Environmental Engineering
ABET Evaluation Summary
2019-2020

This document describes the evaluation of ABET Program Educational Objectives (PEOs) and Student Outcomes for the Environmental Engineering undergraduate program for 2019-20. Data were collected throughout the year and evaluated by the CEE Assessment Committee (Drs. Dupont, McNeill, Rice, and Ball) in June 2020. Note that previous members of the Assessment Committee, Drs. Barr and Tullis, were excused this year due to their appointments in Administrative positions in the USU Provost’s Office and Office of Research, respectively.

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

<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 2020</td>
<td>Fall semester 2020</td>
</tr>
<tr>
<td></td>
<td>Junior design course (CEE 3880)</td>
<td>Every junior class (Spring)</td>
<td>Spring 2020</td>
<td>Spring 2021</td>
</tr>
<tr>
<td></td>
<td>Senior exit interview</td>
<td>Every graduating class (Spring)</td>
<td>April 2020</td>
<td>April 2021</td>
</tr>
<tr>
<td>Employers</td>
<td>Advisory Board meeting</td>
<td>Annually (typically late Fall)</td>
<td>October 2019</td>
<td>November 2020</td>
</tr>
<tr>
<td>Faculty</td>
<td>CEE Faculty Retreat</td>
<td>Annually (August)</td>
<td>August 2019</td>
<td>August 2020</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 may 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. There was only one comment received from students related to the PEOs:

“Regarding PEO 2, social, ethical, and sustainability considerations were only touched on by a small number of professors. I wish there was more of an emphasis on these aspects because as engineers, we will need to address huge challenges in the coming decades that will require us to understand the social, ethical, and sustainability contexts of our projects. Perhaps there is nothing the program can do about this, but a lot (though not all) of the Civils seem to think these are "liberal" concerns that they can ignore. I hope they have to grapple with these problems early in their careers to understand their significance, but I worry the program doesn’t challenge their closely-held beliefs enough on issues they deem political but really
are not completely political. I don't expect the program to change their minds, but to at least show these students that their work doesn't exist in a vacuum when it's out in the world, built, used by others, impacting communities, etc."

This is a very perceptive comment; we occasionally receive this sort of feedback from EnvE students, who are often more civically-inclined than the civil engineering students.

CEE Advisory Board: The CEE Advisory Board met on October 29, 2019 (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 2019 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 half 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 the 2018-2019 school year, we changed to the new ABET Outcomes 1-7 instead of a-k so outcomes 5, 6, and 7 were evaluated in 2019-20.

<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>May 2016</td>
<td>2015-16</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>1, 2, 3, 4</td>
</tr>
<tr>
<td>May 2020</td>
<td>2019-20</td>
<td>5, 6, 7</td>
</tr>
</tbody>
</table>

The assessment process uses data from three sources: student coursework, FE Exam results, and senior exit interviews. The 2019-20 Assessment of Student Outcomes includes data from Fall 2019 and Spring 2020.

Student Coursework: Outcomes 5, 6, and 7 were reviewed in 2019-20 (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 2019 and Spring 2020

<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>5</td>
<td>371</td>
<td>87%</td>
<td>4%</td>
<td>9%</td>
<td>91%</td>
</tr>
<tr>
<td>6</td>
<td>594</td>
<td>81%</td>
<td>14%</td>
<td>5%</td>
<td>95%</td>
</tr>
<tr>
<td>7</td>
<td>347</td>
<td>87%</td>
<td>11%</td>
<td>2%</td>
<td>98%</td>
</tr>
</tbody>
</table>

Both Goals 1 and 2 were met for Outcomes 5, 6, and 7 (Figure 1). However, several instructors of spring 2020 courses noted that teamwork (Outcome 5) was disrupted by the pivot to online teaching due to the COVID-19 pandemic, as indicated by the increase in 0 ratings (Table 5-1 in Appendix D) compared to previous years’ assessment of teamwork in outcome d. We had also planned to use an updated rubric that specifically addresses each of the items listed in the outcome, but this plan was derailed by the pandemic. The rubric will be developed and used starting in the 2020-21 school year.

