Environmental Geology Spring 2021 Final Exam Study Guide
Final – Tuesday June 8, 2021; 12-3 PM, Moodle Course Shell

The Final Exam will be administered over a 3-hour period on Tuesday June 8, from 2 – 5 PM. The exam format will be a combination of short-answer terminology, medium- to long-answer essay, and lab-style quantitative problems. Labs have largely focused on Darcy's Law and solving groundwater flow problems. Be prepared to make sketches of diagrams and recall key equations to illustrate your answers.

I would spend a minimum of studying 8-10 hours total for this exam, to assure maximum success. Use the keyword and concept list below as a check list for studying.

Class Notes and Slide Shows to Review:

Lidar
https://people.wou.edu/~taylors/g473/hill_etal_2000_lidar_overview.pdf
https://people.wou.edu/~taylors/g473/Week6_ES473_Lidar.pptx

Intro to Groundwater
https://people.wou.edu/~taylors/g473/groundwater_notes_sp2020.pdf
https://people.wou.edu/~taylors/g473/Week7_ES473_Groundwater.pptx

Regional Hydrogeology of Willamette Valley
https://people.wou.edu/~taylors/g473/willamette_valley_hydro_review_exercise.ppt

Landfills and Waste Management
https://people.wou.edu/~taylors/g473/ES473_Solid_Waste_Class_Notes.pdf
https://people.wou.edu/~taylors/g473/Week8_ES473_Solid_Waste.pptx

Soil and Water Contamination
https://people.wou.edu/~taylors/g473/ES473_Water_Pollution.pdf
https://people.wou.edu/~taylors/g473/Week9_ES473_Water_Pollution.pptx
https://people.wou.edu/~taylors/g473/Week9_ES473_Groundwater_Contamination.pptx

Groundwater Remediation
https://people.wou.edu/~taylors/g473/Week10_ES473_Remediation_Oregon_Case_Studies.pptx

Text Chapters and Readings:

Lidar
https://people.wou.edu/~taylors/g473/hill_etal_2000_lidar_overview.pdf
https://people.wou.edu/~taylors/g473/glenn_etal_2006_lidar_landslides.pdf

Introduction to Groundwater
https://people.wou.edu/~taylors/g473/10_Keller_Water_Resources.pdf

Regional Hydrogeology of Willamette Valley
https://people.wou.edu/~taylors/g473/hydrogeo_willamette_valley.pdf

Landfills and Waste Management
https://people.wou.edu/~taylors/g473/12_Keller_Waste_Management.pdf

Soil and Water Contamination
https://people.wou.edu/~taylors/g473/11_Keller_Water_Pollution.pdf
https://people.wou.edu/~taylors/g473/gw_cont_sources.pdf

Groundwater Remediation

https://people.wou.edu/~taylors/g473/gwcont4.pdf
https://people.wou.edu/~taylors/g473/8_groundwater_remediation_technologies.pdf

Review Questions and Key Word Worksheets:

Lidar

https://people.wou.edu/~taylors/g473/Glenn_etal_2006_Lidar_Landslide_Applications_Review_Questions.docx
https://people.wou.edu/~taylors/g473/LIdar_key_terms.doc

Introduction to Groundwater

https://people.wou.edu/~taylors/g473/groundwater_video_exercise.pdf
https://people.wou.edu/~taylors/g473/Chapter10_Water_Resources_ver2.docx
https://people.wou.edu/~taylors/g473/Video_review_questions_Darcy_law_youtube.pdf

Regional Hydrogeology of Willamette Valley

https://people.wou.edu/~taylors/g473/Woodward_etal_1999_willamette_hydro_review_questions.docx

Waste Management

https://people.wou.edu/~taylors/g473/Waste_Management_Video_exercise.pdf
https://people.wou.edu/~taylors/g473/Chapter12_Waste_Management.docx

Soil and Water Contamination

https://people.wou.edu/~taylors/g473/Chapter11_Water_Pollution.docx
https://people.wou.edu/~taylors/g473/Hanford_YouTube_Groundwater_Review_Questions_ver2.doc

Groundwater Remediation

https://people.wou.edu/~taylors/g473/Remediation_Key_Word_Search.docx

Supporting Video Study Content:

Lidar

https://www.youtube.com/watch?v=EYbhNSUnIdU

Introduction to Groundwater

https://beta.learner.org/series/earth-revealed/21-groundwater/
https://www.youtube.com/watch?v=MeeYy-dVzJU
http://www.youtube.com/watch?v=8K6V450StO4

Waste Management

https://www.youtube.com/watch?v=Wzo5sv4IrIw
https://www.youtube.com/watch?v=xZEdgdydZR4

Soil and Water Contamination

https://www.youtube.com/watch?v=gRSHJpe8pq8
http://www.youtube.com/watch?v=LYt9yYNJQDc

Groundwater Remediation

https://www.youtube.com/watch?v=DZFInOdxdiA
https://www.youtube.com/watch?v=3GFe1biSbC4

Key Words from Notes

LiDAR
https://people.wou.edu/~taylors/g473/LIdar_key_terms.doc

LIDAR
Laser
Laser pulse
Reflection
Absorption
Two-wave travel time
Laser source
Pulse detector
first-returns
second-returns
last returns
bare-earth model
digital elevation model
DEM
Aerial surveys
Laser swath mapping
Land classification
Vegetative structure
Ground cover
Flight lines
GPS – positioning systems
Watershed modeling
Topographic analysis
Point cloud
Laser altimetry
First-return model

Groundwater
https://people.wou.edu/~taylors/g473/groundwater_notes_sp2020.pdf

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

Geologic Framework of Willamette Lowland Aquifer System
https://people.wou.edu/~taylors/g473/hydrogeo_willamette_valley.pdf

Cacadia 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

Solid Waste / Landfills
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
anerobic 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,

Sources of Ground Water Contamination Reading
https://people.wou.edu/~taylors/g473/ES473_Water_Pollution.pdf

https://people.wou.edu/~taylors/g473/gw_cont_sources.pdf

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
https://people.wou.edu/~taylors/g473/gwcont4.pdf

https://people.wou.edu/~taylors/g473/8_groundwater_remediation_technologies.pdf

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
Contaminant Plume
MCL / TMDL
Plume Mapping
Permeable Reactive Barrier
Air Sparging
Waste isolation
Chemical vs. Physical
Remediation technology
In situ vs. ex situ
Grout Wall

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..

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 wasted accepted? What is a monitoring well and why is it important to measure water depth and water quality?

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

List and discuss examples of remediation technology used at Hanford