

## **Environmental Geology Spring 2015 Final Exam Study Guide**

***Final – Tuesday June 9, 2015 – 12 PM***

The Final Exam will be in 2 parts. Part 1 is closed book with short answer and long answer essay questions. Part 2 involves the open book lab skills portion. You will be able to use your notes, conversion charts, answer keys, etc. to work on Part 2 lab-style problems. Make sure you go over the groundwater problem answer keys before the exam, if you are still uncertain how to solve the problems, see me ASAP. Be prepared to make sketches of diagrams to illustrate your answers.

### ***Key Words***

#### **Landfills / Coffin Butte**

RCRA Subtitle D  
landfill  
solid waste  
liquid waste  
municipal waste  
residual waste  
hazardous waste  
industrial waste  
composting  
sludge ponds  
leachate  
soil contamination  
water contamination  
seepage  
surface runoff  
sediment erosion  
erosion control  
air emissions  
fugitive dust  
methane generation  
anaerobic bacterial decay  
methane  
groundwater monitoring system  
upgradient  
downgradient  
liner system  
double liner system  
geomembrane  
impermeable barrier  
leachate containment  
methane collection system  
air pollution monitoring  
vector control  
erosion and sedimentation  
borrow  
fill  
erosion / sedimentation pond,  
landfill closure,  
daily cover,

disposal cell,  
active life,  
fault / seismic activity,  
seismic impact zone,  
surface water,  
methane monitoring system,  
primary liner,  
secondary liner,  
drainage layer,  
cover liner,  
leachate treatment,  
gas collection,  
rock quarrying,  
leachate lagoon,  
waste screening,  
biomedical waste,  
quarterly water sampling,  
monitoring wells,  
wastewater treatment system,  
clay liner,  
fire hazard,  
Coffin Butte bedrock setting /  
hydrogeology (fractured basalt,  
pillow basalt, regolith/soil),  
methane extraction well,  
leachate collection system,

#### **Geologic Framework of Willamette Lowland Aquifer System**

Cascadia subduction zone  
Cascadia volcanic arc  
Coast range  
Willamette Valley  
Arc volcanism  
Accretionary uplift  
Subducting slab  
Juan de Fuca plate  
NAM plate  
Siletz river volcanics

Tyee Formation  
Yamhill formation  
Spencer Formation  
Western Cascade Volcanism  
High Cascade volcanism  
Fault-fold  
Willamette Aquifer System  
Basement confining unit  
Columbia river basalt  
Willamette confining  
Willamette Aquifer  
Willamette Silt  
Unconsolidated valley fill  
Valley-fill alluvium  
Fractured basalt aquifer  
Gravel aquifers  
Missoula flood silt  
Bedrock / Basement  
Basin-fill sediment  
Floodplain sediment  
Terrace sediment  
Active channels  
Holocene  
Quaternary  
Missoula flood deposits  
Terrace gravels  
Willamette alluvium  
Isopach maps  
Willamette Silt  
Portland Basin Gravels  
Central-Southern Valley silts  
Gravel aquifer

#### **River Restoration**

*Key words to focus on, refer to  
reading / ES407 showcase:*

Anadromous fish  
Salmonids

Oregon Salmon Plan  
 Coho, Chinook, Steelhead,  
 cutthroat  
 Juvenile, spawning  
 Riparian zone  
 Riparian buffer  
 Tree planting  
 Erosion prevention  
 Large woody debris  
 Wetlands  
 Habitat structure  
 Fish passage  
 Flow / discharge  
 Log jams  
 Engineered wood  
 Floodplain connection  
 Stream restoration  
 Watershed scale  
 Reach scale  
 Culverts-dams  
 Passage barriers  
 Sediment regime  
 Spawning gravel  
 Flow regime  
 Frequency-duration  
 Gravel budgets  
 Groundwater connection  
 Hyporheic zone  
 Tributary / back water  
 Habitat assessment  
 Channel cross section  
 Large wood / log jams  
 Best management practice  
 Rearing habitat  
 Refugia  
 Redd

