Final Assessment Report and Implementation Plan

MSc Environmental Engineering

Faculty of Engineering

September 2016

MSc Engineering - Environmental Engineering
Cyclical Program Review
Faculty of Engineering

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Master of Science in Engineering - Environmental Engineering

Review Team

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Background

In accordance with the Lakehead University Institutional Quality Assurance Process (IQAP), a Final Assessment Report has been prepared to provide a synthesis of the external evaluation and internal response and assessments of the Master of Science in Engineering - Environmental Engineering delivered by the Faculty of Engineering. This report identifies the significant strengths of the program, the opportunities for program improvement and enhancement, and sets out and prioritizes the recommendations that have been selected for implementation.

The report includes an Implementation Plan that identifies:

a. who will be responsible for approving the recommendations set out in the Final Assessment Report;
b. who will be responsible for providing any resources made necessary by those recommendations;
c. who will be responsible for acting on those recommendations;
d. any changes in organization, policy or governance that will be necessary to meet the recommendations; and
e. timelines for acting on and monitoring the implementation of those recommendations.

Review Summary

The Faculty of Engineering submitted a Self-Study in April 2014. Volume I presented the program descriptions and outcomes, an analytical assessment of the program, and program information along with institutional information and statistical data. Volume II provided a collection of the program course outlines. Volume III provided the CVs for each full- and part-time instructor contributing to the delivery of the program.

The Review Team for this cyclical program review included two external reviewers and one internal reviewer selected by the Senate Academic Quality Assurance Sub-Committee (SAC-QA) from a set of proposed reviewers. The reviewers examined materials and completed a day and a half site visit on April 30 and May 1, 2014. The site visit included meetings with the Provost and Vice-President (Academic), Dean of the Faculty of Engineering, Dean and Manager of the Faculty of Graduate Studies, Chairs of the Departments of Chemical and Civil Engineering, Coordinator of the Environmental Engineering program, Director of Research Services, Head of Collections Development, as well as full-time faculty members. The Review Team toured facilities including the Instrumentation Laboratory and Faculty laboratories, and met with graduate students, alumni and community partners.

In their report (June 2014), the Review Team provided feedback that describes how the MScEng (Environmental) program meets the Quality Assurance Framework evaluation criteria and is consistent with the University's mission and academic priorities. The admission standards, curriculum structure and delivery, and teaching and assessment methods are appropriate, reflect the current state of the discipline, and are effective in preparing graduates to meet defined program outcomes and the University's Graduate Degree Level Expectations.

The Review Team stated that "the unique interdisciplinary nature of the program integrates multidisciplinary research which includes chemical, civil and mechanical engineering as well as chemistry and forestry". They praised the program for innovation in integrating courses in geoenvironmental engineering, environmental chemistry, experimental design, physicochemical treatment processes and biological treatment processes.

The following program strengths and opportunities for improvement were noted:

Strengths:

- The procedure used to review student thesis work is very detailed and ensures that the expectations of a graduate degree are met; external reviewers have often praised the high quality of theses.
- Graduate students from this program have demonstrated excellent performance in terms of research and academic studies; over the past seven years, 36 peer-reviewed journal papers and 15 conference papers have been published with graduate students as co-authors.
- Graduate students have received numerous awards including NSERC and OGS scholarships.
- The faculty team is strong with well-established research programs, recognized nationally and internationally, and all are involved in teaching.
- Employment rates upon completion of the program exceed 90%; graduates have secured positions as engineers, scientists or technicians.

Opportunities for Improvement (Faculty responses in *italics*):

The Chair of the program, Dr. B. Liao, in consultation with program members, responded to the recommendations made by the Review Team. In the case of this review, recommendations and other items for consideration were listed throughout the review document. Items (with page number) are listed below.

