



The University of Georgia®

University Council
Athens, Georgia 30602

April 22, 2010

UNIVERSITY CURRICULUM COMMITTEE – 2009-2010

Mr. David E. Shipley, Chair

Agricultural and Environmental Sciences - Dr. Timothy L. Foutz

Arts and Sciences - Dr. Roxanne Eberle (Arts)

Dr. Rodney Mauricio (Sciences)

Business - Dr. James S. Linck

Ecology - Dr. James W. Porter

Education - Dr. Yvette Q. Getch

Environment and Design - Mr. Scott S. Weinberg

Forestry and Natural Resources - Dr. Sarah F. Covert

Family and Consumer Sciences - Dr. Jan M. Hathcote

Journalism and Mass Communication - Dr. Wendy A. Macias

Law – No representative

Pharmacy - Dr. Keith N. Herist

Public and International Affairs - Dr. Jerome S. Legge

Public Health – Dr. Phaedra S. Corso

Social Work - Dr. Patricia M. Reeves

Veterinary Medicine - Dr. K. Paige Carmichael

Graduate School - Dr. Malcolm R. Adams

Undergraduate Student Representative – Cameron Secord

Graduate Student Representative – Lauren King

Dear Colleagues:

The attached proposal to offer a Graduate Certificate in Water Resources will be an agenda item for the April 29, 2010, Full University Curriculum Committee meeting.

Sincerely,

David E. Shipley, Chair
University Curriculum Committee

cc: Professor Jere W. Morehead
Dr. Laura D. Jolly

- PROPOSAL -

INTERDISCIPLINARY GRADUATE CERTIFICATE

IN WATER RESOURCES

at The University of Georgia

From:

Warnell School of Forestry and Natural Resources

Odum School of Ecology

Franklin College of Arts and Sciences

Department of Geography

Department of Geology

Department of Marine Sciences

College of Agricultural and Environmental Sciences

Department of Agricultural and Applied Economics

Department of Biological and Agricultural Engineering

Department of Crop and Soil Sciences

Entomology Department

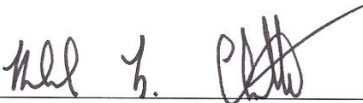
College of Public Health

Environmental Health Science Department

APPROVAL PAGES

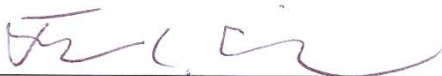
Proposal for an Interdisciplinary Graduate Certificate
in Water Resources at The University of Georgia.

DEANS' SIGNATURES



Michael L. Clutter, Dean
Warnell School of Forestry & Natural Resources

12/1/09
Date



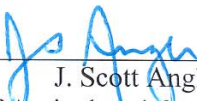
John L. Gittleman, Dean
Odum School of Ecology

12/5/09
Date



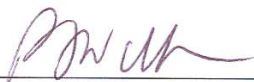
Garnett S. Stokes, Dean
Franklin College of Arts and Sciences

2-7-10
Date



J. Scott Angle, Dean
College of Agricultural & Environmental Sciences

2/5/10
Date

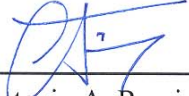
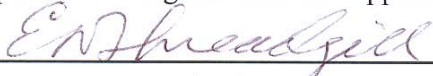
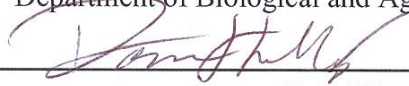
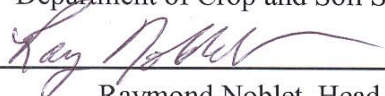
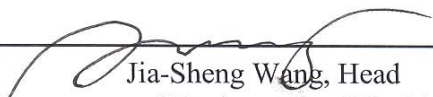
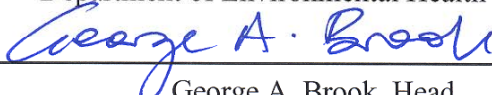
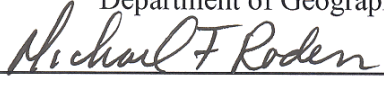
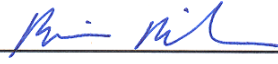


Phillip L. Williams, Dean
College of Public Health

1/6/10
Date

APPROVAL PAGES (Continued)

DEPARTMENTAL HEADS' SIGNATURES

 _____ Octavio A. Ramirez, Head Department of Agricultural and Applied Economics	<u>12-16-09</u> Date
 _____ E. Dale Threadgill, Head Department of Biological and Agricultural Engineering	<u>12-18-09</u> Date
 _____ Donn G. Shilling, Head Department of Crop and Soil Science	<u>12/4/09</u> Date
 _____ Raymond Noblet, Head Entomology Department	<u>12/17/09</u> Date
 _____ Jia-Sheng Wang, Head Department of Environmental Health Science	<u>12-3-2009</u> Date
 _____ George A. Brook, Head Department of Geography	<u>12/16/09</u> Date
 _____ Michael F. Roden, Head Department of Geology	<u>12-9-09</u> Date
 _____ Brian J. Binder, Head Department of Marine Sciences	<u>12/4/09</u> Date

I. Basic Information

1. *Institution:* The University of Georgia

Date: August 2009

2. *Schools/Colleges:* Warnell School of Forestry and Natural Resources, Odum School of Ecology, Franklin College of Arts and Sciences, College of Agricultural and Environmental Sciences, and the College of Public Health

3. *Departments/Divisions:* Department of Plant Biology, Department of Geography, Department of Geology, Department of Marine Sciences, Department of Agricultural and Applied Economics, Department of Biological and Agricultural Engineering, Department of Crop and Soil Sciences, Entomology Department, Environmental Health Science Department

4. *Level:* Graduate

5. *Proposed Starting Date:* Spring 2010

6. *Abstract:*

Increasing demands are being placed on Georgia's water resources. The extreme drought conditions of recent years, coupled with a burgeoning population, are placing severe constraints on the current and future uses of Georgia's water resources. Combined with the increasing instate demands for water, adjacent states (i.e., South Carolina, Alabama, Florida, and Tennessee) are concerned about their future water needs and allocations. Also, groundwater utilization on the Georgia coast is resulting in salt-water contamination, water shortages, and adverse environmental consequences to our unique coastal ecosystems. Even in water-rich southwest Georgia, agricultural water uses may be adversely affecting minimum flows in the Flint River.

