

**Virginia Water Resources Research Center
Annual Technical Report
FY 2006**

Introduction

The Virginia Water Resources Research Center (VWRRC) was established at Virginia Tech in 1965 as a federally authorized program. In 1982, the Virginia General Assembly authorized the VWRRC as a state agency under the Code of Virginia (§23-135.7:8).

Mission

The VWRRC provides research and educational opportunities to future water scientists; promotes research on practical solutions to water resources problems; and facilitates the timely transfer of water resources information to policy- and decision-makers.

Mission Elements

Research

Assisting university researchers in securing research support funds from public and private sources

Assisting university researchers in initiating and executing water resources research

Education

Advancing educational opportunities for students in the water resources by helping university researchers provide undergraduate and graduate research opportunities in water resources

Initiating and expanding student intern opportunities with the private and public sectors

Identifying water resources scholarship opportunities

Outreach

Maintaining a publication series that synthesizes and reports on water policy and science

Securing academic advisors to work in an advisory capacity with the public and private sector

Initiating and participating in the design and execution of conferences and symposia on Virginia and national water issues

Program Administration

Administrative oversight is provided by the Dean of the College of Natural Resources. A Statewide Advisory Board appointed by the Governor advises the VWRRC director on state water research and information priorities. Because of its multiple legislative authorities and administrative responsibilities, the VWRRC has a number of reporting responsibilities. In addition to the annual reporting requirements to the USGS and the National Institutes for Water Resources (NIWR), it presents an annual report to the Virginia Tech administration. Five-year reports and reviews are expected by the USGS and the State Council on Higher Education for Virginia (SCHEV).

National Affiliations

The VWRRC is affiliated with NIWR and UCOWR.

Programs of the VWRRC

The programs are structured to meet the VWRRC's strategic goals and are consistent with the VWRRC mission as authorized by the U.S. Congress and Code of Virginia (§23-135.7:8). Programs in research and education are available to students and faculty at all Virginia colleges and universities. Outreach and collaborative programs include information transfer to policy/decision makers and citizens, and collaborative partnerships with state agencies and other water interest groups.

1) Research Programs

(a) The VWRRC's statewide competitive grants program provides research funds (up to \$20,000) to find practical solutions to water problems in Virginia and the region. The grant period begins July 1 and ends June 30 of the following year. The review criteria include the technical merit of the proposed project, its relevance to Virginia and the region, its address of cutting-edge water issues, and its ability to provide research opportunities for graduate and undergraduate students. A list of water research needs in Virginia compiled from input by university researchers, state and local water agency personnel and water utility managers is available on the VWRRC website: www.vwrcc.vt.edu/publications/recent.htm.

The seed grant program (statewide competition) provides research funds (up to \$5,000) to support background and preliminary research for developing full research proposals to be submitted to external private and public funding agencies. Funds may be used for student support, preliminary analysis to develop a project, and travel to visit a potential research site or to establish appropriate linkages with funding agencies. The final report for seed grants is a proposal submitted to an external funding agency. The duration of each award is one year.

(b) The VWRRC applies for external grants and conducts in-house research.

(c) The VWRRC facilitates team building and interdisciplinary, multi-institute collaborative research.

(d) The VWRRC facilitates research opportunities to other university faculty and external contractors through a partnership with federal agencies that provide targeted funding from the USGS.

2) Educational Programs

(a) The VWRRC provides research opportunities to undergraduate students and assistantships to graduate students who participate in sponsored research. Also, numerous graduate and undergraduate students are supported through the VWRRC's competitive grants program in Virginia Tech academic departments and at Virginia's other colleges and universities.

(b) In 1999, the VWRRC established the William R. Walker Graduate Research Fellowship to honor the many contributions of Dr. William R. Walker, the VWRRC's first director. The \$2,500 award is intended for individuals preparing for a professional career in water resources. Details of the program can be found on the VWRRC website: www.vwrcc.vt.edu/StudentOps/studentops.htm.

