Syllabus

CEE 458: WATER RESOURCES FIELD METHODS

Fall, 2025

Class hour and location 08:00 – 09:50 AM Wed. (2015 Civl & Environmental Engineering Building (CEEB)) and 1:00 to 5:00 PM Thursdays (Section FM1) or Friday (Section FM2), (Meet at 1015 CEEB, travel to various field sites, TBA)

Credit: 4 hours

Instructor

Instructor: Dr. Arthur R. Schmidt, P.E.
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Teaching Assistant: Jim Liu (Thursday)
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Teaching Assistant: Paige Hardt (Friday)
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Office hours: 1-2 PM Monday, B118 NCEL or by appointment

Course Description: This course will emphasize: (1) scientific principles behind measurement technologies and protocols used for water-resources measurements; and (2) experimental design for field-scale water-resources and environmental studies. This course will include discussion sections where the theoretical bases and scientific principles of different measurements and sampling strategies will be discussed, along with several field trips to observe and participate in using the methods that have been discussed. The field trips will examine real-world problems (e.g., design a hydrologic observatory; what is the impact of dredging; what is the impact of disinfection, etc.) and the monitoring that would be needed to support making decisions about such problems.

The course emphasizes applying the materials presented in class to real-world field situations; **regular attendance is therefore expected**, since the hands-on field experience will provide much greater detail than the readings, lecture, or recorded material. This course meets the *Laboratory course* requirements detailed in the Civil Engineering Undergraduate Handbook.

The instructor for this course is Dr. Arthur Schmidt. Dr. Schmidt has over 30 years of experience in a wide variety of field measurements and designing and implementing scientific field studies. Other experts from various campus units as well as from the Illinois State Geological Survey, the Illinois State Water Survey, the U.S. Army Corps of Engineers, and the U.S. Geological Survey may provide additional instruction and demonstration.

Prerequisites: Students should have the basic hydrologic and hydraulic background equivalent to CEE 350 "Water Resources Engineering," and TAM 335 "Introductory Fluid Mechanics". Students should have an introduction to probability and statistics equivalent to CEE 202, "Engineering Risk & Uncertainty."

Textbook and Supplemental Readings: No text is required for CEE 458. All reading assignments are available in the Canvas Learning Management System (LMS).

Additional References:

Butler, James Johnson. The Design, Performance, and Analysis of Slug Tests . 2nd ed. Boca Raton: CRC Press LLC, 2020.

Helsel, Dennis R. et al. Statistical Methods in Water Resources . Revised, May 2020. Reston, Virginia: U.S. Department of the Interior, U.S. Geological Survey, 2020.

Herschy, Reginald W. Hydrometry : Principles and Practices . 2nd ed. New York: John Wiley, 1999.

Herschy, Reginald W. Streamflow Measurement . Second edition. Abingdon, Oxon: Taylor & Francis, 2007.

Northrop, Robert B. Introduction to Instrumentation and Measurements . 2nd ed. Place of publication not identified: CRC Press, 2005. Print.

Course Objectives: This course will provide both an overview on selected measurement technologies and protocols, as well as a broader perspective of measurement and sampling design for environmental problems. The learning objectives of this course are, that upon completion of this course:

1. The students will be able to analyze a complex environmental problem and develop an experimental design that will obtain data that adequately addresses the objectives of the study in a timely manner.
2. The students will comprehend the scientific principles behind the protocols and measurement technologies that are used for field-scale hydrologic and environmental studies and be able to apply this understanding to select appropriate instruments and methods from the complex assortment of available options. The students also will be able to apply this understanding use the selected instruments and protocols properly.
3. The students will be able to evaluate the sampling design, measurement technologies, and protocols used in a study and determine the adequacy of the resulting data to address hydrologic and environmental questions.

The first objective will focus on project planning. This will emphasize formulating scientific research that addresses hydrologic and environmental problems. This will highlight developing a clear statement of the objectives of the research, analysis of existing data to formulate hypotheses, and then development of an experimental plan to test the hypotheses. Data from field-scale hydrologic and environmental studies may well be used to address questions beyond the scope of the original study. Therefore, this objective will address topics such as data reporting and recording of ancillary observations that may make the data more useful for future studies.

