ANNUAL PROGRAM REPORT

College	College of Science
Department	Earth and Environmental Sciences
Program	Geology BS/BA, Env Science BS, Env Geoscience MS
Reporting for Academic Year	2017-2018
Last 5-Year Review	AY 2012-2013
Next 5-Year Review	2020-2021
Department Chair	Jean Moran (until August 2018) Mike Massey (after August 2018)
Date Submitted	

I. SELF-STUDY *(suggested length of 1-3 pages)*

A. Five-Year Review Planning Goals

Present your planning goals from your last 5-year plan. (A PARAGRAPH OR TWO)

From the AY12-13 5 year review:

1) Curriculum

We plan to revise our curriculum during the next two years in response to the University's plan to move from the quarter system to the semester system by Fall 2018. This will require a thorough review of all courses and program requirements. Some courses will be expanded, others eliminated, and some redesigned as hybrid or online courses. We plan to redesign the Environmental Science BS program by combining the current options, to offer increased flexibility and choice for students in designing a program to fit their needs, and decreased time-to-degree.

2) Degree Programs

Continued growth of our programs and improved graduation rates would be stimulated by developing new courses in areas that provide students with practical skills in areas that are becoming increasingly important; these include spatial analysis, environmental monitoring, instrumental analysis, soil science, and engineering geology. We may develop additional hybrid or online courses on topics such as pollution modeling.

3) General Education

Cluster proposals are normally solicited and approved about every three years; we anticipate that our participation in clusters will continue. We foresee a growing demand for General Education (GE) curriculum related to climate. We have accordingly prepared a new course proposal for a lower- division Environmental Science course on Global Change for non-majors that has been approved as a new course and for GE (area B3) credit.

4) Etc.

The top priority for future faculty hires is for an Environmental Scientist with a specialty in climate/global change and/or interactions between the hydrosphere, atmosphere and solid Earth. The second priority for a new faculty hire would be in the area of Environmental Geoscience with a focus on surficial processes.

B. Progress Toward Five-Year Review Planning Goals

Report on your progress toward achievement of the 5-Year Plan. Include discussion of problems reaching each goal, revised goals, and any new initiatives taken with respect to each goal.

1) Curriculum

A huge amount of time and effort over the past three years went into curriculum design and general education under semesters. Field courses were added to enable completion of the BS Geology degree requirements at CSUEB. A concentration in Geoscience Education was developed in collaboration with the Department of Liberal Studies. A number of Geology and Environmental Sciences courses were approved for GE as well as for the Sustainability Overlay.

Additionally, we have developed a concentration in Environmental Health for our Environmental Science degree. The Department of Health Sciences discontinued their program in Environmental Health, and we developed our program in close collaboration with Health Sciences.

2) Degree Programs

Courses in Soil Science, Engineering Geology, Professional Geologist Prepration and Geographic Information Systems (‘practical skills’ areas noted in five year goals) have been approved for semesters.

3) General Education

Several lower and upper division courses focused on climate change were approved as hybrid and/or online courses, which will likely prove popular with students. The department will provide a service course, ENSC 280 (Humans and the Environment in California) to all Health Science and Environmental Science majors, beginning in Fall 2018 (as a hybrid course). Additionally, ENSC 320 (The Science of Climate Change) is being offered as a service course for Liberal Studies majors, and B6 GE credit, with sustainability overlay, in Spring 2019.

Four proposals for Freshman Learning Communities under semesters were approved and the department continued to participate in four clusters in AY 17-18. Even as this program is phased out, we anticipate continued strong demand for our GE courses.

4) Etc.

During AY 16-17, a new faculty member, with expertise in carbon cycling and biogeochemistry, joined the department. Another new faculty member, with expertise in sedimentology and paleoclimatology, began in Fall of 2017. These two hires fulfill the five year planning goals. However, one faculty member left the department during AY 16-17.

C. Program Changes and Needs

Report on changes and emerging needs not already discussed above. Include any changes related to SB1440, significant events which have occurred or are imminent, program demand projections, notable changes in resources, retirements/new hires, curricular changes, honors received, etc., and their implications for attaining program goals. Organize your discussion using the following subheadings.

Overview: We anticipate continued “massive” (for our small department) demand for popular service courses (e.g., ENSC 280 Humans and the Environment in California, ENSC 320 The Science of Climate Change), online-only offerings (e.g., GEOL 340 The Oceans) and online offerings that are in development (e.g., online-only B1, B2, B3, and B6 in support of an online-only degree). We are also working on marketing our programs to students in order to increase majors, with efforts focused on demonstrating paths to high-quality employment opportunities.

Curriculum: As part of the quarter-to-semester transformation, and in response to our previous five-year review, we have added more field courses to the curriculum. This enables students to complete key field studies in geology and environmental science at CSU East Bay, as opposed to having to travel out of state to complete field studies degree requirements.

Students: Our courses in Fall 2018 are at 140% of previous enrollment, despite overall enrollment for the College and Unviersity being down by approximately 10%. We anticipate continued strong demand for our service courses and GE offerings. We continue to attempt to recruit majors, since we have graduated ~90-100 students in the past five years (which is substantial for a department of ~70-100 students). *This assumes the data are accurate, which has historically not been the case, but we will investigate it.*

Faculty: Our department faculty continue to receive both external and internal recognition and research funding. Our faculty received several Faculty Support Grants, as well as external funding totaling over $400,000. Faculty often use this funding to decrease teaching workload in order to make time for research and scholarship. One of our faculty members also received the Rosemary and Matthew Spitzer Distinguished Science Faculty Award.

