

**The Professional Science Master's Program in Natural Resources and Environmental Science at the University of Idaho**

**Program Overview**

There is an imperative in higher education to train a technically educated, professional workforce for a national job market that is increasingly dominated by environmental issues related to concepts of sustainability. Policy makers across the country have emphasized the dual goals of economic growth and environmental sustainability. Between 1998 and 2007, jobs in the emerging green economy grew at a faster rate than jobs overall (9.1% vs. 3.7%), and recent research by the Pew Foundation shows that jobs in this sector are poised for even more dramatic growth. Idaho is one of 5 states where such jobs more than doubled during this time; green jobs in Idaho have an annual growth rate of 10.1%. These trends are underscored by the need of employers in the public and private sectors for an executive workforce with experience in real world problem solving and in project development, management, and finance. As part of our program to meet this demand, this document is a request for Council of Graduate School (CGS) recognition of the Professional Science Master's (PSM) program in natural resources and environmental sciences at the University of Idaho. Our vision for the PSM is to develop a professional workforce in natural resources and environmental sciences with an understanding of the interdisciplinary nature of these areas of science, and the ability to communicate and work with others to apply this understanding to specific science-based problems faced by society.

The program will include seven interdisciplinary specialty tracks that will serve the job market in Idaho and the Northwest. Four Transferable Skills courses will provide training in professional aspects of applied science such as management and communication. Internships and research experiences will be tailored to individual student needs. The science tracks are each focused on a different issue in natural resources and environmental sciences. These include Water Resources Management, Environmental Contamination, Sustainability Science, Climate Change Science, Restoration Ecology, Management of Regulated River Systems, and Ecohydrology Science and Management. All necessary science curricula are already in place as part of existing degree programs.

The four Transferable Skills courses will be the core curriculum for all PSM program tracks. These courses are designed to address the need for a professional science workforce in ways that are not addressed in our traditional master's programs. As emphasized in reports from employers in a variety of science fields, these needs include training in (1) financial and organizational management of scientific projects, (2) ethical reasoning in scientific research and practice, and (3) effective scientific communication, including scientific writing, intra-organization communications, and in speaking to the broader public about scientific issues.

The four goals of the University of Idaho PSM program are:

*Goal 1: Contributing to the National and Regional Workforce.* We will provide a professional workforce for the environmental and natural resource science job market beginning in 2012, with the first students entering the PSM program in fall 2010. We will work closely with businesses, industries, and agencies to continually assess the appropriate foci for the PSM program.

*Goal 2: Producing a Workforce Equipped for the Scientific Challenges of the 21<sup>st</sup> Century.* Our unique approach to training in natural resources and environmental sciences will prepare the graduates of our PSM program to contribute immediately to the complex and challenging fields in which they will be employed. Students will not be trained solely in narrowly defined theoretical aspects or purely applied aspects of their chosen track; rather, students will receive training and education in a manner which will integrate the theoretical, professional, and applied aspects of their chosen field. Internships and research experiences will be selected and designed to complement this holistic, translational approach to science education.

*Goal 3: Producing Science-Ambassadors Trained in Ethics and Effective Communication.* The graduates of the PSM program at UI will be prepared to serve the scientific, professional, and broader community through their training and educational background. In addition to the requisite management skills that will be part of the Transferable Skills courses, our program will place special emphasis on the development of written and verbal communication, including refining students' abilities to communicate with the broader public. Developing an understanding of ethics and the cultural context where science and society intersect will be a required part of all initial and future PSM tracks.

*Goal 4: Producing Native Professional Scientists.* While seeking students from all ethnic groups in Idaho, the University of Idaho will recruit Native students for the PSM in order to meet the economic demand for Natives trained in science. UI has several programs that support Native students, and it is appropriate that we lead the way in training Native PSM students who can provide necessary scientific expertise to address environmental issues and manage natural resources on tribal reservations.

### **Need for PSM in Natural Resources and Environmental Science.**

In October 2009, Economic Modeling Specialists, Inc. (EMSI) completed a commissioned market analysis that showed a significant potential for regional growth in the Pacific Northwest over the next five years in natural resource and environmental jobs. The anticipated jobs include professional positions associated with forestry, conservation, rangeland management, agricultural management, parks and recreation, wildlife biology, fisheries biology, geophysical technology, environmental engineering, environmental mitigation, environmental impact assessment, and waste management. Professional positions in these areas are projected to increase by 10.1% in Idaho and 9.4% regionally by 2014. These employment sectors currently support economic activity in Idaho, Oregon, and Washington at a rate 170% greater than a typical reference economy. In Idaho alone that value is closer to 250%. These values are projected to show little change through 2014, reflecting steady growth in these sectors of the economy as population increases over the coming 5 years. Additional specialty tracks in other areas of science will be developed as partly determined by future employment opportunities and market analysis.

The University of Idaho has a viable and compelling mission to produce a professional workforce for this market. As of 2006, Idaho was in the bottom 15% of states ranked by percent of adult population 25 years and older holding professional or graduate degrees. Both Idaho and Nevada have 7.1%, exceeding only Arkansas, Louisiana, Mississippi, West Virginia, and North Dakota. The national average is 9.9%, led by the populous states of Colorado, Connecticut, Maryland, Massachusetts, New Jersey, New York, Vermont, and Virginia, each with more than 12%. In the Intermountain West, only Wyoming (7.3%) and Montana (7.9%) come close to the low graduate-degree rates of Idaho and Nevada.

Native American Tribes with sovereign status are an important cultural and economic influence in the Intermountain West, and the PSM program will educate Native scientists for employment by tribal organizations. The management of natural resources on tribal lands represents a major investment of tribal resources and tribes such as the Nez Perce maintain sophisticated forestry and fisheries management divisions. The PSM program will specifically link to these programs through its internships and external advisory board.

In recognition of the need for professional training in Natural Resources and Environmental Sciences, the National Science Foundation awarded the University of Idaho College of Graduate Studies \$693,000 in April 2010 (Stephen Mulkey, PI). These funds have been allocated to graduate student fellowships and the development of the PSM. The PSM at the University of Idaho received official approval by the Idaho State Board of Education on 17 June 2010, allowing the University to offer this program as a separate and distinctive degree.

**Program Components – 35 credits**

- Transferable skills courses – 12 credits
- Elective science skills course – 3 credits
- Science track courses – 15 credits
- Internship – 3 credits
- Research experience and seminar - 2 credits

**Program administration**

The PSM Steering Committee will conduct program administration with membership from COGS and the units allied with the environmental and natural resource sciences tracks listed below. COGS will have ultimate responsibility for overall program administration, including administration of matriculation, admission requirements, and tracking of student credits through the program. The Environmental Science Program and Waters of the West (i.e., Water Resources) will be responsible for advising students within their respective tracks, creation and maintenance of relationships with internship sponsors, and creation of student research experiences (described below). Each student will be assigned an advisor from his or her particular area of emphasis. COGS will designate admission requirements for the various tracks in consultation with Environmental Science, Waters of the West, and other relevant academic programs. A PSM program coordinator working through COGS will work with the three overseeing units to facilitate internships, research experiences, and tracking of students.

