COLLEGE OF NATURAL RESOURCES AND ENVIRONMENT
Department of Forest Resources and Environmental Conservation
B.S. Degree in Water: Resources, Policy, and Management
Major: Water: Resources, Policy, and Management
For students graduating in calendar year 2022 and for student date of entry under UG Catalog 2020-2021

Minimum credits required for graduation is 120.

Degree Core Requirements (20 credits)
___ALS/WATR 4614 Watershed Assessment, Management, and Policy* (2 credits)
___ENSC 3604 Fundamentals of Environmental Science* (3 credits)
___FREC/WATR 3104 Principles of Watershed Hydrology* (3 credits)
___FREC/WATR 3754 Watersheds and Water Quality Monitoring* (3 credits)
___FREC/WATR/AAEC 4464 Water Resources Policy & Economics* (3 credits)
___GEOG/WATR 2004 Water, Environment, and Society (3 credits)
___ PHYS 2205 General Physics* (3 credits)

Major Requirements (33 hours)

Water Law and Planning (*3 credits – choose one course*)
___AAEC 3314 Environmental Law (3 credits)
___UAP 3354 Introduction to Environmental Policy and Planning (3 credits)
___UAP 4344 Law of Critical Environmental Areas (3 credits)
___UAP 4374 Land Use and Environment: Planning and Policy* (3 credits)

Geospatial Technology and Informatics (*3 credits – choose one course*)
___BSE 4344 GIS for Engineers* (3 credits)
___FREC 3004 Environmental Informatics* (3 credits) [Pathways Core 5a; Integrative 10]
___FREC 4114 Information Technologies for Natural Resource Management* (3 credits)
___FREC 4214 Forest Photogrammetry and Spatial Data Processing* (3 credits)
___GEOG 2084 Principles of Geographic Information Systems (3 credits)
___GEOG/GEOS 4354 Introduction to Remote Sensing (3 credits)

Labs (3 credits)
___BIOL 1116 Principles of Biology Lab* (1 credit)
___CHEM 1045 General Chemistry Lab* (1 credit) [Pathways Core 4; Integrative 11]
___PHYS 2215 General Physics Lab* (1 credit) [Pathways Core 4; Integrative 10]

Water Science Specialization *(12 credits – choose 9 credits in <u>one</u> of the three specializations listed below and the remaining 3 credits in <u>any</u> of the three specializations listed below)*
(see Water Science Specialization course list)
___I. *Aquatic Ecosystems* _____ _____ _____ _____
___II. *Hydrology* _____ _____ _____ _____
___III. *Water Quality* _____ _____ _____ _____

Water Policy Specialization *(12 credits – choose 9 credits in <u>one</u> of the two specializations listed below and the remaining 3 credits in <u>either</u> of the two specializations listed below)*
(see Water Policy Specialization course list)
___I. *Water Planning, Policy, and Economics* _____ _____ _____ _____
___II. *Water, Climate, Energy, and Global Issues* _____ _____ _____ _____

*Courses may have prerequisites, corequisites, or other restrictions. Consult Course Catalog for details.

Restricted Electives (15 credits) – *see course lists: choose from courses listed under the Water Science or Water Policy Specializations or from those listed as Restricted Electives*

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Free Electives (7 credits)

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Pathways Requirements (45 Pathways credits)

1. Discourse (9 credits: 6 foundational credits, 3 applied/advanced)

___Choose course: Foundational Discourse (3 credits)
___Choose course: Foundational Discourse (3 credits)
___ENGL 3534 Literature and the Environment* (3 credits) **or** ENGL 3764 Technical Writing (3 credits)

2. Critical Thinking in the Humanities (6 credits)

___Choose course (3 credits)
___Choose course (3 credits)
*Suggested: FREC 2554 Leading Global Sustainability (3 credits) **or** HIST 3144 American Environmental History (3 credits)*

