



CURRICULUM VITAE

James Douglas Gregory
Ph.D., CPSS, PWS,

March, 2010

Principal
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Professor Emeritus; Forestry, Watershed and Wetlands Hydrology
Department of Forestry and Environmental Resources
North Carolina State University, Box 8008, Raleigh, NC 27695-8008

EDUCATION

B. S., North Carolina State University, Forest Management	1965
M. S., North Carolina State University, Soil Science	1968
Ph.D., North Carolina State University, Forest Hydrology and Soils	1975

PROFESSIONAL EXPERIENCE

1968 – 1972: U.S. Army. Captain, Rotary Wing Aviator, Maintenance Officer.

1972 – 1992: U.S. Army National Guard, North Carolina National Guard. Served in a series of staff and command positions in National Guard aviation. Terminal position – Lieutenant Colonel, Plans and Operations Officer, HQ, State Area Command.

1992 – present: U.S. Army Reserve. Colonel, Retired Reserve.

1975 – 1978: Assistant Professor of Forestry (Forest Soils), School of Forestry and Wildlife Resources, Virginia Polytechnic Institute and State University, Blacksburg, Virginia (Virginia Tech).

1978 – present: Assistant Professor of Forestry (Watershed and Wetlands Hydrology), 1978 – 1981; Associate Professor of Forestry (1981 – 1996); Professor of Forestry (1996 – 2008);

Professor Emeritus, July 1, 2008 to present; Coordinator of Undergraduate programs, 1985 – 1989; Assistant Head for Undergraduate Programs, 1989 – 1995; Coordinator of N.C. State Environmental Sciences and Natural Resources Programs, 1995 – 2005; Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC (N. C. State).

2005 – present: Principal, Watershed Hydrology Consultants LLC, Raleigh, NC

Professional Activities Below at N.C. State University Unless Otherwise Noted:

ACADEMIC EXPERIENCE

1. Key accomplishments:

- a. Led the Department undergraduate program during a 10-year period of rapid change in the forestry profession and improving/upgrading the Forest Management curriculum. We conducted extensive surveys of forest industry, U.S. Forest Service, and State Forestry Service personnel to determine the knowledge and skills that entry level foresters needed and applied that data to revising and upgrading the N.C. State Forest Management curriculum. Served on two Society of American Foresters academic program review teams that reviewed other university professional forestry programs.
- b. Beginning at Virginia Tech and continued at N.C. State, developed an academic program in watershed and wetlands hydrology with undergraduate and graduate curricula, undergraduate and graduate courses, and a strong program of graduate student education. Much effort on interaction with colleagues in other colleges to develop and administer a broad-based program of graduate education in water resources.
- c. Graduate student mentoring – developed and implemented a new graduate program in watershed hydrology that has been instrumental in providing professionals in agency and private sector organizations. At Virginia Tech and N.C. State, have graduated 37 Masters students, 8 Ph.D. students, and served as an advisory committee member for approximately 80 additional graduate students.
- d. Leader in the development of the Natural Resources and Environmental Sciences intercollege curricula and the Environmental Science Watershed Hydrology Concentration.

2. 1980 – 1995: Advisor, N.C. State Forestry Club

3. 1985 – Present: Chair, N.C. State Water Resources Committee; manages the N.C. State Graduate Minor in Waters Resources; deals with other issues related to graduate education in water resources.

4. University Courses

- a. For about 10 years, taught this Department's primary introductory forestry courses, Introduction to Forestry and Forest System Mapping and Mensuration I.
- b. Undergraduate and graduate courses in Watershed and Wetlands Hydrology at Virginia Tech and N.C. State – 33 years
- c. Graduate course in Wetland assessment, Delineation, and Regulation – 9 years
- d. Fire Management course for 3 years at Virginia Tech and 20 years at N.C. State
- e. Developed and taught for several years a new course in Natural Resources Measurements