**Program Credit Distribution**

The program will be completed in three semesters and a summer session, requiring no more than 18 calendar months to accrue 35 credits. All students will take the Transferable Skills courses (described below). Internships (3 credits) will typically be conducted during the summer following the second (spring) semester. Internships must span a minimum of 6 weeks but may not exceed 10 weeks in duration. The research experience will be acquired through participation in faculty research programs during the third and final (winter) semester. Across the entire PSM curriculum, the majority of credits must be taken at the 500-level, with no more than 6 credits taken at the 400-level. In all PSM tracks, the program director can make appropriate course substitutions as petitioned by students and in accordance with the guidelines developed by the Council of Graduate Schools.

**Online Course Offerings**

The need for online courses to include working professionals in the PSM is integral to the goals of the program. The online courses will include both science and transferable skills courses with a variety of choices. Other courses may be substituted with approval of an advisor and the director. For Fall 2011, all Transferable Skills courses will be online. Presently, sciences courses for the Environmental Contamination, Sustainability Science, Water Resources Management, and Ecohydrology tracks can be completed completely via online courses. Additional tracks will be added to the distance programming as they become available.

**Transferable Skills Courses (12 credits; 500 level)**

The Transferable Skills (TS) courses, common to all PSM tracks, will be designed to address the specific needs of a professional science workforce that are often not addressed in a traditional master's program. As emphasized in reports from employers in natural resource and environmental fields, these needs include training in financial and organizational management of projects, in scientific writing, and in speaking to the broader public about scientific issues (as noted by the National Professional Science Masters Association, 2009). Fulltime students who are resident at the Moscow, ID campus will be expected to enroll in the classroom version of these courses, while online delivery will enable participation by students throughout the University's system, including its Centers in Idaho Falls, Boise, and Coeur d'Alene. Student fees will be used to defray the cost of distance delivery, while the in-class courses are staffed with faculty lines provided by the Provost (1 FTE for the 4 transferable skills course).

The Transferable Skills courses are:

***Business Principles for Scientists I: Managing Scientific Projects*** (3 credits, College of Business and Economics). Modules in the first of two courses in management will engage students in the application of business principles needed to manage scientific projects in both the private and public sector with emphasis on accounting, financial, and scheduling concepts. Course topics include revenue and cost analysis, analysis of financial return, budgeting, project scheduling and capacity planning, risk management, and project control. Modules in each of the management courses will be interdependent and should be taken in sequence. This course will be available online Fall 2011.

***Business Principles for Scientists II: Strategic Management of Scientific Innovation*** (3 credits, College of Business and Economics). Modules in the second course in management will include the study of business principles needed to manage scientific innovation in both the private and public sectors with emphasis on business strategy, organizational leadership, and marketing. Students will engage in active-learning exercises on developing systems and processes that support innovation, managing technical teams, managing organizational change, protecting intellectual property, the commercialization of scientific innovation, and the incorporation of environmental sustainability into organizational strategy and processes. This course will be available online Fall 2011.

***Communication and Science Writing for Science Professionals*** (3 credits, College of Letters Arts and Social Sciences). This course will provide students with the opportunity to develop vital professional skills in oral and written communication. Content will address business and organizational communication issues and topics to include organizational structure and communication networks; innovation and decision making; crisis communication and conflict management; new communication technologies, and inter-organizational and cross-disciplinary communication. Students also will be trained to communicate clearly about science, policy, and technology issues with diverse and geographically-dispersed audiences. This course will be available online Fall 2011.

***Ethical Practice in Natural Resource and Environmental Sciences*** (3 credits, College of Letters Arts and Social Sciences). This course will emphasize ethical dimensions of environmental and natural resource science in the context of globalization, global change, and climate change. The course will build on the communications skill set of the science communication TS course by including a module on the role of science in society. Students will be asked to critically evaluate the ethical dimensions of common scientific practice and issues. This course will be available online in 2012.

### **Elective Science Skills Course (3 credits)**

Students within each of the nine tracks will be required to take an elective 3-credit course that covers the scientific tools specific to their chosen track. The student's advisor and their sponsoring program, including the Environmental Science, the College of Engineering, and Waters of the West, will determine the appropriate skills course for the student. Possible courses are found throughout the University's curriculum and may include courses in statistics, research methods specific to the chosen track, or a directed study with an advisor (e.g., the research experience described below may be expanded through a 500-level directed-study course to accommodate a customized set of science skills).

**Science Emphasis Area (15 credits)**

The PSM will be administratively housed within the College of Graduate Studies, the Environmental Science Program, and programs in Water Resources will be responsible for the content, research experience, and internships for specific tracks. These multiple tracks are not intended to be separate degree programs; they are emphasis areas that allow the PSM students to tailor their education to their career goals. Students will choose a track as an emphasis area, and their advisor will review the student's program of study to ensure that it reflects the goals of the PSM.

Students must meet the following requirements in their selection of courses within the science tracks:

(1) As stated above, no more than 6 credits may be taken at the 400-level across the entire curriculum of the PSM. 400-level course work taken as part of the 15 credits of science must be in an area of science that is central to the student's chosen track, and may not be taken from the social sciences or related areas of human dimensions.

(2) Of the 15 credits required for each science track, 3 credits may be taken from Conservation and Social Science CSS 510, CSS 572, or CSS 573. If a student takes one of these courses to meet the science skills requirement, they may not take an additional CSS or social science course as part of the 15 credits of the science emphasis area.

The CSS courses are:

CSS 510 Communications Theory in Natural Resource Management (3 cr.)

Examination of communication theories and their applications in sustainable natural resource management; emphasis on social psychological approaches to understanding persuasive communication and applications in environmental interpretation and education, marketing, and sustainable development.

CSS 572 Human Dimensions of Restoration Ecology (3 cr.)

An in-depth investigation of multi-dimensional human considerations, including economic, social, and cultural values and the role they play in maintaining, restoring, or sustaining ecosystems. Explores the major premise that projects designed for the restoration and sustainable management of ecosystems and associated resources must be ecologically sound, economically viable, and socially desirable to be successful. Although aspects of this course are specific to restoration ecology, the principles taught in this course are germane to all nine science tracks.

CSS 573 Planning and Decision Making for Watershed Management (3 cr.)

Focus on ecological and human factors in process-oriented approaches to watershed analysis and planning for effective decision making; emphasis on practical applications of current tools and approaches, e.g., GIS, MAU Theory, collaborative management. Although aspects of this course are specific to watershed management, the principles taught in this course are germane to all seven science tracks.

(3) Of the 15 credits required for each science track, one 3-credit 500-level course must be taken as a science breadth requirement. This course must be from an area of science that is closely allied with the student's chosen science track, and may not be taken from the social sciences or related areas of human dimensions. This course will be chosen with the help of an advisor and may be selected from all 500-level science courses offered at the University.

**I. Environmental Science Program.** The Environmental Science Program is a university-wide interdisciplinary curriculum that leads to BS, MS, and PhD degrees. The program draws on the participation of over 95 affiliate faculty holding primary appointments across the full range of the University of Idaho's colleges. Courses in the program curriculum come from many sectors and disciplines of the University. Emphasis areas exist in Natural, Physical, and Social Sciences. The following tracks will be constructed within this framework, utilizing existing courses in the natural and physical sciences.

