

# Virginia Water Resources Research Center

## Annual Technical Report

### FY 2004

## Introduction

The congressional act of 1964 established a network of 54 water resource programs to be placed at land-grant universities. In 1965, the VWRRC was housed in Virginia Tech. In 1982, the Virginia General Assembly authorized the VWRRC as a state agency. Since 1982, the VWRRC has received state appropriation for its programs in water research, education, and outreach (state funding was discontinued from 1992 to 1998). The VWRRC is affiliated with the National Institutes for Water Resources (NIWR). The VWRRC is also the lead member for Virginia Tech faculty at the Universities Council on Water Resources (UCOWR). The VWRRC director reports to the Vice Provost for Research at Virginia Tech.

### Mission of the VWRRC

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

### Programs of the VWRRC

The VWRRC programs in research and education are available to students and faculty of all Virginia colleges and universities. The outreach programs of the VWRRC include information transfer to policy/decision makers and citizens, and collaborative partnerships with state agencies and other water interest groups.

### Research Programs

The VWRRC Competitive Grants program provides research funds (up to \$25,000) to find practical solutions to Virginia and regional water problems.

The VWRRC Seed Grants program provides research funds (up to \$5,000) to support background and preliminary research for developing research proposals to be submitted to other private and public funding agencies.

The VWRRC Challenge Grants program provides matching funds (\$10,000) on a 1:2 (VWRRC: sponsor) basis to initiate a new research partnership with a funding agency.

The VWRRC facilitates developing interdisciplinary multi-investigator and multi-institute collaborative research proposals.

The VWRRC conducts in-house research by acquiring funding from external agencies.

## Educational Programs

The William R. Walker Endowed Graduate Research Fellow in water resources awards up to \$2,500 to individuals who are pursuing graduate work in a field different from their area of emphasis as an undergraduate, or individuals with work experience returning to graduate school and want to enter a water-related profession.

The VWRRC Undergraduate Research Summer Fellowships provides \$2,500 student scholarships and \$500 to faculty mentors for 10-week summer internships.

Virginia Service Training for Environmental Progress (STEP) provides \$2,500 summer internships to students who work in service-learning partnerships with communities on water-related issues. The competitive program accepts both undergraduate and graduate students.

The VWRRC provides year round undergraduate research assistantships to students who participate in sponsored research under supervision of the VWRRC faculty and staff.

The VWRRC coordinates the cross-college watershed management minor program at Virginia Tech.

The VWRRC coordinates the USGS internship program in Virginia.

## Outreach and Service Programs

### a. Outreach Information Transfer

The VWRRC newsletter Virginia Water Central, published quarterly, features scientific and educational articles, legislative information, and news of interest.

The VWRRC Website ([www.vwrcc.vt.edu](http://www.vwrcc.vt.edu)) is a repository of the VWRRC publications, offers a Daily News Update on water related issues in the region, and provides linkage to water agencies and professional organization.

The VWRRC sponsors national, regional, and statewide symposia and facilitates workshops and seminars throughout the year on water research and information transfer.

The VWRRC publishes citizen education booklets and symposia proceedings.

The VWRRC responds to worldwide requests for information on water issues.

### b. Outreach Service and Collaborative Partnerships

The VWRRC provides leadership to a multi-institute Academic Advisory Committee for the Virginia Department of Environmental Quality.

The VWRRC is the administrative home for the Virginia Water Monitoring Council.

The VWRRC facilitates an academic expert database through Centers website.

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

## Research Program

The research program at the VWRRC is supported through its Virginia state appropriation and other external funding. The 104 funds are not allocated to research. The Research programs at the VWRRC can be categorized as the VWRRC awards program, in-house research program, and facilitated grants. The VWRRC awards program is supported through the state appropriation and overhead generated by other external funding. In-house research and facilitated grants are supported through external funding. Below, an overview of VWRRC awards program and list of projects funded through the program is followed by in-house research program and facilitated projects that received external funding.