5. Served as Administrator of the Undergraduate Program in the Department for 10 years.
 - a. Period of change in faculty (many retirements) and forestry undergraduate programs – significant modernization and increased rigor of the Forest Management curriculum.
 - b. 1989 – 1990: With then department head, Art Cooper, I developed the original concepts of and proposal for the Natural Resources Curriculum that later developed into an intercollege program with three colleges participating.
 - c. 1990 – 1992: Served as the college representative on the N.C. State intercollege task forces that developed the proposals for the Natural Resources (NR) and Environmental Science (ES) programs and the core curricula for each program.
 - d. 1994: Served as the college representative on the Natural Resources Coordinating Committee and the Environmental Sciences Coordinating Committee. These committees developed and implemented the structure for administering the NR and ES programs with a Coordinator and an intercollege committee for each program.
 - e. 1994 – 2008: Developed the proposal for the Department of Forestry curriculum in Environmental Sciences, Watershed Hydrology (ESH), guided the proposal through the University review procedures, and served as coordinator of the curriculum and advisor to all ESH students.
6. Development and Administration of the N.C. State Master's Program in Natural Resources (MNR)
 - a. 1993 – 2008: Served on the ad hoc committee that developed the proposal for the intercollege Master's Program in Natural Resources (MNR) in 1993 and served on the Administrative Committee for the program after its establishment.
 - b. 1993 – 2008: Developed the Hydrology Concentration (NRH) for MNR and served as the coordinator of the concentration and advisor of most of the MNR graduates.
7. 1999 – 2008: Developed a proposal for the Undergraduate Minor in Wetland Assessment and served as the coordinator of the minor.

EXTENSION AND OUTREACH EXPERIENCE

1. Key accomplishments

- a. Throughout my career, I have frequently visited various national forests, U.S. Forest Service research locations, forest management and research locations of the wood products industry, and other private forestry operations to keep up to date on current forest management practices and to conduct technology transfer activities.
- b. Because of recognition as the North Carolina expert on forest, watershed, and wetlands hydrology, I have served on a variety of State level committees and task forces related to water resources issues (see below).
- c. As a charter and continuing member of the N.C. Forest Practices Guidelines Technical Advisory Committee established by the North Carolina Legislature in 1989, I have played an important role

in the development of forestry Best Management Practices (BMP) in North Carolina and the drafting and publication of forestry BMP manuals in 1989 and 2007.

- d. Have worked closely with the N.C. Division of Water Quality (NCDWQ) since 1998 on development, testing, and conducting training on the N.C. methods for field determination of the origins of intermittent and perennial streams (see below).
- e. Have become a recognized expert on U.S. Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (Corps) wetlands regulatory programs, particularly application of these regulations to forestry, and regularly give invited presentations on these programs at conferences and workshops. Have taught 1-3 times annually since 1996, a five-day workshop on the Corps wetland delineation methods. Have served as an expert consultant to both private parties and the EPA and Corps on wetlands regulatory cases.

2. **Numerous Short Courses** sponsored by the N.C. State University Forestry and Environmental Outreach Program. These have included Wetlands Delineation, Stream Identification, Wetland Hydrology, Forest Hydrology, Clean Water Act Section 404 Regulations, Riparian Zone Structure and Functions, Soil Management for Wetland and Stream Mitigation, Forest Water Management, Forestry BMPs, Vegetation Management, Forest Soils, Bottomland Hardwoods, Wetland Mitigation, and many others.

3. **Technology Transfer** through service on Statewide committees and task forces:

- a. 1989 – Present: Charter Member, N.C. Forest Practices Guidelines Technical Advisory Committee. Have served as a key member of this committee since it was established by the N.C. legislature in 1989. This committee developed the N.C. Forestry BMP program, drafted the first BMP manual in 1989 and drafted a greatly expanded and updated BMP manual in 2007.
- b. 1982 – 1983: Member, Governor’s Coastal Water Management Task Force; Member, N.C. Forestry Association Task Force on Clean Water Act, Section 404(f) Regulations.
- c. 1998 – 1999: Technical Advisor, Neuse River Buffer Rule Stakeholder’s Committee; Chair, NC Forestry Task Force, Neuse River Buffer Rule.
- d. 1998 – Present: Co-Chair, N.C. Stream Technical Advisory Committee.
- e. 2000 –2010: Member, Technical Advisory Committee of the N.C. Sedimentation Control Commission.

