

# NATURAL RESOURCES MANAGEMENT AND ENVIRONMENTAL SCIENCES

Baker Center for Sciences and Mathematics Bldg. (180), Room 209  
Phone: 805.756.2702; Fax: 805.756.1402  
<http://nres.calpoly.edu>

Department Head: Greg Brown

## Academic Programs

Program name	Program type
Environmental Earth and Soil Sciences	BS
Environmental Management and Protection	BS
Environmental Soil Science	Minor
Forestry and Natural Resources	BS
Forestry Sciences	MS
Indigenous Studies in Natural Resources and the Environment	Minor

The Natural Resources Management and Environmental Sciences department offers three undergraduate majors – Environmental Earth and Soil Sciences, Environmental Management and Projection, and Forestry and Natural Resources. Students have access to several thousand acres of agricultural, forest, and rangeland managed by the college. Students gain hands-on experience with equipment and techniques in common use by foresters, natural resources managers, soil scientists, agricultural scientists, geologists, and environmental scientists. The department is equipped for analysis of soil, plant, tree, rock, and water samples. Analytical methods available to students include inductively coupled plasma – atomic emission spectroscopy (ICP-AES), flame atomic absorption spectrometry (FL-AAS), high temperature combustion analysis of carbon, nitrogen, and sulfur, petrographic microscopy with digital image analysis, as well as a suite of geographic and geospatial analytical techniques and instrumentation.

The department maintains greenhouse research space with an outdoor erosion research facility, providing opportunities for students to assess erosion control practices used to protect and improve water quality. Additionally, the department operates state-of-the-art weather monitoring equipment on Cal Poly rangelands, providing data for a wide variety of interdisciplinary research projects.

## Experiential Learning

The Natural Resources Management and Environmental Sciences Department has a number of outdoor field sites where faculty and student learn-by-doing projects and research are conducted. Facilities sited at the Cal Poly campus include a Forestry Skills Center, computer labs, GIS laboratories, Coastal Resources Institute Research field lab, and several well-equipped greenhouses. Most importantly, the department plays a lead role in administering the Swanton Pacific Ranch and School Forest near Santa Cruz, California. This 3800-acre ranch includes redwood forests, salmonid-bearing streams, agricultural land, and many other ecosystems. The Swanton Pacific Ranch provides hands-on learning of active forest, ranch, agricultural, and watershed management activities. The management of these forest resources is internationally certified by the Forest Stewardship Council. Students make extensive use of these facilities. Significant field work and laboratory activities occur

in all undergraduate and graduate programs requiring field clothing and associated safety equipment.

In addition to these campus-based learning experiences, the department places great importance on work experience before graduation. Work experience validates the student's career goals, confirms the relevance of their classroom education, while offering a pathway to employment. Students can earn course credit through internship, supervisory courses, and/or for volunteer or paid work positions related to their major.

Students are encouraged to reinforce their education, develop professional contacts, and strengthen their career potential by participating in any of the following activities: the Environmental Sciences Club; the Soil Judging Team; Association of Environmental Professionals Student Chapter (AEP); Society of American Foresters Student Chapter (SAF); Logging Team; Student Association of Fire Ecology; and/or Xi Sigma Pi Forestry Honorary Society; attending international and national conferences; and internships and cooperative education programs with government and industry. Each of these opportunities, combined with a friendly, helpful atmosphere, provide students a college experience that is highly personal as well as rewarding. Students also are encouraged to investigate opportunities for international education. Please see the Cal Poly International Program (<http://catalog.calpoly.edu/academicsupportandcampuslife/academicservicesandprograms/calpolyinternationalcenter>) program section of this catalog. Significant field work and laboratory activities occur in all undergraduate and graduate programs requiring field clothing and associated safety equipment.

## Undergraduate Programs

### BS Environmental Earth and Soil Sciences

The BS in Environmental Earth and Soil Sciences provides a strong foundation for understanding and improving the utilization of land, water, and atmospheric resources. The program emphasizes a wide range of disciplines in natural resources and in the cultures that use and modify them. The core of the Environmental Earth and Soil Sciences curriculum is composed of geology, soil science, geography, and basic science courses and is strengthened by a diverse array of related topical and technical specialties, which include: climate change studies, environmental mitigation strategies, environmental policy and management, forest and environmental practices, geospatial technology, hydrology, soil geotechnical studies, sustainable agriculture, and urban forestry.

The Environmental Earth and Soil Sciences major provides detailed and thorough training in the natural and cultural processes that govern the relationship between humans and their habitats. The program also furnishes students with the marketable expertise to assess, manage, repair, and improve this fragile relationship while acquiring a well-rounded education in the natural sciences. In addition, majors can meet the educational requirements for professional certification in a number of areas (e.g. erosion and sediment control, hydrology, soil conservation, soil science) and find their training ideal for graduate school preparation in a number of related disciplines.

Due to the multidisciplinary nature of the Environmental Earth and Soil Sciences major, students have access to diverse faculty and laboratories in several colleges on campus. California's Central Coast offers a diverse environmental and cultural setting for real-world training and experiences in earth sciences.

Undergraduate students majoring in Environmental Earth and Soil Sciences earn the credentials for useful careers in resource assessment and administration. They graduate with a substantial and well rounded education in the natural sciences. Moreover, Environmental Earth and Soil Sciences graduates possess the understanding, flexibility, and tools to appreciate and adapt to a changing world and its employment opportunities.

In addition to the required major courses, students select courses from an expansive list of approved electives, or take a minor, or select one of the following concentrations.

## Concentrations

### Geology

Students learn the fundamentals of a broad variety of geologic subdisciplines, including mineralogy, petrology, seismology, stratigraphy, geochemistry, geomorphology and structural geology. Each of these fundamental subdisciplines are supported by curriculum that emphasizes methods of data collection, interpretation and professional communication of results. Upon completion of this concentration, students are able to critically evaluate geologic reports within the context of our evolving societal needs, and are prepared to pursue post graduate degrees in the geosciences and/or careers in the geotechnical industry.

### Hydrology

Students learn the fundamentals of a broad variety of hydrologic subdisciplines including vadose zone hydrology, groundwater hydrology, soil erosion control, water quality, and watershed management. Each of these fundamental subdisciplines are supported by curriculum that emphasizes methods of data collection and interpretation, and professional communication of results. Upon completion of this concentration, students will be qualified to work in a water-related position for Federal and State agencies, private companies, and environmental consulting firms. Completion of the Hydrology Concentration meets the course requirements of the U.S. Office of Personnel Management (OPM) for employment as a Hydrologist (GS 1315)

## BS Environmental Management and Protection

The BS in Environmental Management and Protection is an interdisciplinary course of study integrating the biophysical and social/economical/political sciences in natural resource management. The curriculum emphasizes management and protection of ecosystem structures and processes that sustain uses of environmental resources. The major provides students with the science and management background that, when properly integrated, can guide consumptive uses of resources in a sustainable manner for current and future generations.

Since environmental problems arise from human demands and stresses on the environment, solutions must focus on the human dimension of ecosystems. Thus, environmental management is the management of both people and resources to attain human goals while protecting environmental values in order to sustain natural systems.

Graduates are prepared for a broad range of professional careers in environmental assessment, impact analysis, project management, and impact mitigation monitoring.

Knowledge of the legal and regulatory environment is balanced with study of ecological and economic theories and practices to solving social conflicts over environmental uses and impacts.

The Environmental Management and Protection major is endorsed and supported by the California Association of Environmental Professionals (AEP), a professional association representing the full range of environmental professions in both private and public sectors.

In addition to the required major courses, students select courses from an expansive list of approved electives, or take a minor, or select one of the following concentrations.

