Environmental Engineering
ABET Evaluation Summary
2015-2016

This document describes the evaluation of ABET Program Educational Objectives (PEOs) and Student Outcomes for the Environmental Engineering undergraduate program for 2015-16. Data were collected throughout the year and evaluated by the CEE Assessment Committee (Drs. Barr, Dupont, McNeill, and Tullis) in January and May 2016.

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

<table>
<thead>
<tr>
<th>Constituency</th>
<th>Review opportunity</th>
<th>Frequency</th>
<th>Most recent reviews</th>
<th>Date of next review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>Freshman Orient. (CEE 1880)</td>
<td>Every freshman class (Fall and Spring)</td>
<td>Spring semester 2016</td>
<td>Fall semester 2016</td>
</tr>
<tr>
<td></td>
<td>Junior design course (CEE 3880)</td>
<td>Every junior class (Spring)</td>
<td>Spring 2016</td>
<td>Spring 2017</td>
</tr>
<tr>
<td></td>
<td>Senior exit interview</td>
<td>Every graduating class (Spring)</td>
<td>April 2016</td>
<td>April 2017</td>
</tr>
<tr>
<td>Employers</td>
<td>Advisory Board meeting</td>
<td>Annually (typically late Fall)</td>
<td>November 2015</td>
<td>November 2016</td>
</tr>
<tr>
<td>Faculty</td>
<td>CEE Faculty Retreat</td>
<td>Annually (August)</td>
<td>August 2015</td>
<td>August 2016</td>
</tr>
</tbody>
</table>

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). PEOs are again shown to the juniors in CEE 3880. This reminds continuing students about the PEOs and allows 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 3, 2015 (see Appendix B for meeting minutes). The PEOs were reviewed and discussion included the desire for the program to encourage students to improve their communication skills (PEO1) and support for including “sustainability considerations” in PEO2. 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 2015 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.

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

The assessment process uses data from three sources: student coursework, FE Exam results, and senior exit interviews. The 2015-16 Assessment of Student Outcomes includes data from Fall 2015 and Spring 2016.

**Student Coursework:** Outcomes e, f, and g were reviewed in 2015-16 (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.

Both goals were met for the three outcomes assessed this year. 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>
<thead>
<tr>
<th>Outcome</th>
<th>Sample size</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>Sum of 1&amp;2 ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>e</td>
<td>426</td>
<td>84%</td>
<td>10%</td>
<td>6%</td>
<td>94%</td>
</tr>
<tr>
<td>f</td>
<td>322</td>
<td>75%</td>
<td>23%</td>
<td>2%</td>
<td>98%</td>
</tr>
<tr>
<td>g</td>
<td>517</td>
<td>80%</td>
<td>16%</td>
<td>4%</td>
<td>96%</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>USU EnvE graduates</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>USU EnvE pass rate at graduation</td>
<td>100%</td>
<td>80%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>89%</td>
</tr>
<tr>
<td>National EnvE pass rate</td>
<td>85%</td>
<td>83%</td>
<td>88%</td>
<td>84%</td>
<td>77%</td>
<td>76%</td>
</tr>
</tbody>
</table>

FE Exam performance by first-time test takers for various engineering topics is summarized in Figures 2, 3, and 4. The uncertainty ranges are relatively large given the small number of students taking the exam, and the trend is skewed by the one high-performing student who took the exam in Spring 2015. Nevertheless, during the Fall 2015 and Spring 2016 testing periods, USU EnvE students performed at or above the national average on all engineering topics (including the uncertainty range) except for the water resources section in Spring 2016. Overall, the fact that nearly all EnvE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcomes e and f. It is also a strong indication of a good foundation for life-long (independent) learning skills.
Figure 2: Scaled Fe Exam results (fluid mechanics, water resources, and water/wastewater). Error bars represent uncertainty range for scaled scores.

