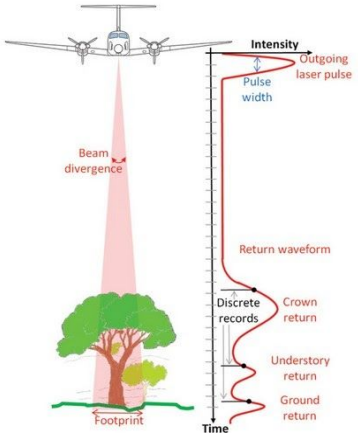
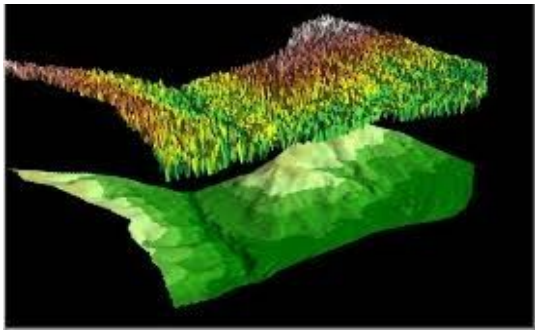
ES473 Environmental Geology – Quiz 3 (30 Pts) **Spring 2020** **Name: EXAMPLE**

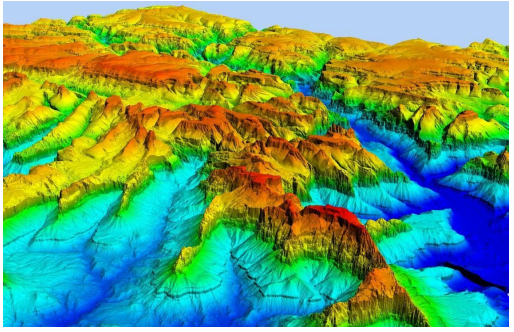
A. **Short Answer Essay / Definition.** Briefly define or discuss the following terms and concepts. Include a drawing or sketch as required. 4 to 5 well written sentences are appropriate for each answer.

1. Discuss the purpose and methodology of bare earth laser swath mapping using LiDAR.. In your answer include explanation of the term LiDAR, procedures of data collection, and products derived from the procedure. Provide two real-world applications of how LiDAR is being used in Environmental Geology (include a sketch to illustrate your answer) **(4 pts)**

LIDAR, light detection and ranging, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges and distances to Earth. Data collection is done with some sort of airborne pulse detector collection device either on an airplane or drone. The products are maps like a bare-earth model, a model of Earth's surface without vegetation, buildings, or other non ground object and a digital elevation model (DEM), a 3D representation of a terrain surface elevation both using laser swath mapping, a method used to define physical features of lands down to a few centimeters. Some real world applications include earthquake detection and coseismic landslides detection like U of O is doing here in Oregon.

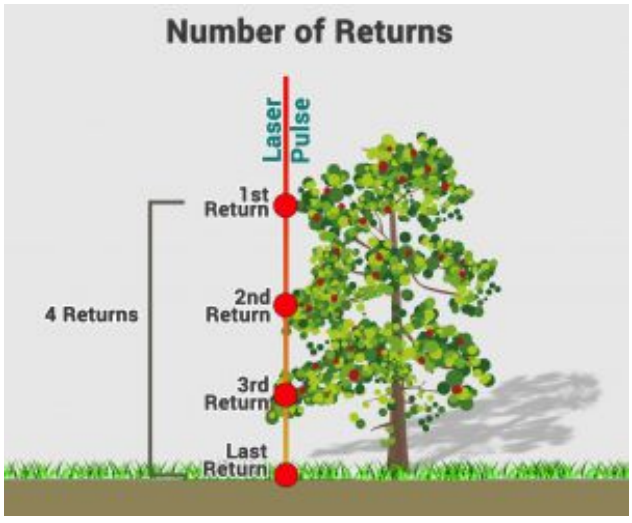






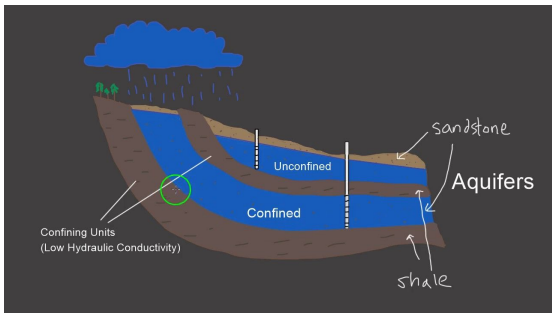
2. Describe the difference between the terms "first return" and "last return" as used in your class work (include a sketch to illustrate your answer) **(4 pts)**

The returns are based off of how soon the laser pulse is reflected back onto the sensor. The 1st returns are the first pulses sent back to the aircraft representing the closest object, the second one is the second return, and so on to the last return being the last pulse to reach the sensors representing the farthest object.