## Concentrations

### Watershed Management and Hydrology

This concentration provides students a focused and encompassing program in watershed management, including a proficiency in watershed hydrology in forest ecosystems, Mediterranean ecosystems, rangeland hydrology, post-fire watershed evaluation, watershed and stream restoration, and urban/wildland hydrologic implications. Students pursuing this concentration can qualify as hydrologists under U.S. Government OPM guidelines (GS 1315).

### Wildlife Biology Concentration

This specialized course of study prepares students for wildlife biology certification and employment in the fish and wildlife areas of law enforcement, management, and production.

## BS Forestry and Natural Resources

The BS in Forestry and Natural Resources prepares students for careers in the protection and management of our forest and natural resources. Students may specialize in watershed management and hydrology, wildlife fire and fuels management, or wildlife biology. Optionally, students may select courses from approved electives that are categorized by career area.

Graduates qualify for such positions as: forester, environmental planner and assessor, natural resource manager, urban forester, park administrator, watershed manager, hydrologist, fire and fuels manager, and many other related environmental career areas. Cal Poly graduates are employed throughout the world: establishing, managing and sustaining forests and urban wildland areas; providing opportunities for a full range of uses; teaching; extension; research; and protecting and managing the environment.

Students can complete an internship equivalent to half-time work. Paid internships are available at Swanton Pacific Ranch, or the student may choose to pursue a seasonal job, volunteer work, or a cooperative education program. Work experience for academic credit must be documented by a work supervisor and approved by the student's academic advisor.

Students are required to purchase 8-inch+ high field boots, hard-hats (OSHA approved), hand calculator capable of linear regression, 10X hand lens, and an engineers scale ruler prior to taking 200- or 300-level major courses. Students are strongly encouraged to purchase a laptop before beginning 300-level major courses.

The Society of American Foresters accredits the Forestry and Natural Resources program. Also, the U.S. Office of Personnel Management (OPM) recognizes employment as a forester with the Federal Government upon graduation.

In addition to the required major courses, students select courses from an expansive list of approved electives, or take a minor, or select one of the following concentrations.

## Concentrations

### Watershed Management and Hydrology

This concentration provides students a focused and encompassing program in watershed management, including a proficiency in watershed hydrology in forest ecosystems, Mediterranean ecosystems, rangeland hydrology, post-fire watershed evaluation, watershed and stream restoration, and urban/wildland hydrologic implications. Students pursuing this concentration can qualify as hydrologists under U.S. Government OPM guidelines (GS 1315).

### Wildlife Biology Concentration

This specialized course of study prepares students for wildlife biology certification and employment in the fish and wildlife areas of law enforcement, management, and production.

### Wildland Fire and Fuels Management

Focused study on the management of fire and fuels on landscapes ranging from the wildlands to the urban interface. Emphasis on the technologies, issues and policies in managing fire, using fire as an ecosystem management tool and social and economic impacts of fire.

## Environmental Soil Science Minor

Natural Resources Management & Environmental Sciences Department  
Bldg. 180, Room 515  
Phone: 805.756.1691  
Email: [cappel@calpoly.edu](mailto:cappel@calpoly.edu)

Coordinator: Dr. Chip Appel

Students completing the minor gain skills in understanding and assessing the science and management of soils. Because soils are necessary for sustaining all living organisms, this minor is relevant to all students. Students will gain practical, meaningful, and hands-on experiences in both environmental and agricultural applications of the world's finite soil resources. This minor allows students the opportunity to relate their interests to the ecology, classification, mineralogy, chemistry, physics, and fertility/health parameters of soils.

**Minor Requirements** (<http://catalog.calpoly.edu/collegesandprograms/collegeofagriculturefoodenvironmentalsciences/naturalresourcesmanagementenvironmentalsciences/environmentalsoftscienceminor>)

## Indigenous Studies in Natural Resources and the Environment Minor

Natural Resources Management & Environmental Resources Department  
Bldg. 11, Room 217  
Phone: 805.756.2702

Coordinators:

Priya Verma, Natural Resources Management and Environmental Sciences  
805.756.2773; [pverma@calpoly.edu](mailto:pverma@calpoly.edu)

Kate Martin, Ethnic Studies  
805.756.2827; [kmartin@calpoly.edu](mailto:kmartin@calpoly.edu)

This interdisciplinary minor is sponsored by the Natural Resources Management and Environmental Sciences department in the College of Agriculture, Food and Environmental Sciences and the Ethnic Studies department in the College of Liberal Arts. The minor consists of innovative coursework and provides research opportunities that incorporate indigenous ecological knowledge in areas such as conservation biology, environmental biology, wildlife and fisheries sciences, forest resources management, environmental studies and environmental sciences: as well as agriculture, ethnic studies, geography, biology, and recreation, parks and tourism.

The Indigenous Studies in Natural Resources Management and the Environment minor aims to bring together principles of both Indigenous knowledge and Western science. Instruction in these two approaches will provide students with the necessary skills, practical research methods and critical thinking abilities for addressing complex environmental and health issues, and resource management problems facing both Indigenous and non-Indigenous communities around the world. Contact the minor coordinator for more details.

## Water Science

An interdisciplinary minor sponsored by the departments of BioResource and Agricultural Engineering, and Natural Resources Management and Environmental Sciences, that emphasizes one of three areas of study: irrigation, water policy, or watershed management. For more information, see the College of Agriculture, Food and Environmental Sciences (<http://catalog.calpoly.edu/collegesandprograms/collegeofagriculturefoodenvironmentalsciences>) section.

The department also participates in offering minors in Land Rehabilitation and Restoration Ecology, Rangeland Resources, Anthropology-Geography, and Geology. Please see College of Agriculture, Food and Environmental Sciences (<http://catalog.calpoly.edu/collegesandprograms/collegeofagriculturefoodenvironmentalsciences>), College of Liberal Arts (<http://catalog.calpoly.edu/collegesandprograms/collegeofliberalarts>) or the Physics (<http://catalog.calpoly.edu/collegesandprograms/collegeofsciencemathematics/physics>) page for additional information.

## Additional Minors

### Geographic Information Systems for Agriculture

An interdisciplinary minor sponsored by the departments of BioResource and Agricultural Engineering, Natural Resources Management and Environmental Sciences, and Horticulture and Crop Science. For more information, see the College of Agriculture, Food and Environmental Sciences (<http://catalog.calpoly.edu/collegesandprograms/collegeofagriculturefoodenvironmentalsciences>) section.

## Graduate Program MS Forestry Sciences

The Master of Science degree program in Forestry Sciences offers advanced study in a range of forest science sub-disciplines or in preparation for study leading to the Ph.D. degree.

### Areas of Emphasis

Students may select one of the following emphasis areas that incorporate specific scientific and professional disciplines:

**Forest Resource Sciences**

Offers advanced preparation in the forestry disciplines of watershed management and hydrology, biometrics, forest health, forest management, fire science, and urban and community forestry.

**Environmental Management**

Offers advanced preparation in the disciplines that comprise the field of environmental management, including environmental assessment, planning, mitigation and policy formation relating to a wide range of landscapes and ecosystems.

**Prerequisites**

For consideration as a graduate student, an applicant will have completed a bachelor's degree in forestry at an accredited forestry four-year college or a related B.S. degree area such as environmental sciences with a minimum grade point average of 2.75 in the last 90-quarter units. An applicant who meets these standards but lacks prerequisite coursework may be admitted as a conditionally classified student and must make up any deficiencies before advancement to classified graduate standing.

**Program of Study**

Graduate students must file a formal study plan with their major professor, graduate committee, department, college and university graduate studies office no later than the end of the quarter in which the 12th unit of approved courses is completed.

