***Twin Cities Campus***

# Natural Resources Science and Management Ph.D.

*Forest Resources*

**College of Food, Agricultural and Natural Resource Sciences**

Link to a list of faculty for this program.

**Contact Information:**
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- Program Type: Doctorate
- Requirements for this program are current for Fall 2018
- Length of program in credits: 59 to 72
- This program does not require summer semesters for timely completion.
- Degree: Doctor of Philosophy

Along with the program-specific requirements listed below, please read the General Information section of the catalog website for requirements that apply to all major fields.

Students in the natural resources science and management (NRSM) PhD program emphasize one of the following tracks: 1) forests: biology, ecology, conservation, and management; 2) economics, policy, management, and society; 3) assessment, monitoring, and geospatial analysis; 4) recreation resources, tourism, and environmental education; 5) forest hydrology and watershed management; 6) forest products; or 7) paper science and engineering.

## Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

## Prerequisites for Admission

The preferred undergraduate GPA for admittance to the program is 3.00.

Other requirements to be completed before admission:
Most admitted students have earned degrees in natural resource-related majors. Applicants with exceptional academic records but no related background are eligible; if admitted, they may complete the prerequisites for advanced courses during the early stages of their graduate program. These prerequisites will vary depending upon the student's chosen track and major advisor.

Applicants will not be admitted unless a member of the program faculty agrees to advise the student ahead of time. This decision depends on admissibility (the applicant's overall credentials), mutual research interests, and the faculty member's ability to take on a new student. Some faculty members will not advise students unless they have funding for the student. Applicants are encouraged to review faculty profiles on the program website and begin making contacts prior to and during the application process.

Applicants must submit their test score(s) from the following:

- GRE

International applicants must submit score(s) from one of the following tests:

- TOEFL
  - Internet Based - Total Score: 79
  - Internet Based - Writing Score: 21
  - Internet Based - Reading Score: 19
  - Paper Based - Total Score: 550
- IELTS
  - Total Score: 6.5
  - Reading Score: 6.5
  - Writing Score: 6.5
- MELAB
  - Final score: 80

Key to test abbreviations(GRE, TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the General Information section of the

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catalog website.

## Program Requirements

35 to 48 credits are required in the major.
0 credits are required outside the major.
24 thesis credits are required.

This program may be completed with a minor.

Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

A minimum GPA of 3.00 is required for students to remain in good standing.

The University of Minnesota requires at least 48 credits for a doctoral degree, 24 of which must be thesis credits [NR 8888]. The NRSM graduate program will typically expect to see 40 to 48 course credits. If a student enters the program with a relevant master's degree, relevant credits from the prior degree can be transferred in to apply toward the doctoral degree pending advisor, committee, graduate program, and college approval. Normally, a student who enters the doctoral program with a master's degree will complete 30-40 additional credits in the major program. There are no minor courses required, but students have the option of formally declaring a minor.

Course selection and thesis proposals are developed by each student in consultation with the faculty advisor and are approved by the Natural Resources Science and Management Graduate Studies Committee. Students must also receive training in the ethical conduct of research and present a formal seminar to faculty and peers. This presentation is separate from the final exam seminar.

**Required Seminar**

All students in NRSM must take the Natural Resources Seminar course. Course was listed as FNRM 8107 prior to spring 2017, and NR 8107 in all future semesters.
NR 8107 - Seminar: Natural Resources Science and Management (1.0 cr)

**Joint- or Dual-degree Coursework:**Law, Science & TechnologyStudent may take a total of 12 credits in common among the academic programs.

## Program Sub-plans

Students are required to complete one of the following sub-plans.
Students may not complete the program with more than one sub-plan.

### Assessment, Monitoring, and Geospatial Analysis

Addresses measurements and related technology applications and resource analysis. Graduate students in this track may choose to specialize in topics such as: geographic information systems (GIS); remote sensing; geospatial analysis; survey design (including forest inventory and monitoring), measurement, modeling; and biometrics. Studies typically focus on landscape, region, or global levels.

**Assessment, Monitoring, and Geospatial Analysis - Suggested Course List**

NRSM students in the assessment, monitoring, and geospatial analysis track should refer to this list when enrolling in courses that are appropriate for their area of study. Students must enroll in at least 34 credits in addition to their seminar and thesis credit (24 credits of NR 8888) requirements. Students may elect to take courses outside of this list if advised to do so by their advisor or committee.
Take 0 or more course(s) from the following:

- AGRO 5121 - Applied Experimental Design (4.0 cr)
- APEC 5031 - Methods of Economic Data Analysis (3.0 cr)
- APEC 5032 - Economic Data Analysis for Managerial and Policy Decisions (3.0 cr)
- APEC 8211 - Econometric Analysis I (2.0 cr)
- APEC 8212 - Econometric Analysis II (2.0 cr)
- CI 8149 - Qualitative Research: Coding, Analysis, Interpretation, and Writing (3.0 cr)
- CSCI 5302 - Analysis of Numerical Algorithms (3.0 cr)
- CSCI 5707 - Principles of Database Systems (3.0 cr)
- DES 8103 - Qualitative Research Methods in Design (3.0 cr)
- ECON 8201 - Econometric Analysis (2.0 cr)
- ECON 8203 - Econometric Analysis (2.0 cr)
- ECON 8204 - Econometric Analysis (2.0 cr)
- EEB 5068 - Plant Physiological Ecology (3.0 cr)
- EEB 5609 - Ecosystem Ecology (3.0 cr)
- EPSY 5221 - Principles of Educational and Psychological Measurement (3.0 cr)
- EPSY 5244 - Survey Design, Sampling, and Implementation (3.0 cr)

