TO: The Engineering Faculty

FROM: Agricultural and Biological Engineering

RE: New undergraduate course – ABE 42600 (Ecological Restoration Engineering)

The Faculty of the Department of Agricultural and Biological Engineering has approved the following course for a permanent number. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM:

ABE 59100 Ecological Restoration Engineering Sem. 2, Class 2, Lab 1, Cr. 3.
Prerequisites: Instructor permission.

Temporary course number. Course was taught Spring 2016 (17), Fall 2017 (6), and Spring 2020 (18).

TO:

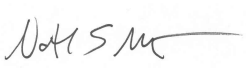
ABE 42600 Ecological Restoration Engineering Sem. 2, Class 2, Lab 1, Cr. 3.
Prerequisites: ABE 32500.

This course focuses on ecologically-based design principles to restore degraded ecosystems, specifically wetlands, stream/floodplains, and prairies. Students will identify and synthesize design elements, natural and anthropogenic stresses, and management considerations to develop resilient restoration designs. Laboratory experience provides open-ended projects, data collection, and field trips to reinforce the design process.

BACKGROUND:
This course has been taught to undergraduate and graduate students in several disciplines of environmental sciences and engineering as a 59100 variable title course. We have elected to place this at the 40000 level to more intentionally link the design in this course to the ENRE core course, ABE 32500 Soil and Water Resources Engineering in our plan of study. The course teaches ecological principles and the design process for restoration of wetlands, stream/floodplains, and prairies. The course meets three times each week; 2 of the meetings are lecture-based with active learning by the instructor and guest lectures for applied topics. The course also has a 2-hour laboratory section that includes design and analysis labs on the computer and field trips to collect data and observe completed restoration projects. The course content comes from a range of sources such as design guidance documents, agency reports, textbooks, and peer-reviewed literature. The course includes weekly lab assignments, a midterm exam, and a final project. Students have opportunities for individual and team-based work. The

attached syllabus has additional details on learning objectives, topics covered, course schedule, and grading policies.

REASON:
Restoring aquatic and terrestrial ecosystems requires integration of multiple disciplines including hydrology, hydraulics, soil science, and ecology with engineering design. The course has been successfully taught by Dr. Sara McMillan in ABE to a mix of graduate and undergraduate students in 2016 (17), 2017 (6), and 2020 (18); enrollment numbers are shown in parentheses. In the Spring 2020, the course was populated by a majority of ABE and EEE undergraduates and focused more heavily on design components and guidelines as well as data synthesis and critical review of literature in this area. Employers who hire these students have stated that these design and application skills in land and water resources will better prepare them for careers in regulatory agencies and consulting firms. This course also fills an important gap in ABE's Environmental and Natural Resources Engineering curriculum and plays an important role in supporting the BioEnvironmental Engineering curriculum.



Nathan S Mosier - Head of ABE

Ecological Restoration Engineering
ABE 59100

Instructors

Dr. Sara Winnike McMillan
Lilly Hall 2-109
765-496-0211
mcmill@purdue.edu

Office hours

Open door policy; you may also send me an email to setup a time.

Class location and hours

Smith Hall 201; Tuesday & Thursday 9:30 am – 10:20 am (Lecture)
Nelson Hall 1195; Thursday 10:30 am – 12:20 pm (Lab)

Course learning objectives

In this course, students will learn and apply governing principles of ecological engineering, including biological, chemical, and physical conditions that guide restoration design. In order to restore any individual ecosystem, it is imperative to have a firm grasp on general ecological concepts that drive ecosystem structure and function. We will begin by reviewing concepts of water and elemental cycling, energy flow through systems, succession, and ecological disturbance. Design elements and processes will focus on streams, floodplains and riparian zones, wetlands, and prairies. For each, we will study natural and anthropogenic stresses, resilience of the designs, and management considerations. Another key objective is to further develop your skills to critically read and extract key findings from assigned readings, communicate to a wide audience from experts (your boss, regulator granting you a permit) to the public (community members who live near your project). Therefore, it is critical that you attend and come prepared to actively participate.

The specific learning objectives for this course include:

1. Identify and synthesize design elements, natural and anthropogenic stresses, and management considerations for restored streams, floodplains & riparian zones, wetlands, and prairies.
2. Apply governing principles of ecological engineering, including biological, chemical, and physical conditions to develop resilient restoration designs.
3. Characterize and give examples of ecological concepts, such as water and elemental cycling, vegetation succession, food web dynamics, and ecological disturbance and how they applying to monitoring restoration success.
4. Critically read and extract key findings from readings
5. Communicate effectively in written and oral format to a wide audience

Course prerequisites:

ABE 325000 or permission of the instructor.

