Discussion Draft:
Proposal for a Graduate Certificate in River Restoration
Second version—May 22, 2006

Background:

In July 2005, a prospectus was developed to create a program to graduate Masters-level students at the University of Washington with professional-quality, interdisciplinary training in the principles and practice of river restoration. This effort was motivated by recognition of a growing need for trained entry-level professionals, and the value of responding to the high level of student interest that already exists in this subject area. It also was borne on the judgment that this field presents an ideal opportunity for the UW to move quickly into a role of national prominence, because interest and attention in this subject is high nationwide but credentialed academic programs do not currently exist.

As originally envisioned, the program would include the following elements:

- Available for students in any one of several departments, the most likely being Earth & Space Sciences, Civil & Environmental Engineering, Aquatic & Fishery Sciences, and Forest Resources;
- Administered as either a two-year (with thesis) or a 12-month (non-thesis) post-baccalaureate program, with the latter option as either a 5th-year MS degree for undergraduate majors or as a professional MS for returning students who have already been active in the field;
- Granting a certificate in river restoration, akin to existing certification programs already offered across the university, to accompany the MS degree that would be earned in the student's home department (although a future stand-alone degree was not to be precluded); and
- Based on a curriculum of traditional coursework, field-based data collection and analysis, development of writing skills, and an integrative project ideally in conjunction with a project of an agency or private firm.

Implementing any such program requires a number of steps between initial conception and accepting its first students. Eight steps have been envisioned, of which the first six will be completed by June 2006:

1. Determine the need, opportunity, and current interest in a graduate river-restoration program.
2. Identify the educational content and desired outcome of this program.
3. Characterize one or more organizational frameworks that could successfully administer a program with this content and outcomes at the University of Washington.
4. Solicit feedback on the content, desired outcomes, and organizational framework(s) from students, faculty, and interested outside professionals; iterate through steps 2 and 3 (above) as needed to reach consensus among interested groups.
5. Determine existing and required resources to implement the program as developed through steps 1–4.

6. Document the outcomes of the first 5 steps, including needs and opportunities in the field, intended educational outcomes, preferred administrative framework, and required new resources.
7. To the extent new resources are needed, open discussions with University administrators and, potentially, outside funding sources.
8. If and when necessary new resources are identified, move to formal establishment of the program. Note that different desired outcomes and administrative frameworks (e.g., certificate vs. graduate degree program) would require different actions at this step.

Steps 1–6 are nearly completed. The outcomes of steps 1 and 2 are posted on the project website, http://depts.washington.edu/cwws/streams.html. In particular, a recent Science article noted that >$1B/year is being spent on "River Restoration" nationwide; of the activity represented by this total, a substantial amount is occurring in the Pacific Northwest and is already providing both post-graduate employment and research opportunities for many in the University community. "Restoration" is already an area of recognized University expertise (e.g., the Restoration Ecology Network), and the improvement of our region's watercourses is a topic of high public interest.

This report follows a first iteration of step 3, "Characterize organizational frameworks," and it is also the product of discussions on the first draft proposal (step 4). It also articulates the level of new resources necessary to execute the proposed program (step 5). It has been informed by a recent workshop sponsored by the NSF-funded National Center for Earth-Surface Dynamics, where participants from the academic and consulting communities explored the options for improving the quality and rigor of stream-restoration training.

****DISCUSSION DRAFT 2****

PROPOSAL FOR A GRADUATE CERTIFICATE IN RIVER RESTORATION
May 22, 2006

Program Structure and Requirements

This program is envisioned as a graduate certificate program, following the framework established by the Graduate School at the University of Washington. Under this framework, each student completes departmental degree requirements and designs a concurrent Certificate program to develop both background and selected technical skills in the field. Coursework is custom-tailored to the individual student but must include at least 15 credits, with a minimum of 9 credits in courses numbered 500 or higher (per Graduate School requirements). Also in accord with Graduate School requirements, certificate programs cannot be simply a subset of courses required for their degree, but courses taken for the certificate can also count as electives to fulfill departmental degree requirements. The program of study will be designed in consultation with an advisory committee and the Graduate Program Coordinator. As part of the required course credits, all students will complete a capstone course of two or three quarters.

