ENV E 320 Environmental Hydrology

Fall 2024 - September 03 to December 09

Class time: Monday, Wednesday, Friday 10:00-10:50 Location: MEC 4-3

Instructor:

Evan Davies, PhD, P.Eng, He/his
(780)492-5134
evan.davies@ualberta.ca
Donadeo Innovation Cntr for Engineering 7-261
Office Hours: Mondays, 1-2 pm, in DICE 7-261. TA office hours are Tuesdays, 1-2 pm, in NREF 2-022

Course Description:

*3.8 (fi) (either term, 3-0-3/2) Introduction to concepts in hydrology and hydrogeology. Hydrology topics include precipitation, evaporation, infiltration, streamflow, and hydrograph analysis. Hydrogeology topics include infiltration, percolation, seepage, drainage, aquifer hydraulics, and urban runoff quality.

Prerequisites: CIV E 330; Corequisite: CIV E 331

Course synchronous and asynchronous content delivery schedule:

Course content for Env E 320 will be delivered synchronously. Course videos are also available on Youtube, with links provided on the eClass page. These videos cover the same content.

Land Acknowledgment:

The University of Alberta respectfully acknowledges that we are located on Treaty 6 territory, a traditional gathering place for diverse Indigenous peoples including the Cree, Blackfoot, Métis, Nakota Sioux, Iroquois, Dene, Ojibway/ Saulteaux/Anishinaabe, Inuit, and many others whose histories, languages, and cultures continue to influence our vibrant community.

TA Information:

Rahel Amare Kidanu (kidanuu@ualberta.ca)
Mustapha Yassin (mnyassin@ualberta.ca)

Lab Sections:

Section	Day	Time	Location
LAB D11	Monday	14:00 - 16:50	NREF 2-001

Course Objectives & General Content:

The primary objective of the course is to introduce students to concepts in hydrology and hydrogeology. Hydrology topics include precipitation, evaporation, infiltration, streamflow, and hydrograph analysis. We also learn to use a well-known hydrological model.
Hydrogeology topics include infiltration, percolation, seepage, drainage, aquifer hydraulics, and urban runoff

quality.

Learning Outcomes:

By the end of this course, students should be able to:

1. Identify primary environmental factors that govern large-scale hydrologic processes
2. Understand climatic regimes across the world and how are they related to the livelihood of people living in those climatic regimes
3. Apply engineering tools such as Intensity-Duration-Frequency curves to design storms of certain return period for sizing municipal infrastructure
4. Know primary forces that govern soil infiltration processes and how much water is expected to infiltrate to subsoil layers
5. Estimate pollution levels of our contaminated ground and surface water resources using key water quality variables such as BOD5 (5-Day Bio-oxygen Demand)
6. Understand our aquifer systems, and know how to estimate the amount and rate of water retrievable from aquifers
7. Understand and model the key drivers of runoff and their transformation into streamflow at a watershed outlet or other point of interest over an hourly to daily timeframe.

Marking Scheme:

Activity	(A)Synchronous	Due/Scheduled	Weight
Homework Assignments	Asynchronous		15%
Laboratory Assignments	Synchronous	See schedule below	15%
Midterm Examination	Synchronous	October 30, 2024, during lecture period	30%
Final Examination	Synchronous	Determined by Registrar's Office	40%

The Faculty recommended grade point average for a 300 level course is 3.0. Instructors have the leeway to deviate from this average and can assign grades based on their own scheme. All grades are approved by the department chair (or delegate). The office of the Dean has final oversight on all grades.

Term Work

All term work solutions will be posted no later than the last day of classes. All term work will be returned to students by the final day of classes, with the exception of major term work due in the last week of classes. The latter will be returned by the day of the final examination or the last day of the examination period if there is no final examination in the course as per university policy; instructors will make accommodations to return these term work. It is the responsibility of the student to pick up all their term work at the specified time and place. Any unreturned term work, shall be retained and then shredded six months after the deadline for reappraisal and grade appeals. Final examinations will be kept for one year as required by

university guidelines and the Government of Alberta's Freedom of Information and Protection of Privacy Act.

Additional Notes

There is typically one homework assignment per week during the term. You may ask your classmates for assistance on these assignments, but it is an academic offence to copy all or even a portion of another person's assignment and submit it as your own.

For written responses, you must write your own! You may use ChatGPT or other AI tools as a writing aid, but only for style and grammar help and not to formulate your response. If you do use such tools, you must state that you have done so on your assignment.