The formal program of study must include a minimum of 45 units (at least 23 of which must be at the 500 level). The broad curriculum for the Master of Science degree in Forestry Sciences is:

- a) 20 units in the required core;
- b) 25 units in area of emphasis approved by the student's major professor and department head;
- c) completion of a thesis or scholarly project, and an oral and written examination. At the discretion of the graduate committee, the written examination may consist of submitting an article for publication to a referred journal.

**ERSC Courses****ERSC 140. Careers in Natural Resources Management and Environmental Sciences. 1 unit**

CR/NC

Term Typically Offered: F

Analysis and development of career goals in natural resources and environmental sciences. Acquainting students with potential career options and preparation of academic plans for the majors in the Natural Resources Management and Environmental Sciences Department. Credit/No Credit grading. 1 activity. Crosslisted as ERSC/NR 140.

**ERSC 144. Introduction to Earth Science. 4 units**

Term Typically Offered: F

Survey of fundamental processes of Earth science. Application of systems thinking to understanding the dynamic interactions among geological, geographic, soils and human factors in shaping the Earth. 3 lectures, 1 activity.

**ERSC 200. Special Problems for Undergraduates. 1-2 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of instructor.

Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 12 units, with a maximum of 2 units per quarter. Crosslisted as ERSC/SS 200.

**ERSC 223. Rocks and Minerals. 4 units**

Term Typically Offered: W

Prerequisite: SS 121, CHEM 111 or CHEM 127.

Origin, composition, identification and weathering of rocks, minerals, and clays important in the development of soils. Parent materials as related to the nature and properties of soils. 3 lectures, 1 laboratory.

**ERSC 250. Physical Geography. 4 units**

Term Typically Offered: F, W

Addresses the origins and patterns of the earth's diverse assemblage of climates, landforms, biota and soils. A major focus on relationship between human cultures and these earthly environments. 4 lectures. Crosslisted as ERSC/GEOG 250.

**ERSC 270. Selected Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of selected topics. The Schedule of Classes will list title selected. Total credit limited to 12 units. 1 to 4 lectures. Crosslisted as ERSC/SS 270.

**ERSC 301. Earth Sciences/Soils Science Practicum. 1-2 units**

CR/NC

Term Typically Offered: TBD

Prerequisite: SS 110 or SS 121.

Supervised practice in technical, educational, professional, and operational applications related to earth sciences or soil science. Students participate in faculty-supervised group or individual activities that support educational and professional goals. Credit/No Credit grading only. Total credit limited to 12 units. 1-2 activities. Crosslisted as ERSC/SS 301.

**ERSC 303. Soil Erosion and Water Conservation. 4 units**

Term Typically Offered: F

Prerequisite: LA/NR 218 or GEOG 318; and SS 121. Replaces ERSC 202.

Evaluation of soil and water conservation and best management practices for agriculture, urban, riparian, and rangelands. Study of process and control of soil erosion, water quality, and stormwater. Development of an erosion and sediment control plan or farm water quality plan to meet regulatory requirements. 3 lectures, 1 activity.

**ERSC 323. Geomorphology. 4 units**

Term Typically Offered: F, SP

Prerequisite: SS 121 and GEOL 201.

Recognizing and identifying major landforms and their components by interpretation of aerial photographs and topographic maps, and observations. Emphasis on analyzing common landforms in the western United States for application in soil science, physical geography, hydrology, and geology. 2 lectures, 1 laboratory, 1 activity.

**ERSC 325. Climate and Humanity. 4 units**

Term Typically Offered: TBD

Prerequisite: Junior standing.

Geographic perspective on the interrelationships between climate and human cultures. Effects of people on climate and the influence of climate and weather upon human activities and behavior. Focus on global human conditions which are responsible for the alteration of climate and in turn are vulnerable to climate change. 4 lectures. Crosslisted as ERSC/GEOG 325.

**ERSC 333. Human Impact on the Earth. 4 units**

Term Typically Offered: TBD

Prerequisite: Junior standing.

Global assessment of the impact of humans on the earth's vegetation, animals, soil, water and atmosphere. Emphasis on problems stemming from the interactions of human attitudes, technologies, and population with natural resources. 4 lectures. Crosslisted as ERSC/GEOG 333.

**ERSC 335. Soil, Water, and Civilization. 4 units**

GE Area F

Term Typically Offered: W, SU

Prerequisite: Junior standing and completion of GE Area B.

Explore past civilizations and how management of soil, water, and other natural resources allowed them to flourish, decline, or fail. Sustainability of natural resource use in modern/future societies. Issues include sustainability, agricultural practices, deforestation, water quality, and land management. 4 lectures. Fulfills GE Area F.

**ERSC 339. Internship in Environmental Earth and Soil Sciences. 1-12 units**

CR/NC

Term Typically Offered: F, W, SP

Prerequisite: Consent of internship instructor.

Selected students will spend up to 12 weeks with an approved firm or agency engaged in work and study related to their major. A detailed written proposal and written interim and final reports required. One unit of credit may be allowed for each full week of internship. Credit/No Credit grading. Crosslisted as ERSC/SS 339.

**ERSC 363. Undergraduate Seminar. 2 units**

Term Typically Offered: F, W, SP

Prerequisite: Junior standing.

Review of current research, experiments, and problems related to the student's major field of interest. Presentation of reports on problems or research activities in preparation for the senior project. Introduction to professional practices within a student's major field of interest. 2 seminars.

**ERSC 400. Special Problems for Advanced Undergraduates. 1-4 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of instructor.

Individual investigation, research, studies or surveys of selected problems. Total credit limited to 12 units. Crosslisted as ERSC/SS 400.

**ERSC 401. Field-Geology Methods. 4 units**

Term Typically Offered: W

Prerequisite: GEOL 102 or GEOL 201, GEOL 241, GEOL 415, ERSC 223, ERSC 323.

Collecting and interpreting field-geologic data. Description of sedimentary rocks and construction of stratigraphic columns. Mapping geologic structures in the field. Surficial geologic stratigraphy and surficial geologic mapping. Understanding geologic processes through field study. Communicating results of field study. 1 lecture, 3 activities. Crosslisted as ERSC/GEOL 401.

**ERSC 402. Geologic Mapping. 4 units**

Term Typically Offered: SP

Prerequisite: ERSC/GEOL 401.

Bedrock geologic mapping on topographic maps and aerial photos. Surficial geologic mapping on topographic maps and aerial photos. Correlating and defining surficial geologic map units on the basis of soil development. Understanding landscape evolution using soil development 4 activities. Crosslisted as ERSC/GEOL 402.

**ERSC 414. Global and Regional Climatology. 4 units**

Term Typically Offered: TBD

Prerequisite: Junior standing.

The earth's pattern of climates and the physical processes that account for them. Focus on interrelationships between climate and the physical/biological and cultural environments. Special emphasis on modern climate changes and their consequences. 3 lectures, 1 laboratory. Crosslisted as ERSC/GEOG 414.

**ERSC 415. Applied Meteorology and Climatology. 4 units**

Term Typically Offered: TBD

Prerequisite: ERSC/GEOG 250.

Physical processes in the atmosphere that determine regional weather, climate and climate variability. Surface and satellite systems for weather observation, and weather/climate modeling. Dynamics of weather systems, including thunderstorms and hurricanes. Emphases on weather/climate affecting agriculture and other human activities. 3 lectures, 1 activity. Crosslisted as ERSC/GEOG 415.

**ERSC 470. Selected Advanced Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 12 units. 1 to 4 lectures. Crosslisted as ERSC/SS 470.

**ERSC 471. Selected Advanced Laboratory. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 laboratories. Crosslisted as ERSC/SS 471.