Figure 3: Scaled Fe Exam results (air quality, solid/hazardous waste, groundwater/soils). Error bars represent uncertainty range for scaled scores.
Senior exit interview: Graduating seniors complete an anonymous online exit interview to provide feedback about the EnvE program. The performance goal is to have at least 80% of the students rating their attainment as “fully met” (2) or “partly met” (1), which was achieved with 83% of students rating Outcome e as “fully met” and 17% as “partly met” for a total of 100% for all three outcomes (Figure 5). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcome.
**Summary:** The CEE Assessment Committee met in January and May 2016 and evaluated all of the assessment data presented herein. The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcomes e, f, and g are being met.

**Recommendations**
Evaluate Outcomes e, f, and g as planned during the 2018-19 school year. Monitor performance on the Water Resources section of the FE Exam and adjust curriculum if necessary.
Appendix A
Slides from CEE 1880
(introducing freshmen students to ABET PEOs and outcomes)
ABET is a voluntary, non-governmental organization that accredits colleges and universities in the disciplines of applied science, computing, engineering, and applied engineering. ABET accreditation provides assurance that an individual program is acceptable in the area of study, which is achieved through a peer evaluation process. The quality standards established by the profession for the program are accomplished through:

- Evaluation by experts in the field
- Evidence of student outcomes
- Evaluation of faculty and staff qualifications
- Assessment of institutional and student support services
- Compliance with ABET criteria

ABET accreditation is voluntary and achieved through a peer review process of the institution. The College of Engineering at Utah State University has been accredited by ABET, which is recognized by the Council for Higher Education Accreditation (CHEA).

The mission of the College of Engineering at Utah State University is to educate students in the fields of civil, structural, environmental, and construction engineering with an emphasis on sustainability and innovation. The curriculum is designed to prepare students for careers in industry, government, and academia.

Program Educational Objectives:
- Graduates will demonstrate knowledge of mathematics, science, and engineering principles.
- Graduates will have an understanding of and an ability to identify, formulate, and solve engineering problems.
- Graduates will have an understanding of engineering and science fundamentals applicable to their discipline.
- Graduates will have an understanding of professional and ethical responsibility.
- Graduates will have an ability to design and conduct experiments, as well as analyze and interpret data.
- Graduates will have an ability to function on multidisciplinary teams.
- Graduates will have an ability to recognize the need for further study.

Program Educational Outcomes:
- Graduates will be able to apply the principles of engineering to solve complex problems.
- Graduates will be able to communicate effectively in both oral and written forms.
- Graduates will have an understanding of the impact of their work on society and the environment.
- Graduates will be able to use and analyze technologies for the solution of complex problems.
- Graduates will be able to engage in lifelong learning and professional development.

Market Outcome:
The Civil Engineering and Environmental Engineering Program at Utah State University is designed to prepare students for careers in the fields of civil, structural, environmental, and construction engineering. Graduates will be well-prepared for careers in industry, government, and academia, as well as for further study in graduate or professional school.

ABET Accreditation at Utah State University:
- Structural Engineering
- Geotechnical Engineering
- Hydraulics and Fluid Mechanics
- Water Resources
- Transportation Engineering
- Environmental Engineering

To an ABET graduate, an achievement of proficiency in at least 4 areas of Civil and Environmental Engineering.
**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 benefit and welfare of humanity and the environment;
- being honest and impartial and serving with fidelity the public, their employers and clients;
- relying on the competence and integrity of their engineering colleagues;
- supporting the professional and technical activities of their discipline.

**Fundamental Canons (from ASCE)**
- Engineers shall hold paramount the safety, health and welfare of the public and shall perform services in the public interest.
- Engineers shall perform services only in areas of their competence.
- Engineers shall be professional advocates for their employers and clients.
- Engineers shall not accept assignments contrary to their own judgment.
- Engineers shall maintain the highest standards of personal and professional character, integrity, and judgment.
- Engineers shall be found to act in good faith and reliability in their professional practices; and
- 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**

- **Civil Engineer:**
  - Have an undergraduate degree in Civil Engineering or Civil Engineering Technology.
  - Pass the Fundamentals of Engineering (F.E.) exam.
  - Pass the Civil Engineering (P.E.) exam.