3. Describe the difference between an unconfined aquifer, and a confined aquifer. Draw sketches of each, to support your answer. **(4 pts)**

An aquifer is called an unconfined aquifer if there are no confining layers restricting the upper surface of the zone of saturation at the water table. If a confined layer is present, the aquifer is called a confined aquifer.



4. Describe and define the terms porosity and permeability, include equations and sketches. Provide examples of two Earth materials associated with high porosity and permeability, and two examples of Earth materials with low permeability **(4 pts)**

Porosity: the percentage of empty space in soil or rock

Volume of pores/Volume of rock

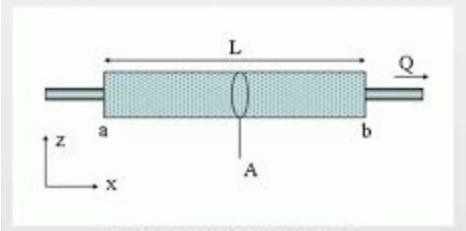
Permeability: the ability for water to flow through the rock freely

Q= KIA

Q: Discharge K: Hydraulic conductivity I: Hydraulic gradient A: Cross sectional area

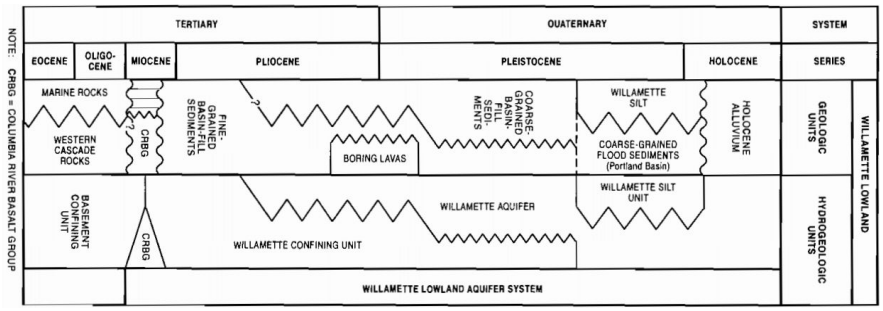
High: Sandstone and Gravel

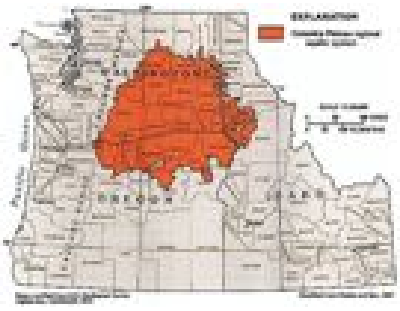
Low: Clay and Granite



5. List and discuss the two primary groundwater aquifer systems in the mid-Willamette Valley. Include a description of Earth materials and the hydraulic parameters that uniquely characterize them. Draw a sketch map to show their relative locations in the Willamette Valley, in relation to Monmouth, the Coast Range, and the Cascades. **(4 pts)**

The Willamette Lowland aquifer is separated into two main aquifers, the Willamette aquifer and the Columbia River Basalt aquifers. These aquifers are separated by a thick, silty clay known as the Willamette confining unit. In some areas the confining unit is absent and the two aquifers are in direct hydraulic connection.