Staff: Our Administrative Support Assistant retired in August 2018, and we hired a new Administrative Support Coordinator to manage our department office. A new Instructional Support Technician began in October 2017, and has been a strong contributor to the Department.

Resources: *(facilities, space, equipment, etc.)* A renovated shared laboratory space, as well as field studies space, has increased our capacity for inter-departmental collaboration in addition to disciplinary research. Additionally, other generous donations enabled the purchase of two new Departmental vans (a shared resource with the College of Science), which have seen frequent use on local, regional, and inter-state field trips.

Assessment: No anticipated changes to our assessment approach, but efforts to improve students' quantitative skills and other competencies will continue.

Other: *(e.g., major program modifications)* The addition of a program in Geoscience Education in Fall of 2018, as well as the addition of the Environmental Health concentration, may require a modified mix of course offerings (and/or faculty members) moving forward.

II. SUMMARY OF ASSESSMENT *(suggested length of 1-2 pages)*

A. Program Learning Outcomes (PLO)

List all your PLO in this box. Indicate for each PLO its alignment with one or more institutional learning outcomes (ILO). For example: "PLO 1. Apply advanced computer science theory to computation problems (ILO 2 & 6)."

All changed with Quarter-to-Semester transformation as of Fall 2018. These PLOs reflect the quarter-based programs.

Geology B.S./B.A.:

1) Identify and classify geologic materials, including minerals, rocks, and fossils, and know their material and/or biological properties or characteristics. (Geologic Materials)

2) Collect, organize, and analyze qualitative and quantitative data from both field and laboratory investigations such as lithostratigraphic and biostratigraphic correlations, geologic maps, geophysical surveys, cross-sections, soil tests, and geochemical and groundwater quality analyses. (Data Collection and Analysis)
3) Synthesize, interpret and critically analyze geologic datasets (2D and 3D) and reports using discipline-specific methods, techniques, and equipment. (Interpretation)
4) Critically analyze geological and environmental issues through the evaluation of scientific literature, and present their positions clearly and persuasively in written and oral form. (Communication)
5) Understand geologic time, evolution, Earth's place in the Universe, and global-scale processes such as plate tectonics, earth systems interactions, and climate change. (Geologic Time)

Environmental Science B.S.:

1) Demonstrate practical skills and theoretical knowledge of the biology, chemistry, geology, and physics relevant to the Earth system, in both laboratory and field settings (physical and life science) (ILO
2) Collect, analyze, and interpret quantitative and qualitative data, individually and in groups, in order to characterize and address environmental issues (data and analysis) (ILO
3) Critically consider scientific findings within the context of the social, cultural, economic, ethical, and human dimensions of contentious environmental issues (socioeconomic context) (ILO
4) Synthesize knowledge of the major components of the Earth system, including physical, biological, and human systems, as well as human impacts (synthesis)
5) Critically analyze environmental issues through the evaluation of scientific literature, andpresent their positions clearly and persuasively in written and oral form (communication)

Geology (Environmental Geosciences under Semester Catalaog) M.S.:

1) Attain an advanced understanding of the relationship between geologic materials and their physical and chemical properties. (Geologic Materials)
2) Collect, analyze, and interpret data using advanced discipline-specific methods, techniques, and equipment. (Data & Analysis)
3) Critically analyze geological and environmental issues through the evaluation of current scientific literature, and present an argument clearly and persuasively in written and oral form. (Communication)
4) Conduct geologic research, including preparation of a project or thesis; the result should be of high enough quality to be presented at a professional meeting. (Research)
5) Understand geologic time, evolution, Earth's place in the Universe, and global-scale processes such as plate tectonics, earth systems interactions, and climate change. (Geologic Time)

B. **Program Learning Outcome(S) Assessed**

List the PLO(s) assessed. Provide a brief background on your program's history of assessing the PLO(s) (e.g., annually, first time, part of other assessments, etc.)

For AY 2017-2018, we assessed:

- Geology B.S./B.A. PLO #2 (data and analysis)
- Environmental Science B.S. PLO #4 (synthesis) and PLO #5 (communication).
- Geology M.S. PLO #2 (data and analysis)

C. **Summary of Assessment Process**

Summarize your assessment process briefly using the following sub-headings.

Instrument(s): Example assessment reports attached. *(include if new or old instrument, how developed, description of content)*
Sampling Procedure: Entire course sections were used.
Sample Characteristics: Entire course sections were used.
Data Collection: *(include when, who, and how collected)* See attached assessment reports.
Data Analysis: See attached assessment reports.

D. **Summary of Assessment Results**

*Summarize your assessment results briefly using the following sub-headings***.**

Main Findings: Our students have generally poor quantitative skills, which, anecdotally, improve over the course of their time at CSU East Bay. Attention to detail and communication skills are also highly variable, but generally students are able to synthesize disparate material and draw relevant conclusions. This is a focal point of our interdisciplinary sciences.

Recommendations for Program Improvement: *(changes in course content, course sequence, student advising)* It would be most helpful if students focused more on practical applications and applied examples in their studies of mathematics. We end up having to teach basic quantitative skills in our program in addition to the course material, but we try our best throughout our program to teach our students the necessary skills. We need to continue to offer students opportunities for practicing quantitative skills, as well as communication skills in the form of written projects, oral presentations, and other discipline-specific media (i.e., maps, graphs, environmental impact assessments).