(c) The VWRRC Undergraduate Research Summer Fellowship provides \$2,500 scholarships to students and \$500 to faculty mentors for 10-week summer internships. Recipients are selected through a statewide competition.

(d) Virginia Service Training for Environmental Progress (STEP) provides \$2,550 summer internships to students working in service-learning partnerships with Virginia communities on water-related issues. The competitive program accepts both undergraduate and graduate students. Recipients are selected through a statewide competition.

(e) The VWRRC coordinates the interdisciplinary watershed management minor and certificate program at Virginia Tech. The program is currently based in the Department of Urban Affairs and Planning at Virginia Tech.

(f) The VWRRC supports the Virginia Tech Chapter of the American Water Resources Association.

2) Outreach and Collaborative Programs

(a) The VWRRC provides administrative support for the Virginia Water Monitoring Council.

(b) The VWRRC publishes research reports, symposia proceedings and citizen education booklets. It provides funding for the publication of outreach efforts.

(c) The VWRRC publishes a quarterly newsletter, *Virginia Water Central*. It features scientific and educational articles, legislative information, and news of interest. Hard copies are distributed to about 2,300 people, and electronic copies are provided to more than 300 people.

(d) The VWRRC sponsors or co-sponsors symposia, workshops, and seminars.

(e) The VWRRC facilitates peer reviews for state programs when requested.

(f) The VWRRC website (www.vwrcc.vt.edu) serves as a repository of the Center's publications, houses an academic expert database, and hosts other relevant programs.

Research Program

Research Program

The research programs of the VWRRC are supported through its Virginia state appropriation, external funding, and overhead generated by external funding. The 104 federal funds are not allocated to support research but are used to support the outreach and information dissemination programs of the VWRRC.

During FY2006, the VWRRC funded four research projects through its competitive grant program and awarded one William R. Walker Graduate Fellowship Award. For the USGS reporting period, funding for four facilitated grants passed through USGS; projects were managed by the VWRRC. Basic information and resulting products are described in the following section.

Grant No. 06HQGR0189 Microtopography Effects on Vegetative and Biogeochemical Patterns in Created Wetlands: A Comparative Study to Provide Guidance for Wetland Creation and Restoration

Basic Information

Title:	Grant No. 06HQGR0189 Microtopography Effects on Vegetative and Biogeochemical Patterns in Created Wetlands: A Comparative Study to Provide Guidance for Wetland Creation and Restoration
Project Number:	2006VA105G
Start Date:	9/1/2006
End Date:	12/31/2008
Funding Source:	104G
Congressional District:	11
Research Category:	Biological Sciences
Focus Category:	Wetlands, Ecology, Hydrogeochemistry
Descriptors:	
Principal Investigators:	changwoo ahn, Gregory B. Noe

Publication

- 1. None

Progress report for USGS

Changwoo Ahn, PI
Environmental Science and Policy
George Mason University

This project involves two-year study of four created wetlands with varying ages, namely Loudoun County Mitigation Bank (LCMB), North Fork mitigation bank, Bull Run mitigation bank, and Airlie wetland, and a reference natural wetland at Battlefield Park, all in northern Virginia. It includes the study of microtopographic variability, soil biogeochemistry, and vegetation characteristics. For the first growing season of the study period, the study began at the newest created wetland – the LCMB – in May 2007.

Site description

The construction of the LCMB, which involved grading and disking using heavy machineries, was started in July and completed in August 2006. Hydro seeding of hydrophytic plants seed-mix within the wetlands and planting of woody vegetation within the wetlands and upland buffers were completed by December 2006. The LCMB is located in Loudoun County, Virginia in the floodplain of Goose Creek and Big Branch, a tributary of Goose Creek, and covers an area of 35 acres on a 200-acre parcel of wetlands bank easement owned by others. This site encompasses 9.5 acres of palustrine-forested wetlands, 4 acres of enhanced and preserved existing wetlands, 11 acres of reforested uplands, and 7.5 acres of preserved existing forest.