Course topics

1. Key ecological frameworks and principles
2. Water and elemental cycles (C, N, P)
3. Ecosystems services
4. River geomorphology
5. Stream restoration and dam removal
6. Riparian zones and floodplains
7. Wetland ecology and restoration
8. Prairies and agroecology

Reading material

Readings will come from the scientific literature, case studies, and agency reports. Relevant readings on each topic area will be assigned weekly and posted to Perusall (https://perusall.com/). We will use Brightspace for all course communication, lecture notes, and assignments.

Course expectations

- Attend class and arrive on time.
- Complete assigned readings **prior** to the class for which they are assigned.
- Participate in class discussions, including your thoughts on assigned readings and lecture topics. Learning is more than passive accumulation of information, and we will be asking a lot of questions in class.
- Bring a laptop or arrange to share a laptop for all lab activities.

Instructors' commitment

It is our goal to facilitate your learning. You can expect us to be courteous, respectful, and prepared for lecture and other class activities; answer questions clearly; provide a suitable guest lecturer when traveling for the University; and grade uniformly and consistently. I encourage you to contact us in person or via email for help of any kind during the semester.

Grading

Individual and group lab activities (weekly)	40%
Midterm Exam	25%
Final project	25%
Class participation	10%

Course grades will be determined as follows:

Score	≥ 97	92-96.9	88-91.9	82-87.9	77-81.9	72-76.9	67-71.9	62-66.9	60-61.9	< 60
Grade	A+	A	A- or B+	B	B- or C+	C	C- or D+	D	D-	F

If you fall into one of the "gray areas" (A- or B+, B- or C+, C- or D+) your grade will be based on two main criteria: (1) whether your performance has improved or gotten worse and (2) your participation in creating a positive learning environment for everyone. If you believe that an error was made in grading either homework or exam, you should write a short justification and email it to the instructors with the original assignment/exam within one week after the work is returned. We will review your concern and respond promptly.

Attendance:
Just like a job, you are expected to attend all class periods and activities. However, at times, anticipated or unanticipated absences can occur. It is your responsibility to inform me in a timely manner, preferably prior to the absence. For excused absences, you will be given an opportunity to make up the work. You will be held responsible for all information presented regardless of attendance.

Homework:
There will be a combination of individual and group assignments. I encourage you to work in teams when working on individual assignments, but you are required to turn in your own work. Regardless of the format, you are responsible for knowing the material individually.

Exam:
We will have 1 midterm exam. Periodic quizzes may be given at the start of class and cover reading materials or other preparations you were expected to complete before class. If you miss the midterm, without either a medical excuse or prior instructor approval, you will receive a zero. Tests missed with approval will be dealt with individually.

Final project:
A key component of this course is to work in groups of 2-3 students on a semester-long design project. The goal is to create something new (e.g., design a restoration project, synthesize publicly available data or collect your own data to determine restoration success, apply a model to conduct virtual experiments of a system). All project ideas must be discussed with and approved by the instructors.

Field trips:
There will be several field trips during the lab period and one mandatory class field trip to a restoration project on a Saturday near the end of the semester. Because these are such valuable learning experiences, please do everything you can to attend. If you are unable to do so, please see me as soon as possible. Students not participating in the Saturday field trip will be required to complete a makeup assignment.

Academic integrity

I expect honesty and integrity from my students. Anything that appears with your name on it must reflect your own work. My definition of "working together" includes teaching each other how to solve a problem or checking each other's work for mistakes. However, all work you submit under your name should be the result of your own efforts. If you copy someone else's work or "split" the work and copy portions of it, you are being dishonest. The penalty for dishonesty is automatic failure and a report to the Dean of Students. You are expected to take your notes during the class and are not allowed to make course notes or other materials developed as part of this course available for others to purchase (e.g., via commercial note-taking service). https://www.purdue.edu/odos/academic-integrity/

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breeches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern. The Purdue Honor Pledge "As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue"

Inclusive learning environment

I am committed to making our classroom an environment where diversity is valued and every person feels respected and free to share their thoughts and opinions. Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the

The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Any student who believes they have been discriminated against may visit www.purdue.edu/report-hate to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously. Purdue's full nondiscrimination policy can be found at: https://www.purdue.edu/purdue/ea_eou_statement.php.