The second objective will emphasize the scientific principles of various sensors, meters, and samplers. Common protocols for using different sensors, meters, and samplers to measure different properties and constituents will be examined to illustrate how the scientific principles are reflected in the protocols. The students will receive "hands-on" experience with common sensors, meters, and samplers in field settings.

The third objective will emphasize the quality of data and how data quality relates to the objectives of hydrologic and environmental studies. This will include basics of uncertainty analysis, sources of

variability, comparability of data from different sources, "representativeness" and independence of data, and basics of hypothesis testing.

Course Outline (Topical):

This is NOT a lecture schedule. In this class we are constrained by the weather and the availability of equipment and access to field sites. I adjust the calendar of what activities/exercises we do each week based on weather and available resources. Furthermore, because I anticipate weather in September will be nicer than in November, I will try to do more field activities in the beginning of the semester and more lectures later on. I will let you know what to expect for each coming week in class and using Announcements and Calendar in Canvas.

I. Introduction, Experimental Design, Program Planning
   - A. Introduction, Measurement vs Calculation vs Estimation
   - B. Hypothesis Testing and Experimental Design
   - C. Uncertainty and Error Analysis

II. Groundwater Measurements and Methods
   - A. Groundwater Hydraulics and Principles
   - B. Well Construction
   - C. Hydraulic Tests and Measurements
   - D. Thermal Property Testing
   - E. Groundwater-quality Sampling

III. Surface-Water and Meteorologic Measurements and Methods
   - A. Open-Channel Hydraulics
   - B. Measurement Principles
   - C. Hydroacoustics
   - D. Meteorologic Measurements
   - E. Tracer Studies

IV. Sediment and Water Quality Measurements and Methods
   - A. Sediment Principles
   - B. Water-quality Principles
   - C. Measurement Principles
   - D Sample Collection
   - E. Sample Preparation

Student Hours (Free-form coaching that someone already paid for; some call this *Office Hours*):
I strongly believe that a key to learning is to give problems and then provide coaching to the students as they work through these problems. This provides opportunity for individualized instruction on the issues that are most challenging to you. I plan to use the Ben Yen Library (2008 CEEB, which is the conference room at west end of the 2nd floor of the CEE Building) for these meetings. [return to top]

Course Expectations
Students are expected to:
1. Arrive on time and contribute actively to classroom discussions
2. Attend each lecture and field session.
3. Contribute actively to your project team. This includes homework and work on your semester project.
4. Refrain from distracting practices, e.g., conversations with classmates, watching movies,

working on homework, texting, or browsing on your computer during lectures. These activities hinder your ability learn the material, and impact the learning of your classmates.
5. Communicate ideas, questions, and concerns promptly to the instructor. This will help you as well as other students in the class.

The instructors are committed to:
1. Being well prepared on course subject matters;
2. Provide clear explanations and examples;
3. Help to assess each student's abilities and areas of growth;
4. Provide relevant and challenging homework, exercises, and exams;
5. Maximize the potential for learning by giving useful and timely feedback.
6. Start and finish class on time.
7. Maintain a positive, respectful learning environment.

Grades:
The evaluation of your performance in this class is based on the activities outlined in Table 1. [return to top]

Table 1.—Breakdown of grades

Homework/Exercises		30%
All About Me Video		4%
PrairieLearn Mastery Exercises		12%
Semester Project		22%
Exam		20%
Participation (Questions in lectures, Discussion posts, etc.)		12%
Near-peer Mentoring and Sampling Design (Extra Credit		6% (EC)
TOTAL		100%

Homework: You will be assigned about eight to twelve homework exercises during the course. Most of these typically will involve some calculations based on the data collected during the course, perhaps coupled with some existing data, or calculations to plan the next day's field work. However, some of our field experiences may not lend themselves to calculations. In this case, you will be asked to individually write a reflection on that field experience. All homework should be submitted electronically to Canvas as professionally formatted reports with supplemental data. Unless stated otherwise, you are free to work in self-selected teams of up to four students on the homework assignments. The *Homework Exercises* are worth 30% of your final grade.