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- EPSY 5247 - Qualitative Methods in Educational Psychology (3.0 cr)
- EPSY 5261 - Introductory Statistical Methods (3.0 cr)
- EPSY 5262 - Intermediate Statistical Methods (3.0 cr)
- EPSY 8266 - Statistical Analysis Using Structural Equation Methods (3.0 cr)
- ESPM 5031 - Applied Global Positioning Systems for Geographic Information Systems (3.0 cr)
- ESPM 5071 - Ecological Restoration (4.0 cr)
- ESPM 5101 *{Inactive}*(3.0 cr)
- ESPM 5111 - Hydrology and Water Quality Field Methods (3.0 cr)
- ESPM 5211 - Survey, Measurement, and Modeling for Environmental Analysis (3.0 cr)
- ESPM 5242 - Methods for Environmental and Natural Resource Policy Analysis (3.0 cr)
- ESPM 5261 - Economics and Natural Resources Management (4.0 cr)
- ESPM 5295 - GIS in Environmental Science and Management (4.0 cr)
- ESPM 5603 - Environmental Life Cycle Analysis (3.0 cr)
- FNRM 5114 - Hydrology and Watershed Management (3.0 cr)
- FNRM 5131 - Geographical Information Systems (GIS) for Natural Resources (4.0 cr)
- FNRM 5218 - Measuring and Modeling Forests (3.0 cr)
- FNRM 5228 - Advanced Topics in Assessment and Modeling of Forests (3.0 cr)
- FNRM 5262 - Remote Sensing and Geospatial Analysis of Natural Resources and Environment (3.0 cr)
- FNRM 5462 - Advanced Remote Sensing and Geospatial Analysis (3.0 cr)
- FNRM 5471 - Forest Management Planning (3.0 cr)
- FNRM 8101 - Research Problems: Physiological Ecology (1.0 - 5.0 cr)
- FNRM 8102 - Research Problems: Forest-Tree Genetics (1.0 - 5.0 cr)
- FNRM 8103 - Research Problems: Forest Hydrology (1.0 - 5.0 cr)
- FNRM 8104 - Research Problems: Forest Ecology (1.0 - 5.0 cr)
- FNRM 8105 - Research Problems: Silviculture (1.0 - 5.0 cr)
- FNRM 8106 - Research Problems: Urban Forestry--Biology and Management (1.0 - 5.0 cr)
- FNRM 8201 - Research Problems: Forest Economics (1.0 - 5.0 cr)
- FNRM 8202 - Research Problems: Forest Biometry and Measurements (1.0 - 5.0 cr)
- FNRM 8203 - Research Problems: Forest Recreation (1.0 - 5.0 cr)
- FNRM 8204 - Research Problems: Forest Policy (1.0 - 5.0 cr)
- FNRM 8205 - Research Problems: Spatial Data Analysis (1.0 - 5.0 cr)
- FNRM 8206 - Research Problems: Forest Management (1.0 - 5.0 cr)
- FNRM 8207 - Economic Analysis of Natural Resource Projects (1.0 - 5.0 cr)
- FNRM 8208 - Research Problems: Environmental Learning and Leadership (1.0 - 5.0 cr)
- FW 8200 - Seminar (1.0 - 4.0 cr)
- GEOG 5531 - Numerical Spatial Analysis (4.0 cr)
- GEOG 5562 - GIS Development Practicum (3.0 cr)
- GEOG 8260 - Seminar: Physical Geography (2.0 cr)
- GIS 5555 - Basic Spatial Analysis (3.0 cr)
- GIS 5571 - ArcGIS I (3.0 cr)
- GIS 5572 - ArcGIS II (3.0 cr)
- GIS 5575 *{Inactive}*(2.0 cr)
- GIS 5577 - Spatial Database Design and Administration (3.0 cr)
- GIS 5578 - GIS Programming (3.0 cr)
- GRAD 8101 - Teaching in Higher Education (3.0 cr)
- GRAD 8200 - Teaching and Learning Topics in Higher Education (1.0 cr)
- NR 5021 - Statistics for Agricultural and Natural Resource Professionals (3.0 cr)
- NR 8100 - Topics in Natural Resources Science and Management (1.0 - 2.0 cr)
- OLPD 5061 - Ethnographic Research Methods (3.0 cr)
- OLPD 5528 *{Inactive}*(1.0 - 3.0 cr)
- PA 5002 - Introduction to Policy Analysis (1.5 cr)
- PA 5031 - Statistics for Public Affairs (4.0 cr)
- PA 5035 *{Inactive}*(1.5 cr)
- PA 5041 - Qualitative Methods for Policy Analysts (4.0 cr)
- PA 5920 - Skills Workshop (0.5 - 4.0 cr)
- POL 8126 - Qualitative Methods (3.0 cr)
- PUBH 7250 - Designing and Conducting Focus Group Interviews (1.0 cr)
- PUBH 7407 - Analysis of Categorical Data (3.0 cr)
- PUBH 8472 - Spatial Biostatistics (3.0 cr)
- SOC 5811 - Social Statistics for Graduate Students (4.0 cr)
- SOC 8801 - Sociological Research Methods (4.0 cr)
- SOC 8811 - Advanced Social Statistics (4.0 cr)
- SOIL 5555 - Wetland Soils (3.0 cr)
- STAT 5021 - Statistical Analysis (4.0 cr)
- STAT 5101 - Theory of Statistics I (4.0 cr)
- STAT 5102 - Theory of Statistics II (4.0 cr)

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•STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
•STAT 5302 - Applied Regression Analysis (4.0 cr)
•STAT 5303 - Designing Experiments (4.0 cr)
•STAT 5401 - Applied Multivariate Methods (3.0 cr)
•STAT 5421 - Analysis of Categorical Data (3.0 cr)
•STAT 5511 - Time Series Analysis (3.0 cr)
•STAT 5601 - Nonparametric Methods (3.0 cr)
•STAT 8051 - Advanced Regression Techniques: linear, nonlinear and nonparametric methods (3.0 cr)
•STAT 8052 - Applied Statistical Methods 2: Design of Experiments and Mixed -Effects Modeling (3.0 cr)
•STAT 8053 - Applied Statistical Methods 3: Multivariate Analysis and Advanced Regression (3.0 cr)
•STAT 8054 - Statistical Methods 4: Advanced Statistical Computing (3.0 cr)
•WRIT 5051 - Graduate Research Writing for International Students (3.0 cr)

## Economics, Policy, Management, and Society

For students interested in focusing on how society values and makes decisions about the use, management, and protection of natural and environmental resources. Graduate students in this track can specialize in areas such as: economics, policy, administration and management, planning, operations research, conflict resolution, human dimensions, and land use planning. Studies might consider choices, impacts, and tradeoffs in protecting, restoring, developing, and allocating natural and environmental resources. The research conducted by students in this track may address a wide range of issues and problems from local to international in scope.

**Economics, Policy, Management, and Society - Suggested Course List**

NRSM students in the economics, policy, management, and society track should refer to this list when enrolling in courses that are appropriate for their area of study. Students must enroll in at least 34 credits in addition to their seminar and thesis credit (24 credits of NR 8888) requirements. Students may elect to take courses outside of this list if advised to do so by their advisor or committee.

Take 0 or more course(s) from the following:

•AGRO 5121 - Applied Experimental Design (4.0 cr)
•APEC 5031 - Methods of Economic Data Analysis (3.0 cr)
•APEC 5032 - Economic Data Analysis for Managerial and Policy Decisions (3.0 cr)
•APEC 5151 - Applied Microeconomics: Firm and Household (3.0 cr)
•APEC 5152 *{Inactive}*(3.0 cr)
•APEC 5321 - Regional Economic Analysis (3.0 cr)
•APEC 5651 *{Inactive}*(3.0 cr)
•APEC 5721 - Economics of Science and Technology Policy (3.0 cr)
•APEC 8004 - Applied Microeconomic Analysis of Social Choice and Welfare (2.0 cr)
•APEC 8202 - Mathematical Optimization in Applied Economics (3.0 cr)
•APEC 8203 - Applied Welfare Economics and Public Policy (3.0 cr)
•APEC 8211 - Econometric Analysis I (2.0 cr)
•APEC 8212 - Econometric Analysis II (2.0 cr)
•APEC 8601 - Natural Resource Economics (3.0 cr)
•APEC 8602 - Economics of the Environment (3.0 cr)
•BIOL 5407 *{Inactive}*(3.0 cr)
•CEGE 5570 *{Inactive}*(3.0 - 9.0 cr)
•CI 5537 *{Inactive}*(3.0 cr)
•CI 5747 *{Inactive}*(3.0 cr)
•CI 8149 - Qualitative Research: Coding, Analysis, Interpretation, and Writing (3.0 cr)
•COMM 5250 *{Inactive}*(3.0 cr)
•COMM 5402 *{Inactive}*(3.0 cr)
•COMM 5441 - Communication in Human Organizations (3.0 cr)
•COMM 8452 - Seminar: Methods of Intercultural/Diversity Facilitation (3.0 cr)
•DES 8103 - Qualitative Research Methods in Design (3.0 cr)
•ECON 8105 - Macroeconomic Theory (2.0 cr)
•ECON 8106 - Macroeconomic Theory (2.0 cr)
•EEB 5609 - Ecosystem Ecology (3.0 cr)
•EEB 8200 - Sustainability Science Distributed Graduate Seminar (3.0 cr)
•EPSY 5221 - Principles of Educational and Psychological Measurement (3.0 cr)
•EPSY 5243 - Principles and Methods of Evaluation (3.0 cr)
•EPSY 5244 - Survey Design, Sampling, and Implementation (3.0 cr)
•EPSY 5247 - Qualitative Methods in Educational Psychology (3.0 cr)
•EPSY 5261 - Introductory Statistical Methods (3.0 cr)
•EPSY 5262 - Intermediate Statistical Methods (3.0 cr)
•EPSY 8266 - Statistical Analysis Using Structural Equation Methods (3.0 cr)
•ESPM 5061 - Water Quality and Natural Resources (3.0 cr)
•ESPM 5071 - Ecological Restoration (4.0 cr)
•ESPM 5101 *{Inactive}*(3.0 cr)
•ESPM 5108 - Ecology of Managed Systems (4.0 cr)
•ESPM 5111 - Hydrology and Water Quality Field Methods (3.0 cr)