Application and Enrollment

Any student enrolled in or entering a graduate degree program in one of the following academic units is eligible to apply:

- Earth and Space Sciences
- Civil and Environmental Engineering
- Aquatic and Fishery Sciences
- Forest Resources

This is not necessarily an all-inclusive list. For example, students in Landscape Architecture, Urban Planning, or the Evans School might well have an interest and background appropriate for such a program. This initial phase of this program is limited to these four units, however, reflecting curricular similarities and current expressions of strongest interest from both faculty and students from these areas.

As with other graduate certificate programs at the University, this is not a stand-alone degree program and does not offer admission to graduate students. Prospective graduate students interested in applying for graduate study in River Restoration at UW should apply to one of the four above-listed academic units. This program is also available for non-matriculated, non-degree courses of study, but it does not provide a graduate degree, only a certificate, and it does not automatically confer acceptance into a graduate degree program.

Advising and Administration

Administration of the Certificate program will be through the Program on the Environment, which already administers two other graduate certificate programs. In the event of further reorganization of the environmentally-oriented programs and centers on campus, the successor unit to PoE may prove to be a more appropriate administrative home. Some level of additional resources will be required for this administration, however, regardless of location. An administrative role is needed in order to provide guidance and other resources for prospective and ongoing students, and to help organize the capstone course (see below) and any seminar series. The Certificate is granted through the University of Washington Graduate School, and the associated Masters Degree through the student's home academic unit.

Core Courses

Five existing courses form the core of the River Restoration curriculum. They have been selected to provide students a fundamental background across the range of disciplines and perspectives important in the theory and practice of river restoration, and they take advantage of existing strengths and offerings of UW faculty:

Risk Analysis and Decision Theory: QERM 514 Analysis of Ecological and Environmental Data I (4) (Quantitative Ecology & Resource Management) *or* Q SCI 482 Statistical Inference in Applied Research (5) (Quantitative Science)

Hydrology: CEE 476 Physical Hydrology (3) (Civil & Environmental Engineering) *or* CFR 525 Advanced Wildland Hydrology (4) (Forest Resources)

Fluvial Geomorphology: ESS 426 Fluvial Geomorphology (5) (Earth & Space Sciences)

Restoration Ecology: ESRM 473 Principles of Ecological Restoration (5) (Forest Resources)

Stream Ecology: FISH 547 Stream and River Ecology (5) (SAFS) *and/or* FISH 438 Biological Monitoring and Assessment (5) (SAFS)

Other recommended and/or worthwhile courses currently available at the University of Washington are summarized on the accompanying table (Appendix A, 10 April 2006 draft).

Capstone Course

As part of the program, students in the program will participate in a two- or three-quarter capstone course on River Restoration. The capstone course is designed to integrate state-of-the-art research findings in combination with ongoing examples from the region. Students and outside professionals have been strong in their support of a field-oriented aspect to this experience. Such an integrative course is a requirement of the Graduate School for any certificate program, but it does not currently exist for this topic in any department at the University of Washington; it represents the single largest need for new resources if this program is to be successful.

Implementation of course program for matriculated students

Because each of the four targeted academic units have somewhat different requirements for its own MS degrees (see Appendix B, 10 April 2006 draft), the implementation of this program will be different for students in each unit. What follows is a discussion, organized by academic unit, of those implementation alternatives based on current published degree requirements. What this discussion does *not* take into account, however, are (1) impending changes to programs that have not yet been implemented but will occur before any new students could begin this proposed program; (2) formal waivers of departmental/school requirements that are available to students via the process of academic advising; and (3) informal practices that are carried out by common consent but not readily apparent from printed policies and procedures. As a result, the following almost certainly diverges from both present and future reality, although presumably not in its gross elements.