- **Registered Professional Civil Engineer (R.P.E.)**
  - Have at least 4 years of professional experience.
  - Pass the Civil Engineering (P.E.) exam.

- **Licensed Professional Civil Engineer (L.P.E.)**
  - Have at least 7 years of professional experience.
  - Pass the Civil Engineering (P.E.) exam.
Note: non-ABET related items have been removed from these minutes

Appendix B
Minutes of the CEE Advisory Board Meeting Nov 3, 2015

- Laurie McNeill-ABET
  - Process:
    - Fall 2013-Spring 2014: self-study report
    - Submitted and had a site visit in Sept 2014 by program evaluators
    - January 2015 received draft report from evaluators
    - Feb 2015 and May 2015 CEE submitted responses to the draft report
  - Did we pass?
    - YES!
    - Accredit to September 20, 2021
      - Maximum time period offered by ABET
  - Deficiency: criterion, policy, procedure is not satisfied
  - Weakness: program lacks the strength of compliance with a criterion, policy, or procedure to ensure the quality of the program will not be compromised
  - Concern: program currently satisfies a criterion policy, or procedure
    - Continuous improvement: the program must regularly use appropriate, documented processes for assessing and evaluation the extent to which student outcomes are being attained
    - We received a concern in each area, and are working to improve everything we can
  - Student coursework, FE exam results
    - We can pick out how well or poor students do in certain areas of the exam
    - Student exit interviews
  - Outcome F
    - Understanding of professional and ethical responsibility
    - We now have guest speakers attend classes and give real life examples of ethics, etc
  - Outcome B
    - Ability to design and conduct experiments, as well as analyze and interpret data
    - Marc Maguire is addressing this in his class
  - To do list
    - Keep assessing one outcome in e,f,g categories
    - Keep implementing structural design
    - Program educational objectives
      - Are these still things we should be expecting from our students?
• Email feedback
  ▪ Abet wants the advisory board to make sure we are all on the same page
    ▪ Allow to take PE exam early
    ▪ Can we track who’s graduated, and is professional?
      ○ Alumni survey
      ○ How many pass the PE, but not individual identifiers
  ▪ How is PEO 1 tracked?
    ▪ We aren’t required to formally track them
    ▪ Do we want to track these officially?
  ▪ PEO 2
    ▪ Report issued annually
    ▪ Depending on if you have a sustainability program in place, it benefits individual businesses
  ▪ Oral communication is extremely important, and people don’t do this anymore
    ▪ Don’t be shy about selling yourself!
      ○ It’s your opportunity to show what you’re able to do
    ▪ Give them the opportunity to interact with other people face to face
ABET evaluation: Laurie

- Did we pass?
  - We don’t know…
  - Handout
  - There is no formal process to evaluate PEOs, but no comments from faculty now
  - Breaking up A-K
- Student course work:
  - Rating scale: 0-2
  - Performance goals
  - Student outcome
    - Outcome B
      - Not necessarily worried
        - Wording out outcome is design and conducted experiments
          - We didn’t have them design experiments
          - “how would you collect the data”?
          - New thing that we’re continuing to implement
  - FE Exam
    - Goal 100% pass rate
    - Wanting to be above national average
    - 93% last year
    - Probability and statistics is below zero
      - Maybe because we no longer offer 3030?
    - Otherwise above or at zero axis
    - Water, transportations, surveying divisions are above average
  - Senior exit interviews
    - Response rate has improved
    - Online survey has helped
    - 80% met or partly met goal
    - Indication of their self-assessment is positive!
- To do
  - Outcomes E,F,G in all UG classes, each time taught
  - Keep implementing experimental design activities
- In the doghouse:
  - Jim Bay
  - Gilberto Urroz
Appendix D
Detailed Evaluation for Outcomes e, f, and g

See following pages
Environmental Engineering
ABET Outcome Summary
2015-2016

Outcome e: an ability to identify, formulate, and solve engineering problems

**Student Course Work Assessment**

Student work is rated on a $0 - 1 - 2$ scale:

- $0 =$ student did not understand the fundamental principle or component
- $1 =$ student applied some but not all of the fundamental principles in their solution
- $2 =$ student applied the correct fundamental principles in their solution

The EnvE program has two goals for student performance for student course work assessment:

- 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.

