

## ERTH 3205 Physical Hydrogeology Course Outline | Fall 2025

### Overview:

Groundwater is the largest reservoir of liquid freshwater on Earth, accounting for almost all usable freshwater. It serves as an essential source of potable water for half of the global population, sustains critical biological habitats in freshwater systems, and transports contaminants, hydrocarbons, and essential metals underground.

ERTH 3205 introduces this underappreciated resource with an emphasis on understanding how groundwater flows through Earth materials. Students will gain insight into groundwater's role in the hydrological cycle, and will apply graphical and analytical methods to quantify groundwater flow and important aquifer properties. Laboratory exercises involve working through problem sets and hands-on learning experiences that provide students with practical skills and reinforces concepts governing fluid flow through porous media.

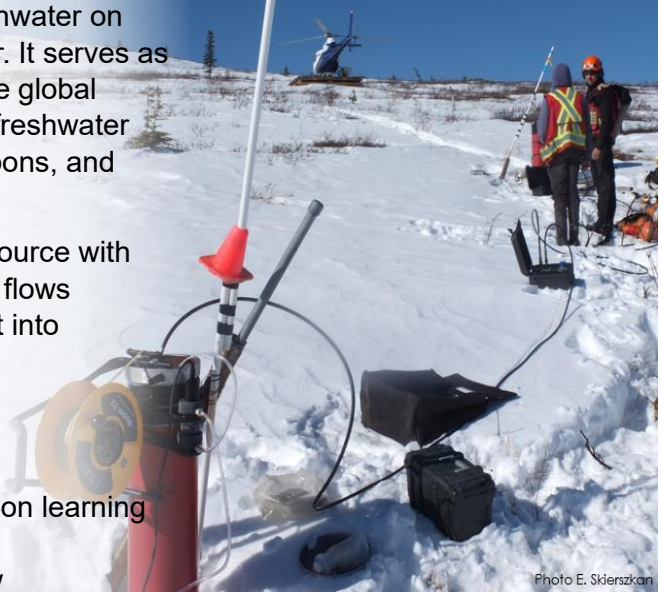


Photo E. Skierszkan

### Instructor

Elliott Skierszkan, PhD  
Institute of Environmental and Interdisciplinary Sciences & Department of Earth Science  
ElliottSkierszkan@CUNET.carleton.ca

### Teaching Assistants

Alexandre Guillerez <AlexGuillerez@cmail.carleton.ca>  
Tiare Sanchez Vasquez <tiaresanchezvazquez@cmail.carleton.ca>

### Class Schedule

In-person lectures and laboratories:

|          |                                       |
|----------|---------------------------------------|
| Lectures | Wednesdays 8:35 AM – 10:25 AM HP 3120 |
| Labs     | Wednesdays 11:35 PM – 2:25 PM HP 2130 |

Lab participation is mandatory. Labs are not held every week, you will be notified ahead of time when they are scheduled. Assignments will last 1 to 2 weeks and will be due at the start of the following lab timeslot.

Assignments will involve solving practical problems pertaining to groundwater flow and groundwater-resource evaluation and will require spreadsheet-based calculations.

## Office Hours

Elliott Skierszan: By appointment, Wednesdays between 10:30 and 11:15 AM

Alexandre Guillerez: Tuesdays 1-2 PM, HP2125

Tiare Sanchez-Vaquez : Thursdays, 3-4PM, HP2125

## Grading Schema

|                 |      |
|-----------------|------|
| Lab assignments | 50 % |
| Mid-term exam   | 20 % |
| Final exam      | 30 % |

## Exam Format

**Exams will be run as Two-Stage exams that include an individual and a group component.** *The group component will include a repetition of some of the questions included in the individual component. If a student's individual grade on the group component is lower than on the individual component, the marks obtained from the individual component will be used. In other words, students will have the opportunity to improve their learning and improve the score of their individual component with the group component, with no possibility of losing marks by participating in the group component.*

*Due to logistical considerations, students choosing to write exams through the McIntyre Exam Centre will not have access to the group exam component.*

## Late Policy

### Assignments

Grace Period: all students are allowed 4 days of grace period for submitting late assignments penalty-free over the course of the term. Beyond this grace period, late submissions will be penalized 10 % daily to a maximum of 50 % without a legitimate excuse. Submissions will not be accepted after graded assignments have been returned.

### Missed Exams

**Midterm:** A missed midterm exam will be available for deferral if appropriate reason is provided within 3 days of the missed exam. If deemed acceptable, a re-write will be scheduled.