**ERSC 476. Senior Project - Advanced Internship Experience in Environmental Science/Management. 3 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: Completion of GE Area A with a grade of C- or better; and ERSC 363 or NR 306 or NR 326.

Independent internship experience conducted under faculty supervision focusing on a discipline area of environmental science/management. Completion of a project as a component of their internship. Satisfies the senior project requirement. Minimum 90 hours required. Crosslisted as ERSC/NR 476.

**ERSC 477. Senior Project - Research Experience in Environmental Science. 3 units**

Term Typically Offered: W

Prerequisite: Completion of GE Area A with a grade of C- or better; and ERSC 363 or NR 306 or NR 326.

Guided research experience in a specific area of environmental science. Implementation of materials and methods. Collection, analysis and interpretation of data. Completion of formal written report. Satisfies senior project requirement. 1 lecture, 2 laboratories. Crosslisted as ERSC/NR 477.

**ERSC 478. Senior Project - Current Topics in Environmental Science/Management. 3 units**

Term Typically Offered: F, W, SP

Prerequisite: Completion of GE Area A with a grade of C- or better; and ERSC 363 or NR 306 or NR 326.

Critical evaluation and formal presentation of current issues in environmental science/management. Evaluation of current topics, analysis of supporting evidence, and synthesis and presentation of resulting perspectives on different approaches to current challenges in environmental science/management. Satisfies the senior project requirement. 3 lectures. Crosslisted as ERSC/NR 478.

**ERSC 479. Senior Project - Independent Study. 3 units**

Term Typically Offered: F, W, SP

Prerequisite: Completion of GE Area A with a grade of C- or better; ERSC 363 or NR 306 or NR 326; and consent of instructor.

Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 90 hours total time. Crosslisted as ERSC/NR 479.

**ERSC 544. Earth Sciences for Educators. 3 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing and consent of instructor.

An interdisciplinary earth sciences course which emphasizes the interactions of multiple systems of air, water, land, life, and human society. Designed for teachers and students seeking teaching credential. Incorporates scientific theory, learning resources, and applications in the field. 3 lectures. Not open to students in Soil Science specialization under MS Agriculture.

**ERSC 570. Selected Topics in Earth Science. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing or consent of instructor.

Directed group study of selected topics for advanced students. The Schedule of Classes will list topic selected. Total credit limited to 12 units. 1 to 4 seminars.

**ERSC 571. Selected Advanced Laboratory. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing or consent of instructor.

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 laboratories.

**NR Courses****NR 140. Careers in Natural Resources Management and Environmental Sciences. 1 unit**

CR/NC

Term Typically Offered: F

Analysis and development of career goals in natural resources and environmental sciences. Acquainting students with potential career options and preparation of academic plans for the majors in the Natural Resources Management and Environmental Sciences Department. Credit/No Credit grading. 1 activity. Crosslisted as ERSC/NR 140.

**NR 141. Introduction to Forest Ecosystem Management. 3 units**

Term Typically Offered: F

Fundamentals of forestry including basic silviculture, forest protection, measurement and policy. Integrated resource management of forest lands for water production, forage, recreation, wildlife, and timber. 3 lectures.

**NR 142. Environmental Management. 3 units**

Term Typically Offered: F

Recommended: NR 140.

Environmental management as a process within functioning societies seeking a harmonious balance between human activities and intrinsic behavior of the natural environment. Major components of the natural environment and the political and social activities that impact that environment. 3 lectures.

**NR 203. Resource Law Enforcement. 3 units**

Term Typically Offered: W

Law enforcement applied to natural resource conservation on public and private lands. Examination of state and federal laws related to fish and wildlife management. Problems associated with implementation of resource laws examined. 3 lectures. Crosslisted as NR/RPTA 203.

**NR 204. Wildland Fire Control. 3 units**

Term Typically Offered: SP

Fire control techniques used on various wildland fuels. Elementary fire physics, fuels, weather, fire behavior, tactics and fire suppression techniques, line construction, 'mop-up', fire line safety, air operations and fire organization. Meets basic wildland fire fighter certification requirements for the USDA Forest Service. Partially meets California Department of Forestry Firefighter I requirements. 2 lectures, 1 laboratory.

**NR 208. Dendrology. 4 units**

Term Typically Offered: F, W, SP  
Recommended: BOT 121.

Identification, classification, silvical characteristics, distribution, environmental requirements and economic importance of woody plants in shrub, woodland, and forest ecosystems of the United States. Emphasis on species located in the Pacific Coastal, Sierran, and Cascade ecosystems. 2 lectures, 2 laboratories.

**NR 215. Land and Resource Measurements. 1 unit**

Term Typically Offered: F, W, SP

Introduction to land and resource measurement technology and methods - field instruments, property description, map and photograph reconciliation, data accuracy and precision. Trigonometric functions as applied to natural resources applications. Field trips required. 1 laboratory.

**NR 218. Applications in GIS. 3 units**

Term Typically Offered: F,W,SP,SU

ARC/INFO and ArcView Geographic Information System (GIS) computer software to explore environmental, natural resource, social and economic issues using spatial data. Develop and apply data base and software management competencies. 1 lecture, 2 laboratories. Crosslisted as LA/NR 218.

**NR 247. Forest Surveying. 2 units**

Term Typically Offered: F, W, SP  
Prerequisite: NR 215.

Use and care of tapes, staff compass, abney levels, total stations, and GPS receivers. Keeping field notes, measurements by tape. Closed and open traverse by compass and total stations. Turning angles and determining directions of lines. Map reading and public land description. GPS measurements. Weekend field trips required. 1 lecture, 1 laboratory. Crosslisted as BRAE/NR 247.

**NR 260. Forest Practices and Environmental Protection. 4 units**

Term Typically Offered: SP  
Recommended: NR 141 and NR 215.

Relationships between forest ecosystem management, forest practices, harvesting methods, timber harvest planning, components of forest harvesting, harvesting effects; cost analysis of harvesting methods; safety management; value-added forest utilization; environmental protection; and road location. Overnight or weekend field trips required. 3 lectures, 1 laboratory.

**NR 270. Selected Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Open to undergraduate students and consent of instructor.

Directed group study of selected topics. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 lectures.

**NR 290. Intercollegiate Forestry Activities. 1 unit**

CR/NC

Term Typically Offered: F, W, SP

Prerequisite: Enrollment limited to those qualified to compete in intercollegiate forestry activities and consent of instructor.

Beginning through advanced skills in the event areas of college forestry activities. Instruction in use of specialized equipment and safety. Minimum of 4 hours of laboratory per week. Total credit limited to 18 units. Credit/No Credit grading only.

**NR 306. Natural Resource Ecology and Habitat Management. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: Completion of GE Areas B2 and B4.

Resource ecology and management implications in the major ecosystems of North America. Importance of maintaining the natural dynamics of energy flow and nutrient cycles at the community and ecosystem level to sustain uses and values. Humanity's role as a principal factor of change of the resources in natural systems. 3 lectures, 1 laboratory.

**NR 307. Fire Ecology. 3 units**

Term Typically Offered: SP

Prerequisite: Completion of GE Areas B2 and B4.

Effects of wildland fires on shrub, woodland, and forest environments to include fuels, plants, soil, water, wildlife, and air. Emphasis on western U.S. forest and shrub ecosystems. 2 lectures, 1 laboratory.

**NR 308. Fire and Society. 4 units**

GE Area D5

Term Typically Offered: F, W, SP

Prerequisite: Junior standing; completion of GE Area A3 with a grade of C- or better; and one lower division course in GE Area D.