Assignment solutions must be uploaded to eClass by 4 pm on the due date. You will have unlimited attempts to submit any numerical responses to eClass; therefore, if you make an error in your calculations, you can retry the assignment without penalty. Written work will be uploaded to eClass separately, but will not be marked. Late assignments will not be accepted.

Your final assignment grade will be calculated using your six highest assignment grades. The short essay is counted separately. That means that you will not be penalized for missing assignments in addition to your six highest grades.

Calculator Policy

Only approved non-programmable calculators are permitted in examinations. Any calculator taken into an examination must have a sticker identifying it as an acceptable non-programmable calculator (gold sticker). Students can purchase calculators at the University Bookstore with the stickers already affixed. Calculators purchased elsewhere can be brought to the Student Services where the appropriate sticker will be affixed to the calculator.

Expectations for AI use

In this course, we commit to AI use guided by ethical and transparent principles. While students are allowed to use advanced automated tools (such as ChatGPT or Dall-E 2) for certain written assignments, it is crucial to adhere to the following guidelines:
Seek prior approval from the instructor for AI use in specific assignments.
When allowed, clearly attribute and cite any AI-generated content in your work, including prompts and AI outputs as part of your academic record. Include an additional reflection component in your assessments, discussing how AI tools contributed to your learning process.
IMPORTANT: Please note that AI use is strictly prohibited in assessments and assignments not approved by the instructor. Failure to abide by this guideline may be considered an act of cheating and a violation as outlined in the relevant sections of University of Alberta (November 2022) Code of Student Behaviour .

Text and References (Mandatory):

Hydrology and Floodplain Analysis, Bedient, P., Huber, W., and Vieux, B., 6th ed., Pearson, 2019. Available from the Bookstore.

Text and References (Recommended):

1) Introduction to Environmental Engineering and Science, Masters, G., and Ela, W., 3rd Edition, Prentice Hall, 2008.
2) Engineering Hydrology: Principles and Practices, Ponce, V. M., Prentice Hall, 1989.
3) Physical Hydrology, Dingman, S. L., 2nd Edition, Waveland Press, 2008.

4) Applied Hydrology, Chow, V., Maidment, D., and Mays, L., McGraw Hill, 1988.
5) Handbook of Hydrology, Maidment, D., McGraw Hill, 1993.
6) Environmental Engineering Science, Nazaroff, W., and Cohen, L., 1st ed., Wiley, 2000.
7) Water Quantity and Quality Control, Wanielista, M., Kersten, R., and Eaglin, R. 2nd ed., Wiley, 1996.

Website:

eClass

Previous Examples of Evaluative Materials:

Where available, sample material will be posted to eClass

Lab Information:

Lab Topic	Date
Lab 1: Catchment characteristics	2024-09-09
Lab 2: Basin-scale precipitation	2024-09-23
Lab 3: Infiltration and runoff	2024-10-21
Lab 4: Hydrograph simulation with HEC-HMS (*take-home with online submission*)	2024-11-04
Lab 5: Water quality and lakes	2024-11-18
Lab 6: Groundwater	2024-12-09

Did you know that the University of Alberta has various low-to-no-cost services to help students succeed? Visit http://www.deanofstudents.ualberta.ca/ for information about the academic, wellness, and various other support services available to U of A students. It's never too early or too late to seek help!

ENV E 320
Environmental Hydrology

Fall 2024

Note: These slides are attached to your course outline and are posted in eClass

Course details

Instructor: **Dr. Evan Davies (he/him)**
Email: evan.davies@ualberta.ca
Telephone: 780-492-5134

TAs: Rahel Amare Kidanu (kidanuu@ualberta.ca)
Romana Saila (saila@ualberta.ca)

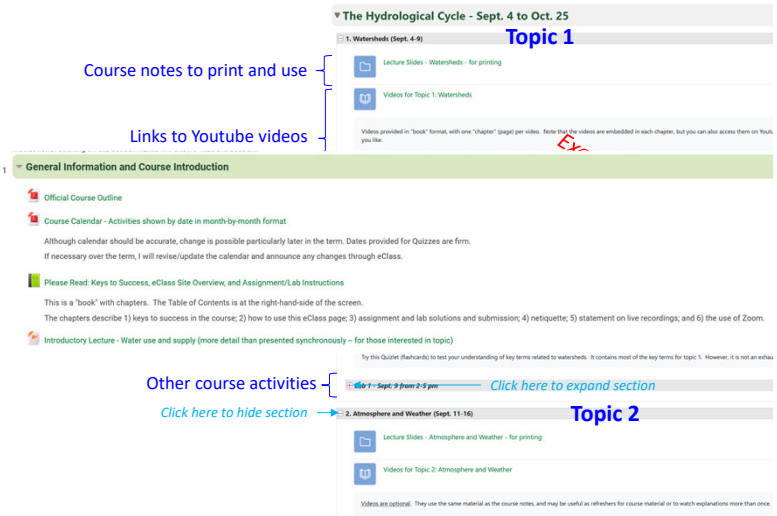
For more information on me (research interests), see:
https://apps.ualberta.ca/directory/person/edavies1
https://www.researchgate.net/profile/Evan-Davies-9