1. (P3) "At the Masters level, the current area of study is appropriate and in-line with Masters programs offered at other Canadian Universities. However, courses in air and solid waste management should be developed to add breath into the program. This recommendation should be carefully examined and not be limited because of the unavailability of resources".
    - *Engineering 0335 Air pollution control and Engineering 0336 Topics in Civil Engineering (Solids waste management) have been offered as senior undergraduate courses and can be taken by environmental engineering graduate students as one of the required four courses. A new graduate course in air pollution control (Engi 5xxx) will be offered in the 2015-2016 academic year. Note – ENG5152 was offered as of Fall 2015.*

2. (P4) "Additional innovation in the program can be developed by integrating courses in water treatment, air pollution, solid waste management, pulp and paper manufacturing technology and mining processes. One possible approach to accomplish this requirement could be integrating courses via video linking to other universities".
    - *Individual courses in water treatment (Engi 5451 and Engi 5551), air pollution (Engi 0335), solid waste management (Engi 0336), pulp and paper manufacturing technology (Engi0551 Kraft Mills and Environment) and mining processes (Engi 0334 Mineral Processing) have been offered for graduate students and/or undergraduate students. Engi 0334 Mineral Processing will be recommended as an elective course for graduate student and approval to offer at the graduate level will be sought from the Faculty of Engineering Graduate Studies and Research Committee in 2014-2015 academic year. The possibility of integrating courses via video linking to other universities may be considered in the future but there are concerns over the complexity involved with tuition payments and facilities.*

3. (P4) "However, it is noted that some faculty members engaged in course delivery do not have a P.Eng. status".
    - *All of the faculty (Drs. Catalan, Gao, Kjartanson and Liao) delivering the five core graduate courses have P. Eng. status. Elective courses from the faculty of science and environmental studies do not require P. Eng. status for instructors. In fact, CEAB does not accredit graduate programs so P. Eng status is not required for any course. However, we certainly understand the significance of licensure and all new faculty members in the Faculty of Engineering are required to obtain P. Eng. before tenure.*

4. (P7) “We feel that increasing the course offerings will enhance student experience and the quality of the program. However, we realize that the true number of courses available to the students is more than what are listed in the academic calendar because many areas have been covered by directed studies”.
    - *We agree with the reviewers. Three new core graduate courses (Engi 5152 Air pollution control; Engi 5190 Modeling techniques in water resources engineering; and Engi 5252 Advanced Green Chemicals and Processes) are being considered to be added to the list of core graduate courses in 2014-2016 academic years. This will increase the core courses from 5 to 8. In addition, Engi 5651 Advanced Topics in Environmental Engineering covers various topics related to research and have been offered by individual faculty members to graduate students as directed studies. (see list below)*

5. (p7) “The administration of the ‘elective – course system’ needs improvement to expand to number of courses.”
    - *The elective courses for environmental engineering graduate students include graduate courses (seven 0.5 FCE’s) from the Faculty of Sciences and Environmental Studies, one 0,5 FCE from the Faculty of Natural Resource Management, and senior undergraduate courses (eleven 0.5 FCE’s) from the Faculty of Engineering. We believe the number of courses is adequate but we are certainly open to enhancing the list as new offerings become available. When an elective course is recommended, the course will be evaluated by the Faculty of Engineering Graduate Studies and Research Committee and recommended for approval if deemed appropriate. (see list below)*

6. (P7) “Adding more research space could enhance the quality of the program”
    - *We agree with the reviewers. More research space is needed for the program. The possibility of adding more research space will be considered in the future, when space is available. The Program Coordinator and Graduate Studies and Research Committee will communicate the program needs to the Infrastructure Committee. The Infrastructure Committee makes recommendations to the Dean, who works with the Administration on space needs.*

7. (P7) “Some faculty members are thinking ahead of possibly developing a PhD program. If this progresses, then additional research space will be required”.
    - *We agree with the reviewers. Additional research space will be needed when the program expands. There is no plan at this point to develop a PhD program in environmental engineering.*

8. (P8) “Limited number of courses available.”
    - *Three new core graduate courses (See Recommendation 4) will be added to the calendar in the 2014-2016 academic years. (see list below)*