In addition to water supply problems, Georgia also faces many water quality challenges. Recent federal court rulings related to instream water quality will require substantial additional investments in industrial, municipal, and agricultural wastewater management and minimization. It is anticipated that billions of dollars will be required to develop new wastewater control and mitigation technologies in the metro-Atlanta area alone.

Meeting these pressing water resource challenges requires trained professionals with skills in management, economics, hydraulics, and water quality. The University of Georgia currently lacks a means for coordinating existing on campus water resources programs at the graduate level. Courses in water resources are currently taught by approximately seventy faculty from eleven academic units. We propose to bring together these faculty members to form a graduate certificate program. The standardized curriculum will broaden communication and consistency between programs, as well as allow faculty to develop new opportunities for research and discussion.

We propose to use existing courses in the Graduate Water Resources Certificate Program. No new courses, instructors, or facilities are required. Our objective is to better utilize existing resources so that an integrated approach to water resources can be achieved. The end product will be professionals with a standardized set of core courses that promotes communication between disciplines.

II. Response to the Criteria for All Programs

1. Purpose and Educational Objectives

The establishment of a Graduate Water Resources Certificate Program is intended to provide incentives and structure for graduate students in water-related fields to broaden and strengthen their education in the area of water resources. While earning a graduate degree in a specific discipline related to water resources, students in the certificate program will be introduced to other disciplines that are equally essential to creating and maintaining healthy water systems. Students who earn a Graduate Water Resources Certificate will acquire an improved understanding of the biophysical, social, and institutional aspects of terrestrial and aquatic systems. This greater knowledge base and enhanced skill set will strengthen graduates' credentials for professional employment and enable greater multidisciplinary communication among future water resource professionals.

There are over 100 faculty across the UGA campus in nineteen academic units who teach, conduct research, or otherwise have an interest in the field of water resources. These faculty members are identified in Appendix A. We use a broad definition of water resources that includes hydrology, water quality, limnology, aquatic ecology, bioremediation, biofiltration, and wetland and stream rehabilitation, water economics, law and policy. The Graduate Water Resources Certificate Program will foster collaboration in teaching and research among these professors. These professors have an informal Water Resources Faculty group that meets several times a year and is involved with the existing Water Resources Certificate Program available at the undergraduate level. This proposed Graduate Water Resources Certificate program was also developed by this group. Reducing redundancies in teaching, eliminating curriculum gaps, and fostering multidisciplinary research are among the goals of this group.

2. Program Need

A Graduate Water Resources Certificate Program is needed because the complexity and breadth of water resource problems are not currently covered by existing degree programs. Traditional graduate programs provide students with in-depth knowledge of a particular discipline, such as hydrology, water chemistry, engineering or economics. While such training is essential preparation for future hydrologists, chemists, engineers and economists, without exposure to the other disciplinary perspectives on water resource problems graduates of these programs might be limited in their ability to communicate and collaborate with water resource professionals from other disciplines. Such interdisciplinary teamwork is essential to tackling water resource problems that involve significant physical, biological, and social challenges. Employment opportunities for water resource professionals are increasing despite rising general unemployment rates (NY Times, March 7, 2009, "Hiring in Hydrology Resists the Slump"). This increased demand for professionals with a broad understanding of water resource management is driven by increasing water demands caused by population growth and more extreme fluctuations in water supply due to increased drought conditions. Severe drought conditions in Georgia over the past two years and the legal and policy activities associated with maintaining an adequate clean water supply have been well publicized. To continue to address these issues in the future, we need to produce qualified professionals. UGA is in a position to play a major role in this effort and the proposed certificate program will support this endeavor.

TABLE 1
UGA GRADUATE WATER RESOURCES CERTIFICATE PROGRAM - PROGRAM DATA

Date of Program Initiation:	Spring Semester 2010
Date of Full Implementation:	Spring Semester 2010
Expected Date of First Certificate Conferral:	Spring Commencement 2011
Expected Number of Annual Graduates:	Five to Seven per year
Expected Future Enrollment Trend:	20 – 30 each year

The required curriculum for the Graduate Water Resources Certificate Program is designed to broaden students' views of water resource issues. Water related graduate courses currently available at the UGA campus are identified in Appendix B. The Graduate Water Resources Certificate Program will make our graduates more attractive to employers and improve their on-the-job performance. Because of the growing importance of water resources issues, the Water Resources Faculty expects this to be a viable and growing program for the indefinite future.

3. Student Demand

Existing student demand for water resources programs is substantial. At the graduate level, students with water related interests are enrolled in more than a dozen units across campus, including the schools and departments submitting this proposal as well as others. All of these students would benefit from a coordinated, interdisciplinary curriculum to broaden their understanding of water resources. For example, students earning a graduate degree in hydrology will benefit from exposure to economics and public policy, just as a student in water resource economics will benefit from a basic understanding of aquatic ecology.

In addition to the added breadth gained by students in degree programs related to water resource, the Graduate Water Resource Certificate program will also be of interest to students have more general interests in natural resources or environmental policy but whose graduate program is not specifically related to water resources. For example, law students interested in practicing environmental law would benefit from the exposure to science and economics the certificate would provide. The expected future enrollment for this program reflects these two different potential audiences.