**A. Environmental Contamination.** Employment opportunities in environmental contamination are numerous in the Intermountain West owing to military, mining, and agricultural activities. This track will significantly expand an existing Environmental Science certificate program. Courses will be offered on bioremediation, hazardous waste management, risk assessment, pollution prevention, analysis of contamination, environmental regulations, environmental toxicology, pesticides, and environmental impact assessment.

#### **Environmental Contamination Curriculum**

**BAE 450 Environmental Hydrology (3 cr.)**

The objective of this course is to provide a comprehensive understanding of the hydrologic processes associated with the environmental processes. Includes components of the hydrologic cycle, analysis of precipitation and run off, evapotranspiration, routing, peak flow, infiltration, soil and water relationships, snowmelt, and frequency analysis. Prereq: Math 170. This course is available online every other spring.

**BAE 533 Bioremediation (3 cr.)**

BAE 533 same as EnvS 533. Theory and practice of bioremediation as applied to toxic and hazardous wastes, including reaction kinetics, reaction stoichiometry, microbiology, and design of ex- and in-situ processes. Graduate credit requires additional design project. Prereq: Biol 115 and Math 170, or Permission

**BAE 534 Applied Bioremediation (3 cr.)**

Application of theory and design learned in prerequisite BAE 433/533 including conducting treatability studies, transportation and fate modeling in the subsurface, and hydrologic testing. Students required to complete laboratory, numerical modeling, and field testing modules in addition to a subsurface modeling project. Prereq: BAE 433/533

**SOIL 438 Pesticides in the Environment (3 cr.)**

Same as Ent and PISc 438. Principles of pesticide fate in soil, water, and air; pesticide metabolism in plants, pesticide toxicology, and pesticide mode-mechanism of action; pest resistance to pesticides; biotechnology in pest control; regulations and liability; equipment application technology; pesticide transport, storage, and disposal; and social and ethical considerations. Recommended Preparation: Chem 275.

**CHE 580 Engineering Risk Assessment for Hazardous Waste Evaluations (3 cr.)**

Quantitative and qualitative approaches to assessing risks to public health and environment from chemical contaminants; toxicology, exposure assessment, risk characterization, and environmental modeling; critical reviews of specific toxins and actual waste site studies. Additional projects/assignments reqd for grad cr.

Recommended Preparation: Biol 100 or 201, Stat 301, and ChE 470. Prereq: Senior or Graduate standing in science or engineering. This course is available online every other fall.

**ENVS 428 Pollution Prevention (3 cr.)**

Basic concepts of pollution prevention and waste minimization; pollution prevention strategies and case studies for solid waste, hazardous waste, water and energy use, and air pollution. The course is available online every fall.

ENVS 541 Sampling & Analysis of Environmental Contamination (3 cr.)  
Monitoring system design, sampling procedures, RCRA/CERCLA sampling, quality assurance data quality objectives. Prereq: Chem 112, Stat 301. This course is available online every spring.

ENVS 579 Introduction to Environmental Regulations (3 cr.)  
Interpretation and implementation of local, state, and federal environmental rules; introduction to environmental regulatory process; topics include regulatory aspects of environmental impact assessment, water pollution control, air pollution control, solid and hazardous waste, resource recovery and reuse, toxic substances, pesticides, occupational safety and health, radiation, facility siting, environmental auditing and liability. Additional projects/assignments required for graduate credit. This course is offered by video to Moscow, Idaho Falls, and Coeur d'Alene.

FS 509 Environmental Toxicology (3 cr.)  
Same as EnvS J409/J509. Fundamental toxicological concepts including dose-response relationships, absorption of toxicants, distribution and storage of toxicants, biotransformation and elimination of toxicants, target organ toxicity and teratogenesis, mutagenesis, and carcinogenesis; chemodynamics of environmental contaminants including transport, fate, and receptors; chemicals of environmental interest and how they are tested and regulated; risk assessment fundamentals. Students registering for FS 509 are required to prepare an additional in-depth report. Recommended Preparation: Biol 102 or Biol 115, Chem 111, Chem 112, Chem 275, and Stat 251. This course is offered online every fall.

GEOG 544 Environmental Impact Assessment (4 cr.)  
Environmental impact statements and their national and state policy frameworks, methods of assessment, and team preparation of an impact statement. Credit not granted for both ES/RP 444 and 544. Cooperative course taught by WSU, open to UI students (GEOG 444).

**B. Climate Change.** This track builds on a new graduate climate curriculum in the Geography Department and the College of Natural Resources, and is intended to address the need for professionals who understand not only climate science, but also specific issues related to impacts, mitigation, and adaptation. For example, several enterprises in the Intermountain West are concerned with biological carbon storage, while others are concerned with energy efficiencies and related carbon footprint issues. This PSM includes graduate courses in biogeography, watershed science, climatology, land use, climate and water resources, spatial analysis and modeling, carbon cycle, climate mitigation, and global environmental change. Future development of this track will utilize facilities and faculty associated with the UI Idaho Falls Center in conjunction with the Department of Energy Idaho National Laboratory and Center for Advanced Energy Studies.

#### **Climate Change Curriculum**

FOR 462 Watershed Science and Management (3 cr.)  
Influence of land management practices on hydrologic processes, water quality, and riparian habitat w/emphasis on wildland watersheds. Two days of field trips.  
Recommended Preparation: Math 143 or 160, high school physics or Phys 100 or 111.

GEOG 401 Climatology (3 cr.)  
Physical basis for climatic processes and patterns; mechanics of global atmospheric circulation; radiation balance and heat budget of the earth; models of weather patterns and climate. Prereq: Geog 301

**GEOG 535 Climate Change Mitigation (3 cr.)**

Overview of methodologies for calculating greenhouse gas (GHG) emissions at the national, state and local level. Cost/benefit analysis of emission reduction strategies. Students utilize the UI campus operations as a learning laboratory for evaluating emission reduction strategies at the local level. Idaho is used as a case study for emission reduction strategies at the state level. For graduate credit, additional literature review and evaluation of new, advanced technologies are required.

**GEOG 505 Climate and Water Resource Change (3 cr.)**

Physical processes that determine the climate of Earth and its past and future changes: greenhouse effect, radioactive and heat feedback processes, orbital parameter theory. Climate and Environmental Periods. Atmospheric and water resources change within the instrumental period of records. Future climate and water resources: Paleo-perspectives on "greenhouse warming". Review of paleoclimate techniques: dendro-climatology, marine and lake sediments, polar and mountain ice core paleo-climatic records, paleoclimatic and historic data analysis. Additional assignments and exams required for grad cr. Prereq: Geog 401 and Stat 251, or Permission

**GEOG 507 Spatial Analysis and Modeling (2 cr.)**

Point Pattern Analysis, Nearest Neighbor, K-Functions, Quadrat Analysis, Spatial Autocorrelation (Moran's I, Geary's ratio, General G-statistics), Order Neighbor Analysis, Spatial Regression (creating prediction models, improving accuracy, validating and working with spatial weighted lags), Spatial Sampling Techniques/Methods, Spatial Dispersion, Spatial Diffusion, Gravity Models, Modeling in GIS, Model Builder, Weighing Layers. Applications in ArcGIS and Matlab. Additional assignments and exams required for graduate credit. Prereq: Geog 385 Prereq or Coreq: Geog 390, Math 143, Math 160 and Stat 251

**GEOG 570 Global Carbon Cycle (3 cr.)**

Patterns and processes of carbon cycling, an important component of global environmental change. Stocks and fluxes of carbon in the lithosphere, atmosphere, hydrosphere, and biosphere. Drivers of the global carbon cycle on time scales of minutes to millennia and spatial scales of microbes to the Earth. Human modifications and their impacts are emphasized. Prereq: Geog 100, Geog 450, EnvS 101, or For 221; or Permission. This is a Directed Study course.

