University of California, Merced

Environmental Systems Graduate Program

Assessment Plan

February 9, 2009

DRAFT

TABLE OF CONTENTS (page 1 double spaced)

DRAFT

I. PROGRAM DESCRIPTION

The Environmental Systems (ES) graduate program confers M.S. and Ph.D. degrees. The goal of the program is to equip students with the knowledge and skills necessary to improve the scientific understanding of coupled Earth systems--atmosphere, hydrosphere, lithosphere and biosphere--and to use this understanding to pursue basic research in environmental systems, optimally manage natural resources, and/or engineer the restoration of impaired environments. This improvement in understanding is gained through the systematic study of biological, chemical and physical processes, socioeconomics and policy, and through rigorous individualized research programs in these areas. Courses are designed to provide an understanding of the scientific principles underlying the function and sustainability of natural and engineered environmental systems, and to equip students to provide strong support for environmental resource decision-makers.

A distinctive feature of the ES graduate program is its multi-disciplinary nature and the accompanying opportunity for inter-disciplinary training this breadth affords. Participating ES faculty are affiliated with the Schools of Engineering, Natural Sciences, and Social Sciences, Humanities and Arts. The current ES faculty research strengths include:

- Earth systems science
- Ecology
- Geospatial Analysis
- Environmental Engineering
- Geochemistry
- Solar Energy
- Climatology & Climate Change
- Hydrology & Water Resources
- Environmental Policy
- Environmental Economics

UC Merced's unique geographical location, its relationship with neighboring institutions, and its seamless integration of science, engineering, and social science will render the ES program distinctive amongst similar programs in California and elsewhere. In particular, a substantial part of ES faculty research involves coupling scientific enquiry, engineering analysis, and policy-making associated with resource management, in natural and engineered settings of the Great Central Valley, the Sierra Nevada, and the world.

We expect our M.S. graduates will find employment with private engineering, hydrologic, and environmental consulting firms, federal agencies such as the U.S. Forest Service, National Park Service, U.S. Enivonmental Protection Agency, as well as state and regional resources agencies, such as the Department of Water Resources, Fish and Game, Water Quality Control Board, and Air Resources Board. Ph.D. graduates will find positions as academic faculty and staff in teaching and research universities, as well as in private and public resource-related agencies. along with

II: ASSESSMENT PLAN

DRAFT

A. Environmental Systems Program Assessment Timeline

The ES program includes continual student-level and programmatic assessment on a 5-year cycle, with the first assessment scheduled for Spring 2013. The Program Learning Outcomes (PLOs) to be evaluated are described in the following section (B). While the program is relatively new, several of the student-level assessment vehicles, particularly those associated with M.S. and Ph.D. research competency (PLO 1 below), have been implemented since even before the official recognition of the program by the UC Coordinating Council on Graduate Affairs (January 2008). Others need to be developed. Furthermore, protocols for capturing all lines of evidence supporting the PLOs need to be put in place.

It is the goal of the ES program to have the assessment plan outlined below in place and ready for evidence gathering in time for the 2010-11 academic year, with staged introduction of evidence gathering beginning in Spring 2008. Lines of evidence to be gathered in support of the PLOs are explained below in section C, and a timeline for staging the evidence gathering, analysis, and curriculum modifications is presented in section D.

B. Environmental Systems Program Learning Outcomes (PLOs)

The overarching goal of the Environmental Systems (ES) program is that its graduates be knowledgeable and professionally competent in one or more areas of environmental systems. The following program learning outcomes (PLOs) are being used to attain this goal:

PLO-1: **Core Knowledge** - Graduates will be knowledgeable, skillful, and self-directed in the observation and analysis of environments systems in terms of their capacity to:

a. (M.S. graduates) Design experiments with appropriate controls and conduct original research, with an appropriate level of supervision, in the context of an M.S. project or thesis
b. (Ph.D. graduates) Independently identify important research questions, formulate experimental plans, data analysis, and formulation of conclusions in the context of a doctoral dissertation

PLO-2: **Communication Skills** - Graduates will be conversant in at least two area(s) of environmental systems, and be adept at oral, written, and visual communication of research results to peers and non-technical decision makers

PLO-3: **Ethics, Community, and Lifelong Learning** - Graduates will understand the importance of research and professional ethics, engagement in the needs of their community, and life-long learning

PLO-4: **Career Placement and Advancement** - Graduates will find suitable career placement and achieve advancement in government agencies, non-government organizations, private industry, and academic teaching and research institutions

These PLOs are to be maintained for review and feedback by constituents and other stakeholders (e.g., employers) on the ES program website (https://es.ucmerced.edu/), and in the UCM Catalog, and will also be disseminated annually to incoming graduate students at the Fall Orientation session.