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- ESPM 5202 - Environmental Conflict Management, Leadership, and Planning (3.0 cr)
- ESPM 5211 - Survey, Measurement, and Modeling for Environmental Analysis (3.0 cr)
- ESPM 5241 - Natural Resource and Environmental Policy (3.0 cr)
- ESPM 5242 - Methods for Environmental and Natural Resource Policy Analysis (3.0 cr)
- ESPM 5245 - Sustainable Land Use Planning and Policy (3.0 cr)
- ESPM 5251 - Natural Resources in Sustainable International Development (3.0 cr)
- ESPM 5256 - Natural Resource Law and the Management of Public Lands and Waters (3.0 cr)
- ESPM 5261 - Economics and Natural Resources Management (4.0 cr)
- ESPM 5602 - Regulations and Corporate Environmental Management (3.0 cr)
- ESPM 5603 - Environmental Life Cycle Analysis (3.0 cr)
- ESPM 5604 - Environmental Management Systems and Strategy (3.0 cr)
- ESPM 5811 - Environmental Interpretation (3.0 cr)
- FNRM 5101 - Park and Protected Area Tourism (3.0 cr)
- FNRM 5104 - Forest Ecology (4.0 cr)
- FNRM 5114 - Hydrology and Watershed Management (3.0 cr)
- FNRM 5131 - Geographical Information Systems (GIS) for Natural Resources (4.0 cr)
- FNRM 5203 - Forest Fire and Disturbance Ecology (3.0 cr)
- FNRM 5204 - Landscape Ecology and Management (3.0 cr)
- FNRM 5264 - Advanced Forest Management Planning (3.0 cr)
- FNRM 5411 - Managing Forest Ecosystems: Silviculture (3.0 cr)
- FNRM 5462 - Advanced Remote Sensing and Geospatial Analysis (3.0 cr)
- FNRM 5413 - Managing Forest Ecosystems: Silviculture Lab (1.0 cr)
- FNRM 5431 - Timber Harvesting and Road Planning (2.0 cr)
- FNRM 5471 - Forest Management Planning (3.0 cr)
- FNRM 5501 - Urban Forest Management: Managing Greenspaces for People (3.0 cr)
- FNRM 8101 - Research Problems: Physiological Ecology (1.0 - 5.0 cr)
- FNRM 8102 - Research Problems: Forest-Tree Genetics (1.0 - 5.0 cr)
- FNRM 8103 - Research Problems: Forest Hydrology (1.0 - 5.0 cr)
- FNRM 8104 - Research Problems: Forest Ecology (1.0 - 5.0 cr)
- FNRM 8105 - Research Problems: Silviculture (1.0 - 5.0 cr)
- FNRM 8106 - Research Problems: Urban Forestry--Biology and Management (1.0 - 5.0 cr)
- FNRM 8201 - Research Problems: Forest Economics (1.0 - 5.0 cr)
- FNRM 8202 - Research Problems: Forest Biometry and Measurements (1.0 - 5.0 cr)
- FNRM 8203 - Research Problems: Forest Recreation (1.0 - 5.0 cr)
- FNRM 8204 - Research Problems: Forest Policy (1.0 - 5.0 cr)
- FNRM 8205 - Research Problems: Spatial Data Analysis (1.0 - 5.0 cr)
- FNRM 8206 - Research Problems: Forest Management (1.0 - 5.0 cr)
- FNRM 8207 - Economic Analysis of Natural Resource Projects (1.0 - 5.0 cr)
- FNRM 8208 - Research Problems: Environmental Learning and Leadership (1.0 - 5.0 cr)
- FW 4001 - Biometry (4.0 cr)
- FW 5003 - Human Dimensions of Biological Conservation (3.0 cr)
- FW 8200 - Seminar (1.0 - 4.0 cr)
- FW 8494 - Research in Wildlife (1.0 - 4.0 cr)
- GEOG 5561 - Principles of Geographic Information Science (4.0 cr)
- GEOG 8101 - Proseminar: Nature and Society (3.0 cr)
- GIS 5555 - Basic Spatial Analysis (3.0 cr)
- GIS 5571 - ArcGIS I (3.0 cr)
- GIS 5572 - ArcGIS II (3.0 cr)
- GRAD 8101 - Teaching in Higher Education (3.0 cr)
- GRAD 8200 - Teaching and Learning Topics in Higher Education (1.0 cr)
- LA 5004 *{Inactive}*(4.0 cr)
- LAW 6062 - Energy Law (3.0 cr)
- MGMT 6033 - Strategy Implementation (2.0 cr)
- MGMT 6055 - Management of Innovation and Change (2.0 cr)
- NR 5021 - Statistics for Agricultural and Natural Resource Professionals (3.0 cr)
- NR 8100 - Topics in Natural Resources Science and Management (1.0 - 2.0 cr)
- OLPD 5061 - Ethnographic Research Methods (3.0 cr)
- OLPD 5104 - Education and the Sustainable Development Goals (3.0 cr)
- OLPD 5501 - Principles and Methods of Evaluation (3.0 cr)
- OLPD 5528 *{Inactive}*(1.0 - 3.0 cr)
- OLPD 5611 - Facilitation and Meeting Skills (1.0 cr)
- PA 5002 - Introduction to Policy Analysis (1.5 cr)
- PA 5011 - Dynamics of Public Affairs Organizations (3.0 cr)
- PA 5021 - Microeconomics for Policy Analysis (3.0 cr)
- PA 5022 - Applications of Economics for Policy Analysis (1.5 - 3.0 cr)
- PA 5031 - Statistics for Public Affairs (4.0 cr)

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•PA 5035 *{Inactive}*(1.5 cr)
•PA 5041 - Qualitative Methods for Policy Analysts (4.0 cr)
•PA 5101 - Management and Governance of Nonprofit Organizations (3.0 cr)
•PA 5122 - Law and Public Affairs (3.0 cr)
•PA 5242 - Environmental Planning, Policy, and Decision Making (3.0 cr)
•PA 5251 - Strategic Planning and Management (3.0 cr)
•PA 5253 *{Inactive}*(3.0 cr)
•PA 5271 - Geographic Information Systems: Applications in Planning and Policy Analysis (3.0 cr)
•PA 5311 - Program Evaluation (3.0 cr)
•PA 5501 - Theories and Policies of Development (3.0 cr)
•PA 5503 - Economics of Development (3.0 cr)
•PA 5721 - Energy Systems and Policy (3.0 cr)
•PA 5722 - Economics of Environmental Policy (3.0 cr)
•PA 5741 - Risk, Resilience and Decision Making (1.5 cr)
•PA 5790 - Topics in Science, Technology, and Environmental Policy (1.0 - 3.0 cr)
•PA 5890 - Topics in Foreign Policy and International Affairs (0.5 - 5.0 cr)
•PA 5920 - Skills Workshop (0.5 - 4.0 cr)
•PA 8790 - Advanced Topics in Science, Technology, and Environmental Policy (1.0 - 3.0 cr)
•POL 5315 - State Governments: Laboratories of Democracy (3.0 cr)
•POL 8126 - Qualitative Methods (3.0 cr)
•PSY 5202 - Attitudes and Social Behavior (3.0 cr)
•PSY 5960 - Topics in Psychology (1.0 - 4.0 cr)
•PUBH 7250 - Designing and Conducting Focus Group Interviews (1.0 cr)
•PUBH 7407 - Analysis of Categorical Data (3.0 cr)
•SCO 8735 *{Inactive}*(3.0 cr)
•SOC 5811 - Social Statistics for Graduate Students (4.0 cr)
•SOC 8701 - Sociological Theory (4.0 cr)
•SOC 8801 - Sociological Research Methods (4.0 cr)
•SOC 8811 - Advanced Social Statistics (4.0 cr)
•SOIL 5611 - Soil Biology and Fertility (4.0 cr)
•STAT 5021 - Statistical Analysis (4.0 cr)
•STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
•STAT 5302 - Applied Regression Analysis (4.0 cr)
•STAT 5303 - Designing Experiments (4.0 cr)
•STAT 5401 - Applied Multivariate Methods (3.0 cr)
•STAT 5421 - Analysis of Categorical Data (3.0 cr)
•STAT 5601 - Nonparametric Methods (3.0 cr)
•STAT 8051 - Advanced Regression Techniques: linear, nonlinear and nonparametric methods (3.0 cr)
•STAT 8052 - Applied Statistical Methods 2: Design of Experiments and Mixed -Effects Modeling (3.0 cr)
•STAT 8053 - Applied Statistical Methods 3: Multivariate Analysis and Advanced Regression (3.0 cr)
•STAT 8054 - Statistical Methods 4: Advanced Statistical Computing (3.0 cr)
•WRIT 5051 - Graduate Research Writing for International Students (3.0 cr)
•WRS 5101 - Water Policy (3.0 cr)

## Forest Hydrology and Watershed Management

Brings together the integrally related areas of earth sciences, soils, and water resources management with an applied focus on wildland ecosystems, which may include the interface of forests with grasslands, wetlands, and agriculture. Graduate students in this track may specialize in areas such as: forest hydrology, water quality, and watershed management. Research would focus on forest, riparian, and wetland ecosystems.