Prehistorical and historical record of human use of and attitude toward fire. Mythology and religion of fire. Traditional, cultural and ethnic variations and their influence on modern U.S. institutions involved in managing fire. 3 lectures, 1 activity. Crosslisted as ES/NR 308. Fulfills GE D5.

**NR 312. Technology of Wildland Fire Management. 4 units**

GE Area F

Term Typically Offered: F, W, SP

Prerequisite: Junior standing and completion of GE Area B2 or B3.

Models and technology to solve complex land management problems. Historic, current and future perspectives of wildland fire in California. Sustainability and ecosystem health. Assumptions and limitations of fire behavior and suppression models. 3 lectures, 1 activity. Fulfills GE Area F.

**NR 314. Environmental Life-Cycle Analysis. 4 units**

Term Typically Offered: W, SP

Prerequisite: NR 306.

Estimation and assessment of environmental impacts of human activity and product development using life-cycle analysis methodology; organization and presentation of modeling results. 3 lectures, 1 laboratory.

**NR 315. Measurements and Sampling in Forested Environments. 4 units**

Term Typically Offered: W, SP

Prerequisite: BRAE 239 or BRAE/NR 247; and STAT 217 or STAT 218.

Recommended: MATH 161 or MATH 221 or equivalent.

Principles and methods of sampling and measurement for forest and natural resource quantities and qualities. Modeling and estimation for tree volumes, stand structure and composition, and related forest vegetation. Applications in sampling, statistical and inventory techniques. 2 lectures, 2 laboratories. Overnight, weekend field laboratories required.

**NR 317. The World of Spatial Data and Geographic Information Technology. 4 units**

GE Area F

Term Typically Offered: TBD

Prerequisite: Junior standing and completion of GE Area B2.

Basic foundation for understanding the world through geographic information and tools available to utilize spatial data. Application of Geographic Information Systems (GIS) and related technologies, including their scientific basis of operation. Not open to students with credit in LA/NR 218. 3 lectures, 1 activity. Crosslisted as LA/NR 317. Fulfills GE Area F.

**NR 320. Watershed Processes and Management. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: NR/LA 218 and SS 121. Recommended: NR 306.

Introduction, analysis, and measurement of watershed processes of precipitation, evapotranspiration, streamflow, stream channels, erosion, and riparian functions. Watershed management toward aquatic habitat and water quality goals. Weekend field trip required. 3 lectures, 1 laboratory.

**NR 321. Water Systems Technology, Issues and Impacts. 4 units**

GE Area F

Term Typically Offered: TBD

Prerequisite: Junior standing and completion of GE Area B2.

Sustainable strategies and technologies to enhance freshwater supplies and marine habitats. Systems treated include artificial wetlands, stormwater, drinking water, agricultural and industrial waste water. 3 lectures, 1 activity. Fulfills GE Area F.

**NR 323. Human Dimensions in Natural Resources Management. 4 units**

GE Area D5

Term Typically Offered: W, SP

Prerequisite: Junior standing; completion of GE Area A3 with a grade of C- or better; and GE Area D1.

Social, economic, political and ecological conditions and institutions that influence decisions affecting the environment; examination of human-caused environmental impacts and how they in turn influence social institutions. 4 lectures. Fulfills GE D5 except for Forestry and Natural Resources majors.

**NR 324. Social Dimensions of Sustainable Food and Fiber Systems. 4 units**

GE Area D5

Term Typically Offered: W

Prerequisite: Completion of GE Area A with a grade of C- or better; completion of 2 lower division courses in GE Area D; and junior standing.

Historical, political, socio-economic, and cultural dimensions of sustainable food and fiber systems. Overview of frameworks used for understanding agro-ecological sustainability with an emphasis on human elements. Exploration of core sustainability concepts, practices, and goals through case studies. 4 lectures. Fulfills GE D5 except for Environmental Management and Protection majors.

**NR 326. Natural Resources Economics and Valuation. 4 units**

Term Typically Offered: F, W

Prerequisite: MATH 161 or MATH 221 or equivalent. Recommended: GE Area D2 (ECON 201 recommended), AGB 212.

Theory of efficient use of renewable and nonrenewable natural resources, including methods for attaching value to marketable and non-market natural resources. Environmental economic theories and techniques to address allocation of water, timber, wildlife/fisheries, open space, and recreation. 3 lectures, 1 activity.

**NR 335. Conflict Management in Natural Resources. 4 units**

Term Typically Offered: F, W

Prerequisite: NR 141 or NR 142. Recommended: PSY 201 or PSY 202.

Application of behavioral science principles and techniques in the management of natural resource systems. Management of internal and external human resource issues and concerns in natural resources organizations is emphasized. 3 lectures, 1 laboratory.

**NR 339. Internship in Forest and Natural Resources. 1-12 units**

CR/NC

Term Typically Offered: F,W,SP,SU

Prerequisite: Consent of instructor.

Selected students will spend up to 12 weeks with an approved firm or agency engaged in forest or natural resources management. Applying and developing managerial skills and abilities. One unit of credit may be allowed for each full week of completed and reported internship. Credit/No Credit grading.

**NR 340. Wildland Fire Management. 3 units**

Term Typically Offered: F

Prerequisite: NR 204.

Wildland fuels, fire weather, and fire danger ratings in chaparral, grassland, and forested areas. Advanced modeling of surface and crown fire behavior. Fire management strategies and implications, policies and objectives of fire management organizations. Saturday field trips may be required. 3 lectures.

**NR 350. Urban Forestry. 3 units**

Term Typically Offered: TBD

Prerequisite: NR 208.

Establishment and management of municipal forests, wildland-urban interface, wildlife habitat, and pollution abatement. Management of forest areas requiring special attention because of heavy recreational use, fire hazard, watershed, and societal values. Full-day field trips may be required. 2 lectures, 1 laboratory.



**NR 351. Introduction to Emergency Management in California. 3 units**

Term Typically Offered: TBD

Prerequisite: Completion of GE Area B3 or D.

Emergency management emphasizing the Standardized Emergency Management System (SEMS) and Emergency Operations Center (EOC) operations. Earthquake hazard used as the case to explore potential wide geographic impacts, multiple secondary hazards, and multidisciplinary problem-solving methods in natural disasters faced by local governments and communities. 2 lectures, 1 activity. Crosslisted as CRP/NR 351.

**NR 360. Ethnicity and the Land. 4 units**

GE Area C4; USCP

Term Typically Offered: F, W, SP

Prerequisite: Junior standing; completion of GE Area A with a grade of C- or better; and one lower division course in Area C. Recommended: One lower division Ethnic Studies course and an introductory natural resources course.

Comparative study of how race and culture shape landscapes, and how social hierarchies allocate the use of natural resources and the burdens of environmental pollution. 4 lectures. Crosslisted as ES/NR 360. Fulfills GE C4 and USCP.

**NR 365. Silviculture and Vegetation Management. 4 units**

Term Typically Offered: F, SP

Prerequisite: NR 208 and NR 315. Corequisite: NR 260 and NR 306.

Applied forest ecology focusing on development of prescriptions for achieving diverse forest ecosystem management objectives. Topics include natural stand dynamics, traditional/contemporary silvicultural systems, forest health assessments/diagnoses, emulating natural disturbances, and managing ecosystem services. Overnight and/or weekend field trips required. 2 lectures, 2 laboratories.

**NR 400. Special Problems for Advanced Undergraduates. 1-4 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of instructor.

Individual investigation, research, studies or surveys of selected problems. Total credit limited to 12 units.

**NR 401. Disaster Recovery. 3 units**

Term Typically Offered: TBD

Prerequisite: CRP/NR 351.