**ENVS 501 Seminar in Climate Change (2-3 cr.)**

**REM 450 Global Environmental Change (3 cr.)**

Major global environmental changes addressed using an interdisciplinary approach. Topics may include processes and principles of ecosystems, biogeochemical cycles, impacts and mitigation of climatic change, atmospheric chemistry, feedbacks between climate and various earth system processes, and trends in global biodiversity. Prereq: Math 143 or Stat 251

**REM 507 Landscape and Habitat Dynamics (3 cr.)**

Students explore landscape change occurring a variety of spatial and temporal scales, including global change, succession, disturbance events, and change induced by humans. Via scientific readings, models and spatial analysis students will learn how to quantify landscape change and how a change in environmental conditions and disturbance regimes may affect the composition of landscapes, specifically plant and animal habitats. Recommended Preparation: courses in ecology, statistics, and GIS.

**REM 560 Plant Ecophysiology (3 cr.)**

Functional responses and adaptations of individual plant species to their environment, emphasizing morphological and physiological mechanisms that influence plant establishment, the physical environment, below- and above-ground productivity, and plant interactions such as competition, herbivory, and allelopathy. Prereq: A course in general ecology (i.e. REM 221) and general botany, or Permission

**SOIL 528 Advanced Chemistry of Soil Environment (3 cr.)**

Practical treatment of physical and chemical processes affecting ion retention and bioavailability in soils and sediments including speciation, adsorption, precipitation, dissolution and redox reactions. Prereq: Soil 422 or Permission. Offered every other fall.

**BIOP 520 Introduction to Bioregional Planning (3 cr.)**

This class introduces first semester Bioregional Planning and Community Design students to bioregional planning concepts and current implementation practices.

**C. Sustainability Science.** Public and private agencies and businesses dealing with issues related to the management of environmental issues frequently lack professional expertise in science aspects of coupled natural and human systems. This PSM track is intended to provide science professionals for this growing field and builds on the existing Environmental Science curriculum in the physical and natural sciences. Courses in this track must be drawn from the University 500-level science courses (the list below contains suggestions only), and must represent an integrated course of study that focuses on a particular area of sustainability that is relevant to the student's professional goals. Internships in science practicum will be available through Sustainable Idaho, the outreach arm of the University of Idaho Sustainability Center. All students in the track are required to take ENVS 596, the integrative capstone course in sustainability science.

**Required synthesis course**

**ENVS 596 Advanced Environmental Science (3 cr.)**

Interdisciplinary capstone graduate course for the PSM and PhD in Environmental Science exploring the scholarship of integration across scientific disciplines with respect to sustainability science and current environmental issues related to global change. The course will focus on real world issues of sustainability and strive to improve communication and problem-solving skills across disciplines. (Fall, alt/yrs) Prereq: Admission to candidacy upon completion of preliminary examination (EnvS students), admission to the PSM degree program (PSM students), or instructor permission.

**Possible courses for the Sustainability Science Curriculum**

**ENVS 596 Advanced Environmental Science (3 cr.)**

Interdisciplinary capstone graduate course for the PhD in Environmental Science exploring the scholarship of integration with respect to current environmental issues related to global change. The course will explore topics relevant to current student research and help them improve communication and problem-solving skills across disciplines. (Fall, alt/yrs). **Prereq:** Admission to candidacy upon completion of preliminary examination or instructor permission.

**WLF 440 Conservation Biology (3 cr.)**

Patterns of biological diversity; factors producing changes in diversity; values of diversity; management principles applied to small populations, protected areas, landscape linkages, biotic integrity, restoration, legal issues, and funding sources. Prereq: For 221 or Biol 314 or Permission

**REM 440 Wildland Restoration Ecology (3 cr.)**

Ecological principles and management practices involved in restoring and rehabilitating wildland ecosystems after disturbance or alteration to return damaged ecosystems to a productive and stable state. Recommended Preparation: a course in general ecology. This course is offered online every spring.

**REM 456 Integrated Rangeland Management (3 cr.)**

Management strategies for integrating grazing with other natural resource values such as wildlife, water, timber, recreation, and aesthetics; emphasis on herbivore ecology including ecological impacts of grazing, ways to manage grazing, and nutritional relationships between plants and free-ranging ungulates on rangeland, pastureland, and forest ecosystems. One 1-week field trip. Recommended Preparation: REM 251.

**CHE 580 Engineering Risk Assessment for Hazardous Waste Evaluations (3 cr.)**

Quantitative and qualitative approaches to assessing risks to public health and environment from chemical contaminants; toxicology, exposure assessment, risk characterization, and environmental modeling; critical reviews of specific toxins and actual waste site studies. Additional projects/assignments reqd for grad cr. Recommended Preparation: Biol 100 or 201, Stat 301, and ChE 470. Prereq: Senior or Graduate standing in science or engineering. This course is offered online every other fall.

**ENVS 428 Pollution Prevention (3 cr.)**

Basic concepts of pollution prevention and waste minimization; pollution prevention strategies and case studies for solid waste, hazardous waste, water and energy use, and air pollution. This is offered online every fall.

**GEOG 560 Population Dynamics and Distribution (3-4 cr.)**

Effects of fertility, mortality, and migration on population size and distribution; demographic trends in U.S. and other societies and how these relate to economic, political, environmental, and other factors. One hour additional meeting per week or project for fourth credit. Additional assignments and exams required for graduate credit.

**GEOG 535 Climate Change Mitigation (3 cr.)**

Overview of methodologies for calculating greenhouse gas (GHG) emissions at the national, state and local level. Cost/benefit analysis of emission reduction strategies. Students utilize the UI campus operations as a learning laboratory for evaluating emission reduction strategies at the local level. Idaho is used as a case study for emission reduction strategies at the state level. For graduate credit, additional literature review and evaluation of new, advanced technologies are required.

**REM 507 Landscape and Habitat Dynamics (3 cr.)**

Students explore landscape change occurring a variety of spatial and temporal scales, including global change, succession, disturbance events, and change induced by humans. Via scientific readings, models and spatial analysis students will learn how to quantify landscape change and how a change in environmental conditions and disturbance regimes may affect the composition of landscapes, specifically plant and animal habitats. Recommended Preparation: courses in ecology, statistics, and GIS. Prereq: Permission

**REM 527 Landscape Ecology of Forests and Rangelands (3 cr.)**

Ecological relationships of biotic communities in heterogeneous environments, spatial and temporal patterns, importance of landscapes in maintenance of ecosystem diversity and function. In addition, those students taking 3 credits will meet an additional hour a week, focusing on quantitative landscape analysis, and they will participate in a 2-day field trip. (Spring only) Prereq: Upper-division plant or animal ecology or permission

**FISH 540 Wetland Restoration (3 cr.)**

This web-based course contains modules covering wetland science, restoration ecology, freshwater restoration, coastal restoration, and monitoring/maintenance. The emphasis is on the science of wetland ecosystems and the applied ecology/practice of restoration, with additional consideration of cultural and socio-political contexts. Students apply their learning in and contribute relevant professional experience to weekly online discussions. Students are also responsible for obtaining documentation of at least one wetland restoration site in their region and conducting a site visit in order to evaluate the success of the restoration project. Prereq: Biol 115 and 116; and For 221 or Biol 314 or Permission. This class is offered online every fall.