As discussed previously with outcome b, the EnvE program has intentionally added exercises that require students to develop (design) and conduct experiments as well as analyze data, and these continue to be successful. The new “use engineering judgment to draw conclusions” aspect of the outcome has also been embraced.

Figure 1: Aggregated Assessment Results for EnvE Classes for Fall 2019 and Spring 2020
**FE Exam:** The EnvE program goal is to have a 100% pass rate for first-time test takers; the minimum acceptable level of performance is a pass rate at or above the national average, which has been achieved only two of the past six years (three times if we consider 6/8 students passed in 2018 which is very close to the national average of 78%, Table 4). The first-time pass rate in 2019-20 was particularly low, especially in the spring 2020 testing period. This may have been due to COVID-19 conditions. Note that starting with the student cohort entering the professional program in the 2014-15 academic year, all EnvE students are required to pass the FE Exam prior to graduation, so by definition we now have a 100% pass rate for our graduates.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>USU graduates passing FE (%)</td>
<td>100%</td>
<td>89%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>USU first-time pass rate</td>
<td>100%</td>
<td>57%</td>
<td>60%</td>
<td>75%</td>
<td>90%</td>
<td>55%</td>
</tr>
<tr>
<td>National first-time pass rate</td>
<td>77%</td>
<td>76%</td>
<td>77%</td>
<td>78%</td>
<td>78%</td>
<td>78%</td>
</tr>
</tbody>
</table>

*Preliminary estimate; 2019-20 graduation numbers will be finalized later this summer

FE Exam performance by topic for first-time test takers is summarized in Figures 2 through 5. For Fall 2019 and Spring 2020 (orange data points), students performed at or above the national average (considering the error bars) on all topics except for mathematics (Figure 5) and materials science (Figure 2). Performance on the risk assessment section was above average, reversing the below-average results from the past two years (Figure 2). Overall performance in individual subjects is reasonably good given the low pass-rate (55%) for this cohort.

![Scaled Fe Exam results (materials science, thermodynamics, environmental chemistry, risk assessment). Error bars represent uncertainty range for scaled scores.](image-url)
Figure 3: Scaled Fe Exam results (fluid mechanics, water resources, and water/wastewater). Error bars represent uncertainty range for scaled scores.

Figure 4: Scaled Fe Exam results (air quality, solid/hazardous waste, groundwater/soils). Error bars represent uncertainty range for scaled scores.
Figure 5: Scaled Fe Exam results (math, stats, ethics and professional practice, economics). 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 and rate their perceived progress in meeting each of the outcomes. The performance goal is to have at least 80% of the students rating their attainment as “fully met” or “partly met”, which was achieved for all three outcomes (Figure 5). The survey response rate was 62%, which is lower than usual, likely due to the COVID-19 conditions at the end of the semester when the survey was administered. Despite the lower response rate, and 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 outcomes.
Summary: The CEE Assessment Committee met in June 2020 and evaluated all of the assessment data presented herein. The evaluation of student work, FE Exam results, and senior exit interviews indicates that Outcomes 5, 6, and 7 are being met. However, we need to use the updated rubric for team work to assess Outcome 5 in the future. We also need to continue monitoring FE Exam performance on math and material science (formally assessed as part of Outcome 1).

Recommendations
Evaluate outcomes 1, 2, 3, and 4 as planned during the 2020-2021 school year.
ABET Accreditation

Why Should I Care?

CEE graduating class, 2019

The undergraduate Civil Engineering and Environmental Engineering programs are accredited by the Engineering Accreditation Commission of ABET

Students

Your degree is a significant achievement and perhaps the largest investment you will make toward your future. The quality of education you receive makes a big difference in your career success. ABET accreditation:

• Verifies that your educational experience meets the global standard for technical education in your profession.

• Enhances your employment opportunities—many corporations require graduation from an accredited program.

