

# Virginia Water Central

Virginia Water Resources Research Center

Blacksburg, Virginia

August 1999

## SPECIAL ISSUE ON WATER RESEARCH

### Laying the Foundation for a Virginia Water Research Inventory

By Leonard Shabman, director of the Virginia Water Resources Research Center

"What research is being done on Virginia's water resources?" As Water Center director, I have been asked variations of this question many times, and every time I have struggled to offer a good answer. This is not due to any lack of research: Virginia colleges and universities, government agencies, private consultants, and others sponsor or conduct hundreds of water-related research projects each year. The problem, rather, is that there is no single, convenient, statewide list of ongoing water-related research.

The Water Center is making a two-pronged effort to respond to this apparent public-information gap. First, in November of this year we are sponsoring a Virginia water-research symposium—a forum for researchers to inform private citizens, public officials, and others about their work, and in turn possibly to learn of new research needs. Second, in this issue of *Water Central* we describe recent research activities in which the Water Center has been involved, either by providing funds,



helping researchers secure funds from other sources, or taking part in the work.

We hope this issue will encourage other research institutions to consider collaborating with us on a *statewide* inventory of water-quality, drinking-water, and water-supply research. Even more importantly, we hope interested readers will let us know whether such an inventory would be valuable, and, if so, how we might design and distribute it to suit your needs.

### A Guide to Our Research Review

Pages 8-11 list research projects supported by the Water Center from 1996-1999. Some of these projects were funded from federal and state money made available to the Water Center for research. For other projects, the

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VIRGINIA POLYTECHNIC INSTITUTE  
AND STATE UNIVERSITY

Center participated in securing grant and contract funds from state or federal agencies.

Accompanying our project inventory are two essays on our research program and related outreach activities. The first describes studies focused on *drinking water*, specifically for small water systems and isolated communities in southwest Virginia. The contrasts in this story are fascinating. We have found that “old-fashioned” technologies like cistern water have modern applications; at the same time, modern

computerization and other technologies can help address long-standing needs at water systems.

The second essay discusses research on *water quality* in natural aquatic systems—rivers, streams, lakes, and groundwater. To organize our research on this huge topic, we use the concept of a **water-quality management cycle**. The essay describes this concept, with examples of some Water Center-affiliated studies underway or recently completed.

## Research on Small Water Systems and Community Drinking Water

*Poto ergo sum*—I drink (water), therefore I am. (After Descartes)

Having safe and affordable drinking water for all citizens is a major yardstick of the state of our civilization. Most citizens in the United States are very fortunate in having safe and adequate water. Even in this country and in Virginia, however, some citizens face drinking-water problems. Issues related to water conservation, wellhead and other source-water protection, and water treatment are the focus of nationwide research and technology development. The Water Center has been particularly involved with two drinking-water issues: 1) sustainability of small public water systems; and 2) water supply to households that are *not* linked to public water.

The first issue involves systems that serve fewer than 3,300 people; such systems provide water to about 20 percent of people served by all public systems. Several studies have shown that many small systems are not in compliance with national drinking-water standards. Many are privately owned<sup>1</sup> and have limited money or technical capabilities.

Second, many individual households are not connected to public water supplies, for a variety of reasons. Most of these households depend on groundwater (from wells or springs). Others receive water by means of “rainfall harvesting” with storage in cisterns, while some communities receive treated water by truck

hauling, not only during droughts but throughout the year.

### Sustaining Small Water Systems

The Water Center research program on small water systems was prompted by the enactment of the 1996 Amendments to the Safe Drinking Water Act (SDWA). Part of these amendments requires the U.S. Environmental Protection Agency (EPA)—and consequently the states—to work toward “capacity development” for small systems and to facilitate technical assistance to them.<sup>2</sup> For this work, the Water Center formed interdisciplinary teams and secured external funding from the EPA, the Va. Department of Health, and the Montana Water Resources Research Institute. The research has focused on three areas: 1) capacity-development guidelines for Virginia; 2) using telemetry<sup>3</sup> and remote-control systems; and 3) developing an Internet-based information network for small water systems. Brief descriptions of the projects begin on page 3.

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<sup>2</sup> The goal of the capacity-development provision of the SDWA is to bring small systems into compliance with drinking water standards, while at the same time assuring financially viable systems. For more on the SDWA, please see the December 1998 and February 1999 issues of *Water Central*.

<sup>3</sup> Telemetry is the use of electronic instruments to make measurements at one location and then transfer the information to a recording instrument at a base location. Telemetry has many scientific applications and uses.

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<sup>1</sup> The term “public water system” refers not to ownership of the system but to whom the system serves. The Safe Drinking Water Act defines various types of public water systems, depending on how many people are served and how often.

## Capacity Development

This research has been guided by the research needs identified in a 1997 National Research Council publication, *Safe Water From Every Tap—Improving Water Services to Small Communities*. The goal is to develop guidelines for three essential aspects of running a small water system: public health performance appraisal; financing and rate setting; and restructuring management.

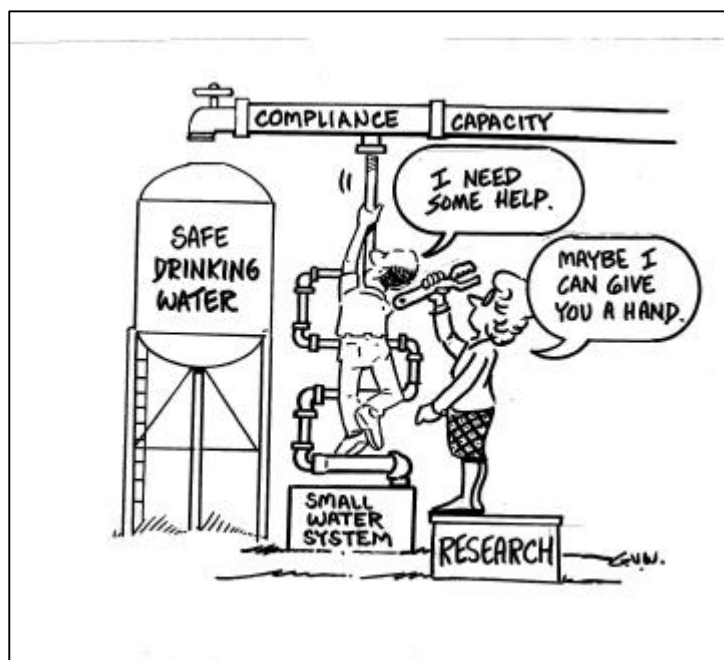
The research on public health performance appraisals and water system planning was conducted by David Keuhl, a Virginia Tech graduate student working under John Randolph (Urban Affairs and Planning Dept.). A survey collected data related to system characteristics, management, water source, operations, maintenance practices, emergency preparedness efforts, and record keeping. The data have been compiled in a computer for various analyses. The final report, *The Virginia Small Water Systems Survey*, will be available from the Water Center after September 1, 1999.

The research on developing guidelines for evaluating financing and rate-setting options was conducted by Andrea Williams, a Virginia Tech graduate student working under William Cox (Civil and Environmental Engineering Dept.). They developed a user-friendly guide and computer program to help systems identify capital needs, make budgets, and set water rates. The final report, *Evaluating Financing and Rate Setting Options for Small Water Systems*, will be available from the Water Center after September 1, 1999.