9. *(P8*) “Student seminar is unorganized. Two major complaints are short notice and no regular time schedule. If the number of students enrolled is insufficient to schedule regular seminars, then faculty members’ research presentations could assist in filling the gaps”.
    - *The seminar is organized in a way that gives the graduate students flexibility. Graduate students can give the seminar in any term of the first four terms. Graduate students first register the seminar and talks with the supervisor (s) and graduate co-ordinator to accommodate the schedule of the thesis committee members and the graduate-co-ordinator. The Graduate Secretary in the Faculty of Engineering will announce the seminar with an abstract to all graduate students and environmental engineering faculty members in approximately one week ahead. We believe the current process meets our needs.*

10. (P8) “Organize committee members for student research proposal shortly after they join the program”.
    - *There are three committees involved in the graduate studies. The supervisory committee is formed in the first term. The thesis committee, which includes members of supervisory committee and at least an additional graduate faculty member will be formed within the first three term of graduate studies. The Thesis examination committee will be formed when thesis is ready for examination. We believe the current process serves the students well.*

11. (P9) “Develop industry related projects to promote employment routes and marketable skills”.
    - *Currently, there are a number of ongoing industry related projects that provide opportunities for graduate students to interact with industry partners. Faculty members have a track record of working with industry partners and sponsors.*

12. (P9) “Consider developing a part-time program”.
    - *We used to have a part-time program in environmental engineering. The Faculty of Graduate Studies has developed policies limiting part-time graduate studies. The Dean will discuss changes to these policies with the Administration and we may consider this option in the future should policies be revised.*

13. (P9) “Limited lab space is identified as a problem. Most of the available space is shared and in some cases, faculty members are forced to utilize space in the undergraduate laboratory”
    - *We agree with the reviewers. While the current practice of utilizing undergraduate lab space presents challenges, we must work within available resources. However, more research space is needed as the program grows.*

14. (P9) “A full-time technician is required to support the graduate program. The current individual is used over 3 semesters for the undergraduate program and has very little time allocated to support the graduate program”.
    - *We agree with the reviewers. The Departmental technologist is primarily focused on equipment related to instruction. Hence, research equipment training and repairs often fall to individual faculty members and their students. We will consider the addition of a technician to this program when resources are available.*

15. (P9) “Financial support for international students is limited”.
    - *We agree with the reviewers. Graduate assistantships (GAs) for the international students are limited. The University is taking steps to match the contribution of faculty members for international students. In addition, the Faculty of Engineering has created scholarships for top international students.*

16. (P10) “Teaching load adjustment needs to consider for those with a high research load. In some cases, faculty teaching 4 courses are also expected to assist with capstone.”
    - *We agree with the reviewers. The current load is high for research intensive faculty although in agreement with the terms of the Collective Agreement. Holders of Canada Research Chair positions have a two half-course release each academic year. Internal Lakehead Chairs may also be given course release. Long-term, there is a need for additional faculty resources if the teaching loads are to be reduced. The Dean works with the Administration to identify Faculty needs and support engineering programs.*

17. (P10) “Possible faculty retirement need to be addressed to sustain the graduate and undergraduate programs”.
    - *The retirement of Dr. Allan Gilbert in Chemical Engineering has been replaced by the new hiring of Dr. Leila Pakzak.*

18. (P10) “Limited course availability can delay student graduation”.
    - *We agree with the reviewers. Three new 0.5 FCE core graduate courses will be added to the calendar in 2014-2-16 academic years, which will increase the core graduate courses from 5 to 8. (see list below)*

19. (P10) “The funding mechanism from the administration to the Dean’s office needs to be carefully examined and reviewed”.
    - *The Dean is working with the Administration to review funding related to graduate program resources.*

20. (P10) “Offer more graduate courses in pulp and paper technology and mining”.
    - *We have two elective courses in pulp and paper technology (Engi0551 Kraft Mills and Environment) and mining (Engi 0334 Mineral Processing*

(to be approved as an elective course in 2014-2015 academic year) for graduate students. The possibility of a new graduate course in pulp and paper technology and mining is being considered. (see list below)

