

# **Virginia Water Resources Research Center**

## **Annual Technical Report**

### **FY 2003**

## **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 1996 to 1998). The VWRRC is affiliated with the National Institutes for Water Resources (NIWR). 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.

## Section 104 Objectives

The use of 104 funds is critical to the management of the VWRRC. The 104 funds have been instrumental in increasing the university (Virginia Tech) and state commitment to the programs of the VWRRC. The 104 funds are also offered (and serve) as evidence of federal-state partnership. This is important because less restrictive 104 funds can be used as match for fund raising efforts and marginally supplementing other funding sources. The 104 funds are also offered (and serve) as evidence of federal-state partnership. Overall, the VWRRC program management is based on realities of state and federal budget prospects. The VWRRC does not completely rely on the 104 base grant funding to support its programs. The VWRRC seeks project specific external funding in collaboration with the university faculty and plays a leadership role to facilitate funding from external sources.

## 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 is an overview of the VWRRC awards program and a list of projects funded through the program, followed by the 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, in all areas of water environment and water resources management. Submitted proposals are 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 June. The starting date for successful projects is July 1 with an 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 a seed grant is a proposal submitted to an external funding agency.

### VWRRC Research Awards

Competitive Grants (July 1, 2002- June 30, 2003)

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

Quantifying the effects of land-use change and population on pollutant delivery from an urbanizing watershed in northern Virginia. Randy Dymond, Civil & Environmental Engineering Department, Virginia Tech.

Nutritional factors promoting algal blooms in the lower Chesapeake Bay. Margaret Mulholland, Department of Ocean, Earth and Atmospheric Sciences, Old Dominion University.

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 Stevenson, Virginia Tech

Effects of Dissimilatory Iron Reducing Bacteria on the Longevity of Iron Permeable Reactive Barriers. Peter Vikesland, Virginia Tech

Identification of Native Brook Trout Streams that are Impaired by Acidification. James N. Galloway, University of Virginia

VWRRC Research Awards

Seed Grants (July 1, 2002- June 30, 2003)

Effects of plant lipid content on the transfer of pollutants from plant to air. James Smith, Department of Civil Engineering, University of Virginia.

Statistical analysis of the antibiotic resistance analysis BST method for use in fecal coliform TMDL/TMDL implementation plan development. Eric P. Smith, Statistics Department, Virginia Tech.

Applications of neural networks for watershed management. Darrell Bosch, Department of Agricultural and Applied Economics, Virginia Tech.

Impact of *Morone* spp. on water quality management of reservoirs. T. Shahady, Department of Environmental Sciences, Lynchburg College.

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

Monitored Natural Remediation of Contaminated Ground Water by Diffusion and Barometric Pumping. James A. Smith, University of Virginia

Initiation of Activities to Establish an Institute for Drought Management Studies. Vinod Lohani, Engineering Fundamentals, Virginia Tech

# Phytoremediation of Organic Contaminants in Soils and Ground Water

## Basic Information

<b>Title:</b>	Phytoremediation of Organic Contaminants in Soils and Ground Water
<b>Project Number:</b>	2002VA13S
<b>Start Date:</b>	1/1/2002
<b>End Date:</b>	2/28/2004
<b>Funding Source:</b>	Supplemental
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	Biological Sciences
<b>Focus Category:</b>	Water Quality, Groundwater, None
<b>Descriptors:</b>	phytoremediation, organic contaminants, groundwater
<b>Principal Investigators:</b>	James A Smith, James A Smith

## Publication

1. Buckels, J.L., 2003, Quantification of contaminant Uptake by Plants and Evaluation of a Partition-Limited Equilibrium Model, Master of Science thesis, Dept. of Civil Engineering, University of Virginia, 64 p.
2. Wenk, T.F., 2003, Testing and Validating a Partition-Limited Model for the Uptake of MTBE by Various Plants, Master of Science thesis, Dept. of Civil Engineering, University of Virginia, 43 p.
3. Barbour, J.P., Smith, J.A., Buckels, J.L., and Wenk, T.F., 2003, Study of a Model for the Plant Uptake of Organic Contaminants, Proceedings of the Virginia Water Resources Research Symposium, Blacksburg, VA.

This work represents a joint collaboration between Dr. Cary Chiou of the National Research Program of the USGS and Dr. James Smith of the University of Virginia. Recently, Chiou et al. (2001) have developed a new model to describe the uptake of organic contaminants from soil and ground water by plants. The model is relatively simple to implement, and is based on equilibrium-driven partitioning of the organic contaminant between water and specific organic components (e.g., lipids and carbohydrates) present in any location of the plant. The model is compatible with limited plant-uptake data in the literature. However, it has not been rigorously tested by extensive data to verify many important implications of the model field applications. The primary objective of this work is to perform a series of laboratory experiments to validate (or invalidate) this new model. These data and model results will be of primary benefit to engineers designing phytoremediation systems for shallow soil and ground water contaminated with organic pollutants. The results will improve our understanding of levels of crop contamination by pesticides for different crops in various contaminated soils.