**BAE 533 Bioremediation (3 cr.)**

BAE 533 same as EnvS 533. Theory and practice of bioremediation as applied to toxic and hazardous wastes, including reaction kinetics, reaction stoichiometry, microbiology, and design of ex- and in-situ processes. Graduate credit requires additional design project. Prereq: Biol 115 and Math 170, or Permission

**BAE 534 Applied Bioremediation (3 cr.)**

Application of theory and design learned in prerequisite BAE 433/533 including conducting treatability studies, transportation and fate modeling in the subsurface, and hydrologic testing. Students required to complete laboratory, numerical modeling, and field testing modules in addition to a subsurface modeling project. Prereq: BAE 433/53

**WR 506 Interdisciplinary Methods in Water Resources (3 cr.)**

Student and faculty teams from traditionally disparate disciplines address real issues to develop methods for communicating across disciplines and for solving water resources problems. The course takes a problem-oriented approach using case studies. Faculty will lead students through this integrative process with lectures and working sessions. This class is offered through video to Boise and Idaho Falls.

**D. Restoration Ecology.** Professionals trained in this PSM track will be prepared to work for consulting firms and agencies specializing in habitat remediation and restoration. Coursework in this track significantly expands on an existing certificate program offered by the College of Natural Resources and includes wetland restoration, landscape ecology, ecology of forests and rangelands, wildland restoration ecology, landscape and habitat dynamics, soil and environmental physics, fire ecology, and advanced soil chemistry. Students will be expected to participate in a practicum in restoration ecology as part of their research experience.

**Restoration Ecology Curriculum**

**FOR 429 Landscape Ecology (3 cr.)**

Same as REM 429. Ecological relationships and conservation issues for biotic communities across the landscape, including spatial and temporal dynamics and patterns, and importance of landscapes in maintenance of ecosystem diversity and function. One or more field trips; one 2-3 hour lab period per week. Recommended Preparation: Familiarity with spreadsheet programs and problem solving using computers. Prereq: For 221 or REM 221

**REM 440 Wildland Restoration Ecology (3 cr.)**

Ecological principles and management practices involved in restoring and rehabilitating wildland ecosystems after disturbance or alteration to return damaged ecosystems to a productive and stable state. Recommended Preparation: a course in general ecology. This course is offered online every spring.

**SOIL 415 Soil and Environmental Physics (3 cr.)**

Physical properties of soils and their relationships to moisture, aeration, and temperature; plant-soil-atmospheric relationships; solute transport and soil salinity. Two lec and one 3-hr lab a wk. Recommended Preparation: Soil 205, 206, and Phys 111.

**FOR 527 Landscape Ecology of Forests & Rangelands (2-3 cr.)**

Ecological relationships of biotic communities in heterogeneous environments, spatial and temporal patterns, importance of landscapes in maintenance of ecosystem diversity and function. In addition, those students taking 3 credits will meet an additional hour a week, focusing on quantitative landscape analysis. Prereq: Upper-Division plant or animal ecology

**FISH 540 Wetland Restoration (3 cr.)**

This web-based course contains modules covering wetland science, restoration ecology, freshwater restoration, coastal restoration, and monitoring/maintenance. The emphasis is on the science of wetland ecosystems and the applied ecology/practice of restoration, with additional consideration of cultural and socio-political contexts. Extensive readings, an assignment, and a study guide are required for each module. Students apply their learning in and contribute relevant professional experience to weekly online discussions. Students are also responsible for obtaining documentation of at least one wetland restoration site in their region and conducting a site visit in order to evaluate the success of the restoration project. A final exam (re-design of a failed restoration project) is administered online, with partial credit earned through discussion with an interdisciplinary team of classmates and the remaining credit earned through individual analysis and synthesis. Prereq: Biol 115 and 116; and For 221 or Biol 314 or Permission. This course is offered online every fall.

**REM 507 Landscape and Habitat Dynamics (3 cr.)**

Students explore landscape change occurring a variety of spatial and temporal scales, including global change, succession, disturbance events, and change induced by humans. Via scientific readings, models and spatial analysis students will learn how to quantify landscape change and how a change in environmental conditions and disturbance regimes may affect the composition of landscapes, specifically plant and animal habitats. Recommended Preparation: courses in ecology, statistics, and GIS. Prereq: Permission

**SOIL 528 Advanced Chemistry of Soil Environment (3 cr.)**

Practical treatment of physical and chemical processes affecting ion retention and bioavailability in soils and sediments including speciation, adsorption, precipitation, dissolution and redox reactions. Prereq: Soil 422 or Permission

**BIOL 567 Ecological Restoration (3 cr.)**

Introduction to major issues in restoration ecology; major ecological dimensions of restoration. Cooperative course taught with Washington State University.

**BAE 533 Bioremediation (3 cr.)**

BAE 533 same as EnvS 533. Theory and practice of bioremediation as applied to toxic and hazardous wastes, including reaction kinetics, reaction stoichiometry, microbiology, and design of ex- and in-situ processes. Graduate credit requires additional design project. Prereq: Biol 115 and Math 170, or Permission

**BAE 534 Applied Bioremediation (3 cr.)**

Application of theory and design learned in prerequisite BAE 433/533 including conducting treatability studies, transportation and fate modeling in the subsurface, and

hydrologic testing. Students required to complete laboratory, numerical modeling, and field testing modules in addition to a subsurface modeling project. Prereq: BAE 433/533

LARC 480 The Emerging Landscape (3 cr.)

A capstone course exploring the emerging cultural and environmental issues significant to the practice and scholarship of landscape architecture, land planning and community development. Keeping a journal and attendance at lectures outside of class time required. Includes service learning. Recommended Preparation: **Comm 101**. (Spring only)

**II. University of Idaho Water Resources Programs.** Water Resources programs at the University of Idaho include the Center for Ecohydraulics Research at the UI Boise Center, the Idaho Water Resources Research Institute, and the interdisciplinary graduate program Waters of the West. The following tracks will be administered jointly by Waters of the West and COGS in consultation with the other Water Resources programs. Faculty affiliated with these groups offer a wide array of research opportunities for PSM students, and each maintains relationships with agencies and industries dealing with water resource issues. Collectively, these programs will facilitate the following PSM science tracks.

**A. Water Resources Management.** This track expands an existing non-thesis MS degree program in Environmental Science to include a wider range of water management subject matter. This PSM track is intended to complement the more issue-specific tracks described below and will train professionals with the broader range of knowledge that is required to be an effective water resource manager. Students in this track will be trained for entry-level management positions in industries and agencies that offer a diversified portfolio in water resources management. Coursework for this track includes curricular elements that are currently part of the University's premier program in water resources, Waters of the West. Students will select courses that review wastewater operations, hydrology, water quality, watershed management, ground water engineering, water policy, water resources systems analysis, wetland restoration, remote sensing, geochemistry, and hydrogeology.

