

Two-Year Progress Report Earth Sciences (BSc, Minor, MSc, PhD) and Environmental Sciences (BSc) June 2022

Background

In accordance with University of Waterloo's Quality Assurance Process (IQAP), the various undergraduate and graduate academic programs offered by the Department of Earth and Environmental Sciences underwent an external review in November 2019. The [Final Assessment Report](#) was approved at Senate in January 2022. A total of 10 recommendations were made for consideration. This document is a progress report on each of the recommendations.

Enrollment over the past two years

	Earth Sciences BSc		Environmental Sciences BSc		Earth Sciences Minor	Earth Sciences MSc	Earth Sciences PhD
	H	HC	H	HC			
Fall 2022	34	61	115	76	20	44	44
Fall 2021	40	51	111	60	30	53	42
Fall 2020	48	51	63	63	27	64	42
Fall 2019	53	55	22	54	21	54	35
Fall 2018	60	54	20	48	12	62	44

Progress on Implementation Plan

Recommendation 1

Overall the curriculum is consistent with other Canadian and international geoscience and environmental programs and meets professional accreditation standards. Some small tweaks are possible; both identified in the self-study report and in this evaluation. In other words, we do not feel that a major overhaul is needed. Course descriptions should be updated in describing content, and could include major themes in Earth and Environmental Sciences such as tectonics, climate change, sustainability, etc.

Status: In progress

Details: The recommended review of the courses has been completed to ensure that course titles, descriptions and prerequisites have been clarified. These revisions have been taken through the formal approval process and will appear in future undergraduate academic calendars.

After completing this process, the departmental Undergraduate Committee began planning for a comprehensive curriculum review of all of our degree specializations. To this end, a Curriculum Review Committee was formed to carry out this task. A major objective will be the development of a detailed mapping of course content to identify the important scientific concepts and professional skills intended to be acquired by students within each specialization. This review will seek to eliminate unnecessary overlaps/redundancies and identify gaps that currently exist in our program's various specializations.

Given the number of recent faculty additions to the department, this review will also seek to capitalize on this infusion of new expertise in modernizing our program. An example of one such modification currently under consideration is the replacement of EARTH 358 (Earth System Science) with EARTH 355 (Data to Decisions) as a degree requirement. This change will replace a course with poor student reviews and ill-defined content with one that teaches the quantitative and coding skills that students currently seek.

Another curriculum modification being considered is the creation of a common first year program for our Earth Sciences specializations to parallel the common first year program currently existing for the Environmental Sciences specializations. This modification can be done with only minor alterations that will have little, if any, impact on academic outcomes. This change, however, is expected to increase the sense of community and comradery in the first-year cohort and allow students to postpone the choice of their specialization until after exposure to their first year courses.

Recommendation 2

The department can and needs to continue to increase the number of undergraduate students. In discussions with faculty it was felt there is still room for additional undergraduate student capacity. That said, the department needs to be very careful with regards to limits of faculty and lecturer time and departmental resources.

Status: In progress

Details: As stated in our initial response, undergraduate recruiting is a major focus for the Department and we are continuing to pursue a number of initiatives. To further enhance these efforts, we have recently formed a departmental Recruitment Committee (headed by Professor David Rudolph, former Department Chair) to oversee and coordinate recruitment activities.

In addition, we are considering the creation of a common first year program for our various Earth Sciences specializations as mentioned earlier, and this change is anticipated to improve recruiting effectiveness by having a single, overall Earth Sciences focus, in contrast to the more fragmented recruitment effort needed for three distinct Earth Sciences programs.

Recommendation 3

An issue at many universities, including Waterloo, is confusion around environment programs on campus. As discussed, having a Faculty of Environment (without a BSc program) and a Department of Earth and Environmental Sciences (in the Faculty of Science) is leading to confusion. Many interviewees specifically mentioned the development of a Geography BSc. While it seemed that no-one had seen the proposed curriculum, it is assumed that there will be some overlap with the EES environment program. The integration and overlap of these two programs should be addressed.

