

## Environmental Engineering ABET Evaluation Summary 2014-2015

This document describes the evaluation of ABET Program Educational Objectives (PEOs) and Student Outcomes for the Environmental Engineering undergraduate program for 2014-15. Data were collected throughout the year and evaluated by the CEE Assessment Committee (Drs. Barr, Dupont, McNeill, and Tullis) in January and May 2015.

### **Program Educational Objectives**

The Environmental Engineering (EnvE) Program Educational Objectives (PEOs) are reviewed by each of the program's three constituencies (Table 1).

Table 1: PEO Review Process and Schedule for EnvE Program Constituency

Constituency	Review opportunity	Frequency	Most recent reviews	Date of next review
Students	Freshman Orient. (CEE 1880)	Every freshman class (Fall and Spring)	Spring semester 2015	Fall semester 2015
	Junior design course (CEE 3880)	Every junior class (Spring)	Spring 2015	Spring 2016
	Senior exit interview	Every graduating class (Fall and Spring)	April 2015	November 2015
Employers	Advisory Board meeting	Annually (typically late Fall)	November 2014	November 2015
Faculty	CEE Faculty Retreat	Annually (August)	August 2014	August 2015

**Students:** The PEOs are introduced to the freshman class in CEE 1880 as part of a lecture on the accreditation and licensing processes (see the slides in Appendix A). The CEE Assessment Committee met in January 2015 to evaluate assessment results from the Fall 2014 semester. With respect to students and PEOs, the committee recommended that the PEOs be introduced in the first class of the capstone design sequence (CEE 3880) beginning Spring semester 2015. This will remind continuing students about the PEOs and also allow transfer students (who typically do not take CEE 1880) to see the PEOs. Finally, as part of the senior exit interview process, graduating seniors are given an opportunity to review the PEOs in an effort to establish some big picture career goals. No feedback was received from students related to the PEOs.

**CEE Advisory Board:** The CEE Advisory Board met on November 7, 2014 (see Appendix B for meeting minutes). The Advisory Board unanimously approved keeping the current PEOs. The PEOs will continue to be reviewed and discussed at all future annual Advisory Board Meetings.

**Program Faculty:** The PEOs are reviewed and discussed with the program faculty at the annual faculty retreat, which takes place every August just prior to the Fall semester. The faculty unanimously approved keeping the current PEOs during the 2014 faculty retreat (see Appendix C for meeting minutes). The PEOs will continue to be reviewed and discussed at all future annual faculty retreats.

## **Student Outcomes**

Evaluation of the Student Outcome attainment is conducted by the CEE Assessment committee on a specified schedule with approximately one-third of the Student Outcomes assessed every year (Table 2). When deficiencies are identified, recommendations are made to fix specific problems and support continuous improvement. For example, Outcome f was re-assessed this year because the program did not meet the performance goals in 2013-14.

Table 2: Evaluation Schedule for Student Outcomes

Evaluation Date	School Year	Outcomes evaluated
<b>May 2015</b>	<b>2014-15</b>	<b>a, b, c, d, f</b>
May 2016	2015-16	e, f, g
May 2017	2016-17	h, i, j, k
May 2018	2017-18	a, b, c, d
May 2019	2018-19	e, f, g
May 2020	2019-20	h, i, j, k

The assessment process uses data from three sources: student coursework, FE Exam results, and senior exit interviews. The 2014-15 Assessment of Student Outcomes includes data from Fall 2014 and Spring 2015.

**Student Coursework:** Outcomes a, b, c, d, and f were reviewed in 2014-15 (Table 2). Assessment data are summarized in Table 3 and Figure 1; detailed evaluation of each outcome is presented in Appendix D. Student assignments are evaluated on a 0-1-2 scale, which corresponds to the student's performance not meeting, partially meeting, and meeting the Outcome Objective, respectively. The EnvE program has two goals for student performance:

- Goal 1: a minimum of 70% of the students will perform at a 2 level
- Goal 2: a minimum of 80% of the students will perform at the 1 or 2 level.

