

Cross-College Watershed Management Minor/Certificate

Objective

In the 21st century, watershed management, water quantity and water quality issues will be intensified in Virginia and the nation, owing to increased water demand, changes in land-use and other competing interests. Management of water resources is a critical issue facing governmental agencies as well as the private/industrial sector and citizens. Universities and colleges have a major responsibility to prepare future water and land managers to meet these challenges. Future water managers and decision makers need knowledge and training in natural science, technical assessment, economics, planning, and policy.

In recent years, it has been recognized that the most effective approach to management of water resources is at the watershed scale with input from various stakeholders. Furthermore, there have been significant advances in understanding watershed science both in the natural and social sciences, and there is a national trend to integrate various facets of watershed studies in interdisciplinary programs.

The Watershed Management Undergraduate Minor integrates existing programs and courses from five colleges and twelve departments at Virginia Tech to provide an interdisciplinary and substantive understanding of watershed science, policy, and decision-making. The program is designed to prepare Virginia Tech graduates for critical future tasks and will be a strong incentive for others who consider enrollment at Virginia Tech.

Program Requirements

Undergraduate students select courses at 4000 levels and below. With satisfactory completion of the program's 20 hours requirements with a satisfactory GPA in those courses (minimum 2.0), the student will receive a printed certificate. Upon graduation, the minor is noted on the student's transcript.

A checklist of courses for the proposed program is attached to this proposal. There are five categories of courses in the program: watershed hydrology; watershed water quality; watershed ecology; watershed geospatial information systems; and watershed law, policy and planning. Two courses, UAP 4374 Land Use and Environment and ALS 4614 Watershed Assessment, Management, and Policy are proposed as required core courses. Justification for these core courses is given below.

UAP 4374 Land Use and Environment: Planning and Policy: is an interdisciplinary course in applied environmental science, planning, and policy, focusing on the use of the land, its effects on water and ecological resources, and methods of land analysis and management to mitigate those impacts. The course emphasizes each of the five areas of the Watershed Management Concentration:

- Watershed Hydrology: basic hydrology, hydrograph, storm frequency-duration-intensity, watershed delineation, stream order, stream morphology, effects of impervious surface, TR-55 methods, channel capacity, measures to enhance detention and infiltration, sizing detention, flood plain mapping, flood profiles, flood plain management, land use properties of soils, soil surveys and interpretive soils mapping.
- Watershed Water Quality: water quality fundamentals; non-point pollution sources, effects and controls; BMPs; WQ standards; TMDLs; monitoring; groundwater flow and contamination; DRASTIC; well-head protection.
- Watershed Ecology: vegetation inventories, urban forestry, land-water interface (riparian lands, coastal zone, wetlands), wetland benefits, wetland mitigation and banking, wildlife habitats, habitat conservation planning, ecosystem management.

- Watershed Geospatial Information Systems: maps, map types and scales, aerial photos and satellite data; ArcView fundamentals and exercises including soils mapping and watershed delineation; Land suitability analysis, carrying capacity and environmental thresholds, environmental impact assessment, build-out analysis.
- Watershed Planning and Policy: watershed protection approach; flood plain management; stormwater management; urban forestry; environmentally sensitive land development design; land conservation by land trusts and conservation easements; local land use planning and growth management including regulatory and non-regulatory approaches; regional, state, and federal land use management; collaborative environmental planning.

ALS 4614 Watershed Assessment, Management, and Policy: is a team-taught, interdisciplinary course aimed at identifying problems and designing solutions to water pollution damages within watershed ecosystems. Topics include:

- Watershed assessment: assessing stream ecology; use of monitoring and modeling to assess watersheds; risk-based assessments; problems of urbanizing watersheds.
- Watershed management: land use planning cycle; decision support tools for watershed management; geographic information systems; management options for urban and non-urban watersheds; risk management; planning and implementation of total maximum daily loads (TMDL).
- Policy design for watershed protection: historical overview of watershed management policy in the U.S.; identification of policy goals for watershed protection; policy instruments for achieving policy goals; evaluating policy effectiveness.

Students in interdisciplinary teams apply watershed analysis concepts to selected case watersheds. Oral and written team presentations describe key watershed problems, management options available to resolve problems, and policies influencing watershed management options. Students evaluate critically current watershed management practices and recommend management alternatives to improve watershed habitat. Information gaps are described and research strategies are presented to reduce uncertainties.