4. **Development and implementation of the N.C. Division of Water Quality *Identification Methods for the Origin of Intermittent and Perennial Streams*:**

- a. As Co-Chair of the N.C. Stream Technical Advisory Committee, I have worked closely with personnel of the NCDWQ since 1998 in the development, testing, and implementation of the North Carolina stream identification methods. Those methods were originally developed for implementation of the Neuse River Basin Riparian Buffer Rules but have since been adopted for application of all N.C. stream regulatory programs including basic Waters of the State determinations. The stream identification methods have been adopted by several other States and are being utilized by EPA and Corps field personnel to assist in making Waters of the United States determinations. <http://portal.ncdenr.org/web/wq/swp/ws/401/policies>

- b. I have conducted cooperative research with NCDWQ to test various elements of the stream identification methods and to learn more about the geologic, hydrologic, and biologic characteristics and functions of headwaters streams.
- c. I assisted NCDWQ in 2001 in the development of the 4-day training and certification course on the N.C. stream identification methods required by State law for personnel of NCDWQ, the N.C. Division of Forest Resources and local governments who have accepted delegation of the river basin riparian buffer rules. I serve as a key instructor for the NCDWQ stream identification workshops offered for staff of public agencies, conduct identical workshops for private consultants through the N.C. State University Forestry and Environmental Outreach Program, and conduct workshops out-of-State on a consulting basis.

EXPERTISE AND EXPERIENCE RELATED TO WETLANDS DELINEATION

- 1. Knowledge of and experience in wetlands of the southeastern US: Through research projects, teaching activities, and technology transfer activities, I am quite familiar with all of the wetland types of NC, VA, SC, and GA and have visited major wetland types in most other southern States.
- 2. Scientific background: I have much knowledge and experience in the science of wetland hydrology and wetland soils, much less so in the science of hydrophytic plants. I have conducted research on wetland hydrology in all of the forested wetland types in N.C. Dr. Jon Stucky, Professor of Plant Biology at N.C. State and a specialist in wetland plants, assists me in all of my classes on wetland delineation and wetland functional assessment to teach all segments on hydrophytic plants.
- 3. Experience in wetland delineation: I teach the Corps wetland delineation methodology, implemented first in 1996 as part of a graduate course on Wetland Assessment, Delineation, and Regulation and then in 1998 as a standard, week-long short course offered through the N.C. State Forestry and Environmental Outreach Program. The short course is offered at least once annually and has been taught 2-3 times in several years.
- 4. June 2007: Member of Peer Review Team appointed by Corps to review *Draft Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region*.

TEACHING AND TECHNOLOGY TRANSFER ACTIVITIES RELATED TO WETLANDS LAWS AND REGULATIONS

- 1. I have worked closely for many years with staff of the Wilmington District Regulatory Division, Corps, and the Wetlands and Stormwater Unit, N.C. Division of Water Quality on issues related to application of Sections 401 and 404 of the Clean Water Act.
- 3. I provided instruction on Sections 401 and 404 of the Clean Water Act and all the associated EPA, Corps, and State of N.C. regulations several times a year: (1) In a graduate course that I taught – NR 521 Wetland Assessment, Delineation, and Regulation; (2) in a one-week wetlands delineation training workshop that I teach, and (3) guest lectures in graduate courses on natural resources policy.
- 4. I frequently answer questions from landowners, State service foresters, consulting foresters, and environmental consultants on applications of the Section 404 regulations in silviculture.
- 5. I have been a frequent invited speaker at workshops and conferences on Section 404 of the Clean Water Act and related regulations and guidance that apply to silviculture.

6. As a member of the N.C. Forest Practices Guidelines Technical Advisory Committee, I served as the chief author of two new sections of the greatly expanded 2007 edition of the *North Carolina Forestry Best Management Practices Manual to Protect Water Quality*: (1) Water Quality Regulations Affecting Forestry, and (2) Silvicultural Activities in Forested Wetlands.
7. I have worked with foresters of the N.C. Division of Forest Resources and the forest industry for many years on various types of research and technology transfer projects related to the design and management of minor drainage systems and the hydrologic impacts of management of pine plantations on wetland sites in eastern NC, VA, SC, and GA and management of bottomland hardwood stands on floodplain wetlands.
8. Participated in a series of meetings of a multi-interest task force that reviewed the impacts of the Supreme Court's SWANNC decision on isolated wetlands and its impact in N.C. The task force provided input to the NCDWQ and the N.C. Environmental Management Commission on proposed N.C. regulations for a permit program for activities in isolated wetlands that no longer are under U. S. Army Corps of Engineers jurisdiction.

INTERNATIONAL EXPERIENCE

1. 1976-1980: Reforestation and soil conservation research and development in Haiti.
2. 1979: Training Team, Resource Conservation and Utilization Project, Nepal; developed plans for a new university unit in Renewable Natural Resources in Nepal.
3. 1991: Application of the Universal Soil Loss Equation in Senegal.