Note the "sample size" in Table 3 refers to the number of individual examples of student work that were assessed for each outcome, not the number of students.

Table 3: Aggregated Assessment Results for EnvE Classes, Fall 2014 and Spring 2015

Outcome	Sample size	2	1	0	Sum of 1&2
a	286	73%	12%	15%	85%
b	85	93%	7%	0%	100%
c	235	82%	11%	7%	93%
d	238	86%	11%	3%	97%
f	241	72%	25%	3%	97%

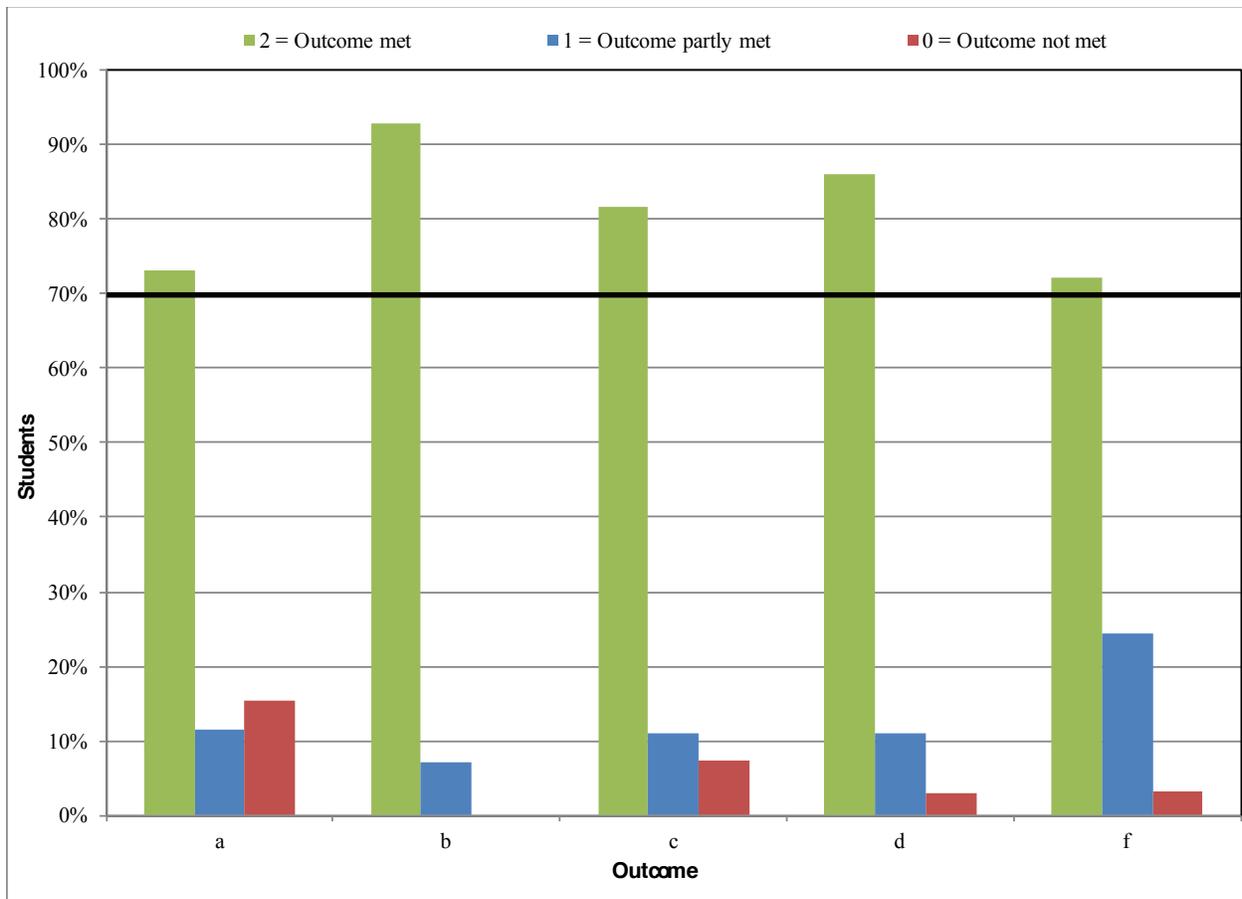


Figure 1: Aggregated Assessment Results for EnvE Classes for Fall 2014 and Spring 2015