The management research was done by Kyle Garcia, a Virginia Tech graduate student working under George Morgan (Finance, Insurance, and Business Law Dept.) and Christie Thompson (Center for Wireless Telecommunications). Their study discusses a co-operative operation and management system, intended to improve small systems' financial, technical, and managerial capabilities. The study report, *Restructuring Strategies for Small Water Systems*, should be available after September 1, 1999.

## Telemetry Research

For small water systems, telemetry is a way to link several storage tanks and water-treatment facilities to a central operation unit. The central operator would then be able to



monitor simultaneously key processes (for example, pumping rates) as developments are occurring. The operator could respond to problems more quickly than is currently possible when an operator visits sites on a rotating schedule. Telemetry, therefore, has great potential to increase operators' efficiency and improve systems' performance.

The telemetry research seeks to develop guidelines for using the technology cost-effectively. The Tazewell County Public Service Authority is the project's pilot-study site. The researchers come from several Virginia Tech departments and centers: Agricultural and Applied Economics; Electrical Engineering; Geography; the Center for Wireless Telecommunications; Management Science and Information Technology; the School of Business; and the Water Center.<sup>4</sup> A draft report for this project is expected by December 31, 1999.

## Virginia Interactive Technology Assistance Network

Many small water systems share similar technical and managerial problems. Some of these problems can be solved if owners, managers, and operators have convenient access to timely and accurate information. To help small systems get useful information rapidly and cost-effectively, the Water Center is

<sup>4</sup> For a list of the 10 researchers, please contact the Water Center.

developing an Internet site called the Virginia Interactive Technology Assistance Network. The site will have two main purposes: 1) a place for users to post questions and receive answers (such as an operator asking a question of a regulator); and 2) links to other Web-sites—such as those of the EPA and the Va. Department of Health—to help users expand their search for information about regulations, managing costs, funding sources, training opportunities, and other topics. The network should be in operation by Fall, 1999.

## Drinking-water Alternatives for Households

About 5,000 households in seven coalfield counties of southwest Virginia (Buchanan, Dickenson, Lee, Russell, Scott, Tazewell, and Wise) lack adequate and safe drinking water, due to natural groundwater conditions or to past mining activities. Extending public water lines to these communities is expensive because of the rough terrain and the low number of households in each community. In March, 1997, the Virginia General Assembly (HJR No. 592) requested that the State Water Commission, with the assistance of the Water Center, study options for providing safe, reliable, and affordable domestic water supplies to communities that are not likely to be served by future public water systems.<sup>5</sup>

With funds provided by the Powell River Project and the Southeast Rural Community Assistance Project in Roanoke, the Water Center began research on alternative household-water sources. Three possibilities were investigated: rainfall harvesting with cistern storage; water hauling; and developing mine-cavity water. The research team included faculty and students from the Virginia Tech departments of Agricultural and Applied Economics, Biological Systems Engineering, Civil and Environmental Engineering, and Geological Sciences, along with the Water Center.<sup>6</sup> Planning district commissions, public service authorities, the Va. Department of

Health, the Va. Department of Mines, Minerals and Energy, personnel from coal mining industry, and many other local experts were consulted as the research was being developed. The research team has completed its work and forwarded recommendations to the State Water Commission. Brief descriptions of the three parts of this research are given below.

## Feasibility of Rainfall Harvesting and Cistern Storage

Despite widespread use of cisterns in coalfield communities, little information was available about the water quality or the reliability of cisterns as a home water source. Water testing and a survey of cistern use indicated that rainfall harvesting with cistern storage can be a viable temporary or alternative water source for ridge-top communities; the study also developed guidelines for proper cistern use and maintenance. A report on this topic, *Evaluation of Rooftop Rainfall Collection-Cistern Storage Systems in Southwest Virginia*, is available from the Water Center.

## The Economics of Water Hauling

In small, isolated communities or other areas where extending public water lines is too costly, one alternative is to haul treated water. Such a large-scale water-hauling system requires a tanker truck to carry treated drinking water to a community storage tank—from which the water is distributed to households by connecting pipes—or to tanks at each household.

The Water Center supported a study to evaluate the economic feasibility of water hauling and distribution to small communities. A computer model was designed and used to evaluate the costs of water hauling options for Trammel Gap community in Dickenson County, along with several hypothetical scenarios designed to represent a range of conditions in the region. The study found that conditions do exist where water hauling could be a cost-effective way to provide water, *provided* funds for the start-up costs are available. This model and the conclusions reached were developed for southwest Virginia, but they may have statewide applicability. A report with a user-friendly diskette, *Economic Analysis of Water Hauling for Southwest Virginia Communities*, is available from the Water Center.

<sup>5</sup> The Cumberland Plateau and Lenowisco planning district commissions in southwest Virginia are working on a plan to extend public water mains to unserved areas.

<sup>6</sup> For a list of the seven researchers, please contact the Water Center.

## The Potential for Developing Mine Cavity Water for Water Supplies

Contrary to the popular perception, not all mines produce acidic water drainage. In certain areas, water existing in mine cavities can be a potential local source for a small community. Although the practice is rare in Virginia, a number of individual households and a few communities in southwest Virginia have used mine-cavity water for quite some time, and many communities in Kentucky and especially West Virginia have done so for decades. The goals of this project, therefore, were to assess the potential for developing mine-cavity water as a drinking-water source in Virginia's coalfield counties, and to develop guidelines for local governments and others considering the use of mine-cavity water.

A site in Dickenson County where individual households have used mine-cavity water for several years was used as case study to assess proposed scenarios. At this site, hydrologic analysis (analysis of water location and movements) indicated that the source water is sustainable and adequate to meet the demand of the nearby community. Chemical and biological analyses showed that the mine discharge is suitable for development as a drinking-water source. These results support the potential for developing mine-cavity water

as a drinking-water source in some parts of the Virginia coalfields. The study report, *Potential for Developing Mine Cavity Water for Water Supplies: Institutional and Water Quality Issues*, is available from the Water Center.

## After Research, What Next?

Having completed research on capacity development for small water systems, the Water Center now plans to assist the state Health Department in organizing workshops and conducting demonstration projects on this topic for small systems in Virginia. The telemetry research will continue through Spring 2000; however, by late Fall 1999, enough information will be available to assist with a telemetry-system design for Tazewell County. We also hope to assist with implementation of the recommendations on alternative drinking-water sources for Virginia's coalfield communities, if additional funds for this purpose become available.

In these ways, the Water Center is working on an essential part of its mission: helping its research results really get *used*. The following essay looks in more detail at how this happens.

—By Tamim Younos, associate director of the Virginia Water Resources Research Center

## Water Science and Water Quality Management

Last year *Water Central* (October 1998 issue) described how Section 303 of the federal Clean Water Act, as well as state legislation, had initiated a new era in water quality management—we could call it, “the TMDL Era.” Under Section 303, each state is required to publish a list of waters that do not meet water-quality standards; this list is often referred to as the “impaired waters list.” For each impaired water, the state is expected to establish a **total maximum daily load (TMDL)**, a measure of the amount of a pollutant that may be received daily by that water body. With the TMDL determined, the state with local partners is to design and implement a water-quality improvement and protection strategy for the impaired water body.