21. (P10) "Consider sharing core course equally between faculty members".
    - *Current way for offering graduate courses by individual faculty member is effective. The way of sharing core course equally between faculty members will cause problems of teaching loading.*

22. (P10) "Offer reading course which can be tailored to the needs of particular students".
    - *Engi 5651 Advanced Topics in Environmental Engineering has been offered by individual faculty members to meet the need of research for particular students.*

23. (P10) "Develop a strategy to overlap courses from the civil program with those in the environmental program".
    - *We will share some of the core courses with the Civil Engineering Masters program from 2015-2016 academic year. These courses include Engi5251 Geoenvironmental Engineering; Engi5451 Physicochemical Treatment Processes; and Engi5190 Modeling Techniques in Water Resources Engineering. (see list below)*

24. (P10) "Need to develop a mechanism to offer make-up courses for students entering from biology, physics, geology and math".
    - *There are mechanisms in place for make-up courses for students entering from biology, chemistry, geology and math. The admission requirements state the need of university chemistry, physics and math backgrounds for applicants. Students entering from sciences backgrounds are usually required to take two additional math courses, if they have university chemistry and physics background.*

25. (P10) "Considering using international graduate student tuition to pay graduate assistants".
    - *Graduate assistantships (GAs) for graduate students as teaching assistants are paid by the university. The revenue and allocations of international graduate student tuition are managed by the university. Some funds are returned to the Faculty and have been used to support graduate students beginning this year and continuing into the future depending on available funds.*

26. (P10) "Decentralize funding directly to the Dean's office. This will result in a more efficient time management".
    - *The Dean is working with the Administration to review funding related to graduate program resources. A decentralized model does have strengths in terms of efficiency and effectiveness although the discussion is clearly*

at the University level given the wide-ranging impact of any plan for decentralization.

27. (P10) “Improve the mechanism used to review student admission application and issuing offers. Delays can cause students to seek out opportunities elsewhere”.
    - *We agree with the reviewers. There are two major admission meetings: One in March (for Fall admission) and the other in September or October (for Winter admission). Otherwise, the applications are evaluated case-by-case when complete applications are received. Earlier admission will be taken when the scholarships and Gas allocation from the Faculty of Graduate Studies in December.*

28. (P10) “Consolidate student funding from graduate studies and the international office”.
    - *We agree with the reviewers. The Dean is working with the Administration to review graduate student funding models.*

29. (P10) “High tuition fees and limited number of Graduate Student Assistantships for international students hinders recruitment efforts. The situation also negatively affects the progress of research programs and opportunities to secure external research funding because of the lack of sufficient applications from domestic students and the increased emphasis on HQP”
    - *We agree with the reviewers. The University and the Faculty of Engineering are taking initiatives to solve this problem or minimize its impact.*

30. (P10) “a. Create a MScEng program unique to Lakehead University and use the program as a recruitment tool. The current program is similar to many Canadian MSc Environmental Engineering programs”
    - *We do not agree with the reviewers. This graduate program is unique in Canada in that it brings together faculty members from three different Engineering areas (Chemical, Civil, and Mechanical) and two other disciplines (Chemistry and Forestry) that collaborate in both graduate teaching and student supervision. As a result, graduate students have access to a breadth of expertise that enables them to work effectively on research topics requiring a multidisciplinary approach, e.g., topics which involve both the design of industrial processes and the assessment of environmental impacts. This arrangement also helps graduate students achieve an integrated understanding of the multifaceted components of environmental issues.*

31. (P10) “b. Encourage faculty to gain P.Eng. accreditation”.
    - *Faculty members in the Faculty of Engineering are required to obtain P. Eng. by the terms of their initial contract and, in most cases, prior to*

tenure.