# 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>	2/28/2005
<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. William C. Holiday. 2002. White Paper on Revitalization of Corps of Engineers Projects. Working Draft Report for Institute for Water Resources, U.S. Army Corps of Engineers. 62 pp.
2. William C. Holiday. 2004. Report on Reconciliation of Federal Flood Hazard Mitigation Programs. Final Draft for Institute of Water Resources and U.S. Army Corps of Engineers. 56 pp. plus Appendix.

US Army Corps of Engineers policies, program and budget have been under increased review by the public, U.S. Congress, and the administration. Policy and planning for civil works projects are perceived as confusing and needs modernization to reflect the current state-of-the-art planning practices. The VWRRC coordinates policy reviews and applied research on planning for the following efforts:

1. Produce background documents that can be used to develop a uniform rationale and procedure for monetary and non-monetary evaluation of ecosystem benefits and costs.
2. Review the Corps' environmental project reports to identify types of data available, the level of detail, and excerpt information related to economic valuation of environmental features, benefits, and costs of projects.
3. Determine how the effects of project-induced sequestration or release of carbon might be accounted for in the process of project evaluation according to the planning framework established by the economic and environmental principles and guidelines for water related land resources implementation studies.
4. Review and update the 1971 National Shoreline Study Report.



# 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>	12/31/2004
<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>	Tamim Younos, Charles Hagedorn

## Publication

1. Comparison of Seven Protocols to Identify Fecal Contamination Sources using Escherichia coli: Berkeley County, West Virginia. Donald M. Stoeckel[1], Melvin V. Mathes[2], Kenneth E. Hyer[3], Charles Hagedorn[4], Howard Kator[5], Jerzy Lukasik[6], Tara L. OBrien[7], Mansour Samadpour[8], Kriston M. Strickler[9], and Bruce A. Wiggins[10]. Manuscript submitted to the Journal of Environmental Science & Technology (in review). Authors' Affiliation: [1]U.S. Geological Survey, 6480 Doubletree Avenue, Columbus, Ohio 43229. [2]USGS, 11 Dunbar Street, Charleston, West Virginia 25301. [3]USGS, 1730 East Parham Road, Richmond, Virginia 23228. [4]Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061. [5]College of William and Mary, Virginia Institute of Marine Science, 1208 Greate Road, Gloucester Point, Virginia 23062. [6]Biological Consulting Services of North Florida, 4641 NW 6th Street, Gainesville, Florida 32609. [7]Marshall University School of Medicine, 1542 Spring Valley Drive, Huntington, West Virginia, 25704. [8]Institute for Environmental Health, 8279 Lake City Way NE, Seattle, Washington 98115. [9]West Virginia Department of Agriculture, 60B Moorefield Industrial Park Rd, Moorefield, West Virginia 26836. [10]James Madison University, Harrison, Virginia 22807.

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. Outreach programs of the VWRRC include the following: website; newsletter; organizing symposia, seminars and workshops; publication and dissemination of the VWRRC supported research results and technical/educational reports prepared by the Center's 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)) serves 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 date 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.

## Water Center Newsletter

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 the Water Centers website: [www.vwrrc.vt.edu/central/virginia.htm](http://www.vwrrc.vt.edu/central/virginia.htm).

As of June 2004, the newsletter mailing list included approximately 2400 recipients of hard copies (free of charge) and 320 recipients of electronic copies (an e-mail notice is sent to subscribers whenever a new issue has been posted to the Centers website).

## Symposia, workshops

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

Virginia Water Research Symposium & Workshops 2003, October 7-10, 2003, Virginia Tech, Blacksburg, Virginia. Attendance 130.

#### 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. AAC reports are posted on the Water Center website.

#### 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. 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 activities 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>	3/1/2003
<b>End Date:</b>	2/29/2004
<b>Funding Source:</b>	104B
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	None
<b>Focus Category:</b>	Education, None, None
<b>Descriptors:</b>	None
<b>Principal Investigators:</b>	Tamim Younos

## Publication

1. Proceedings, Virginia Water Research Symposium 2003
2. Bacteria Total Maximum Daily Load Issues: Report of the Bacteria TMDL Subcommittee of the Water Quality Academic Advisory Committee. VWRRRC Special Report No. SR 24-2004. 23 pp.
3. Issues Concerning Bioassessment and their Use with Narrative Standards: Report of the Bioassessment Subcommittee of the Water Quality Academic Advisory Committee. VWRRRC Special Report No. SR 23-2004. 12 pp.
4. Newsletter: Virginia Water Central. No. 26 (March 2003), No. 27 (August 2003), No. 28 (November 2003), No. 29 (January 2004).
5. VWRRRC Website: [www.vwrrc.vt.edu](http://www.vwrrc.vt.edu)

## **Information Dissemination**

The VWRRC supports timely dissemination of science-based information to decision-making bodies and citizens. The Water Center used its 104 funds to support skilled personnel with responsibility for activities related to information dissemination. The 104 funds supported preparation and distribution of the VWRRC newsletter "*Virginia Water Central*" that is printed and posted on the VWRRC Website. In 2003, *Virginia Water Central* was distributed to about 2,800 readers nationwide. Other information transfer activities of the VWRRC during the application period that were partially supported by 104 funds include management of the Service Training for Environmental Progress (STEP), an educational/outreach internship program of the VWRRC, organizing the annual Virginia Water Research Symposium, and administrative support for the Virginia Water Monitoring Council.