- Earth and Space Sciences: At present, departmental requirements are little different from those of the Graduate School, and so a non-thesis degree program could consist exclusively of courses from the recommended list for the River Restoration program. A sample curriculum for a student in ESS might therefore look like this:

  Risk Analysis and Decision Theory: QERM 514 Analysis of Ecological and Environmental Data I (4) (Quantitative Ecology & Resource Management) *or* Q SCI 482 Statistical Inference in Applied Research (5) (Quantitative Science) (CORE)

  Hydrology: CEE 476 Physical Hydrology (3) (CORE); CEE 574 Advanced Hydrology (3) (Civil & Environmental Engineering)

  Fluvial Geomorphology: ESS 426 Fluvial Geomorphology (5) (Earth & Space Sciences) (CORE)

  Restoration Ecology: ESRM 473 Principles of Ecological Restoration (5) (Forest Resources) (CORE)

  Stream Ecology: FISH 547 Stream and River Ecology (5) (SAFS) *and/or* FISH 438 Biological Monitoring and Assessment (5) (SAFS) (CORE)

  Sediment Transport: OCEAN 542 Sediment Dynamics and Boundary-Layer Physics (4) (Oceanography)

  Watershed Processes : FISH 447 Watershed Ecology and Management (3) (SAFS)

  Capstone course (6–10) (CORE)

These courses total 41 credits out of a minimum requirement of 45, and so additional coursework options are still available. Note that this curriculum includes only one ESS course, however, suggesting that such a graduate student might wish to explore other coursework outside of those listed here in order to maintain his or her disciplinary foundation (or, at least, to explore their disciplinary interests).

Proposed changes within the ESS department would significantly change this prospective program, insofar as a number of new courses would be required of all ESS students. The flexibility currently provided to students in this program, and the opportunities that this

flexibility currently provides for exploring diverse topics within the field of river restoration, may thus be short-lived.

- Civil and Environmental Engineering: The primary curricular requirement for students in this department is the need for 15 credits at the 400 or 500 level from within the CEE offerings. In combination with the core courses for the River Restoration certificate, a sample program might include the following:

  Risk Analysis and Decision Theory: QERM 514 Analysis of Ecological and Environmental Data I (4) (Quantitative Ecology & Resource Management) *or* Q SCI 482 Statistical Inference in Applied Research (5) (Quantitative Science) (CORE)

  Hydrology: CEE 476 Physical Hydrology (3) (CORE); CEE 574 Advanced Hydrology (3) (Civil & Environmental Engineering)

  Sediment Transport: CEE 474 Hydraulics of Sediment Transport (3) (Civil and Environmental Engineering)

  Hydraulics: CEE 472 Introduction to Hydraulics in Water Resources (3); CEE 570 Hydrodynamics (4) (Civil & Environmental Engineering)

  Fluvial Geomorphology: ESS 426 Fluvial Geomorphology (5) (Earth & Space Sciences) (CORE)

  Restoration Ecology: ESRM 473 Principles of Ecological Restoration (5) (Forest Resources) (CORE)

  Stream Ecology: FISH 547 Stream and River Ecology (5) (SAFS) *and/or* FISH 438 Biological Monitoring and Assessment (5) (SAFS) (CORE)

  Capstone course (6–10) (CORE)

  This course of study totals 41 credits, and so additional coursework options remain available for students. A number of current CEE graduate students report that they are *already* taking, in effect, the existing courses in this curriculum, and they emphasize the importance that a capstone course would have in creating a truly integrative experience.

- Aquatic and Fishery Sciences: Of the 27 coursework credits required for the MS degree in this school, 15 are specified. Of those 15 credits, one of the courses (QSCI 482, Statistical Inference in Applied Research, 5 credits) is already part of the River Restoration core. The remaining core courses total 18 units:

  Hydrology: CFR 525 Advanced Wildland Hydrology (4) (Forest Resources) (CORE)

  Fluvial Geomorphology: ESS 426 Fluvial Geomorphology (5) (Earth & Space Sciences) (CORE)

  Restoration Ecology: ESRM 473 Principles of Ecological Restoration (5) (Forest Resources) (CORE)

Stream Ecology: FISH 547 Stream and River Ecology (5) (SAFS) *and/or* FISH 438 Biological Monitoring and Assessment (5) (SAFS) (CORE)

…and the capstone adds an additional 6 or more units. This total, 24 credits, is 12 credits more than the departmental minimum. It constitutes a feasible course of study over a two-year MS degree program (already likely as a consequence of the school's thesis requirement) but renders a one-year alternative virtually impossible.

