ABE 456: Land & Water Resources Engineering - Fall 2026

Credit	3 undergraduate hours; 3 or 4 graduate hours
Course duration	Full semester (August 24-December 9, 2026), with the final written project due during finals week
Format / contact hours	Laboratory Lecture. Two 110-minute instructional sessions per week in most weeks. One scheduled meeting (November 4) will be completed as an asynchronous instructional activity.
Schedule	Mondays and Wednesdays, 1:00-2:50 PM
Location	242 Agricultural Engineering Sciences Building (AESB)
Instructor	Luciano Alves de Oliveira
Office	360Q Agricultural Engineering Sciences Building (AESB)
E-mail	luciano8@illinois.edu
Phone	(217) 333-1078
Student Hours (Office Hours)	Mondays, 3:00-4:00 PM in 360Q AESB; additional meetings by appointment via email

Course Description

ABE 456 applies hydrology and hydraulics to the analysis and design of systems that conserve soil and water resources and protect water quality in agricultural landscapes. The course connects precipitation, evapotranspiration, soil-water storage, infiltration, runoff, erosion, open-channel flow, water storage, drainage, and conservation structures with engineering design, construction considerations, and cost/feasibility evaluation. Examples and datasets emphasize Illinois agriculture while developing methods that transfer to other land and water systems.

How This Course Works

The course moves from hydrologic processes to engineering decisions. Students first characterize the water entering, leaving, and moving through a field or watershed. They then quantify runoff, erosion, conveyance, storage, and water-management needs. The second half of the course uses those calculations to select, size, compare, and defend engineering solutions. Weekly applied exercises build the technical skills; two decision memos develop concise engineering recommendations; and the individual final project integrates the semester into a complete land-and-water engineering solution.

Prerequisite

Credit or concurrent registration in TAM 335.

Course Objective

Students will analyze land and water systems, quantify key hydrologic and hydraulic processes, design conservation and water-management practices, evaluate engineering alternatives, and communicate technically justified recommendations for agricultural and environmental applications.

Learning Outcomes

- Characterize watersheds and agricultural fields using topography, soils, climate, crops, and management information.
- Evaluate precipitation, evapotranspiration, soil-water, and infiltration data, including the limitations and uncertainty of common data sources.
- Calculate infiltration, runoff volume, design rainfall, peak discharge, and other hydrologic quantities needed for engineering analysis.
- Estimate soil erosion and sediment risk and use those estimates to identify appropriate conservation practices.
- Apply open-channel hydraulics and engineering criteria to the design of waterways, terraces, storage systems, and water/sediment-control structures.
- Evaluate drainage, drainage water recycling, and edge-of-field water-quality practices as components of integrated agricultural water management.
- Compare engineering alternatives using performance, constructability, cost/feasibility, resource-protection, and uncertainty considerations.
- Communicate engineering analyses and recommendations clearly through calculations, technical memos, design documentation, and oral presentation.

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Textbook and References

Primary textbook: Brooks, K.N., Ffolliott, P.F., and Magner, J.A. Hydrology and the Management of Watersheds, 4th Edition, 2012.

- Huffman, R.L., Fangmeier, D.D., Elliot, W.J., and Workman, S.R. Soil and Water Conservation Engineering, 7th Edition, 2013 (or 6th Edition, 2011).
- Haan, C.T., Barfield, B.J., and Hayes, J.C. Design Hydrology and Sedimentology for Small Catchments.
- USDA NRCS, Urban Hydrology for Small Watersheds (TR-55), National Engineering Handbook Part 630 - Hydrology, and Engineering Field Handbook Part 650.
- Allen, R.G., Pereira, L.S., Raes, D., and Smith, M. FAO Irrigation and Drainage Paper 56: Crop Evapotranspiration (selected material).
- Illinois Agronomy Handbook and selected University of Illinois Extension publications.
- Selected NOAA/NWS, Midwestern Regional Climate Center, Illinois State Water Survey, USDA NRCS, and peer-reviewed resources provided through Canvas.

Course Materials, Technology, and Canvas

Canvas is the official course website and communication hub. Course notes, datasets, assignment instructions, rubrics, announcements, due-date changes, and grades will be posted there. Students should check Canvas regularly and enable announcement notifications. Individual matters should be communicated through Illinois email.