Status: In progress

Details: Since our initial report, the Department of Geography and Environmental Management (GEM) within the Faculty of Environment has obtained approval for a BSc in Climate and Environmental Change and has recently started this program. While we continue to monitor possible impacts this new degree program may have on enrolment in our undergraduate programs, we are working hard to ensure that potential applicants to environmental sciences programs at Waterloo are aware of the advantages of our specific program offerings in this area. The significant differentiators include: (1) a strong foundation of science courses in our three Environmental Sciences programs, (2) curriculums that ensure the educational qualifications to attain licensure as a Professional Geoscientist (P. Geo.), and (3) the high demand from employers for our graduates, as well as co-op jobs for our students.

Recommendation 4

We felt there was potential scope for more online courses. In the Canadian university earth science departments, we do not know of many other online course offerings. In particular, courses that would be for degree credit have potential (as opposed to MOOCs or general interest courses).

Status: In progress

Details: The EES Department has continued its effort to increase the offering of fully online courses. At the time of the program review, EES offered only one fully online course (EARTH 121 - Introductory Earth Sciences); that course has now successfully run for a number of Fall and Spring terms. Subsequently, two more courses (EARTH 122 - Introductory Environmental Sciences and EARTH 123 - Introductory Hydrology) have been approved for the development of fully online versions and resources have been allocated for that purpose.

The first of these courses for which an online version was developed is EARTH 123. The first offering was in Spring 2023. There is an on-campus version of this course offered in the Fall 2023. The development of the fully online version of EARTH 122 has just been completed. The first offering will be in Fall 2024. The timing of these two new fully online courses was judged to be the best to not compete with the on-campus offerings. Hence, by the end of 2024, EES will have all three of our first-year courses (EARTH 121, 122, and 123) available in a fully online format. In Fall 2023 a new blended version of EARTH 121 is being piloted with Earth and Environmental Sciences students using online components and tutorials.

We are also planning the next phase of developing other fully online undergraduate courses. Priority is being placed on the two second year, general interest, higher enrolment courses (EARTH 270 - Disasters and Natural Hazards and EARTH 281 - Geological Impacts on Human Health). In addition, we are considering the possible development of fully online versions of selected upper-level EARTH courses. While many of the upper-level EARTH courses have lower enrolments and significant course components that are not easily converted to an online environment, EARTH 444 (Applied Wetland Science) and EARTH 458 (Physical Hydrogeology) are potential candidates for development.

Recommendation #5

There is potential scope for a Professional MSc in Hydrogeology or a related field. The first step is for EES to develop a business plan that clearly lays out the potential risks and benefits of such a program.

Status: In progress

Details: The Department recently started to discuss the feasibility of offering a mostly online professional course-based masters program with capstone project, rather than a thesis, focused on our long-standing strengths in hydrogeology. This degree program is intended to be a terminal degree (similar to an MBA as opposed to an MSc). Some elements of this program are likely to require in-person field methods activities/short courses. We expect significant interest in such a program to be from students from programs offered outside of Earth Sciences departments; accordingly, a key driver for the curriculum of this program will be that graduates become technically qualified to work as Professional Geoscientists. The mainly online delivery of this graduate program should be attractive to working professionals seeking to upgrade their qualifications.

We expect to begin this work in Fall 2022, headed by one of our faculty members with experience in establishing a similar program elsewhere. The initial work will involve a survey of similar programs at other institutions in North America, to better understand the competition and to optimally position our offering.

Recommendation 6

At the undergraduate level, the students are overall satisfied and feel a close sense of community within EES. It was clear that the undergraduate thesis course requires additional clarification in terms of guidelines, student feedback, and engagement, but the focus on a thesis is certainly a valuable component of their training and professional development.

Status: In progress

Details: As acknowledged in the initial report, EES recognizes the need for the improvement of the undergraduate thesis courses (EARTH 436A and EARTH 436B). The course format was significantly changed for the 2019-2020 academic year, and we have closely monitored the course to determine the effects of these changes. A major change was the implementation of standard class hours and activities for the first portion of the thesis course (EARTH 436A). This allowed students to meet expectations and

the early deadlines for the development of their projects along with helping them develop a better understanding of how to appropriately design an undergrad thesis.

While significant improvement has been made in terms of conveying the necessary elements of the thesis process to the students, we need to make further improvements in the monitoring of both student and supervisor activities to achieve successful and timely completion of course milestones. This will be one of the primary goals of the new course administrator who will take over EARTH 436A and 436B in the Fall 2022 term.