Since last year's article, several TMDL/impaired waters events have occurred:

- the lawsuit against the U. S. Environmental Protection Agency (EPA), challenging its oversight of Virginia's TMDL program, has been settled;
- the EPA has added a number of water bodies to the state's list of impaired waters, including Virginia's portion of the Chesapeake Bay;
- planning for water-quality improvement in several Virginia watersheds is now underway; and
- the EPA will soon publish revised TMDL regulations.

These and other TMDL-related events are dominating current water-quality discussions and management in Virginia.<sup>7</sup>

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<sup>7</sup> Future issues of *Water Central* will continue to update readers on TMDL developments.

During the last three years, part of the Water Center's research program has been devoted to helping meet present and future information needs created by these developments in water-quality management. The guide for our research agenda is the concept of the "**water-quality management cycle**," shown in the illustration below. Research that generates sound scientific information and data helps keep the "cycle" on course and rolling.

## A Trip Around the Cycle

### Water-quality Standards

Legal standards are the starting point for the water-quality management cycle. Standards are *specific* measures of biological, chemical, or physical factors. Examples include the acceptable amount of dissolved oxygen in a given volume of water or the maximum allowable number of bacterial colonies generated from a water sample. For some water-quality factors, such as sediments or nutrients (primarily nitrogen and phosphorus), there are no specific, legal standards, but given measures of the factors may be well-known indicators of water quality. Numerical standards and related measurements ultimately are used to judge whether a water body is supporting **beneficial uses**, such as swimming, fishing, aquatic life, or supplying drinking water.

Water-quality standards change when society's standards or needs change, or when assessments indicate that existing standards need revision. Currently, in fact, the EPA has several initiatives underway to reevaluate the nation's water-quality standards and to consider

standards for sediments and nutrients. The Water Center is chairing the Water Quality Academic Advisory Committee (with members from across the state), which will compare standards in Virginia with those other states and will propose work to assure the scientific validity of Virginia's standards.

### Monitoring

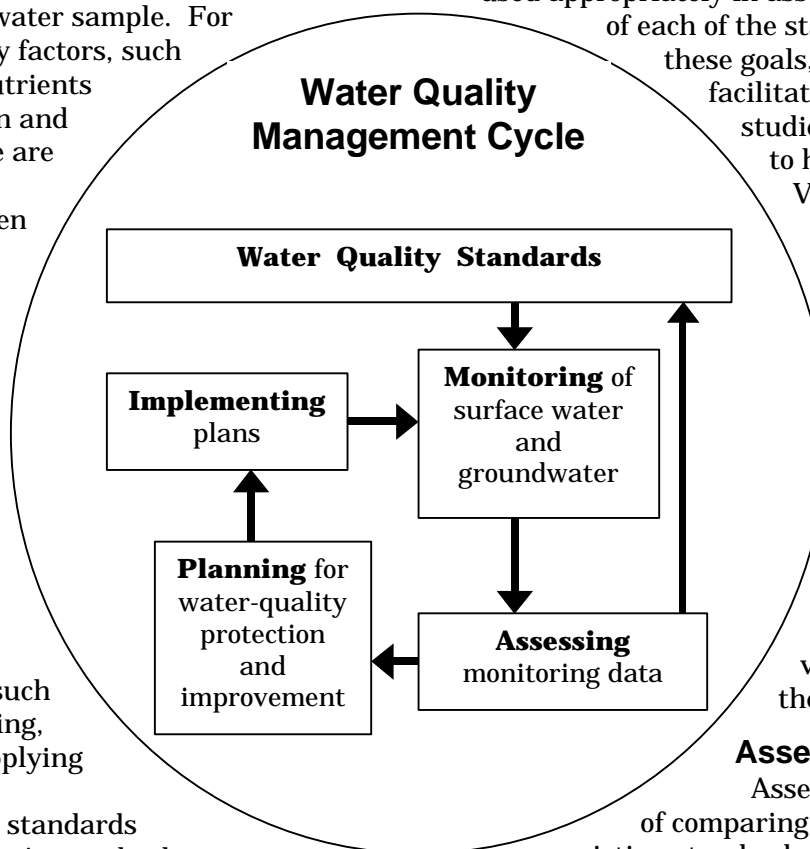
Adequate and reliable monitoring data are necessary for determining water-quality conditions.<sup>8</sup> A wide range of monitoring activities occur in Virginia. State officials, local governments, regional organizations, citizen groups, and others monitor streams, lakes, groundwater, and coastal waters.

But not all monitoring is the same. The purposes, methods, skills required, and accuracy of data collection can vary considerably. A current challenge in water-quality management, therefore, is assuring that data are of the best quality possible and are used appropriately in assessing the condition

of each of the state's streams. Toward these goals, the Water Center has facilitated several monitoring studies, and has been asked to help establish the Virginia Water Monitoring Council. This will be a statewide body to coordinate and improve the communication among the various monitoring groups in the state. The objective of this effort is to help all monitors generate the most scientifically valid and useful data they can.

### Assessment

Assessment is the process of comparing monitoring data with existing standards to determine if a



<sup>8</sup> Here we are referring to monitoring the conditions *in* a water body, not those of water in a drinking-water system or in a wastewater discharge.

water body is healthy or impaired. For an impaired water body, the process ideally would establish the likely source of the impairment: one or more specific points of discharge, nonpoint runoff, or a combination of sources. Research toward this objective includes work on new methods of identifying the source of bacterial contamination of streams (fecal coliform bacteria are the cause of impairment in the majority of the Virginia's impaired waters). The Water Center is seeking to advance such research and technology development, and we are also planning to have a workshop on fecal contamination next year.

Assessment also helps *set priorities* for watershed improvement by identifying the most significant problems and where restoration is most likely to be successful. To accomplish this task, assessment involves experience, and professional judgment applying statistical procedures to monitoring data. Consequently the Water Center is involved in efforts to reconsider and refine the statistical approaches currently applied to Virginia's monitoring data. In one study, improved procedures were used to identify trends in water-quality data (the results of this work are available at the Water Center's Web-site, [www.vwrrc.vt.edu](http://www.vwrrc.vt.edu)). A second effort is seeking to improve the validity of the state's statistical analyses when only a small amount of data are available.

Ultimately, the assessment step is critical in helping people decide whether water-quality programs and investments are paying environmental dividends.

### Planning for Improvement

A water-quality improvement plan is a written strategy for managing water quality. Some plans describe a trial-and-error strategy, relying on implementing controls, monitoring the results, and then making adjustments. More often, however, plan development relies on *computer modeling* of watersheds, especially if there is impairment resulting from nonpoint-pollution sources.

If a computer model is employed, its mathematical equations and its data must reflect the best scientific understanding of watershed processes. Unfortunately, this often poses a problem for small watersheds, that is, ones on the order of a few square miles in area, rather than the thousands of square miles in

major Virginia watersheds, such as the James or Potomac river basins. For smaller watersheds, model developers may not have access to adequate data, or there may be only a limited understanding of the various processes that need to be modeled. A large number of projects affiliated with the Water Center seek to address such computer modeling problems, both for urbanizing areas and for watersheds dominated by agricultural land uses. Other projects seek to make models easier to use and more relevant to the needs of decision makers.