RESEARCH EXPERIENCE

1. Key accomplishments

- a. Established a program of research in forest and watershed hydrology and wetlands hydrology that resulted in a wide variety of research projects related to the research needs of N.C. and the Southeast.
- b. Became a recognized expert in the fields of forest hydrology, wetland hydrology, management of wetland forests and drained forest plantations, and the EPA and Corps wetlands regulatory programs as related to forestry.
- c. Grants and contracts: as Principal Investigator or Co-PI, I have been involved in research projects funded by grant and contract awards totaling more than \$3.5 million.
- d. Publications
 - i. 32 peer reviewed publications
 - ii. 15 proceedings publications
 - iii. 2 editorships of proceedings publications
 - iv. 12 unpublished research project reports
 - v. 55 paper presentations

2. Research experience – Major projects included:

- a. Silviculture – Conducted several studies on the impacts of silvicultural practices on tree growth and stand development, including timber harvesting. Have extensive experience in the silviculture and hydrology of mountain hardwood forests through interactions on research, education, and outreach activities with scientists of the U.S. Forest Service mountain silviculture

and forest hydrology research centers at Coweeta Hydrologic Laboratory near Franklin, NC, Bent Creek Experimental Forest near Asheville, NC, and the Timber and Watershed Laboratory near Parsons, WV.

- b. Watershed hydrology and forest water quality – conducted several studies on watershed hydrology and the effects of silvicultural practices on runoff and water quality.
- c. Wetland Hydrology - studied hydrology of wetland forests in many different landscapes, including the ridge and swale topography of Hatteras Woods on the Outer Banks; pine plantations and natural stands on mineral and organic flats of the Hofmann Forest; pine plantations on several different Weyerhaeuser Company sites; natural pond pine stands of the large military bombing ranges in Dare County; bottomland hardwood stands on flood plains in two different States; and three large Carolina Bays.
- d. Wetland mitigation – Effects of restoration on the hydrology of a large Carolina Bay with prior converted agricultural land; development of practices for hydrologic assessment of potential restoration sites and for hydrologic restoration.
- e. Water management in drained forest plantations – series of cooperative studies with Weyerhaeuser Company and the N.C. State Departments of Biological and Agricultural Engineering and Soil Science; studies in the Hofmann Forest on hydrology and water management.
- f. Stream Networks – Identification, classification, and assessment of streams; geomorphic, hydrologic, and biologic characteristics of headwater streams; water quality functions of riparian zones; bottomland hardwood management; development of LIDAR/GIS based methods for improved mapping of headwaters streams.
- g. Forest Soils - Fertilization of loblolly pine stands; effects of silvicultural practices on soil physical and chemical properties; reforestation and soil conservation in developing countries.

EXPERIENCE IN HYDROLOGIC MODELING

1. Academic – FOR 420 and FOR 520 Watershed and Wetlands Hydrology; have long included a section on the theory and application of hydrologic models, an overview of several widely used rainfall-runoff models, and an extensive student exercise on the application of TR-55, the widely used and often misused stormflow prediction model developed by the Natural Resources Conservation Service.
2. Research – Have served as a member of the research team on several long running forest hydrology research projects in which hydrologic model development and testing were major objectives. Developing forestry applications of the water management model, DRAINMOD, developed by Dr. Wayne Skaggs of the N.C. State Department of Biological and Agricultural Engineering, was the focus of many of those studies.
3. Consulting – Planned and supervised the development of an application of the watershed rainfall-runoff model, HEC-HMS, to a 132 mi² watershed in West Virginia and use of the predicted peak flows for a large flood event to predict flood elevations at a large number of locations in the watershed using HEC-RAS.

SELECTED RECENT PUBLICATIONS

(Total of 61 publications and reports and 55 paper presentations)