Next Step(s) for Closing the Loop: *(recommendations to address findings, how & when)* The challenges our students face with basic quantitative skills and communication are well known, and not unique to our department. We will continue to attempt to improve students' aptitudes in these areas.

Other Reflections: With interdisciplinary programs such as ours, in which we depend on other departments for many of our program offerings, we have very limited control over much of what our students learn in courses outside of the department. We have more control over the curriculum for our M.S. students, and they generally perform reasonably well on assessments.

E. **Assessment Plans for Next Year**

Summarize your assessment plans for the next year, including the PLO(s) you plan to assess, any revisions to the program assessment plan presented in your last five-year plan self-study, and any other relevant information.

In the 2018-2019 academic year, we will be designing a new five-year assessment plan, since our current five-year assessment plan has concluded. Additionally, this redesign coincides with a substantial revision of PLOs associated with the Quarter-to-Semester transformation.

III. DISCUSSION OF PROGRAM DATA & RESOURCE REQUESTS

Each program should provide a one-page discussion of the program data available through CAPR. This discussion should include an analysis of trends and areas of concern. Programs should also include in this discussion requests for additional resources including space and tenure-track hires. Resource requests must be supported by reference to CAPR data only. Requests for tenure-track hires should indicate the area and rank that the program is requesting to hire. If a program is not requesting resources in that year, indicate that no resources are requested.

A. **Discussion of Trends & Reflections**

Notable Trends:

Summarize and discuss any notable trends occurring in your program over the past 3-5 years based on program statistics (1-2 paragraphs). You may include 1-2 pages of supplemental information as appendices to this report (e.g., graphs and tables).

The most notable trend in our program that has occurred in the past 5 years has been a marked increase in student graduation (visible in the marked change between AY 2012-2013, with a total of 4 undergraduate and 5 graduate degrees conferred, and subsequent years). Around 20-25+ students per year have graduated from our various programs, which was a marked increase from prior years. We have had difficulties growing our total number of majors as a result of this, since our majors are not usually easy to recruit. Beginning in AY 2018-2019, our new concentration in Environmental Health is expected to be an area of future growth. Additionally, as noted above, for Fall 2018, our enrollment is at 140% of previous years, despite the University and College enrollments being down by about 10%. We expect these strong totals to continue.

We are also proud to be a diverse program, especially compared to Earth and Environmental Sciences programs across the US. The Earth and Environmental Sciences fields have historically been dominated by white males. In contrast, students in our department are ~40% female, and ~60% non-white, which is substantially more diverse than the field as a whole. We strive to be welcoming to all students, and are committed to making strides with respect to improving representation among both students and department faculty.

Reflections on Trends and Program Statistics:

Provide your reflections on the trends discussed above and statistics and supplemental information presented in this report.

A perennial issue for our department has been the quality of these enrollment data and statistics. For example, in previous years, these data have not reflected students in all three Environmental Science options (on the quarter catalog), along with students who had not yet declared an option. This issue may persist, even now. If the historical inaccuracies persist, I suspect that the data may be under-counting our number of majors and graduates. However, at least as an order-of-magnitude estimate, the numbers seem reasonable.

Our hope is to double the size of our program (in terms of number of majors), and maintain strong enrollment in our service courses and GE offerings, in the coming years. Faculty and student diversity are also a focal point.

B. **Request for Resources** *(suggested length of 1 page)*

1. **Request for Tenure-Track Hires**

The department plans to submit a proposal for a TT faculty search in AY 18-19. For students taking a course offered by the EES department, the chances of having a TT instructor are about 40%. In addition, the curricular demands of the new concentration Environmental Health, and in Geoscience Education (which includes an Atmospheric Science course), and advances in inter-disciplinary approaches to the study of interactions between humans and the environment, call for a faculty member with expertise in these areas. Possible sub-disciplines include geostatistics, water quality and human health, air quality and atmospheric science, climate change and urban flooding & landslides, or sustainability and the food-water-energy nexus.

2. **Request for Other Resources**

The department anticipates increased needs for instructional software and for other instructional equipment as instruction becomes centered around active and experiential learning. For example, faculty requests for portable air quality monitoring equipment and water quality monitoring equipment could not be granted this year due to budget constraints, and software licenses for EdGCM, MATLAB, ROCKWORKS, and AnalyzeIT, etc. will amount to at least $4,000 more than previously budgeted for software expenses. A2E2/EIRA has become an indispensable source of funds for field trip transportation and new equipment, and will continue to be relied upon under semesters, to fund a portion of the field courses, and to update aging equipment in instructional laboratories.

The department holds teaching & learning workshops with instructional faculty to move toward student-centered, active learning. Funds are needed for release time for coordination of these events, and travel to NSF-SERC (Science Ed Resource Center) workshops for new faculty.

Funds and support for marketing/outreach/recruitment will be required in order to grow our program in the future (we hope to double our majors within 5 years).

GEOL BS/BA Assessment 2017-2018

PLO 2. Data & Analysis

GEOL 4010 – Applied Geophysics – Spring 2018

For the Geology BS/BA program, PLO 2 (Data & Analysis), was assessed using a lab assignment from GEOL 4010 (Applied Geophysics). PLO 2 includes the collection, organization, and analysis of qualitative and quantitative data from field investigations, including geophysical surveys. GEOL 4010 is an upper-division elective for Geology majors in which students learn how to use quantitative skills to test physics-based geologic models. The assignment used for assessment is a laboratory assignment involving the analysis of data collected by the same students during a previous lab period. It assesses a student's understanding of the analysis of data using the seismic refraction method and depends partly on the student's understanding of data acquisition. Students work with digital waveform data and learn how to distinguish between signal and noise. Based on the physical properties of common materials such as air, water, soil, and rock, students verify and interpret their results. Students learn how to use data analysis and modeling in an iterative fashion.