While it is difficult to provide accurate estimates of future enrollments, we offer the following to support our estimated student demand. There are currently 120 members of the UGA Water Faculty (see Appendix A). Some of these faculty have very large graduate research programs directly related to water resources and others have few or no graduate advisees and are in more peripheral disciplines. However, a conservative estimate of graduate students advised by these faculty members is 240, an average of two students per faculty. If only 10% of this potential pool of interested students actually enrolls in the certificate program, this will lead to an annual enrollment of about 24 students. Given growing interest in water resource issues and the growth of employment opportunities, we predict 10% is a very low estimate and enrollment in the certificate program will continue to grow in the future.

4. Curriculum

No new classes will be developed for the program. The certificate curriculum is based on existing classes in participating schools and departments. The Graduate Water Resources Certificate will be granted in addition to (and upon completion of) an MS or a PhD from a student's home department.

The Graduate Water Resources Certificate Program requires students to complete 18 credit hours, including three credit hours from each of six categories as outlined in the Graduate Water Resources Certificate Course List (Table 2). A class not on the approved list may be substituted upon approval by the Water Resources Certificate Program Director.

The certificate program is expected to add no more than one semester to most students' programs because most students will be required to take some of these classes for their primary degree requirements. These classes have been selected to provide a broad base in the physical, biological, economic, and social components of water resources issues and problems.

5. Faculty Resources

There are over 100 faculty across the UGA campus in nineteen academic units who teach, conduct research, or otherwise have an interest in the field of water resources. These faculty members are identified in Appendix A. We use a broad definition of water resources that includes hydrology, water quality, limnology, aquatic ecology, hydrometeorology, bioremediation, biofiltration, and wetland and stream rehabilitation, economics and policy. These faculty members have worked together on a variety of endeavors through the Water Resources Faculty, which meets 2-3 times per year, maintains a website, and coordinates the Undergraduate Water Resources Certificate Program.

From this larger group, a core group of UGA Graduate Water Resources faculty is identified in Appendix C. These faculty will form the core of the Graduate Water Resources Certificate Program and will be responsible for recruiting students and maintaining the academic rigor and relevance of this certificate program.

6. Library, Computer, and Instructional Resources Needed

No additional library, computer, or instructional resources are needed for this program because the curriculum is composed of existing classes taught on a regular basis.

7. Physical Facilities Required

No additional physical facilities are needed for this program because the curriculum is composed of existing classes taught on a regular basis.

8. Institutional Expenses

Expenses include support for secretarial assistance to the core faculty, along with a small budget for miscellaneous expenses, such as publications. The proposed budget is provided in Table 3, below.

TABLE 2
UGA GRADUATE WATER RESOURCES CERTIFICATE PROGRAM - COURSE LIST

Category - Course ID	Course Title	Instructor	Semester	Credits
Hydrology and Environmental Chemistry				
CRSS 6600	Soil Physics	Radcliffe	Fall/Spr	4
CRSS 6670	Environmental Soil Chemistry	Miller	Fall	3
CRSS 8000	Soil Physical Chemistry	Miller	Fall/Spr	3
ECOL/FISH/WASR 6310/6310L	Limnology	Rosemond	Fall	4
GEOL 8150	Earth Surface Geochemistry	Nzengung	Spring	3
GEOL 8460	Isotope Geochemistry	Roden and Wright	Spring	3
GEOL 8700	Physical Hydrogeology	Dowd	Fall	3
WASR 6500	Quantitative Methods in Hydrology	Rasmussen	Fall	3
WASR/FORS 6110	Hydrology and Watershed Management	Jackson	Spring	4
WASR/GEOL 8730	Aquifer Mechanics	Rasmussen and Dowd	Spring	3
Environmental Considerations				
CRSS(ECOL) 8650	Nutrient Cycling Models	Cabrera	Fall/Spr	3
ECOL 8220	Stream Ecology	Covich and Freeman	Spring	2
ECOL 8420	Watershed Conservation	Freeman	Fall -Even	3
ECOL 8990	Aquatic Ecosystems and Water Quality	Rosemond	Fall/Spr/Smr	1-3
ECOL/ENTO/BTNY 8150	Wetland Ecology	Batzer	Spr-Oodd	3
EHSC 6610	Water Pollution and Human Health	Black	Fall	3
EHSC 8310	Aquatic Microbiology, Health and the Environment		Fall-Odd	3
EHSC 8410	Oceans and Human Health		Fall-Even	3
EHSC 8610	Aquatic Toxicology	Black	Spr-Odd	3
ENGR 6130	Bio Engineering		Fall	3
FISH 6300	Environmental Biology of Fishes		Fall	3
FISH 8350	Fundamentals of Ecotoxicology		Fall	3
Social Institutions				
AAEC 6930	Environmental Law and Governmental Regulation	Centner	Fall-Odd	3
ECOL 8710	Environmental Law Practicum	Fowler	Fall/Spr	4
ECOL 8720	Environmental Law for Design Professionals	Fowler	Spring	3
EHSC 6250	Environmental and Public Health Law		Spring	3
FANR 7850	Natural Resources Law for Managers	Clutter	Spring	4