3. Reasoning in the Social Sciences (6 credits)

___AAEC 1005 Economics of the Food and Fiber System (3 credits) **or** ECON 2005 Principles of Economics (3 credits)
___AAEC 1006 Economics of the Food and Fiber System (3 credits) **or** ECON 2006 Principles of Economics (3 credits)

4. Reasoning in the Natural Sciences (6 credits)

___BIOL 1106 Principles of Biology* (3 credits)
___CHEM 1035 General Chemistry* (3 credits)

5. Quantitative and Computational Thinking (9 credits: 6 foundational credits, 3 applied/advanced credits)

___MATH 1025 Elementary Calculus (3 credits) **or** MATH 1225 Calculus of a Single Variable (4 credits)
___MATH 1026 Elementary Calculus (3 credits) **or** MATH 1226 Calculus of a Single Variable (4 credits)
___Choose advanced/applied course (3 credits)
Suggested: FREC 3004 Environmental Informatics (3 credits) **or** FREC 4354 Forest Soil and Watershed Management* (3 credits)*

6. Critique and Practice in Design and the Arts (6 credits: 3 design & 3 arts, or 6 integrated)

___Choose course (3 credits)
___Choose course (3 credits)
Suggested: FREC 4554 Creating the Ecological City (3 credits)

7. Critical Analysis of Identity and Equity in the United States (3 credits) – may be double-counted with another core outcome or major requirement

___Choose course (3 credits)

*Courses may have prerequisites, corequisites, or other restrictions. Consult Course Catalog for details.

Pathways Core Concepts
1f = Foundational Discourse
1a = Advanced/Applied Discourse
2 = Critical Thinking in the Humanities
3 = Reasoning in the Social Sciences
4 = Reasoning in the Natural Sciences
5f = Foundational Quantitative and Computational Thinking
5a = Advanced/Applied Quantitative and Computational Thinking
6d = Critique and Practice in Design
6a = Critique and Practice in the Arts
6ad = Critique and Practice in Design and the Arts
7 = Critical Analysis of Equity and Identity in the United States
Pathways Integrative Concepts
10 = Ethical Reasoning
11 = Intercultural and Global Awareness

WATER: RESOURCES, POLICY, AND MANAGEMENT NOTES

1. **In-Major GPA Computation:** Degree core requirements and major requirements (with the exception of PHYS 2205 and Lab major requirements) count toward in-major GPA. This includes courses in the water science specialization and water policy specialization. For restricted electives and free electives, any course taken from either a water science specialization or a water policy specialization counts toward the in-major GPA.

2. **Satisfactory Progress:** By the end of the semester in which the student has attempted 60 credits (including transfer, advanced placement, advanced standing, and credit by examination), "satisfactory progress" towards a B.S. degree in Water: Resources, Policy, and Management will include the following minimum criteria:

    - Having an in-major and overall grade point average of at least 2.0
    - Passing at least 24 semester credits that apply to Pathways Requirements
    - Passing the following courses, or their equivalents: BIOL 1106, 1116; CHEM 1035, 1045; and MATH 1026

3. **Foreign Language Requirement:** Students who did not successfully complete at least two years of a single foreign, classical, or sign language during high school must successfully complete six semester hours of a single foreign, classical, or sign language at the college level. Course taken to meet this requirement do not count toward the hours required for graduation. Please consult the Undergraduate Catalog for details.

4. **Policy on Student Exchanges:** Studying overseas or at another U.S. university is a wonderful opportunity to enhance your education. However, planning for an exchange should begin at least nine months prior to leaving for the exchange. This will allow time to determine what substitutions, if any, will be allowed and time to arrange your schedule at Virginia Tech to ensure that all requirements for graduation are met.

5. **GPA for Graduation:** An in-major and overall GPA of 2.0 is required for graduation.

6. In accordance with university guidelines, courses satisfying degree core requirements may not be double counted to satisfy other areas of a degree (e.g., Pathways Requirements).

*Courses may have prerequisites, corequisites, or other restrictions. Consult Course Catalog for details.