Strategies and procedures for public sector management of recovery from disasters. Understanding the role of, and relationship between, federal, state and local agencies to provide assistance to individuals and communities in the post-disaster environment. Issues in the recovery process. 2 lectures, 1 activity. Crosslisted as CRP/NR 401.

**NR 402. Forest Health. 4 units**

Term Typically Offered: W

Prerequisite: NR 208, and NR 306 or BIO 325, or consent of instructor.

Impact and losses to forested areas caused by physical and biotic agents (such as insects and diseases) other than fire; relation of direct and indirect control practices to forest management. Saturday field trips required. 3 lectures, 1 laboratory.

**NR 404. Environmental Law. 3 units**

Term Typically Offered: F, W

Prerequisite: Junior standing.

Detailed examination of the law governing use and protection of natural resources with focus on the legal institutions entrusted with the public duty of protecting the environment. 3 lectures. Crosslisted as CRP/NR 404.

**NR 406. Indigenous Peoples and International Law and Policy. 4 units**

Term Typically Offered: W

Prerequisite: ES 241; and NR 141 or NR 142; and junior standing required.

Interdisciplinary examination of the evolution of international law effecting indigenous peoples in the U.S. and in the Americas. Development of international legal and sociological norms and their impact on human rights of indigenous peoples with particular attention to environmental issues. 4 lectures. Crosslisted as ES/NR 406.

**NR 408. Water Resource Law and Policy. 3 units**

Term Typically Offered: SP

Prerequisite: Junior standing.

Detailed examination of the various legal systems of water use, regulation and management in California and the United States. Discussion on the key concepts and principles of state, federal and interstate water quantity and quality control; focusing on issues and problems, why conflicts occur and how solutions evolve. 3 lectures. Crosslisted as CRP/NR 408.

**NR 412. Senior Assessment Project. 3 units**

Term Typically Offered: F, SP

Prerequisite: NR 326 and completion of GE Area A3 with a grade of C- or better.

Principles and practices of integrated sampling and inventory of natural resource values in terrestrial ecosystems, culminating in a student project report. 2 lectures, 1 laboratory.

**NR 414. Sustainable Forest Management. 4 units**

Term Typically Offered: W

Prerequisite: NR 326, NR 365.

Biophysical, economic, social and political influences on optimal forest management for purposes of providing sustained yields of goods and services. Growth and yield modeling; forest investment analysis; sustainable forest production; harvest schedule modeling. Day field trip required. 3 lectures, 1 laboratory.

**NR 416. Environmental Impact Analysis and Management. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: BIO 263 or NR 306.

National Environmental Policy and California Environmental Quality Acts as applied to environmental and natural resource management problems and projects. Intent, purpose and history of the laws; differences between laws identified. Request for proposals and preparation of environmental assessment documents covered. 3 lectures, 1 laboratory.

**NR 418. Applied GIS. 3 units**

Term Typically Offered: F, SP  
Prerequisite: NR/LA 218.

Acquisition, organization and analysis of spatial data from diverse sources using Geographic Information System (GIS) software. GIS modeling applications and validation techniques used in development and preparation of client-driven projects. 1 lecture, 2 activities.

**NR 420. Watershed Assessment and Protection. 4 units**

Term Typically Offered: W  
Prerequisite: NR 320; or graduate standing.

Analysis of streamflow, peak flows, and land management effects using established techniques and hydrologic models. Fluvial processes, sediment transport, and channel restoration techniques. Assessment and restoration of watersheds toward protection of aquatic and public resources. Weekend field trips required. 3 lectures, 1 laboratory.

**NR 421. Wetlands. 4 units**

Term Typically Offered: W  
Prerequisite: BOT 121 or BIO 162, CHEM 111 or CHEM 127, and SS 121 or SS 131. Recommended: one of the following: BIO 327, BOT 313, BOT 326, MSCI 328 or NR 306.

The formation, characteristics, and functions of wetlands. Genesis of hydric soils. Plant adaptations to saturated soils. Wetlands as wildlife habitat. Policies and social issues associated with wetlands. The procedures of wetland delineations. 3 lectures, 1 laboratory. Crosslisted as BIO/NR/SS 421.

**NR 425. Applied Resource Analysis and Assessment. 4 units**

Term Typically Offered: F, W, SP  
Prerequisite: NR 416.

Environmental impacts in responses to resource management, projects, programs and activities. Preparation, implementation, and coordination of environmental plans. Criteria for measurements, interpretation, and evaluation. Resource inventories, analysis, evaluation, synthesis, environmental assessment writing and preparation. 3 lectures, 1 laboratory.

**NR 434. Wood Properties, Products and Sustainable Uses. 4 units**

Term Typically Offered: TBD  
Prerequisite: Completion of GE Area B.

Principles of wood properties, green building practices, sustainable and efficient use of renewable wood resources including methods for using wood as an energy source. Field trips required. 3 lectures, 1 laboratory.

**NR 435. Environmental Policy Analysis. 4 units**

Term Typically Offered: SP  
Prerequisite: NR 326. Recommended: NR 335.

Policy process approach to understanding the efforts to resolve natural resource problems in the public and private sector. Principles and techniques used to analyze the effects of environmental policies. Analysis of major federal and state environmental laws. 4 lectures.

**NR 455. Wildland-Urban Fire Protection. 4 units**

Term Typically Offered: W  
Prerequisite: NR 340.

Biophysical and socioeconomic issues affecting wildland fire management in urbanized landscapes. Fire risk assessment. Pre-fire prevention, mitigation, and preparedness, during-fire response, and post-fire recovery actions by public- and private-sector agencies and residents. 3 lectures, 1 laboratory.

**NR 465. Ecosystem Management. 4 units**

Term Typically Offered: SP  
Prerequisite: NR 326 and NR 416.

Capstone course that integrates biophysical, economic and socio-political sciences. Principles, concepts and techniques designed to utilize resources while sustaining ecosystem health within acceptable limits of change. Ecosystem assessment, planning, management and monitoring project. 3 lectures, 1 laboratory.

**NR 470. Selected Advanced Topics. 1-4 units**

Term Typically Offered: TBD  
Prerequisite: Consent of instructor.

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 lectures.

**NR 471. Selected Advanced Laboratory. 1-4 units**

Term Typically Offered: TBD  
Prerequisite: Junior standing.

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 laboratories.

**NR 472. Leadership Practice. 1 unit**

Term Typically Offered: W  
Prerequisite: Junior standing.

Tasks associated with development of personal leadership skills. Study and practice in setting goals and objectives; developing, evaluating and implementing a project independently and as part of a team; decision making and problem-solving emphasized. Total credit limited to 4 units. 1 laboratory. Crosslisted as NR/RPTA 472.

**NR 475. Sustainable Forest and Environmental Practices. 12 units**

Term Typically Offered: SU  
Prerequisite: Completion of GE Area B and consent of instructor.  
Recommended: Junior or senior standing.

Typical modules related to sustainable forest management, ecosystem sampling and inventory methods, photo interpretation, hydrologic resources, road condition, project impact analysis, best management practices. Topics covered vary from term to term depending on the priority for learning modules. Residency at Swanton Pacific and extended field trips required. 8 lectures, 4 activities. Crosslisted as HNRS/NR 475.

**NR 476. Senior Project - Advanced Internship Experience in Environmental Science/Management. 3 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: Completion of GE Area A with a grade of C- or better; and ERSC 363 or NR 306 or NR 326.

Independent internship experience conducted under faculty supervision focusing on a discipline area of environmental science/management. Completion of a project as a component of their internship. Satisfies the senior project requirement. Minimum 90 hours required. Crosslisted as ERSC/NR 476.

**NR 477. Senior Project - Research Experience in Environmental Science. 3 units**

Term Typically Offered: W

Prerequisite: Completion of GE Area A with a grade of C- or better; and ERSC 363 or NR 306 or NR 326.