Students should have access to a scientific/engineering calculator, a device capable of joining Kahoot quizzes, and spreadsheet software such as Microsoft Excel. Additional GIS, data-analysis, or engineering tools may be used in selected activities; instructions and access information will be provided when needed.

Course Requirements and Assessment Overview

Students registered for 3 credits should plan for approximately 6 hours of course work outside scheduled instruction per week. Students registered for 4 graduate credits should plan for approximately 8 hours outside scheduled instruction per week, including the graduate extension described below. Actual weekly workload will vary as students move between short quizzes, applied calculations, and the final design project.

Applied Engineering Exercises - 25%

Nine individual applied engineering exercises are planned. Students will work with real or realistic land, water, soil, climate, and engineering data to practice watershed characterization, precipitation analysis, evapotranspiration and water balance, infiltration, runoff, erosion, channel design, drainage water recycling, conservation structures, storage, and engineering feasibility. Some exercises will begin during class and be completed afterward. The lowest applied-exercise score will be dropped; the remaining scores will form the 25% course component.

Kahoot Quizzes - 10%

Ten short Kahoot quizzes are planned, generally during the first 10-15 minutes of class. Quizzes may include concepts, terminology, units, short calculations, graphs, and engineering interpretation. The score generated by Kahoot will be used as the quiz score. The two lowest quiz scores will be dropped. Questions that reveal widespread misunderstanding may return in a revised form on a later quiz or the midterm.

There are normally no make-up Kahoot quizzes for ordinary absences because two scores are dropped. A student who misses more than two quizzes because of university-recognized absences will receive an equivalent alternative or an excused score, as appropriate. A student who arrives after a Kahoot quiz has closed will normally receive a missed-quiz score unless an approved absence applies.

Midterm Exam - 20%

There will be one individual, in-person midterm exam on October 7. The exam will emphasize application and interpretation of the hydrologic foundations covered during the first half of the course, including precipitation, evapotranspiration, soil-water relationships, infiltration, runoff, design rainfall, and related engineering concepts. The exam may include conceptual questions, short calculations, and engineering interpretation.

Students may use a calculator and may bring one self-prepared U.S. letter-size (8.5 x 11 inch) sheet of notes, using both sides. The sheet may be handwritten or typed. Students who bring the authorized note sheet will receive one bonus point on the exam (a 100-point exam may therefore receive a maximum score of 101). The instructor will not provide an equation/reference sheet. Internet access, generative-AI tools, communication with other people, and additional notes or reference materials are not allowed during the exam.

Technical Decision Memos - 10%

Students will complete two individual technical decision memos, each worth 5% of the course grade. Each memo will normally be 1-2 pages and will ask the student to convert an engineering analysis into a concise recommendation for a realistic audience such as a producer, conservation professional, consultant, or engineer. The memo must identify the problem, present the key evidence or calculations, state a recommendation, and explain why that recommendation is technically justified. Detailed prompts and rubrics will be provided in Canvas.

Individual Final Engineering Project - 30%

The final project is an individual engineering design project worth 30% of the course grade: 20% for the written engineering report and 10% for the oral presentation. Each student will select from instructor-provided cases or propose an Illinois agricultural land-and-water problem for approval. The project will characterize the site/problem, perform the necessary hydrologic and hydraulic analyses, evaluate technically reasonable alternatives, develop and justify an engineering solution, consider construction and cost/feasibility, and explain expected resource-protection benefits and limitations. Students may propose an instructor-approved research case when it provides an equivalent ABE 456 engineering problem.

Project topics must be approved by October 14. A design checkpoint will occur on November 18. Final presentations will be held on December 9; presentations will normally be approximately 10-12 minutes plus questions, with exact timing announced in Canvas. The final written report is due December 16 at 11:59 PM Central. A report template and grading rubric will be provided in Canvas. There is no final exam.

Additional Requirement for 4-Credit Graduate Registration

Graduate students registered for 4 credits must complete an approved graduate extension in addition to the standard ABE 456 project. The extension must be concrete, technically substantive, and connected to course learning outcomes. Students will choose one of two pathways:

- Advanced Design Extension: perform a deeper engineering analysis, compare additional alternatives and/or methods, use current technical literature, and provide expanded feasibility, uncertainty, or design justification beyond the standard project.
- Thesis/Dissertation Application: demonstrate how ABE 456 concepts directly enhance the student's thesis or dissertation and complete an approved technical analysis or design deliverable that applies course methods to that research.