**Forest Hydrology and Watershed Management - Suggested Course List**

NRSM students in the forest hydrology and watershed management track should refer to this list when enrolling in courses that are appropriate for their area of study. Students must enroll in at least 34 credits in addition to their seminar and thesis credit (24 credits of NR 8888) requirements. Students may elect to take courses outside of this list if advised to do so by their advisor or committee.

Take 0 or more course(s) from the following:

•AGRO 5121 - Applied Experimental Design (4.0 cr)
•APEC 5031 - Methods of Economic Data Analysis (3.0 cr)
•APEC 5032 - Economic Data Analysis for Managerial and Policy Decisions (3.0 cr)
•APEC 8211 - Econometric Analysis I (2.0 cr)
•APEC 8212 - Econometric Analysis II (2.0 cr)
•BBE 5513 - Watershed Engineering (3.0 cr)
•BBE 5523 - Ecological Engineering Design (3.0 cr)
•BBE 5535 - Assessment and Diagnosis of Impaired Waters (3.0 cr)
•BBE 8013 - Parameter Estimation in Biosystems and Agricultural Engineering (3.0 cr)
•BBE 8513 - Hydrologic Modeling of Small Watersheds (3.0 cr)
•CEGE 4501 - Hydrologic Design (4.0 cr)

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- CEGE 4512 - Open Channel Hydraulics (3.0 cr)
- CEGE 5541 - Environmental Water Chemistry (3.0 cr)
- CEGE 8506 - Stochastic Hydrology (4.0 cr)
- CEGE 8511 - Mechanics of Sediment Transport (3.0 cr)
- CEGE 8561 - Analysis and Modeling of Aquatic Environments I (3.0 cr)
- CEGE 8562 - Analysis and Modeling of Aquatic Environments II (3.0 cr)
- CEGE 8601 - Introduction to Stream Restoration (3.0 cr)
- CI 8149 - Qualitative Research: Coding, Analysis, Interpretation, and Writing (3.0 cr)
- DES 8103 - Qualitative Research Methods in Design (3.0 cr)
- EEB 5053 - Ecology: Theory and Concepts (4.0 cr)
- EEB 5601 - Limnology (3.0 cr)
- EEB 5609 - Ecosystem Ecology (3.0 cr)
- EEB 8601 - Introduction to Stream Restoration (3.0 cr)
- EEB 8602 - Stream Restoration Practice (2.0 cr)
- EPSY 5221 - Principles of Educational and Psychological Measurement (3.0 cr)
- EPSY 5244 - Survey Design, Sampling, and Implementation (3.0 cr)
- EPSY 5247 - Qualitative Methods in Educational Psychology (3.0 cr)
- EPSY 5261 - Introductory Statistical Methods (3.0 cr)
- EPSY 5262 - Intermediate Statistical Methods (3.0 cr)
- EPSY 8266 - Statistical Analysis Using Structural Equation Methods (3.0 cr)
- ESCI 4401 - Aqueous Environmental Geochemistry (3.0 cr)
- ESCI 4702 - General Hydrogeology (4.0 cr)
- ESCI 4703 - Glacial Geology (4.0 cr)
- ESCI 5205 *{Inactive}*(3.0 cr)
- ESPM 4216 - Contaminant Hydrology (3.0 cr)
- ESPM 5061 - Water Quality and Natural Resources (3.0 cr)
- ESPM 5071 - Ecological Restoration (4.0 cr)
- ESPM 5111 - Hydrology and Water Quality Field Methods (3.0 cr)
- ESPM 5211 - Survey, Measurement, and Modeling for Environmental Analysis (3.0 cr)
- ESPM 5241 - Natural Resource and Environmental Policy (3.0 cr)
- ESPM 5242 - Methods for Environmental and Natural Resource Policy Analysis (3.0 cr)
- ESPM 5261 - Economics and Natural Resources Management (4.0 cr)
- ESPM 5295 - GIS in Environmental Science and Management (4.0 cr)
- ESPM 5402 - Biometeorology (3.0 cr)
- ESPM 5555 - Wetland Soils (3.0 cr)
- ESPM 5575 - Wetlands (3.0 cr)
- ESPM 5603 - Environmental Life Cycle Analysis (3.0 cr)
- ESPM 5703 *{Inactive}*(3.0 cr)
- ESPM 5811 - Environmental Interpretation (3.0 cr)
- FNRM 5114 - Hydrology and Watershed Management (3.0 cr)
- FNRM 5131 - Geographical Information Systems (GIS) for Natural Resources (4.0 cr)
- FNRM 5153 - Forest Hydrology & Watershed Biogeochemistry (3.0 cr)
- FNRM 8101 - Research Problems: Physiological Ecology (1.0 - 5.0 cr)
- FNRM 8102 - Research Problems: Forest-Tree Genetics (1.0 - 5.0 cr)
- FNRM 8103 - Research Problems: Forest Hydrology (1.0 - 5.0 cr)
- FNRM 8104 - Research Problems: Forest Ecology (1.0 - 5.0 cr)
- FNRM 8105 - Research Problems: Silviculture (1.0 - 5.0 cr)
- FNRM 8106 - Research Problems: Urban Forestry--Biology and Management (1.0 - 5.0 cr)
- FNRM 8201 - Research Problems: Forest Economics (1.0 - 5.0 cr)
- FNRM 8202 - Research Problems: Forest Biometry and Measurements (1.0 - 5.0 cr)
- FNRM 8203 - Research Problems: Forest Recreation (1.0 - 5.0 cr)
- FNRM 8204 - Research Problems: Forest Policy (1.0 - 5.0 cr)
- FNRM 8205 - Research Problems: Spatial Data Analysis (1.0 - 5.0 cr)
- FNRM 8206 - Research Problems: Forest Management (1.0 - 5.0 cr)
- FNRM 8207 - Economic Analysis of Natural Resource Projects (1.0 - 5.0 cr)
- FNRM 8208 - Research Problems: Environmental Learning and Leadership (1.0 - 5.0 cr)
- FW 8051 - Statistical Modeling of Ecological Data using R and WinBugs/JAGS (4.0 cr)
- GEOG 8260 - Seminar: Physical Geography (2.0 cr)
- GIS 5555 - Basic Spatial Analysis (3.0 cr)
- GIS 5577 - Spatial Database Design and Administration (3.0 cr)
- GRAD 8101 - Teaching in Higher Education (3.0 cr)
- GRAD 8200 - Teaching and Learning Topics in Higher Education (1.0 cr)
- LAAS 5311 - Soil Chemistry and Mineralogy (3.0 cr)
- NR 5021 - Statistics for Agricultural and Natural Resource Professionals (3.0 cr)
- NR 8100 - Topics in Natural Resources Science and Management (1.0 - 2.0 cr)
- OLPD 5061 - Ethnographic Research Methods (3.0 cr)

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•OLPD 5528 *{Inactive}*(1.0 - 3.0 cr)
•PA 5002 - Introduction to Policy Analysis (1.5 cr)
•PA 5031 - Statistics for Public Affairs (4.0 cr)
•PA 5035 *{Inactive}*(1.5 cr)
•PA 5041 - Qualitative Methods for Policy Analysts (4.0 cr)
•PA 5920 - Skills Workshop (0.5 - 4.0 cr)
•POL 8126 - Qualitative Methods (3.0 cr)
•PUBH 6190 - Environmental Chemistry (3.0 cr)
•PUBH 7250 - Designing and Conducting Focus Group Interviews (1.0 cr)
•PUBH 7407 - Analysis of Categorical Data (3.0 cr)
•SOC 5811 - Social Statistics for Graduate Students (4.0 cr)
•SOC 8801 - Sociological Research Methods (4.0 cr)
•SOC 8811 - Advanced Social Statistics (4.0 cr)
•SOIL 5232 - Vadose Zone Hydrology (3.0 cr)
•STAT 5021 - Statistical Analysis (4.0 cr)
•STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
•STAT 5302 - Applied Regression Analysis (4.0 cr)
•STAT 5303 - Designing Experiments (4.0 cr)
•STAT 5401 - Applied Multivariate Methods (3.0 cr)
•STAT 5421 - Analysis of Categorical Data (3.0 cr)
•STAT 5601 - Nonparametric Methods (3.0 cr)
•STAT 8051 - Advanced Regression Techniques: linear, nonlinear and nonparametric methods (3.0 cr)
•STAT 8052 - Applied Statistical Methods 2: Design of Experiments and Mixed -Effects Modeling (3.0 cr)
•STAT 8053 - Applied Statistical Methods 3: Multivariate Analysis and Advanced Regression (3.0 cr)
•STAT 8054 - Statistical Methods 4: Advanced Statistical Computing (3.0 cr)
•WRIT 5051 - Graduate Research Writing for International Students (3.0 cr)
•WRS 5101 - Water Policy (3.0 cr)

## Forest Products

For students who wish to specialize in areas such as: wood and fiber as raw materials; deterioration of wood; wood mechanics and structural design; wood moisture interactions and drying; processing and performance of composites; economics of manufacturing systems; technology and processing of solid wood products; marketing, design and production of housing components; and energy-efficient building construction.