• Supports your entry to a technical profession through licensure, registration and certification—all of which often require graduation from an ABET-accredited program as a minimum qualification.

• Establishes your eligibility for many federal student loans, grants, and/or scholarships.

• Paves the way for you to work globally, because ABET accreditation is recognized worldwide through international agreements, and many other countries' national accrediting systems are based on the ABET model.

www.abet.org
Program Educational Objectives

Within five years of graduation:

PEO 1: Graduates will be successfully employed in Civil (Env) 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 (env) 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

By the time of graduation, students will:

1. identify, formulate, and solve complex engineering problems
2. apply engineering design to produce solutions that meet specified needs with consideration of various factors
3. communicate effectively with a range of audiences
4. recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions
5. function effectively on a team
6. develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. acquire and apply new knowledge as needed

ABET timeline

- ABET is a 6 year cycle
- Data collection during 2019-2020 school year:
  - submit examples of your course work
  - fill out a survey about our programs
  - fill out a survey about summer and permanent jobs
  - meet with our industrial advisory board
- Next site visit: Fall 2020 semester
  - meet with the Program Evaluator
  - spruce up your lab/office/hallway
  - help with a tour

https://dopl.utah.gov/eng/
Appendix B
Minutes of the CEE Advisory Board Meeting October 29, 2019

ABET (Laurie)
- ABET timeline
  - ABET is a 6 year cycle
  - Next site visit: Fall 2020
  - Self study report due: July 1 2020
  - 2019-2020 school year is heavy on data collection
- Review program education objectives (handout)
  - Any feedback or changes from the board?
    - No
- Fe exam results (handout)
  - Department now requires students to pass the FE before they graduate
    - The board encourages this to stay as is
  - Pass rate for first-time test takers is high 70-low 90%
  - Our students are well above the national average
  - Civil students scored above national average in 10 of 18 topics
  - Environmental students scored above average in 4 of 14 topics, at the average for 9 to 14 topics, and below average in one topic
- Evaluation of students outcomes
  - A-k student outcomes now 1-7 (handout)
    - Very school year we assess a subset of outcomes
    - 2018-2019 we assessed outcomes 1-4
    - 2019-2020 will assess 5-7
- How the advisory board can help
  - Case studies and examples!
  - Meet with the ABET evaluator in Fall 2020

Note: non-ABET related items have been removed from these minutes
Appendix C
CEE Annual Faculty/Staff Retreat Minutes
August 23, 2019

- ABET 9:10-9:30 (Laurie McNeill)
  - ABET timeline
    - Abet is a 6 year cycle
    - Next site visit: fall 2020
    - Self study report due July 1 2020
    - 2019-2020 school year is heavy on data collection
      - Course binders
      - Faculty info (cv, data tables)
      - Timely assessment data
  - PEOs
    - Handout
      - Within 5 years of graduation, students should feel they have met these objectives
      - Are these PEOs agreed upon, or do we need to make changes?
        - PEOs are agreed upon
  - Evaluation of student outcomes
    - Course work
    - FE exam
    - Senior Exit interviews
    - May 2019 outcomes 1, 2, 3, 4
      - Goal met
    - This year we will work on outcomes 5, 6, 7
  - To-Do
    - Handout
    - Faculty qualifications table
    - Send ABET CV to Haley (spring)
    - For all undergrad CEE classes:
      - Regular syllabus and ABET syllabus
      - Good/medium/poor (2/1/0) examples of all exams or major assignments
    - For all required UG CEE classes or design classes:
      - Assess at least two outcomes (5,6,7 or as discussed)

Note: non-ABET related items have been removed from these minutes
Appendix D
Detailed Evaluation for Outcomes 5, 6, and 7

See following pages
Outcome 5: an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

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.