### VWRRC Competitive Grants

This competitive grants program was initiated in 1999. The VWRRC considers proposals for funding up to \$25,000/year under the VWRRC statewide competitive grants program. Proposals are considered in all areas of water environment and water resources management. Submitted proposals is reviewed and ranked by the Water Centers Technical Advisory Panel. Call for proposals are issued in late January with a deadline of March 30. Successful proposals are announced by late May. Starting date for successful projects is July 1 with ending date of June 30 of the following year. Review criteria include technical merit of the proposed project and research opportunities provided for graduate and undergraduate students.

### VWRRC Seed Grants

The seed grants program was initiated in 1997. The VWRRC awards research grants of up to \$5,000 in a statewide competition. The seed-grant program is intended as seed money for background studies and preliminary research, leading to full research proposals for outside funding agencies. Duration of each award is one year. 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.

### VWRRC Research Awards

#### Competitive Grants (July 1, 2003 - June 30, 2004)

Hydrologic impacts of urbanization on small watersheds and the effectiveness of BMPs, Williamsburg/James City County, Virginia. Gregory S. Hancock, The College of William and Mary.

Water demand reduction effectiveness of drought curtailment policies in Virginia. Kurt Stephenson, Virginia Tech.

Effects of dissimilatory iron reducing bacteria on the longevity of iron permeable reactive barriers. Virginia Tech

Identification of native brook trout streams that are impaired by acidification. James N. Galloway, University of Virginia.

Competitive Grants (July 1, 2004 - June 30, 2005)

Role of sediment as a source and reservoir of fecal coliforms with regard to shellfish TMDL in Virginia. Howard Kator, Virginia Institute of Marine Science

Development of soluble manganese sorptive contactors for enhancing potable water treatment practices. William R. Knocke and John C. Little, Virginia Tech.

Industrial mercury pollution of the North Fork Holston River (Virginia): new non-invasive strategies for assessing anthropogenic deterioration of freshwater ecosystems. Michal Kowalewski, Virginia Tech.

Fate and transport of reproductive hormones as environmental contaminants. Janet Herman, University of Virginia.

VWRRC Research Awards

Seed Grants (July 1, 2003 - June 30, 2004)

Monitored natural remediation of contaminated groundwater by diffusion and barometric pumping. James A. Smith, University of Virginia.

Initiation of activities to establish an institute for drought management studies. Vinod Lohani, Virginia Tech

Seed Grants (July 1, 2004 - June 30, 2005)

Discharge measurements in streams using a large-scale particle image velocimetry prototype. Saied Mostaghimi, Kevin Brannon, and Aaron Harpold, Virginia Tech.

Selection and testing of primers for rRNA analysis of the microbial populations in biofilms that harbor *Legionella pneumophila*. H. Shen and L. Brown, Virginia State University.

# Modernizing US Army Corps of Engineers Policies and Programs

## Basic Information

<b>Title:</b>	Modernizing US Army Corps of Engineers Policies and Programs
<b>Project Number:</b>	2002VA14S
<b>Start Date:</b>	3/1/2001
<b>End Date:</b>	7/31/2006
<b>Funding Source:</b>	Supplemental
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	Social Sciences
<b>Focus Category:</b>	Law, Institutions, and Policy, None, None
<b>Descriptors:</b>	policy, ecosystems, global warming, shoreline erosion
<b>Principal Investigators:</b>	Tamim Younos

## Publication

1. Holiday, W.C. 2003. Revitalization of Corps of Engineers Projects. IWR Report 03-SP-1. 60 pp.
2. Holiday, W.C. 2004. Reconciliation of Federal Flood Hazard Mitigation Programs. U.S. Army Corps of Engineers. 56 pp. plus Appendix.
3. Nyc, R. 2005. National Shoreline Management Study Environment: International Literature Review. Draft Report. 28 pp.

US Army Corps of Engineers (Corps) policies, program and budget have been under increased review by the public, Congress, and the administration. Policy and planning for civil works projects have been described as confusing and needing modernization to reflect current state of the art planning practices. The Virginia Water Resources Research Center conducts policy reviews and applied research on planning for each of the following four efforts:

1. Produce background documents upon which can be developed a uniform rationale and procedure for monetary and non-monetary evaluation of ecosystem benefits and costs.