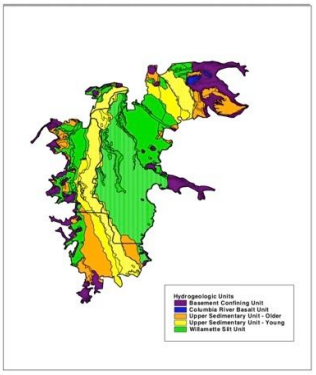


FIGURE 3

Southern Willamette Valley Hydrogeologic Units

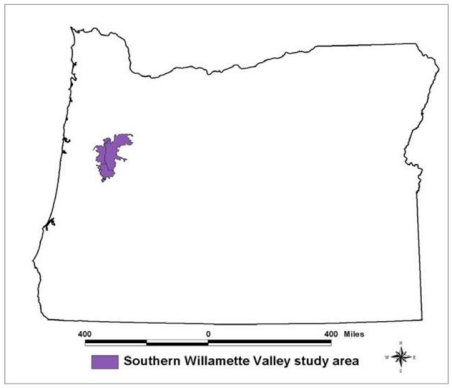
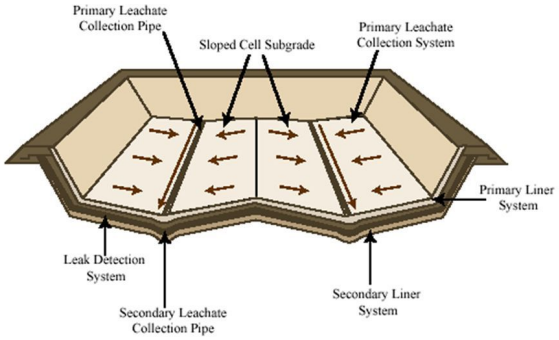


Figure 1

Locale of the Study Area

6. List and discuss the essential components of three primary environmental control systems associated with modern Subtitle D solid waste landfills. Include sketches for each, to support your answer. **(4 pts)**

- Leachate Collection System- this system is used to collect haz waste from the landfill so it can be disposed of.
- Plastic and Compacted Clay Liners- this system is used to keep out unwanted item from the landfill
- Leak Detection System- this system is used to monitor leakage of the landfill



B. **Lab-Style Problem Solving.**

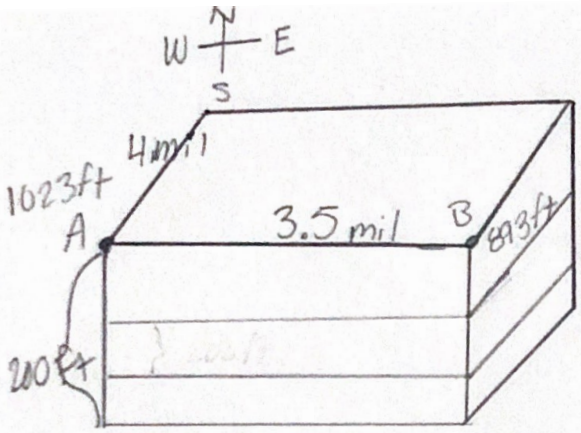
7. Two wells are installed in an unconfined sand and gravel aquifer. Well A is located 3.5 miles due west, of Well B. The static water level elevation in Well A rests at 1023 ft above sea level; static water level elevation in Well B rests at 893 feet above sea level. The hydraulic conductivity of the aquifer is 2.3 x 10^{-2} cm/sec, the saturated zone of the aquifer is 200 ft thick, and aquifer width is 4 miles. Complete the following tasks, show all of your math work and unit algebra.

A. Draw a 3-D block diagram or cross-sectional sketch illustrating the above relationships. Mark the sketch with directions or north arrow. **(2 pts)**

B. Calculate the hydraulic gradient in ft/ft. In which direction is the groundwater flowing? **(2 pts)**

C. Calculate the aquifer discharge of groundwater cubic meters per day and gallons per day. **(2 pts)**

A)



B) $\frac{130ft}{18480ft} = 0.00703\ ft/ft = I$

$1023 - 893 = 130ft$

$3.5 \cdot 5280 = 18480ft$

Water is flowing west to east.

C) $Q = KIA = 19.872\ m/day \cdot 0.00703$

$K = 2.3 \cdot 10^{-2}\ cm/sec = 19.872\ m/day$

$2.3 \cdot 10^{-2} \frac{cm}{sec} \cdot \frac{1m}{100cm} \cdot \frac{60sec}{1min} \cdot \frac{60min}{1hr} \cdot \frac{24hr}{1day}$

$A = 4mil \cdot \frac{5280ft}{1mil} = 21120ft \cdot 200ft = 4224000ft^2$

$4224000ft^2 \cdot \frac{.3048^2 m}{1^2 ft} = 392422.441m^2$

$Q = 19.872\ m/day \cdot 0.00703 \cdot 392422.441m^2$

$Q = 54821.48\ m^3/day$

$54821.48 \frac{m^3}{day} \cdot \frac{264.172gal}{1m^3}$

$Q = 14482300.01\ gal/day$