#### **Water Resources Management Curriculum**

FOR 462 Watershed Science and Management (3 cr.)

Influence of land management practices on hydrologic processes, water quality, and riparian habitat w/emphasis on wildland watersheds. Recommended Preparation: Math 143 or 160, high school physics or Phys 100 or 111.

BAE 450 Environmental Hydrology (3 cr.)

Carries no credit after BAE 355 or CE 325. The objective of this course is to provide a comprehensive understanding of the hydrologic processes associated with the environmental processes. Includes components of the hydrologic cycle, analysis of precipitation and run off, evapotranspiration, routing, peak flow, infiltration, soil and water relationships, snowmelt, and frequency analysis. Prereq: Math 170. This course is offered online every other spring.

BAE 504 Environmental Water Quality (2 cr.) Engineering design to monitor, evaluate, and minimize non-point pollution from agriculture, environmentally acceptable disposal of wastes, bioremediation. Graduate credit requires an additional project and report. Prereq: Chem 112 and Soil 205 or MMBB 250, and BAE 355 or BAE 450.

BAE 552 Environmental Water Quality (3 cr.)

Engineering design to monitor, evaluate, and minimize non-point pollution from agriculture, environmentally acceptable disposal of wastes, bioremediation. Graduate credit requires an additional project and report. Two lec and one 3-hr lab a wk. **Prereq:** Chem 112 and Soil 205 or MMBB 250, and BAE 355 or BAE 450.

**ENVS 546 Drinking Water and Human Health (3 cr.)**

Same as Soil 546. Understand the characterization, testing, and treatment of chemical, microbial and hazardous compounds and their impact on human health. Be familiar with drinking water standards, regulatory aspects and protection of municipal, community, and private well systems.

**ENVS 538 Western US Water Resource Policy & Environmental Equity (3 cr.)**

Participatory online course focusing on social justice constraints reflected in the struggle over water resource management in the US West. Uses an environmental equity conceptual framework to analyze institutional control, rural-urban conflicts, and cultural impacts on disenfranchised groups. Additional assignments/projects required for graduate credit. Recommended Preparation: For 235 or AgEc J477/J577.

**FISH 540 Wetland Restoration (3 cr.)**

This web-based course contains modules covering wetland science, restoration ecology, freshwater restoration, coastal restoration, and monitoring/maintenance. The emphasis is on the science of wetland ecosystems and the applied ecology/practice of restoration, with additional consideration of cultural and socio-political contexts. Students apply their learning in and contribute relevant professional experience to weekly online discussions. Students are also responsible for obtaining documentation of at least one wetland restoration site in their region and conducting a site visit in order to evaluate the success of the restoration project. Prereq: Biol 115 and 116; and For 221 or Biol 314 or Permission. This course is offered online every fall.

**GEOG 524 Hydrologic Applications of GIS and Remote Sensing (3 cr.)**

Concepts of area-based hydrologic modeling and assessment and the various types of spatially distributed information commonly used in these activities, such as topographic data, vegetation cover, soils and meteorologic data. Hands-on experience in manipulating these types of data sets for hydrologic applications. Recommended Preparation: Geog 385, For 462, BAE 355, CE 325 or Equivalent. This course is offered by video to Coeur d'Alene and Boise every spring.

**GEOL 564 Geochemistry of Natural Waters (3 cr.)**

Basic principles of aqueous geochemistry applied to natural waters (ground waters, lake and river waters, seawater), presented at an intermediate level; carbonate equilibria and alkalinity, solubility of minerals, sorption processes and surface reactions, redox reactions and Eh-pH diagrams, organic geochemistry, etc. For graduate credit, students are required to prepare two in-depth term papers and demonstrate through exam work and papers a more in-depth understanding of the material. One compressed video and one web-based lecture a wk. Recommended preparation: Geol 423. Prereq: Chem 111-112. This course is offered online every other spring.

**HYDR 512 Environmental Hydrogeology (3 cr.)**

Methods of hydrogeologic site characterization for the delineation of environmental problems such as contaminated ground water plumes, and ground water dewatering for landslide remediation. For grad credit, students are required to complete an additional independent research paper/project.

**WR 506 Interdisciplinary Methods in Water Resources (3 cr.)**

Student and faculty teams from traditionally disparate disciplines address real issues to develop methods for communicating across disciplines and for solving water resources problems. The course takes a problem-oriented approach using case studies. Faculty will lead students through this integrative process with lectures and working sessions. This course is offered by video to Boise and Idaho Falls.

**B. Management of Regulated River Systems.** Professionals trained in this PSM program track will be able to work for a variety of agencies and firms in the West that specialize in aspects of regulated flowing water, especially including the major tributaries to the Columbia and Klamath Rivers. Graduate course work will expand the opportunities available through the Ecohydraulics program in Boise, including courses in riparian ecology, river restoration, engineering hydrology, open channel hydraulics, fluid dynamics, sedimentation, aquatic habitat modeling, channel flow, water resources systems analysis, stochastic hydrology and fluvial geomorphology. Students in this track will be trained for mid to upper range technical positions, and will be eligible for employment with industries and agencies that whose mission it is to manage regulated river systems, and consulting firms that provide technical support to these entities.

**Management of Regulated River Systems Curriculum – Boise Center**

FISH 415 Limnology (4 cr.)

Physical, chemical, and biological features of lakes and streams. Four 1-day field trips. (Fall only) Prereq: Stat 251 and For 221 or Biol 314

FISH 430 Riparian Ecology and Management (3 cr.)

Structure, function, and management of riparian ecosystems; interrelationships of terrestrial and aquatic components of riparian areas. 3 field trips. Special fee required. Prereq: For 221 or Biol 314

FISH 515 Large River Fisheries (2 cr.)

Management issues and problems in large river fisheries in North America and globally; importance of flood plains; ecological bases for management actions in large rivers; river fisheries in the context of multiple use of large rivers.

CE 421 Engineering Hydrology (3 cr.)

Same as BAE ID 451. Hydrologic design including: statistical methods, rainfall analysis and design storm development, frequency analysis, peak discharge estimation, hydrograph analysis and synthesis, flow routing, and risk analysis. Prereq: CE 325 or BAE 355

CE 428 Open Channel Hydraulics (3 cr.)

Hydraulics of uniform and varied flow in open channels with fixed and movable beds. Recommended Preparation: CE 322.

CE 504 Special Topics in River Restoration (3 cr., arranged) A faculty mentored course for independent study designed on an individual basis for each student.

CE 520 Fluid Dynamics (3 cr.)

Cr not granted for both ME 420 and ME 520. A second fluid dynamics course featuring vector calculus and integral and differential forms of the conservation laws. Topics include fluid properties, fluid statistics, inviscid flow; conservation of mass, momentum, and energy; and turbulence. Other topics may be covered. Additional projects/assignments reqd for grad cr. Prereq: Engr 335, Math 310, or Permission. This course is offered through Engineering Outreach, please contact for details.

CE 521 Sedimentation Engineering (3 cr.)