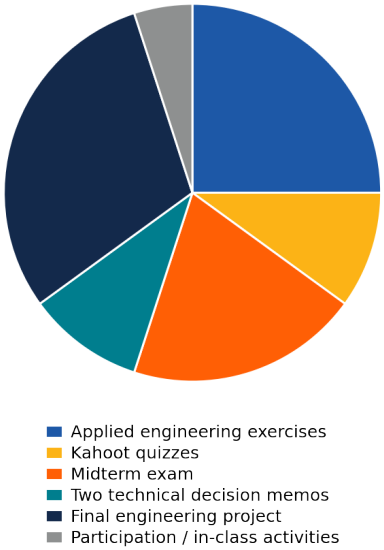
A one-page graduate-extension proposal is due October 14 and must be approved by the instructor. The extension may be integrated into the final report or submitted as a clearly identified technical appendix. For 4-credit students, 5 percentage points of the 20% written-project grade are specifically assigned to the graduate extension. The course still totals 100%; the extension is not extra credit. Graduate students registered for 3 credits complete the standard course requirements without this additional extension.

Participation and In-Class Engineering Activities - 5%

Participation is based on active contribution rather than physical presence alone. Credit may come from in-class calculations, design discussions, short interpretation activities, project workshops, guest-lecture engagement, and peer feedback. Two lowest participation/in-class activity scores will be dropped. University-recognized absences will be handled under the absence policy and will not be penalized simply because a student could not be physically present.

Course Evaluation

Applied engineering exercises (lowest score dropped): 25%
Kahoot quizzes (two lowest scores dropped): 10%
Midterm exam: 20%
Two technical decision memos: 10%
Final engineering project - written report: 20%
Final engineering project - oral presentation: 10%
Participation and in-class activities: 5%
Total: 100%



Percentage	Grade
97.5-100.0	A+
92.5-97.4	A
90.0-92.4	A-
87.5-89.9	B+
82.5-87.4	B
80.0-82.4	B-
77.5-79.9	C+
72.5-77.4	C
70.0-72.4	C-
67.5-69.9	D+
62.5-67.4	D
60.0-62.4	D-
<60.0	F

Final grades are calculated from the exact numerical course average and are not rounded. The minimum percentage required for each letter grade is shown below.

Course Schedule

The schedule below is the planned Fall 2026 sequence. The course intentionally moves from hydrologic forcing and soil-water response to runoff/erosion, hydraulics, conservation structures, water management, water quality, and integrated design. Field conditions, guest availability, data availability, or the pace of the class may require adjustments. Any change to a due date, assessment, or class format will be announced through Canvas.