### Implementation

A complete water-quality improvement plan includes steps for implementing the plans. In this part of the management cycle, research often looks at the costs and benefits of various practices (such as streamside forest buffers) employed to improve water quality. Such research helps predict or explain the people's reactions to proposed or required practices to improve water quality. Similar research can help policy makers or managers develop budgets for implementing water-quality programs.

Of particular interest to the Water Center has been research on *incentives* for people to implement water-quality improvement practices. One example is research on the problems and opportunities associated with "effluent allowance trading," a system that allows water dischargers to trade pollution-control obligations in order to lower their joint compliance costs. A report on this topic is available from the Center.

### Bringing Science to Decision Makers (Like You)

One aspect of the Water Center's mission is to assure that useful research results and outreach programs will be available for each step in the water-quality management cycle. To do so, we need to keep talking and listening to researchers, policy makers, and citizens. Just as importantly, we need to help the people we serve keep talking *to each other*. We hope our work is helping you and other Virginians think, talk, and make good decisions about Virginia's waters.

—By Len Shabman, director of the Virginia Water Resources Research Center

## VWRRC Research Program Documentation for 1996-1999

The Water Center supports research in four main ways:

1. **competitive-grants program**, providing support for the faculty members, students, and expenses necessary to complete a full research study;
2. **seed-grant program**, supporting exploratory work necessary to securing more substantial grants and contracts; for 1998, \$35,000 in the seed-grant program yielded over \$800,000 in project support;
3. **fellowship projects**, supporting research by rising college seniors with a strong academic records and an interest in a water-resources career;
4. **facilitated, collaborative, and in-house projects** in which the Water Center helps others secure funds or actually conducts the research; over the last three years the Water Center has helped secure nearly \$2 million for such projects.

For numbers 1-3 above, application is open to any faculty member or student at any Virginia public or private college or university. In fiscal year 1999-00, the Water Center had about \$140,000—part of its base support from federal and state funds—available for these three categories. Number 4 involves funds *outside* of the Center's base support, secured through grants and contracts. In *facilitated* projects, the Water Center helps other researchers get the needed funds, but does not participate in the work. In *collaborative* projects, the Water Center assists in obtaining funds and participates in the research. On *in-house* projects, the Water Center is responsible for the completion of the study (others may contribute through sub-contracts).

The projects below are listed according to these four groups. Within the groups, the projects are listed alphabetically by the main author's last name. The following symbols identify a project's general subject:

☉ = drinking-water supply; ♪ = water quality; \* = other

For details about any of the projects listed, please contact the Water Center (contact information is given on the last page of this newsletter). You can find more information about the Water Center's different funding programs at the Center's Web-site, [www.vwrrec.vt.edu](http://www.vwrrec.vt.edu).

### **I. Competitive Projects Program: VWRRC Funded (about \$75,000 in 1999)**

- ♪ *Costs and Adoption Barriers for Agricultural BMPs*. D. Bosch and J. Pease, Va. Tech.
- ☉ *A Non-Invasive Cost-Efficient Methodology for Identifying Production Zones and Recharge Source Areas in Fractured or Faulted Rocks*. T. Burbey and W. Seaton, Va. Tech.
- ☉ and ♪ *Virginia's Water Resources: An Assessment of Potential Conflict between Water Supply Development and Environmental Protection*. W. Cox, Va. Tech.
- ♪ *Development of Predictive Relationships between Stressors and Macrobenthic Communities for Use in Implementing TMDL's*. R. C. Jones and C. Hamblin-Katnik, George Mason University.
- ☉ and ♪ *Options for Modeling and Managing Stream Temperature in the Face of Increasing Water Demands and Minimum Instream Flows*. T. J. Newcomb and D. J. Orth, Va. Tech.
- ♪ *Retention and Commitment of Save our Streams Volunteers*. J. Roggenbuck, Va. Tech.

### **II. Seed-grant Program: VWRRC Funded (about \$35,000 in 1999)**

- \* *Anthropogenic and Topographic Controls on Transition of Coastal Marshes to Phragmites sp. Dominance*. J. Albertson, University of Virginia.
- ☉ *Hydrological Reconnaissance of the Piedmont and Blue Ridge Provinces for Characterization of Fracture Flow*. T. J. Burbey, Va. Tech.
- ☉ *Wellhead Protection in the Piedmont and Blue Ridge Provinces: Analysis of Flow Conditions and Evaluation of Current State Regulations*. T. Burbey and W. J. Seaton, Va. Tech.
- ♪ *Impact of Forest Utilization and Pollution-Meditated Base Depletion on Surface and Ground Water Quality*. J. A. Burger, R. Jones, and L. Zelazny, Va. Tech.
- ♪ *Photodegradation of Water Pollutants Using Nanoparticle Semiconductor-Coated Fiber and Waveguide Bundles*. R. O. Claus and Y. Liu, Va. Tech.
- ♪ *Lead Release into Surface and Ground Waters from Shooting Ranges*. J. Craig and P. Scanlon, Va. Tech.
- \* *The Influence of Flood Plain Vegetation on River Flow Conveyance*. C. L. Dancy and P. Diplas, Va. Tech.
- ♪ *Investigating Toxicity of Agricultural Chemicals to Commercial Shellfish*. A. Dietrich and D. Gallagher, Va. Tech.