In professional engineering practice, when you submit a report you do not receive a grade. If your work is sub-par, your supervisor (or client) will tell you to fix it and (hopefully) you get the hang of what is a good report before you lose your job or lose a valuable client. In CEE 458 we are going to follow the professional example where reports you submit are expected to: a) satisfy the objectives of the project, b) provide sufficient detail to replicate your analysis, and c) be clearly and succinctly written, d) be your

work, not copied from other sources—particularly AI generated, and e) be professionally formatted and organized. With each assignment you will be given a due date to submit a 'near-final' report for review. This is not a draft. This should be, "We think we did a really good job, but we've never done this before so please review before we send to the client". The instructors will review this and provide helpful comments. This is not grading. This is a quicker look and telling students our overall impression of what needs improved. The instructors will confer and present a few positive examples and/or common shortcomings to the class. You will then have a specified time to revise and resubmit for your final grade. In order to encourage you to submit a 'near-final' report, not a rough draft, we will assign a rough score (on the order of nearest 10%) based on our quick review of the submission. This will be weighted with the grade for your final submission to give the overall score for that homework. Because you do not know what we consider a good report, the weight for the initial 'near-final report' will be 10% of the overall grade for Homework 1. As the semester progresses the weight for the initial 'near-final report' will increase. For the last homeworks of the semester, we may have you peer review another team and only submit a final report. [return to top]

All About Me Video Introduction: Creating community is a vitally important aspect of meaningful and enjoyable learning. Being a part of a learning community helps students feel more involved and connected, and thus, helps them want to learn the course content more deeply. The goal of the *All About Me* assignment is to help build community in CEE 458 by sharing a little about yourself with your classmates and the instructor. In this assignment you will produce a short video (2 to 4 minutes) in which you tell us a little bit about yourself. Be sure to include your name, where you are from or where you live, what you are currently doing (e.g., 'I'm a junior specializing in EWES with secondary in construction materials', 'I'm a M.S. student in EWES doing research on hydropower', 'I'm an on-line M.S. student and work full time at a water-resources consulting company', etc.,), how you got interested in studying Civil & Environmental Engineering, and three things you love to do. You will upload your video to the course Canvas website. You are encouraged to watch the videos posted by the instructor and your classmates. The *All About Me* assignment is worth 4% of your final grade. [return to top]

PrairieLearn Mastery Exercises: I have produced some on-line exercise sets using PrairieLearn. These will provide an opportunity for you to work on mastery of selected topics. The objective of these exercises is allow you to repeat attempts on selected problems until you master the material. I am continuing to create and uploading additional exercise sets. These will be organized by the major topic areas in the course outline. Several of these exercises will be incorporated in your examination. These exercises will be available until midnight on Wednesday, December 10, 2025. The *PrairieLearn Mastery Exercises* are worth 12% of your final grade. Here is a link to enroll in PrairieLearn: https://us.prairielearn.com/pl/course_instance/189505 [return to top]

Semester Project: One of the grand challenges of water resources is the range of scales of the natural environment. For example, the mean annual discharge of the Mississippi River at the mouth is about 600,000 cubic feet per second (ft^3/sec), but the U.S. EPA reports that about 60% of the streams in the continental United States only flow seasonally or after storms. What this means is that the instruments and tools used for some streams or portions of streams will not work for other locations. Even at the same cross section, it is not uncommon to need different instruments to measure the entire cross section and flow. This semester you will work in a self-selected team of up to four students. developing a sampling design to collect data that will support development and calibration of a 2-D hydrodynamic and transport model for a small-mid-sized stream (many spots too deep to wade, but significant parts not accessible by boat) flowing through a vegetated floodplain (so LiDAR limited). I would like you to find teammates no later than noon on Wednesday, September 17. I would like each team to draft plan

for their instrumentation (instruments, platforms, methods, measurement locations etc.) by Wednesday, October 22. This will give about eight weeks to modify and refine your plan and sampling design (if needed) and prepare your final report and presentation. All teams are expected to present their results to the class. These presentations will take place during the labs sessions on December 4 & 5. All teams are expected to submit a written report to your team's Box folder no later than 11:59 PM Dece5ber 12, 2025. The *Semester* assignment is worth 22% of your final grade. [return to top]