Week	Date	Topic	Detailed coverage	Activity / Assessment
1	Mon Aug 24	Course introduction: land & water engineering in Illinois	Course structure; land and water problems in Illinois agriculture; hydrology-to-design framework; final project overview.	Project cases introduced; in-class problem-framing activity.
1	Wed Aug 26	Watersheds, water cycle, topography, and hydrologic response	Watershed concepts; drainage divides; landform/topographic controls; water-cycle components; engineering interpretation of field and watershed boundaries.	Applied Exercise 1 introduced: watershed/data characterization.
2	Mon Aug 31	Precipitation measurement, variability, and data quality	Rain gauges and station data; spatial variability; missing and questionable data; station versus gridded products; implications for design inputs.	Kahoot Quiz 1; continue Applied Exercise 1.
2	Wed Sep 2	Design rainfall, frequency, intensity, and extreme events	Return period and exceedance concepts; rainfall frequency/intensity; design-event selection; interpreting extreme precipitation for engineering applications.	Applied Exercise 1 due Fri Sep 4, 11:59 PM.
3	Mon Sep 7	Labor Day	All-campus holiday.	No class.
3	Wed Sep 9	Evapotranspiration and crop water demand	Evaporation and transpiration; reference ET and crop ET; weather controls on atmospheric demand; why ET matters in agricultural water engineering.	Kahoot Quiz 2; Applied Exercise 2 introduced: ET and soil-water balance.
4	Mon Sep 14	Soil physical and hydraulic properties	Porosity, bulk density, water content, field capacity, permanent wilting point, available water, hydraulic behavior, and soil controls on storage and movement.	In-class soil-water calculations.
4	Wed Sep 16	Sequential soil-water balance in agricultural systems	Precipitation, ET, runoff, drainage, and soil-water storage; deficit versus excess water; Illinois spring/summer water-management context.	Kahoot Quiz 3; Applied Exercise 2 due Fri Sep 18, 11:59 PM.
5	Mon Sep 21	Infiltration: processes and prediction	Infiltration mechanisms; initial conditions; infiltration capacity; common prediction approaches; links to runoff and design.	Applied Exercise 3 introduced: infiltration measurement/prediction.
5	Wed Sep 23	Infiltration measurement and applied analysis	Field or dataset-based infiltration measurement; parameter estimation; interpretation of spatial variability and method limitations.	Kahoot Quiz 4; Applied Exercise 3 due Fri Sep 25, 11:59 PM. Field activity is weather dependent.
6	Mon Sep 28	Runoff generation and Curve Number methods	Runoff mechanisms; abstraction; NRCS Curve Number concepts; runoff depth; soil, land use, and antecedent-condition effects.	Applied Exercise 4 introduced: runoff and design flow.

Week	Date	Topic	Detailed coverage	Activity / Assessment
6	Wed Sep 30	Peak runoff, hydrographs, and design flow	Peak discharge; time of concentration; hydrograph concepts; connecting design rainfall to engineering flow.	Kahoot Quiz 5; Applied Exercise 4 due Fri Oct 2, 11:59 PM.
7	Mon Oct 5	Hydrologic design synthesis and review	Integrated field/watershed case linking precipitation, ET, soils, infiltration, runoff, and design flow; midterm review.	Kahoot Quiz 6; review activity.
7	Wed Oct 7	Midterm Exam	Hydrologic foundations through October 5.	Midterm exam in class.
8	Mon Oct 12	Soil erosion processes	Detachment, transport, deposition; rainfall/runoff drivers; topographic and management controls; conservation context.	Applied Exercise 5 introduced: erosion and soil-loss estimation.
8	Wed Oct 14	Soil-loss prediction and conservation interpretation	USLE/RUSLE concepts; factor interpretation; soil-loss calculations; translating estimated loss into engineering need.	Kahoot Quiz 7; project topic approval due; 4-credit graduate extension proposal due; Applied Exercise 5 due Fri Oct 16, 11:59 PM.
9	Mon Oct 19	Conservation planning and engineering alternatives	From problem diagnosis to practice selection; structural versus management options; performance criteria; limitations and tradeoffs.	Decision Memo 1 introduced: erosion/runoff conservation recommendation.
9	Wed Oct 21	Open-channel hydraulics	Uniform flow concepts; Manning equation; hydraulic radius; flow geometry; velocity and capacity; engineering assumptions.	Kahoot Quiz 8; in-class channel calculations.
10	Mon Oct 26	Channel design	Sizing channels for capacity and stability; velocity limits; lining/roughness; freeboard and practical design considerations.	Decision Memo 1 due Mon Oct 26, 11:59 PM; Applied Exercise 6 introduced.
10	Wed Oct 28	Grassed waterways	Hydrologic input, cross-section selection, allowable velocity, vegetation, outlet considerations, and complete design workflow.	Kahoot Quiz 9; Applied Exercise 6 due Fri Oct 30, 11:59 PM.
11	Mon Nov 2	Guest lecture: Drainage Water Recycling	Eric Henning (remote). Drainage, water capture/storage, reuse, crop-water supply, and DWR as an integrated Illinois agricultural water-management system.	Remote guest lecture; instructor will join remotely for introduction.
11	Wed Nov 4	Asynchronous DWR engineering case	Individual application of water balance, drainage, storage, and reuse concepts to a realistic agricultural case. No in-person meeting.	Applied Exercise 7 due Fri Nov 6, 11:59 PM.
12	Mon Nov 9	Terrace systems	Purpose and types of terraces; runoff interception; layout, spacing, grade, outlets, and integration with conservation systems.	Applied Exercise 8 introduced: structures and storage.
12	Wed Nov 11	Water and sediment-control structures	Grade-control concepts; outlets; water/sediment-control basins and related conservation structures; design criteria and failure considerations.	Kahoot Quiz 10.
13	Mon Nov 16	Reservoirs, ponds, and agricultural water storage	Storage-volume concepts; inflow/outflow; detention versus conservation storage; pond/reservoir sizing; links to DWR and farm water management.	Project design checkpoint workshop.
13	Wed Nov 18	Integrated structural design and alternative selection	Compare waterways, terraces, storage, drainage/reuse, and control structures; performance, constructability, risk, and engineering tradeoffs.	Applied Exercise 8 due Fri Nov 20, 11:59 PM; Decision Memo 2 introduced.
14	Mon Nov 23	Fall Break	University fall break.	No class.
14	Wed Nov 25	Fall Break	University fall break.	No class.
15	Mon Nov 30	Construction, cost estimation, and engineering feasibility	Constructability; quantities; conceptual cost estimation; operation and maintenance; lifecycle and feasibility considerations; choosing among technically viable alternatives.	Applied Exercise 9: feasibility/cost worksheet, due Tue Dec 1, 11:59 PM.
15	Wed Dec 2	Guest lecture: Woodchip Bioreactors	Carolina Diaz Garcia. Nitrate removal from drainage water; hydraulic and treatment concepts; sizing/operation considerations; edge-of-field water-quality engineering. Format announced in Canvas.	Guest lecture; Decision Memo 2 due Fri Dec 4, 11:59 PM.
16	Mon Dec 7	Final design workshop and course synthesis	Integrate hydrology, hydraulics, soil/water conservation, water management, water quality, constructability, and cost; project troubleshooting and final questions.	Final project workshop and presentation preparation.
16	Wed Dec 9	Final project presentations	Individual engineering-design presentations and course synthesis.	Final project oral presentations (10%); last day of instruction.
Finals	Wed Dec 16	Final written engineering report due	No final exam.	Final written project report (20%) due in Canvas by 11:59 PM Central.