C: Evidence

A mapping of the ES PLOs to lines of evidence to be used for assessment purposes is provided in Table 1. Give that ES is a relatively new program, not all lines of evidence are currently being gathered and examined. Hence, the current status of each line of evidence in Table 1 is designated as "in place," or "under development." A plan and timetable for having these assessment tools in place is detailed in the following section.

Table 1 - Lines of evidence for assessing Environmental Systems program learning outcomes (PLOs).

PLO	Lines of Evidence: Direct	Lines of Evidence: Indirect
PLO-1: Core knowledge	(a1) Core course project[1] (b) Qualifying exam[2] (c) Research proposal[2] (d) Thesis/dissertation[1]	(a2) Core course student survey[1] (e) Program exit interview[1] (f) Alumni survey[1]
PLO-2: Communications	(a1) Student seminar[1] (b) Qualifying exam[2] (c) Research proposal[2] (d) Thesis/dissertation[1]	(a2) Seminar peer-assessment[1] (e) Alumni survey[1] (f) Community client questionnaire[1]
PLO-3: Ethics, Community, Life-long learning	(a1) Community service self-evaluation[1] (b) Research ethics course[1]	(a2) Community client questionnaire[1] (c) Alumni survey[1]
PLO-4: Career Placement and Advancement	(a) Employment record[1] (b) Professional publications[1]	(c) Alumni survey[1]

[1]Line of evidence for both M.S. and Ph.D. degrees.
[2]Line of evidence for Ph.D. degree only.

The lines of evidence summarized in Table 1 are expanded here in terms of specific data gathered, data analysis, and curricular modifications aimed at improving this outcome. The lines of evidence for PLO-1 (Core knowledge) are as follows:

(a1 and a2) Core course project (M.S. and Ph.D. degrees). ES 200 Environmental Systems is a required course for all M.S. and Ph.D. students in the program. Reports from the self-directed student projects will become part of each student's work portfolio. The instructor(s) for ES 200 will provide copies of the student reports along with their evaluations. Each summer, the ES Educational Policy Committee (EPC) will review the reports and solicit input from ES students (typically during their 2nd year annual curriculum planning "checkup"—see section planning and make recommendations to the instructor(s) on improving the ES 200 course and self-directed projects. Student exit survey data from this course will also be used by the instructor(s) to improve the course with respect to PLO-1 using anonymous student feedback.

(b) Ph.D. qualifying exam (Ph.D. degree only). Each doctoral student is required to pass the qualifying exam before they can advance to candidacy. This exam is detailed in the ES Policies and Procedures (Section 2.4.5). The purpose of the exam is to test basic knowledge and the

ability to formulate and defend two proposals for original research. Following the exam, copies of the two proposals along with a written assessment from the examination committee will become part of the student's portfolio. The assessment will be compiled by the chair of the exam and will focus primarily on technical content, particularly on the student's knowledge base and ability to think independently. This assessment will be reviewed by the student and his/her faculty advisor after the exam for the purpose of addressing any deficiencies noted by the examination committee. Qualifying exam documents (student proposals and committee evaluations) will be reviewed by the ES EPC on a **3-year cycle** to assess whether its format and/or execution are contributing sufficiently to PLO-1, and modified if necessary.

(c) Ph.D. research proposal (Ph.D. degree only). Doctoral students prepare their research proposal in consultation with their major advisor, and submit the completed proposal to committee members for review (ES Policies and Procedures Section 2.4.6). The committee will review this document and determine if the student has outlined a project that is appropriate for a Ph.D. A copy of the proposal and the committee's written comments will become part of the student's portfolio. This material will be reviewed by the ES EPC on a **3-year cycle** to assess whether its format and/or execution are contributing sufficiently to PLO-1. In the event of a negative assessment, best practices will be solicited from other graduate program at UCM and other universities.

(d) Thesis/Dissertation. The thesis/dissertation is the final opportunity for the dissertation committee to assess PLO-1. The dissertation committee will review this document with respect to technical content and likelihood of publication in the peer-reviewed research literature. A copy of the thesis/dissertation and written comments by the dissertation committee will become part of the student's portfolio. The EPC will review theses/dissertations on a **3-year cycle** to assess whether their quality is indicative of successful attainment of PLO-1, and will use these documents to suggest improvements to the overall curriculum and/or assessment plan.