Nearly all of the upper-division courses require some sort of team project, as does the capstone design sequence. Outcome 5 is assessed mainly via peer evaluations of student groups wherein students rate the performance of their teammates in a variety of areas, as well as by instructor evaluation and a quiz on team dynamics (Table 5-1, Figure 5-1). Student performance is satisfactory and meets both Goal 1 (87% rating a 2) and Goal 2 (91% rating a 1 or 2). However, several instructors of spring 2020 courses noted that teamwork was disrupted by the pivot to online teaching due to the COVID-19 pandemic, as indicated by the increase in 0 ratings (Table 5-1) compared to previous years’ assessment of teamwork in outcome d. We had also planned to use an updated rubric that specifically addresses each of the items listed in the outcome, but this plan was derailed by the pandemic. The rubric will be used starting in the 2020-21 school year.

Figure 5-1: Summary of ratings of student work on Outcome 5
Table 5-1: List of student work assessed for Outcome 5

<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>2019-20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEE</td>
<td>2890 EnvE Sophomore Seminar</td>
<td>McLean</td>
<td>Sp</td>
<td>7</td>
<td>team project</td>
<td>evaluation of team poster</td>
<td>43%</td>
<td>57%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>3640 Drinking Water Engineering</td>
<td>Stevens</td>
<td>Sp</td>
<td>31</td>
<td>team project</td>
<td>peer and instructor evaluation</td>
<td>97%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>3650 Wastewater Engineering</td>
<td>Dupont</td>
<td>Sp</td>
<td>18</td>
<td>team project</td>
<td>peer evaluation</td>
<td>83%</td>
<td>11%</td>
<td>6%</td>
</tr>
<tr>
<td>CEE</td>
<td>3780 Solid and Haz Waste Mgmt</td>
<td>Dupont</td>
<td>F</td>
<td>20</td>
<td>group project</td>
<td>peer evaluation</td>
<td>45%</td>
<td>45%</td>
<td>10%</td>
</tr>
<tr>
<td>CEE</td>
<td>3880 CEE Design I</td>
<td>Ball</td>
<td>Sp</td>
<td>63</td>
<td>quiz on teams</td>
<td>quizzes on reading &quot;The Five Dysfunctions of a Team&quot;</td>
<td>97%</td>
<td>0%</td>
<td>3%</td>
</tr>
<tr>
<td>CEE</td>
<td>3880 CEE Design I</td>
<td>Ball</td>
<td>Sp</td>
<td>63</td>
<td>group project</td>
<td>evaluation of team project proposal</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>4870 CEE Design II</td>
<td>Ball</td>
<td>F</td>
<td>73</td>
<td>group project</td>
<td>peer evaluation</td>
<td>84%</td>
<td>0%</td>
<td>16%</td>
</tr>
<tr>
<td>CEE</td>
<td>4880 CEE Design III</td>
<td>Ball</td>
<td>Sp</td>
<td>73</td>
<td>group project</td>
<td>peer evaluation</td>
<td>79%</td>
<td>0%</td>
<td>21%</td>
</tr>
<tr>
<td>CEE</td>
<td>5930 Green Infrastructure</td>
<td>Dupont</td>
<td>F</td>
<td>23</td>
<td>group project</td>
<td>peer evaluation</td>
<td>96%</td>
<td>0%</td>
<td>4%</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 and rate their perceived progress in meeting each of the outcomes. Student ratings of their own achievement on Outcome 5 is high. The program is clearly meeting the goal of ≥ 80% saying they “met” or “partly met” this outcome (Figure 5-2). 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 (5) Rating](image)

Figure 5-2: Student exit interview ratings of progress on Outcome 5

**Summary**
The evaluation of student work and senior exit interviews indicates that Outcome 5 is being met. The new rubric that specifically looks at all teamwork items listed in the outcome will be used starting in the 2020-21 school year.

**Recommendations**
Evaluate Outcome 5 as planned during the 2021-2022 school year.
Outcome 6: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

*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 the 2019-20 school year and both goals were met with 81% of students performing at the 2 level and 95% at the 1 or 2 level (Table 6-1, Figure 6-1). As discussed previously with outcome b, the EnvE program has intentionally added exercises that require students to develop (design) and conduct experiments as well as analyze data, and these continue to be successful. The new “use engineering judgment to draw conclusions” aspect of the outcome has also been embraced.