Category - Course ID	Course Title	Instructor	Semester	Credits
Economics				
ENVM 6800	Water Resources Economics	Mullen	Fall	3
AAEC 8100	Nonmarket Economic Valuation Techniques and Applications	Bergstrom	Fall	3
FANR 7680	Economic Perspectives on Natural Resource Issues	Moore	Spring	3
FANR/AAEC 7860	Natural Resource and Environmental Economics	Moore	Fall	3
Environmental Policy				
AAEC 7600	Environmental Economics and Policy Analysis		Spring	3
AAEC 8750	Natural Resource and Environmental Economics		Spr-Odd	3
AAEC(ECOL) 8700	Advanced Environmental Economics & Policy Analysis	Ferreira		3
EHSC/AAEC 8120	Roles and Responsibilities of Environmental Policy Makers	Williams	POD	2
MARS/ANTH 8210	Topics in Coastal Marine Policy	Alber	Spr-Even	3
Advanced Tools and Methods				
CRSS 6600	Soil Physics	Radcliffe	Fall/Spr	4
CRSS 8600	Advanced Soil Physics: Numerical Methods	Radcliffe	Spring	2
CSCI 6210	Modeling and Simulation		POD	4
ECOL 6130	GIS for Environmental Planning	Kramer	Spring	3
ENGR 6140	Intro to Systems Modeling		Spring	3
GEOG 6330/6330L	Aerial Photographs and Image Interpretation		Fall/Spr	3
GEOG 6350/6350L	Remote Sensing of Environment		Fall/Spr	3
GEOG 6370/6370L	Geographic Information Science		Fall/Spr/Smr	3
GEOL/WASR 8740	Hydrologic Flow and Transport Modeling	Dowd and Rasmussen	Spring	3
HORT 8160	Measurement and Control in Plant and Soil Science	van Iersel		3
MARS 8510	Modeling Marine Systems		Fall/Spr	3
WASR 8300	System Identification for the Environment	Beck	POD	3
WASR 8500	Environmental Systems Analysis and Control	Beck	POD	1-3

TABLE 3
UGA GRADUATE WATER RESOURCES CERTIFICATE PROGRAM - PROPOSED BUDGET

	<i>Item</i>	<i>Year</i>		
		<i>1</i>	<i>2</i>	<i>3</i>
1	Personnel	\$0	\$0	\$0
2	Operating Costs	\$1,000	\$1,000	\$1,000
3	Capital Outlays	\$0	\$0	\$0
4	Library Acquisitions	\$0	\$0	\$0
5	Total	\$1,000	\$1,000	\$1,000

9. Commitments of Financial Support

The Dean of the Warnell School of Forestry and Natural Resources will provide the operating costs necessary for implementation of the certificate program.

10. Program Administration

The program will be administered by a Director, with support from a Steering Committee comprised of the Core Water Resources faculty identified in Appendix C. The Director will have an annual appointment. The Director's position will be rotated between the Water Resources faculty within the Warnell School of Forestry and Natural Resources. The administrator will also serve as the program advisor for students.

The program will accept and maintain any interested student who is in good academic standing with their home department. The certificate will be granted to any student who passes the required classes and fulfills the degree requirements of their home program.

APPENDIX A

UGA WATER RESOURCES FACULTY

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	Grundstein, Andrew	706-583-0430	andrewg@uga.edu

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HORT	Berle, David	706-542-2471	dberle@uga.edu
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APPENDIX B

UGA GRADUATE-LEVEL WATER RESOURCES COURSES

Course Number	Title	Hr	F	Sp	Su
ENVM 4800/6800	Water Resources Economics	3	x		
AAEC 4930/6930	Environmental Law and Governmental Regulation	3	o		
AAEC 7600	Environmental Economics and Policy Analysis	3		x	
AAEC 8100	Nonmarket Economic Valuation Techniques and Applications	3	x		
AAEC 8750	Natural Resource and Environmental Economics	3		o	
AAEC(EHSC) 4250	Environmental and Public Health Law	3		x	
CRSS 4510/6510	Contaminants in Soils and Water	3	x		
CRSS 4520/6520 [+lab]	Field Soil and Site Assessment	3	x	x	
CRSS 4540/6540 [+lab]	Pedology	3	x	x	
CRSS 4580/6580 [+lab]	Soil Erosion and Conservation	4	x		
CRSS 4590/6590 [+lab]	Soil Fertility and Plant Nutrition Laboratory	3	x		
CRSS 4600/6600 [+lab]	Soil Physics	4	x	x	
CRSS 4660/6660 [+lab]	Chemical Analysis of Environmental Samples	3	x	x	
CRSS 4670/6670 [+lab]	Environmental Soil Chemistry	3	x		
CRSS 8000	Soil Physical Chemistry	3	x	x	
CRSS 8540 [+lab]	Soil Mineralogy	4	x	x	
CRSS 8610	Advanced Soil Physics: Spatial Modeling	3	x	x	
CRSS(ECOL) 8650	Nutrient Cycling Models	3	x	x	
CRSS(MIBO) 4610/6610 [+lab]	Soil Microbiology	3	x	x	
ECOL 4050/6050	Ichthyology	4		x	
ECOL 8220	Stream Ecology	2		x	
ECOL 8230	Lake Ecology	2			
ECOL 8420	Watershed Conservation	3	e		
ECOL 8600	Nuclear Tracers in Ecology	3			
ECOL 8710	Environmental Law Practicum	4	x	x	
ECOL 8720	Environmental Law for Scientists	3		x	
AAEC(ECOL) 8700	Advanced Environmental Economics & Policy Analysis	3		x	
ECOL(EETH) 4200/6200	Ecologic Values	4	x	x	
ECOL(EETH) 4200/6200	Ecologic Values	4	x	x	
ECOL(ENTO)(BTNY) 8150 [+lab]	Wetland Ecology	3-4		o	
ECOL(FISH)(WASR) 4310/6310 [+lab]	Limnology	4	x		
EHSC 4060/6150	Biomonitoring: Freshwater Invertebrates	4		x	
EHSC 4150/6150	Solid and Hazardous Waste Management	3	x		
EHSC 4150/6150	Soil Hazardous Waste Management	3	x		
EHSC 4250/6250	Environmental and Public Health Law	3		x	
EHSC 4350/6350 [+lab]	Environmental Chemistry	3	e		
EHSC 4490/6490	Environmental Toxicology	3	x		
EHSC 4610/6610	Water Pollution and Human Health	3	x		
EHSC 8510/8510L	Environmental Risk Assessment and Communication	3		o	
EHSC(AAEC) 8120	Roles and Responsibilities of Environmental Policy Makers	2		x	
EHSC(ECOL) 8610	Aquatic Toxicology	3		x	
EHSC(FDST)(MIBO) 4310/6310	Environmental Microbiology	4		x	
ENGR 4440/6440	Environmental Engineering - Unit Operations	3	x		
ENGR 4450/6450	Environmental Engineering - Remediation Design	3		x	
ENGR 4920	Engineering Design Project	4		x	