Guided research experience in a specific area of environmental science. Implementation of materials and methods. Collection, analysis and interpretation of data. Completion of formal written report. Satisfies senior project requirement. 1 lecture, 2 laboratories. Crosslisted as ERSC/NR 477.

**NR 478. Senior Project - Current Topics in Environmental Science/Management. 3 units**

Term Typically Offered: F, W, SP

Prerequisite: Completion of GE Area A with a grade of C- or better; and ERSC 363 or NR 306 or NR 326.

Critical evaluation and formal presentation of current issues in environmental science/management. Evaluation of current topics, analysis of supporting evidence, and synthesis and presentation of resulting perspectives on different approaches to current challenges in environmental science/management. Satisfies the senior project requirement. 3 lectures. Crosslisted as ERSC/NR 478.

**NR 479. Senior Project - Independent Study. 3 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: Completion of GE Area A with a grade of C- or better; ERSC 363 or NR 306 or NR 326; and consent of instructor.

Selection and completion of a project under faculty supervision. Projects typical of problems which graduates must solve in their fields of employment. Project results are presented in a formal report. Minimum 90 hours total time. Crosslisted as ERSC/NR 479.

**NR 500. Individual Study. 1-3 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of instructor.

Advanced independent study planned and completed under the direction of a member of the department faculty. Open only to graduate students who have demonstrated ability to do independent work. Total credit limited to 4 units.

**NR 503. Tropical Forest Ecosystem. 3 units**

Term Typically Offered: TBD

Prerequisite: Consent or instructor.

Tropical forest ecosystem classification, function and limitations. Applied tropical forest management systems; tropical problems, management, and political strategies; over-grazing and desertification; overcutting and fuelwood shortages. 3 seminars.

**NR 532. Applications in Biometrics and Econometrics. 4 units**

Term Typically Offered: F

Prerequisite: One course in undergraduate statistics, graduate standing, or consent of instructor.

Parametric and semi-parametric statistical methods in modeling biological and economic phenomena. Biometric modeling of stand growth and inventory. Econometric modeling of market and environmental values. 3 lectures, 1 laboratory.

**NR 534. Environmental Modeling. 3 units**

Term Typically Offered: W

Prerequisite: One course in statistics or graduate standing.

Methods and modeling approaches used in quantifying ecological and environmental processes and conditions, such as fire behavior, wildland hydrology, terrestrial and aquatic habitat condition, using GIS and other models. 2 lectures, 1 laboratory.

**NR 539. Graduate Internship in Forest Resources. 1-9 units**

Term Typically Offered: TBD

Prerequisite: Consent of internship instructor.

Application of theory to the solution of problems of forest resources or related businesses in the field. Analyze specific management problems and perform general management assignments detailed in a contract between the student, the firm or organization, and the faculty advisor before the internship commences. Degree credit limited to 6 units.

**NR 570. Selected Topics in Forest Resources. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of selected topics for advanced students. The Schedule of Classes will list title selected. Total credit limited to 12 units. 1-4 seminars.

**NR 571. Selected Topics Forest Resources Laboratory. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group laboratory of selected topics for advanced students. The Schedule of Classes will list title selected. Total credit limited to 12 units. 1-4 laboratories.

**NR 575. Applications in Advanced Watershed Hydrology. 2 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor. Recommended: NR 420.

Techniques and applications in watershed hydrology to real-world projects. Projects could include water quality or quantity assessments, water quality or channel morphology monitoring, and structural and non-structural enhancements for channel and upland watersheds, culminating in a final report and presentation. 2 laboratories.

**NR 581. Graduate Seminar in Environmental Sciences. 3 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Student study and presentation of selected developments, trends and problems in the field of forest and natural resources, earth and soil sciences, and environmental management. 3 seminars. Crosslisted as NR/SS 581.

**NR 599. Thesis. 1-9 units**

Term Typically Offered: F,W,SP,SU  
Prerequisite: Consent of instructor.

Individual research in forest or natural resources management under the general supervision of faculty, leading to a graduate thesis. Degree credit limited to 9 units.

**SS Courses****SS 121. Introductory Soil Science. 4 units**

GE Area B5

Term Typically Offered: F, W, SP

Prerequisite: College chemistry; and passing score on ELM examination or an ELM exemption or MATH 96 (formerly MATH 104) or MATH 115 or appropriate Math Placement Level.

Biological, chemical, physical and genetic properties of soils. Application of scientific principles to solving land use, water management, and soil conservation problems. Interpretation of soils data for making environmental decisions, applying management practices, and sustainable food production. 3 lectures, 1 laboratory. Fulfills GE Area B5.

**SS 131. Soils in Environmental and Agricultural Systems. 4 units**

Term Typically Offered: TBD

Soils' ecological functions; soil and the water cycle; soil in production of food, fiber, and forest materials; techniques and reports of soil analyses with agricultural and environmental applications; soil quality; introductory overview of soils and civilizations. Not open to students with credit in SS 121. 3 lectures, 1 activity.

**SS 200. Special Problems for Undergraduates. 1-2 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of instructor.

Individual investigation, research, studies, or surveys of selected problems. Total credit limited to 12 units, with a maximum of 2 units per quarter. Crosslisted as ERSC/SS 200.

**SS 221. Soil Health and Plant Nutrition. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: SS 121.

Plant nutrient requirements in the context of soil health. Composition, value, and use of fertilizer materials, conditioners and agricultural minerals for sustainable crop production and environmental quality. 3 lectures, 1 laboratory.

**SS 270. Selected Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of selected topics. The Schedule of Classes will list title selected. Total credit limited to 12 units. 1 to 4 lectures. Crosslisted as ERSC/SS 270.

**SS 301. Earth Sciences/Soils Science Practicum. 1-2 units**

CR/NC

Term Typically Offered: TBD

Prerequisite: SS 110 or SS 121.

Supervised practice in technical, educational, professional, and operational applications related to earth sciences or soil science. Students participate in faculty-supervised group or individual activities that support educational and professional goals. Credit/No Credit grading only. Total credit limited to 12 units. 1-2 activities. Crosslisted as ERSC/SS 301.

**SS 321. Soil Morphology. 4 units**

Term Typically Offered: F, W, SP

Prerequisite: SS 121.

Identification of soil morphological and site properties. Correlation of soil physical and chemical properties with soil taxonomy and land use. Techniques of interpretations for agriculture, forest lands, wetlands, range lands and urban development. 3 lectures, 1 laboratory.

**SS 322. Soil Plant Relationships. 4 units**

Term Typically Offered: W

Prerequisite: SS 221, CHEM 111 or CHEM 128.

Investigation and evaluation of the nutrient supplying ability of soils. Conditions and transformations involved in the transfer of mineral nutrients from soils to plants. Effects of cultural treatments on soil fertility. Diagnostic techniques and data interpretation in soil and plant analysis. 3 lectures, 1 laboratory.

**SS 339. Internship in Environmental Earth and Soil Sciences. 1-12 units**

CR/NC

Term Typically Offered: F,W,SP,SU

Prerequisite: Consent of internship instructor.

Selected students will spend up to 12 weeks with an approved firm or agency engaged in work and study related to their major. A detailed written proposal and written interim and final reports required. One unit of credit may be allowed for each full week of internship. Credit/No Credit grading. Crosslisted as ERSC/SS 339.

**SS 400. Special Problems for Advanced Undergraduates. 1-4 units**

Term Typically Offered: F, W, SP

Prerequisite: Consent of instructor.

Individual investigation, research, studies or surveys of selected problems. Total credit limited to 12 units. Crosslisted as ERSC/SS 400.