- Amatya, D. M., R. W. Skaggs, and J. D. Gregory. 1995. A watershed scale hydrologic model for drained forested land. Pp. 73-82. *In* Proceedings of the Watershed Management Symposium of the 1995 ASCE International Water Resources Engineering Conference, San Antonio, TX, August 14-16, 1995
- Amatya, D. M., R. W. Skaggs, and J. D. Gregory. 1996. Effects of controlled drainage on the hydrology of a drained pine plantation in the North Carolina Coastal Plain. *Journal of Hydrology* 181: 211-232.
- Calvo, J. C. and J. D. Gregory. 1997. Predicting mean annual runoff and suspended sediment yield in rural watersheds in North Carolina. University of North Carolina, Water Resources Research Institute Report No. 307.
- Amatya, D. M., R. W. Skaggs, and J. D. Gregory. 1997. Evaluation of a watershed scale forest hydrologic model. *Agricultural Water Management* 32 (1997): 239-258.
- Amatya, D. M., R. W. Skaggs, J. D. Gregory, and R. B. Herrmann. 1997. Hydrology of a drained forested pocosin watershed. *Journal of the American Water Resources Association* 33 (3): 525-546.
- Edwards, P. J., J. D. Gregory, and H. L. Allen. 1999. Seasonal sulfate deposition and export patterns for a small Appalachian watershed. *Water, Soil, and Air Pollution* 110: 137-155.
- Amatya, D. M., J. D. Gregory, and R. W. Skaggs. 2000. Effects of controlled drainage on storm event hydrology in a loblolly pine plantation. *Journal of the American Water Resources Association* 36(1): 175-190.
- Franklin, E. C., J. D. Gregory, D. W. Hazel, and J. W. Parsons. 2000. Management of forested filter zones for dispersion and treatment of agricultural runoff. University of North Carolina, Water Resources Research Institute Report No. 312.
- Gregory, J. D., S. D. Smith, E. Fleek, and D. Penrose. 2002. What is a stream? Proceedings, Watershed 2002, February 23-27, 2002, Ft. Lauderdale, FL. Water Environment Federation, Alexandria, VA
- Darling, R., J. Lawson, J. D. Gregory, and D. Penrose. 2002. Stream identification and mapping for watershed protection. Proceedings, Watershed 2002, February 23-27, 2002, Ft. Lauderdale, FL. Water Environment Federation, Alexandria, VA.
- Colson, T. P., J. D. Gregory, H. Mitasova, and S. A. C. Nelson. Comparison of stream extraction models using LIDAR DEMs. Proceedings, Geographic Information Systems and Water Resources IV, AWRA Spring Specialty Conference, May 8-10, 2006, Houston, TX. American Water Resources Association, Middleburg, VA.
- Colson, T. P., J. D. Gregory, S. A. C. Nelson, and E. G. Shipman. A mobile geographic information system to support stream identification. Proceedings, Geographic Information Systems and Water Resources IV, AWRA Spring Specialty Conference, May 8-10, 2006, Houston, TX. American Water Resources Association, Middleburg, VA.

Colson, T. P. 2006. Stream Network Delineation from High Resolution Digital Elevation Models. Ph.D. Dissertation, Dept. of Forestry and Environmental Resources, NC State University, Raleigh, NC. <http://www.lib.N.C.State.edu/theses/available/etd-10302006-122024/>

Caldwell, P. V., M. J. Vepraskas, and J. D. Gregory. 2007. Physical Properties of Natural Organic Soils in Carolina Bays of the Southeastern United States. SSSAJ 71: 1051-1057.

AWARDS/RECOGNITIONS/CERTIFICATIONS

1. N.C. State University Academy of Outstanding Teachers.
2. 1984 Professional Achievement Award, North Carolina Chapter, Soil Conservation Society of America.
3. 1988-1989 N.C. State Administrative Fellow.
4. 2000 – College of Forest Resources Nominee, Alumni Distinguished Undergraduate Professor Award
5. Certified Professional Soil Scientist, American Registry of Certified Professionals in Agronomy, Crops, and Soils
6. Professional Wetland Scientist, Society of Wetland Scientists Certification Program, Inc.

PROFESSIONAL SOCIETIES

Society of American Foresters; Society of Wetland Scientists; North Carolina Forestry Association; North Carolina Association of Environmental Professionals; Soil Science Society of North Carolina.

HONOR SOCIETIES

Sigma Xi, The Scientific Research Society; Phi Kappa Phi, National Honor Society; Gamma Sigma Delta, The Honor Society of Agriculture; Xi Sigma Pi, Forestry Honor Society; Alpha Zeta, Agricultural and Forestry Honor Society