Exams: We will have one open-book, open-notes, take-home exam. **This is to be your work alone—you are not to work with or discuss your work with anyone but the instructor!** The exam may be a combination of written responses to questions, spreadsheets, and calculation results. Students will need to convert/scan their final response **to a PDF** and return this to me electronically. Supplemental material (spreadsheets, figures, computation results, code) can be other formats that can be delivered electronically, **provided you clear the format with the instructor in advance**. All the files will be combined into a single .zip file that you will submit online. Electronic exam submissions need to be received no later than the time specified on the due date of the exam. In the unlikely event of problems with the on-line course website system, you can email your submission to me with an explanation of the Canvas problem you encountered.

As a senior/graduate-level course, I feel that it is essential to provide opportunity for you to grow in your critical thinking skills. As part of this, the exams will be a hybrid of traditional exam and peer evaluation. After each exam, I will assign each student to peer-evaluate the equivalent of three class-mates' examinations (I will randomize among questions and students). Your grade for the examination will be 60% based on your original submission, 25% based on your peer evaluation comments/input to your classmates, and 15% based on any revisions you make to your original submission based on peer-review comments. Depending on the content of the exam, I may only allocate a subset of the exam for peer review and revision. The exam is worth 20% of your final grade. [return to top]

Class Participation: I encourage you to pose questions and comments about the class material and relevant water-resources issues before, during, and after class. Various activities will be included during the lecture-discussion time to facilitate discussion with both the instructor and your peers. In addition, you are **strongly encouraged to use the Canvas discussion forum** (see below) to present your questions or comments to the class as a whole and to respond to the questions and discussions posted by your peers. In particular, the on-line discussion area is on-line student's greatest opportunity for participation. If you directly email questions to the instructor, you will be asked to post these to the course website's discussion area in order to facilitate interaction with your peers and to allow others to benefit from your questions and discussions. Twelve percent of your semester grade will reflect your participation in field exercises, classroom and field discussion, *Student Hours,* and on-line discussions. [return to top]

Near-peer mentoring (Extra Credit Opportunity): I strongly believe that *Entrepreneurial Mindset Learning (EML)* provides valuable learning experience that differs from more conventional instruction. Therefore, I am planning to incorporate an EML opportunity into CEE 458 as Extra Credit. EML concepts include ***curiosity*** about new opportunities and ideas; ***connections*** with other knowledge and experience; and ***creating value*** for stakeholders. In this assignment you will form teams of two students that will be paired with a project team from the CEE 190 *Project-based Intro to CEE* course. You will provide some project ideas that will be shared will CEE 190; you will assume the role of campus stakeholders and communicate values and concerns to the CEE 190 students; you will assume the role of consultants and provide a peer review/mentoring session for your team. In addition, you will design a sampling/monitoring program that would meet the data needs of the proposed project. This potential extra credit that you and your teammate can earn from this exercise is

up to 6% of the total points in CEE 458.

Many of you are concurrently enrolled in CEE 495 and will be required to participate in this peer mentoring as part of CEE 495. In CEE 495 you will be required to participate in three (out of five total) peer mentoring sessions. Simply meeting the CEE 495 requirements will **not** earn extra credit in CEE 458. To earn the full extra credit in CEE 458 you will need to participate in all five mentoring sessions (scheduling a make-up sessions with your mentees within one week of any session you miss will satisfy this requirement). In addition, you will need to develop a sampling design and submit a report on this design to earn extra credit. [return to top]

Learning Management System: Canvas: Supplemental instructional materials for this course will be delivered to you via the Canvas LMS. Canvas contains a variety of different modules, including supplemental references, various design manuals and manuals of practice, commonly used software, links to related web sites, homework assignments and solutions, example problems, etc. You may access the course website using an Internet browser at https://canvas.illinois.edu/.

You will need to login using your NetID and your NetID password. Since the campus has just adopted the Canvas LMS, you most likely have no experience with this system. Some help resources are available at https://online.illinois.edu/getting-started/learning-management-systems/canvas to get you started with Canvas.