Course Policies

Attendance and Absences

Regular attendance is expected because many meetings involve calculations, field/data activities, design work, guest speakers, and project workshops. Attendance itself is not a large stand-alone grade; participation points reflect active engagement. Students should notify the instructor before a known absence whenever possible and as soon as reasonably possible after an unexpected absence. University-recognized absences will be handled consistently with the Student Code. Documentation may be requested when appropriate. The two dropped participation/activity scores and two dropped Kahoot scores provide flexibility for ordinary missed days, but they do not replace approved accommodations for recognized absences.

Campus attendance policy: Student Code §1-501

Late Work

Unless an assignment states otherwise, work submitted within 24 hours after the deadline receives a 10% deduction. Work more than 24 hours late is normally not accepted unless the student made arrangements before the deadline or has a documented/university-recognized reason. Students should contact the instructor as early as possible when circumstances may affect a deadline. Final presentation and final-report deadlines are firm except for approved circumstances. Unless otherwise stated, Canvas submissions are due at 11:59 PM Central on the listed date.

Individual Work and Collaboration

Applied exercises, decision memos, the midterm, and the final project are individual work. Students may discuss concepts, assumptions, and problem-solving approaches with classmates unless an assignment says otherwise. Each student must independently complete and submit their own calculations, figures, spreadsheets/code, interpretation, and writing. Sharing completed solutions, files, or text for another student to submit is not allowed.

Generative Artificial Intelligence

Generative-AI tools may be used on homework, applied exercises, decision memos, and project work as learning/support tools when the assignment does not prohibit them. Appropriate uses include helping explain a concept, checking an approach, debugging spreadsheet/code, improving writing clarity, or exploring possible alternatives. Students remain responsible for every calculation, citation, design choice, source, and statement they submit. AI-generated calculations, designs, interpretations, or recommendations must be independently verified against course methods and reliable sources.

When generative AI materially contributes to a submitted assignment, include a brief AI-use statement identifying the tool, what it was used for, and how the student verified or revised the output. Exact prompt transcripts are not required unless an assignment specifically requests them. Generative AI is not allowed during Kahoot quizzes or the midterm exam unless the instructor explicitly authorizes it.