**Forest Products - Suggested Course List**

NRSM students in the forest products track should refer to this list when enrolling in courses that are appropriate for their area of study. Students must enroll in at least 34 credits in addition to their seminar and thesis credit (24 credits of NR 8888) requirements. Students may elect to take courses outside of this list if advised to do so by their advisor or committee.

Take 0 or more course(s) from the following:

•AGRO 5121 - Applied Experimental Design (4.0 cr)
•APEC 5031 - Methods of Economic Data Analysis (3.0 cr)
•APEC 5032 - Economic Data Analysis for Managerial and Policy Decisions (3.0 cr)
•APEC 8211 - Econometric Analysis I (2.0 cr)
•APEC 8212 - Econometric Analysis II (2.0 cr)
•BBE 5001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products (4.0 cr)
•BBE 5023 - Process Control and Instrumentation (3.0 cr)
•BBE 5301 - Applied Surface and Colloid Science (3.0 cr)
•BBE 5302 - Biodegradation of Bioproducts (3.0 cr)
•BBE 5303 - Introduction to Bio-based Materials Science (3.0 cr)
•BBE 5401 - Bioproducts Separation and Purification Processes (3.0 cr)
•BBE 5402 - Bio-based Products Engineering Lab II (2.0 cr)
•BBE 5403 - Bio-based Products Engineering Lab I (2.0 cr)
•BBE 5404 - Biopolymers and Biocomposites Engineering (3.0 cr)
•BBE 5608 - Environmental and Industrial Microbiology (3.0 cr)
•BBE 5713 - Biological Process Engineering (3.0 cr)
•BBE 5733 - Renewable Energy Technologies (3.0 cr)
•BBE 8001 - Seminar I (1.0 cr)
•BBE 8002 - Seminar II (1.0 cr)
•BBE 8013 - Parameter Estimation in Biosystems and Agricultural Engineering (3.0 cr)
•CHEM 4214 - Polymers (3.0 cr)
•CHEM 4221 - Introduction to Polymer Chemistry (3.0 cr)
•CHEM 5210 - Materials Characterization (4.0 cr)
•CI 8149 - Qualitative Research: Coding, Analysis, Interpretation, and Writing (3.0 cr)
•DES 8103 - Qualitative Research Methods in Design (3.0 cr)
•ENTR 6041 - Initiating New Product Design and Business Development (4.0 cr)
•EPSY 5221 - Principles of Educational and Psychological Measurement (3.0 cr)

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- EPSY 5244 - Survey Design, Sampling, and Implementation (3.0 cr)
- EPSY 5247 - Qualitative Methods in Educational Psychology (3.0 cr)
- EPSY 5261 - Introductory Statistical Methods (3.0 cr)
- EPSY 5262 - Intermediate Statistical Methods (3.0 cr)
- EPSY 8266 - Statistical Analysis Using Structural Equation Methods (3.0 cr)
- ESPM 5211 - Survey, Measurement, and Modeling for Environmental Analysis (3.0 cr)
- ESPM 5242 - Methods for Environmental and Natural Resource Policy Analysis (3.0 cr)
- ESPM 5603 - Environmental Life Cycle Analysis (3.0 cr)
- FNRM 5131 - Geographical Information Systems (GIS) for Natural Resources (4.0 cr)
- FNRM 8101 - Research Problems: Physiological Ecology (1.0 - 5.0 cr)
- FNRM 8102 - Research Problems: Forest-Tree Genetics (1.0 - 5.0 cr)
- FNRM 8103 - Research Problems: Forest Hydrology (1.0 - 5.0 cr)
- FNRM 8104 - Research Problems: Forest Ecology (1.0 - 5.0 cr)
- FNRM 8105 - Research Problems: Silviculture (1.0 - 5.0 cr)
- FNRM 8106 - Research Problems: Urban Forestry--Biology and Management (1.0 - 5.0 cr)
- FNRM 8201 - Research Problems: Forest Economics (1.0 - 5.0 cr)
- FNRM 8202 - Research Problems: Forest Biometry and Measurements (1.0 - 5.0 cr)
- FNRM 8203 - Research Problems: Forest Recreation (1.0 - 5.0 cr)
- FNRM 8204 - Research Problems: Forest Policy (1.0 - 5.0 cr)
- FNRM 8205 - Research Problems: Spatial Data Analysis (1.0 - 5.0 cr)
- FNRM 8206 - Research Problems: Forest Management (1.0 - 5.0 cr)
- FNRM 8207 - Economic Analysis of Natural Resource Projects (1.0 - 5.0 cr)
- FNRM 8208 - Research Problems: Environmental Learning and Leadership (1.0 - 5.0 cr)
- GIS 5555 - Basic Spatial Analysis (3.0 cr)
- GRAD 8101 - Teaching in Higher Education (3.0 cr)
- GRAD 8200 - Teaching and Learning Topics in Higher Education (1.0 cr)
- ME 5228 - Introduction to Finite Element Modeling, Analysis, and Design (4.0 cr)
- NR 5021 - Statistics for Agricultural and Natural Resource Professionals (3.0 cr)
- NR 8100 - Topics in Natural Resources Science and Management (1.0 - 2.0 cr)
- OLPD 5061 - Ethnographic Research Methods (3.0 cr)
- OLPD 5528 *{Inactive}*(1.0 - 3.0 cr)
- PA 5002 - Introduction to Policy Analysis (1.5 cr)
- PA 5031 - Statistics for Public Affairs (4.0 cr)
- PA 5035 *{Inactive}*(1.5 cr)
- PA 5041 - Qualitative Methods for Policy Analysts (4.0 cr)
- PA 5920 - Skills Workshop (0.5 - 4.0 cr)
- POL 8126 - Qualitative Methods (3.0 cr)
- PUBH 7250 - Designing and Conducting Focus Group Interviews (1.0 cr)
- PUBH 7407 - Analysis of Categorical Data (3.0 cr)
- SOC 5811 - Social Statistics for Graduate Students (4.0 cr)
- SOC 8801 - Sociological Research Methods (4.0 cr)
- SOC 8811 - Advanced Social Statistics (4.0 cr)
- SSM 5616 - Building Science I: Fundamentals (4.0 cr)
- SSM 5614 - Building Systems Performance: Testing & Diagnostics (2.0 cr)
- STAT 5021 - Statistical Analysis (4.0 cr)
- STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
- STAT 5302 - Applied Regression Analysis (4.0 cr)
- STAT 5303 - Designing Experiments (4.0 cr)
- STAT 5401 - Applied Multivariate Methods (3.0 cr)
- STAT 5421 - Analysis of Categorical Data (3.0 cr)
- STAT 5601 - Nonparametric Methods (3.0 cr)
- STAT 8051 - Advanced Regression Techniques: linear, nonlinear and nonparametric methods (3.0 cr)
- STAT 8052 - Applied Statistical Methods 2: Design of Experiments and Mixed -Effects Modeling (3.0 cr)
- STAT 8053 - Applied Statistical Methods 3: Multivariate Analysis and Advanced Regression (3.0 cr)
- STAT 8054 - Statistical Methods 4: Advanced Statistical Computing (3.0 cr)
- WRIT 5051 - Graduate Research Writing for International Students (3.0 cr)

## Forests: Biology, Ecology, Conservation, and Management

Focuses on forest resources and allows students to choose from specializations in the following areas: forest biology, ecology, ecophysiology; genetics and tree improvement; tree physiology; reproductive biology and forest regeneration; forest growth and vegetation dynamics; timber harvesting, silviculture, and sustainable forest management; landscape ecology, restoration, and management; conservation of biodiversity and wildlife habitat management; forest health; disturbance (including fire) ecology; urban and community forestry; and agroforestry. Research normally focuses on forest and related ecosystems.