Participating Colleges and Departments

The interdisciplinary watershed management program will be a cross-college program between five colleges and ten departments. Participating colleges and departments are as follows:

- College of Agriculture and Life Sciences
 - Department of Agriculture and Applied Economics
 - Department of Crop, Soil and Environmental Sciences
 - Department of Entomology
- College of Architecture & Urban Studies
 - Department of Urban Affairs and Planning
 - Department of Landscape Architecture
- College of Sciences
 - Department of Biology
 - Department of Geosciences
- College of Engineering
 - Department of Biological Systems Engineering
 - Department of Civil and Environmental Engineering
- College of Natural Resources
 - Department of Forestry
 - Department of Fisheries and Wildlife Sciences
 - Department of Geography

Program Management

A committee comprised of faculty members from participating colleges and the Water Resources Research Center provides oversight to the program. The Water Resources Research Center serves as the program host, coordinates committee meetings and facilitates program publicity and program tracking and evaluation. Each participating department is expected to report the program completion for their students to the registrar's office. The Water Resources Research Center will issue a printed Certificate upon student's completion of the course work.

Oversight Committee

Darrell Bosch, Agricultural and Applied Economics
William E. Cox, Civil and Environmental Engineering
Jim McKenna, Crop and Soil Environmental Sciences
Saied Mostaghimi, Biological Systems Engineering
Donald J. Orth, Fisheries and Wildlife Science (Alternate: Tammy Newcomb)
John Randolph, Urban Affairs and Planning
Jack Webster, Biology
Tamim Younos, Water Resources Research Center

Checklist for Graduating Class of 2006
Watershed Management Minor/Certificate (undergraduate)
(20 hours)

- The Watershed Management Minor/Certificate is a cross-college program available to all undergraduate students in the university.
- Undergraduate students select from the courses below. Students must satisfy course prerequisites.
- With satisfactory completion of the program's 20 hour requirements with at least a 2.0 GPA in those courses, the student will receive a printed certificate from the Virginia Water Resources Research Center. Upon graduation, the minor will be noted on the student's transcript.

A. Required Core (5 hours):		Credit Hours	Check
UAP 4374	Land Use and Environment: Planning and Policy	3	_____
ALS 4614	Watershed Assessment, Management & Policy	2	_____
B. Additional Courses (15 credits):			
1. Watershed Hydrology (choose 1 course, 3 hours)		3	_____
BSE 2384	Soil & Water Resources Management (may fulfill (1) or (2) not both)		
BSE 3305	Land and Water Resources Engineering		
CEE 4304	Hydrology (pre: 3314, 3304)		
FOR 4354	Forest Soils and Hydrology (pre: 3314)		
GEOL 4804	Groundwater Hydrology		
LAR 4244	Landscape Technology Hydrology		
2. Watershed Water Quality (choose 1 course, 3 hours)		3	_____
BSE 2384	Soil & Water Resources Management (may fulfill (1) or (2) not both)		
BSE 4304	Nonpoint Source Pollution Modeling and Management (pre: 3306)		
BSE 4324	Nonpoint Source Pollution (pre: CEE 3104)		
CEE 4354	Environmental Hydrology (pre: 3104, 3314, 3304)		
CSES/CEE 4594	Soil and Groundwater Pollution (pre: 4314, 3314, 3304)		
ENT 4484	Freshwater Biomonitoring (pre: BIO 2804 & BIO/ENT 4354 or FIW 4424 or 4614)		
3. Watershed Ecology (choose 1 course, 3 hours)		3	_____
BIO 4004	Freshwater Ecology (pre: 2804)		
BIO/ENT 4354	Aquatic Entomology		
CEE/BIO 4154	Aquatic Microbiology (pre: 2604) (new: BIO/CSES/CEE Env Micro)		
FIW 4534	Ecology & Management of Wetlands		
FOR 4374	Forested Wetlands (pre: CSES 3114)		
LAR 3004	Natural and Human Systems (pre: LAR 1004)		
4. Watershed Geospatial Information Systems (choose 1 course, 3 hours)		3	_____
BSE 4344	Geographic Information Systems for Engineers		
FOR 4214	Forest Photogrammetry		
GEOG 4084	Intro. to Geographic Information Systems		
GEOG 4354	Intro. to Remote Sensing		
GEOG 4384	ARC/INFO Geographic Information System		
5. Watershed Law, Policy, and Planning (choose 1 course, 3 hours)		3	_____
AAEC 3314	Environmental Law		
AAEC 4304	Environmental and Sustainable Development Economics		
AAEC 4344	Sustainable Development Economics		
CEE 4344	Water Resources Planning		
FOR 4434	Forest Resource Policy		
LAR 3044/5044	Land Analysis and Site Planning		
UAP 4184	Community Involvement and Public Participation		
UAP 4344	Law of Critical Environmental Areas		