Students recorded data in the field during one lab period and analyzed the data during a separate lab period. Data were collected using a 24-channel seismograph and sledgehammer source. Data were uploaded to a computer lab for analysis. Students picked P-wave first arrivals and analyzed travel time data to determine P-wave velocity structure.

The success of ten students in the GEOL 4010 class in meeting the Data & Analysis PLO was assessed using the Lab Project rubric. Students fell into three main groups. Four achieved overall scores of 12-13, four had scores of 9-10, and two had scores of 7-8. Students in the first group achieved mainly exemplary or accomplished ratings in individual categories. Students in the second group achieved mainly accomplished ratings. Students in the third group were either competent or accomplished. In summary, all of the students achieved at least competency in all items. Most of the students in the class performed at or beyond expectations when given sufficiently detailed instructions.

CSUEB Geology Programs – LABORATORY SKILLS / COURSE PROJECT RUBRIC

Laboratory skills and course projects and assignments are where the discipline-specific skills, methods, techniques and processes that are fundamental to the Earth Sciences are acquired and utilized.

This rubric or portions of it may be applied to student **laboratory and course assignments** and **projects** in order to assess how well the Geology Program Learning Outcomes have been achieved.

	Exemplary 3	**Accomplished 2**	**Competent 1**	**Insufficient Evidence 0**
1. Organization	Organization is **clear, consistent, observable** and **skillful** and content is **cohesive**.	Organization is **clear**, **consistent** & **observable**.	Organization is **intermittently observable**.	Organization is **poor** or **not observable**.
2. Presentation	Work is **attractive**, **clean**, **clear**, **accurate**, visually **strong**	Work is **well produced**, **clear**, **mostly-accurate**, visually **effective**	Work is adequate with **minor errors**, visually **inert**	Work is **unclear**, **informal, minimally** conveys intent and **error prone**
3. Quantitative Skills	Applied **innovative** and **insightful** mathematical methods and techniques. Demonstrates mathematical **mastery**.	Applied **situation-appropriate** mathematical methods and techniques. Demonstrates **solid** math skills.	Applied **basic** mathematical methods. Demonstrates **modest** math skills.	**Unable** to apply basic mathematical methods and techniques. Insufficient math skills.
4. Execution	Work is complete to levels **above expectation** and turned in **early or on time**	Work is **strong**, **complete** and turned in **on time**	Work is **adequate**, **complete** and turned in **on time**	Work is **incomplete** or not turned in **on time**
5. Connection, Synthesis, Transformation	**Synthesizes** ideas or solutions into a coherent whole. **Creates** connections to higher-level discipline-specific concepts and practices.	**Connects** ideas or solutions in novel ways. **Recognizes** connections to higher-level discipline-specific concepts and practices.	**Acknowledges** existing connections among ideas or solutions.	**No recognition** of significance of exercise to discipline or global context.

Modified from: AAC&U

CSUEB Geology B.S., B.A. Program Assessment

PLO: Data & Analysis
Rubric: **Lab Project**
Course: GEOL 4010
Quarter: Spring 2018
Assignment: Seismic Refraction Lab

Student ID	Organization	Presentation	Quantitative Skills	Execution	Connection, Synthesis, Transformation	Total
1	3	2	2	3	2	12
2	3	2	2	2	1	10
3	2	2	2	2	2	10
4	3	2	3	3	2	13
5	1	1	2	2	1	7
6	2	2	2	2	2	10
7	2	2	2	1	2	9
8	3	2	3	2	3	13
9	1	2	2	2	1	8
10	2	3	2	3	2	12

Notes: 3 = exemplary, 2 = accomplished, 1 = competent, 0 = insufficient evidence

Your Name ____________________________

GEOL 4010, Applied Geophysics - M. Craig
Lab Exercise: Seismic Refraction
SeisImager; Pickwin and Plotrefa
Spring 2018
Version 2e, updated 22 April 2018

Objectives: Pick first arrivals
Assignment: Complete the tasks below and prepare a Word document (.docx file) containing the requested information, including blanks that were filled in, answers to questions, and screen shots. Name the file as follows: *name*_seisimager.docx, where *name* is your name. The document should be submitted to the instructor both in printed form and electronically by email.

Preliminaries

1. Create a home directory (folder) to save your work in a location recommended by the instructor. On the computers in N339, the preferred location is beneath D:\users. The name of your home directory should be short, easy to type, and recognizable. Common conventions are first name, last name, or three initials (e.g, *mary*, *curry*, or *reh*). Avoid using spaces or punctuation characters.
2. Create a new folder beneath your home directory named *refract* for this exercise.
3. Copy the sample data to this directory.
4. Confirm that the folder and its contents were copied. There should be several files with names ending with the **.dat** extension. Each file is one of a series of shots along a line. The file basename is a sequential shot number. Enter the filenames for in the table below. You may need to modify the table depending on the number of shots to be picked. Leave shot locations blank for now. Include a completed version of the table below in your report.

Shot #	Filename	Shot loc. (m)
1		
2		
3		
4		
5		
6		
7		
8		
9		

Task 1. Pick First Arrivals using Pickwin

Objective: use Pickwin to pick first arrivals from the seismic trace data.