**Forests: Biology, Ecology, Conservation, and Management - Suggested Course List**

NRSM students in the forests: biology, ecology, conservation, and management track should refer to this list when enrolling in courses

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that are appropriate for their area of study. Students must enroll in at least 34 credits in addition to their seminar and thesis credit (24 credits of NR 8888) requirements. Students may elect to take courses outside of this list if advised to do so by their advisor or committee.

Take 0 or more course(s) from the following:

- AGRO 5121 - Applied Experimental Design (4.0 cr)
- APEC 5031 - Methods of Economic Data Analysis (3.0 cr)
- APEC 5032 - Economic Data Analysis for Managerial and Policy Decisions (3.0 cr)
- APEC 5651 *{Inactive}*(3.0 cr)
- APEC 8211 - Econometric Analysis I (2.0 cr)
- APEC 8212 - Econometric Analysis II (2.0 cr)
- BBE 5001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products (4.0 cr)
- BBE 5302 - Biodegradation of Bioproducts (3.0 cr)
- BBE 5535 - Assessment and Diagnosis of Impaired Waters (3.0 cr)
- CI 8149 - Qualitative Research: Coding, Analysis, Interpretation, and Writing (3.0 cr)
- DES 8103 - Qualitative Research Methods in Design (3.0 cr)
- EEB 4609W - Ecosystem Ecology [ENV, WI] (3.0 cr)
- EEB 5068 - Plant Physiological Ecology (3.0 cr)
- EEB 5609 - Ecosystem Ecology (3.0 cr)
- EEB 8200 - Sustainability Science Distributed Graduate Seminar (3.0 cr)
- ENT 4251 - Forest and Shade Tree Entomology (3.0 cr)
- EPSY 5221 - Principles of Educational and Psychological Measurement (3.0 cr)
- EPSY 5244 - Survey Design, Sampling, and Implementation (3.0 cr)
- EPSY 5247 - Qualitative Methods in Educational Psychology (3.0 cr)
- EPSY 5261 - Introductory Statistical Methods (3.0 cr)
- EPSY 5262 - Intermediate Statistical Methods (3.0 cr)
- EPSY 8266 - Statistical Analysis Using Structural Equation Methods (3.0 cr)
- ESPM 5071 - Ecological Restoration (4.0 cr)
- ESPM 5101 *{Inactive}*(3.0 cr)
- ESPM 5108 - Ecology of Managed Systems (4.0 cr)
- ESPM 5202 - Environmental Conflict Management, Leadership, and Planning (3.0 cr)
- ESPM 5211 - Survey, Measurement, and Modeling for Environmental Analysis (3.0 cr)
- ESPM 5242 - Methods for Environmental and Natural Resource Policy Analysis (3.0 cr)
- ESPM 5256 - Natural Resource Law and the Management of Public Lands and Waters (3.0 cr)
- ESPM 5555 - Wetland Soils (3.0 cr)
- ESPM 5603 - Environmental Life Cycle Analysis (3.0 cr)
- ESPM 5703 *{Inactive}*(3.0 cr)
- FNRM 5104 - Forest Ecology (4.0 cr)
- FNRM 5114 - Hydrology and Watershed Management (3.0 cr)
- FNRM 5131 - Geographical Information Systems (GIS) for Natural Resources (4.0 cr)
- FNRM 5153 - Forest Hydrology & Watershed Biogeochemistry (3.0 cr)
- FNRM 5203 - Forest Fire and Disturbance Ecology (3.0 cr)
- FNRM 5204 - Landscape Ecology and Management (3.0 cr)
- FNRM 5205 *{Inactive}*(3.0 cr)
- FNRM 5218 - Measuring and Modeling Forests (3.0 cr)
- FNRM 5262 - Remote Sensing and Geospatial Analysis of Natural Resources and Environment (3.0 cr)
- FNRM 5264 - Advanced Forest Management Planning (3.0 cr)
- FNRM 5411 - Managing Forest Ecosystems: Silviculture (3.0 cr)
- FNRM 5413 - Managing Forest Ecosystems: Silviculture Lab (1.0 cr)
- FNRM 5501 - Urban Forest Management: Managing Greenspaces for People (3.0 cr)
- FNRM 8101 - Research Problems: Physiological Ecology (1.0 - 5.0 cr)
- FNRM 8102 - Research Problems: Forest-Tree Genetics (1.0 - 5.0 cr)
- FNRM 8103 - Research Problems: Forest Hydrology (1.0 - 5.0 cr)
- FNRM 8104 - Research Problems: Forest Ecology (1.0 - 5.0 cr)
- FNRM 8105 - Research Problems: Silviculture (1.0 - 5.0 cr)
- FNRM 8106 - Research Problems: Urban Forestry--Biology and Management (1.0 - 5.0 cr)
- FNRM 8201 - Research Problems: Forest Economics (1.0 - 5.0 cr)
- FNRM 8202 - Research Problems: Forest Biometry and Measurements (1.0 - 5.0 cr)
- FNRM 8203 - Research Problems: Forest Recreation (1.0 - 5.0 cr)
- FNRM 8204 - Research Problems: Forest Policy (1.0 - 5.0 cr)
- FNRM 8205 - Research Problems: Spatial Data Analysis (1.0 - 5.0 cr)
- FNRM 8206 - Research Problems: Forest Management (1.0 - 5.0 cr)
- FNRM 8207 - Economic Analysis of Natural Resource Projects (1.0 - 5.0 cr)
- FNRM 8208 - Research Problems: Environmental Learning and Leadership (1.0 - 5.0 cr)
- FW 5003 - Human Dimensions of Biological Conservation (3.0 cr)
- FW 5603W - Habitats and Regulation of Wildlife [WI] (3.0 cr)
- FW 8051 - Statistical Modeling of Ecological Data using R and WinBugs/JAGS (4.0 cr)

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- FW 8200 - Seminar (1.0 - 4.0 cr)
- FW 8452 - Conservation Biology (3.0 cr)
- GEOG 5426 - Climatic Variations (3.0 cr)
- GEOG 5839 - Introduction to Dendrochronology (4.0 cr)
- GEOG 8260 - Seminar: Physical Geography (2.0 cr)
- GIS 5555 - Basic Spatial Analysis (3.0 cr)
- GRAD 8101 - Teaching in Higher Education (3.0 cr)
- GRAD 8200 - Teaching and Learning Topics in Higher Education (1.0 cr)
- HORT 5071 - Ecological Restoration (4.0 cr)
- NR 5021 - Statistics for Agricultural and Natural Resource Professionals (3.0 cr)
- NR 8100 - Topics in Natural Resources Science and Management (1.0 - 2.0 cr)
- OLPD 5061 - Ethnographic Research Methods (3.0 cr)
- OLPD 5528 *{Inactive}*(1.0 - 3.0 cr)
- PA 5002 - Introduction to Policy Analysis (1.5 cr)
- PA 5031 - Statistics for Public Affairs (4.0 cr)
- PA 5035 *{Inactive}*(1.5 cr)
- PA 5041 - Qualitative Methods for Policy Analysts (4.0 cr)
- PA 5920 - Skills Workshop (0.5 - 4.0 cr)
- PA 8201 *{Inactive}*(4.0 cr)
- PLPA 5003 - Diseases of Forest and Shade Trees (3.0 cr)
- PLPA 5480 - Principles of Plant Pathology (3.0 cr)
- POL 8126 - Qualitative Methods (3.0 cr)
- PUBH 7250 - Designing and Conducting Focus Group Interviews (1.0 cr)
- PUBH 7407 - Analysis of Categorical Data (3.0 cr)
- SOC 5811 - Social Statistics for Graduate Students (4.0 cr)
- SOC 8801 - Sociological Research Methods (4.0 cr)
- SOC 8811 - Advanced Social Statistics (4.0 cr)
- SOIL 5611 - Soil Biology and Fertility (4.0 cr)
- STAT 5021 - Statistical Analysis (4.0 cr)
- STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
- STAT 5302 - Applied Regression Analysis (4.0 cr)
- STAT 5303 - Designing Experiments (4.0 cr)
- STAT 5401 - Applied Multivariate Methods (3.0 cr)
- STAT 5421 - Analysis of Categorical Data (3.0 cr)
- STAT 5601 - Nonparametric Methods (3.0 cr)
- STAT 8051 - Advanced Regression Techniques: linear, nonlinear and nonparametric methods (3.0 cr)
- STAT 8052 - Applied Statistical Methods 2: Design of Experiments and Mixed -Effects Modeling (3.0 cr)
- STAT 8053 - Applied Statistical Methods 3: Multivariate Analysis and Advanced Regression (3.0 cr)
- STAT 8054 - Statistical Methods 4: Advanced Statistical Computing (3.0 cr)
- WRIT 5051 - Graduate Research Writing for International Students (3.0 cr)