2. The Corps is developing a Corps Environmental Performance Atlas (CEPA) as an online tool for analyzing, managing, and improving the Corps environmental performance. CEPA will help Corps analysts collect and compare information on environmental issues and the Corps environmental programs. There is a need to analytically review Corps environmental project reports, i.e., to extract specific information on economic valuation of environmental features of Corps projects. This review will be utilized in finalizing the final format for the CEPA. The purpose of this study is to review Corps environmental project reports to identify the types of data might be available, the level of detail, and excerpt information related to economic valuation of environmental features, benefits, and costs of projects.

3. Carbon dioxide is included in the category of greenhouse gases that are believed to contribute to global warming. The possible consequences of climate change caused by greenhouse gas emissions present Corps planners with the question of how to incorporate consideration of project-induced changes in carbon emissions or sequestration rates in the project planning process. This study will consider how the effects of project-induced sequestration or release of carbon might be accounted for in the process of project formulation and evaluation according to the planning framework established by the Economic and Environmental Principles and Guidelines for Water Related Land Resources Implementation Studies.

4. The role and magnitude of Federal agencies in shore protection is a contentious issue and frequently modified by Federal legislation. The most comprehensive survey of shoreline change was the 1971 National Shoreline Study conducted by the Corps. That report identifies categories of shoreline erosion and associated development patterns. This study will review and update the 1971 National Shoreline Study Report. The review will focus on the "critical erosion" category to look at changes in development patterns for those areas.

# Multi-Institute Bacterial Source Tracking Project

## Basic Information

<b>Title:</b>	Multi-Institute Bacterial Source Tracking Project
<b>Project Number:</b>	2002VA15S
<b>Start Date:</b>	1/1/2002
<b>End Date:</b>	12/31/2005
<b>Funding Source:</b>	Supplemental
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	Water Quality
<b>Focus Category:</b>	Methods, Non Point Pollution, Surface Water
<b>Descriptors:</b>	bacteria, E.coli, fecal contamination, source tracking
<b>Principal Investigators:</b>	

## Publication

1. Stoeckel, D.M., Mathes, M.V., Hyer, K.E. Hagedorn, C., Kator, H., Lukasik, J. OBrien, T.L., Samadpour, M., Strickler, K.M., and Wiggins, B.A. 2004. Comparison of Seven Protocols to Identify Fecal Contamination Sources using Escherichia coli: Berkeley County, West Virginia. Environ. Sci. Technol 38:6109-6117.
2. McKinney, J.M. 2004. Identifying Sources of Fecal Pollution in the Appomattox River Watershed. M.S. Thesis, Department of Crop and Soil Environmental Sciences, Virginia Tech, Blacksburg, Virginia.

The purpose of this multi-institute project is to compare four methods of Bacterial Source Tracking (BST) to identify sources of fecal pollution. Methods to be studied include: Carbon source utilization of bacterial source samples; Pulsed-field gel electrophoresis analysis of bacterial source samples; Ribotyping of bacterial source samples; Antibiotic resistance analysis of bacterial source samples.

Information and knowledge gained from this study will advance field and analytical methodologies of bacteria source determination in natural waters. The evaluation and comparison of bacteria source tracking methods will provide information that will help other investigators across the nation choose appropriate techniques for determining sources of bacteria in natural waters.



## Information Transfer Program

The outreach programs of the VWRRC are supported through 104 funds. During the review period (1998-2002) the VWRRC expanded its outreach programs significantly. Outreach programs of the VWRRC include the following: The VWRRC website; the VWRRC newsletter; organizing symposia, seminars and workshops; publication and dissemination of the VWRRC supported research results and technical/educational reports prepared by the Center staff; and establishing collaborative links with federal, state, and other groups to facilitate transfer of science-based knowledge to policy- and decision-makers and other interest entities. An overview of the outreach and service programs is given below.

### The VWRRC Website

The VWRRC website ([www.vwrrc.vt.edu](http://www.vwrrc.vt.edu)) is serving as a window to the VWRRC programs as well as facilitating several significant functions to serve the academia, state and other regulatory agencies, and interested citizens.