1. Start Pickwin (Courseware / Geophysics / Pickwin)
2. Select **File | Open SEG2 file** and open one of the **.dat** files that is in the middle of the sequence of file numbers to be analyzed, these correspond to shot locations that are in the middle of the receiver spread.
3. A Pickwin window will open listing some basic recording parameters read from the file header, enter them below:

   Number of traces = ______

   Sampling time = ________

   Number of samples = __________

   Hit OK to dismiss the window.
4. The seismic data from one record are displayed on the screen. The Source location is indicated in the upper left corner of the display, enter it in the table above.

Q1: Can you guess what are the units of the sampling time (sampling interval) in #2 above? Based on the sampling interval and number of samples, what is the trace length? Show your work. Is this consistent with the length of traces shown in the display? (You may need to zoom out to see the full length of the traces).

Scale the data to fit the display

5. Scale the data so that the entire seismic record fits on the screen. Select **View | Axis Configuration.** Set Time axis direction to Time axis vertical. Set Units to m(ft) and msec. Set Distance Interval to 5 m.
6. On the top menu bar, find the three buttons that are shaped like wavelets. These control trace display mode. Click the rightmost one to display the traces in filled wiggle-trace mode.

Use the pairs of buttons with red arrows on the top toolbar to adjust the display as described in the next three steps:

7. The rightmost set of up/down arrow buttons (dark blue background) controls the time scale. Adjust the time scale so that the first arrivals are magnified for maximum clarity and so that they all fit on the screen.
8. The first set of up/down arrow buttons (green background) controls the gain, or trace amplitude. Increase the trace amplitude using the icon on the toolbar that is an up arrow. Adjust the trace amplitudes to optimize the clarity of the first arrivals on all traces.
9. The left/right buttons (light blue background) control the trace spacing. Test this to see how it works. Adjust so all traces fit within the display.

Apply Filter

10. Filters are available under **Edit | Display | Filter**. The keyboard shortcuts are Ctrl-H and Ctrl-L for highcut and lowcut filters, respectively. Apply a highcut filter by hitting Ctrl-H once. Note that the status in the upper left corner of the screen now indicates HCF=1000 Hz*. Note that each time you hit Ctrl-H, the frequency will decrease. The goal is to reduce noise and enhance the clarity of the first breaks. Watch how the character of the first break waveform changes as you change the filter. Stop when you reach a highcut frequency of 167 Hz. Use Ctrl-L to set a low-cut frequency at about 10 Hz. If you overshoot the desired frequency, select **Edit | Undo** to remove the filter and start over. You will apply the same filter to all shots prior to picking first breaks.

    Filter frequencies: Minimum (low cut) _______ Maximum (high cut): _______

    *If you don't see the filter status in the upper left corner of the pickwin window after hitting Ctrl-H or Ctrl-L, you may be in edit mode. To get out of edit mode, select **Edit | Exit edit** mode.

Pick First Arrivals

11. Use the scale buttons described above to adjust the trace amplitude so that the first arrival for each trace is distinct. If you are experiencing problems with a few high-amplitude traces obscuring the other traces, the traces may be clipped using **View | Clipping**.

12. **Pick first arrival | Pick first breaks** (P button on toolbar). The first breaks will be automatically picked. You can edit the picks by clicking at the desired location for the first arrival on each trace. Try to pick in a consistent manner, i.e. pick the same waveform on each trace. You can pick arrivals on several adjacent traces by dragging with the mouse. When you are satisfied with the picks for this record, hit the red star button to finalize your picks. Your picks will be connected with a line. Travel time should increase with distance from the source. Adjust the picks if necessary. Hit the star button again to finalize the shot.

13. Save your picks. **File | Save pick file**. Name the file *picks*. The filename will have the .vs extension, of type "Traveltime data file for Plotrefa".

14. Go on to the next shot by selecting File Open **SEG2 file** and open the corresponding **.dat** file. In the popup window, Open data file, accept the default selection: New file. A green line will appear corresponding to your previous picks.

    Before you can apply the bandpass filter, you may need to select **Edit | Exit edit mode** turn off the picking mode. Repeat the procedure described above to apply the filter. Click the P button to re-enable picking and pick first arrivals.

15. Save your picks after each shot to the same file. Picks from each shot will be combined together in the same file.

16. Repeat the procedure above to pick first breaks for all shots, including those preceding the first shot that you picked.

Review Picks

17. Review your travel-time curves and first-break picks. Look for any obvious errors such as wild picks or missing picks. In order to repick first breaks for a shot, reopen the SEG2 file for that shot. When you are satisfied with your picks, save the pick file.

Screen shot1 : Use Alt-PrtScn to copy a sample picked shot record to the clipboard, and Ctrl-V to paste into the Word document that contains your answers. Include a simple figure caption.

18. Exit from Pickwin.

Task 2. Refraction Analysis using Plotrefa

Use Plotrefa to analyze first arrivals and determine a velocity model solution.

1. Start Plotrefa (Courseware | Geophysics | Plotrefa)
2. **File | Open Plotrefa file** (traveltime data and velocity model), and browse to your pick file (picks.vs). Your picks from all shots will now be displayed as open circles. The distance scale is the same as before, but note that the time axis is now positive upward.
3. **View | Scale | Vertical Exaggeration**. Set to 0.65
4. Adjust overall scale by using toolbar vertical arrow buttons.