## Paper Science and Engineering

Specializes in areas such as: the chemistry and biotechnology of lignocellulosic materials; material science of paper and fiber products; paper recycling; energy and manufacturing efficiency in the pulp and paper-making process; novel and environmentally friendly pulping and bleaching, transport processes through porous media, surface and colloid science of papermaking; chemical engineering applications in pulp and paper processes; and statistical process control.

**Paper Science and Engineering - Suggested Course List**

NRSM students in the paper science and engineering track should refer to this list when enrolling in courses that are appropriate for their area of study. Students must enroll in at least 34 credits in addition to their seminar and thesis credit (24 credits of NR 8888) requirements. Students may elect to take courses outside of this list if advised to do so by their advisor or committee.

Take 0 or more course(s) from the following:

- AGRO 5121 - Applied Experimental Design (4.0 cr)
- APEC 5031 - Methods of Economic Data Analysis (3.0 cr)
- APEC 5032 - Economic Data Analysis for Managerial and Policy Decisions (3.0 cr)
- APEC 8211 - Econometric Analysis I (2.0 cr)
- APEC 8212 - Econometric Analysis II (2.0 cr)
- BBE 5001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products (4.0 cr)
- BBE 5023 - Process Control and Instrumentation (3.0 cr)
- BBE 5301 - Applied Surface and Colloid Science (3.0 cr)
- BBE 5302 - Biodegradation of Bioproducts (3.0 cr)
- BBE 5303 - Introduction to Bio-based Materials Science (3.0 cr)
- BBE 5305 - Pulp and Paper Technology (3.0 cr)
- BBE 5401 - Bioproducts Separation and Purification Processes (3.0 cr)
- BBE 5402 - Bio-based Products Engineering Lab II (2.0 cr)
- BBE 5403 - Bio-based Products Engineering Lab I (2.0 cr)

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- BBE 5404 - Biopolymers and Biocomposites Engineering (3.0 cr)
- BBE 5608 - Environmental and Industrial Microbiology (3.0 cr)
- BBE 5713 - Biological Process Engineering (3.0 cr)
- BBE 5733 - Renewable Energy Technologies (3.0 cr)
- BBE 8001 - Seminar I (1.0 cr)
- BBE 8002 - Seminar II (1.0 cr)
- BBE 8013 - Parameter Estimation in Biosystems and Agricultural Engineering (3.0 cr)
- BBE 8300 - Research Problems (1.0 - 10.0 cr)
- CHEM 5210 - Materials Characterization (4.0 cr)
- CI 8149 - Qualitative Research: Coding, Analysis, Interpretation, and Writing (3.0 cr)
- DES 8103 - Qualitative Research Methods in Design (3.0 cr)
- EPSY 5221 - Principles of Educational and Psychological Measurement (3.0 cr)
- EPSY 5244 - Survey Design, Sampling, and Implementation (3.0 cr)
- EPSY 5247 - Qualitative Methods in Educational Psychology (3.0 cr)
- EPSY 5261 - Introductory Statistical Methods (3.0 cr)
- EPSY 5262 - Intermediate Statistical Methods (3.0 cr)
- EPSY 8266 - Statistical Analysis Using Structural Equation Methods (3.0 cr)
- ESPM 5211 - Survey, Measurement, and Modeling for Environmental Analysis (3.0 cr)
- ESPM 5242 - Methods for Environmental and Natural Resource Policy Analysis (3.0 cr)
- ESPM 5603 - Environmental Life Cycle Analysis (3.0 cr)
- FNRM 5104 - Forest Ecology (4.0 cr)
- FNRM 5131 - Geographical Information Systems (GIS) for Natural Resources (4.0 cr)
- FNRM 8101 - Research Problems: Physiological Ecology (1.0 - 5.0 cr)
- FNRM 8102 - Research Problems: Forest-Tree Genetics (1.0 - 5.0 cr)
- FNRM 8103 - Research Problems: Forest Hydrology (1.0 - 5.0 cr)
- FNRM 8104 - Research Problems: Forest Ecology (1.0 - 5.0 cr)
- FNRM 8105 - Research Problems: Silviculture (1.0 - 5.0 cr)
- FNRM 8106 - Research Problems: Urban Forestry--Biology and Management (1.0 - 5.0 cr)
- FNRM 8201 - Research Problems: Forest Economics (1.0 - 5.0 cr)
- FNRM 8202 - Research Problems: Forest Biometry and Measurements (1.0 - 5.0 cr)
- FNRM 8203 - Research Problems: Forest Recreation (1.0 - 5.0 cr)
- FNRM 8204 - Research Problems: Forest Policy (1.0 - 5.0 cr)
- FNRM 8205 - Research Problems: Spatial Data Analysis (1.0 - 5.0 cr)
- FNRM 8206 - Research Problems: Forest Management (1.0 - 5.0 cr)
- FNRM 8207 - Economic Analysis of Natural Resource Projects (1.0 - 5.0 cr)
- FNRM 8208 - Research Problems: Environmental Learning and Leadership (1.0 - 5.0 cr)
- GIS 5555 - Basic Spatial Analysis (3.0 cr)
- GRAD 8101 - Teaching in Higher Education (3.0 cr)
- GRAD 8200 - Teaching and Learning Topics in Higher Education (1.0 cr)
- ME 5228 - Introduction to Finite Element Modeling, Analysis, and Design (4.0 cr)
- NR 5021 - Statistics for Agricultural and Natural Resource Professionals (3.0 cr)
- NR 8100 - Topics in Natural Resources Science and Management (1.0 - 2.0 cr)
- OLPD 5061 - Ethnographic Research Methods (3.0 cr)
- OLPD 5528 *{Inactive}*(1.0 - 3.0 cr)
- PA 5002 - Introduction to Policy Analysis (1.5 cr)
- PA 5031 - Statistics for Public Affairs (4.0 cr)
- PA 5035 *{Inactive}*(1.5 cr)
- PA 5041 - Qualitative Methods for Policy Analysts (4.0 cr)
- PA 5920 - Skills Workshop (0.5 - 4.0 cr)
- POL 8126 - Qualitative Methods (3.0 cr)
- PUBH 7250 - Designing and Conducting Focus Group Interviews (1.0 cr)
- PUBH 7407 - Analysis of Categorical Data (3.0 cr)
- SOC 5811 - Social Statistics for Graduate Students (4.0 cr)
- SOC 8801 - Sociological Research Methods (4.0 cr)
- SOC 8811 - Advanced Social Statistics (4.0 cr)
- STAT 5021 - Statistical Analysis (4.0 cr)
- STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
- STAT 5302 - Applied Regression Analysis (4.0 cr)
- STAT 5303 - Designing Experiments (4.0 cr)
- STAT 5401 - Applied Multivariate Methods (3.0 cr)
- STAT 5421 - Analysis of Categorical Data (3.0 cr)
- STAT 5601 - Nonparametric Methods (3.0 cr)
- STAT 8051 - Advanced Regression Techniques: linear, nonlinear and nonparametric methods (3.0 cr)
- STAT 8052 - Applied Statistical Methods 2: Design of Experiments and Mixed -Effects Modeling (3.0 cr)
- STAT 8053 - Applied Statistical Methods 3: Multivariate Analysis and Advanced Regression (3.0 cr)
- STAT 8054 - Statistical Methods 4: Advanced Statistical Computing (3.0 cr)

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•WRIT 5051 - Graduate Research Writing for International Students (3.0 cr)

## Recreation Resources, Tourism, and Environmental Education

Focuses on the use and management of natural resources for recreation and tourism. Graduate students in this track may specialize in areas such recreational land management, resource-based tourism, planning for recreation and tourism, and the human dimensions of natural resource uses. Additionally, students may focus on environmental education and leadership for effective communication with diverse publics about natural resources.