Intro to river morphology and channel responses; fluvial processes of erosion, entrainment, transportation, and deposition of sediment. Prereq: CE 428 or Permission

CE 526 Aquatic Habitat Modeling (3 cr.)

The course objective is to learn the underlying principles of all components required for aquatic habitat modeling, to be able to perform such projects in riverine ecosystems including project design, data collection, data analysis and interpretation of the results

and to learn the use of computational aquatic habitat models. Students will be working on their own modeling projects using the simulation model CASiMiR. Prereq: CE 322 and CE 325 or BAE 355; or Permission

CE 535 Fluvial Geomorphology (3 cr.)

Hydraulic and morphologic processes of rivers. Drainage network development, channel hydraulics and shear stress partitioning via boundary layer theory, hydraulic geometry and cross-sectional form, sediment transport and bed material sampling, reach-scale morphologies and processes from headwater streams to lowland rivers, physical processes of forest rivers, sediment budgets, and river valley evolution. Field exercises emphasize quantitative analysis of fluvial processes and channel form, acquisition of field skills (measuring hydraulic and geomorphic variables, topographic surveying), and scientific writing. Prereq: CE 428 or Permission

**C. Ecohydrology Science and Management.** Students trained in this PSM track will understand the interaction between the hydrological cycle and ecosystems, and be able to work at the interface between terrestrial and aquatic ecosystems. Students in this track will be trained for mid to upper level technical positions, and will be eligible for employment with consulting firms, federal and state agencies like the USDA and EPA, non-profit organizations, and tribal entities whose missions are to manage land and water resources at the landscape to regional scale. Graduate coursework will emphasize the mixed use of watershed landscapes and the coupling between human and natural systems.

#### **Ecohydrology Science and Management Curriculum**

BAE 450 Environmental Hydrology (3 cr.)

Carries no credit after BAE 355 or CE 325. The objective of this course is to provide a comprehensive understanding of the hydrologic processes associated with the environmental processes. Includes components of the hydrologic cycle, analysis of precipitation and run off, evapotranspiration, routing, peak flow, infiltration, soil and water relationships, snowmelt, and frequency analysis. Prereq: Math 170. This course is offered online every other spring.

BAE 552 Environmental Water Quality (2 cr or arranged) A faculty mentored course for independent study designed on an individual basis for each student.

REM 507 Landscape and Habitat Dynamics (3 cr.)

Students explore landscape change occurring a variety of spatial and temporal scales, including global change, succession, disturbance events, and change induced by humans. Via scientific readings, models and spatial analysis students will learn how to quantify landscape change and how a change in environmental conditions and disturbance regimes may affect the composition of landscapes, specifically plant and animal habitats. Recommended Preparation: courses in ecology, statistics, and GIS. Prereq: Permission

FOR 462 Watershed Science and Management (3 cr.)

Influence of land management practices on hydrologic processes, water quality, and riparian habitat w/emphasis on wildland watersheds. Recommended Preparation: Math 143 or 160, high school physics or Phys 100 or 111.

REM 440 Wildland Restoration Ecology (3 cr.)

Ecological principles and management practices involved in restoring and rehabilitating wildland ecosystems after disturbance or alteration to return damaged ecosystems to a productive and stable state. Recommended Preparation: a course in general ecology. This course is offered online every spring.

**REM 452 Western Wildland Landscapes (1 cr.)**

Survey of wildland plant communities of western North America, focusing on their natural history, including the effects of use by human beings, based on their physical, climatic, and biological characteristics. Recommended Preparation: REM 221 or For 221. Prereq: Geog 310

**FISH 415 Limnology (4 cr.)**

Physical, chemical, and biological features of lakes and streams. Prereq: Stat 251 and For 221 or Biol 314

**FISH 430 Riparian Ecology and Management (3 cr.)**

Structure, function, and management of riparian ecosystems; interrelationships of terrestrial and aquatic components of riparian areas. Special fee required. Prereq: For 221 or Biol 314

**FISH 514 Fish Population Ecology (2 cr.)**

Review of abiotic and biotic factors controlling or regulating fish population densities and critical review of relevant literature.

**FISH 515 Large River Fisheries (2 cr.)**

Management issues and problems in large river fisheries in North America and globally; importance of flood plains; ecological bases for management actions in large rivers; river fisheries in the context of multiple use of large rivers.

**FISH 540 Wetland Restoration (3 cr.)**

This web-based course contains modules covering wetland science, restoration ecology, freshwater restoration, coastal restoration, and monitoring/maintenance. The emphasis is on the science of wetland ecosystems and the applied ecology/practice of restoration, with additional consideration of cultural and socio-political contexts. Extensive readings, an assignment, and a study guide are required for each module. Students apply their learning in and contribute relevant professional experience to weekly online discussions. Students are also responsible for obtaining documentation of at least one wetland restoration site in their region and conducting a site visit in order to evaluate the success of the restoration project. Prereq: Biol 115 and 116; and For 221 or Biol 314 or Permission. This course is offered online every fall.

**GEOG 524 Hydrologic Applications of GIS and Remote Sensing (3 cr.)**

Concepts of area-based hydrologic modeling and assessment and the various types of spatially distributed information commonly used in these activities, such as topographic data, vegetation cover, soils and meteorologic data. Hands-on experience in manipulating these types of data sets for hydrologic applications. Recommended Preparation: Geog 385, For 462, BAE 355, CE 325 or Equivalent. This course is offered online every spring.

**HYDR 512 Environmental Hydrogeology (3 cr.)**

Methods of hydrogeologic site characterization for the delineation of environmental problems such as contaminated ground water plumes, and ground water dewatering for landslide remediation. For grad credit, students are required to complete an additional independent research paper/project. Prereq: Geol 309

### **Internships (3 credits)**

The PSM program has made contact with several industries and agencies who are the primary employers of our alumni MS graduates or who are significant employers in fields allied with natural resources and environmental science. A total of 12 organizations have written letters of commitment to the PSM and indicated that they are willing and able to accept PSM students for internship experiences. These include state and federal agencies including the National Park Service, the Bureau of Indian Affairs, the Rocky Mountain Research Station of the U. S. Forest Service, the Idaho Water Resource Board, and the Idaho Department of Environmental Quality. Private industry and non-governmental organizations that are willing to host our students include Simplot, CH2M Hill, Terra Graphics, the Palouse Clearwater Environmental Institute, the Nature Conservancy, and the Idaho Water Users Association. The Nez Perce tribal operations in forest and fisheries have agreed to host students.

Students in each track will be matched as closely as possible with an appropriate industry or agency for internship experience. Internships will be constructed in such a way as to provide students with a team-based, hands-on training experience that closely reflects the work of the industry or agency. Students will be required to establish learning goals and submit a midterm and final report to a supervising instructor during the term of the internship. A formal presentation will serve as a summary report to faculty and peers at the end of the internship. During summer 2010, the PSM program will expand the available internship possibilities to include additional organizations that typically hire professional workers in natural resources and environmental science.