**Final:** A formally scheduled final exam will take place during the exam period. A deferred final exam is subject to the university's approval, as per the [official deferral process](#). Instructors cannot grant final exam deferrals.

## Course website

Brightspace will serve as the hub for all course materials, including posting lectures and assignments and a forum for questions about course materials. Students will be required to use Brightspace to communicate with the instructor and the TA.

## Textbook

The course draws heavily on material from the book *Groundwater* by Allan R. Freeze and John G. Cherry. This book is commonly found on bookshelves of practicing hydrogeologists. The

entire textbook is freely available only by the authors via The Groundwater Project: [gw-project.org/books/groundwater/](http://gw-project.org/books/groundwater/).

*Applied Hydrogeology* by C.W. Fetter Jr. is another excellent resource. There are affordable second-hand versions at online bookstores (e.g., Amazon) that range in price but are typically less than \$100.

### **Pre-Requisites**

1.0 credit from EARTH 1001, EARTH 1006, EARTH 1007 or equivalent

## Learning Outcomes

The course introduces the physical principles of groundwater flow. It builds on students' basic knowledge of bedrock and surficial geology and introduces how a fluid exists and flows within Earth materials. At the end of this course, students will have developed a theoretical and practical understanding of groundwater occurrence and flow. Students will be able to:

- Explain the role of groundwater within the hydrological cycle.
- Explain groundwater behavior: origins, flow, storage, extraction, and discharge
- Relate subsurface geological material properties to groundwater movement
- Apply graphical and analytical methods to quantify groundwater flow
- Apply analytical methods to determine aquifer properties using well-pumping tests
- Apply analytical methods to calculate travel times for nonreactive and reactive contaminants in a groundwater system
- Differentiate between mechanisms of groundwater and contaminant transport in the subsurface (advection, hydrodynamic dispersion, diffusion)

## Copyright

Lectures and course materials are protected by copyright and owned by the instructor. You may take notes and make copies of course materials for your own educational use. You may not allow others to reproduce or distribute lecture notes and course materials publicly for commercial purposes without the instructor's express written consent.

## Schedule

*Timeline is subjected to change depending on course progress.*

| Week | Date    | Theme                            | Lecture                                                                                                                                     | Lab Assignment                                                                                                                                                 | Important Academic deadlines                                                                                                |
|------|---------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 1    | 3-Sept  | Introduction                     | Groundwater in the hydrological cycle;<br>Groundwater and society                                                                           | Lab 1 – Groundwater in the hydrologic cycle, Groundwater in society (due Sept 10 <sup>th</sup> )<br><br><b>On-campus well site visit</b>                       |                                                                                                                             |
| 2    | 10-Sept | Aquifer Properties               | Porosity, hydraulic conductivity, Darcy's Law 1.                                                                                            | Lab 2 – Groundwater model, Darcy's Law, Potentiometric Mapping, Porosity (due Sept 24 <sup>st</sup> )                                                          |                                                                                                                             |
| 3    | 17-Sept |                                  | Porosity, hydraulic conductivity, Darcy's Law 2.                                                                                            | Lab 2 work period                                                                                                                                              | Sept 16 <sup>th</sup><br>Last day for registration and course changes                                                       |
| 4    | 24-Sept | Steady-state groundwater flow    | Groundwater flow equations<br>Graphical solutions                                                                                           | Lab 3 – <b>Field lab part 1:</b> Campus hydrogeology, more graphical solutions (due Oct 1)                                                                     |                                                                                                                             |
| 5    | 1-Oct   |                                  | Storage, subsidence                                                                                                                         | Lab 4 - <b>Field lab part 2:</b> Slug tests, measuring hydraulic conductivity (due Oct 10 <sup>th</sup> )                                                      | Sept 30 <sup>th</sup> Last day to withdraw with a full fee adjustment.                                                      |
| 6    | 8-Oct   | Transient-state groundwater flow | <b>Guest Lecture 1: Tessa Di'Iorio – City of Ottawa – Ottawa's Groundwater Resources</b><br><br><b>(To be confirmed)</b><br><br>Vadose zone | Lab 4 work period                                                                                                                                              | December Exam schedule available Oct 10 <sup>th</sup>                                                                       |
| 7    | 15-Oct  |                                  | <b>Mid-term exam</b>                                                                                                                        | Vadose zone hydrogeology                                                                                                                                       | Oct 13 <sup>th</sup> Thanksgiving holiday – university closed                                                               |
| 8    | 22-Oct  |                                  | No Class - Reading Week                                                                                                                     |                                                                                                                                                                |                                                                                                                             |
| 9    | 29-Oct  |                                  | Storage, subsidence                                                                                                                         | Lab 5. Subsidence and Storage; Vadose zone.                                                                                                                    |                                                                                                                             |
| 10   | 5-Nov   | Groundwater contamination        | Aquifer testing.                                                                                                                            | Lab 5 Work period                                                                                                                                              |                                                                                                                             |
| 11   | 12-Nov  |                                  | Aquifer testing II : Single well tests                                                                                                      | Lab 6. Pumping tests.                                                                                                                                          | Nov 15 <sup>th</sup> - Last day for academic withdrawal                                                                     |
| 12   | 19-Nov  |                                  | Groundwater transport: advection, dispersion, diffusion                                                                                     | <b>Guest Lecture 2: Cole Fischer, Yukon Government – Hydrogeology of the Eagle Gold Mine Disaster</b><br><br><b>(To be Confirmed)</b><br><br>Lab 6 work period | Mar 25 – Last day for summative tests and examinations worth more than 15 % of the final grade in full winter term courses. |
| 13   | 26-Nov  | Review                           | Groundwater geochemistry                                                                                                                    | Lab 7. Contaminant hydrogeology and groundwater geochemistry.                                                                                                  | April 8 – Winter term ends. Last day of classes.                                                                            |
| 14   | 3-Dec   |                                  | Review/Buffer.                                                                                                                              | Lab 7 work period                                                                                                                                              |                                                                                                                             |