Recommendation 7

The graduate students would benefit from a formalized 'new graduate student' orientation. While the staff and faculty are easily available for answering graduate student inquiries, the students we spoke with identified initial struggles with understanding the bureaucracy and steps required to commence their graduate degrees (especially for those who did not do their undergraduate degree in EES or at Waterloo). A new graduate student orientation session, mentoring program, and/or an EES graduate student handbook would assist alleviate this issue.

Status: In progress

Details: As indicated in the initial response, the Department has a Graduate Student Handbook (on the EES website) which is sent to all incoming Graduate students upon arrival and is available to all instructors and students. It is updated regularly and is intended to provide all the information that should be required to get through the program as well as the most important and useful web links to important university, Faculty of Science, and Graduate Studies and Postdoctoral Affairs resources for graduate students. Following consulting with graduate students, we created a Microsoft Teams channel to host all relevant documents and to enhance our communication with students. We have resumed our orientation (meet and greet) session for new graduate students (starting in September 2021 though Teams), at which we have a PowerPoint presentation giving new students most pertinent information, reminding existing students of the same and answering any questions they may have. The Department also has a very active Earth Sciences Graduate Association (ESGA) and helps sponsor its activities. The annual Logan Day celebration in September, curling event in the winter and in particular the weekly "Geocafe" talks at the Grad House provide good opportunities for graduate students at various stages of the program to interact and learn from each other. To enhance the communication with graduate students, we have invited an ESGA representative to attend the monthly Department meeting. Through the varied initiatives outlined above, we are able to obtain regular feedback from our graduate students to ensure we are meeting their needs in a timely and effective manner.

Recommendation 8

We were impressed with Environmental Isotope Laboratory (EIL) as a global recognized core facility that serves both outer and inner users. Budget revenue should be shared with the department versus merely sustainment. Should this be a pan-university centre or institute for isotope analysis?

Status: Completed

Details: As indicated in our original response to this recommendation, the EIL is a multi-user EES facility and is not driven by any individual faculty member's research program, as are many other laboratory facilities in the Faculty of Science. This facility is recognized as a core facility – the only other departmental facility with a similar broad user base is the Hydrogeology lab facility. The EIL employs 9 full-time and 3-4 part-time and student employees in addition to 2-3 UW co-op students annually, and has an annual gross revenue of approximately \$1,000,000. Its significant annual carryforwards allow it to plan for equipment upgrades and be prepared for emergency repairs, and other contingencies. These purchases are often in the hundreds of thousands of dollars and require several years to accumulate. The Faculty of Science is moving forward to bring existing core facilities under a broader Faculty umbrella. However, the Dean of Science has allowed the EIL to continue operating within its current administrative framework. We expect to regularly revisit the administrative model of the EIL to ensure it remains responsive to the demands from its internal and various external users, while continuing to attract the necessary financial resources to ensure its long-term viability.

Recommendation 9

Based on our discussions, we feel that the Department should develop a strategic plan, specifically in the area of hiring priorities. As discussed in meetings and in the self-study report, there are upcoming potential retirements. With the recent cluster of water related hires, the Department must now develop a plan for the next hires. The department's strategic plan should also rationalize its specialized programs with respect to faculty who can teach the courses. For example, it is our understanding that in the area of geophysics, there is only one faculty member and one definite term lecturer in EES. This creates an inequitable teaching and resource distribution that is not sustainable in the long term and can be dealt with by either closing or broadening the geophysics program and/or hiring additional faculty in this researcher area. Ensure utmost attention to improving gender diversity in faculty, via future hires.

Status: In progress

Details: As explained in the Final Assessment Report, the recent hires made at that time, besides helping to address the gender imbalance in our department, were also anticipated to bring additional breadth to our strengths in water-related research. At that time, we made the conscious decision to allow these new hires to begin to establish themselves before immersing the department in conversations concerning our future directions. There are also a number of looming retirements of senior faculty. We are now ready to have an informed and inclusive discussion of a departmental strategic plan. The plan will focus on two thematic areas.

The first thematic area is an academic plan which will include a critical review of our existing programs to ensure their curricula reflect the current priorities of a comprehensive geoscience education, as well as to ensure our students are fully qualified to seek professional licensure (where appropriate). This work has started in the last year with updates at the course-level (calendar descriptions, titles, prerequisites, etc. – see progress report on Recommendation 1 above). At the graduate level we have

also started discussion on a professional course-based, mainly online masters program with capstone project focused on our long-standing strengths in hydrogeology (described in our current response to Recommendation 5 above). The academic plan will also help shape our approaches to student recruitment, an area of ongoing concern in our department and in geoscience departments across the country.