Experimental design

The LCMB is comprised of three wetland cells; however, this study is performed in cells: 1 and 2 (Figure 1). Six 10m x 10m plots are laid out in each cell; three plots were disked by heavy machinery while three plots remained undisked prior to seeding (hydrophytic vegetation) and planting (woody vegetation) (Figure 1). Each disked plot is laid adjacent to the undisked plot to reduce variability in other environmental variables as much as possible. All plots are permanently marked.

Microtopography

Microtopography measurements were taken in all the 12 study plots using a Sokkia SET4110 total station between mid-May and mid-June 2007. The total station measures three-dimensional coordinate positions with sub-millimeter precision on elevation measurements at the distances used (Sokkia Co., 1997). Field measurements were taken along a set of tangentially-conjoined circular transects; these were laid out as 0.5m-, 1m-, 2m-, and 4m- diameter using crosslinked polyethylene (PEX) tubing hoops. Each set of circular transects was randomly placed within the 10m x 10m plots; however, transects were always laid out to have first reading (0 cm) in south direction to maintain consistency (Figure 2). Measurements were taken at 10 cm intervals along the 0.5m-, 1m-, and 2m- diameter circular transect paths, and at 20 cm intervals along the 4m- diameter circular transect path. Coordinate data were recorded to the nearest millimeter. Field measurements within all plots were performed during relatively drier period, except plots D and DD which were in saturated soil conditions. Care was taken not to disturb the microtopography along these circular transect paths.

Other study sites

Microtopography measurements also began at the North Fork Mitigation bank – a created wetland at seventh growing season. The North Fork Mitigation Wetland Bank is located in Prince William County, Virginia. Created in the pastureland, this wetland mitigation bank includes 7 acres of open water, 76 acres of wetlands and 42 acres of upland buffer. This wetland includes a “Main Pod”, overbank flow area, four tiers, and vernal pools (Figure 1), and is mainly dependent on Broad Run stream, precipitation, and surface runoff for its hydrology. Six 10m x 10m plots are laid out in this site: 4 in the Main Pod and 2 in the vernal pool.

Microtopography measurement is expected to be completed in all sites, including Bull Run mitigation bank (4 plots), Airlie wetland (4 plots), and Battlefield Park reference wetland (4 plots) by the end of June 2007. Fieldwork pertinent to vegetation and soil for this growing season is expected to be completed for all sites in July and August.

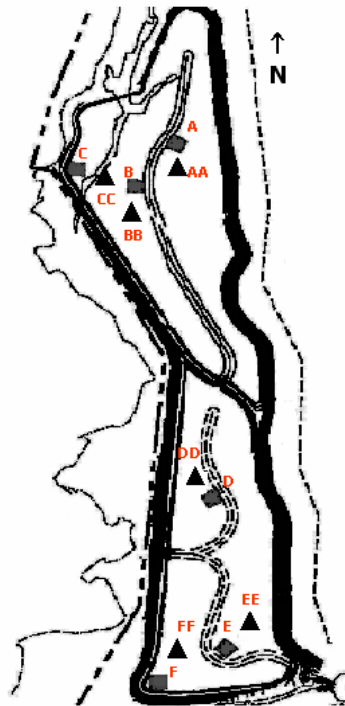


Figure 1. Permanent plot (10m x 10m) locations for microtopography study in cell 1 and cell 2 at LCMB. Each cell has 3 disked and 3 nondisked plots, totaling 12 plots. Triangles (AA-FF) are disked and squares (A-F) are nondisked.

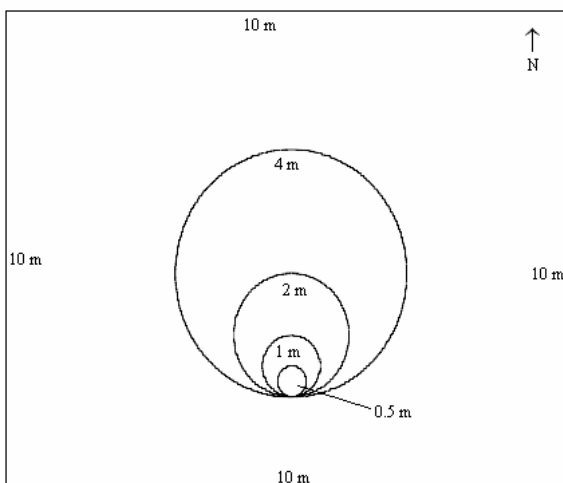


Figure 2. Nested circular transect layout. Plot size and transects diameters indicated.