Content Delivery

This course is taught "synchronously":
The course content will be delivered through regular lectures, three days per week. Course notes are posted in eClass. Print them and bring them with you to lectures.

Note: The course content is also available through videos posted to Youtube. You can watch them for a refresher or to see a particular explanation again. The course notes indicate which video to watch for each topic

Content Delivery: eClass



Course Details and Extra Help

Lectures: Regularly scheduled lectures are on **M-W-F, 10 am.**
See the **posted calendar** for details

Labs: **M, 2-5 pm**, in person (*except Lab 4)*
There are six labs. They are not held every week

Lab 1: Sept 9 **Lab 2**: Sept 23 **Lab 3**: Oct 21
Lab 4: Nov 4 **Lab 5**: Nov 18 **Lab 6**: Dec 9
Note: *Lab 4 is a take-home lab with online help session*

Course Details and Extra Help

Assignments: **Wednesdays** at 4pm (1st is due Sept. 25)
I include only your top six numerical assignments in your grade. There is also a separate essay on climate change

Assignments are posted to eClass approx. one week before the due date. See me or TAs during office hours for help

Submission is through eClass. You may try the assignment as many times as you like – *there are no limits on attempts*. We keep your **highest mark** for each assignment.

You must also upload a **scan of your written work** – this is not marked, but must be present to receive a mark on the assignment.

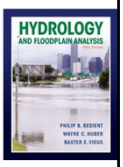
Course Details and Extra Help

Office Hours: **Monday, 1-2 pm (Dr. Davies)**
In person in DICE 7-261

Help Desk: **Tuesday, 1-2pm (TAs)**
In person in NREF 2-022

Office Hours begin the week of Sept. 16

Textbook and Course Readings



- Course textbook is Bedient et al., 2019, *Hydrology and Floodplain Analysis*, 6th Edition, Pearson
  - *Fifth edition should also be fine*
- Selected chapters also come from (**at Cameron Library**),
  - Masters, G., and Ela, W., 2008, *Introduction to Environmental Engineering and Science*, 3rd Edition, Prentice Hall. Available in library with **call number TD 145 M4232 2011**
  - Barry, R., and Gan, T., 2011, *Global Cryosphere, Past, Present and Future*, Cambridge University Press. **Call number QC 880.4 C79 B37 2011**
- See also course handout for additional references

Marks Distribution

Assignments	15%	Asynch.
Laboratories	15%	Synch.
Midterm	30%	Synch.
Final Exam	40%	Synch.
TOTAL	100%	

All dates posted on monthly calendar

1. ***All Assignments*** *submitted digitally through eClass*
2. ***All Labs*** *(except Lab 4) submitted on paper, in person*
3. ***Midterm and Final Exam*** *will be written on paper, in person*

Background to Environmental Hydrology

- *Hydrology is not an exact science*
- Study of hydrology provides understanding of the occurrence, distribution and movement of water
  - Essential in agriculture, forestry, soil science, geography, ecology, geology, botany, climatology & geomorphology
- Further, we need to control quantity and quality
  - The engineering perspective

Hydrologists

- Study aspects of the hydrological cycle
  - e.g. rainfall, runoff, groundwater
- Predict the magnitude of floods
- Study the effect of weather (climate change) on water quantity
  - e.g. drought on the Prairies

The 1996 big flood in Chicoutimi

1997 Red River flood (Grand Forks)

Engineering hydrology

- "…includes those segments of the field pertinent to planning, design and operation of engineering projects for the control and use of water" (Linsley, Kohler and Paulhus, 1982)
- Practical applications of hydrology include the planning, design and/or operation of:
  - floodplain delineations and emergency responses
  - hydraulic structures such as dams
  - irrigation and stormwater systems
  - water supply systems
  - wastewater treatment plants
  - pollution abatement
  - fish and wildlife protection

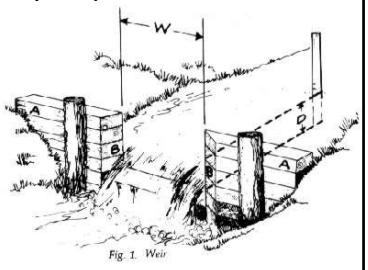


Fig. 1. Weir

http://www.waterwheelfactory.com/weir.htm

Env E 320 course objectives

The primary objective of the course is to introduce students to concepts in hydrology and hydrogeology.