A. Layered Solution

In this section you will use the mouse to define segments of each traveltime curve that correspond to the direct and refracted arrivals, using a two or three layer model. To get started, inspect all of the traveltime curves that are currently displayed. Try to identify the most obvious slope break that appears in most or all of the traveltime curves at approximately the same time.

5. **Time-term inversion | Assign Layer 2 arrivals**. All picks turn red. Use the mouse to pick the first slope break. All picks for the second layer will turn green. Be sure to leave at least one pick assigned to the first layer (red).
6. **File | Save Plotrefa file**. Save As filename *picks_layers.vs* . The file now contains both picks and layer assignments.
7. **Time-term inversion | Do time-term inversion**. Topography window: Flat surface. Cell size window: take defaults, OK. The Plotrefa window pops up indicating that the program completed. Hit OK and a layered velocity model will appear.
8. **Raytracing | Execute**
9. Switch to the Traveltime display: **View | Show traveltime curves** (TT button). Compare observed vs. theoretical travel time curves. Identify one of the traveltime curves with relatively large discrepancies between observed and theoretical values. Based on its shot location (where the travel time curve intersects the distance axis) look up its file number in the table you prepared above.
10. Restart Pickwin. Open the seismic record that you identified in the preceding step and open your existing pick file (*picks.vs*). Change individual picks as desired. You may also open any of the other seismic records at this time, compare your picks against the first breaks, and make any other changes needed.
11. Save the updated picks to a new file with a different name (e.g., *picks2.vs*). Return to Plotrefa, open picks2.vs, and rerun the inversion above, including the step for layer assignment.

Screen shot 2: Layered velocity model.

12. Switch to the Traveltime display.

Screen shot 3: Traveltime graph, showing layer assignments and theoretical traveltime curves.

13. Add captions underneath the velocity model and traveltime graph.

B. Tomographic Solution

In this section, you will analyze first breaks using tomographic inversion. This method differs from the layered solution above in that no layer assignment is necessary.

14. Tomography | Generate Initial Model. Take defaults.

    1. Tomography | Inversion (with default params).
    2. Velocity model | Color shading (No lines).

Screenshot 4: Traveltime graph from the tomographic inversion, including observed and theoretical traveltimes.

Screenshot 5: Tomographic velocity model.

15. Add figure captions underneath the velocity model and traveltime graph.

CSUEB Environmental Science B.S. Program Learning Outcome Evaluation

Overall Assessment Narrative

Out of the 22 examples of student work ("Brownfield Action" simulation project reports) evaluated to assess the Program Learning Outcomes for "synthesis" (PLO #4) and "communication" (PLO #5), 3 students failed to meet the "synthesis" PLO, and 5 students failed to meet the "communication" PLO for the Environmental Science BS degree. Students scored reasonably well in areas of applying disciplinary competencies, and connecting and synthesizing ideas. These are important skills for scientists in an interdisciplinary field such as environmental science. Identified areas for improvement include submitting quality, on-time work, and organization. Most students displayed basic proficiency with quantitative skills, but little knowledge of the context of their answers, so quantitative skills remain an ongoing, perennial struggle.

Moving forward, students will continue to receive more guidance in discipline-specific communication (e.g., scientific writing, presentations), professionalism, and quantitative skills. Student performance in creating professional, visually striking reports was uneven, so some instruction in these areas will help students to communicate their ideas and findings more effectively.

The variations between this assessment and the previous iteration seem to be connected chiefly with differences in the students themselves, rather than differences in the program. The data are likely insufficient for drawing conclusions regarding the program.

Course evaluated: ENSC 4800 Seminar in Environmental Science, Winter 2018

Assignment evaluated: *"Brownfield Action" capstone project*

Rubric(s) used: EESC BS/BA Critical Thinking Rubric ("synthesis" PLO), EESC Laboratory Skills/Course Project Rubric ("communication" PLO)

"Synthesis" objective evaluation (ENSC 4800 Seminar in Environmental Science)

22 students evaluated, 22 students in class

Student	Competencies	Problem Solving	Embracing Contradictions	Innovative Thinking	Connecting, Synthesizing	Total
01	2	2	1	1	2	8
02	2	2	1	2	1	8
03	2	2	1	2	2	9
04	2	2	1	2	2	9
05	1	1	1	1	1	5
06	2	1	1	1	2	7
07	2	2	1	1	2	8
08	1	1	1	1	1	5
09	3	2	2	2	2	11
10	2	1	1	1	2	7
11	2	2	1	1	1	7
12	2	2	1	1	2	8
13	2	2	1	1	1	7
14	2	2	1	1	1	7
15	2	2	1	1	2	8
16	2	2	1	1	1	7
17	2	2	1	1	1	7
18	**1**	**1**	**0**	**0**	**1**	**3**
19	**1**	**1**	**0**	**0**	**1**	**3**
20	**1**	**1**	**0**	**0**	**0**	**2**
21	2	2	1	1	2	8
22	3	2	2	2	2	11

"Communication" objective evaluation (ENSC 4800 Seminar in Environmental Science)