Information Transfer Program

The VWRRC supports timely dissemination of science-based information to policy and decision-making bodies and citizens. The VWRRC used its 104 funds to support expert personnel with responsibilities related to the VWRRC's outreach and collaborative programs. The 104 funds supported:

1. Preparation of the newsletter *Virginia Water Central*
2. Service Training for Environmental Progress (STEP) [an educational/outreach internship program]
3. Partial support for organizing the annual Virginia Water Research Symposium
4. Partial administrative support for the Virginia Water Monitoring Council
5. Partial support for management of the VWRRC webpage.

Information Dissemination

Basic Information

Title:	Information Dissemination
Project Number:	2006VA97B
Start Date:	3/1/2006
End Date:	2/29/2008
Funding Source:	104B
Congressional District:	9th
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	
Principal Investigators:	Stephen H. Schoenholtz

Publication

1. THESIS AND DISSERTATIONS

Jocelyn Fraga Muller. 2006. The Role of Multidrug Efflux Pumps in the Stress Response of *Pseudomonas aeruginosa* to Organic Contamination. Ph.D., Civil and Environmental Engineering, Virginia Tech.

Constance A. Sullivan. 2007. Biomarker responses in fathead minnows (*Pimephales promelas*) during exposure to Exceptional Quality biosolids. M.S. Thesis. The College of William and Mary.

2. JOURNAL ARTICLES

Eisenbies, M.H., W.M. Aust, J.A. Burger, M.B. Adams. 2007. Forest operations, extreme flooding events, and considerations for hydrologic modeling in the Appalachians - a review. *Forest Ecology and Management*. 242: 77-98.

Eisenbies, M.H., M.B. Adams, W.M. Aust, J.A. Burger. 2007. Bibliography concerning forest water yields, flooding issues, and the hydrologic modeling of extreme flood events. USDA Forest Service General Technical Report (in press).

Sullivan, C.A., C. L. Mitchelmore, R. C. Hale and P.A. Van Veld. 2007. Induction of CYP1A and DNA damage in the fathead minnow (*Pimephales promelas*) following exposure to biosolids. *Science of the Total Environment* (in press).

Kaurish, F., T. Younos. 2007. Developing a Standardized Water Quality Index for Evaluating Surface Water Quality. *Jour. American Water Resources Association*, 43(2):533-545.

Younos, T., V. J. Harwood, J.O. Falkinham, H. Shen. 2007. Pathogens in Natural and Engineered Water Systems: Emerging Issues. *Water Resources Impact* 9(3):11-14.

3. CONFERENCE PROCEEDINGS

Ikuma, K., J.F. Muller, A.M. Stevens, C. Hagedorn and N.G. Love. 2007. Evaluating the extent of pollution-induced antibiotic resistance in environmental bacterial strains. To be presented by Nancy Love at the AWRA 2007 Summer Specialty Conference on Emerging Contaminants of Concern in the Environment, Vail, Colorado, June 25-27, 2007.

Schwartz, B.F. and M.E. Schreiber. 2005. New applications of differential Electrical Resistivity Tomography and Time Domain Reflectometry to modeling infiltration and soil moisture in agricultural sinkholes. Proceedings of the Tenth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, Austin TX.

Zhao, Z., K. F. Knowlton and N. G. Love. 2007. Dairy Manure Estrogens with Advanced Treatments. 2007 ADSA/PSA/AMPA/ASAS Joint Meeting. July 8-12. San Antonio, Texas. In press.

Zhao, Z., K. F. Knowlton, N. G. Love and Y. Fang. 2007. Advanced Treatment to Reduce the Estrogen Content of Dairy Manure. World Environmental and Water Resources Congress. May 15-19, 2006. Tampa, Florida.