Hydrology topics include precipitation, evaporation, infiltration, streamflow, and hydrograph analysis.

Hydrogeology topics include infiltration, percolation, seepage, drainage, aquifer hydraulics, and urban runoff quality.

Course outline

(Approx. one week per topic)

- Introduction
  - Background to water use and course rationale
- Watersheds
  - Water balance, catchment delineation and area, drainage patterns, stream order
- The Weather and Climate
  - Atmospheric characteristics, clouds, air masses and fronts, weather, and introduction to precipitation

Course outline

- Precipitation
  - Point measurements, hyetographs and cumulative precipitation, areal precipitation, IDF curves
- Evaporation
  - Evaporation, evapotranspiration, measurement and estimation/calculation
- Infiltration
  - Soil types and hydraulic properties, infiltration and infiltration models, measurements

Course outline

- Runoff/Hydrographs
  - Hydrograph theory, unit hydrographs, synthetic unit hydrographs; also a section on watershed modelling

Midterm here.

- Lakes and Water quality
  - Water quality, lakes and reservoirs, water quality in lakes, water quality models
- Snow hydrology
  - Snowfall formation and accumulation, snow measurement, snow pack characteristics, snowmelt modelling

Course outline

- Groundwater
  - Aquifers, hydraulic gradients, Darcy's Law, contaminant transport, cone of depression, capture zone curves
- Climate change
  - The IPCC, atmospheric chemistry, global temperatures, greenhouse effect, global energy balance, CO2 and emissions

Cheating

❖ If you look at someone else's test, get information from someone else's during a test, give someone else information or allow someone to copy from your test, or bring a 'cheat sheet' into a test (even if you don't use it!), that's cheating.

❖ If you let someone else write a test, assignment or paper for you, or if you do those things for someone else, that's cheating.

❖ If you get too much editing or writing help (to the extent that your paper looks substantially different than it would if you wrote it on your own), that's cheating.

❖ If you submit something in a class that has already been submitted and graded in another class, that's cheating.

❖ If you include facts or references that you know to be false in any assignment of any kind, that's cheating.

In other words, cheating is dishonest behaviour designed to gain academic advantage. Any work you hand in or do for credit at the University of Alberta MUST be done honestly and with integrity!

See also notes on student conduct in Course Outline

FACULTY OF ENGINEERING

From the Office of the Dean, Faculty of Engineering

Students PLEASE READ. It is your responsibility to be aware of and understand the implications of contravening the University of Alberta's Code of Student Behaviour.

All suspected infractions identified by Faculty, TAs, Markers and Exam Invigilators will be:

University and faculty policies

Respect and professionalism

The Faculty of Engineering is committed to fostering and protecting an equitable, inclusive, and respectful work and study environment in line with University of Alberta policies and professional engineering industry standards.

The faculty prepares students to uphold industry standards to become a Professional Engineer (P.Eng). Therefore, respect, professionalism, and accountability must be upheld within the Faculty of Engineering and the University of Alberta.

Academic integrity

All students are expected to follow the University of Alberta's Student Code of Behaviour and Student Conduct Policy. The faculty expects an environment free of harassment, discrimination, and bullying. We encourage you to talk to the Office of Safe Disclosure and Human Rights about experiences, questions, or concerns. Additional resources and support for students are attached below.

Engineering students studying in the province of Alberta must also follow the Code of Ethics set by the Association of Professional Engineers and Geoscientists of Alberta (APEGA).

Course outline policies, course requirements, evaluation and grading information can be found in the University Calendar.

Safety during learning activities

In all Faculty of Engineering courses, labs, seminars or other learning activities, safety is of paramount importance. In some cases, laboratory work in a program requires high standards for risk management to keep potential hazards safely under control.

Anyone found to be unable to function safely in the class, lab, seminar or other learning activity may be asked to leave or be removed for their and the safety of other participants and instructors in alignment with the Student Code of Behaviour and Student Conduct Policy. As members, or prospective members, of the engineering profession, it is your responsibility to identify and inform the proper authorities of unsafe work.