## **Centre for Student Academic Support**

The Centre for Student Academic Support (CSAS) designs, develops, and implements educational programs and services that are available to support all Carleton University students to have successful academic experiences. <https://carleton.ca/csas/pass/pass-schedule/>

## **Science Student Success Centre**

The Science Student Success Centre helps all undergraduate students in the Faculty of Science define and achieve their academic, career, and social goals. Visit <https://sssc.carleton.ca/about>

## **Academic Integrity and Usage of Generative Artificial Intelligence (AI)**

### *Artificial Intelligence*

I recommend relying primarily on course notes, textbook material, and interactions with your peers and instructional team when working through assignment questions. These questions form the basis of your learning and similar styles and types of questions will be asked during exams.

If you rely on AI to assist in completing your assignments, you are at high risk of failing the course because you will not have learnt the material that will be assessed on exams. If you choose to use AI as part of your study process, I also highly recommend you be very skeptical about its answers and cross-check everything against course notes and textbooks.

In my experience, these technologies are very adept at providing answers to hydrogeological programs that appear correct to the untrained eye, but are blatantly wrong and unreliable when cross-examined by an expert.

As our understanding of the uses of AI and its relationship to student work and academic integrity continue to evolve, students are required to discuss their use of AI in any circumstance not described here with the course instructor to ensure it supports the learning goals for the course.

### *Group Work and Plagiarism*

I recommend you work in groups of 2-3 together to work through assignment problems. This approach highly benefits your learning (and is funner!). It is acceptable to discuss how to solve problems, and to cross-check answers with each other, but your submitted work must be your own.

It is not acceptable to copy someone else's work and submit it as your own. It is also not acceptable to allow someone else to copy your work and submit it as theirs. Both scenarios violate Carleton's [Academic Integrity Policy](#). This policy outlines the procedure to be followed in the event of suspected academic misconduct (e.g., plagiarism, disruption of classroom activities, improper access to confidential information). In cases where a violation of the academic policy is suspected, it is our responsibility, as instructors, to report violations to the Chair and the Associate Dean, who perform investigations and decide on outcomes.

The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes

reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source. Examples of sources from which the ideas, expressions of ideas or works of others may be drawn from include but are not limited to: books, articles, papers, literary compositions and phrases, performance compositions, chemical compounds, art works, laboratory reports, research results, calculations and the results of calculations, diagrams, constructions, computer reports, computer code/software, material on the internet and/or conversations.

Examples of plagiarism include, but are not limited to:

- any submission prepared in whole or in part, by someone else;
- using ideas or direct, verbatim quotations, paraphrased material, algorithms, formulae, scientific or mathematical concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another's data or research findings without appropriate acknowledgement;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own; and
- failing to acknowledge sources through the use of proper citations when using another's work and/or failing to use quotations marks.

Plagiarism is a serious offence that cannot be resolved directly by the course's instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of "F" for the course or even suspension or expulsion from the University.

## Academic Accommodations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes, including information about the *Academic Consideration Policy for Students in Medical and Other Extenuating Circumstances*, are outlined on the Academic Accommodations website ([students.carleton.ca/course-outline](https://students.carleton.ca/course-outline)).