Zhang, Y., S. Triantifylloidou, and M. Edwards. 2007. Impact of GAC filters on Water Quality and Lead and Copper Leaching in Homes. To be presented at the Universities Forum, AWWA Annual Conference in Toronto, Canada.

Sullivan, C.A. C.L. Mitchelmore, R.C. Hale and P.A. Van Veld. 2006. Cytochrome P4501A induction and DNA Damage in *Pimelphales promelas* during exposure to Exceptional Quality biosolids. 27th Annual Meeting of the Society of Toxicology and Chemistry. Montréal, Quebec, Canada. November 5-9, 2006

Schwartz BF and Schreiber ME. 2006. Integrating Differential Electrical Resistivity Tomography and Time Domain Reflectometry as a tool for modeling soil moisture and infiltration in sinkholes. Geological Society of America Annual Meeting Oct 21-24, 2006, Philadelphia PA.

Schwartz BF and Schreiber ME. 2006. Combining Differential Electrical Resistivity Tomography and Time Domain Reflectometry to model soil moisture and infiltration in sinkholes. SEG Conference, Vancouver, BC, August 2006.

Schwartz BF, Schreiber ME. 2005. Using Time Domain Reflectometry and 2-D Differential ERT to Monitor Changes in Soil Moisture in Mantled Agricultural Sinkholes. Geological Society of America Abstracts with Programs. GSA Annual Meeting, Salt Lake City UT Oct 15-19, 2005.

Schwartz, BF, Schreiber ME, Orndorff, W. 2005. New applications of differential Electrical Resistivity Tomography and Time Domain Reflectometry to modeling infiltration and soil moisture in agricultural sinkholes, Tenth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, Austin TX, Sept 2005.

Adams, M.B., M.H. Eisenbies (presenter), W.M. Aust, J.A. Burger. 2007. Hydrologic modeling approaches to evaluate forest management effects on extreme flooding events. Dean's Forum on the Environment, Virginia Tech, Blacksburg, VA. February 26, 2007.

Eisenbies, M.H. 2007. Wetlands and flooding. Class lecture provided to Forested Wetlands Class, Virginia Tech, 2007.

Eisenbies, M.H. 2006. Silviculture and flooding. Class lecture provided to class on Forest Soils and Hydrology at Virginia Tech. Fall Semester, 2006

Sullivan, C. 2007. Biomarker responses in fathead minnow exposed to biosolids. Pacific Northwest Chapter of the Society of Environmental Toxicology and Chemistry. Port Townsend WA April 12-14 2007.

4. **VWRR SPECIAL REPORTS**

SR33-2007: Report of the Academic Advisory Committee to the Virginia Department of Environmental Quality: Freshwater Nutrient Criteria for Rivers and Streams.

SR32-2007: Pathogen Research Symposium: Pathways and Monitoring in Natural and Engineered Systems (Nov. 1, 2006, symposium report).

SR31-2006: Analysis of Sinkhole Susceptibility and Karst Distribution in the Northern Shenandoah Valley, Virginia: Implications for Low Impact Development (LID) Site Suitability Models.

SR30-2006: Report of the Academic Advisory Committee to the Virginia Department of Environmental Quality: Freshwater Nutrient Criteria for Rivers and Streams.

5. ***VIRGINIA WATER CENTRAL***

Virginia Water Central, May 2007 (No. 41), 44 pp.

Virginia Water Central, January 2007 (No. 40), 32 pp.

Virginia Water Central, September 2006 (No. 39), 31 pp.

Virginia Water Central, June 2006 (No. 38), 34 pp.

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Student Support

Student Support					
Category	Section 104 Base Grant	Section 104 NCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	0	0	0	0	0
Masters	0	0	0	0	0
Ph.D.	0	2	0	1	3
Post-Doc.	0	0	0	0	0
Total	0	2	0	1	3

Notable Awards and Achievements

Publications from Prior Projects

None