Both goals were met for the five outcomes assessed this year. As noted in the 2013-14 report, previous assessment for Outcome b focused on students' ability to conduct experiments and analyze/interpret data, but not on design of experiments. Based on the Assessment Committee's recommendation, during Spring 2015 we intentionally introduced assignments requiring students to design (not just conduct) experiments. This was the first time such exercises have been included in CEE 5610 and 5750 (see Appendix D), and the instructors and students were enthusiastic about this type of assignment.

During the 2013-14 evaluation of Outcome f (ethics), it was noted that 94% of student assessments rated a 1 or 2, which met Goal 2. However, Goal 1 was not met, as only 66% of the students performed at a 2 level. This was mainly due to poorer performance on the ethics quiz in CEE 3880 (Design I). Based on this evaluation, we added additional information on professional ethics and brought in a guest speaker from the Utah Division of Occupational and Professional Licensing for the Fall 2014 CEE 4870 (Design II) class. During 2014-15, student performance on Outcome f was improved and both goals were met.

**Fe Exam:** Our goal is to have 100% pass rate on the FE exam; our minimum acceptable level of performance is a pass rate at or above the national average. Table 4 summarizes the FE results for the past six years, including the percentage of students who had passed the FE exam by the time of graduation. The USU EnvE pass rate has been either 100% or comparable to the national average (considering the small number of USU EnvE graduates).

Table 4: EnvE Graduates Passing FE Exam vs. National Pass Rate

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
USU EnvE graduates	10	6	10	4	5	2
USU EnvE pass rate at graduation	80%	100%	80%	100%	100%	100%
National EnvE pass rate	84%	85%	83%	88%	84%	77%

FE Exam performance by first-time test takers for various engineering topics is summarized in Figure 2. Only one student’s FE Exam performance by topic was reported. This student performed well above the national average on all fundamental engineering topics except materials science (Figure 2). Given only one data point, however, it is difficult to draw any conclusions from this result. Nevertheless, the fact that all of the EnvE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes a and f. It is also a strong indication of a good foundation for life-long (independent) learning skills.