Audio and video recording

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan.

Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

Only those items specifically authorized by the instructor may be brought into the exam facility. Students must not bring any unauthorized electronic device into an examination room, including cell phones or other devices.

Student services and support

Health & Wellness Support

Counselling and Clinical Services

Free, short-term, appointment-based counselling and psychiatric services. Also offers drop-in workshops. Book an initial consultation. Visit uab.ca/CCS to learn more.

Wellness Supports Social Workers

Free one-on-one support for students in the areas of housing, finances, academics, personal wellness, life skill development, family dynamics, system navigation, and any area of life where there is a desire to invite change. Visit uab.ca/wellness to learn more.

Sexual Assault Centre

Free, anonymous, and confidential drop-in counselling. Visit uab.ca/UASAC to learn more.

The Office of Safe Disclosure & Human Rights (OSDHR)

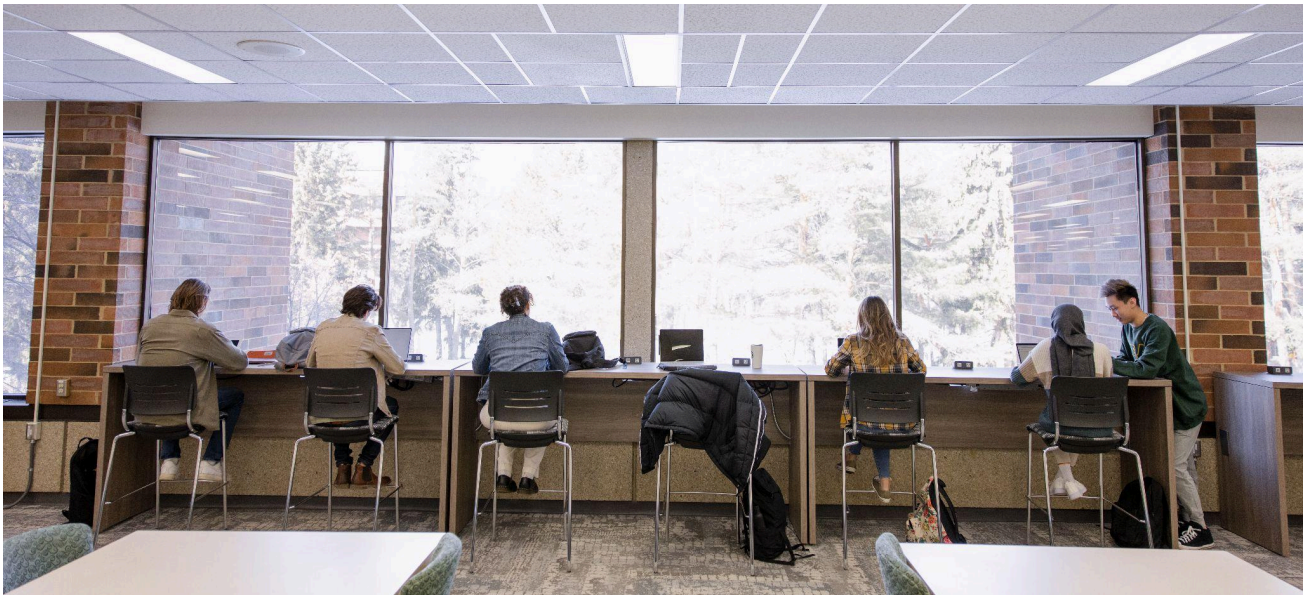
The OSDHR advises confidentially on sensitive issues you may not feel comfortable solving on your own. Contact the OSDHR if you want to get help or to make a report while keeping your privacy. Visit uab.ca/OSDHR to learn more.

HIAR (Helping Individuals at Risk)

If you're worried about someone, contact HIAR, who can help assess risk and connect individuals to support. Learn more at uab.ca/HIAR.

Immediate External Supports

Health Link Alberta: 811
Suicide Crisis Helpline: 988



Academic support

Academic Success Centre
Access to a variety of services to maximize your academic success. Learn more at uab.ca/ASC.

Accessibility Resources
Connects students with disabilities to accommodations. Learn more at uab.ca/Access under accommodations + accessibility.

Decima Robinson Support Centre
Academic support for 100- or 200-level introductory calculus, linear algebra and statistics courses. Visit uab.ca/DSC to learn more.