22 students evaluated, 22 students in class

Student	Organization	Presentation	Quantitative Skills	Execution	Connecting, Synthesizing	Total
01	2	0	1	1	1	5
02	2	2	1	2	1	8
03	2	1	1	1	2	7
04	2	2	1	2	2	9
05	**1**	**0**	**0**	**0**	**1**	**2**
06	2	1	1	1	1	6
07	2	1	1	2	2	8
08	**1**	**0**	**0**	**0**	**1**	**2**
09	2	1	1	2	2	8
10	1	1	1	1	1	5
11	2	1	1	1	2	7
12	2	2	1	1	2	8
13	2	2	1	1	1	7
14	2	2	1	1	1	7
15	2	2	1	2	2	9
16	**2**	**2**	**0**	**1**	**1**	**6**
17	1	1	1	1	1	5
18	**0**	**0**	**0**	**1**	**1**	**2**
19	**0**	**0**	**0**	**0**	**1**	**1**
20	**1**	**0**	**0**	**0**	**0**	**1**
21	1	1	1	1	2	6
22	3	3	1	3	2	12

	Exemplary 3	Accomplished 2	Competent 1	Insufficient Evidence 0
1. Competencies *Strategies and skills that apply to Earth Science problem solving (i.e. discipline-specific lab & field exercises)*	**Clearly understands** purpose and role of the exercise and its importance and context within the Earth Sciences and/or related subfield. Proposes/develops **new means/methods** to address the problem.	**Strong understanding** of purpose and role of the exercise and its importance and context within the Earth Sciences and/or related subfield. Uses **discipline-appropriate means** to address the problem.	**Understanding** of the purpose and role of the exercise and some insight into its importance and context within the Earth Sciences and/or related subfield. **Follows instructions** and understands the steps.	Poor understanding of the purpose and role of the exercise with little/no insight into its importance and context within the Earth Sciences and/or related subfield. **Unable** to follow instructions.
2. Problem Solving	Develops a **logical, consistent plan** to solve problem, **recognizes consequences** of solution, and **can articulate** reason for choosing solution.	Develops a **plan** to solve the problem. Has some **insight into consequences** and **some ability to articulate** reason for choosing solution.	**Considers and rejects less acceptable approaches** to solving problem.	Only a **single approach** is considered and used to solve the problem.
3. Embracing Contradictions	**Integrates** alternate, divergent, or contradictory perspectives or ideas **fully**. **Proposes/uses** multiple working hypotheses.	**Incorporates** alternate, divergent, or contradictory perspectives or ideas in an **exploratory** way. **Applies** multiple working hypotheses.	**Includes** (**recognizes** value) alternate, divergent, or contradictory perspectives or ideas in a limited way. Has **difficulty** creating multiple working hypotheses.	**Fails to acknowledge** alternate, divergent, or contradictory perspectives or ideas. **No use** of multiple working hypotheses.
4. Innovative Thinking	**Creates** a novel/unique idea, method, hypothesis, format, or product.	**Imagines/conceives** a novel/unique idea, method, hypothesis, format, or product.	**Reformulates** a collection of available ideas.	**No new ideas.**
5. Connecting, Synthesizing	**Synthesizes** ideas or solutions into a **coherent whole.** **Creates** connections to higher-level discipline-specific concepts and practices.	**Connects** ideas or solutions in novel ways. **Recognizes** connections to higher-level discipline-specific concepts and practices.	**Recognizes existing connections** among ideas or solutions.	**No recognition** of significance of exercise to discipline or global context.

	Exemplary 3	Accomplished 2	Competent 1	Insufficient Evidence 0
1. Organization	Organization is **clear, consistent, observable,** and **skillful**; content is **cohesive.**	Organization is **clear, consistent & observable.**	Organization is **intermittently observable.**	Organization is **poor** or **not observable.**
2. Presentation	Work is **attractive, clean, clear, accurate,** visually **strong.**	Work is **well-produced, clear, mostly-accurate,** visually **effective.**	Work is **adequate** with **minor errors,** visually **inert.**	Work is **unclear, informal, minimally conveys intent,** and **error-prone.**
3. Quantitative Skills	Applied **innovative** and **insightful** mathematical methods and techniques. Demonstrates mathematical **mastery.**	Applied **situation-appropriate** mathematical methods and techniques. Demonstrates **solid** math skills.	Applied **basic** mathematical methods. Demonstrates **modest** math skills.	**Unable** to apply basic mathematical methods and techniques. **Insufficient** math skills.
4. Execution	Work is complete to levels **above expectation,** and turned in **early or on time.**	Work is **strong, complete,** and turned in **on time.**	Work is **adequate, complete,** and turned in **on time.**	Work is **incomplete** or **not turned in on time**
5. Connecting, Synthesizing	**Synthesizes** ideas or solutions into a coherent whole. **Creates** connections to higher-level discipline-specific concepts and practices.	**Connects** ideas or solutions in novel ways. **Recognizes** connections to higher-level discipline-specific concepts and practices.	**Acknowledges existing connections** among ideas or solutions.	**No recognition** of significance of exercise to discipline or global context.

Assessment Summaries, ENSC BS, 2017-2018

Overview

We present an assessment from the ENSC BS program that evaluates our Program Learning Outcome 4) Synthesis.

ENSC 3999 Advanced Topics in Environmental Science "Carbon Markets and Ecological Restoration" - Spring 2018

PLO 4. Synthesis

Carbon Market Project. Term-long comprehensive study of a facet of financing ecological restoration using carbon markets.

This project assesses the ability of ENSC students to synthesize knowledge concerning the intersection of Earth system science with policy and economics. It builds and tests the strength of a student's foundation of knowledge in climate change, biogeochemical cycling, atmospheric science, ecology and environmental biology, which are studied throughout the course and the ENSC BS program. For this project, the students are required to test a unique hypothesis concerning ecological restoration and carbon markets by conducting an original analysis such as mathematical modeling or synthesizing data from multiple resources into a table or conceptual diagram.