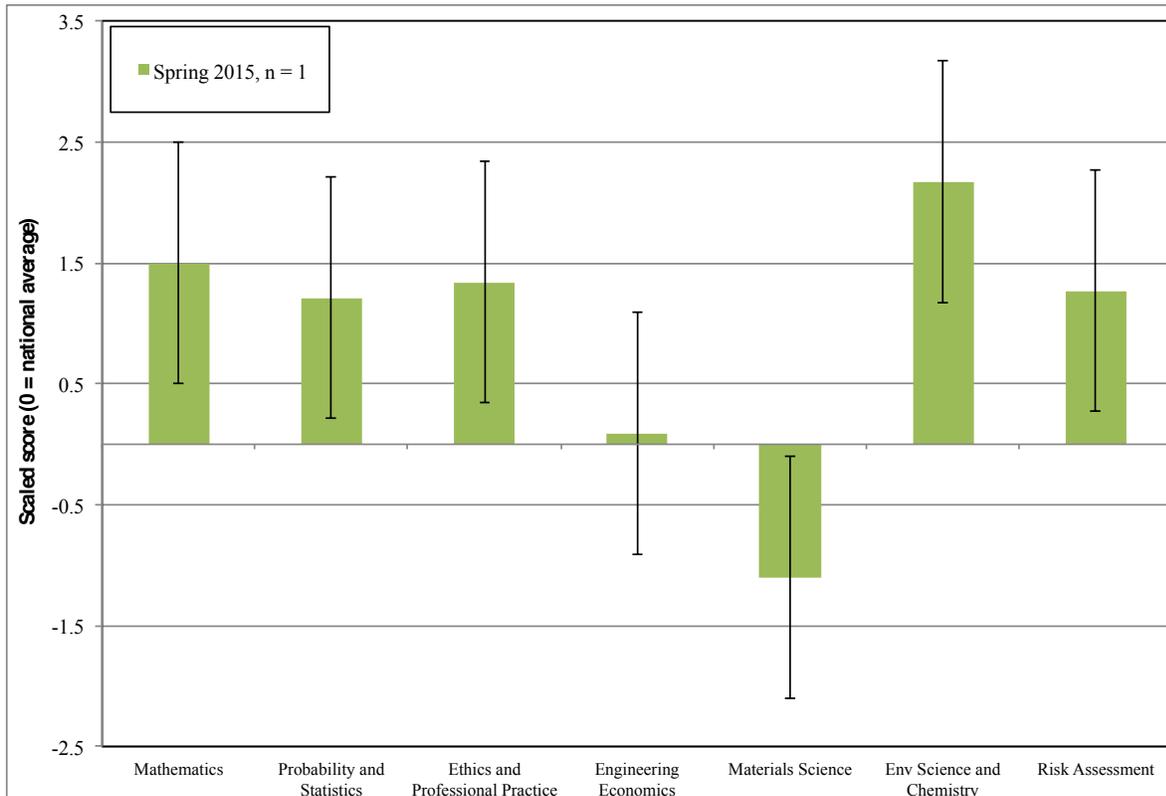


Figure 2: Scaled Fe Exam results (math, science, engineering fundamentals). Error bars represent uncertainty range for scaled scores.

**Senior exit interview:** During the Fall 2014 semester, the senior exit interview process was updated and converted to an online format. At this time, the Student Outcomes evaluation method was updated to the 0-1-2 method to be consistent with the other assessment (0 = outcome not met, 1 = outcome partly met, 2 = outcome fully met). The performance goal is to have at least 80% of the students rating their attainment as “fully met” (2) or “partly met” (1). Only two students graduated this year, and the small sample size makes it difficult to draw conclusions. Overall, responses were positive and both students rated Outcomes a, c, d, and f as “fully met.” For outcome b, one student rated the outcome as “fully met” and the other rated it as “partly met” (Figure 3). Acknowledging that this is a subjective self-evaluation with a small sample size, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