Engineering Student Success Centre
The Faculty of Engineering provides drop-in tutoring for first-year courses. Visit uab.ca/ESSC to learn more.

Office of the Student Ombuds
Call for complex problems and conflict mediation. Learn more at uab.ca/ombuds.

Financial support

Student Service Centre

For awards and other funding support. Learn more at uab.ca/ask.

Campus Food Bank

The Campus Food Bank Society is an independent charity supporting University of Alberta students, faculty, staff, and alumni for up to five years. For additional information visit their website at campusfoodbank.com.

September

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
1 WEEK 1	2	3 **LABOUR DAY**	4 First Lecture **Topic 1: Watersheds**	5	Top
8 WEEK 2	9 Top 1, Lec 3 **Lab 1** (Watersheds)	10	11 **Topic 2: Weather**	12	Top
15 WEEK 3	16 Top 2, Lec 3	17	18 **Topic 3: Precipitation**	19	Top
22 WEEK 4	23 Top 3, Lec 3 **Lab 2** (Precipitation)	24	25 **Topic 4: Evapotrans.** **Asst 1** (Wtrshd/Weath.)	26	Top
29 WEEK 5	30 **Nat'l Day for Truth & Reconcil. – no class**				

NOTES

Topics 1-4

Course begins with key topics in the **hydrological cycle**: watersheds, weather and atmosphere, precipitation, and evapotranspiration.

Assignments and Labs

Lab 1 is in-person on Sept. 9. Solutions are due at the end of the lab period. Assignment 1 is due Sept. 25, in fourth week of lectures. Assignment submission is through eClass

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October

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
WEEK 5		1	2 **Topic 5: Infiltration** **Asst 2** (Precipitation)	3	Top
6 WEEK 6	7 Top 5, Lec 3	8	9 Top 5, Lec 4 **Asst 3** (Evap./ET)	10	**Topic 6: Runoff**
13 WEEK 7	14 **THANKSGIVING – no class**	15	16 Top 6, Lec 2 **Asst 4** (Infiltration)	17	Top
20 WEEK 8	21 Top 6, Lec 4 **Lab 3** (Infil./Runoff)	22	23 **Topic 7: Hydr. Model**	24	Top
27 WEEK 9	28 Midterm Review ***Asst 5*** (Runoff)	29	30 **MIDTERM EXAM** (during lecture hour)	31	

NOTES

Topics 5-7

Month begins with Infiltration unit. By end of Oct., we will have finished "hydrological cycle" topics and start on water quality in November.

Assignments 2-5 and Lab 3

Assts 2-4 are due on Wednesdays. Asst 5 is due on a Monday.
Lab 3 is in-person. Lab 4 is a take-home lab, released after the Midterm and due in November

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November

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
WEEK 9					**Topic 8: Water** **S. E. Asst releas**
3 WEEK 10	4 Top 8, Lec 2 **Lab 4 help (Zoom)**	5	6 Top 8, Lec 3	7	Top **Lab 4 due** (tak
10 WEEK 11: READING WEEK	11 No Class **Remembrance Day**	12	13 No Class	14	
17 WEEK 12	18 **Topic 9: Snow Hydr.** **Lab 5** (Water Qual.)	19	20 Top 9, Lec 2 **Asst 6** (Water Quality)	21	Top
24 WEEK 13	25 Top 9, Lec 4	26	27 **Topic 10: Grndwater** **Asst 7** (Snow Hydrol)	28	Top

NOTES

Topics 8-10
Hydrologically important topics of water quality, snow hydrology, and groundwater.
No class in Reading Week.

Assignments 6 and 7
Two assignments due late in the month on Wednesdays.

Short Essay Assignment
Short essay on climate change for department's *e-Portfolio* program

Labs
Lab 4
HEC-
Lab 5
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December

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
1 WEEK 14	2 Top 10, Lec 3 **S. E. Asst due**	3	4 Top 10, Lec 4	5	**Topic 11: Clima**
8 WEEK 15	9 Final Review **Lab 6** and **Asst 8** (Gwtr)	10	11	12	**FINAL EX** (See Be
15	16	17	18	19	
22	23	24	25	26	
29	30	31			

NOTES

Topics 10 and 11
Continuation of groundwater topic and introduction to climate change. Last lecture is review for the final exam.

Short Essay, Assts 8 and 9, Lab 6
Short Essay is due Dec. 2.
Lab 6 and Asst 8 are on the last day of class. Asst 9 is for practice and not marked.

Final
Final
1 pm
Exam
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