Western University - Faculty of Engineering
Department of Civil and Environmental Engineering

CEE 4476B – Environmental Hydraulics Design - Course Outline 2026

This course applies the principles of hydraulics and fluid mechanics to environmental flows of water in open channels. At the end of this course students will be able to:

- Identify, formulate, and analyze environmental hydraulics of open channel flows
- Apply knowledge of hydraulics and fluid mechanics to the analysis and design of hydraulic structures and river flows
- Plan, and design, and interpret the results of a laboratory investigation in support of a design project in a small group
- Improve communication skills by contributing to the preparation of comprehensive reports and an oral presentation
- Develop an awareness of water resources issues surrounding environmental flows in open channel waters, and appreciate professional responsibility issues
- Creatively solve problems individually and in small groups

Calendar Copy:

The application of hydraulic engineering principles in the analysis of environmental flows. Topics include: open channel transitions, flow measuring devices, stabilization of a natural river, flood control channels, spillways and stilling basins, culverts, and sediment transport in alluvial channels.

Prerequisites:

CEE 2224

Antirequisites:

None

Note: It is the student's responsibility to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the student's responsibility to ensure that they have not taken a course listed as an Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

Contact Hours:

2 lecture hours/week;

Lectures are organized into weekly learning modules, including in-person discussion. Students should review the online lectures in the week they are posted, and be prepared to discuss and apply the concepts presented during the weekly lecture sessions. Review of lecture material and attendance at lecture sessions should take approximately 5 hours per week.

2 tutorial hours/week.

A 2-hour tutorial session will be delivered each week during the scheduled tutorial hours. An assignment will be completed each week and must be submitted by the specified due date.

1-hour laboratory sessions/week.
Students will be placed in teams and complete laboratory sessions over the course of the term. A schedule for laboratory activities will be provided by the course instructor

Attendance at the tutorial/laboratory session is **mandatory**.

Instructor:

[redacted]

Textbook:
The required text for this class is:

- Sturm, T. *Open Channel Hydraulics, 3rd Edition*. McGraw-Hill Higher Education, 2021. Can be purchased at the bookstore or Amazon.

Other References

- Chanson H., *Hydraulics of Open Channel Flow*, *2nd Edition*. Butterworth-Heinemann, 2004.
- Chanson H., *Environmental Hydraulics for Open Channel Flows.* Butterworth-Heinemann, 2004.
- French R., *Open Channel Hydraulics*. Water Resources Publications, 2007.

Active Engaged Classroom:
It is important for the students to attend the class and actively participate in different activities that are set to encourage engaged learning. Web-browsing, texting, and social media are not allowed during class time as they will distract other students.

Units:
Both SI and FPS unit systems may be used in lectures, tutorials and examinations.

Specific Learning Objectives [GA Indicator – bold denotes evaluated indicator]:
1. *Basic Principles* [PA1]

- Classify different types of flow regimes in open channel hydraulics
- Demonstrate an understanding of the important concepts in fluid mechanics (continuity, momentum and energy equations)

2. *Specific Energy* [**PA1, KB2**]

- Describe and compute the specific energy diagram and critical depth in simple and complex channel cross-sections

- Apply the governing equations for open channel contractions and expansions with head loss
- Determine the discharge range of critical depths in overbank flow conditions
- Apply weirs in the design of open channel flow measuring devices
- Apply the energy equation in stratified flows

3. *Momentum* [**PA1**, **DE1**, **KB2**]
- Apply the momentum equation in open channel flows for the analysis of hydraulic jumps
- Design a stilling basin to stabilize hydraulic jumps
- Analyze the occurrence of surges in open channel hydraulics
- Apply momentum analysis to backwater effects caused by flow obstructions

4. *Uniform Flow* [**PA1**, **DE1**]
- Describe the flow resistance in turbulent open channel flows and the resulting velocity distributions for various hydraulic conditions
- Compute uniform flow depth in simple and compound channels
- Design channels with flexible linings, flood control and flood diversion channels

5. *Gradually Varied Flow* [**PA1**, **IN3**, **DE1**, **KB2**]
- Describe gradually varied flows and apply the related equations
- Classify water surface profiles
- Compute water surface profiles in artificial and natural channels
- Use HEC-RAS to compute water surface profiles

6. *Hydraulic Structures* [**PA1**, **IN2**, **DE1**, **DE2**, **DE4, KB2**]
- Design spillways to transfer large flood discharges safely downstream from a reservoir
- Describe and apply methods for computing bridge backwater effects

7. *Unsteady Flow* [**PA1**, **DE1**]
- Describe the development and application of dynamic wave equations
- Apply the Saint-Venant equations to characterize unsteady flow conditions

8. *Flow in Alluvial Channels* [**PA1**, **IN3**, **DE1**, **DE2**, **DE4**]
- Compute the fall velocity of sediment in water for various conditions
- Determine the stability of the bed and banks of natural alluvial channels by evaluating the threshold of sediment movement
- Predict bed-load transport and the total sediment discharge of an alluvial stream
- Estimate streambed adjustments and scour

9. *Laboratory Investigation* [**IN2**, **IN3**, **DE1**, **DE2**, **DE4**, **KB2**]
Plan, design and interpret a laboratory investigation in support of a design project
Instructor may expand on material presented in the course as appropriate

10. *Engineering Tools* [ET1]
- Apply HEC-RAS software to simulate water surface profiles.

11. *Communication* [CS1]
- Prepare and present a final project report and oral presentation summarizing the design process and results.