Course Number	Title	Hr	F	Sp	Su
ENGR 6410	Open Channel Hydraulics and Sediment Transport	3			
ENGR 7430	Nonpoint Source Modeling	3			o
ENGR 8420	Theory of Drainage - Saturated Flow	3			e
ENGR(GEOG) 4161/6161 [+lab]	Environmental Microclimatology	4	e		
ENGR(MARS) 4171/6171	Atmospheric and Oceanic Thermodynamics	4		o	
ENGR(MARS) 4113/6113 [+lab]	Introductory Geophysical Fluid Dynamics with Applicaitons	4	o		
ENGR(MARS) 4175/6175	Coastal Meteorology	4	o		
ENTO 8940/8940L	Aquatic Entomology	4		e	
FANR 7860	Resource Economics and Management	3		x	
FISH(WASR) 4160/6160 [+lab]	Environmental Monitoring	3	x		
FORS 8180	Principles of Forest Land Treatment	2		e	
GEOG 4020/6020	Fluvial Geomorphology	3	x	x	
GEOG 4150/6150	Physical Climatology	3	o		
GEOG 4160/6160	Applied Climatology in the Urban Environment	3	x	x	
GEOG 8020	Geomorphology Seminar	3		x	
GEO 4110/6110	Principles of Geochemistry	3	x		
GEO 4130/ 6130	Aqueous Environmental Geochemistry	3	x		
GEO 4220/6220	Hydrogeology	3	x		
GEO 4270	Geology Field Studies	6			x
GEO 4620/6620	Exploration Geophysics	3		x	
GEO 4640/6640	Geochemical and Geophysical Surveys	3		e	
GEO 4670/6670	Environmental Instrumental Analysis	3	x		
GEO 8150	Earth Surface Geochemistry	3		o	
GEO 8460	Isotope Geochemistry	3		o	
GEO 8700	Physical Hydrogeology	3	x		
GEO 8750	Environmental Organic Geochemistry	3		e	
GEO 8770	Hazardous Waste Site Remediation	3		o	
GEO 8780	Environmental Isotopes	3		o	
GEO(CRSS) 8760	Organic Contaminant Hydrogeology	3		e	
GEO(FORS) 8740	Hydrologic Flow and Transport Modeling	3		o	
HORT 4440/6440	Environmental Physiology of Horticultural Crops	3	x		
MARS 4100/6100	Physical Processes in the Ocean	3		o	
MARS 4200/6200	Chemical and Biological Oceanography	3	x		
MARS 4450/6450	Introduction to Marine Chemistry	3	x		
MARS 4810/6810	Global Biogeochemical Cycles	3		o	
MARS 6100	Physical Processes of the Ocean	3	o		
MARS 8020/8020L	Chemical Oceanography	3	x		
MARS 8030	General Physical Oceanography	3		x	
MARS 8100	Estuarine and Coastal Physical Oceanography	3	o		
MARS 8120	Geophysical Fluid Dynamics	3	e		
MARS 8130	Seminar in Hydrobiology	1-3	x		
MARS 8150	Ocean Waves	3	o		
MARS 8160	Marine Ecology	3		o	
MARS(ANTH) 8210	Topics in Coastal Marine Policy	3		e	
MARS/MIBO 4620/6620	Micobial Ecology	3	o		
WARS 4400/4400L	Introduction to Wetlands	3		x	
WARS 6800	Control and Systems Theory for the Environ Scientist	3			
WASR 4120/6120	Quantitative Methods in Hydrology	3	x		
WASR 4300L/6300L	Field Methods in Hydrology	3		x	
WASR 8200	Hillslope Hydrology Seminar	3		o	

Course Number	Title	Hr	F	Sp	Su
WASR 8300	System Identification for the Environmental Scientist	3			
WASR 8400	Environmental Process Control Laboratory	2			
WASR 8500	Environmental Systems Analysis and Control	1-3			
WASR 8730	Aquifer Mechanics	3		e	
WASR(FORS) 4110/6110 [+lab]	Forest Hydrology	4		x	

APPENDIX C

GRADUATE WATER RESOURCES CERTIFICATE PROGRAM CORE FACULTY

Name and Rank: C. Rhett Jackson, Professor of Hydrology

Academic Specialty:

Effects of human land use activities, specifically forestry, agriculture, and urbanization, on water quality and aquatic habitat. Effectiveness of silvicultural and agricultural BMPs in reducing nonpoint pollution. Sediment mobilization and transport. Fluvial geomorphology. Hillslope and wetland hydrology.