This outcome was assessed in ten classes, ranging from 2000-level sophomore courses to 5000-level upper-division classes, using 426 samples of student work including homework, quizzes, a group project, and exams (see Table E-1 on the next page). Student performance met both goals, with 84% of students rating a 2 and 94% rating a 1 or 2 (Figure E-1).

![Outcome e graph](image_url)

Figure E-1: Summary of ratings of student work on Outcome e
Table E-1: List of student work assessed for Outcome e

<table>
<thead>
<tr>
<th>Class</th>
<th>Name</th>
<th>Instructor</th>
<th>Term</th>
<th>Enrol.</th>
<th>Method</th>
<th>Description</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>Intro to Programming</td>
<td>Urroz</td>
<td>F2015</td>
<td>97</td>
<td>HW</td>
<td>calc discharge and velocity in pipeline</td>
<td>98%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>CEE</td>
<td>Engineering Hydrology</td>
<td>Tarboton</td>
<td>Sp2016</td>
<td>73</td>
<td>HW</td>
<td>design detention basin for flash flooding</td>
<td>70%</td>
<td>20%</td>
<td>11%</td>
</tr>
<tr>
<td>CEE</td>
<td>Hydraulics</td>
<td>Urroz</td>
<td>Sp2016</td>
<td>69</td>
<td>HW</td>
<td>rating curve for irregular x-section open channel</td>
<td>78%</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>CEE</td>
<td>Environmental Management</td>
<td>McNeill</td>
<td>F2014</td>
<td>67</td>
<td>HW</td>
<td>risk analysis - cancer risk from chem exp</td>
<td>85%</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>CEE</td>
<td>Environmental Management</td>
<td>McNeill</td>
<td>F2015</td>
<td>72</td>
<td>HW</td>
<td>calc oxygen demand from organic sample</td>
<td>89%</td>
<td>7%</td>
<td>4%</td>
</tr>
<tr>
<td>CEE</td>
<td>Water and Wastewater Trt</td>
<td>McNeill</td>
<td>Sp2016</td>
<td>21</td>
<td>HW</td>
<td>design filter, adsorption, ion exchange</td>
<td>86%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>CEE</td>
<td>Water and Wastewater Trt</td>
<td>Dupont</td>
<td>Sp2016</td>
<td>21</td>
<td>group project</td>
<td>design wastewater system for local town</td>
<td>62%</td>
<td>38%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>Transport Phenomena</td>
<td>Neilson</td>
<td>Sp2016</td>
<td>10</td>
<td>HW</td>
<td>energy balance for heat transfer problem</td>
<td>89%</td>
<td>11%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>Groundwater Engineering</td>
<td>Kaluarachichi</td>
<td>F2015</td>
<td>6</td>
<td>exam</td>
<td>well hydraulics in groundwater eng</td>
<td>67%</td>
<td>33%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>Analysis/fate Org Contam</td>
<td>Doucette</td>
<td>F2015</td>
<td>1</td>
<td>quiz</td>
<td>partitioning between air/water/sediment</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
**FE Exam Results**

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 E-2 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>
<thead>
<tr>
<th>Table E-2: EnvE Graduates Passing FE Exam vs. National Annual Pass Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>USU EnvE pass rate at graduation</td>
</tr>
<tr>
<td>National EnvE pass rate</td>
</tr>
</tbody>
</table>

FE Exam performance by first-time test takers for various engineering topics is summarized in Figures E-2 and E-3. The uncertainty ranges are relatively large given the small number of students taking the exam, and the trend is skewed by the one high-performing student who took the exam in Spring 2015. Nevertheless, during the Fall 2015 and Spring 2016 testing periods, USU EnvE students performed at or above the national average on all engineering topics (including the uncertainty range) except for the water resources section in Spring 2016. Overall, the fact that nearly all EnvE students continue to pass the FE exam is a strong, independent, external indicator for meeting Student Outcome e. It is also a strong indication of a good foundation for life-long (independent) learning skills.