7. **American Institute of Hydrology - Educational Criteria:** This is an option for students interested in pursuing a Professional Hydrology certification with the American Institute of Hydrology after completing their B.S. and five years of experience. See American Institute of Hydrology Professional Hydrology Certification Application Process for specific requirements.

   Basic Education Requirements:
   Completion of a full course of study leading to a bachelor's or higher degree at an accredited college or university with a major in hydrology, physical or natural science or engineering. The study must have included a minimum of:
   - 5 semester hours in Chemistry (e.g., CHEM 1035 and 1036)
   - 5 semester hours in Physics (e.g., PHYS 2205 and 2206)
   - 5 semester hours in Differential and Integral Calculus (e.g., MATH 1025 and 1026)
   - One basic course in surface or groundwater hydrology (3 semester hours; e.g., FREC 3104)
   - 25 semester hours in the specialty areas (Students may meet these requirements if they select the Hydrology or Water Quality specialization).
     - Completion of 25 semester hours of which at least 10 semester hours must come from Category I listing of courses and the rest from a combination of Category II and Category III listing of courses. Twenty semester hours must be in the third or fourth year or graduate course studies.
     - Category I. Courses in hydrology, hydrogeology, or water quality - minimum of 6 semester hours.
     - Category II. Courses in allied subjects in which hydrology, hydrogeology or water quality constitutes more than 10 percent of the course work - minimum of 9 semester hours.
     - Category III. Supplemental courses - minimum of 6 semester hours. These courses would include subjects such as economics, geology, geophysics, law, planning, remote sensing, statistics, land and water policy, resource management, water administration, and so forth.

8. **US Office of Personnel Management: Hydrology Qualification Standards:**
   Basic Requirements:
   Degree: physical or natural science, or engineering that included at least 30 semester hours in any combination of courses in hydrology, the physical sciences, geophysics, chemistry, engineering science, soils, mathematics, aquatic biology, atmospheric science, meteorology, geology, oceanography, or the management or conservation of water resources. The course work must have included at least 6 semester hours in calculus (including both differential and integral calculus, e.g., MATH 1025 and 1026), and at least 6 semester hours in physics (e.g., PHYS 2205 and 2206).

Water Science Specialization Courses

I. Aquatic Ecosystems

BIOL	4004	Freshwater Ecology* (4 credits)
BIOL/CSES/ENSC	4164	Environmental Microbiology* (3 credits)
BIOL/ENT	4354	Aquatic Entomology* (4 credits)
BIOL	4454	Invertebrate Zoology* (4 credits)
ENT/BIOL/FIW	4484	Freshwater Biomonitoring* (4 credits)
FIW	4534	Ecology & Management of Wetland Systems* (3 credits)
FIW	4614	Fish Ecology* (3 credits)

*Courses may have prerequisites, corequisites, or other restrictions. Consult Course Catalog for details.

FIW	4624	Marine Ecology* (3 credits)
FIW	4714	Fisheries Management* (4 credits)
FREC	4374	Forested Wetlands* (3 credits)

II. Hydrology

BSE	4224	Field Methods in Hydrology* (3 credits)
CEE	3314	Water Resources Engineering* (4 credits)
CEE	4304	Hydrology* (3 credits)
CEE	4314	Groundwater Resources* (3 credits)
CEE	4324	Open Channel Flow* (3 credits)
CSES/GEOG/GEOS	3304	Geomorphology* (3 credits)
CSES/ENSC	3614	Soil Physical & Hydrological Properties* (3 credits)
FREC	4354	Forest Soil and Watershed Management* (3 credits)
GEOS	3014	Environmental Geosciences* (3 credits)
GEOS	4804	Groundwater Hydrology* (3 credits)