In many cases there will be considerable flexibility within an agency or industry regarding the structure and content of the internship. Whenever possible, we will match Native students with internships available with the Nez Perce Tribe operations in forestry and fisheries management, or in an equivalent agency in their own tribe if such internships can be developed. Finally, in addition to external internships, we have considerable flexibility in providing internships through Sustainable Idaho, which functions as the outreach and engagement arm of the University of Idaho Sustainability Center. Sustainable Idaho routinely accepts contracts from industry (e.g., Boeing, Agribeeff, and Beef Northwest) to evaluate industry practices for carbon and energy lifecycle analyses and sustainability assessments. Students will be able to conduct their internships through these contracts while working under the supervision of the Director of Sustainable Idaho and the Director of Environmental Science.

### **Research Experience and Seminar (2 credits)**

The team-based research experience for PSM students will be developed at field and laboratory sites managed by faculty at the University of Idaho. As such, the research experience will generally not be included in the internships described above, although internships may include research activities as part of the ongoing work at the sponsoring organization. The research experience will be designed for each student entering the PSM program in collaboration with participating faculty who will incorporate these students into teams in their ongoing research programs. The student's advisor will help the student identify an appropriate research experience and ensure that it is integrated with the student's science track. The Environmental Science program and the University of Idaho Water Resources programs include faculty who have research programs that can provide a problem-focused research experience across the range of science tracks described below. Students will receive graduate credit for participating in a semester-long research experience that will include a weekly seminar class where interdisciplinary faculty will mentor students in interpretation and application of research results. The seminar component of the research experience will focus on the integration of the experience with each student's science curriculum. A final written report of publishable quality will be submitted to the student's advisor.

In compliance with our NSF Science Master's Program award, there are two goals for the team-based research aspect of the PSM training program. First, we intend for students to participate in the development of research programs that are intrinsically interdisciplinary in focus. They will work as part of a team that includes other graduate students and faculty who are working on different aspects of an interdisciplinary problem. Secondly, we intend for each PSM student to have autonomous responsibility for contributing to at least one aspect of the overarching research program. Faculty leading the research teams will be asked to explicitly identify components that will incorporate PSM students, and an advisor

will evaluate each student's proposed research experience to ensure that it is both supported by the student's science track and clearly identified with an independent part of an overall team-based research program. As part of the research experience, students will participate in a seminar class where interdisciplinary faculty will mentor students in the interpretation and reporting of research results.

There are at least three options for how PSM students can be included as part of a team of researchers. (1) There are several faculty members with active, interdisciplinary research programs in each of the three administrative units where PSM students will work on a science track. Typically, these labs involve several graduate students working on different theoretical and applied aspects of a research program. PSM students involved with these labs will develop projects that are consistent with their chosen science track. (2) The University of Idaho IGERT program (Evaluating resilience of ecological and social systems: a doctoral research and education program in Idaho and Costa Rica) is now forming its first entering class for fall 2010. Leadership of the IGERT program agreed to include PSM students in the Idaho-based interdisciplinary research teams (letter of commitment appended to proposal). (3) A PSM student may choose to design an interdisciplinary research experience in partnership with other PSM students. The Advisor will identify faculty from appropriate disciplines who can support the development of such a project, and each student on a team will be required to author a unique aspect of the project.

### **Performance Assessment**

In the near term, there are five mechanisms to ensure the quality of the PSM. These are:

(1) In fall 2010 we will apply for membership in the National Professional Masters of Science Association. Although this is the national professional organization for this type of program, this group has elected to not develop a licensing or credentialing standard because of the diverse array of PSM programs in existence and under development.

(2) The University of Idaho PSM will be certified as meeting the PSM requirements set forth by the Council of Graduate Schools (this application) before fall 2010. This will permit the program to use the PSM logo for recruitment, which indicates our compliance with the national standards for the PSM.

(3) Students admitted to the PSM program must have a B.S. in biological, environmental, or natural resource sciences, or fields closely related to these sciences with a 3.0 GPA (out of 4.0) or higher from an accredited university or college. Also appropriate are undergraduate degrees in Civil Engineering and Biological and Agricultural Engineering, depending on the interest area identified by the student. Closely related fields include botany, ecology, wildlife, fisheries, forestry, range science, and environmental sciences.

(4) The PSM program will support an external advisory board whose membership represents the agencies, industries, businesses, and non-governmental organizations that employ our graduates. Feedback from these groups will be used to refine the PSM program.

(5) Coursework in the PSM will be a unique mix of theory and applied science that is drawn from degree programs that are presently accredited and considered an integral part of the University.

In addition to the mechanisms listed above, ongoing assessment of the PSM program will focus on the skills that graduates bring to the workplace and employer satisfaction with employee productivity. It is our experience that few professional or academic graduate programs directly assess their effective delivery of skills; they often make the assumption that the career success of graduates in the marketplace will reflect the effectiveness of the program. The employers of traditional master's degree graduates often report that students require substantial retraining, and that students are frequently deficient in necessary communications skills (NPSMA, 2009). The PSM program at UI will employ ongoing assessment of student learning during training and subsequent surveys of employer and employee satisfaction with the effectiveness of our program. Learning outcome assessments will be developed during summer 2010, prior to the entry of the first class, and modified as appropriate during each subsequent summer.

**Annual assessment cycle.** The University of Idaho has recently become a leader in institutional assessment. UI employs a rigorous annual assessment and reporting procedure that is required of all undergraduate and graduate program administrators. Beginning in the fall and continuing through spring of each academic year, each program collects data on student comprehension of material based on standardized student learning outcomes. Standardized learning outcomes are intended to be direct measures of the basic skills that students should acquire during an academic year. Program faculty review outcomes early in the fall of the subsequent academic year. For the PSM program, special attention will be paid to the development of learning outcomes for the Transferable Skills courses and for the translational aspect of the curriculum. Indirect measures to be employed will include student focus groups and exit surveys. During the terminal capstone seminar course, a faculty committee will evaluate student assimilation of learning goals using learning outcome assessments that have been developed to reflect the goals for each science track.

**Post graduation assessment.** Beginning two years after graduation of the first cohort, we will conduct annual surveys of program graduates and their employers. Responses will be evaluated against the learning outcome assessments established for the specific goals of each science track. In some cases confidentiality will require that information gathered from employers be of a general nature rather than specific to particular employees. Based on reports from alumni and their employers, we will review and modify the Transferable Skills and science curricula as necessary to improve our delivery of skills. Additional data will be collected on placement, salaries, number of employers, and other demographic and economic measures of our graduates' success in the workforce.

#### **External Advisory Board**

The duties of an external advisory board would be to advise and assist the College of Graduate Studies in matters of mutual interest pertaining to the Professional Science Master's program regarding teaching, research, and service. The PSM Steering Committee will inform the Board of all significant developments in the conduct of the PSM. The board will consist of a chair and vice chair, both chosen from among the nonacademic leadership. The board's non-academic members will consist of up to 10 individuals representing the interests of industries, agencies, and business relevant to regional and national development of careers in the natural resources and environmental sciences. Academic members of the board shall consist of the Dean of the College of Graduate Studies and the Director of the Environmental Science program. The President of the University of Idaho will appoint additional academic members, including members from other academic institutions.

The PSM Steering Committee will coordinate at least one yearly face-to-face or electronic meeting with an External Advisory Board. Members of the board will serve for two years. Individual members of the Board will be available for consultation throughout their term of service. Membership from participating industries and agencies will help us design a program that addresses the needs of our stakeholders. The first meeting of the board will be during early August 2010.

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