Figure E-2: Scaled Fe Exam results (fluid mechanics, water resources, and water/wastewater). Error bars represent uncertainty range for scaled scores.
### Senior Exit Interviews

Graduating seniors complete an anonymous online exit interview to provide feedback about the EnvE program. The performance goal is to have at least 80% of the students rating their attainment as “met (2)” or “partly met (1)”, which was achieved with 83% of students rating Outcome e as “met” and 17% as “partly met” for a total of 100% (Figure E-4). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

Figure E-3: Scaled Fe Exam results (air quality, solid/hazardous waste, groundwater/soils). Error bars represent uncertainty range for scaled scores.
Summary
The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcome e is being met.

Recommendations
Evaluate Outcome e as planned during the 2018-19 school year. Monitor performance on the Water Resources section of the FE Exam and adjust curriculum if necessary.
Environmental Engineering
ABET Outcome Summary
2015-2016

Outcome f: an understanding of professional and ethical responsibility

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

0 = student did not understand the fundamental principle or component
1 = student applied some but not all of the fundamental principles in their solution
2 = student applied the correct fundamental principles in their solution

The EnvE program has two goals for student performance for student course work assessment:

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.

Student attainment was assessed in seven classes through a group writing assignment on the ethics associated with an engineering failure, an essay about ethics, homework, and quizzes (322 samples of student work; see Table F-1 on the next page). Results indicate that both performance goals were met (Figure F-1).

Figure F-1: Summary of ratings of student work on Outcome f
<table>
<thead>
<tr>
<th>Class</th>
<th>Name</th>
<th>Instructor</th>
<th>Term</th>
<th>Enrol.</th>
<th>Method</th>
<th>Description</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE</td>
<td>1880 CEE Orientation</td>
<td>Rahmeyer</td>
<td>F2015</td>
<td>73</td>
<td>group report</td>
<td>summarize ethics of an eng failure</td>
<td>39</td>
<td>61</td>
<td>0</td>
</tr>
<tr>
<td>CEE</td>
<td>1880 CEE Orientation</td>
<td>Rahmeyer</td>
<td>Sp2016</td>
<td>60</td>
<td>group report</td>
<td>summarize ethics of an eng failure</td>
<td>68</td>
<td>32</td>
<td>0</td>
</tr>
<tr>
<td>CEE</td>
<td>2890 Sophomore Seminar</td>
<td>Stevens</td>
<td>Sp2016</td>
<td>13</td>
<td>quiz</td>
<td>quiz on ethics</td>
<td>91</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>CEE</td>
<td>3610 Environmental Management</td>
<td>McNeill</td>
<td>F2015</td>
<td>72</td>
<td>quiz</td>
<td>quiz on code of ethics</td>
<td>94</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>CEE</td>
<td>3640 Water and Wastewater Trt</td>
<td>McNeill</td>
<td>Sp2016</td>
<td>21</td>
<td>essay HW</td>
<td>ethical issues in Flint, MI drinking water</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CEE</td>
<td>3780 Solid and Haz Waste Mgmt</td>
<td>Dupont</td>
<td>F2015</td>
<td>43</td>
<td>HW</td>
<td>essay on LEED design agreement</td>
<td>76</td>
<td>21</td>
<td>2</td>
</tr>
</tbody>
</table>
FE Exam Results

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 F-2 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 F-2: EnvE Graduates Passing FE Exam vs. National Annual Pass Rate