Regrade Requests

Requests to reconsider a graded item must be submitted in writing within 7 calendar days after the graded work is returned. The request should identify the specific item and explain the basis for reconsideration. The instructor may re-evaluate the relevant work in full; the resulting grade may increase, decrease, or remain unchanged. Clerical or arithmetic errors should be reported as soon as they are noticed.

Course Communication

Canvas announcements are the official channel for course-wide communication. Illinois email should be used for individual questions or matters that should not be discussed publicly. Students should normally expect an instructor response within one business day, Monday through Friday. Messages sent during evenings, weekends, or university holidays may be answered on the next business day. Students are responsible for information and schedule changes communicated through Canvas.

Auditing Students

Students formally enrolled as auditors are welcome to attend class and participate in learning activities and discussions. Auditors do not receive a course grade or course credit through ABE 456 and are not required to complete graded assessments unless they make a separate arrangement with the instructor.

Academic Integrity

All students are expected to follow the University of Illinois Student Code requirements for academic integrity. Work represented as a student's own must be that student's own, and all sources, data, code, external assistance, and

permitted AI use must be handled transparently. Questions about whether a form of collaboration or assistance is permitted should be resolved with the instructor before submission. Academic-integrity violations may result in course penalties and university procedures.

Academic integrity policy: Student Code Article 1, Part 4

Students with Disabilities

The University is committed to removing barriers to learning and participation. Students who have a DRES Letter of Academic Accommodations should share it with the instructor as early as possible so the accommodations can be implemented. Students seeking disability-related academic accommodations should contact Disability Resources and Educational Services (DRES), 1207 S. Oak St., Champaign; 217-333-1970; disability@illinois.edu.

DRES: go.illinois.edu/DRES

Religious Observances

The University provides reasonable accommodations when a student's religious beliefs, observances, or practices conflict with class attendance, examinations, or required work. Students should notify the instructor in advance of a known conflict so an appropriate alternative can be arranged.

Sex-Based Misconduct and Reporting

The University is committed to preventing and responding to sex-based misconduct. Faculty and staff are required to report disclosures of sex-based misconduct to the University Title IX Office, which can provide information about rights, accommodations, support services, reporting options, and university processes. Confidential resources are available for students who want to discuss concerns without triggering the same reporting obligation.

Resources and confidential options: We Care at Illinois

Community of Care and Student Support

Academic performance can be affected by health, mental-health, family, financial, housing, food-security, or other significant circumstances. Students who need help identifying resources or navigating a serious situation may contact the Connie Frank CARE Center in the Office of the Dean of Students at 217-333-0050. Students are also encouraged to refer concerns about a classmate's well-being or safety when appropriate.

Connie Frank CARE Center: go.illinois.edu/CAREcenter

Emergency Response

Students should become familiar with emergency exits, severe-weather shelter locations, and emergency procedures for AESB. In an active-threat emergency, follow campus emergency instructions and Illini-Alert messages. Review the Division of Public Safety emergency guidance early in the semester.

Emergency guidance: Run, Hide, Fight - Division of Public Safety

FERPA and Student Privacy

Student education records and grades are handled in accordance with the Family Educational Rights and Privacy Act (FERPA) and University policy. Course grades and individual performance will not be discussed with people who are not authorized to receive that information.

FERPA information: Office of the Registrar - FERPA

Veterans and Military-Connected Students

Students with military obligations such as deployment, training, or drills should communicate known conflicts to the instructor in advance whenever possible. University policies provide accommodations for qualifying military and national-defense service obligations.

Course Climate and Professional Conduct

ABE 456 depends on respectful technical discussion. Students should critique calculations, assumptions, and engineering ideas rather than people. Discriminatory, harassing, threatening, or persistently disruptive behavior is inconsistent with the learning environment and may be addressed under University policy. Professional communication is expected in class, email, Canvas, guest lectures, and peer feedback.

Syllabus and Schedule Changes

This syllabus is intended to function as the course guide for Fall 2026. The instructor may make reasonable changes when needed because of field conditions, guest-speaker availability, class progress, data availability, or other circumstances. Changes that affect assignments, due dates, grading, or class format will be communicated through Canvas. The most recent version posted in Canvas will be the controlling course document.