- The website offers a Daily News Update on regional water related issues published in the regional newspapers.
- The website contains an inventory of the VWRRC publications. New reports are posted immediately on the website. Old research reports are gradually scanned and posted to make them accessible. There is a great demand for several hundred Water Center publications that dates back to 1965. Availability of these publications on the website will reduce printing and mailing costs and assure all time availability of the Centers publications.
- The website facilitates an expert database that will be helpful to regulatory agencies and others seeking experts and to potential graduate students in water research areas seeking research advisors in Virginias colleges and universities.
- The website provides linkage to federal and state agencies and professional organizations.
- The website provides a home to other organizations and activities such as the Virginia Water Monitoring Council.

The publication Virginia Water News, a longtime newsletter of the Water Center was terminated in early 1990s because of budget cuts. In June 1998, the Water Center restored the publication of its newsletter under a new name Virginia Water Central. The newsletter is published four to five times per year. The page length varies from 16 or 20 pages. All issues of Virginia Water Central are posted on Water Centers website: [www.vwrrc.vt.edu/central/virginia.htm](http://www.vwrrc.vt.edu/central/virginia.htm).

Virginia Water Central focuses on water-related issues in Virginia. The main elements of the newsletter (a given issue typically includes all elements) are a feature article on water policy or law; an article on scientific concepts related to current news; short summaries of recent water-related news items; notices of events, publications; a guide to finding information on water-related topics; a guidance on the Virginia K-12 Standards of Learning; and legislative information. As of May 2005 the newsletter mailing list included approximately 2400 recipients of hard copies (free of charge) and 320 recipients of electronic copies (an e-mail notice sent to subscribers whenever a new issue has been posted to the Centers website).

Each year the VWRRC organizes research symposia, workshops and seminars.

#### Collaborative and Service Programs of the VWRRC

##### Academic Advisory Committee (AAC)

The VWRRC has established a working relationship with the leadership and staff of the Virginia Department of Environmental Quality (DEQ). As a result, the VWRRC was asked to lead a statewide academic advisory committee (AAC) that has provided scientific advice to the agency on its water quality improvement programs. This advisory role has been instrumental in gaining U.S. Environmental Protection Agency (EPA) approval of Virginia's water monitoring programs and water quality data interpretation procedures. This year, the Center coordinated the fourth year of the AAC activities and submitted the AAC activity report and recommendations to DEQ. In addition, the work of the AAC has been considered in debates affecting changes in national water quality policy and programs that are administered by the U.S. EPA.

##### The Virginia Water Monitoring Council

In 1999, VWRRC staff coordinated discussions with personnel from the Virginia Department of Environmental Quality (DEQ) and the USGS Regional Office about the concept and realization of the Virginia Water Monitoring Council (VWMC), an organization that could coordinate all governmental and non-governmental water monitoring activities in Virginia. The VWRRC staff provided leadership and co-hosted several organizational meetings with the DEQ and USGS in Charlottesville and Richmond. As a result, the VWMC, representing many diverse interests in water monitoring in Virginia, was formed, the VWMC charter was developed, and a VWMC Steering Committee was established. The first annual meeting of the VWMC was held on November 7, 2000. The third VWMC annual meeting was held September 27, 2002 in the Hotel Roanoke. At present, approximately 150 members belong to the VWMC and represent about 100 different organizations. The Water Center provides administrative support for the VWMC through the assignment of a Water Center staff member as the VWMC administrative assistant. Details about the VWMC are on the website: <http://www.vwrcc.vt.edu/vwmc/> hosted by the VWRRC.

# Information Dissemination

## Basic Information

<b>Title:</b>	Information Dissemination
<b>Project Number:</b>	2003VA28B
<b>Start Date:</b>	3/1/2004
<b>End Date:</b>	2/28/2005
<b>Funding Source:</b>	104B
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	Not Applicable
<b>Focus Category:</b>	Education, None, None
<b>Descriptors:</b>	
<b>Principal Investigators:</b>	Tamim Younos