### **Groundwater**

groundwater  
 meteoric water  
 connate water  
 juvenile water  
 porosity  
 permeability  
 horizontal permeability  
 vertical permeability  
 intergranular porosity  
 fracture porosity  
 solution cavities

total porosity  
 yield porosity  
 primary vs. secondary porosity  
 Darcy's law  
 $Q=KIA$   
 hydraulic gradient  
 cross-sectional area  
 specific yield  
 specific retention  
 zone of aeration  
 vadose zone  
 zone of saturation  
 phreatic zone  
 water table  
 groundwater flow  
 cone of depression  
 aquifer  
 aquitard  
 artesian aquifer  
 water table aquifer  
 confined aquifer  
 unconfined aquifer  
 water table  
 potentiometric surface  
 piezometer  
 unconsolidated aquifer  
 consolidated aquifer  
 infiltration  
 groundwater contamination  
 contaminant plume  
 well  
 monitoring well  
 static water level  
 depth to water  
 drawdown  
 hydraulic head  
 specific capacity  
 pumping rate

### **WOU Academic Showcase**

Prepare to answer a ½-1 page  
 essay question on your top 4  
 senior seminar topics  
 encountered at WOU academic  
 showcase. Use the web  
 resources and meeting abstracts  
 to prepare to answer this  
 question.

### **Water Wells / Drilling**

Hollow stem auger  
 Cable tool drilling  
 Air rotary drilling  
 “Casing”  
 “Well Screen”  
 Grout  
 Slotted screen  
 Riser pipe  
 Sand pack  
 Tri-cone rotary bit  
 Well log  
 Drillers log  
 Total depth  
 Bore-hole diameter  
 Annular diameter  
 SWL  
 TD  
 Static water level  
 DTW  
 Depth to water  
 Datum

know what a well installation  
 looks like (be able to sketch it)

drill rig  
 hollow stem auger  
 well screen  
 well riser  
 well diameter  
 static water level  
 pumping water level

### **Willamette Aquifer- Willamette Silts Case Study (Nitrate Problem)**

Willamette silt  
 Willamette aquifer  
 Gravel aquifer  
 Willamette Confining Unit  
 Aquifer vs. aquitard  
 “buffer”  
 basalt aquifers  
 river alluvium  
 alluvial aquifers  
 Missoula flood gravels  
 Erratics  
 Pumping / drawdown

Pump tests  
Slug test  
Permeability  
Storativity  
Chemical buffer  
Oxidation / reductions  
Denitrification  
Denitrifying bacteria

### **Sources of Ground Water Contamination Reading**

Heavy metals  
Organic chemicals  
Chlorinated solvents  
Industrial processes  
Agricultural pesticides  
/herbicides  
Underground storage tanks  
Petroleum hydrocarbons  
Land fills  
Migration pathways  
Risk assessment  
Surface impoundments  
Deep disposal wells  
Septic / sewage wastes  
NAPL's  
DNAPL's  
LNAPL's

### **Overview of Site Investigations and Groundwater Remediation**

Site history  
Site geology  
Site hydrogeology  
Aquifer characterization  
Contamination assessment  
Contaminant characterization  
Contaminant distribution  
LNAPLs  
DNAPLs  
Soil sampling  
Water sampling  
Monitoring well construction  
Contaminant plume  
Groundwater plume  
Vapor phase  
Liquid phase  
Soluble phase

“free product”  
Analysis  
Risk assessment  
Remediation study  
Passive vs. active remediation  
Source removal  
Plume confinement  
Bioremediation  
Chemical treatment  
Natural attenuation  
Waste Isolation  
Pump-and-treat systems  
Capping and isolation  
Bioremediation  
Soil vapor extraction

***Key Concepts / Skills / Possible essay questions and other concepts***

What is the difference between geologic hazard and risk?