![Figure 6-1: Summary of ratings of student work on Outcome 6](image-url)
<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>2019-20</td>
<td>Engineering Surveying</td>
<td>Caliendo</td>
<td>F 2018</td>
<td>103</td>
<td>lab</td>
<td>conduct ext, analyze data-trigonometric leveling with total station</td>
<td>87%</td>
<td>13%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>2890 Env. Microbiology</td>
<td>Dupont</td>
<td>Sp 2020</td>
<td>7</td>
<td>dry lab</td>
<td>analyze and interpret data from respirometry lab</td>
<td>43%</td>
<td>43%</td>
<td>14%</td>
</tr>
<tr>
<td>CEE</td>
<td>3430 Engineering Hydrology</td>
<td>Neilson</td>
<td>Sp 2020</td>
<td>75</td>
<td>HW</td>
<td>run and analyze HEC-HMS model results to design detention basin</td>
<td>84%</td>
<td>11%</td>
<td>5%</td>
</tr>
<tr>
<td>CEE</td>
<td>3500 Fluid Mechanics</td>
<td>McKee</td>
<td>F 2019</td>
<td>72</td>
<td>lab exercise</td>
<td>design ext to measure pipe roughness</td>
<td>96%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>3510 Hydraulics</td>
<td>Crookston</td>
<td>Sp 2019</td>
<td>75</td>
<td>lab exercise</td>
<td>design experiment for various hydraulics topics, analyze/interpret data</td>
<td>86%</td>
<td>14%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>3610 Environmental Management</td>
<td>McNell</td>
<td>F 2019</td>
<td>74</td>
<td>HW</td>
<td>analyze data from online water quality webpage</td>
<td>76%</td>
<td>5%</td>
<td>19%</td>
</tr>
<tr>
<td>CEE</td>
<td>3650 Wastewater Engineering</td>
<td>Dupont</td>
<td>Sp 2020</td>
<td>18</td>
<td>team project</td>
<td>analyze and interpret data, use eng judgment in for WW system</td>
<td>22%</td>
<td>78%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>3670 Transport Phenomena</td>
<td>Stevens</td>
<td>Sp 2020</td>
<td>10</td>
<td>HW</td>
<td>analyze and interpret data for heat flux</td>
<td>78%</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>CEE</td>
<td>3670 Transport Phenomena</td>
<td>Stevens</td>
<td>Sp 2020</td>
<td>9</td>
<td>HW</td>
<td>Analyze inactivation data and interpret to find time to pasteurize</td>
<td>79%</td>
<td>17%</td>
<td>4%</td>
</tr>
<tr>
<td>CEE</td>
<td>4200 Engineering Economics</td>
<td>Rosenberg</td>
<td>F 2019</td>
<td>71</td>
<td>group project</td>
<td>analyze/interpret data, use eng. judgement: electric vs diesel buses</td>
<td>79%</td>
<td>17%</td>
<td>4%</td>
</tr>
<tr>
<td>CEE</td>
<td>5610 Env. Quality Analysis</td>
<td>McLean</td>
<td>F 2019</td>
<td>12</td>
<td>lab exercise</td>
<td>conduct ext, analyze and interpret data from dissolved oxygen lab</td>
<td>64%</td>
<td>27%</td>
<td>9%</td>
</tr>
<tr>
<td>CEE</td>
<td>5610 Env. Quality Analysis</td>
<td>McLean</td>
<td>F 2019</td>
<td>12</td>
<td>lab exercise</td>
<td>design experiment for research projects</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>5610 Env. Quality Analysis</td>
<td>McLean</td>
<td>F 2019</td>
<td>15</td>
<td>lab exercise</td>
<td>develop and conduct ext for measuring dissolved oxygen</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>5610 Env. Quality Analysis</td>
<td>McLean</td>
<td>F 2019</td>
<td>15</td>
<td>lab exercise</td>
<td>analyze and interpret data from DO lab</td>
<td>67%</td>
<td>33%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>5610 Env. Quality Analysis</td>
<td>McLean</td>
<td>F 2019</td>
<td>15</td>
<td>lab exercise</td>
<td>use eng. judgement to monitor river for DO</td>
<td>60%</td>
<td>27%</td>
<td>13%</td>
</tr>
<tr>
<td>CEE</td>
<td>5860 Air Quality Management</td>
<td>Martin</td>
<td>F 2018</td>
<td>14</td>
<td>group project</td>
<td>develop AERMOD model for emissions compliance, use judgement</td>
<td>100%</td>
<td>0%</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 and rate their perceived progress in meeting each of the outcomes. Student ratings of their own achievement on Outcome 6 are high and the program is meeting the goal of ≥ 80% saying they “met” or “partly met” this outcome (Figure 6-2). 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 (6) Rating](image)