## Publication

1. Newsletter: Virginia Water Central. No. 30 (April 2004); No. 31 (August 2004); No. 32 (November 2004); No. 33 (January 2005).
2. Zipper, C. J. J. Ney, L. A. Smock, E. P. Smith, J. C. Little, K. Stephenson, P. A. Bukaveckas, G. R. Yagow, J. Walker, and T. Younos. 2005. Issues Related to Freshwater Nutrient Criteria for Lakes And Reservoirs in Virginia: Report of the Bioassessment Subcommittee of the Water Quality Academic Advisory Committee. SR27-2005, Virginia Water Resources Research Center, Virginia Tech, Blacksburg, VA. 98 pp.
3. Dillaha, T. S. Mostaghimi , L. A. Shabman, E. P. Smith, T. Younos, and C. E. Zipper. 2004. Bacteria Total Maximum Daily Load Issues: Report Of The Bacteria TMDL Subcommittee Of The Water Quality Academic Advisory Committee. SR24-2004, Virginia Water Resources Research Center, Virginia Tech, Blacksburg, VA. 27 pp.
4. Smock L. A. E. F. Benfield, T. A. Dillaha, S. Mostaghimi , L. A. Shabman, E. P. Smith, T. Younos, and C. E. Zipper. 2004. Issues Concerning Bioassessments And Their Use With Narrative Standards: Report of the Bioassessment Subcommittee of the Water Quality Academic Advisory Committee. SR23-2004, Virginia Water Resources Research Center, Virginia Tech, Blacksburg, VA. 16 pp.
5. Water Research Symposium Proceedings (October 4-6, 2005, Blacksburg, VA)(under preparation).
6. Younos, T. 2004. The Feasibility of Using Desalination To Supplement Drinking Water Supplies in Eastern Virginia. SR25-2004, Virginia Water Resources Research Center, Blacksburg, VA. 127 pp.
7. Long, G. R. and R. C. Jones. 2004. Development of Predictive Relationships Between Stressors and Macroenthic Communities For Use in Implementing TMDLs. SR26-2004, Virginia Water Resources Research Center, Blacksburg, VA. 75 pp.
8. Roth, R.A. 2005. Biological Integrity and Virginias Rivers. ER01-2005, Virginia Water Resources

Research Center, Virginia Tech, Blacksburg, VA. 35 pp.

9. Younos, T. 2005. Water Research Needs in Virginia. Virginia Water Resources Research Center, Virginia Tech, Blacksburg, VA. 8 pp.
10. Burdige, D. J. et al. 2004. Recent and Historical Environmental Change in Lake Drummond, Within the Great Dismal Swamp. Final Project Report to Virginia Water Resources Research Center. 13 pp.
11. Mulholland, M. 2004. Nutritional Factors Promoting Algal blooms in the Lower Chesapeake Bay. Final Project Report to Virginia Water Resources Research Center. 8 pp.
12. Dougherty, M. 2004. Quantifying Hydrologic and NPS Pollutant Responses in an Urbanizing Watershed. Ph.D. in Civil and Environmental Engineering, Virginia Tech.
13. Harpold, A. A. 2005. Discharge Measurement in Streams Using a Large-Scale Particle Image Velocimetry Prototype. M.S. in Biological Systems Engineering, Virginia Tech.
14. Bogucki, M.A. 2005. Evaluation and testing of a vertical flux chamber to quantify gasoline hydrocarbon emissions from the subsurface to the atmosphere under natural conditions. M.E. in Civil Engineering, University of Virginia.
15. Makus, K.E. 2005. Carbon Tetrachloride Reduction by Nanoscale Magnetite. M.S. in Civil and Environmental Engineering, Virginia Tech.
16. Krause, C. W. B. Lockard, T. J. Newcomb, D. Kibler, V. Lohani, and D. J. Orth. 2004. Predicting Influences of Urban Development on Thermal Habitat in a Warm Water Stream. *Jour. AWRA* 40(6): 1645-1658.
17. Brown, M.E., M. Kowalewski, R.J. Neves, D.S. Cherry, and M.E. Schreiber. 2005. Freshwater mussel shells as environmental chronicles: Geochemical and taphonomic signatures of mercury-related extirpations in the North Fork Holston River, Virginia. *Environmental Science and Technology* 39:1455-1462.
18. Brown, B.L., A.D. Slaughter, and M. E. Schreiber. 2005. Controls on arsenic transport within agricultural watersheds. *Applied Geochemistry* 20(1): 123-133.
19. Choi, J. W., and J.A. Smith. 2005. Geoenvironmental factors affecting organic vapor advection and diffusion fluxes from the unsaturated zone to the atmosphere under natural conditions. *Environmental Engineering Science* 22(1): 95-108.
20. Schreiber, M.E., J.S. Yi, and J.S. Herman. 2004. Persistence and migration of manure-derived solutes in soil water underlying an agricultural watershed: Arsenic, 17 $\beta$ -estradiol, and nutrients. In: *Proceedings (R.B. Wanty and R.R. Seal, Eds.) of the 11th International Symposium on Water-Rock Interaction*. p. 1633-1635.
21. Harpold, A., and S. Mostaghimi. 2004. Stream discharge measurement using large-scale particle image velocimetry. In: *Proceedings of Fall Meeting of the American Geophysical Union, San Francisco, California*. p. 235-243.
22. Brown, M.E., M. Kowalewski, R.J. Neves, D.S. Cherry, and M.E. Schreiber. 2004. Using geochemical and taphonomic signatures of freshwater mussel shells to explore industry-related extirpation in the North Fork Holston River, Virginia. *Abstract. Geological Society of America*. V 36(2), p. 134.
23. Christianson, E.G., N.L. Matell, J.J. Wacksman, and G.S. Hancock. 2004. Water table and overbank flow frequency changes due to suburbanization-induced channel incision, Virginia Coastal Plain, USA, *Geological Society of America Abstracts with Programs*, 36 (5), 491.
24. Hancock, G.S., N.L. Matell, E.G. Christianson, and J.J. Wacksman. 2004. Water table and overbank flow frequency changes due to suburbanization-induced channel incision, Virginia Coastal Plain, USA, *Eos Trans. AGU. Fall Meeting Supplement*, 85 (47), Abstract H51D-1183.
25. Murray, J.T., D.G. Gibson, and G.S. Hancock. 2004. Land use impacts on storm hydrographs and the