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>USU EnvE graduates</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>USU EnvE pass rate at graduation</td>
<td>100%</td>
<td>80%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>89%</td>
</tr>
<tr>
<td>National EnvE pass rate</td>
<td>85%</td>
<td>83%</td>
<td>88%</td>
<td>84%</td>
<td>77%</td>
<td>76%</td>
</tr>
</tbody>
</table>

FE Exam performance by first-time test takers on the ethics and professional practice section is summarized in Figure F-2. The uncertainty ranges are relatively large given the small number of students taking the exam, and the trend is skewed by the one high-performing student who took the exam in Spring 2015. Nevertheless, students performed at or above the national average, considering the uncertainty range (error bars). Overall, the fact that nearly all EnvE students continue to pass the FE exam is a strong independent external indicator for meeting Student Outcome f. It is also a strong indication of a good foundation for life-long (independent) learning skills.

Figure F-2: Scaled Fe Exam results for ethics and professional practice. Error bars represent uncertainty range for scaled scores.
**Senior Exit Interviews**
Graduating seniors complete an anonymous online exit interview to provide feedback about the EnvE program. The performance goal is to have at least 80% of the students rating their attainment as “met (2)” or “partly met (1)”, which was achieved with 83% of students rating Outcome e as “met” and 17% as “partly met” for a total of 100% (Figure F-3). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

![Outcome f](chart.png)

**Figure F-3**: Student exit interview ratings of progress on Outcome f

**Summary**
The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcome f is being met.

**Recommendations**
Evaluate Outcome f as planned during the 2018-2019 school year.
Outcome g: an ability to communicate effectively

Student Course Work Assessment

Student work is rated on a 0 – 1 – 2 scale:

- 0 = student did not understand the fundamental principle or component
- 1 = student applied some but not all of the fundamental principles in their solution
- 2 = student applied the correct fundamental principles in their solution

The EnvE program has two goals for student performance for student course work assessment:

- 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.

Written and oral communication skills are emphasized throughout the curriculum, starting with the freshman orientation seminar (CEE 1880) and continuing into upper-division classes and the capstone design sequence. Outcome g was assessed in 17 different classes, with 517 samples of student work (see Table G-1 on the next page). Student performance is satisfactory and meets both Goal 1 and Goal 2 (Figure G-1). We note, however, that students in the junior/senior design sequence only rated a 1 on their capstone design reports and presentations. The faculty mentors will work with future teams to improve these projects to a 2 rating.

Since Spring 2014, students in the EnvE program have been taking a new college-specific course, ENGR 3080 – Technical Communication, which replaced the broader ENGL 3080 class. The consensus from students and faculty is that the ENGR 3080 class is a great success and is improving communication skills.

Figure G-1: Summary of ratings of student work on Outcome g
Table G-1: List of student work assessed for Outcome g

