Earth Sciences 4440a/b, Hydrogeology: Principles, Processes, and Professional Practice – 2019

Description: Occurrence, distribution, movement, chemistry and composition of ground water as a function of the geological environment; water quality and ground water contamination; collection and evaluation of hydrogeologic data; modeling ground water flow and advective transport; case histories. A strong linkage between theory and practice will be maintained and a quantitative approach will be used. The study of ground water is interdisciplinary in nature and is pertinent to many fields including geological sciences, hydrology, soil science, geography, ecology, and agricultural, geotechnical, mining and petroleum engineering.

Prerequisites: Earth Science 3340a/b, or CEE 3326, or 80% in Geography 3342a/b, or permission of the department. (0.5 course)

- *Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.*
- *Accessibility Statement: Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.*
- *Students who are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.*

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Course Outline: Lecture Topics

- Principles of ground water flow
- Geology and ground water
- Hydrostratigraphy, aquifers and confining units
- Field mapping of hydraulic head and flow
- Theory of ground water flow & numerical models
- Hydrogeologic site investigation tools and techniques
  - site investigations – drilling techniques
  - site investigations – water sampling techniques
- Flow system delineation and regional ground water flow
- Ground water – surface water interactions
- Ground water flow to wells – storage, aquifer types
  - response of confined aquifers to pumping
  - response of leaky aquifers to pumping
  - response of unconfined aquifers to pumping
  - slug and step testing of aquifers and aquitards
- Ground water geochemistry – dissolved mass & data analysis
- Key reactions influencing ground water chemistry
- Basics of mass transport – advection, dispersion, diffusion
- Intro. to contaminant hydrogeology – dissolved mass, NAPL's
- Mass transport: economic mineral deposits, petroleum hydrogeology, geothermal energy

Laboratory Exercises

Lab 1. Jan. 14 - basic flow calculations, permeability

Lab 2. Jan. 21 – hydrogeologic cross sections, potentiometric surfaces

Lab 3. Jan. 28 – Potentiometric profiles, regional groundwater flow

Lab 4. Feb. 4 – case study, past midterm due Feb. 11 ***in class (9:30 a.m.)***
no lab Feb. 11; pickup lab Feb. 15
no lab Feb. 25

Lab 5. March 4 - well hydraulics lab 1 due March 18

Lab 6. March 18 - well hydraulics lab 2 due April 1.

Text: No textbook required; all material will be in course notes + Owl documents

Lectures/Lab: 2 lecture hours and 2 laboratory hours per week
lectures (PAB 117) – Mon. 9:30 to 11:20 a.m.
laboratory – Mon. 2:30 to 4:30 p.m. - BGS 0184

Marking Scheme:			
	Hand-in assignments	32%	
	Midterm* (110 min)	34%	Feb. 25 in-class
	Final Exam* (2 hrs)	34%	

Learning Outcomes

Upon successful completion of this course students will be able to:

- Evaluate and assess the use of empirical (grain size), laboratory (permeameter), and field based (slug and pump tests) techniques for measuring hydraulic conductivity.
- Describe the hydrostratigraphy of glacial deposits in the Ontario region and basin hydrostratigraphic relationships in Ontario and Alberta using a case study approach.
- Construct geologic and hydrostratigraphic cross sections from well logs.
- Construct and evaluate potentiometric surfaces and profiles using well and lithologic information.
- Quantify ground water flow and velocities from potentiometric surfaces and potentiometric profiles.
- Work with multiple data sets to delineate regional ground water flow patterns.
- Quantify ground water flow, vectors, and assess the hydrologic impact of developments from subdivisions to mines using environmental impact assessment consulting reports.
- Perform basic geologic and hydrogeologic investigations at the regional, local, and site scale using topographic, soil and geologic maps, aerial photographs, satellite imagery, water well, stream discharge and climate databases.
- Explain the various drilling techniques used in hydrogeologic investigations and how to emplace water table monitoring wells and piezometers within boreholes.
- Perform hydraulic head measurements in the field using piezometers and water table wells.
- Properly sample ground waters to ensure geochemical integrity of the sample.
- Analyze pump and slug test results using both hand and computer software (AQTESOLV Pro).
- Define key contaminant physical and geochemical transport processes and how they are manifest in various hydrogeologic environments.

Lecture Material: The text portion of the lecture presentation slides will be made available on OWL. Figures used in the lectures come from the textbook, various web links, government sources, or various consulting reports. Text figures, or material with disclosure issues (e.g. consulting reports), will not be posted on OWL. You are expected to attend lectures and make additional notes to augment the text provided. The main purpose of the lectures is to help you understand key hydrogeological parameters & processes and the techniques used to quantify these. The labs are where you apply the techniques. Case studies / consulting reports give you the real-world application of these techniques.

Assignments: Help with assignments and some lecture material on assignments will be given during laboratory session. Assignments will be available on OWL along with lecture notes. Many of the exercises will involve spread sheet programs (MS Excel) or aquifer analysis software. Any assignments handed in past the due date will be subject to a penalty of 20% per late day (if you have exceptional circumstances contact Dr. Schincariol prior to due date via email). NOTE: The majority of marks for

questions are given for problem setup, assumptions, solution approach, and proper use of significant figures and units. Simply writing down a formula (or providing an Excel output) and giving the answer, even if correct, will not result in full marks. NOTE: 20% of each assignment grade is for proper layout and organization, neatness, and significant figures / statement of uncertainty.

Labs 1 to 4 are one week labs and worth 4% each. Labs 5 and 6 are two week labs and worth 8%. You should use your time in the lab to both complete the assigned problems and go over any difficulties you had with the previous week's labs. Students who do not use the assigned lab times for inquiries should not expect additional help from the teaching assistant and/or professor.

* Exams & tests will be closed book (definitions; short answer; calculations). Bring pencil, ruler, eraser, and basic calculator (basic math & geometry functions; but no extensive non-volatile memory capability). *A calculator is to be used for calculations only and not storage of information - any recall of such stored information will be considered a scholastic offense (cheating). No other electronic devices will be allowed. Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.*

➢ *If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see the Policy on Accommodation for Medical Illness at: www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf*

➢ *For work worth less than 10% (e.g. individual assignments) if accommodation is required for medical or non-medical reasons email the instructor. In these cases either an extension will be given or a re-weighting to other components of the course – at the instructors discretion – will be done.*