12. *Individual and Teamwork* [TW1]
- Collaborate effectively in small groups to design and implement hydraulic experiments.

13. *Impact on Society* [IS1]
- Evaluate the environmental impact and societal implications of hydraulic structure designs, particularly in flood-prone areas.

The instructor may expand, or revise material presented in the course as appropriate.

General Learning Objectives:

I=Introduce, D = Developing, A = Advanced level

Problem Analysis	A	Teamwork	D	Ethics and Equity	
Investigation	A	Communication	D	Economics and Project Management	
Design	D	Professionalism		Life-Long Learning	
Engineering Tools	D	Impact on Society	D	Knowledge base	A

Evaluation:

The final mark will be determined as follows:

Participation	10 %
Assignments	15 %
Laboratory Project	15 %
Midterm	15 %
Final Examination	45 %
Total	100 %

Note: Participation will be tracked through forum posts and discussions during lecture hours.

Accreditation Units:

Engineering Science: 50%, Engineering Design: 40%, Complementary Studies: 10%

1. Quizzes and Examinations:

A 90-minute midterm exam will be held during tutorial hours. A three-hour final examination will take place during the examination period. Programmable calculators are not permitted in the final exam and tests. Both tests and the final examination will be Closed Book. A list of acceptable calculators for closed book exams will be posted on the bulletin board across from the Department of Civil and Environmental Engineering Office: please be sure your calculator is on it!

2. Weekly Assignments:

Assignments will be given on a weekly basis. Assignments are to be submitted prior to the due date to OWL. Late assignments will be assessed a penalty of 10% per day, to a maximum of 4 days, after which they will receive a mark of zero. Extensions are to be negotiated with the course instructor, not the teaching assistants.

3. Laboratories:

Students in small groups will plan, design and carry out a laboratory investigation of an environmental hydraulics problem. At the end of the course each group is required to submit a final report (~3000 words) and make a 10-min oral presentation. An additional progress report (1000 words) must also be submitted by each group for review and marking. A Logbook of group activities related to the project must be maintained and submitted as an attachment to the progress and final reports. Contributions by individual members of a group must be clearly identified in the Logbook and in the progress and final reports.

4. Use of English:

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

CEE Course Outline Additional Information

The sections below can be included following the "Evaluation" section of the sample course outline (replacing the red text in the course outline template). Text in blue below should appear in all course outlines. Text in red will be applicable to some courses and not to others.

I. Missed/Late Accommodation Policy:

1. Students missing a test/assignment/lab or examination you will report the absence by submitting Academic Consideration Request form through STUDENT ABSENCE PORTAL.
2. Documentation must be provided as soon as possible.

II. Exam Accommodation:

1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.

3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department and the Associate Dean and in order to apply you must submit an the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
   PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

III. Late Assignments:

1. Students must advise the course instructor if they are having difficulty completing an assignment on time (prior to the due date of the assignment).
2. Students should be prepared to submit the Academic Consideration Request Form and provide documentation if requested to do so by the course instructor (see reverse side for information on documentation).
3. If granted an extension, a revised due date should be established with the course instructor. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4. This course has 10 assignments with only 8/10 assignments counted towards your final grade. Academic consideration will not be granted for missed assignments. If students miss 2/10 assignments, the remaining 8 assignments will be used in the calculation of the final grade. If students miss more than 2 assignments, they will receive a grade of zero on each missed assignment.
5. This course employs flexible deadlines for assignments. The assignment deadlines can be found above in the course outline. For each assignment, students are expected to submit the assignment by the deadline listed. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 72 hours past the deadline without academic penalty. Should students submit their assessment beyond 72 hours past the deadline, a late penalty of XX% per day will be subtracted from the assessed grade. As flexible deadlines are used in this course, requests for academic consideration will not be granted. If you have a long-term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted deadline.
6. Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

IV. Medical Accommodation:

1. Requests for Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Requests for academic consideration must include the following components:
   a. Self-attestation signed by the student (*This is only accepted for the first/one absence*)
   b. Medical note

c. Indication of the course(s) and assessment(s) affected by the request
d. Supporting documentation as relevant

3. Requests without supporting documentation are limited to one per term per course.
4. **Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**
5. Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline. Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals without academic penalty, may only be granted by the Academic Advising office of the Faculty of Engineering.

V. Religious Accommodation:

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

VI. Academic Integrity:

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit Academic Integrity Western Engineering for more information

VII. Academic Offences:

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university.
Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know

Students must write their reports, essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (http://www.turnitin.com). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

VIII. Faculty of Engineering AI Policy:

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. However, the use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource.
GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use. If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

IX. Use of English Policy:

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work except for the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

X. Accessibility:

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the Accessibility Western University for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit Academic Support & Engagement -Academic Accommodation.

XI. Inclusivity, Diversity, and Respect:

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating

multiple ways of knowing, being, and doing. Please visit the Office of Equity, Diversity and Inclusion.

XII. Health and Well-Being:

- Health & Wellness Services – Students - Offers appointment-based medical clinic for all registered part-time and full-time students.
- Mental Health Support - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
- Crisis Support - For immediate assistant, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click here.
- Gender-Based Violence and Survivor Support - Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Important Contacts:

Engineering Undergraduate Services	SEB 2097	519-661-2130	engugrad@uwo.ca
Civil & Environmental Engineering	SEB 3005	519-661-2139	civil@uwo.ca
Office of the Registrar/Student Central	WSSB 1120	519-661-2100	

Important Links:

- WESTERN ACADEMIC CALENDAR
- ACADEMIC RIGHTS AND RESPONSIBILITIES