32. (P10) “c. Provide course relief and encourage faculty to develop new courses”.
    - *Regular faculty members in Faculty of Engineering are required to teach four half-credit courses plus the capstone design project(s). They are also required to develop new courses when needed.*

Environmental Engineering Masters Program – Graduate Course Listing

Core Graduate Courses

ENGI 5151 Geoenvironmental Engineering
ENGI 5251 Environmental Chemistry
ENGI 5351 Experimental Design and Analysis for Environmental Engineers
ENGI 5451 Physicochemical Treatment Processes
ENGI 5551 Biological Treatment Processes
ENGI 5190 Modeling Techniques in Water Resources
ENGI 5152 Air Pollution Control Methods and Analysis
ENGI 5252 Advanced Green Chemicals and Processes
ENGI 5811 Seminar

Elective Graduate Courses (from other Faculties)

CHEM 5171 Advanced Topics in Analytical Chemistry
CHEM 5311 Advanced Research Methodology
ENGI 5651 Advanced Topics in Environmental Engineering
BIOL 5730 Advanced Limnology
FORE 5132 Special Topics (When offered as Soils/Environmental Factors)
GEOL 5115 Advanced Mineralogy
BIOL 5131 Special Topics II (Biostatistics)
BIOL 5171 Biostatistics

Senior Undergraduate Elective Courses

ENGI 0650 Hazardous and Industrial Waste Management
ENGI 0336 Topics in Civil Engineering (When offered as Solid Waste Management)
ENGI 0437 Topics of Soil Mechanics (When offered as Principles of Unsaturated Soil Mechanics and Waste Containment Systems)
ENGI 0551 Kraft Mills and the Environment
ENGI 0533 Electrochemical Engineering
FORE 4270 Advanced Studies in Forestry II (When offered as Ecosystem Restoration)
ENGI 0653 Fundamentals of Petroleum Recovery
ENGI 0334 Selected Topics in Chemical Engineering (When offered as Fuels, Energy and the Environment)
ENGI 0657 Energy Conversion Engineering
ENGI 0335 Air Pollution Control Methods
ENGI 0334 Mineral Processing

Implementation Plan (Part A): Departmental Responsibilities

Recommendation	Proposed Follow-up	Responsibility*	Timeline
Review and rationalize course offerings	Address the following suggestions and concerns (8, 18): a. Develop courses in air and solid waste management (1), water treatment, air pollution, pulp and paper manufacturing and mining processes (2, 20) b. Clarify role of directed studies/advanced topics in addressing course needs (4, 22) c. Clarify administration of electives (5) d. Address student concerns regarding organization of the Seminar course (9) e. Consider more courses that serve more than one graduate program (23) f. Plan for course renewal (32) g. Review teaching allocations (16, 21)	Program Coordinator and Program Chair; Dean ENGI	Spring 2017
Address resource challenges	Address the following suggestions and concerns: a. access to research space for graduate students (6, 7, 13) b. technical staff assistance (14) c. identify ways to support International students (15) d. identify ways to support additional graduate assistants (25)	Program Coordinator and Program Chair; Director International, Dean FGS	Spring 2017
Student Committee Structure	Review in light of student comments; revise if appropriate.	Program Coordinator and Program Chair; Dean ENGI	Spring 2017

Address recruitment options	Address the following suggestions and concerns: a. consider part-time Masters and new PhD programming (7, 12) b. develop mechanism to bring non-direct entry students (e.g. biology, chemistry, math, geology) into the program (24) c. improve process for reviewing applicants; reduce delays (27) d. highlight uniqueness of existing program to attract new pool of students (30) e. identify, advertise and exploit all funding options for domestic and international students (29)	Program Coordinator and Program Chair; Dean FGS;	Spring 2017
Items 3, 11, 31	Have been dealt with in Chair's response.	Program Chair	

Implementation Plan (Part B): Decanal & Administration Responsibilities

Recommendation	Proposed Follow-up	Responsibility*	Timeline
Review Faculty funding model	As part of annual budget cycle, consider alternate funding models based on existing and new revenue streams (19, 26, 28).	Dean	Ongoing
Maintain faculty complement	As part of annual budget cycle, consider appropriate renewal of faculty complement (17)	Dean	Ongoing

**The Dean of the Faculty, in consultation with the Department Chair shall be responsible for monitoring the Implementation Plan. The details of progress made will be presented in the Deans' Annual Reports and filed in the Office of the Provost and Vice-President (Academic).*