Students were required to develop a hypothesis early in the quarter which was graded and approved by the instructor. A few weeks before the final assignment was due, students were required to turn in a rough draft of the project. The instructor as well as 1 peer student reviewed each proposal and gave feedback. The peer review required the students to use the rubric to score their peers, which helped ensure that all students were familiar with the rubric and how they would be graded on the final assignment. Before and after this peer review process, the instructor met one on one with each student during class to check in and give individual feedback, as each project had unique challenges. This process helped support synthesis of information by the students as well as development of evaluation skills.

The Synthesis rubric was used to evaluate student work. Out of 15 possible, overall scores ranged from 5 to 15, with an average of 11.5 and standard deviation of 3. All 25 out of 25 students who completed the assignment displayed at least the basic level of competency (score of 1) in all five areas of synthesis criteria; 16 out of 25 displayed competency at the mastery level (score of 2) in all areas. Four students displayed an exemplary level (score of 3) in all five areas of synthesis criteria, although two of these students were graduate students. One student who received a WU in the course was not included in these statistics.

The students in this section of ENSC 3999 are experienced students, mostly upper-division ENSC majors and 2 MS students in GEOL and BIOL. With extensive coaching, many of the students in ENSC 3999 were able to achieve a pretty high level of synthesis, with highest scores in innovative thinking, a critical (and required) component of the assignment. Students' abilities in

the competency and embracing contradictions criteria lagged behind the others (with a few notable exceptions). Possible ways to improve learning outcomes include:
1) include within assignment rubric a criteria to evaluate multiple hypotheses, thereby encouraging students' ability to embrace contradictions,
2) encourage development of novel methods of addressing an environmental issue instead of only encouraging creating a novel/unique hypothesis, format or product (which was required for the assignment).

Because this project provides an excellent introduction to synthesis and the scientific method required of a professional environmental scientist and incorporates all of the ENSC BS PLOs, it will continue to be a component of program assessment. A similar assignment will be used in-class and for assessment again in the future, and some or all of these recommendations will be implemented in order to improve students' synthesis abilities.

Student ID	Competencies	Problem Solving	Embracing Contradictions	Innovative Thinking	Connecting, Synthesizing	Total
1	2	2	2	3	2	11
2	2	2	2	3	2	11
3	3	3	3	3	3	15
4	2	3	2	3	3	13
5	2	2	1	3	2	10
6	2	2	2	3	2	11
7	2	2	2	3	2	11
8	1	2	1	2	2	8
9	3	3	3	3	3	15
10	2	3	2	3	2	12
11	1	2	1	1	1	6
12	3	3	3	3	3	15
13	2	2	2	3	2	11
14	2	2	2	3	2	11
15	2	3	3	3	2	13
16	3	3	2	3	3	14
17	2	2	2	1	1	8
18	3	3	3	3	3	15
19	2	3	3	3	3	14
20	3	3	2	3	3	14
21	1	2	1	1	1	6
22	2	2	2	3	2	11
23	3	3	2	3	3	14

24	2	3	3	3	3	14
25	1	1	1	1	1	5
average	2.12	2.44	2.08	2.64	2.24	11.52
SD	0.665832812	0.583095189	0.702376917	0.757187779	0.723417814	3.001666204

Assignment (an exerpt from syllabus ENSC 3999 Spring 2018)

Individual Project (140 pts)

Each of you will select a topic of interest relating to carbon markets, ecological restoration and/or biogeochemistry and conduct a research project. The project must include a literature review (at least 2 sources including 1 primary research article and 1 newspaper article) ***and*** data analysis and/or modeling component. The project must be **hypothesis driven**.

For example, you may hypothesize that water demands for a wetland restoration project outweigh the climate change mitigation impact. First, you will read articles on the subject and find a dataset before conducting an analysis to test your hypothesis.

The project report must be **4-5 pages single spaced**, Times New Roman 12pt font and **include figures** from your analysis. The project must be organized into an Abstract (300 words max), Introduction (0.5 pg), Materials and Methods (0.5 pg), Results (1pg), Discussion (1pg), Conclusion (300 words max), and References (MLA format; not included in page count).

Individual Project Rubric (140 pts):

Component	Description	Points Possible	Due date
Project Proposal	300 word max summary of proposal including hypothesis	20 pts	April 16
Draft Project Report	Rough draft of project Must include at least a draft of each section: abstract, intro, methods, results, discussion, conclusion.	40 pts • *Has all required sections in draft form =20 pts* • *Includes a draft of figures/tables =10 pts* • *Includes a references section (MLA format) =10 pts*	May 9
Final Project Report (80pts)			**May 30**

Formatting	Is the formatting correct? • 12pt Times New Roman • 4-5 pgs total • Includes all of the following sections: abstract, intro, methods, results, discussion, conclusion. • References in MLA format • References include 1 primary literature article and 1 newspaper article	20 pts • *Length and overall formatting=10 pts* • *Appropriate references listed in MLA format=10pts*	
Hypothesis/Introduction	Is this clearly a ***hypothesis-driven*** project? Are background information and references provided to set context for the hypothesis?	20 pts	
Methods/Results	Are the methods clearly outlined and reproducible? Are the figures/tables clear and easy to read? Are there appropriate figure and table **captions**?	20 pts	
Discussion/Conclusion	Are appropriate and reasonable conclusions drawn from the analysis?	20 pts	