- 🔪 *A Nuclear Magnetic Resonance Technique to Determine Transport Properties of Motile Bacteria which Degrade Groundwater Pollutants.* E. J. Fernandez and R. M. Ford, University of Virginia.
- 🔪 *Support for Equipment for DNA Fingerprinting.* C. Hagedorn, Va. Tech.
- 🔪 *Transport and Removal of Viruses in Wastewater as a Function of Soil Depth and Additional Treatment in Texture Group 2 (Loam) and 3 (Silt Loam) Soils.* C. Hagedorn and R. B. Reneau, Jr., Va. Tech.
- \* *Friendly Methods for the Determination of Organophosphate Pesticides in Environmental Samples.* R. C. Hale, M. H. Roberts and R. J. Byrne, Virginia Institute of Marine Science, College of William and Mary.
- 🔪 *Hyperspectral Imagery Applications for Watershed Management.* C. Heatwole, Va. Tech.
- 🔪 *Characterizing Topographic-chemical Relationships: A Soil-moisture Approach.* G. Hornberger, University of Virginia.
- 🔪 *Selection and Testing of an Oligonucleotide Probe for Identification of *Streptococcus bovis* as an Animal Fecal Indicator and Identification of Sequence Data for Future Ribotyping and PCR Applications.* H. Kator, S. Kotob, and M. Rhodes, Virginia Institute of Marine Science/College of William and Mary.
- 🔪 *Reducing N Loading to Surface Water through Prediction and Control of Ammonia Volatilization from Dairy Manure.* K. F. Knowlton and J. H. Herbein, Va. Tech.
- 🔪 *GIS, Modeling, and Monitoring Support for Development of TMDL Plans in Virginia.* S. Mostaghimi, Va. Tech.
- 🔪 *Determining the Fate of Nitrogen from Biosolids and Commercial Fertilizers.* S. Mostaghimi, R. B. Reneau, Jr., K. Brannan and T. W. McClellan, Va. Tech.
- 🔪 *Study of an Artificial Wetland System in Monterey, Virginia.* J. Novak, Va. Tech.
- ⊕ *Estimation of *in-situ* aquifer porosity and total dissolved solids by electric resistivity survey: a case study in Northampton County, Eastern Shore, Virginia.* A. Nowroozi, Old Dominion University.
- 🔪 *Intensive Pasture-based Dairy Production: Impact of Profitability and Water Quality.* J. Pease, G. Groover and D. Bosch, Va. Tech.
- 🔪 *Appomattox River Water Quality Baseline Study.* K. Register, Longwood College.
- \* *Manganese Oxyhydroxide Scavenging of Toxic Metals as a Geochemical Remediation Tool for the Removal of Inorganic Contaminants from Groundwater.* J. D. Rimsidt and J. J. Rosso, Va. Tech.
- 🔪 *Use of Colloidal Biological Activated Carbon (CoBAC) to Enhance Pollutant Biodegradation in Soil-Water Systems.* J. A. Smith and T. B. Culver, University of Virginia.
- 🔪 *Developing New Techniques for the Analysis of Tributyltin Particles in Contaminated Sediments.* M. A. Unger and W. G. MacIntyre, Virginia Institute of Marine Science/College of William and Mary.
- ⊕ *Bacterial Degradation of Haloacetic Acids (HAAs) in the Distribution System by a Haloacid Dialogues Enzyme.* R. W. Williams and J. Yuan, Old Dominion University; and S. Williams, Newport News Waterworks.

### **III. Student Research Fellowships: VWRRC Funded (about \$30,000 in 1999). Prior to 1999, this program was limited to Virginia Tech students.**

#### 1999 William R. Walker Graduate Research Fellowship Award

Theresa M. Wynn, Va. Tech

#### Undergraduate Research Summer Fellowships

##### **1999**

- \* *Studying the Stratification Process in the Spring Hollow Reservoir* (tentative title). Paul A. Gantzer, Va. Tech.
- 🔪 *Appomattox River Water Quality Baseline Study* (tentative title). Arthur T. Green, III, Hampden-Sydney College.

##### **1998**

- 🔪 *Citizens in Action: Volunteer Monitoring of Stream Health.* Michael P. Joyce.
- \* *Inland Recreational Fishing Rights in Virginia: Implications of the Virginia Supreme Court Case Kraft v. Burr.* Elizabeth A. Murphy.
- \* *Random Amplified Polymorphic DNA (RAPD) Analysis and Antibiotic Resistance Patterns.* Sandra L. Robinson.

##### **1997**

- 🔪 *Habitat of the Riverweed Darter, *Etheostoma posdestemone* Jordan.* William Connelly.

- 📌 *Surface Water Quality Impacts of Best Management Practices Implemented at an Agrichemical Storage and Handling Facility in Virginia.* Sharla B. Lovern.
- \* *Examination of the Effectiveness of Bicinchoninic Acid Protein Assay and Fluorescein Diacetate Hydrolysis for Measuring Biomass Growth on Industrial Waste Oil.* Michael Shrader.

#### 1996

- 📌 *On the of Diel Oxygen Fluctuations as a Bioindicator for Eutrophication of Lotic Waters, and the Longitudinal Variation of Water Quality and Current Condition of the Roanoke River, Virginia and North Carolina.* Daniel Liebert.
- 📌 *Modeling the Utility of Three Plant Species for Use in Constructed Wetlands Designed to Treat Domestic Wastewater.* Nathaniel Rudy.
- \* *Isolation and Characterization of Methyl Ethyl Ketoxime and Acetaldehyde Oxime Degrading Bacteria from Activated Sludge.* Mary Rust.

### IV. Facilitated, Collaborative, and In-house Projects: Grant and Contract Funded

#### Facilitated Projects

- 📌 *Generation of Non-Point Source Pollution and Flood Waters: Identifying Source Areas from Consideration of Soil Moisture Dynamics.* J. D. Albertson and P. Wiberg, University of Virginia.
- \* *Sediment Flushing Capabilities of Unsteady River Flows and Effects on Spawning Gravel.* P. Diplas and D. Orth, Va. Tech.
- \* *Uncertainty, Sensitivity and Risk in the Mississippi, Missouri and Illinois Rivers Flow Frequency Study.* Y. Haimes, University of Virginia.
- ⊕ *An Optimal Rehabilitation-Design Model for a Reliable Water Distribution Network System.* G. V. Loganathan and H. D. Serali, Va. Tech.
- \* *An Investigation into the Use of Biologically Based Treatment Technologies for Waste Oil Volume Reduction at Norfolk Southern Corporation.* N. G. Love, M. Widdowson, and J. Novak, Va. Tech.
- 📌 *A Framework for Evaluating BMP Effects on N and P Discharges from Watersheds.* S. Mostaghimi, S. Shukla, R. B. Reneau, D. Bosch, and J. A. Burger, Va. Tech.

#### Collaborative Projects

- 📌 *An Assessment Tool for Evaluation of Nonpoint Source Pollution Control Policies in Watersheds.* D. Bosch, M. L. Wolfe, N. Stone, Va. Tech.
- 📌 *An Integrated Environmental and Economic Model for Evaluating Alternative Development Scenarios in Virginia Watersheds.* T. Dillaha and K. Stephenson, Va. Tech.
- 📌 *From Landscapes to Waterscapes: An Integrating Framework for Urbanizing Watersheds.* P. Diplas, F. Benfield, D. Bosch, D. Kibler, R. Gupta, W. Cox, V. Lohani, S. Mostaghimi, K. Stephenson, and L. Shabman, Va. Tech.
- 📌 *Options for Developing State-Local Cooperative Agreements for Implementing Virginia Tributary Strategies.* L. Shabman and K. Stephenson, Va. Tech.
- 📌 *An Academic Advisory Committee for the Virginia Water Quality Assessment Process.* L. Shabman, T. Younos, E. Smith, C. Zipper, T. Dillaha, Va. Tech; S. Yu, University of Virginia; L. Smock, Virginia Commonwealth; H. Kator and C. Hershner, Virginia Institute of Marine Science/College of William and Mary.
- 📌 *Nitrogen, Phosphorus, and Sediment Loss from Dairy Loafing Lots as Affected by Rotational Vegetated Paddocks.* E. Collins, T. Younos, and B. B. Ross, Va. Tech.
- 📌 *A Prototype Web Site for Sharing, Visualization, and Decision Support for Environmental Management.* R. Dymond, T. Younos, and V. Lohani, Va. Tech.
- 📌 *Analysis and Interpretation of Water Quality Data to Support Clean Water Act Implementation.* C. Zipper and G. Holtzman, Va. Tech.
- 📌 *Long-Term Water Quality Trends in Virginia's Waterways.* C. Zipper and G. Holtzman, Va. Tech.