III. Water Quality

BSE	4394	Water Supply & Sanitation in Developing Countries* (3 credits)
CEE	3104	Introduction to Environmental Engineering* (3 credits)
CEE	4104	Water & Wastewater Treatment Design* (3 credits)
CEE	4114	Fundamentals of Public Health Engineering* (3 credits)
CEE	4174	Solid & Hazardous Waste Management* (3 credits)
CSES	4644	Land Based Systems for Waste Treatment (3 credits)
CSES/BIOL/ENSC	4164	Environmental Microbiology* (3 credits)
CSES/ENSC	3634	Physics of Pollution* (3 credits)
CSES/ENSC/CHEM	4734	Environmental Soil Chemistry* (3 credits)
ENSC/CSES	4314	Water Quality* (3 credits)
FREC	4354	Forest Soil and Watershed Management* (3 credits)
FREC	4374	Forested Wetlands* (3 credits)
FREC	4784	Wetland Hydrology and Biogeochemistry* (3 credits)
GEOS	4634	Environmental Geochemistry* (3 credits)

Water Policy Specialization Courses

I. Water Planning, Policy, & Economics

AAEC	3004	Agricultural Production & Consumption Economics* (3 credits)
AAEC	3014	Analytical Methods in Applied Economics* (3 credits)
AAEC	3314	Environmental Law (3 credits)
AAEC	3324	Environment and Sustainable Development Economics* (3 credits)
AAEC	3604	Agricultural Law (3 credits)
AAEC	4314	Environmental Economic Analysis & Management* (3 credits)
AAEC	4344	Sustainable Development Economics* (3 credits)
CEE	4134	Environmental Sustainability – A Systems Approach* (3 credits)
CEE	4344	Water Resources Planning* (3 credits)
FREC/NR	4014	Natural Resources Economics* (3 credits)
FREC	4434	Natural Resource Policy* (3 credits)
GEOG	4204	Geography of Resources* (3 credits)
LAR	3154	Watershed Sensitive Site Design & Construction* (4 credits)
SPIA	2554	Collaborative Policy-Making and Planning (3 credits)
UAP	3224	Policy Implementation* (3 credits)

*Courses may have prerequisites, corequisites, or other restrictions. Consult Course Catalog for details.

UAP	3354	Introduction to Environmental Policy & Planning (3 credits)
UAP	4344	Law of Critical Environmental Areas* (3 credits)
UAP	4374	Land Use & Environment: Planning & Policy* (3 credits)

II. Water, Climate, Energy, & Global Issues

ALS/HORT	4714	Global Seminar* (1 credit)
BIOL	4114	Global Change Ecology* (3 credits)
BSE	4394	Water Supply & Sanitation in Developing Countries* (3 credits)
CEE	4134	Environmental Sustainability – A Systems Approach* (3 credits)
CEE	4264	Sustainable Land Development* (3 credits)
FREC	2124	Forests, Society & Climate (3 credits)
FREC/SBIO	2784	Global Forest Sustainability (3 credits)
FREC	3604	Climate Science* (3 credits)
GEOG	1514	Introduction to Meteorology (3 credits)
GEOG	3104	Environmental Problems, Population, & Development (3 credits)
GEOG/GEOS	4134	Interdisciplinary Issues and Ethics in Water Resources (3 credits)
IS	4014	International Development (3 credits)
ME/ESM	4194	Sustainable Energy Solutions for a Global Society* (3 credits)
NR/GEOG	4444	Practicing Sustainability* (3 credits)
PSCI/UAP	3344	Global Environmental Issues: Interdisciplinary Perspectives* (3 credits)
UAP/GEOG/WGS	4214	Gender, Environment, and International Development* (3 credits)
UAP/GEOG/SOC	4764	International Development Policy & Planning* (3 credits)