The second theme of the strategic plan – faculty renewal - will focus on future research directions, taking into account the infusion of new research expertise of our recent hires as well as the potential loss of research expertise due to imminent retirements. All of our faculty will be encouraged to participate so as to ensure a critical and transparent appraisal of how and where we can make the most significant impact as a department.

The creation of a strategic plan (academic and faculty renewal themes) will start in the Fall 2022 term and is anticipated to be completed by December 2023.

Recommendation 10

We understand that introduction of the activities-based budget model has put the Faculty of Science and EES under stress. The university should develop clear metrics for reconciliation of budgets and appropriate scale of EES (numbers of students, budgets, outcomes). This should include efforts by senior administration to reconcile the broader value of EES as a key component of the “environmental” theme at Waterloo to ensure continued health and success of EES and the Faculty of Science.

Status: In progress

Details: Our response to this recommendation in the Final Assessment Report indicated our intention to increase undergraduate enrolment, expand research activities, attract endowment funding and seek new ways of growing revenue (e.g., new course-based graduate program) to demonstrate and enhance our role in the Faculty and University. The details, implementation and reporting metrics related to the new Waterloo Budget Model (WBM), however, are determined at the Faculty level and higher. The recent external review of the WBM has pointed to the need for changes to the structure of the WBM and the need to integrate budget planning with other planning processes at the University. We anticipate that once there is the enhanced clarity on the WBM, departments, such as Earth and Environmental Sciences, will be in a better position to plan.

Explain any circumstances that have altered the original implementation plan

N/A

Address any significant developments or initiatives that have arisen since the program review process, or that were not contemplated during the review

N/A

Report on anything else you believe is appropriate to bring to Senate concerning this program

N/A

Updated Implementation Plan

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	<i>Course descriptions should be updated in describing content, and could include major themes in Earth and Environmental Sciences such as tectonics, climate change, sustainability, etc.</i>	<ul style="list-style-type: none"> Comprehensive curriculum review of all undergraduate degree specializations 	<ul style="list-style-type: none"> Curriculum review committee Associate Chair, undergraduate studies Department Chair 	<ul style="list-style-type: none"> First phase completed (updating course descriptions) Dec. 2023 for comprehensive curriculum review
2.	<i>Continue to increase the number of undergraduate students</i>	<ul style="list-style-type: none"> Critically assess recruitment efforts Consider feasibility of a common first year program for the Earth Sciences specializations 	<ul style="list-style-type: none"> Recruitment Committee Associate Chair, undergraduate studies Department Chair Director, Geological Engineering Science outreach staff 	April 2023
3.	<i>The integration and overlap of the Faculty of Environment BSc in Climate and Environmental Change and EES' environmental programs should be addressed.</i>	<ul style="list-style-type: none"> Continue to monitor possible impacts on enrolment in EES programs Ensure potential applicants to environmental sciences programs at Waterloo are aware of the advantages of EES program offerings in this area. 	<ul style="list-style-type: none"> Recruitment Committee Associate Chair, undergraduate studies Department Chair Science outreach staff 	Ongoing
4.	<i>Explore potential scope for more online courses, especially courses for degree credit</i>	<ul style="list-style-type: none"> Engaged in continuous planning to roll-out online undergraduate courses, soon 	<ul style="list-style-type: none"> Associate Chair, undergraduate studies Departmental Teaching Fellow 	Ongoing