(e) Program exit interview. The ES Academic Advising Committee (AAC) will conduct exit interviews with students when they complete their M.S. or Ph.D. degree. Several questions in the exit interview will assess PLO-1 from the students' perspective. The AAC will prepare a transcript of the interview for review by the ES EPC with respect to potential curriculum modifications.

(f) Alumni survey. The EPC will develop a database of ES alumni and use this database to solicit alumni participation in an on-line survey every **4 years**. Several questions in the exit interview will address whether PLO-1 was achieved by the ES program. The EPC will use the results from the interview to help address deficiencies in achieving PLO-1.

The lines of evidence for PLO-2 (Communications) are to assess written, verbal, and visual/graphical communication for both technical and non-technical audiences. They include the following:

(a1 and a2) Program seminar presentation (M.S. and Ph.D. degrees). All ES M.S. and Ph.D. students are required to give at least one open seminar while in the program (see ES Policies and Procedures section 2.4.8). The students' peer group will complete a survey (developed by the EPC) on the quality of the presentation in terms of technical clarity, non-technical context, and demonstrated verbal and visual/graphical communication skills. The student will review the recorded seminar and survey results with his/her faculty advisor, and these materials will become

part of the student's work portfolio. Seminar and survey content will be reviewed by the ES EPC on a **3-year cycle** to assess whether its format and/or execution are contributing sufficiently to PLO-2, and modify the procedures if necessary.

(b) Ph.D. qualifying exam (Ph.D. degree only). The purpose and format of the Ph.D. qualifying exam is described above with respect to PLO-1. The examination committee will include an assessment of student's demonstrated communication skills (written, oral, and graphical) with respect to the documents and presentations. This assessment will be included in the committee evaluation discussed above for PLO-1, and will be reviewed by the student and his/her faculty advisor after the exam for the purpose of addressing any deficiencies noted by the examination committee. Qualifying exam material will be reviewed by the ES EPC on a **3-year cycle** to assess whether its format and/or execution are contributing sufficiently to PLO-2, and modify procedures if necessary.

(c) Ph.D. research proposal (Ph.D. degree only). The examination committee will include an assessment of student's demonstrated communication skills (written and graphical) with respect to the dissertation research proposal described above for PLO-1. This assessment will be included in the committee evaluation discussed above for PLO-1, and will be reviewed by the student and his/her faculty advisor after the exam for the purpose of addressing any deficiencies noted by the examination committee. Qualifying exam material will be reviewed by the ES EPC on a **5-year cycle** to assess whether its format and/or execution are contributing sufficiently to PLO-1, and modify procedures if necessary.

(d) Thesis/Dissertation. The dissertation committee's written evaluation (discussed above for PLO-1) will include an assessment of the student's communication skills (verbal, written, visual/graphical), which will become part of the student's work portfolio. The ES Educational Policy Committee will review theses/dissertations on a **5-year cycle** to assess whether their quality is indicative of successful attainment of PLO-1, and will use these documents to suggest improvements to the overall curriculum and/or assessment plan.

(e) Alumni survey. The EPC will develop a database of ES alumni and use this database to solicit alumni participation in an on-line survey every **4 years** so that the results may be incorporated into the programs 5-year review. Several questions in the survey will address the alumni's perception of whether PLO-2 was achieved by the ES program and what improvements might be made. The EPC will use the results from the survey to help address deficiencies in achieving PLO-2.

(f) Community client questionnaire. This questionnaire is discussed in more detail below in the context of student outreach or community service activities associated with PLO-3. This questionnaire will provide feedback from the targeted outreach group(s) on the student's ability to communicate technical information to a non-technical audience in a comprehensible and respectful manner.

PLO-3 is concerned with students understanding the importance of professional ethics, community service, and life-long learning. The lines of evidence to assess PLO-3 are as follows:

(a1 and a2) Community service self-evaluation and client questionnaire. All ES students will be required to participate in a community service effort during the course of their studies. Examples are contributions to local community planning activities, presenting short-courses or

seminars to students, teachers, or non-government organizations (NGSs), assistance to undergraduate service learning groups or to local, national, or international non-government organizations. Students will prepare a self-evaluation summarizing the nature and quality of their service activity. In addition, the student must provide a client questionnaire to the relevant contact(s) for their assessment of the services, presentation, or course delivery. The student's faculty advisor and ES Academic Advising Committee (AAC) will review merits of the service activities on as soon as they are completed in order to evaluate whether this aspect of PLO-3 has been achieved.