## Program Administration

### Basic Information

<b>Title:</b>	Program Administration
<b>Project Number:</b>	2003VA30B
<b>Start Date:</b>	3/1/2003
<b>End Date:</b>	2/29/2004
<b>Funding Source:</b>	104B
<b>Congressional District:</b>	Ninth
<b>Research Category:</b>	None
<b>Focus Category:</b>	None, None, None
<b>Descriptors:</b>	None
<b>Principal Investigators:</b>	Tamim Younos

### Publication

## **Program Administration**

The use of 104 funds is critical to the management of the VWRRC. The 104 funds have been instrumental in increasing the university (Virginia Tech) and state commitment to the programs of the VWRRC. The 104 funds were used to support skilled personnel with responsibility for activities related to program administration and activities related to the VWRRC Website: (1) Updating, editing and maintenance of the homepage; (2) Posting Daily Water News (on a daily basis, water news is extracted from the regional newspapers and posted on the VWRRC Website); (3) Scanning and posting of several hundred VWRRC publications that date back to 1965 (recent publications are created in pdf file and posted on the Web); (4) Developing a web-based inventory of all VWRRC publications. In addition, 104 funds were used to provide personnel support for maintenance of hardware and software to ensure that VWRRC Website capabilities and computer capabilities are state of the art.



## Student Support

Student Support					
Category	Section 104 Base Grant	Section 104 RCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	0	0	0	11	11
Masters	0	0	0	7	7
Ph.D.	0	0	0	2	2
Post-Doc.	0	0	0	0	0
<b>Total</b>	0	0	0	20	20

## Notable Awards and Achievements

### Publications from Prior Projects

- 2001VA9S ("Modernizing US Army Corps of Engineers Policies and Programs") - Other Publications - Holliday, W.C. 2004. Reconciliation of Federal Flood Hazard Mitigation Programs. Final Draft. Submitted to the Institute for Water Resources and U.S. Army Corps of Engineers. 56 pp (plus Appendix).
- 2003VA28B ("Information Dissemination") - Articles in Refereed Scientific Journals - Younos, T., R. De Leon and C. Lewicki. 2003. Integrating Service-Learning Into Watershed Management Programs: Opportunities and Challenges. JAWRA 39(1)1-5.
- 2003VA28B ("Information Dissemination") - Dissertations - Buckels, J.L., 2003, Quantification of contaminant Uptake by Plants and Evaluation of a Partition-Limited Equilibrium Model, Master of Science thesis, Dept. of Civil Engineering, University of Virginia, 64 p.
- 2003VA28B ("Information Dissemination") - Dissertations - Wenk, T.F, 2003, Testing and Validating a Partition-Limited Model for the Uptake of MTBE by Various Plants, Master of Science thesis, Dept. of Civil Engineering, University of Virginia, p.43
- 2003VA28B ("Information Dissemination") - Dissertations - Wetzel, G.L. 2003. A Parametric Simulation Model for Evaluating Cost Effectiveness of Remote Monitoring For Risk Reduction in Rural Water Supply Systems and Application to the Tazewell County, Virginia System. Master of Science thesis, Department of Agricultural and Applied Economics, Virginia Tech. 113 pp.
- 2003VA28B ("Information Dissemination") - Other Publications - Newsletter: Virginia Water Central, No. 25 (March 2003); No. 26 (August 2003); No. 27 (November 2003); No. 28 (January 2004).
- 2003VA28B ("Information Dissemination") - Water Resources Research Institute Reports - Dougherty, M. 2003. Quantifying NPS Pollutant Discharges from an Urbanizing Headwater Basin. Available on Web: <http://www.vwrrc.vt.edu/publications/recent.htm>
- 2003VA28B ("Information Dissemination") - Water Resources Research Institute Reports - Culver, T.B. 2003. Demonstration and Evaluation of Optimal Design Tools for Determination of TMDL

Allocations. Available on Web: <http://www.vwrrc.vt.edu/publications/recent.htm>.

9. 2003VA28B ("Information Dissemination") - Conference Proceedings - Proceedings of the Virginia Water Research Symposium 2003. October 7-10, 2003, Blacksburg, Virginia. P9-2004. Available on the Web: <http://www.vwrrc.vt.edu/Proceedings.htm>
10. 2003VA28B ("Information Dissemination") - Water Resources Research Institute Reports - Mulholland, M.R. 2003. Nutritional factors promoting algal blooms in the lower Chesapeake Bay. Available on the Web: <http://www.vwrrc.vt.edu/publications/recent.htm>
11. 2003VA28B ("Information Dissemination") - Dissertations - Holbrook, R.D. 2003. Fate and Transport of Endocrine Disrupting Compounds During Wastewater Treatment: The Role of Colloidal and Particulate Material. Ph.D. Dissertation in Civil and Environmental Engineering, Virginia Tech.