Figure 6-2: Student exit interview ratings of progress on Outcome 6

**Summary**
The evaluation of student work and exit interviews indicates that goals related to Outcome 6 are being met.

**Recommendations**
Evaluate Outcome 6 during the 2021-2022 school year as planned.
Outcome 7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

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 the 2019-20 school year and both goals were met (Figure 7-1). Ten courses across the curriculum assessed students’ ability to gain and apply new knowledge through exploratory projects, field trips, and research and design projects (Table 7-1).
Table 7-1: List of student work assessed for Outcome 7

<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>3430 Engineering Hydrology</td>
<td>Neilson</td>
<td>Sp 2020</td>
<td>75</td>
<td>HW</td>
<td>apply new knowledge of water balances at field scale</td>
<td>95%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>CEE</td>
<td>3610 Environmental Management</td>
<td>McNell</td>
<td>F 2019</td>
<td>74</td>
<td>HW</td>
<td>field trip for onsite WW trt - answer questions and design exercises</td>
<td>81%</td>
<td>19%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>3780 Solid and Hazardous Waste Mgmt</td>
<td>Dupont</td>
<td>F 2019</td>
<td>20</td>
<td>group project</td>
<td>waste reduction and recycling plan for client</td>
<td>85%</td>
<td>15%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>4870 CEE Design II</td>
<td>Ball</td>
<td>F 2019</td>
<td>72</td>
<td>group project</td>
<td>various capstone design projects - concept and alternatives report</td>
<td>79%</td>
<td>21%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>4880 CEE Design III</td>
<td>Ball</td>
<td>Sp 2020</td>
<td>73</td>
<td>group project</td>
<td>various capstone design projects - final plan set</td>
<td>93%</td>
<td>7%</td>
<td>0%</td>
</tr>
<tr>
<td>CEE</td>
<td>5190 GIS for CEE</td>
<td>Horsburgh</td>
<td>Sp 2020</td>
<td>21</td>
<td>final project</td>
<td>explore GIS toolset to apply to an eng problem</td>
<td>81%</td>
<td>0%</td>
<td>19%</td>
</tr>
<tr>
<td>CEE</td>
<td>5670 Haz. Chem Handling and Safety</td>
<td>Doucette</td>
<td>Sp 2020</td>
<td>13</td>
<td>exam</td>
<td>researching HAZWOPER information</td>
<td>100%</td>
<td>0%</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 and rate their perceived progress in meeting each of the outcomes. Student ratings of their own achievement on Outcome 7 is very high (Figure 7-2). The program is clearly meeting the goal of ≥ 80% saying they “met” or “partly met” this outcome. 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 (7) Graph](chart.png)

Figure 7-2: Student exit interview ratings of progress on Outcome 7

Summary
The evaluation of student work and exit interviews indicates that goals related to Outcome 7 are being met.

Recommendations
Evaluate Outcome 7 during the 2021-2022 school year as planned.