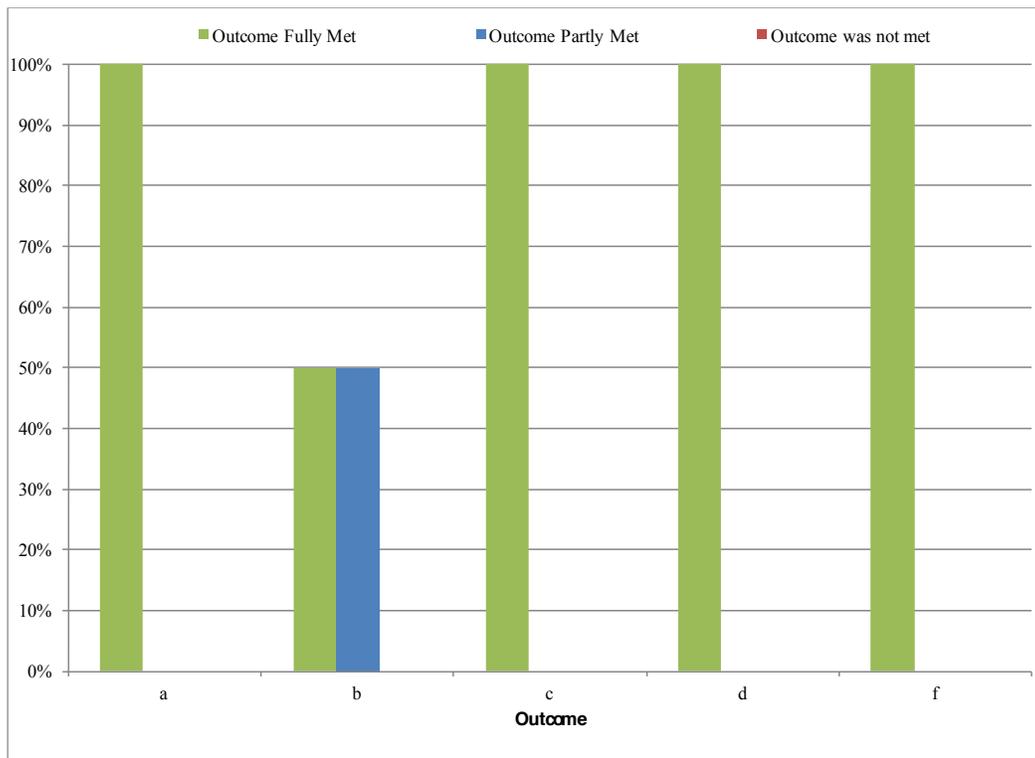


Figure 3: Student exit interview ratings of progress on Outcomes a, b, c, d, and f

**Summary:** The CEE Assessment Committee met in January and May 2015 and evaluated all of the assessment data presented herein.

The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcomes a, b, c, d, and f are being met. Performance on Outcome f was improved due to inclusion of additional material on ethics and professional licensure in senior design.

**Recommendations**

Evaluate Outcomes a, b, c, and d as planned during the 2017-18 school year, and evaluate Outcome f as planned in the 2015-16 school year. Continue to implement new experimental design activities for Outcome b.

## Appendix A Slides from CEE 1880

**(introducing freshmen students to ABET PEOs and outcomes)**

**CEE Degrees offered at USU**

- Bachelor of Science Accredited Degrees
  - Civil Engineering
  - Environmental Engineering
- Masters Degrees
- Doctor of Philosophy Degrees (PhD)



**ABET Accreditation is important**

- Accreditation Board of Applied Sciences, Computing, Engineering, and Technology
- Required ABET degree to achieve a Professional Engineers License (PE) to practice as a professional engineer

**New Engineering Building at Utah State University**




**New Engineering Building at Utah State University**




**NEW ENGINEERING BUILDING  
UTAH STATE UNIVERSITY**

COLLEGE OF ENGINEERING    LOGAN, UTAH 84322-4111



UTAH STATE DIVISION OF  
FACILITIES CONSTRUCTION & MANAGEMENT  
DFCM PROJECT NO. 01020300

**Western Schools with ABET Accredited  
Degrees in Both Civil and in Environmental Engineering**



- Oregon State University
- Utah State University
- University of California at Berkeley
- University of Nevada at Reno
- Colorado State University
- University of Colorado
- United States Air Force Academy
- California Polytechnic State University
- University of Southern California
- Northern Arizona University
- University of Oklahoma
- University of Texas at Austin



ABET is a nonprofit, non-governmental organization that accredits college and university programs in the disciplines of applied science, computing, engineering, and engineering technology. ABET accredits over 3,300 programs at more than 600 colleges and universities in 24 countries. ABET provides specialized, programmatic accreditation that evaluates an individual program of study, rather than evaluating an institution as a whole.

ABET accreditation, which is voluntary and achieved through a peer review process, provides assurance that a college or university program meets the quality standards established by the profession for which the program prepares its students. ABET is recognized by the Council for Higher Education Accreditation (CHEA).



#### Utah State University Mission Statement

The mission of Utah State University is to be one of the nation's premier student-centered and grant and space-grant universities by fostering the principles that academics value first, by cultivating diversity of thought and culture, and by serving the public through learning, discovery, and engagement.

#### College of Engineering Mission Statement

The mission of the USU College of Engineering is to foster a diverse and creative learning environment that will empower students and faculty with the necessary knowledge and facilities to be international leaders in creating new technologies and services that will improve.

#### Program Educational Objectives

Program educational objectives (PEOs) are broad statements that describe what graduates are expected to attain within five years of graduation.