- Forest Resources: Of the 36 course credits required for the MS degree, 14 are specified. Of those 14, 4 that are targeted for "research design and quantitative analysis" are almost certainly satisfied by the River Restoration core (via QERM 514). Thus, a potential curriculum for a graduate student in this unit might include the following:

  Risk Analysis and Decision Theory: QERM 514 Analysis of Ecological and Environmental Data I (4) (Quantitative Ecology & Resource Management) *or* Q SCI 482 Statistical Inference in Applied Research (5) (Quantitative Science) (CORE)

  Hydrology: CFR 525 Advanced Wildland Hydrology (4) (Forest Resources) (CORE)

  Fluvial Geomorphology: ESS 426 Fluvial Geomorphology (5) (Earth & Space Sciences) (CORE)

  Restoration Ecology: ESRM 473 Principles of Ecological Restoration (5) (Forest Resources) (CORE)

  Stream Ecology: FISH 547 Stream and River Ecology (5) (SAFS) *and/or* FISH 438 Biological Monitoring and Assessment (5) (SAFS) (CORE)

  Capstone course (6–10) (CORE)

As with SAFS, a thesis is required (although the minimum number of credit-hours for this effort is only 9). This degree requirement also makes the likelihood of accomplishing the river restoration certification as part of a 1-year program rather low.

Discussion and Issues

Under the current structures of the four targeted academic units, the prospective certificate program could be accomplished by matriculated MS students while pursuing their primary degree. Students in Civil and Environmental Engineering would probably have the most straightforward time in satisfying both the degree and certificate requirements in a single year (albeit with difficulty), subject only to course timing and availability (see below). One-year coursework-only MS degrees are already a well-established element of the department, and so there are no apparent "cultural" impediments. Indeed, many of the recent graduates from this department are already working professionally in the field of river restoration, suggesting that some informal implementation of this general approach is already taking place.

Students in Earth and Space Sciences are nominally presented with the greatest flexibility and opportunity to pursue this course of study, but as a practical matter virtually no graduate students are accepted into that department with the expectation of a coursework-only degree. It

is also quite unusual for students with sufficient disciplinary interest and expertise in either geology or geophysics to embark on a course of graduate study that includes almost no coursework explicitly in their chosen discipline. This suggests the most likely alternative for future ESS graduate students in this program would be through the implementation of a 5th-year MS program that drew from recent BS graduates of the department. Under current written procedures there is no formal impediment to beginning such a program, but departmental policy allocates incoming graduate-student "slots" on the basis of RA or TA funding availability over a 3-year period; graduate students are not accepted into the department unless funding is available. That policy obviously has no relevance for a 1-year terminal degree program, but it nonetheless would have to be changed before such a program could begin. The department is also considering an increase in the specified coursework requirements for all incoming graduate students, which would not preclude the successful completion of this program but would probably add 1 or 2 additional quarters to a student's residency.

Students in Forest Resources and SAFS have ample curricular flexibility, and substantial overlap in relevant courses offered through their respective units, to readily meet the proposed certificate requirements over the ~2 years normally required for a thesis-based MS program. A number of students already are pursing a de facto program in river restoration; for them, this proposal would provide them with greater coherence and formal recognition for what they are already accomplishing on their own. As with Earth and Space Sciences, graduate students in these units are not currently accepted with the expectation of a coursework-only degree.

The most obvious, significant obstacle to beginning this program is the lack of a "capstone" course (and the faculty available to create and to teach it). A set of less-apparent but related issues is the irregularity with which some of the key courses are taught, the currently limited coordination for scheduling and sequencing of courses to fit an individual student's course of study, and the possible or impending departure of certain faculty without a matching institutional commitment to replace them in kind. These all point to the likely need for additional new resources, or permanent reallocation of existing faculty commitments, to support and implement this program as currently envisioned.

This program demonstrates one of the greatest challenges facing interdisciplinary programs: because they involve multiple faculty from multiple disciplines in multiple departments, there is no institutional "home" for the program and there is no overarching commitment to maintain each of its necessary pieces. Faculty departures or redirection of teaching/research interests could leave such a program without one or more of its key courses, and with no departmental incentive to replace them. Therefore, although the "nominal" needs of the program are for one additional faculty FTE (to develop and teach the capstone course and provide an overall intellectual coherence to the program), a second FTE is almost certainly necessary to provide resources to maintain the key core courses.