Students with disabilities

If you have a disability that requires special academic accommodation, please make an appointment to speak with me within the first week of the course in order to discuss any adjustments. It is important that we talk about this as soon as possible. It is the student's responsibility to notify the Disability Resource Center (http://www.purdue.edu/drc) of an impairment/condition that may require accommodations and/or classroom modifications.

Emergencies & safety considerations

- Evacuation Emergency Assembly Areas (fire alarm): Immediately evacuate the building and proceed to the parking lot area south of the building (Smith); green space north of the building (Nelson).
- Shelter in Place recommendation for a tornado warning: If a tornado warning has been issued for campus, move to the lowest level possible away from exterior doors and windows. Seek more information on storm conditions from National Weather Service weather radio or application on mobile device.
- Shelter in Place recommendation for an active threat such as a shooting: If one cannot get away, shelter in a room that is securable preferably without windows. Close and lock the building's or room's door(s). If unable to lock the door secure it by any means possible.
- Shelter in Place recommendation for a major hazardous materials release: shelter in nearest building or classroom, shutting any open doors and windows.

Mental Health Statement

- If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time.
- If you need support and information about options and resources, please see the Office of the Dean of Students for drop-in hours (M-F, 8 am- 5 pm).
- If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Weekly Schedule (subject to change)

Week	Date	Topic	Homework
1	14 Jan	Introduction & key concepts; road map	
	16 Jan	Ecosystem restoration guiding principles	
	16 Jan - lab	Ecological energese lab - LAPTOP	Google slides due 1/23
2	21 Jan	Ecosystems & ecology - 5 needs for life	
	23 Jan	Photosynthesis & respiration	
	23 Jan - lab	River Continuum Concept (RCC) lab - LAPTOP	RCC lab report due 1/30
3	28 Jan	Nitrogen cycling	
	30 Jan	Phosphorus cycling & stoichiometry	
	30 Jan - lab	Nutrient limitation lab - LAPTOP	Nutrients lab report due 2/6
4	4 Feb	Key ecological theories	
	6 Feb	Food webs	
	6 Feb - lab	Food web case study presentations	Annotated bibliography due 2/13
5	11 Feb	Disturbance - rocky intertidal case study	
	13 Feb	Patch dynamics	
	13 Feb - lab	Habitat restoration lab - LAPTOP	Habitat lab report due 2/20
6	18 Feb	Ecosystem services (regulating, provisioning, supporting)	
	20 Feb	Ecosystem services (cultural)	
	20 Feb - lab	Ecosystem services paper presentations	Annotated bibliography due 2/27
7	25 Feb	Geomorphology + hydraulics	
	27 Feb	Sediment transport	
	27 Feb - lab	Bank erosion lab - LAPTOP	Turn in work at end of lab (no homework)
8	3 Mar	Stream restoration & exam review	
	5 Mar	No class meeting	
	5 Mar - lab	EXAM 1	
9	10 Mar	Stream restoration + mitigation	
	12 Mar	Todd's Creek field trip	
	12 Mar - lab		Field journal due 3/26
10	**16-21 Mar**	**SPRING BREAK**	
11	24 Mar	In-channel structures	
	26 Mar	Bank stabilization approaches	
	26 Mar - lab	Stream restoration case studies	Critical review of design elements lab due 4/2
12	31 Mar	Floodplain function	
	2 Apr	Riparian buffer design	
	2 Apr - lab	Two-stage channel design lab / field trip	Stream-floodplain design lab due 4/9
13	7 Apr	Wetlands - plant ecology & physiology	
	9 Apr	Wetland hydrology	
	9 Apr - lab	Wetland restoration planting design lab	Wetlands design lab due 4/16
14	14 Apr	Treatment wetlands	

Week	Date	Topic	Homework
	16 Apr	Wetland field trip	
	16 Apr - lab		Prairie design lab due 4/23
15	21 Apr	Prairies + agroecology	
	23 Apr	Kankakee Sands case study	
	23 Apr - lab	Field trip to Kankakee Sands (SATURDAY 24 APRIL)	
16	28 Apr	Group project work time	
	30 Apr	Group project work time	
	30 Apr - lab	Group project work time	
17	**4-8 May**	**FINALS WEEK - Final project presentations**	