(b) Research ethics course. All ES students will complete a professional ethics course (QSB 294 or equivalent); this requirement may be fulfilled as a directed independent or group study course (ES 298 or ES 299) prior to the end of their second year in the program. In this course, the student must complete a pertinent project or paper for inclusion in his/her work portfolio. The student's faculty advisor and ES Academic Advising Committee (AAC) will review the projects annually with respect to this aspect of PLO-3.

(c) Alumni survey. The EPC will develop a database of ES alumni and use this database to solicit alumni participation in an on-line survey every **4 years**. Several questions in the survey will address whether PLO-3 was achieved by the ES program and what improvements might be made. The EPC will use the results from the survey to help address deficiencies.

PLO-4 is concerned with successful career placement and advancement of ES program graduates. The lines of evidence to assess PLO-4 are as follows:

(a) Employment. Graduate employment records will be maintained by the program based on exit survey information and input from faculty advisors. Data to be collected will include position attained, salary level, and information pertaining to the manner and ease with which the position was attained. Career advancement will be tracked using the alumni survey. These data will be summarized and critically evaluated by the EPC for each 5-year review.

(b) Professional publications. Graduate publications will be tracked throughout their careers, including peer-reviewed research articles, government agency/NGO reports, and trade publications. These data will be collected using library search engines and via the alumni survey, and will be summarized and critically evaluated by the EPC for each 5-year review.

(c) Alumni surveys. In addition to the record-keeping noted above, the alumni survey will include questions aimed as assessing the graduate's career satisfaction and perceived level of competence as a result of their ES degree. These responses will be synthesized by the EPC for each 5-year review.

D. Process

A timeline for implementing the assessment plan for the PLOs described above is summarized in Table 2. The ES program individuals and committees charged with the development of the assessment vehicles are the same as those charged with evidence gathering in the previous section. As can be seen from Table 2, the ES program has made some progress in developing their assessment plan with respect to PLO-1. In some cases, however, slight modifications are necessary to ready these vehicles for the assessment of other PLOs. For example, while the qualifying exam is in place for assessing PLO-1, an assessment rubric for the exam with respect to PLO-2 needs to be developed.

DRAFT

Table 2 – Timeline for line of evidence gathering for the Environmental Systems PLOs.

PLO line of evidence	Develop vehicle (by whom)	Data gathering/analysis
PLO-1: Core knowledge		
(a1) Core course project[1]	Completed (instructor)	Spring 2009 (instructor, EPC)
(a2) Core course student survey[1]	Spring 2009 (instructor, EPC)	Spring 2009 (instructor, EPC)
(b) Qualifying exam[2]	Completed	Ongoing (EPC)
(c) Research proposal[2]	Completed	Ongoing (EPC)
(d) Thesis/dissertation[1]	Completed	Ongoing (EPC)
(e) Program exit interview[1]	Fall 2009 (AAC)	Spring 2010 (EPC)
(f) Alumni survey[1]	Fall 2011 (AAC)	Spring 2012 (EPC)
PLO-2: Communications		
(a1) Student seminar[1]	Fall 2009 (EPC)	Spring 2010 (EPC)
(a2) Seminar peer-assessment[1]	Fall 2009 (AAC, students)	Spring 2010 (AAC, students)
(b) Qualifying exam[2]	Spring 2010 (EPC)	Fall 2010 (EPC)
(c) Research proposal[2]	Spring 2010 (EPC)	Fall 2010 (EPC)
(d) Thesis/dissertation[1]	Spring 2010 (EPC)	Fall 2010 (EPC)
(e) Alumni survey[1]	Fall 2011 (AAC)	Spring 2012 (EPC)
(f) Community client questionnaire[1]	Spring 2012 (AAC)	Fall 2012 (EPC)
(**PLO-3: Ethics, Community, Life-long learning**		
(a1) Community service self-evaluation[1]	Spring 2012 (AAC, students)	Fall 2012 (AAC)
(a2) Community client questionnaire[1]	Spring 2012 (AAC)	Fall 2012 (AAC)
(b) Research ethics course[1]	Fall 2011 (faculty)	Spring 2012 (EPC)
(c) Alumni survey[1]	Fall 2011 (AAC)	Spring 2012 (EPC)
PLO-4: Career Placement and Advancement		
(a) Employment record[1]	Complete	Ongoing (faculty, EPC)
(b) Professional publications[1]	Complete	Ongoing (faculty, EPC)
(c) Alumni survey[1]	Fall 2011 (AAC)	Spring 2012 (EPC)

[1]Line of evidence for both M.S. and Ph.D. degrees.
[2]Line of evidence for Ph.D. degree only.
Note: EPC = Educational Planning Committee; AAC = Academic Advising Committee