Educational Background:

1992, PhD, Hydrology, Department of Civil and Env. ENgr., University of Washington

1985, MSE, Civil and Environmental Engineering, Duke University

1983, BSE, Civil and Environmental Engineering, Duke University

Special Qualifications Related to Program:

- Teaches a wide range of graduate hydrology courses, including
 - Forest Hydrology, FORS 6110
 - Hillslope Hydrology, FORS 8120
- Long and productive history of interdisciplinary research and teaching collaborating with colleagues from Geology, Geography, Entomology, Marine Sciences, Ecology, Crop and Soil Sciences, and Bio and Ag Engineering.
- Founder and long term member of the Water Resources Faculty

Relevant professional and scholarly activity for past five years:

Refereed and Peer-Reviewed Journal Articles – last 5 years

Jackson, C.R. and C.M. Pringle. Accepted. When unnatural hydrologic connectivity has ecological benefits in human dominated landscapes. *Bioscience*.

Neary, D.G., G.G. Ice, and C.R. Jackson. In Press. Linkages between forest soils and water quality and quantity. *J. Forest Ecology & Management*.

Wenger, S.J., A.H. Roy, C.R. Jackson, E.S. Bernhardt, T.L. Carter, S. Filoso, C.A. Gibson, N.B. Grimm, W.C. Hession, S.S. Kaushal, E. Martí, J.L. Meyer, M.A. Palmer, M.J. Paul, A.H. Purcell, A. Ramirez, A.D. Rosemond, K.A. Schofield, T.R. Schueler, E.B. Sudduth, and C.J. Walsh. In Press. Twenty-six key research questions in urban stream ecology: an assessment of the state of the science. *J of the North American Benthological Society*.

Carter, T. C.R. Jackson, A.D. Rosemond, C.M. Pringle, D.E. Radcliffe, W. Tollner, J.C. Maerz, D.S. Leigh. Accepted. Beyond urban gradient studies: barriers and opportunities for timely studies of urbanization effects on aquatic ecosystems. *Journal of the North American Benthological Society*.

Peterson, J.T., C.R. Jackson, C.P. Shea, and G. Li. In Press. The development and evaluation of a stream channel classification for estimating the response of fishes to changing streamflow. *Transactions of the American Fisheries Society*.

- Radcliffe, D.E., Z. Lin, L.M. Risse, J. Romeis, and C.R. Jackson. 2009. Modeling phosphorus in the Lake Allatoona watershed using SWAT: I. Developing phosphorus parameter values. *Journal of Environmental Quality* 38:111-120.
- Lin, Z., D.E. Radcliffe, D.E., L.M. Risse, J. Romeis, and C.R. Jackson. 2009. Modeling phosphorus in the Lake Allatoona watershed using SWAT: II. Effect of land use change. *Journal of Environmental Quality* 38:121-129.
- Carroll, G.D. and C.R. Jackson. 2008. Observed relationships between urbanization and riparian cover, shredder abundance, and stream leaf litter standing stocks. *Fundamental and Applied Limnology* 173(3):213-225.
- Pinho, A.P., L.A. Morris, C.R. Jackson, W.J. White, P.B. Bush, and A.T. Matos. 2008. Contaminant Retention Potential of Forested Filter Strips Established as SMZs in the Piedmont of Georgia. *J. Amer. Water Resources Assoc.* 44(6):1564-1577.
- White, W.J., L.A. Morris, A.P. Pinho, and C.R. Jackson. 2007. Sediment retention by forested filter strips in the Piedmont of Georgia. *J. Soil and Water Conservation* 62(6):453-463.
- Jackson, C.R., D.P. Batzer, S.S. Cross, S.M. Haggerty, and C.A. Sturm. 2007. Headwater Streams and Timber Harvest: Channel, Macroinvertebrate, and Amphibian Response and Recovery. *Forest Science* 53(2):356-370.
- Freeman, M.C., C.M. Pringle, and C.R. Jackson. 2007. Hydrologic connectivity and the contribution of stream headwaters to ecological integrity at regional scales. *J. Amer. Water Resour. Assoc.* 43(1):5-14.
- Li, G. and C.R. Jackson. 2007. Simple, Accurate, and Efficient Revisions to MacCormack and Saul'yev Schemes: High Peclet Numbers. *Applied Mathematics and Computation* 186(1):610-622.
- Carter, T. and C.R. Jackson. 2007. Vegetated roofs for stormwater management at multiple spatial scales. *Landscape and Urban Planning* 80(1-2):84-94.
- Jackson, C.R., J.K. Martin, D.S. Leigh, and L.T. West. 2005. A Southeastern Piedmont Watershed Sediment Budget; Evidence for a Multi-Millennial Agricultural Legacy. *J. Soil Water Cons.* 60(6):298-310.
- Carroll, G.D. and C.R. Jackson. 2005. DISCUSSION: "Urbanization influences on aquatic communities in northeastern Illinois streams", by F. Fitzpatrick, M. Harris, T. Arnold, and K.D. Richards. *J. Amer. Water Res. Assoc.* 41(1):219-220.
- Ward, J.M. and C.R. Jackson. 2004. Sediment trapping within forestry streamside management zones: Georgia Piedmont, USA. *J. Amer. Water Res. Assoc.* 40(6):1421-1431.
- Rivenbark, B.L. and C.R. Jackson. 2004. Concentrated flow breakthroughs moving through silvicultural streamside management zones: southeastern Piedmont, USA. *J. Amer. Water Res. Assoc.* 40(4):1043-1052.
- Rivenbark, B.L. and C.R. Jackson. 2004. Average discharge, perennial flow initiation, and channel initiation - small southern Appalachian basins. *Journal American Water Resources Association* 40(3):639-646.
- Haggerty, S.M., D.P. Batzer, and C.R. Jackson. 2004. Macroinvertebrate response to logging in coastal headwater streams of Washington, USA. *Canadian Journal of Fisheries and Aquatic Sciences* 61: 529-537.
- Pinho, A., L. daCosta, L.A. Morris, R. Jackson, W. White, and M. Martinez. 2004. Retencao de atrazina, picloram e caulinita em zona riparia localizada em area de silvicultura. *Engenharia na Agricultura, Vicosa-MG* 12:260-270.