The PEOs for the **Civil Engineering Program** are that within five years of graduation:

PEO 1: Graduates will be successfully employed in civil engineering or related careers and will become independent thinkers and effective communicators, team members, and decision makers.

PEO 2: Graduates will incorporate economic, environmental, social, ethical, and sustainability considerations into the practice of civil engineering and will promote public health and safety.

PEO 3: Graduates will engage in life-long learning by pursuing advanced degrees or additional educational opportunities through coursework, professional conferences and training, or participation in professional societies.

PEO 4: Graduates will pursue professional licensure or other appropriate certifications.

#### Program Educational Objectives

Program educational objectives (PEOs) are broad statements that describe what graduates are expected to attain within five years of graduation.

The PEOs for the **Environmental Engineering Program** are that within five years of graduation:

PEO 1: Graduates will be successfully employed in environmental engineering or related careers and will become independent thinkers and effective communicators, team members, and decision makers.

PEO 2: Graduates will incorporate economic, environmental, social, ethical, and sustainability considerations into the practice of civil engineering and will promote public health and safety.

PEO 3: Graduates will engage in life-long learning by pursuing advanced degrees or additional educational opportunities through coursework, professional conferences and training, or participation in professional societies.

PEO 4: Graduates will pursue professional licensure or other appropriate certifications.

#### Student Outcomes

The Civil Engineering and Environmental Engineering Programs use 11 student outcomes to prepare graduates of the programs to attain the program educational objectives. By the time of graduation, students will have:

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
- (i) the recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

#### ABET Accreditation at Utah State University leads to proficiency in at least 4 areas of Civil and Environmental Engineering

- Structural Engineering
- Geotechnical Engineering
- Hydraulics and Fluid Mechanics
- Water Resources
- Transportation Engineering
- Environmental Engineering

Most USU graduates will achieve proficiency in 5 to 6 areas

### Code of Ethics (from ASCE)

**Fundamental Principles**  
Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

- using their knowledge and skill for the enhancement of human welfare and the environment;
- being honest and impartial and serving with fidelity the public, their employers and clients;
- striving to increase the competence and prestige of the engineering profession; and
- supporting the professional and technical societies of their disciplines.

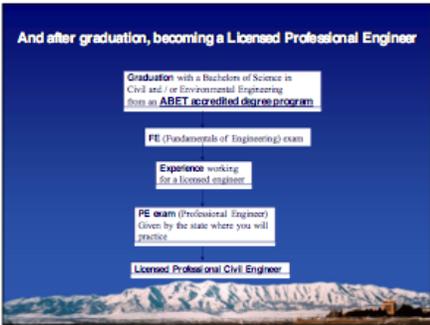


### Fundamental Canons (from ASCE)

- Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties.
- Engineers shall perform services only in areas of their competence.
- Engineers shall issue public statements only in an objective and truthful manner.
- Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
- Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
- Engineers shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession.
- Engineers shall continue their professional development throughout their careers, and shall provide opportunities for the professional development of those engineers under their supervision.



### And after graduation, becoming a Licensed Professional Engineer



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graph TD; A["Graduation with a Bachelor's degree in Civil and/or Environmental Engineering from an ABET accredited degree program"] --> B["FE (Fundamentals of Engineering) exam"]; B --> C["Experience working for a licensed engineer"]; C --> D["PE exam (Professional Engineer) Given by the state where you will practice"]; D --> E["Licensed Professional Civil Engineer"];
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**Appendix B**  
**Minutes of the CEE Advisory Board Meeting**  
**Nov 7, 2014**

Hardcopy of meeting minutes is available in the ABET Binder

**Appendix C**  
**CEE Annual Faculty/Staff Retreat Minutes**  
**August 18, 2014**

Hardcopy of meeting minutes is available in the ABET Binder

**Appendix D**  
**Detailed Evaluation for Outcomes a, b, c, d, and f**

Hardcopies of detailed evaluations are available in the ABET Binder