		<p>to include selected 2nd year and more advanced courses</p> <ul style="list-style-type: none"> • Focus will be courses with high enrolments as well as those that address academic requirements for professional licensure (e.g., EARTH 281, 458) 	<ul style="list-style-type: none"> • Department Chair 	
5.	<i>Explore the feasibility of a professional MSc in Hydrogeology or a related field.</i>	<ul style="list-style-type: none"> • Develop a business plan informed by surveying similar programs at other institutions in North America, including examining potential risks and benefits of such a program in our department, and understanding how to best leverage our assets to optimally position our offering 	<ul style="list-style-type: none"> • Special service task to faculty member with experience developing a similar program elsewhere • Associate Chair, graduate studies • Department Chair 	Start in Fall 2022; complete in December 2023
6.	<i>The undergraduate thesis course requires additional clarification in terms of guidelines, student feedback, and engagement.</i>	<ul style="list-style-type: none"> • Make further improvements in the monitoring of both student and supervisor activities in our thesis courses (EARTH 436A, 436B) to achieve timely and successful completion of course milestones. 	<ul style="list-style-type: none"> • EARTH 436A,B instructor • Associate Chair, undergraduate studies • Department Chair 	Start in Fall 2022; complete in December 2023
7.	<i>A new graduate student orientation session, mentoring program, and/or an EES graduate student handbook would assist graduate students in understanding the bureaucracy and</i>	<ul style="list-style-type: none"> • Graduate student handbook (online) will continue to be updated regularly so as to provide information required 	<ul style="list-style-type: none"> • Associate Chair, graduate studies • Graduate Administrative Coordinator 	Ongoing

	<i>steps required to commence their graduate degrees</i>	<p>to get through the program as well as key web links</p> <ul style="list-style-type: none"> • Continue using a Microsoft Teams channel to host all the relevant documents and enhance our communication with students. • Resume our orientation (meet-and-greet) sessions for new students • Monthly Department meetings now include a graduate student representative • Department will continue to support graduate student-focused events 	<ul style="list-style-type: none"> • Department Chair 	
8.	<i>Environmental Isotope Laboratory (EIL) budget revenue should be shared with the department versus merely sustainment. Should this be a pan-university centre or institute for isotope analysis?</i>	<ul style="list-style-type: none"> • Following extensive discussions at the Faculty level concerning core and individual research facilities, the Dean of Science has allowed the EIL to continue operating using its current administrative framework to service both internal and external users. 	<ul style="list-style-type: none"> • EIL Manager • Department Chair • Dean of Science 	Completed
9.	<i>Department should develop a strategic plan, specifically in the area of hiring priorities...The department's strategic plan should also rationalize its specialized</i>	<ul style="list-style-type: none"> • Develop an academic plan to include a critical review of our existing programs to ensure curricula reflect the current 	<ul style="list-style-type: none"> • Executive Committee • Departmental faculty, staff and students • Department Chair 	Start in Fall 2022; complete in December 2023

	<p><i>programs with respect to faculty who can teach the courses. ...Ensure utmost attention to improving gender diversity in faculty, via future hires.</i></p>	<p>priorities of a comprehensive geoscience education, as well as to ensure our students are fully qualified to seek professional licensure</p> <ul style="list-style-type: none"> • Develop a faculty renewal plan focusing on future research directions that also support the academic plan, taking into account the infusion of new expertise of our recent hires 		
10.	<p><i>We <i.e., the reviewers> understand that introduction of the activities-based budget model has put the Faculty of Science and EES under stress. The university should develop clear metrics for reconciliation of budgets and appropriate scale of EES (numbers of students, budgets, outcomes). This should include efforts by senior administration to reconcile the broader value of EES as a key component of the “environmental” theme at Waterloo to ensure continued health and success of EES and the Faculty of Science.</i></p>	<ul style="list-style-type: none"> • The recent external review of the Waterloo Budget Model (WBM) points to needed changes to the WBM. With the anticipated clarity, we will be in a better position to plan actions related to increasing undergraduate enrolment, expanding research activities, attracting endowment funding and seeking new ways of growing revenue. 	<ul style="list-style-type: none"> • Department Chair • Dean of Science • Provost 	Ongoing

The Department Chair/Director, in consultation with the Dean of the Faculty shall be responsible for monitoring the Implementation Plan.

Date of next program review: _____ **2025-2026** _____
Date

Signatures of Approval:



July 24, 2023

Chair/Director

Date

AFIW Administrative Dean/Head (For AFIW programs only)

Date

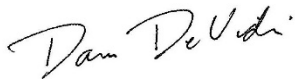


July 24/23

Faculty Dean

Date

Note: AFIW programs fall under the Faculty of ARTS; however, the Dean does not have fiscal control nor authority over staffing and administration of the program.



July 24, 2023

Associate Vice-President, Academic
(For undergraduate and augmented programs)

Date

On Behalf of Associate Vice-President, Graduate Studies and Postdoctoral Affairs