On-line Discussion Forum:

This term we will be using the *Discussions* tool in *Canvas* for class discussion. Rather than emailing questions to the teaching staff, I encourage you to post your questions on *Discussions*. If you send class-related questions to the instructors via e-mail we will re-direct you to *Discussions* so that your classmates can benefit from the discussion and so that you have the opportunity to respond (and thereby learn) from the discussion. Naturally, if you have a personal or sensitive issue, you should use email rather than *Discussions*.

Field Considerations: Because it is a field methods course, we may occasionally go over the scheduled ending time. Although I will work hard to avoid this happening, it is kind of the nature of the beast. You may want to keep this in mind so that you don't schedule things right after class if you can keep from it.

Because we are working outdoors, we are subject to all the uncertainty of nature. We may get hot, cold, wet, etc. It would not be surprising if someone ends up slipping and as a result getting wet. I suggest that everyone bring a backpack with at least a pair of dry socks. I keep a towel, a set of dry clothes, a raincoat, some bug spray, some sun block, and some hand sanitizer in my backpack. I also put my wallet, cell phone, and anything else I don't want to get wet (in case I am the one to slip and get soaked) in the vehicle when possible.

Remember, we are working outdoors in a natural setting. Dress appropriately. Fashion doesn't mean a thing—function is critical. Please, wear comfortable boots or shoes, not heels or open sandals or dress shoes. I often wear sandals or sneakers in the car and have my boots in the back to put on before going from the car to the work site. Likewise, your clothing should be something that you don't mind getting dirty—it is there to protect you. Jeans are great—I wear old ones that already have a hole or two so I don't get upset if I snag them on a branch or something. I often bring a wide-brimmed hat that helps prevent sunburn.

I suggest that you bring a bottle of water or sports drink every class. You also may want to bring a snack—four hours working outside can make you hungry and there will not be time to go back into town to get something to eat.

Since this is field work, weather conditions could lead us to make last-minute decisions to alter the schedule. For example, I may postpone a scheduled lecture and go to the stream to measure a transient condition. You should be prepared for this possibility.

Student Feedback and Evaluation: A critical part of making this course a valuable and enjoyable learning experience is your feedback. I try to gauge how well you have understood the materials I've presented and adjust in class to clarify any questions. I have found, however, that your feedback throughout the semester is critical to help me adjust what I am doing and thereby meet the goals and learning objectives of the course. In particular, this helps to ensure that neither you nor I have any terrible surprises from the examinations. I encourage you to post your question(s) or comment(s) to the Discussions area in the course website so that both you and the other students in the course may benefit from these questions and responses. This will be a key part of your **participation grade**. [return to top]

What to do in an emergency

The campus public safety office has produced a one-page document with suggestions about what to do in an emergency situation. That handout is available on the course website and at https://police.illinois.edu/wp-content/uploads/2017/08/syllabus-attachment.pdf

Additional Resources

Statement of Academic Integrity: The *University of Illinois at Urbana-Champaign Student Code (http://studentcode.illinois.edu/)* will be applied in all instances of academic misconduct committed by CEE 458 students. Part 4 of Article 1 of this code describes the University policy that students and instructors are expected to know and follow. This applies to all exams, assignments, and Illinois Canvas materials distributed or used in this course. Please feel free to ask your instructors if you have any questions or concerns about what might constitute a breach of academic integrity. [return to top]

Family Educational Rights and Privacy Act (FERPA): Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See http://registrar.illinois.edu/ferpa for more information on FERPA. [return to top]

Students with Disabilities: To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St.,

Champaign, call 333-4603, e-mail disability@illinois.edu or go to https://www.disability.illinois.edu. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page. [return to top]

Emergency Response Recommendations: Emergency response recommendations can be found at the following website: http://police.illinois.edu/emergency-preparedness/. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/. [return to top]

Sexual Misconduct Reporting Obligation: The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available here: wecare.illinois.edu. [return to top]

Religious Observances: Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at https://odos.illinois.edu/community-of-care/resources/students/religious- observances/ to request appropriate accommodations. This should be done in the first two weeks of classes. [return to top]

Anti-Racism and Inclusivity Statement: The *Grainger College of Engineering* is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (https://bart.illinois.edu/). Based on your report, BART members will follow up and reach out to students to make sure they have

the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action. [return to top]