RECENT CONSULTING EXPERIENCE

1. Experience as an expert advisor and expert witness
 - a. 1993 – I served as an expert witness before a state Administrative Law Judge for the U.S. National Park Service (NPS) and Southern Environmental Law Center in an appeal of a permit issued by the State of North Carolina for installation of a new field of water supply wells in the N.C. Coastal Reserve on Hatteras Island, NC. With funding supplied by NPS, I had collected rainfall and water table data for a period of two years and calibrated a ground water model to predict that installing and operating the proposed water supply wells would lower the water table in wetlands located in the NPS Cape Hatteras National Seashore, adjacent to the Coastal Reserve.
 - b. 2001 – Lawsuit against a homeowner in Apex, NC filed by his neighbor alleging damage in her yard from stormwater flow in a natural ephemeral stream that traversed the rear yard areas of several lots. I served as an expert witness on the hydrology and erosion issues for the homeowner who was being sued in a superior court proceeding.
 - c. 2002 – 2003: For the Counsel of Region 3, USEPA, Philadelphia, PA, I served as an expert witness before a federal Administrative Law Judge in a hearing in Virginia regarding a violation by a developer of Clean Water Act, Section 404 regulations. The focus of my expert testimony was on normal silvicultural operations, minor drainage, and water management in wetland forests conducted in accordance with the silvicultural exemption from permitting requirements.

- d. 2005 – 2006, 2009: For Steptoe and Johnson, PLLC, Clarksburg, WV, defending wood products companies against lawsuits alleging that timber harvesting had exacerbated a large, damaging flood in southern West Virginia on July, 2001. My work involved background research and drafting an extensive report on small watershed research related to hydrologic impacts of timber harvesting, hydrologic modeling applied to assessment of timber harvesting impacts, and specific issues of hydrologic impacts of timber harvesting in a 132 mi² watershed in central W.V. Also assisted in reviewing plaintiff's experts' reports, depositions of plaintiff's experts, developing lines of questions for depositions of plaintiff's experts and for questioning in court, etc. Additional work on this case in 2009 with addition of the hydrologic modeling work noted above.
 - e. 2007 – For the U.S. Department of Justice, Environmental Division, Washington, DC. I served as an expert consultant and expert witness on hydrology issues for a complex wetlands case involving violations of Section 404 of the Clean Water Act on a 1500 acre site in southeastern Virginia that had a former silvicultural drainage system. Extensive field work (including total station surveying) was conducted to assess the character of the drainage system, forest stands, and connections to navigable waters; to develop an accurate GIS database of the site; and to assess the type and extent of activities that constituted Section 404 violations.
 - f. 2009 – For Brooks, Pierce, McLendon, Humphrey & Leonard, L.L.P., Greensboro, NC; expert advisor and potential expert witness regarding forest and hydrology issues related to the Clean Water Act Section 404 application, EIS, and permit of PCS Phosphate, Inc., Aurora, NC for phosphate mine expansion.
2. Stormwater management issues – private clients.
 3. Wetlands and stream determinations for private clients.
 4. Assessment and mapping of forest ecosystem types, quantitative forest inventory, and assessment of soil mapping units and soil conditions, streams, wetlands, and other surface waters on several large tracts for private clients.
 5. Planning/implementing wetland and riparian buffer mitigation projects, N.C. Department of Transportation and private consulting firms.
 6. Assessment of potential environmental impacts of planned land development projects – private clients. Evaluated, hydrology, soils, and wetlands issues; stormwater management planning, onsite waste water management; ground water availability, etc.
 8. Application of Clean Water Act, Section 404(f) regulations to silvicultural activities; assisting private clients in interactions with the U.S. Army Corps of Engineers.
 9. Assessment of potential damage to trees along a sewer line easement in Chapel Hill, NC. This project involved an initial assessment of potential impacts of new pipeline installation on adjacent trees; inventory and condition assessment of trees close to the proposed construction corridor; and implementation of a long term tree monitoring program to assess the factors that influence the degree of tree damage that resulted from the pipeline installation activities.
 10. Assessment of risk of water quality degradation resulting from routine aerial application of a commonly used forest fire retardant. EPA has recently issued new recommendations for maximum stream water concentrations of a chemical in the retardant to preclude acute and chronic toxicity to

aquatic animals. My work for the chemical manufacturer involved assessment of the risk of that chemical being transported to a receiving stream in runoff in different scenarios of aerial fire suppression tactics and rainfall/runoff patterns.

11. Assessment of water supplies available to the Town of Southern Pines as a consultant to a local citizens group.
12. Consultant to CC&T Real Estate Services, Charleston, SC regarding hydrological assessments and stormwater management planning for a planned unit development adjacent to the Angel Oak, a very old and large live oak tree in a small city park.
13. Planning and conduct of many 3-5 day workshops on wetland determination and delineation, wetland plant identification, and the N.C. Division of Water Quality *Identification Methods for the Origins of Intermittent and Perennial Streams* in North Carolina, Virginia, South Carolina, and Georgia.