulic conductivities make for good aquifer potential.

Examine the specific capacity map of the Willamette Valley. Where do the highest specific capacities occur in the valley? Where do the lowest occur? Compare the thickness map data to the hydraulic conductivity data to the specific capacity data. Where would you recommend installing large-scale pumping wells with the best chance of success for ground water production in the Willamette Valley? Explain your reasoning.

Slides 24 and 25

Slides 24 and 25 show groundwater levels in production wells from the Willamette (gravel) aquifer and deep CRB aquifer units. Describe both the seasonal and long-term groundwater withdrawal / water level patterns that you observe. Has there been massive groundwater decline in the Willamette Valley over the past 50 years? Provide an overview of production potential for groundwater resource development in the Willamette Valley.