List and discuss anthropogenic vs. natural environmental geology problems.

List and discuss the types of environmental hazards (natural and manmade) in Oregon / PNW

What are the range and types of anthropogenic groundwater and soil contaminant sources in the western Oregon region..

What is the nature of the Willamette Valley “nitrate problem”, where does it occur and why? What are the geologic controls?

Be able to apply basic physics and geology principles to quantitative-style problem solving.

Be able to do unit conversions from English to metric units?

Be able to problem solve using your notes and calculator.

Know how to work the groundwater well and aquifer equations. Can you calculate seepage velocity? Porosity? Permeability? Hydraulic gradient?

Can you work volume and rate problems? Discharge and flow? Can you solve Darcy’s law? Can you sketch Darcy’s experiment?

what is the difference between a "confined aquifer" and "unconfined aquifer"? How are porosity and permeability related? What types of earth materials are associated with what types of porosity and permeability? (unconsolidated vs. bedrock?, examples (e.g. gravel vs. clay)).

What are the sources of environmental contamination in the Dallas-Monmouth area? What are the controlling factors of groundwater flow in the area? What are the aquifers?

Do you know how a monitoring and production well are constructed? Can you draw a diagram showing well construction?

Do you know how to work the groundwater flow problems?

Can you list and discuss the sources of contaminants, types of contaminants, and remediation strategies as applied to the Willamette Valley?

Can you discuss (in an essay question) the hydrogeologic setting of the mid-Willamette Valley?

Can you discuss the geologic setting associated with the Missoula floods?

Can you relate Willamette Valley Hydrogeology to nitrate contamination problems?

Can you discuss the environmental setting and issues associated with the Willamette basin?

***Groundwater Hydrology Lab Exercise – Key Words***

Groundwater, hydrologic cycle, water quality, water quantity, primary porosity, secondary porosity,

permeability, hydraulic conductivity, darcy's law, effective porosity, water table, unconfined aquifer, confined aquifer, artesian well, flowing artesian well, aquifer recharge, till, gravel, sand, clay, shale, limestone, regolith, depth, elevation, well log, water table map, geologic map, geologic cross-section

## **LANDFILLS**

What are the primary elements of a Subtitle D landfill? How does the liner system work? How is methane managed? How is leachate managed? Why are the active landfill cells covered with plastic? What is a groundwater monitoring system and how does it work? Why are some types of waste accepted at Coffin Butte, but others are not? What is a monitoring well and why is it important to measure water depth? Do you think it a good idea to actively excavate in old, unknown, military waste? What would be some alternative approaches to determining the type of military waste at Coffin Butte? Why are the basalts underlying Coffin Butte so fractured, faulted, and folded? What is the primary source of permeability in the basalts underlying Coffin Butte?

### ***Possible essay questions and other concepts***

Describe, sketch, map, draw cross-sections of the regional hydrogeologic setting of the Willamette Valley. Include concepts of Willamette Aquifer, Willamette Confining Unit, Willamette Silts, Basement Confining Unit, CRB's, Marine Sedimentary Units.

Identify, list, and describe the major aquifer / aquitard units in the Willamette Valley. Discuss the Missoula Flood history and deposits of the Willamette Valley.

List and discuss the types of environmental hazards (natural and manmade) in Oregon / PNW.

List and discuss the sources of anthropogenic contaminants in the Willamette Valley

Expect a summary essay questions from the AEG student night, WOU Academic Showcase and the Senior Seminar Presentations.

Provide an overview of RCRA/CERCLA regulations; what are they, how to they differ? How do they related to Coffin Butte Landfill and Pacific Wood Preserving field trips.

Provide a summary of the McFarland Cascade Wood Preserving field trip. In your answer include site history, contamination sources, contamination pathways and remedial action plan used to mitigate the environmental risk.