#### In-house Projects

- \* *Evaluating Floodplain and Riparian Zone Restoration on Frequently Flooded Farmland.* L. Shabman, Va. Tech.
- \* *Evaluation of Relocation as a Flood Hazard Management Strategy.* L. Shabman, Va. Tech.
- 📌 *Financing Restoration of Forested Riparian Buffer Zones.* L. Shabman, Va. Tech.
- \* *Modernizing U. S. Army Corps of Engineers Policies and Programs.* L. Shabman, Va. Tech.

- 📄 *Effluent Allowance Trading: A New Approach to Watershed Management.* L. Shabman and K. Stephenson, Va. Tech; and R. Collins, University of Virginia.
- 📄 *Cistern Design and User Manual for Coalfield Community Households.* T. Younos, Va. Tech.
- \* *Developing an Existing Natural Wetland as a Demonstration Site for Educational Purposes and Studying Wetland's Nonpoint Source Mitigation Impacts.* T. Younos, Va. Tech.
- 📄 *Developing Guidelines for Sustainable Small Drinking Water Systems in Virginia.* T. Younos, Va. Tech.
- 📄 *Evaluation of Runoff Water Quality in the Vicinity of the Slussers Chapel Cave Preserve, Blacksburg, Virginia.* T. Younos, Va. Tech.
- 📄 *Review of Remediation Technologies for Batie-West Spring, Lee County, Virginia.* T. Younos, Va. Tech.
- 📄 *A Strategic Plan for Applying Small-Scale Technologies to Coalfield Households Not Likely to be Served by Public Water Extensions.* T. Younos, Va. Tech.
- 📄 *The Potential for Developing Mine-Cavity Water for Drinking Water Supplies.* T. Younos, T. Burbey, D. Reaves, and J. Novak, Va. Tech.
- 📄 *Research, Development, and a Feasibility Study of Telemetry/Remote Control for Small Water Systems in a GIS Environment: A Case Study of Tazewell Water System [Tazewell County], Virginia.* T. Younos, W. Carstensen, W. Farely, L. Matheson, G. Morgan, and D. Reaves, Va. Tech

## IN AND OUT OF THE NEWS

### Newsworthy Items You May Have Missed

*The following summaries are based on information in the source or sources indicated at the end of each item. Selection of this issue's drought-related items concluded August 11, 1999; selection of non-drought items concluded July 22*

*If you have access to the Internet, you can follow water-related news with the "Daily News Update" at the Water Center's Web site ([www.vwrrc.vt.edu](http://www.vwrrc.vt.edu)).*

### **Drought News**

Across Virginia, only one 12-month period—the Great Drought of 1930-31—was drier than the period from July 1998 to June 1999. By late July/early August, the National Weather Service classified the drought as "extreme" in northern Virginia; "severe" in central Virginia, the Roanoke Valley, southern Shenandoah Valley, the west-central highlands, and the northern Piedmont; "moderate" in the New River Valley and the southern Piedmont; and "mild" in eastern Virginia (*Richmond Times Dispatch*, 7/14/99; NWS [Virginia offices] *Drought/Water Supply Statements*, 7/28 and 8/4/99).

The drought has affected much of the eastern United States. The April—July 1999 period was the driest on record (105 years) in Delaware, Maryland, New Jersey, and Rhode Island. The Great Lakes were at their lowest level in 32 years. The mighty Susquehanna River and other rivers originating in upstate New York were flowing at their lowest levels ever recorded in July. The Potomac River was at one-fifth its normal level in mid-July, with 500 million gallons of water to be drawn each day from its 600-million gallon flow. By late July, the U. S. Geological Survey reported that 70 percent of mid-Atlantic region streams

had flows among their lowest 25 percent on record. (*Associated Press* 7/19/99; *Binghamton Press & Sun-Bulletin* 7/13/99; *Washington Post*, 7/16/99; *Baltimore Sun*, 8/7/99 NWS [Blacksburg office] *Drought/Water Supply Statement*, 7/28/99).

Here's a sample of the impacts of the dry weather on some Virginia areas:

☉ In early June, the volume of water entering Occoquan Reservoir (between Fairfax and Prince William counties) was the smallest since 1928 (when record-keeping began).

☉ In mid-June, citizens in the northern Shenandoah Valley localities of Winchester, Frederick County, and Shenandoah County were asked to restrict water use;

☉ Near Lynchburg, many crews declined to participate in the annual James River Batteau Festival in mid-June, fearing their boats would be gouged by rocks in the low-flowing river.

☉ Mandatory restrictions were imposed in the city of Roanoke July 7 for the first time in the city's history, as water levels at the city's main reservoir, Carvin's Cove, fell more than 24 feet below full pond. By August 10, the reservoir had fallen to over 27 feet down; if it reaches 30 feet down, additional use restrictions are possible. Neighboring Roanoke County and the city of

Salem, meanwhile, had sufficient water (from a different source), so there was considerable public discussion about whether and how the city's predicament could have been avoided.

☉ In Loudoun County, mandatory restrictions—effective August 1—were placed on car washing and lawn watering, after voluntary restrictions did not lower demand sufficiently.

☉ By August 8, voluntary water restrictions were in effect in the Northern Virginia localities of Fairfax County, Arlington County, and the city of Alexandria, but not in Prince William and Fauquier counties. (*Lynchburg News & Advance*, 6/16/99; *Northern Virginia Daily*, 6/16/99; *Potomac News*, 7/16/99; *Roanoke Times*, 7/8/99, 8/4/99, 8/11/99; and *Washington Post*, 6/8/99, 7/22/99, 8/8/99)

In Maryland, officials in some localities began in June to enact mandatory water-use restrictions, while by July other localities were asking residents to conserve water. But these actions were superseded in early August when Gov. Glendening ordered statewide limits on water use. (*Associated Press*, 6/11/99; *Baltimore Sun*, 7/14/99; *Washington Post*, 6/13/99 and 8/8/99)

The drought is affecting not only public water supplies and households but also farmers in some places, many of whom are now receiving federal crop disaster assistance for the impact of last year's long dry spell. For example, as of July 13, 61 percent of Virginia's pasture lands were in "poor" or "very poor" condition. (*Associated Press*, 6/29/99; *NWS [Blacksburg office] Drought/Water Supply Statement*, 7/28/99)

Humans aren't the only creatures being affected by the dry conditions. In late June and early July, fish died by the tens of thousands in several Maryland streams near Baltimore. The fish kills were attributed to low oxygen levels caused by heat, lack of fresh water flow, and increased salinity, all due to low rainfall. (*Baltimore Sun*, 7/1/99, 7/8/99)

By early June 6,000 acres of forestland in Virginia burned this year, more than the total for all of 1998. By late July, the state forester had instructed all Va. Forestry Department staff to prepare for a "severe" fall fire season. (*Washington Post*, 6/8/99; *Va. Dept. of Emergency Services—Emergency Operations Center*, 7/29/99)

The drought may even be driving bears out of the woods. Eighteen bears have been sighted along the C&O Canal National Park towpath near Sharpsburg, Md., most likely driven down to the Potomac in search of water and food. Park officials recalled only two such bear sightings in the last decade. (*Washington Post*, 7/11/99)