<table>
<thead>
<tr>
<th>Class</th>
<th>Name</th>
<th>Instructor</th>
<th>Term</th>
<th>Enrol.</th>
<th>Method</th>
<th>Description</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE 1880</td>
<td>CEE Orientation</td>
<td>Rahmeyer</td>
<td>F2014</td>
<td>62</td>
<td>group project</td>
<td>written report</td>
<td>79%</td>
<td>19%</td>
<td>2%</td>
</tr>
<tr>
<td>CEE 1880</td>
<td>CEE Orientation</td>
<td>Rahmeyer</td>
<td>F2014</td>
<td>62</td>
<td>group project</td>
<td>powerpoint slides</td>
<td>92%</td>
<td>6%</td>
<td>2%</td>
</tr>
<tr>
<td>CEE 1880</td>
<td>CEE Orientation</td>
<td>Rahmeyer</td>
<td>F2014</td>
<td>62</td>
<td>group project</td>
<td>oral presentation</td>
<td>85%</td>
<td>11%</td>
<td>3%</td>
</tr>
<tr>
<td>CEE 3610</td>
<td>Environmental Management</td>
<td>McNeill</td>
<td>F2014</td>
<td>67</td>
<td>essay HW</td>
<td>summarize EIS - language mechanics</td>
<td>88%</td>
<td>0%</td>
<td>12%</td>
</tr>
<tr>
<td>CEE 3610</td>
<td>Environmental Management</td>
<td>McNeill</td>
<td>F2015</td>
<td>72</td>
<td>essay HW</td>
<td>summarize EIS - language mechanics</td>
<td>81%</td>
<td>15%</td>
<td>4%</td>
</tr>
<tr>
<td>CEE 3640</td>
<td>Water and Wastewater Trt</td>
<td>McNeill</td>
<td>Sp2016</td>
<td>21</td>
<td>group project</td>
<td>ethical issues in Flint, MI drinking water</td>
<td>76%</td>
<td>24%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE 3640</td>
<td>Water and Wastewater Trt</td>
<td>McNeill</td>
<td>Sp2016</td>
<td>21</td>
<td>group project</td>
<td>water master plan for local community</td>
<td>57%</td>
<td>43%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE 3640</td>
<td>Water and Wastewater Trt</td>
<td>Dupont</td>
<td>Sp2016</td>
<td>21</td>
<td>group project</td>
<td>wastewater design for local community</td>
<td>52%</td>
<td>38%</td>
<td>10%</td>
</tr>
<tr>
<td>CEE 3780</td>
<td>Solid and Haz Waste Mgmt</td>
<td>Dupont</td>
<td>F2015</td>
<td>43</td>
<td>group project</td>
<td>oral presentation</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE 3780</td>
<td>Solid and Haz Waste Mgmt</td>
<td>Dupont</td>
<td>F2015</td>
<td>43</td>
<td>group project</td>
<td>written report</td>
<td>69%</td>
<td>19%</td>
<td>12%</td>
</tr>
<tr>
<td>CEE 3880</td>
<td>CEE Design I - EnvE</td>
<td>Peralta</td>
<td>Sp2016</td>
<td>9</td>
<td>group project</td>
<td>written report</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE 4870</td>
<td>CEE Design II - EnvE</td>
<td>Peralta</td>
<td>F2015</td>
<td>4</td>
<td>group report</td>
<td>oral presentation</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE 4880</td>
<td>CEE Design III - EnvE</td>
<td>Peralta</td>
<td>Sp2016</td>
<td>4</td>
<td>group report</td>
<td>written report</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE 5610</td>
<td>Env Quality Analysis</td>
<td>McLean</td>
<td>F2015</td>
<td>6</td>
<td>lab exercise</td>
<td>written report on DO</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE 5610</td>
<td>Env Quality Analysis</td>
<td>McLean</td>
<td>F2015</td>
<td>6</td>
<td>lab exercise</td>
<td>written report on hardness</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE 5635</td>
<td>Env Eng in Devel Countries</td>
<td>Adams</td>
<td>F2015</td>
<td>4</td>
<td>oral presentation</td>
<td>disease/health issue in developing world</td>
<td>75%</td>
<td>25%</td>
<td>0%</td>
</tr>
</tbody>
</table>
**FE Exam Results**
Not applicable to this outcome.

**Senior Exit Interviews**
Graduating seniors complete an anonymous online exit interview to provide feedback about the EnvE program. The performance goal is to have at least 80% of the students rating their attainment as “met (2)” or “partly met (1)”, which was achieved with 83% of students rating Outcome g as “met” and 17% as “partly met” for a total of 100% (Figure G-2). Acknowledging that this is a subjective self-evaluation, these exit interview results are taken as a general indication that students feel they are meeting the outcome.

![Outcome g Chart](chart.png)

Figure G-2: Student exit interview ratings of progress on Outcome g

**Summary**
The evaluation of student work and senior exit interviews indicates that Outcome g is being met.

**Recommendations**
Evaluate Outcome g as planned during the 2018-19 school year.