Projected Responsibility and Required Adjustments in Current Assignments.

- Continue to provide leadership for collaborative academic efforts in water resources at UGA and across the state.

- Facilitate coordination between the management of the undergraduate and graduate certificates in water resources.
- No required adjustments in current assignments anticipated

Name and Rank: Rebecca Moore, Assistant Professor of Natural Resource Economics

Academic Specialty:

Environmental and natural resource economics; economic valuation; dynamic optimization; applied econometrics; water resources

Educational Background:

Ph.D., Agricultural and Applied Economics, University of Wisconsin, 2006
B.A., Geology, University of Colorado, 2000

Special Qualifications Related to Program:

- Teaches a wide range of graduate courses, including
 - Environmental and Natural Resource Economics I, FANR/AAEC 7860
 - Economic Perspectives on Natural Resource Issues, FANR 7680
- Directs graduate students in water resource economics research

Relevant professional and scholarly activity for past five years:

Champ, P.A., R. Moore, and R.C. Bishop. "A Comparison of Approaches to Mitigate Hypothetical Bias." *Agricultural and Resource Economics Review* (Accepted).

Moore, R., "Economic analysis of municipal water pricing schemes," Proceedings of the Georgia Water Resources Conference 2009.

Price, J. and Moore, R., "Productive Efficiency in Water Usage: An Analysis of Differences Among Farm Types and Sizes in Georgia," Proceedings of the Georgia Water Resources Conference 2009.

Moore, R. 2008. "The Value of Water" In *Encyclopedia of Rural America, 2nd edition*. Gary Goreham, editor. New York: Grey House Publishing. pg 1071-1074.

Moore, R., R. Bishop, and B. Provencher, "Valuing a Spatially Diverse Non-market Good: The Benefits of Reduced Non-Point Source Pollution in Green Bay, WI," American Agricultural Economics Association, 2007 Selected Paper 174740 (34 pgs).

Provencher, B. and R. Moore. 2006. "A Discussion of 'Using Angler Characteristics and Attitudinal Data to Identify Environmental Preference Classes: A Latent-Class Model'" *Environmental and Resource Economics* 34: 117-124.

Macpherson, A., R. Moore, and B. Provencher. 2006. "A Dynamic Principle-Agent Model of Human Mediated Aquatic Species Invasions." *Agricultural and Resource Economics Review* 35(1): 144-154.

Projected Responsibility and Required Adjustments in Current Assignments.

- Will assist with administering the program, i.e., approving certificates, evaluating curriculum, and organizing faculty participants
- No required adjustments in current assignments anticipated

Name and Rank: David E. Radcliffe, Professor of Crop and Soil Sciences

Academic Specialty:

Water movement and nutrient and sediment transport in on-site wastewater systems and at the watershed scale using field measurements and modeling studies

Educational Background:

Ph.D. Soil Physics, University of Kentucky, 1984.

M.S. Soil Physics, University of Kentucky, 1979.

B.S. Naval Science, United States Naval Academy, 1971

Special Qualifications Related to Program:

- Teaches a wide range of graduate courses, including
 - Soil Physics, CRSS 6600
 - Advanced Soil Physics: Numerical Methods, CRSS 8600
- Advises graduate students in water resources
- Founder and long term member of the Water Resources Faculty

Relevant professional and scholarly activity for past five years:

Radcliffe, D.E., J. Freer, O. Schoumans. Diffuse phosphorus models in the U.S. and Europe: Their usages, scales, and uncertainties. In press.

Radcliffe, D.E., and L.T. West. 2009. Design hydraulic loading rates for on-site wastewater systems. *Vadose Zone Journal*. 8:64-74.

Radcliffe, D.E., Z. Lin, L.M. Risse, J.J. Romeis, and C.R. Jackson. 2009. Modeling phosphorus in the Lake Allatoona watershed using SWAT: I. Developing phosphorus parameter values. *J. Environ. Qual.* 38:111-120.

Lin, Z. and D.E. Radcliffe. 2009. Modeling Phosphorus in the Lake Allatoona watershed using SWAT: II. Effect of landuse change. *J. Environ. Qual.* 38:121-129.

Lin, Z., D.E. Radcliffe, M.B. Beck, and L.M. Risse. Modeling phosphorus in the upper Etowah River basin: Identifying sources under uncertainty. *Water Science and Technology*. In press.

Finch, S.D., D.E. Radcliffe, and L.T. West. Modeling trench sidewall and bottom flow in on-site wastewater systems. *J. Hydrologic Eng. J. Hyd. Eng.* 13:693-701.

Franklin, D.H., L.T. West, D.E. Radcliffe, and P.F. Hendrix. Characteristics and genesis of preferential flow paths in a Piedmont Ultisol. *Soil Sci. Soc. Am. J.* In press.

D.E. Radcliffe and Z. Lin. 2006. Modeling phosphorus with the Hydrologic Simulation Fortran Program (HSPF) model. *In* D.E. Radcliffe and M.L. Cabrera (ed.). *Modeling phosphorus in the environment*. Taylor and Francis Group, LLC. pg 189-214.

D.E. Radcliffe and M.L. Cabrera. 2006. Suggestions for future modeling of phosphorus. *In* D.E. Radcliffe and M.L. Cabrera (ed.). *Modeling phosphorus in the environment*. Taylor and Francis Group, LLC. pg 405-415.

Sangsupan, H.A., D.E. Radcliffe, P.G. Hartel, M.B. Jenkins, W.K. Vencill, and M.L. Cabrera. 2006. Sorption and transport of 17-beta estradiol and testosterone in intact soil columns. *J. Environ. Qual.* 35:2261-2272.