**SS 402. Soil, Compost, and Water Testing Enterprise. 3 units**

Term Typically Offered: TBD

Prerequisite: CHEM 111, CHEM 125 or CHEM 128; SS 221; and junior standing.

Experience in soil, compost, and water testing. Sampling rationale and protocol. Analyses of compost feedstocks and finished compost; monitoring for consistency. Theory and practice in use of analytical instrumentation. Interpretation of results for soil, compost, and water management. Total credit limited to 6 units for SS or ERSC majors. Total credit limited to 3 units for Soil Science minor.

**SS 421. Wetlands. 4 units**

Term Typically Offered: W

Prerequisite: BOT 121 or BIO 162, CHEM 111 or CHEM 127, and SS 121 or SS 131. Recommended: one of the following: BIO 327, BOT 313, BOT 326, MSCI 328 or NR 306.

The formation, characteristics, and functions of wetlands. Genesis of hydric soils. Plant adaptations to saturated soils. Wetlands as wildlife habitat. Policies and social issues associated with wetlands. The procedures of wetland delineations. 3 lectures, 1 laboratory. Crosslisted as BIO/NR/SS 421.

**SS 422. Soil Ecology. 4 units**

Term Typically Offered: SP

Prerequisite: CHEM 212, CHEM 312, or CHEM 313; and SS 221; or graduate standing.

Biochemical activities, ecology and environmental implications of soil organisms. Effects on the formation, characteristics, and productivity of soils. Methods of studying soil organisms. 3 lectures, 1 laboratory.

**SS 423. Environmental Soil and Water Chemistry. 5 units**

Term Typically Offered: F

Prerequisite: CHEM 129; CHEM 212, CHEM 216, CHEM 312, or CHEM 316; ERSC 223; MATH 118, MATH 141, or MATH 161; or graduate standing.

Chemical processes governing weathering, soil mineral formation and stability, common solubility equilibria. Use of chemical principles to explain surface chemical properties of soils and environmental problems in water and soil chemical systems. Preparation of professional quality reports based on laboratory data and library research. 3 lectures, 1 laboratory, 1 activity.

**SS 431. Digital Soil Mapping. 4 units**

Term Typically Offered: F

Prerequisite: GEOG 318 or LA/NR 218; SS 321; STAT 217 or STAT 218; or graduate standing.

Development and production of digital soil surveys for interpretive purposes. Use of soil taxonomy, land classification systems, geographic information system (GIS) software, and geostatistics to evaluate land for best management practices. 2 lectures, 2 laboratories.

**SS 432. Environmental Soil Physics. 5 units**

Term Typically Offered: W

Prerequisite: CHEM 128; MATH 141 or MATH 161; PHYS 121 or PHYS 141; SS 121; or graduate standing.

Matter and energy in soils, with emphasis on properties and behavior of solids, water, air, and heat. Applications to agriculture, forestry, range management, engineering, and environmental sciences. Preparation of professional reports based on laboratory data and library research. 3 lectures, 1 laboratory, 1 activity.

**SS 440. Forest and Range Soils. 4 units**

Term Typically Offered: F

Prerequisite: SS 121, SS 321 or consent of instructor.

Ecosystem approach to chemical, biological, physical and mechanical properties of forest and range soils. Site quality, nutrient cycling, erosion and mass movement, fire effects. Preparation of soil management reports similar to those required by various land management organizations. Overnight field trips. 3 lectures, 1 laboratory.

**SS 442. Vadose Zone and Groundwater Processes. 4 units**

Term Typically Offered: SP

Prerequisite: CHEM 212, CHEM 216, or CHEM 312; GEOL 201; MATH 161 or MATH 141; and SS 121.

Vadose zone and groundwater modeling and monitoring for groundwater basin management. Principles of saturated and unsaturated flow. Fate and transport of contaminants in soils and subsurface porous media. Soil remediation and reclamation of disturbed lands. 3 lectures, 1 laboratory.

**SS 444. Soil Judging. 2 units**

Term Typically Offered: W, SP

Prerequisite: SS 321.

Morphological description of soils in the field. Taxonomic determination of classifications and interpretive properties from soil descriptions. Participation in collegiate soil judging contests. Total credit limited to 12 units. 1 lecture, 1 laboratory.

**SS 463. Undergraduate Seminar. 2 units**

Term Typically Offered: SU

Prerequisite: SS 461.

Review of current research, experiments, and problems related to the student's major field of interest. Preparation and presentation of reports on problems or research activities. 2 seminars.

**SS 470. Selected Advanced Topics. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 12 units. 1 to 4 lectures. Crosslisted as ERSC/SS 470.

**SS 471. Selected Advanced Laboratory. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1 to 4 laboratories. Crosslisted as ERSC/SS 471.

**SS 500. Individual Study in Soil Science. 1-6 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: Consent of instructor.

Advanced independent study planned and completed under the direction of a member of the Earth and Soil Sciences faculty. Total credit limited to 6 units.

**SS 501. Research Planning. 4 units**

Term Typically Offered: W

Prerequisite: Graduate standing or consent of instructor.

Problem solving and research planning for agriculture, natural resources and related sciences. Preparation of study plans that identify problems, review appropriate literature, formulate objectives, develop methods and provide for presentation and interpretation of results. Oral reports. 4 lectures.

**SS 508. Environmental Assessment for Erosion Control. 3 units**

Term Typically Offered: TBD

Prerequisite: SS 121 or equivalent and graduate standing, or consent of instructor.

Assessment techniques for the development of soil erosion control and the dispersal of surface runoff water on urban, agriculture, riparian, and rangelands. Development of a water quality management plan for a specific land use. 3 lectures.

**SS 522. Advanced Soil Fertility. 3 units**

Term Typically Offered: TBD

Prerequisite: SS 322, graduate standing or consent of instructor.

Current research frontiers in soil fertility. Evaluating soil testing philosophy, theories and interpretation. Optimizing soil conditions for maximizing crop production. Consequences of environmental pollution, trace elements and organic amendments. Chemical reactions including solubility and chelate equilibria, adsorption phenomena, nutrient mobility, soil mineralogy and weathering. Use of foliar fertilization. Radioisotopes in soil fertility. 3 lectures.

**SS 570. Selected Topics in Soil Science. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing or consent of instructor.

Directed group study of selected topics for advanced students. Open to undergraduate and graduate students. Class Schedule will list topic selected. Total credit limited to 12 units. 1 to 4 seminars.

**SS 571. Selected Advanced Laboratory. 1-4 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing or consent of instructor.

Directed group laboratory study of selected topics for advanced students. Open to undergraduate and graduate students. The Schedule of Classes will list title selected. Total credit limited to 8 units. 1-4 laboratories.

**SS 581. Graduate Seminar in Environmental Sciences. 3 units**

Term Typically Offered: TBD

Prerequisite: Consent of instructor.

Student study and presentation of selected developments, trends and problems in the field of forest and natural resources, earth and soil sciences, and environmental management. 3 seminars. Crosslisted as NR/SS 581.

**SS 582. GIS in Advanced Land Management. 3 units**

Term Typically Offered: TBD

Prerequisite: Graduate standing, NR/LA 318, or consent of instructor.

Development of plans and practices for the management of crop, range, urban and wood land. 2 seminars, 1 laboratory.

**SS 599. Thesis. 1-6 units**

Term Typically Offered: F,W,SP,SU

Prerequisite: Graduate standing and consent of instructor.

Individual research in soil science under faculty supervision, leading to a scholarly written presentation exhibiting originality, clarity, critical and independent thinking, proper analysis of data, appropriate organization and format, and accurate and thorough documentation. Six units required for the M.S. degree.