Restricted Electives

ALS	2204	Introduction to Civic Agriculture (3 credits)
ALS	3404	Ecological Agriculture Theory & Practice* (3 credits)
BIOL	1105	Principles of Biology* (3 credits)
BIOL	1115	Principles of Biology Lab* (1 credit)
BIOL	2504	General Zoology* (3 credits)
BIOL	2604	General Microbiology* (3 credits)
BIOL	2704	Evolutionary Biology* (3 credits)
BIOL	2804	Ecology* (3 credits)
BIOL	3204	Plant Taxonomy* (3 credits)
BSE	3334	Nonpoint Source Pollution Assessment & Control* (3 credits)
BSE	4304	Introduction to Watershed Modeling* (3 credits)
BSE	2304	Landscape Measurements and Modeling* (3 credits)
BSE	3324	Small Watershed Hydrology (3 credits)
CEE	2814	Civil and Environmental Engineering Measurement* (4 credits)
CEE	3274	Introduction to Land Development Design* (3 credits)
CEE	3304	Fluid Mechanics for Civil and Environmental Engineering* (4 credits)
CEE	3514	Introduction to Geotechnical Engineering* (4 credits)
CEE	4264	Sustainable Land Development* (3 credits)
CHE	3114	Fluid Transport* (3 credits)
CHE	3144	Mass Transfer* (3 credits)
CHEM	1036	General Chemistry* (3 credits)
CHEM	1046	General Chemistry Lab* (1 credit)
CHEM	2114	Analytical Chemistry* (3 credits)
CHEM	2514	Survey of Organic Chemistry* (3 credits)
CHEM	2535	Organic Chemistry* (3 credits)
CSES/ENSC/GEOS	3114	Soils* (3 credits)
CSES/ENSC/GEOS	3124	Soils Lab* (1 credit)

*Courses may have prerequisites, corequisites, or other restrictions. Consult Course Catalog for details.

CSES/ENSC	3134	Soils in the Landscape* (3 credit)
CSES/ENSC	4774	Reclamation of Drastically Disturbed Lands* (3 credits)
ECON	4014	Environmental Economics* (3 credits)
ENSC/CSES	4324	Water Quality Lab* (1 credit)
ENSC	4414	Monitoring and Analysis of the Environment* (2 credits)
ENSC/CSES	4854	Wetland Soils and Mitigation* (3 credits)
ESM	3024	Introduction to Fluid Mechanics* (3 credits)
FIW	2114	Principles of Fish and Wildlife Conservation* (3 credits)
FIW	3514	Fisheries Techniques* (3 credits)
FIW	4424	Ichthyology (4 credits)
FREC	Any 2000 – 4000 level FREC course	
GEOG	1104	Introduction to Physical Geography (3 credits)
GEOG/NR	1115	Seeking Sustainability (3 credits)
GEOG/NR	1116	Seeking Sustainability (3 credits)
GEOG	Any 2000 – 4000 level GEOG course	
GEOS	1004	Earth Science: Our Past, Present, and Future (3 credits)
GEOS	1014	Evolution of the Earth-Life System (3 credits)
GEOS	1024	Earth Resources, Society, and Environment (3 credits)
GEOS	1034	Earth's Natural Hazards (3 credits)
GEOS	2104	Elements of Geology (3 credits)
GEOS	3034	Oceanography* (3 credits)
HIST	3144	American Environmental History (3 credits)
LAR	2164	Landform Function and Aesthetics* (4 credits)
MATH	2114	Introduction to Linear Algebra* (3 credits)
MATH	2214	Introduction to Differential Equations* (3 credits)
PHYS	2206	General Physics* (3 credits)
PHYS	2216	General Physics Lab* (1 credit)
PHYS	2305	Foundations of Physics* (4 credits)
PSCI/UAP	3444	Administrative Law and Policy* (3 credits)
PSCI/UAP	3714	The US Policy Process* (3 credits)
PSCI/UAP	3744	Public Policy Analysis* (3 credits)
STAT	3005	Statistical Methods* (3 credits)
STAT	3006	Statistical Methods* (3 credits)
STAT	3615	Biological Statistics (3 credits)
STAT	3616	Biological Statistics* (3 credits)
UAP	3014	Urban Policy and Planning* (3 credits)
UAP	3024	Urban and Regional Analysis* (3 credits)
UAP	4754	Legal Foundations of Planning* (3 credits)

*Courses may have prerequisites, corequisites, or other restrictions. Consult Course Catalog for details.