Lin, Z. and D.E. Radcliffe. 2006. Automatic calibration and predictive uncertainty analysis of a semi-distributed watershed model. *VZJ.* 5:248-260.

- Radcliffe, D.E., L.T. West, and J. Singer. 2005. Gravel effect on wastewater infiltration from septic system trenches. *Soil Sci. Soc. Am. J.* 69:1217-1224.
- Byers, H.L., M.L. Cabrera, M.K. Matthews, D.H. Franklin, J.G. Andrae, D.E. Radcliffe, M.A. McCann, H.A. Kuykendall, C.S. Hoveland, and V.H. Calvert II. 2005. Phosphorus, sediment, and *Escherichia coli* loads in unfenced streams of the Georgia Piedmont, USA. *J. Environ. Qual.* 34:2293-2300.
- McVay, K.A., D. E. Radcliffe, L.T. West, and M.L. Cabrera. 2004. Anion exchange in saprolite. *Vadose Zone Journal* 3: 668-675.
- Schroeder, P.D., D.E. Radcliffe, M.L. Cabrera, and C.D. Belew. 2004. Relationship between soil test phosphorus and phosphorus in runoff: Effects of soil series variability. *J. Environ. Qual.* 33:1452-1463.
- Schroeder, P.D., D.E. Radcliffe, M.L. Cabrera. 2004. Rainfall timing and litter application rate effect on phosphorus loss from surface-applied poultry litter. *J. Environ. Qual.* 33:2201-2209.
- McVay, K.A., D.E. Radcliffe, M.L. Cabrera, and G. Hoogenboom. 2004. Water balance of a dairy loafing lot using geotextile and its impact on water quality. *J. Soil and Water Conserv.* 59: 142-153.

Projected Responsibility and Required Adjustments in Current Assignments.

- Will assist with administering the program, i.e., approving certificates, evaluating curriculum, and organizing faculty participants
- No required adjustments in current assignments anticipated

Name and Rank: Todd C. Rasmussen, Professor of Hydrology and Water Resources

Academic Specialty:

Fluid flow and transport through surface and subsurface environments, focusing on the physical, chemical, mathematical, and statistical description and quantification of hydrologic processes.

Educational Background:

1988, Doctor of Philosophy, Department of Hydrology and Water Resources, College of Engineering and Mines, The University of Arizona, Major: Hydrology, Title of Dissertation: “Fluid Flow and Solute Transport Through Three-Dimensional Networks of Variably Saturated Discrete Fractures”, Advisor: Daniel D. Evans.

1982, Master of Science, Department of Hydrology and Water Resources, College of Earth Sciences, The University of Arizona, Major: Hydrology, Title of Thesis: “Solute Transport in Saturated Fractured Media”, Advisor: Eugene S. Simpson.

1976, Bachelor of Science, School of Forestry, University of California, Berkeley, Major: Forest Resource Management, Advisor: Paul J. Zinke.

Special Qualifications Related to Program:

- Teaches a wide range of graduate hydrology courses, including
 - Quantitative Hydrology, WASR 6500
 - Field Methods in Hydrology, WASR 6300
 - Hydrologic Modeling, WASR 8740
 - Aquifer Mechanics, WASR 8730
 - Hydrology, Geology, and Soils of Georgia, WASR 6700
- Director, UGA Undergraduate Water Resources Certificate Program
- Co-Chair, Georgia Water Resources Conference
- Founder and long term member of the Water Resources Faculty

Relevant professional and scholarly activity for past five years:

- Organizer, 2007 & 2009 Georgia Water Resources Conferences
- Publications:
 - Rasmussen TC, TL Mote, 2007, “Monitoring surface and subsurface water storage using confined aquifer water levels at the Savannah River Site, USA”, *Vadose Zone Journal*, 6(2):327-335.
 - Belk EL, D Markewitz, TC Rasmussen, EJM Carvalho, DC Nepstad, EA Davidson, 2007, “Modeling the effects of throughfall reduction on soil water content in a Brazilian Oxisol under a moist tropical forest”, *Water Resources Research* 43:W08432, doi:10.1029/2006WR005493.
 - Toll NJ, TC Rasmussen, 2007, “Removal of barometric pressure effects and Earth tides from observed water levels”, *Ground Water* 45(1):101-105.
 - Rasmussen TC, GQ Yu, 2006, “Determination of groundwater flownets, fluxes, velocities, and travel times using the complex variable boundary element method”, *Engr. Analysis with Boundary Elements* 30(12):1030-1044.
 - Mathes SE, TC Rasmussen, 2006, “Combining multivariate statistical analysis with geographic information systems mapping: A tool for delineating groundwater contamination”, *Hydrogeology Journal* 14(8):1493-1507

- Carter TL, TC Rasmussen, 2006, "Hydrologic behavior of vegetated roofs", J. American Water Resources Association, 42(5):1261-1274.
- Zeng X, TC Rasmussen, MB Beck, AK Parker, ZL Lin, 2006, "A biogeochemical model for metabolism and nutrient cycling in a southeastern piedmont impoundment", Environmental Modelling and Software, 21(8):1073-1095.
- Tollner EW, TC Rasmussen, B Upchurch, J Sikes, 2005, "Simulated moving bed form effects on real-time in-stream sediment concentration measurement with densitometry", J. Hydraulic Engineering - ASCE, 131(12):1141-1144.
- Zeng X, TC Rasmussen, 2005, "Multivariate statistical characterization of water quality in Lake Lanier, Georgia, USA", Journal of Environmental Quality, 34:1980-1991.

Projected Responsibility and Required Adjustments in Current Assignments.

- Will assist with administering the program, i.e., approving certificates, evaluating curriculum, and organizing faculty participants
- No required adjustments in current assignments anticipated