## Other News

• **A Virginia river once polluted by hog waste from Smithfield Foods** shows declining levels of nitrogen and phosphorus—some by tenfold—two years after the meatpacker was fined \$12.6 million for discharging slaughterhouse waste. Although the Virginia Institute of Marine Science (VIMS) didn't measure fecal coliform in the Pagan River and the river is still closed to shellfish harvesting, the VIMS study indicates some ecological recovery. (*Associated Press*, 5/19/99)

• **The Chesapeake Bay lost about 5,700 acres of grass beds** in 1998; runoff washed in by heavy spring rains that year is getting the brunt of the blame. Such grasses protect shoreline, help reduce pollution, and provide food and shelter for birds and other bay creatures. The largest declines were in the Tangier Sound area, where two-thirds of the grass beds have disappeared since 1992. (*Associated Press*, 5/28/99; *Washington Post*, 6/13/99)

• Newport News Waterworks' proposal to build **\$130-million, 1,500-acre reservoir in King William County** continues to be debated. A preliminary decision in June by the U. S. Army Corps of Engineers said that the reservoir is not needed and would cause too much environmental harm. The Corps said that the waterworks did not "convincingly demonstrate" that, by the year 2040, the Peninsula area (including Newport News, Hampton, Poquoson, Williamsburg, James City County, and York County) would need an additional 33 million gallons of water per day. The Corps estimates the needed increase at 17 million gallons per day. The waterworks and the Virginia Department of Health, however, claimed in a mid-July rebuttal that the Corps underestimated how much the area's population will grow and overestimated how much water could be conserved.

After considering the rebuttals, the Corps of Engineers will make a final decision. Because the state and the Corps disagree, the matter may go before the Corps' New York office. Even if the Corps ultimately approves the project, the U. S. EPA could still block it. (*Virginian-Pilot*, 6/8/99 and 7/15/99; *Richmond Times-Dispatch*, 7/15/99; *Hampton Roads Daily Press*, 7/28/99)

• **Recycling used motor oil** is the focus of a new public-service announcement campaign that enlists celebrities in California. The film, television, and sports figures will tell those who change their own car oil how to find businesses that will recycle used oil. Last year about 20

million gallons of motor oil sold in California were improperly disposed into waterways, in landfills, or on the ground. (*Business Wire*, 6/10/99)

According to the annual "National Report Card on Environmental Knowledge, Attitudes and Behaviors," only one in seven Americans knows that individuals changing motor oil is the **main source of oil contamination to surface waters**. (*Report by the National Environmental Education & Training Foundation and Roper Starch Worldwide*, December 1998)

•In **South Carolina, 25 waterways** were added to the list of rivers and lakes that contain mercury-contaminated fish, approximately doubling the previous list. A suspected cause is air-borne mercury from industrial smokestacks and power plants. (*The State* [Columbia, S.C.], 6/11/99)

•The **Smyth County Board of Supervisors** is seeking \$3.6 million in state funds for seven projects to improve drinking water for about 800 residents. Many of these citizens are currently being served by contaminated springs or wells. (*Smyth County News & Messenger*, 6/12/99)

•**North Carolina officials plan to inventory state water supplies** to determine how much water can be pumped without irrevocably damaging groundwater aquifers. By next year, one in four public water systems will likely be using 80 percent or more of their available water. (*Associated Press*, 6/16/99)

•**Border Collies are being used to chase off Canada Geese** in hopes of reducing the amount of geese droppings along the shores of Lake Barcroft in Fairfax County. The trained dogs, who don't harass goslings or injured geese, have been successful in scaring off all but a few stoic birds. (*Washington Post*, 6/19/99)

•Environmentalists have won a court order forcing the **U. S. EPA to take a more aggressive role in protecting Virginia waterways** from pollution. The suit claimed that the federal agency was not enforcing provisions in the 1972 Clean Water Act that require state officials to develop maximum pollution levels permitted in state waters. Similar suits have been filed against EPA in some over 20 states; about half have been settled, although the suits in Maryland and DC are pending. (*Washington Post*, 6/23/99) (For more on this issue, which involves "impaired waters" and "total maximum daily loads" [TMDLs], please see the Feature Article in the October 1998 issue of *Water Central*.)

•**Robots the size of muskrats are patrolling Alexandria, Va.'s sewers** for leaks that allow water to seep in during rainstorms, swelling the system from 2 million gallons a day to an unmanageable 20 million gallons. When this happens and the system's capacity is overloaded, tons of untreated sewage are discharged directly into Four Mile Run. (*Alexandria Journal*, 6/30/99)

•Congress is considering a \$7.8-billion plan to **restore the Everglades** by re-creating natural water flows across South Florida. The Clinton Administration's plan seeks to reverse some of the effects of flood-control and water projects, which have reduced the Everglades by half and diverted billions of gallons of fresh water out to sea. The 20-year project would nearly double the supply of fresh water in South Florida and use 80 percent of that to increase flows to the Everglades at crucial times. If approved, it would be funded by state and federal money. (*Washington Post*, 7/1/99)

•Although most **rivers flowing into the Chesapeake Bay are cleaner** than they were when the Chesapeake Bay Commission was formed in 1983, the amount of dissolved oxygen in the main part of the bay has not increased, according to the commission's executive director. Since an agreement in 1987 established a 40-percent nutrient-reduction goal, the amount of phosphorus flowing into the bay has been reduced by nearly this percentage. A 40-percent reduction in nitrogen levels may be attained by 2001 or 2002. (*Associated Press*, 7/9/99)

•Residents of the **Quantico** (Prince William County) area and its accompanying Marine Corps base were warned to stop drinking tap water in early July after inspectors found **unacceptable levels of fecal-coliform bacteria in the water supply**. The 16,000 people affected were advised to boil their water or use bottled water to avoid diarrhea, nausea, cramps, or other ailments; no signs of these problems were reported, officials said. The advisory was lifted in mid-July after continued sampling revealed no signs of contamination. (*Washington Post*, 7/10/99; *Prince William Journal*, 7/15/99)

•In a measure to prevent pollutants from being dumped into drains, **Newport News is offering a 15-percent reduction in its stormwater-management fee** to citizens who use a drop-off site to dispose of certain toxic chemicals. The typical rebate will be about \$4 or \$5. (*Virginian-Pilot*, 7/13/99)

•Virginia erred in waiting almost 20 years to tell citizens that fish in parts of the **Staunton River** are contaminated with toxic PCB (polychlorinated biphenyl) chemicals, and in not warning residents of **Culpeper and Buchanan counties** of similar problems in their rivers, according to a report from the state's Joint Legislative Audit and Review Commission. The affected areas are the Staunton River between Long Island in Campbell County and Clover in Halifax County, the Levisa Fork in Buchanan County, and Mountain Run in Culpeper County. The DEQ is now investigating the cause of the contamination of the Staunton River. (*Lynchburg News & Advance*, 6/23/99; *Richmond Times-Dispatch*, 7/13/99)

•The **Seattle** City Council has unanimously approved a plan intended to **save the salmon in the city's primary water supply**. The council voted to ban all logging and improve the Cedar River Watershed for the next 50 years by capping water withdrawals, restoring fish habitat, building fish ladders around a dam, and spending