effectiveness of Best Management Practices, Virginia Coastal Plain, USA, Geological Society of America Abstracts with Programs, 36 (2), 63.

26. Rebodos, R. and Vikesland, P.J. 2005. Effects of Co-solutes on Bioaugmented Granular Iron Systems. In Proceedings of the 15th V.M. Goldschmidt Conference, Moscow, ID, May. Abstract.
27. Makus, K.E. and Vikesland, P.J. 2005. Reduction of Halogenated Groundwater Contaminants by Nano-Sized Magnetite. In: Proceedings of the 15th V.M.Goldschmidt Conference, Moscow, ID. Abstract.

The VWRRC supports timely dissemination of science-based information to policy and decision-making bodies and citizens. The Water Center used its 104 funds to support expert personnel with responsibilities related to the Center's outreach and collaborative programs. The 104 funds supported preparation of the VWRRC newsletter "Virginia Water Central"; the Service Training for Environmental Progress (STEP) [an educational/outreach internship program]; partial support for organizing the annual Virginia Water Research Symposium; partial administrative support for the Virginia Water Monitoring Council; and partial support for the Center's multi-institute and interdisciplinary academic advisory committee for the Virginia Department of Environmental Quality.

## Student Support

Student Support					
Category	Section 104 Base Grant	Section 104 RCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	0	0	0	21	21
Masters	0	0	0	8	8
Ph.D.	0	0	0	4	4
Post-Doc.	0	0	0	0	0
Total	0	0	0	33	33

## Notable Awards and Achievements

Student Recognition Award, American Society of Limnology and Oceanography 2004. Andrea Rocha, doctoral student, Old Dominion University for paper presentation entitled: Incorporation of thymidine and leucine by marine phytoplankton: implications for bacterial productivity rate estimates (co-authors: M.R. Mulholland, A.M. Watson, and P.W. Bernhardt).

Dr. Tamim Younos, Interim Director of the Virginia Water Resources Research Center, has edited a book entitled "Total Maximum Daily Load: Approaches and Challenges" (348 pp) that will be published by PennWell Books in June 2005.

## Publications from Prior Projects