**Recreation Resources, Tourism, and Environmental Education - Suggested Course List**

NRSM students in the recreation resources, tourism, and environmental education track should refer to this list when enrolling in courses that are appropriate for their area of study. Students must enroll in at least 34 credits in addition to their seminar and thesis credit (24 credits of NR 8888) requirements. Students may elect to take courses outside of this list if advised to do so by their advisor or committee.

Take 0 or more course(s) from the following:

•AGRO 5121 - Applied Experimental Design (4.0 cr)
•APEC 4311 *{Inactive}*(3.0 cr)
•APEC 5031 - Methods of Economic Data Analysis (3.0 cr)
•APEC 5032 - Economic Data Analysis for Managerial and Policy Decisions (3.0 cr)
•APEC 8211 - Econometric Analysis I (2.0 cr)
•APEC 8212 - Econometric Analysis II (2.0 cr)
•CI 5537 *{Inactive}*(3.0 cr)
•CI 5747 *{Inactive}*(3.0 cr)
•CI 8149 - Qualitative Research: Coding, Analysis, Interpretation, and Writing (3.0 cr)
•DES 8103 - Qualitative Research Methods in Design (3.0 cr)
•EEB 5053 - Ecology: Theory and Concepts (4.0 cr)
•EPSY 5221 - Principles of Educational and Psychological Measurement (3.0 cr)
•EPSY 5243 - Principles and Methods of Evaluation (3.0 cr)
•EPSY 5244 - Survey Design, Sampling, and Implementation (3.0 cr)
•EPSY 5247 - Qualitative Methods in Educational Psychology (3.0 cr)
•EPSY 5261 - Introductory Statistical Methods (3.0 cr)
•EPSY 5262 - Intermediate Statistical Methods (3.0 cr)
•EPSY 8251 - Statistical Methods in Education I (3.0 cr)
•EPSY 8266 - Statistical Analysis Using Structural Equation Methods (3.0 cr)
•ESPM 5202 - Environmental Conflict Management, Leadership, and Planning (3.0 cr)
•ESPM 5211 - Survey, Measurement, and Modeling for Environmental Analysis (3.0 cr)
•ESPM 5242 - Methods for Environmental and Natural Resource Policy Analysis (3.0 cr)
•ESPM 5245 - Sustainable Land Use Planning and Policy (3.0 cr)
•ESPM 5251 - Natural Resources in Sustainable International Development (3.0 cr)
•ESPM 5261 - Economics and Natural Resources Management (4.0 cr)
•ESPM 5603 - Environmental Life Cycle Analysis (3.0 cr)
•ESPM 5811 - Environmental Interpretation (3.0 cr)
•FNRM 5101 - Park and Protected Area Tourism (3.0 cr)
•FNRM 5104 - Forest Ecology (4.0 cr)
•FNRM 5131 - Geographical Information Systems (GIS) for Natural Resources (4.0 cr)
•FNRM 5201 *{Inactive}*(3.0 cr)
•FNRM 5232 - Managing Recreational Lands (4.0 cr)
•FNRM 5259 - Visitor Behavior Analysis (3.0 cr)
•FNRM 8101 - Research Problems: Physiological Ecology (1.0 - 5.0 cr)
•FNRM 8102 - Research Problems: Forest-Tree Genetics (1.0 - 5.0 cr)
•FNRM 8103 - Research Problems: Forest Hydrology (1.0 - 5.0 cr)
•FNRM 8104 - Research Problems: Forest Ecology (1.0 - 5.0 cr)
•FNRM 8105 - Research Problems: Silviculture (1.0 - 5.0 cr)
•FNRM 8106 - Research Problems: Urban Forestry--Biology and Management (1.0 - 5.0 cr)
•FNRM 8201 - Research Problems: Forest Economics (1.0 - 5.0 cr)
•FNRM 8202 - Research Problems: Forest Biometry and Measurements (1.0 - 5.0 cr)
•FNRM 8203 - Research Problems: Forest Recreation (1.0 - 5.0 cr)
•FNRM 8204 - Research Problems: Forest Policy (1.0 - 5.0 cr)
•FNRM 8205 - Research Problems: Spatial Data Analysis (1.0 - 5.0 cr)
•FNRM 8206 - Research Problems: Forest Management (1.0 - 5.0 cr)
•FNRM 8207 - Economic Analysis of Natural Resource Projects (1.0 - 5.0 cr)
•FNRM 8208 - Research Problems: Environmental Learning and Leadership (1.0 - 5.0 cr)
•FW 5003 - Human Dimensions of Biological Conservation (3.0 cr)
•GIS 5555 - Basic Spatial Analysis (3.0 cr)
•GRAD 8101 - Teaching in Higher Education (3.0 cr)
•GRAD 8200 - Teaching and Learning Topics in Higher Education (1.0 cr)
•LS 5950 *{Inactive}*(1.0 - 4.0 cr)

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- NR 5021 - Statistics for Agricultural and Natural Resource Professionals (3.0 cr)
- NR 8100 - Topics in Natural Resources Science and Management (1.0 - 2.0 cr)
- OLPD 5061 - Ethnographic Research Methods (3.0 cr)
- OLPD 5501 - Principles and Methods of Evaluation (3.0 cr)
- OLPD 5502 - Comparative evaluation theory for practice (3.0 cr)
- OLPD 5528 *{Inactive}*(1.0 - 3.0 cr)
- OLPD 5611 - Facilitation and Meeting Skills (1.0 cr)
- PA 4101 - Nonprofit Management and Governance (3.0 cr)
- PA 5002 - Introduction to Policy Analysis (1.5 cr)
- PA 5011 - Dynamics of Public Affairs Organizations (3.0 cr)
- PA 5031 - Statistics for Public Affairs (4.0 cr)
- PA 5035 *{Inactive}*(1.5 cr)
- PA 5041 - Qualitative Methods for Policy Analysts (4.0 cr)
- PA 5111 *{Inactive}*(3.0 cr)
- PA 5501 - Theories and Policies of Development (3.0 cr)
- PA 5920 - Skills Workshop (0.5 - 4.0 cr)
- POL 8126 - Qualitative Methods (3.0 cr)
- PSY 5202 - Attitudes and Social Behavior (3.0 cr)
- PSY 5960 - Topics in Psychology (1.0 - 4.0 cr)
- PUBH 7250 - Designing and Conducting Focus Group Interviews (1.0 cr)
- PUBH 7407 - Analysis of Categorical Data (3.0 cr)
- SOC 5811 - Social Statistics for Graduate Students (4.0 cr)
- SOC 8701 - Sociological Theory (4.0 cr)
- SOC 8801 - Sociological Research Methods (4.0 cr)
- SOC 8811 - Advanced Social Statistics (4.0 cr)
- STAT 5021 - Statistical Analysis (4.0 cr)
- STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
- STAT 5302 - Applied Regression Analysis (4.0 cr)
- STAT 5303 - Designing Experiments (4.0 cr)
- STAT 5401 - Applied Multivariate Methods (3.0 cr)
- STAT 5421 - Analysis of Categorical Data (3.0 cr)
- STAT 5601 - Nonparametric Methods (3.0 cr)
- STAT 8051 - Advanced Regression Techniques: linear, nonlinear and nonparametric methods (3.0 cr)
- STAT 8052 - Applied Statistical Methods 2: Design of Experiments and Mixed -Effects Modeling (3.0 cr)
- STAT 8053 - Applied Statistical Methods 3: Multivariate Analysis and Advanced Regression (3.0 cr)
- STAT 8054 - Statistical Methods 4: Advanced Statistical Computing (3.0 cr)
- WRIT 5051 - Graduate Research Writing for International Students (3.0 cr)

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