\$1 million for research on the rivers' salmon. (*Seattle Post-Intelligencer Reporter*, 7/13/99)

•The **Green Valley Poultry Farm**, an egg-processing plant near Abingdon (Washington County) was lauded recently by the Boone Watershed Partnership for its **practices that protect the quality of Boone Lake**. (The watershed of Boone Lake, located in Tennessee, extends northward into the Abingdon area.) Among other activities, the staff haul all the plant's wastewater to a treatment facility, and they raise an insect that, by feeding on fly larvae, is intended to reduce the need for insecticides. (*Associated Press*, 7/16/99)

•Finally, here's a **drought-appropriate quote** from Chrissie Hynde, a rock musician who led the group The Pretenders in the 1980s: "All I know is, I've had fun with [rock music]. I try to keep the perspective that it's still not as important as the water supply...." (*New York Daily News* article, printed in *The Roanoke Times*, 6/30/99)

—Compiled by Su Clauson-Wicker

## N O T I C E S

### Small Drinking-water System Certification / Licensure Survey

The Virginia Department of Health and Virginia Tech researchers will be sending a questionnaire to owners and operators of small drinking-water systems in August, 1999. In order to meet U. S. EPA regulations, Virginia is seeking input on how to implement a certification or licensing program for small-system operators and owners. The EPA regulations affect all small drinking-water systems. If you feel you should be sent a questionnaire and do not receive one by mid-September, please call the Virginia Tech Small Systems Research Team at (540) 231-2013, or send e-mail to [awhelton@vt.edu](mailto:awhelton@vt.edu).

### 15<sup>th</sup> Annual Conference on Contaminated Soil and Water

This international conference will be held Oct. 18—21, 1999, at the University of Massachusetts, Amherst. Pre-registration deadline (to avoid \$50 late fee) is October 1. For more information: Denise Leonard, (413) 545-1239; [dleonard@schoolph.umass.edu](mailto:dleonard@schoolph.umass.edu); Web-site: **[www.aehs.com](http://www.aehs.com)**.

### “Odor Most Foul! —

**Management and Control Approaches for Wastewater Systems”** is the title for this year's annual education seminar by the Virginia Water Environment Association, to be held Nov. 3—4, 1999, in Richmond. For more information: Debbie Healey Langley, (703) 213-2034, or Keith Kornegay, (703) 213-6292.

### Delmarva Coastal Bays Conference

“Major Fisheries and Marine Dependents in Shallow Water Estuarine Systems” will be held Nov. 12—13, 1999, at Ocean City, Maryland. Sponsored in part by the Virginia Coastal Program, this conference's focus is the estuarine system that stretches from the lower Delmarva Peninsula to Cape Charles, Virginia. Registration deadline is October 1. For more information: Assateague Coastal Trust, phone (410) 629-1538, fax (410) 629-1059, e-mail: [act@beachin.net](mailto:act@beachin.net).

### The Worst Drought Since...?

“2000 Years of Drought Variability in the Central United States” is the topic of the December, 1998, Bulletin of the American Meteorological Society. Cost is \$80 for

institutions; the text is available free at [www.ams.allenpress.com](http://www.ams.allenpress.com). For more information: AMS, 1701 K Street, NW, Washington, DC 20006; (617) 227-2426; [amsjol@ametsoc.org](mailto:amsjol@ametsoc.org).

### On the Public Calendar

Sept. 15—Public hearing on allocation of funds to the Water Quality Improvement Fund; 1 p.m., in Richmond.

Sept. 21—Groundwater Protection Steering Committee meeting; 9 a.m., in Richmond.

Sept. 23—State Water Control Board meeting; 9:30 a.m., in Richmond.

For more information: Va. Dept. Env. Quality Central Office, P.O. Box 10009, Richmond, VA 23240; (800) 592-5482 (toll-free in Virginia).

### At the Water Center

•Time to register for the **1999 Virginia Water Research Symposium!** The symposium will be held Nov. 14—16 at the Holiday Inn South, Koger Center, in Richmond. Early registration (before September 15) provides a \$40 savings. Download the registration form from the Center's Web-site ([www.vwrrc.vt.edu](http://www.vwrrc.vt.edu)) or contact Judy Poff: (540) 231-8030; fax (540) 231-6673; email: [jupoff@vt.edu](mailto:jupoff@vt.edu). Spaces are still available for exhibitors. Booth rental is \$350 for a 10' x 8' space; After Sept. 1, the booth fee is \$400.

•The Water Center is sponsoring a mini-symposium entitled **"Innovative Wastewater Treatment Technologies for Small Communities"** to be held Sept. 10, 1999 (8:15

a.m.-4:30 p.m.), in the Donaldson Brown Center at Virginia Tech in Blacksburg. Co-sponsored by the Town of Blacksburg and several university departments, the gathering will feature several experts on recent technologies. The symposium is free and no registration is required. For more information, call the Water Center at (540) 231-5624; e-mail: [water@vt.edu](mailto:water@vt.edu).

### •New Water Center Publications

*A Homeowner's Guide to the Development, Maintenance, and Protection of Springs as a Drinking Water Source* provides information for proper and safe use of springs for drinking water.

*Inland Recreational Fishing Rights in Virginia: Implications of the Virginia Supreme Court Case Kraft v. Burr.* This special report looks at inland fishing rights in Virginia prior to 1996, reviews an important 1996 Virginia Supreme Court ruling, and examines the possible implications of the ruling on future recreational fishing rights in Virginia.

*Evaluation of Precipitation Quality Trends in Virginia.* This four-page paper was presented at the recent "Specialty Conference on Potential Consequences of Climate Variability and Change to Water Resources of the United States."

*The Potential for Developing Mine Cavity Water for Water Supplies,* a special report on a potentially valuable water source for Virginia's coalfield counties.

Single copies are free to Virginia residents, while the supply lasts, and may be obtained from the Water Center at (540) 231-5624, e-mail: [water@vt.edu](mailto:water@vt.edu). There is a small fee for residents of other states.

## CORRECTIONS FROM PREVIOUS ISSUES OF WATER CENTRAL

- 1) The Science article in the June 1999 issue (p. 6) misspelled Lake Erie. Our apologies.
- 2) The "In and Out of the News" section in the June 1999 issue (p. 11) mentioned that a fishing ban on the North Fork Holston River had been replaced with a fishing advisory. A state Department of Health official wrote to clarify that the department *does still prohibit*—not just advises against—*eating* fish taken from the river between Saltville and the Virginia/Tennessee border. Catch-and-release fishing is not prohibited.

## SCIENCE BEHIND THE NEWS, FOR THE RECORD, and TEACHING WATER are all on vacation this issue.

These three regular sections of *Water Central* will return in the October 1999 issue.

## Virginia Water Central

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### Attention Web fans!!

*Water Central* available on the Water Center's Web site, [www.vwrrc.vt.edu](http://www.vwrrc.vt.edu). If you prefer to read the newsletter there, *instead of* receiving a paper copy, please send your e-mail address to [water@vt.edu](mailto:water@vt.edu), and we will notify you when a new issue is posted.

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